



LAWRENCE  
LIVERMORE  
NATIONAL  
LABORATORY

# Tier 1 Seismic Evaluation of 41 Buildings

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February 7, 2013

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## LAWRENCE LIVERMORE NATIONAL LABORATORY LIVERMORE, CALIFORNIA

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**Tier I Seismic Evaluation of 41 Buildings**  
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# FINAL REPORT



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## Executive Summary

This Seismic Evaluation Report summarizes Tier I evaluations for 41 buildings at Lawrence Livermore National Laboratory in accordance with ASCE 31 Life Safety criteria for a 10% in 50 year earthquake. This group of buildings represents the remaining buildings on the LLNL campus that 1) have not been evaluated in the past, and 2) have not been exempted by evaluation according to the Executive Order 12941 (EO 12941) requirements.

Within the 41 buildings, there are 90 seismically independent building sectors. Evaluation results are:

- 33 building sectors are exempt from evaluation based on standard exemptions included in EO 12941. These building sectors are not included in the LLNL seismic mitigation program.
- 20 building sectors meet the structural Life-Safety criteria of ASCE 31.
- 34 building sectors do not meet the structural Life Safety criteria of ASCE 31.
- 3 building sectors were not evaluated due to lack of available structural drawings.

Evaluation of nonstructural component bracing was not included in the scope of this evaluation.

The 57 building sectors that are not exempt from evaluation are recommended to be included in the LLNL seismic mitigation program. The seismic mitigation program at LLNL is based on a prioritization system to evaluate and strengthen buildings to meet the Life-Safety performance objective in a 10% in 50 year earthquake. Recommendations for prioritization of seismic evaluation and strengthening work are based on observed behavior of similar buildings in past earthquakes, with the more vulnerable buildings given a higher prioritization.

This evaluation report contains cost projections for the 57 building sectors recommended to be included in the LLNL seismic mitigation program based on FEMA 156 and 157 methodology. These cost projections are based on historical cost data for the seismic strengthening of buildings. We recommend preparing concept level strengthening schemes as the basis for developing construction budgets.

## 1.0 Introduction

This Seismic Evaluation Report summarizes Tier 1 seismic evaluations of 41 buildings at the Lawrence Livermore National Laboratory (LLNL) performed as part of the LLNL seismic mitigation program. To date, all other buildings on the LLNL campus have had a seismic evaluation performed or have been exempted from evaluation by LLNL in accordance with the requirements of Executive Order 12941 (EO 12941) titled "Seismic Safety of Existing Federally Owned or Leased Buildings". Evaluation of non-structural component anchorage was not part of the scope.

There are 90 seismically independent building sectors within the group of 41 evaluated buildings included in this report. Each building sector was screened in accordance with the requirements of EO 12941, and if required, evaluated in accordance with the life safety requirements of ASCE 31, "ASCE Standard – Seismic Evaluation of Existing Buildings". This report includes the following:

1. Background information on the past seismic evaluations and the current seismic mitigation program at LLNL (Section 2).
2. Summary of site information, including seismicity (Section 3),
3. Summary of seismic screening and evaluation results for the 90 building sectors (Section 4):
4. Recommendations for prioritization of building sectors for the LLNL seismic mitigation program based on observed structural performance of similar buildings in past earthquakes (Section 5).
5. Cost projection to strengthen building sectors to meet Life-Safety performance level based on the methodology of FEMA 156 and 157, "Typical Costs for Seismic Rehabilitation of Existing Buildings" (Section 6).
6. Collection of building data in a standardized format. Building data includes building size, year constructed, description of structural system, identification of potential life safety deficiencies (if any), and preliminary seismic mitigation recommendations. See Appendix A, B, and C.

The scope of work in this evaluation included the following:

1. Coordination with LLNL personnel to obtain drawings for each non-exempt and non-evaluated building. The drawings were the basis for the seismic evaluations.
2. A walkthrough of each building to confirm that the available drawings properly identify the extent of the building, and to observe whether significant building modifications have occurred.

## 2.0 LLNL Seismic Mitigation Program Background

The seismic mitigation program at LLNL was initiated in 1996 to meet the requirements of EO 12941. EO 12941 required each federal agency to develop an inventory of its buildings and to estimate costs of mitigating unacceptable seismic risks in those buildings. In September 1998, LLNL submitted to the Department of Energy (DOE) an electronic database with building inventory information and a report titled "Supporting Documentation on the Implementation of EO 12941". A summary report for LLNL building evaluations was prepared by Degenkolb in October 1998 titled "Seismic Evaluation for Compliance with Executive Order 12941".

At the time of the 1998 EO12941 Report, there were a total of 534 buildings included in the LLNL facility database (not including multiple building sectors). Prior to the start of this evaluation, 449 of those buildings were exempt and 85 were non-exempt. 44 of the non-exempt buildings were previously evaluated. The remaining 41 non-exempt buildings make up the scope of this seismic evaluation report.

The minimum standard for evaluation and mitigation of seismic risks for federal government buildings is defined by RP4 and RP6, titled "Standards of Seismic Safety for Existing Federally Owned or Leased Buildings", which was developed by the Interagency Committee on Seismic Safety in Construction (ICSSC). RP6 is the update to RP4, which incorporated new knowledge in earthquake engineering gained from research and from observed performance of structures in recent earthquakes.

The primary objective of RP4/RP6 is to reduce the life-safety risk to occupants and to the public. Life-Safety is defined as the minimum performance level appropriate for Federal Buildings. Life-Safety building performance is described as "building performance that includes significant damage to both structural and nonstructural components during the design earthquake, though at least some margin against either partial or total structural collapse remains. Injuries may occur, but the level of risk for life threatening injury and entrapment is low. People will likely be unable to reoccupy the building for continuous use until structural repairs are completed."

The seismic mitigation program at LLNL is based on a prioritization system to evaluate and strengthen buildings to meet the life safety performance level. We understand the prioritization system considers expected seismic performance as well as building occupancy level. The duration of the mitigation program will likely depend on the availability of funding, resources, schedule to perform the rehabilitation work, and opportunity planning to coincide with other work. Attributes of the LLNL seismic mitigation program are:

- Buildings that are "exempt" do not require further evaluation or mitigation to comply with the minimum Federal Standard for seismic safety and therefore are not included in the LLNL seismic mitigation program.

- Buildings that are “non-exempt” and have been shown by evaluation to not meet structural life safety standards of RP4/RP6 are prioritized based on observed performance of similar buildings in past earthquakes. The highest priority is for buildings that are considered “exceptionally high risk” and seismic mitigation is mandated by RP6.
- Buildings that are “non-exempt” and have been shown by evaluation to meet the structural life safety standards of RP4/RP6 are considered a low priority. Mitigation of nonstructural deficiencies will proceed as part of the ongoing facility maintenance program.
- In addition, RP6 requires seismic mitigation of “non-exempt” buildings when certain trigger events occur, such as changes in facility use, major building alterations, or when the building experience earthquake related damage.

See Appendix F for the Degenkolb letter dated June 3, 2003, which provides further description of seismic mitigation program at LLNL.

## 3.0 Site Information

### 3.1 General Site Description

The Lawrence Livermore National Laboratory is located east of Livermore, California, along the Diablo foothills of the San Francisco Bay Area. The campus is located at the southeastern edge of the city of Livermore and the easternmost edge of Alameda County.

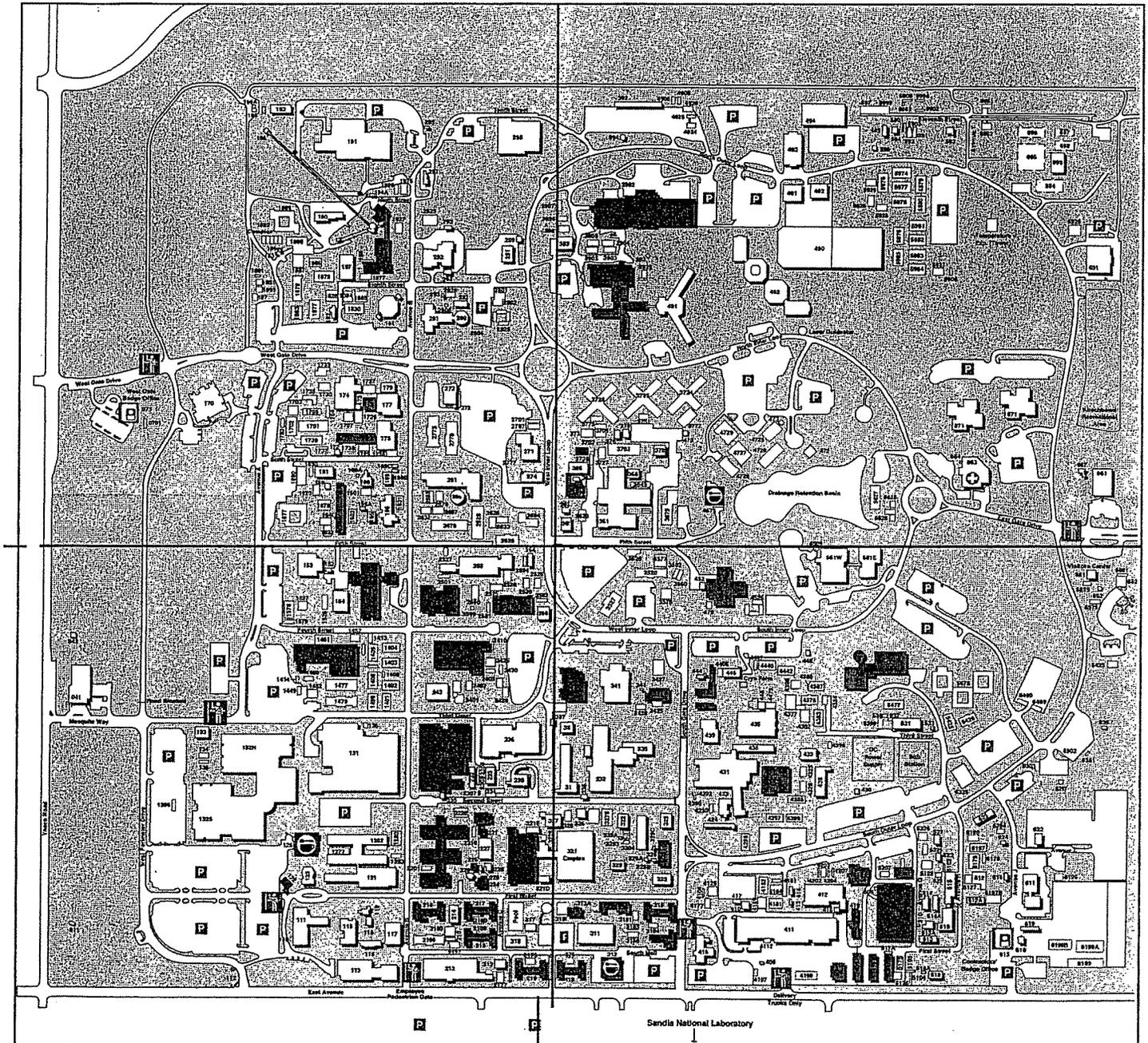
According to the geotechnical report by John A. Blume & Associates dated 1971, the LLNL site is "underlain by poorly consolidated sandy clay at the surface and dense sands, gravels and some hard clay to a depth in excess of 400 feet." We understand that LLNL has classified this soil type as  $S_D$ .

There are four major active faults that pass through the Bay Area and have historically produced earthquakes strong enough to cause structural damage at LLNL. These faults are the San Andreas fault, the Hayward fault, the Calaveras fault, and the Greenville fault, which are 35, 17, 10, and 3 miles away, respectively.

The buildings evaluated are located either at the LLNL Main Site (Site 200) or the LLNL Off-Site (Site 300).

### 3.2 Site Plan

## LLNL Site Plan All Quadrants



### 3.3 Site Seismicity

The basis for evaluation of the LLNL buildings is the spectral response accelerations with a 10% chance of exceedence in 50 years. This is equivalent to an earthquake with a 474-year return period. The shaking values were obtained from the seismic hazard maps, which show values of 5% damped, spectral response accelerations with a 10% chance of exceedence in 50 years. This spectral response acceleration is modified to account for Site Class effects.

The response spectrum and corresponding parameters are shown on the following page. The appropriate portions of the response spectrum were used to evaluate the structures. For comparison, the 2% in 50-year earthquake response spectrum, the 5% in 50-year earthquake response spectrum and the 50% in 50-year earthquake response spectrum are also shown. These were not used for the building evaluations and are shown for information only.

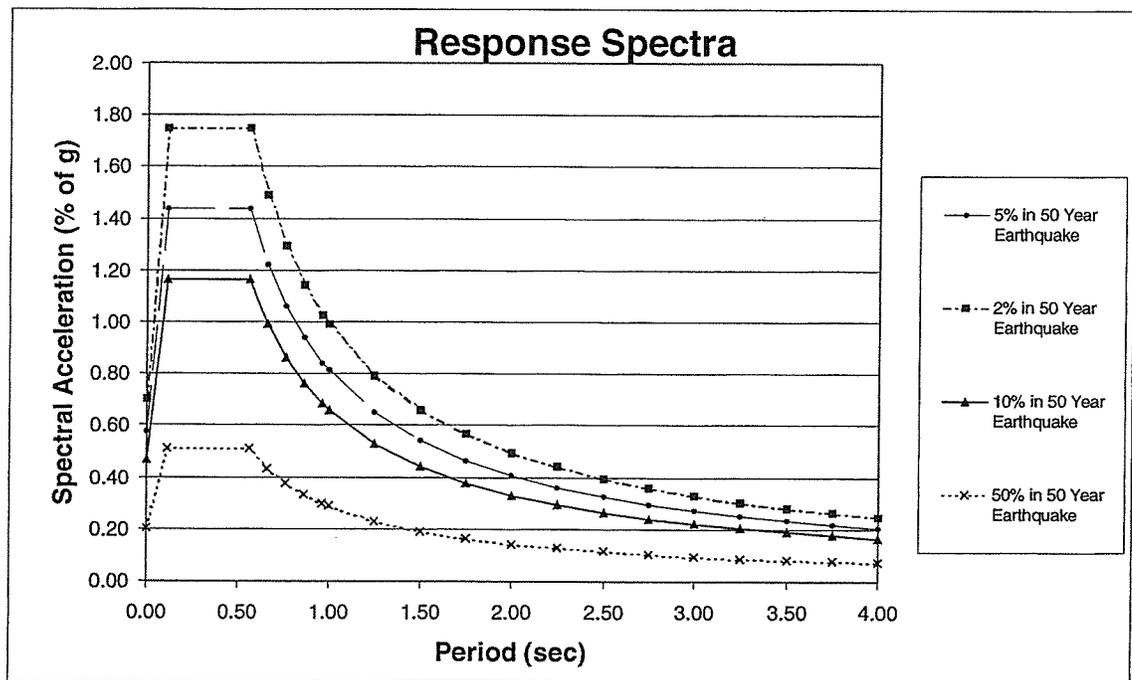


Figure 2.1 – Site Response Spectra

#### Spectrum Parameters

Site Class: D

Fa: 1.00

Fv: 1.50

## 4.0 Seismic Evaluation

### 4.1 Procedure

The procedure for the seismic evaluation of the 41 buildings was as follows:

- Reviewed the 1998 Seismic Evaluation Report and the 2003 Seismic Mitigation and Prioritization Study by Degenkolb Engineers.
- Performed a walkthrough of each of the 41 building. During the site visits a total of 90 seismically independent building sectors were identified.
- Identified building sectors that meet the standard exemptions of RP6 and do not require evaluation or mitigation.
- Obtained drawings from LLNL personnel for each evaluated building sector.
- Reviewed reports, drawings and calculations from past evaluations of the non-evaluated and non-exempt buildings. The only available past evaluation data for review was for Building 326.
- Prepared building descriptions and building data sheets for each evaluated building sector. See Appendix A.
- Performed a Tier I seismic evaluation in accordance with ASCE 31 for a 10% in 50 year earthquake and identified potential structural deficiencies with respect to the Life Safety performance level for each building sector. Life Safety deficiencies are identified in the building data sheets in Appendix A.
- Identified preliminary strengthening schemes or mitigation measures each evaluated building sector. Narrative strengthening recommendations are included in the building data sheets in Appendix A.

### 4.1 Results

#### *Exempt Building Sectors*

33 of the 90 building sectors are exempt from seismic evaluation based on the standard exemptions allowed by EO 12941. The exemptions are for buildings that have been recently constructed, buildings that are small and have a type of lateral system with low vulnerability in earthquakes, or have low occupant usage. These building sectors are not part of the LLNL seismic mitigation program:

Building	Exemption	Description
165, Research Building	E3	Steel light frame less than 3,000 sq. ft.
165, Optical Laboratory	E3	Steel light frame less than 3,000 sq. ft.

166B	E3	Steel light frame less than 3,000 sq. ft.
166E	E3	Steel light frame less than 3,000 sq. ft.
166F	E3	Steel light frame less than 3,000 sq. ft.
3203	E3	Wood/Steel light frame less than 3,000 sq. ft.
292, Addition #1	NA	No longer exists
292 Addition #2	NA	No longer exists
327, Room 1275	E3	Steel light frame less than 3,000 sq. ft.
4675, Addition #2	E3	Wood light frame less than 3,000 sq. ft.
4675, Addition #3	E3	Wood light frame less than 3,000 sq. ft.
805	E8	Remaining useful life less than 5 years. According to LLNL Planned Relocation to EMPC complex within 5 years.
807	E8	Remaining useful life less than 5 years. According to LLNL Planned Relocation to EMPC complex within 5 years.
806, Original Building	E8	Remaining useful life less than 5 years. According to LLNL Planned Relocation to EMPC complex within 5 years.
806A, Lunch Room Addition	E8	Remaining useful life less than 5 years. According to LLNL Planned Relocation to EMPC complex within 5 years.
806B	E8	Remaining useful life less than 5 years. According to LLNL Planned Relocation to EMPC complex within 5 years.
812B	E3	Small metal building less than 3,000 sq. ft.
812C, Part 1	E3	Small metal building less than 3,000 sq. ft.
812C, Part 2	E3	Small metal building less than 3,000 sq. ft.
812 Cooling Tower	E1	Non-building structure incidental human occupancy
817B, Press Building	E3	Steel light frame less than 3,000 sq. ft.

817D, Machinery Building	E3	Small metal prefabricated building less than 3,000 sq. ft.
817E, Press Building	E3	Small metal building less than 3,000 sq. ft., no longer in use
817G	E3	Steel light frame less than 3,000 sq. ft.
817H	E3	Steel light frame less than 3,000 sq. ft.
817 Cooling Tower	E3	Non-building structure
818C	E3	Steel light frame less than 3,000 sq. ft.
836, Solvent Storage Building	NA	No longer exists
836, Shaker Building	NA	Underground Structure
851, Increment #1 Bunker Modification	NA	Underground Structure
851, Increment #2 Bunker Modification	NA	Underground Structure
851B	E3	Steel light frame less than 3,000 sq. ft.
851D	E1	Non-building structure – Incidental Human Occupancy

***Evaluated Building Sectors that Meet Structural Life Safety Standards***

20 of the 90 building sectors were evaluated and meet the structural Life-Safety performance criteria of ASCE 31, "ASCE Standard - Seismic Evaluation of Existing Buildings" for a 10% in 50 year earthquake. These building sectors are considered a low priority in the LLNL seismic mitigation program, with mitigation of nonstructural deficiencies proceeding as part of the ongoing facility maintenance program. The following building sectors are included in this category:

166A*	281 (South Addition)	812E	519B*
166D*	292	817A	836A
181 (Increment 2)	810B	825	851C
253(original Bldg)	298**	817C	850

253 (Addition)	802A	817F	851
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\* Buildings have potential deficiencies expected to be mitigated by detailed evaluation.

\*\* Rating is pending completion of retrofit project currently underway.

***Evaluated Building Sectors that Do Not Meet Structural Life Safety Standards***

34 of the 90 building sectors were evaluated and do not meet the structural Life-Safety performance criteria of ASCE 31 based on the Tier I evaluation for a 10% in 50 year earthquake. Detailed evaluations were not performed as part of this scope of work. It is possible that some potential deficiencies identified by the Tier I evaluation would be eliminated based a detailed evaluation. These buildings are part of the LLNL seismic mitigation program. Recommendations for prioritization are given in Section 5 of this report. Potential structural deficiencies are identified on building data sheets in Appendix A. The following building sectors are included in this category:

041 (Office Area)	233	4675 Original & Addition #1	827A
041 (Warehouse)	253 (Increment 2)	515	827D
115 (Original)	281 (Original)	519A	827E
115 (Addition)	322	809	833
115 (Vault)	326	810A	836B
116	327	810C	836D
117B	362	817C	870
165 (Annex)	363	818A	
166C	435	826	

Buildings 805, 806 Original, 806A, 806B and 807 do not meet Life Safety by evaluation. These buildings are exempt because functions are planned for relocation to the EMPC complex within the next 5 years according to LLNL.

***Non Evaluated Building Sectors***

Many of the building sectors did not have structural drawings available for review, but evaluations were completed based on observation of the structural system on the initial site visit. Evaluations for the following three buildings without available drawings could not be performed within the scope of this project. We recommend detailed site investigation of the following building sectors.

117A	117C	435 (High Bay Mezzanine)	
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## 5.0 Recommended Prioritization

The seismic mitigation program at LLNL is based on a prioritization system to evaluate and strengthen buildings to meet the Life-Safety performance objective in a 10% in 50 year earthquake. The framework for the prioritization system has recently been developed and is summarized in the June 6, 2003 letter by Degenkolb Engineers. See Appendix D. Recommendations for prioritization of seismic evaluation and strengthening work is based on observed behavior of similar buildings in past earthquakes, with the more vulnerable buildings given a higher prioritization. The prioritization system has five classifications (Class A to Class E) as described below.

Thirty-three of the 90 building sectors reviewed as part of this evaluation are exempt from evaluation and strengthening according to EO12941 and are not included in the LLNL seismic mitigation program. Fifty-seven of the 90 building sectors are included in the LLNL seismic mitigation program, with recommended prioritization classifications described below.

The recommendations for prioritization of seismic evaluation and strengthening work and descriptions of expected damage state are for an earthquake at the LLNL site with a 10% chance of exceedance in 50 years; an earthquake with a return period of 474 years. The buildings at LLNL have not been exposed to such a large earthquake in the past. However, they were exposed to a moderate sized magnitude 5.6 earthquake on January 24, 1980. According to the Consortium of Organizations for Strong-Motion Observation Systems the epicenter was in Clayton, California, approximately 10 miles North of Livermore. A peak ground acceleration of .125g was measured in this event by instrumentation at Veterans Hospital in Livermore, approximately 16 miles from the epicenter. Using attenuation equations developed by Boore, Joyner and Fumal, the peak ground acceleration (PGA) at the LLNL site during that earthquake is estimated to be between 0.15g and 0.20g. This represents an earthquake at the LLNL site with an approximate return period of between 75 and 100 years. It has been reported that the LLNL buildings sustained only minor damage in that earthquake.

### 5.1 Class A - Highest Priority Buildings (Zero Building Sectors)

No building sectors in this evaluation are placed in Classification A for "Exceptionally High Risk" buildings. Exceptionally high risk buildings do not meet the Life Safety for a 10% in 50 year earthquake and were defined in the 1998 evaluation on the basis that a) they have a structural system known to be especially vulnerable to earthquake induced damage, or b) they have a combination of high occupancy and high seismic risk in accordance with Approach A in the DOE Management Plan. Class A buildings have the potential for collapse and are required to be evaluated and strengthened according to RP6.

## 5.2 Class B - High Priority Buildings (8 Building Sectors)

Eight building sectors in this evaluation are placed in Classification B for High Priority buildings. High Priority buildings do not meet Life Safety and may sustain heavy damage and possibly local collapse conditions in a 10% in 50 year earthquake. A margin against complete collapse is expected based on observed structural performance of similar buildings in past earthquakes. Based on a Tier I rapid seismic evaluation, buildings included in this classification are:

115 (Original)	166C	327
115(Addition)	253 (Increment 2)	435
116	326	

RP6 currently does require action for these buildings unless they are exposed to trigger events such as a change in facility usage or a major building alteration. We recommend these buildings be evaluated and strengthened to life-safety as an "active" part of the LLNL seismic mitigation program. We recommend LLNL to determine the cost to strengthen these buildings, obtain funding and strengthen these buildings as funding becomes available.

## 5.3 Class C - Medium Priority Buildings (26 Building Sectors)

Twenty-six building sectors in this evaluation are placed in Classification C for Medium Priority buildings. Medium Priority buildings do not meet Life-Safety and have the potential to sustain "life threatening damage" affecting people in the vicinity of where the damage occurred in a 10% in 50 year earthquake. Complete collapse of these buildings is not likely. Based on a Tier I rapid seismic evaluation, buildings included in this classification are:

041 (Office)	322	809	827D
041 (Warehouse)	362	810A	827E
115 (Vault)	363	810C	833
117B	4675	818A	836B
165 (Annex)	515	826	836D
233	519A	827A	870
281 (Original)		827C	

We recommend strengthening of these buildings as they are remodeled or modernized, or as seismic mitigation funding becomes available.

## 5.4 Class D - Low Priority Buildings (20 Building Sectors)

Twenty building sectors in this evaluation are placed in Classification D for Lowest Priority buildings. These buildings have no structural deficiencies that require mitigation to meet the structural Life-Safety performance level. The buildings are not exempt based on EO12941 since nonstructural component bracing evaluations for these buildings was not included in the scope of work. If present, non-structural bracing deficiencies may result in life threatening damage due to falling hazards. Building sectors included in this classification are:

166A	281 (South Addition)	810B	825
166D	292	812E	836A
253 (Original)	298	817A	850
253 (Addition)	519B	817C	851
281 (Increment 2)	802A	817F	851C

We recommend that non-structural bracing deficiencies be identified and mitigated as part of ongoing facility maintenance programs for all non-exempt buildings.

## 5.5 Class E - Non-Evaluated Buildings (3 Building Sectors)

Many of the building sectors did not have structural drawings available for review, but evaluations were completed based on observation of the structural system on the initial site visit. Evaluations for the following three buildings without available drawings could not be performed within the scope of this project. We recommend detailed site investigation of the following building sectors.

117A	117C	435 (High Bay Mezzanine)	
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## 5.6 Non-Exempt Building Prioritization Matrix

Table 5.1 Non-Exempt Building Prioritization Matrix

Non-Exempt Building Prioritization Matrix - Seismic Life Safety <sup>2,6</sup>						
Classification <sup>1</sup>	Structural Life Safety	Recommendations	Damage State	Performance	Vulnerability Rating	Evaluated Buildings (Tier I evaluations)
A	No	<b>Highest Priority:</b> Buildings are ranked as Exceptionally High Risk and require active seismic evaluation and mitigation by RP6 <sup>5</sup> .	Potential Catastrophic Collapse - Does not meet structural Life-Safety	Extremely Poor	10+	
	No		Potential Collapse - Does not meet structural Life-Safety	Very Poor	10 9	
B	No	<b>High Priority:</b> Strengthen buildings as an "active" part of the LLNL seismic mitigation program. Determine cost to strengthen, obtain funding and strengthen as funds are allocated. RP6 does not currently trigger action.	Heavy Damage - Does not meet structural Life-Safety	Very Poor	8	115 (Original) 115 Addition, 116, 166C, 253 (Increment #2), 326, 327, 435
					7	
C	No	<b>Medium Priority:</b> Strengthen as buildings are remodeled and modernized, or as seismic mitigation funding becomes available.	Life Threatening Damage, collapse not likely - - Does not meet structural Life-Safety	Poor	6	041 (Office Area), 041 (Warehouse), 115 (Magnetic Vault), 165 (Annex), 233, 281 (Original), 322, 362, 363, 4675, 515, 519A, 809, 810A, 810C, 818A, 826, 827A, 827C, 827D, 827E, 833, 836B, 836D, 870
					5	
					4	
D <sup>3</sup>	Yes	<b>Lowest Priority:</b> Mitigate nonstructural deficiencies as part of the ongoing facility maintenance program.	Potential Nonstructural Deficiencies Only; Meets Structural Life-Safety	Fair/Good Structural; Potentially Poor Nonstructural	1 to 3	253 (Original Building), 253 (Addition), 281 (Increment 2), 281 (Addition), 292, 298(8), 802A, 810B, 812E, 817A, 166A(7), 166D (7), 519B(7), 817C, 817F, 825, 826, 836A, 850, 851, 851C
E <sup>4</sup>	N/A	<b>Perform on-site detailed observations to complete Tier I seismic evaluations and prioritize.</b>	Buildings have not been evaluated.			117A, 117C, 435 (High Bay Mezzanine)
<b>Building Totals =</b>						<b>57</b>

(1) Classifications are used to describe groupings of buildings at LLNL with similar recommendations.

(2) A nonstructural evaluation has not been performed for any of the non-exempt buildings.

(3) Class D buildings are Life Safe for structural performance. They have not had a nonstructural evaluation and are therefore non-exempt.

(4) Buildings have not been evaluated due to lack of information.

(5) RP6 is the current federal regulatory Standard that provides common minimum requirements for seismic safety of existing Federal buildings titled, "Standard of Seismic Safety for Existing Federally Owned and Leased Buildings".

(6) The seismic mitigation recommendations are for Life-Safety performance only. Buildings that require higher performance levels, including exempt buildings, should be individually evaluated for recommended strengthening.

(7) Evaluation of steel moment connections required to confirm buildings meet structural Life Safety performance level

(8) Rating is pending completion of retrofit project currently underway.

## 6.0 Cost Projections

Cost projections for seismic mitigation of non-exempt buildings have been developed based on the same approach used as a standard by the DOE in responding to EO 12941. Cost projections have been developed using information collected by FEMA and methodology presented in FEMA 156 and 157.

Based on the statistical methodology of FEMA 156 and 157, typical costs are available for common building types, building sizes, different seismic performance objectives, and seismicity levels. Typical costs also are provided for nonstructural finishing work (patch and repair) and project costs (project management, design, and testing).

See Appendix D for a listing of projected costs per building. The mean cost is also shown in the Appendix. Actual cost of strengthening may vary significantly from the FEMA 156 based costs. First, based on the statistical methodology included in FEMA 156, actual cost for any one building may vary by up to a factor of 3 to obtain a confidence level of 75%. For large groups of buildings the statistical variance decreases. For instance, to get a 75% confidence level for a group of 50 buildings, actual costs may be 10% to 15% higher. Second, laboratory buildings at LLNL may be inherently more costly to upgrade than considered in FEMA 156 because of the special laboratory environment. Therefore, we recommend that the concept level strengthening schemes and cost estimates for each individual building be developed before construction budgets are established.

## 7.0 References

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**Appendix A**      **Building Data Sheets**  
**Class B – High Priority Buildings**

### ***Building 115, Computer Building***

Building 115 is a one-story reinforced masonry bearing shear wall building. The main building structure was constructed in 3 phases. The roof structure in the first two phases of construction consists of 2" poured gypsum over 1/2" gypsum board or fiberglass formboard. The slabs are supported by open web joists, which are supported by interior and exterior steel wide flange columns and perimeter reinforced concrete shear walls. In the third phase, the roof structure consists of a lightweight concrete fill over metal deck. The slab is supported by steel wide flange beams and girders, which are supported by concrete block walls.

The primary structural deficiencies noted for Building 115 are as follows: 1) The gypsum board diaphragm cannot adequately transfer seismic loads; 2) There is no apparent out-of-plane anchorage in the first two phases of construction; and 3) There are no cross ties in the first two phases of construction.

For the building to meet life-safety requirements, we recommend replacing the gypsum board diaphragm and adding both out-of-plane anchorage and cross ties where required.



Building Name: **Building 115 (A, B, AB)**

Date: **July 24, 2003**

Building Address: **Lawrence Livermore National Laboratory**

Page: **1** of **2**

Job Number: **A20047.08**

Job Name: **LLNL Prioritization**

By: **JYF** Checked: **JEH**

## PRIORITIZATION BUILDING DATA SHEET

### BUILDING DATA

Year Built:	1954	Year(s) Remodeled:	1955 (added Bldg 115 B), 1961 (added Bldg 115 AB)	UBC Zone:	4 – Type B Near Field
Area (sf):	11,600	Length (ft):	89	Width (ft):	139
No. Stories:	1+Basement	Story Height:	17'-8"	Total Height:	17'-8"

### CONSTRUCTION DATA

Gravity Load Structural System: Building 115 A: 2" poured gypsum o/ 1/2" gypsum board supported by open web joists, which span to WF columns or concrete block walls at the perimeter.  
 Building 115 B: 2" poured gypsum o/ 1" fiberglass formboard supported by open web joists, which span to WF columns or concrete block walls at the perimeter.  
 Building 115 AB: 1 1/2" lightweight concrete fill o/ Tufcor 1 5/16" deck supported by WF beams and girders, which span to concrete block walls or existing walls at Bldgs 115 A or 115 B.

Exterior Transverse Walls: 8" concrete block walls      Openings?: Door and window openings  
 Exterior Longitudinal Walls: 8" concrete block walls      Openings?: Door and window openings

Roof Framing: 2" poured gypsum o/ 1/2" gypsum board, 2" poured gypsum o/ 1" fiberglass formboard, 1 1/2" lightweight concrete fill o/ Tufcor 1 5/16" deck

Intermediate Floor Framing: None

Ground Floor: 6" concrete floor slab supported by 12"x12" or 12"x14" interior concrete columns (10' in hgt) or exterior 10" concrete walls in the basement.

Columns: WF columns

Foundation: Concrete strip footing and spread footings

### LATERAL-FORCE-RESISTING SYSTEM

	Longitudinal	Transverse
System Classification:	Type 13 (Reinforced Masonry Bearing Wall Building w/ Flexible Diaphragm) and Type 14 (Reinforced Masonry Bearing Wall Building w/ Stiff Diaphragm)	Type 13 (Reinforced Masonry Bearing Wall Building w/ Flexible Diaphragm) and Type 14 (Reinforced Masonry Bearing Wall Building w/ Stiff Diaphragm)
Vertical Elements:	Open web joists, steel beams, reinforced concrete block walls; concrete columns and concrete bearing walls at basement	Open web joists, steel beams, reinforced concrete block walls; concrete columns and concrete bearing walls at basement
Diaphragms:	2" poured gypsum o/ 1/2" gypsum board, 2" poured gypsum o/ 1" fiberglass formboard, 1 1/2" lightweight concrete fill o/ Tufcor 1 5/16" deck	2" poured gypsum o/ 1/2" gypsum board, 2" poured gypsum o/ 1" fiberglass formboard, 1 1/2" lightweight concrete fill o/ Tufcor 1 5/16" deck

SEISMIC EVALUATION PERFORMED? Yes EVALUATION: Rapid Evaluation YEAR: 2003

SEISMIC EVALUATION CRITERIA: Life Safety/ ASCE 31-02

VULNERABILITY RATING: 7  
(1=low to 10=high)

PRIORITIZATION CLASSIFICATION: CLASS B



Building Name: Building 115 (A, B, AB)

Date: July 24, 2003

Building Address: Lawrence Livermore National Laboratory

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Job Number: A20047.08

Job Name: LLNL Prioritization

By: JYF Checked: JEH

**PRIORITIZATION BUILDING DATA SHEET**

**POTENTIAL LIFE SAFETY DEFICIENCIES:**

THIS BUILDING WAS EVALUATED FOR THE 10% IN 50 YR. EARTHQUAKE.

**OTHER DIAPHRAGMS**

*Building 115 A: 2" poured gypsum o/ 1/2" gypsum board. Building 115 B: 2" poured gypsum o/ 1" fiberglass formboard. Deck is not adequate to transfer seismic loads..There are no potential life safety deficiencies identified.*

**WALL ANCHORAGE**

*There is no out of plane anchorage for the walls in Buildings 115 A and 115 B.*

**CROSS TIES**

*Bar joists serve as the cross ties in the NS direction. There are no cross ties in the EW direction in Buildings 115 and 115 B.*

**PRELIMINARY STRENGTHENING SCHEMES OR MITIGATION MEASURES:**

- Strengthen the gypsum board diaphragm with diaphragm rod bracing or another method of strengthening
- Strengthen the out of plane wall anchorage
- Add cross ties in the EW direction in Buildings 115A and 11B



Building Name: Building 115 (A, B, AB)

Date: July 24, 2003

Building Address: Lawrence Livermore National Laboratory

Page: 1 of 3

Job Number: A20047.08

Job Name: LLNL Prioritization

By: JYF Checked: JEH

# ASCE 31\* BASIC CHECKLIST RM1: REINFORCED MASONRY BEARING WALL BUILDINGS WITH FLEXIBLE DIAPHRAGMS

C NC N/A

Comments

## BUILDING SYSTEM

<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.1.1	LOAD PATH: The structure shall contain a minimum of one complete load path for Life Safety and Immediate Occupancy for seismic force effects from any horizontal direction that serves to transfer the inertial forces from the mass to the foundation.	<p>Building 115 A: 2" poured gypsum o/ 1/2" gypsum board supported by open web joists, which span to WF columns or concrete block walls at the perimeter. At the north elevation, there is steel frame w/ rod bracing.</p> <p>Building 115 B: 2" poured gypsum o/ 1" fiberglass formboard supported by open web joists, which span to WF columns or concrete block walls at the perimeter. At the south elevation, there is steel frame w/ rod bracing.</p> <p>Building 115 AB: 1 1/2" lightweight concrete fill o/ Tufcor 1 5/16" deck supported by WF beams and girders, which span to concrete block walls or existing walls at Bldgs 115 A or 115 B.</p> <p>The concrete block walls are doveled into the concrete bearing walls at the basement level, which are doveled into the concrete strip footings. Building 115AB is connected to Buildings 115 A and 115 B with angles and 1/4" fillet welds. Load is transferred from the Buildings 115 A and 115 B via the diaphragm to the concrete block walls in Building 115AB. In the evaluation, the rod bracing is assumed to take no seismic load.</p>
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.1.2	ADJACENT BUILDINGS: The clear distance between the building being evaluated and any adjacent building shall be greater than 4% of the height of the shorter building for Life Safety and Immediate Occupancy.	There are no adjacent buildings.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.1.3	MEZZANINES: Interior mezzanine levels shall be braced independently from the main structure, or shall be anchored to the lateral-force-resisting elements of the main structure.	There are no mezzanines.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.1	WEAK STORY: The strength of the lateral-force-resisting system in any story shall not be less than 80% of the strength in an adjacent story above or below for Life-Safety and Immediate Occupancy.	One story building
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.2	SOFT STORY: The stiffness of the lateral-force-resisting-system in any story shall not be less than 70% of the lateral-force-resisting system stiffness in an adjacent story above or below, or less than 80% of the average lateral-force-resisting system stiffness of the three stories above or below for Life Safety and Immediate Occupancy.	One story building
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.3	GEOMETRY: There shall be no changes in horizontal dimension of the lateral-force-resisting system of more than 30% in a story relative to adjacent stories for Life Safety and Immediate Occupancy, excluding one-story penthouses and mezzanines.	One story building

Building Name: **Building 115 (A, B, AB)**

Date: **July 24, 2003**

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Job Number: **A20047.08**

Job Name: **LLNL Prioritization**

By: **JYF** Checked: **JEH**

## ASCE 31\* BASIC CHECKLIST RM1: REINFORCED MASONRY BEARING WALL BUILDINGS WITH FLEXIBLE DIAPHRAGMS

**C NC N/A**

**Comments**

### BUILDING SYSTEM

- |   |          |  |   |
|---|----------|--|---|
| <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> | 4.3.2.4  | VERTICAL DISCONTINUITIES: All vertical elements in the lateral-force-resisting system shall be continuous to the foundation.   | The concrete block walls are doweled into the concrete bearing walls at the basement level, which are doweled into the concrete strip footings. |
| <input type="checkbox"/> <input type="checkbox"/> <input checked="" type="checkbox"/> | 4.3.2.5  | MASS: There shall be no change in effective mass of more than 50% from one story to the next for Life Safety and Immediate Occupancy. Light roofs, penthouses and mezzanines need not be considered.                                 | One story building  |
| <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> | 4.3.3.1  | DETERIORATION OF WOOD: There shall be no signs of decay, shrinkage, splitting, fire damage, or sagging in any of the wood members and none of the metal connection hardware shall be deteriorated, broken, or loose.                 | Site visit made on 7/30/03. No signs of deterioration were observed.  |
| <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> | 4.3.3.7  | MASONRY UNITS: There shall be no visible deterioration of masonry units.   | Site visit made on 7/30/03. No signs of deterioration were observed.  |
| <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> | 4.3.3.8  | MASONRY JOINTS: The mortar shall not be easily scraped away from the joints by hand with a metal tool, and there shall be no areas of eroded mortar.   | Site visit made on 7/30/03. No eroded mortar was observed.  |
| <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> | 4.3.3.10 | REINFORCED MASONRY WALL CRACKS: All existing diagonal cracks in wall elements shall be less than 1/8" for Life Safety and 1/16" for Immediate Occupancy, shall not be concentrated in one location, and shall not form an X pattern. | Site visit made on 7/30/03. There are no cracks >1/8".  |

### LATERAL-FORCE-RESISTING SYSTEM

- |   |           |   |   |
|---|-----------|---|---|
| <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> | 4.4.2.1.1 | REDUNDANCY: The number of lines of shear walls in each principal direction shall be greater than or equal to 2 for Life Safety and Immediate Occupancy.   | There are at least two lines of shear walls in both the longitudinal and transverse directions.   |
| <input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/> | 4.4.2.4.1 | SHEAR STRESS CHECK: The shear stress in the reinforced masonry shear walls, calculated using the Quick Check Procedure of Section 3.5.3.3, shall be less than 70 psi for Life Safety and Immediate Occupancy.   | The maximum shear stress in the concrete block wall is 26 < 70 psi in the transverse (EW) direction.  |
| <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> | 4.4.2.4.2 | REINFORCING STEEL: The total vertical and horizontal reinforcing steel ratio in reinforced masonry walls shall be greater than 0.002 for Life Safety and Immediate Occupancy of the wall with the minimum of 0.0007 for Life Safety and Immediate Occupancy in either of the two directions; the spacing of reinforcing steel shall be less than 48" for Life Safety and Immediate Occupancy; and all vertical bars shall extend to the top of the walls. | <p>Typ. reinforcement in reinforced concrete block walls:</p> <p>Vertical Reinforcing = #4@32" o.c.: reinforcing ratio = 0.00078 &gt; 0.0007</p> <p>Horizontal Reinforcing = 2#4@48" o.c. horizontal: reinforcing ratio = 0.001 &gt; 0.0007.</p> <p>Total reinforcing steel ratio = <math>(0.2 \cdot 48/32 + 0.4) \text{in}^2 / (48 \cdot 8) = 0.002 = 0.002</math></p> |



Building Name: **Building 115 (A, B, AB)**

Date: **July 24, 2003**

Building Address: **Lawrence Livermore National Laboratory**

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Job Number: **A20047.08**

Job Name: **LLNL Prioritization**

By: **JYF** Checked: **JEH**

## ASCE 31\* BASIC CHECKLIST RM1: REINFORCED MASONRY BEARING WALL BUILDINGS WITH FLEXIBLE DIAPHRAGMS

C NC N/A

Comments

### CONNECTIONS

<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	4.6.1.1	WALL ANCHORAGE: Exterior concrete or masonry walls, that are dependent on the diaphragm for lateral support, shall be anchored for out-of-plane forces at each diaphragm level with steel anchors, reinforcing dowels, or straps that are developed into the diaphragm. Connections shall have adequate strength to resist the connection force calculated in the Quick Check Procedure of Section 3.5.3.7.	There is no out of plane anchorage for the walls in Buildings 115 A and 115 B.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.6.1.2	WOOD LEDGERS: The connection between the wall panels and the diaphragm shall not induce cross-grain bending or tension in the wood ledgers.	There are no wood ledgers.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.6.2.1	TRANSFER TO SHEAR WALLS: Diaphragms shall be connected for transfer of loads to the shear walls for Life Safety and the connections shall be able to develop the lesser of the shear strength of the walls or diaphragms for Immediate Occupancy.	1/2" diameter dowels @ 16" o.c. from slab to concrete beam and concrete block wall.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.6.3.5	FOUNDATION DOWELS: Wall reinforcement shall be doweled into the foundation for Life Safety and the dowels shall be able to develop the lesser of the strength of the walls or the uplift capacity of the foundation for Immediate Occupancy.	#4x 4'-0" dowels @ 32" o.c. into the concrete foundation to match vertical reinforcing in the concrete block walls.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.6.4.1	GIRDER/COLUMN CONNECTION: There shall be a positive connection utilizing plates, connection hardware, or straps between the girder and the column support.	Steel beams are connected to the WF columns w/ bolts and welds.

\* – Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.

Building Name: Building 115 (A, B, AB)

Date: July 24, 2003

Building Address: Lawrence Livermore National Laboratory

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Job Number: A20047.08 Job Name: LLNL Prioritization

By: JYF Checked: JEH

## ASCE 31\* SUPPLEMENTAL CHECKLIST RM1: REINFORCED MASONRY BEARING WALL BUILDINGS WITH FLEXIBLE DIAPHRAGMS

**C NC N/A**

**Comments**

### LATERAL-FORCE-RESISTING SYSTEM

- |                          |                          |                                     |   |                                |
|--------------------------|--------------------------|-------------------------------------|---|--------------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.2.4.3 REINFORCING AT OPENINGS: All wall openings that interrupt rebar shall have trim reinforcing on all sides. This statement shall apply to the Immediate Occupancy Performance Level only. | Life Safety Performance Level. |
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.2.4.4 PROPORTIONS: The height-to-thickness ratio of the shear walls at each story shall be less than 30. This statement shall apply to the Immediate Occupancy Performance Level only.        | Life Safety Performance Level. |

### DIAPHRAGMS

- |                                     |                                     |                                     |  |   |
|-------------------------------------|-------------------------------------|-------------------------------------|--|---|
| <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | 4.5.1.2 CROSS TIES: There shall be continuous cross ties between diaphragm chords.   | Bar joists serve as the cross ties in the NS direction. There are no cross ties in the EW direction in Buildings 115 A and 115 B. |
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/>            | 4.5.1.4 OPENINGS AT SHEAR WALLS: Diaphragm openings immediately adjacent to the shear walls shall be less than 25% of the wall length for Life Safety and 15% of the wall length for Immediate Occupancy.  |   |
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/>            | 4.5.1.6 OPENINGS AT EXTERIOR MASONRY SHEAR WALLS: Diaphragm openings immediately adjacent to exterior masonry shear walls shall not be greater than 8 ft long for Life Safety and 4 ft long for Immediate Occupancy.   |   |
| <input type="checkbox"/>            | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | 4.5.1.7 PLAN IRREGULARITIES: There shall be tensile capacity to develop the strength of the diaphragm at re-entrant corners or other locations of plan irregularities. This statement shall apply to the Immediate Occupancy Performance Level only.   | Life Safety Performance Level.  |
| <input type="checkbox"/>            | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | 4.5.1.8 DIAPHRAGM REINFORCEMENT AT OPENINGS: There shall be reinforcing around all diaphragm openings larger than 50% of the building width in either major plan dimension. This statement shall apply to the Immediate Occupancy Performance Level only.  | Life Safety Performance Level.  |
| <input type="checkbox"/>            | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | 4.5.2.1 STRAIGHT SHEATHING: All straight sheathed diaphragms shall have aspect ratios less than 2 to 1 for Life Safety and 1 to 1 for Immediate Occupancy in the direction being considered.   |   |
| <input type="checkbox"/>            | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | 4.5.2.2 SPANS: All wood diaphragms with spans greater than 24 ft for Life Safety and 12 ft for Immediate Occupancy shall consist of wood structural panels or diagonal sheathing.  |   |
| <input type="checkbox"/>            | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | 4.5.2.3 UNBLOCKED DIAPHRAGMS: All diagonally sheathed and unblocked wood structural panel diaphragms shall have horizontal spans less than 40 ft for Life Safety and 30 ft for Immediate Occupancy and shall have aspect ratios less than or equal to 4 to 1 for Life Safety and 3 to 1 for Immediate Occupancy. |   |
| <input type="checkbox"/>            | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | 4.5.3.1 NON-CONCRETE FILLED DIAPHRAGMS: Untopped metal deck diaphragms or metal deck diaphragms with fill other than concrete shall consist of horizontal spans of less than 40 ft and shall have aspect ratios less than 4 to 1. This statement shall apply to the Immediate Occupancy Performance Level only.  | Life Safety Performance Level.  |

Building Name: Building 115 (A, B, AB)

Date: July 24, 2003

Building Address: Lawrence Livermore National Laboratory

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Job Number: A20047.08

Job Name: LLNL Prioritization

By: JYF Checked: JEH

## ASCE 31\* SUPPLEMENTAL CHECKLIST RM1: REINFORCED MASONRY BEARING WALL BUILDINGS WITH FLEXIBLE DIAPHRAGMS

C NC N/A

Comments

### DIAPHRAGMS

4.5.7.1 OTHER DIAPHRAGMS: The diaphragm shall not consist of a system other than wood, metal deck, concrete or horizontal bracing.

**Building 115 A: 2" poured gypsum o/ 1/2" gypsum board. Building 115 B: 2" poured gypsum o/ 1" fiberglass formboard. Deck is not adequate to transfer seismic loads.**

### CONNECTIONS

4.6.1.4 STIFFNESS OF WALL ANCHORS: Anchors of concrete or masonry walls to wood structural elements shall be installed taut and shall be stiff enough to limit the relative movement between the wall and the diaphragm to no greater than 1/8".

\* – Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.

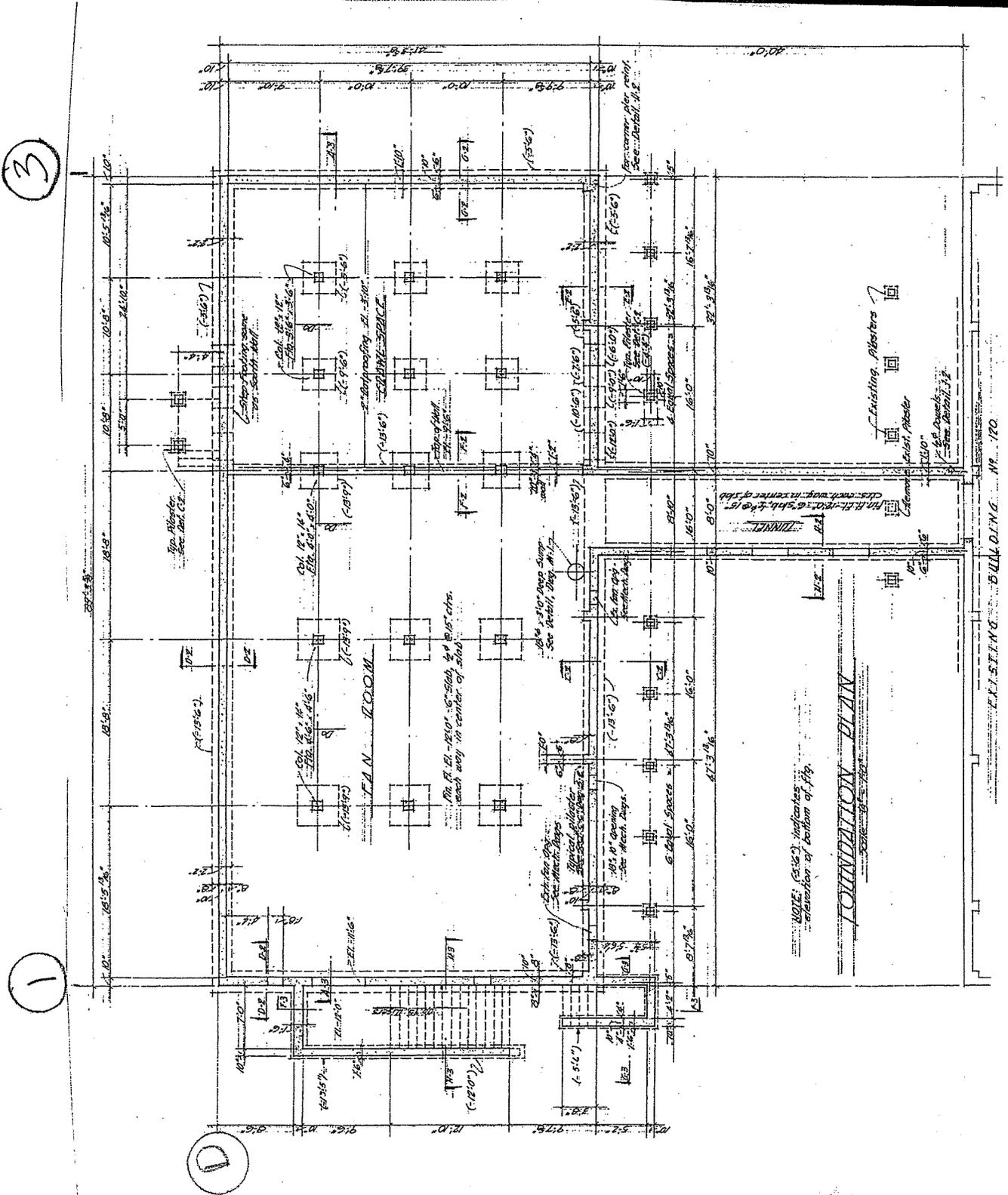
***Building 115, Addition***

Building 115, Addition is approximately 2,000-sq. ft. and is a concrete bearing wall building. Building 115, Addition is not evaluated because of lack of structural information. A detailed on-site evaluation is required to conclusively determine the structural deficiencies in the building. However, based on our site visit observations, Building 115, Addition is similar in construction to Building 115, Computer Building. The deficiencies and recommendations for strengthening identified for Building 115, Computer Building are also applicable to Building 115, Addition.





**BUILDING PLAN**



3

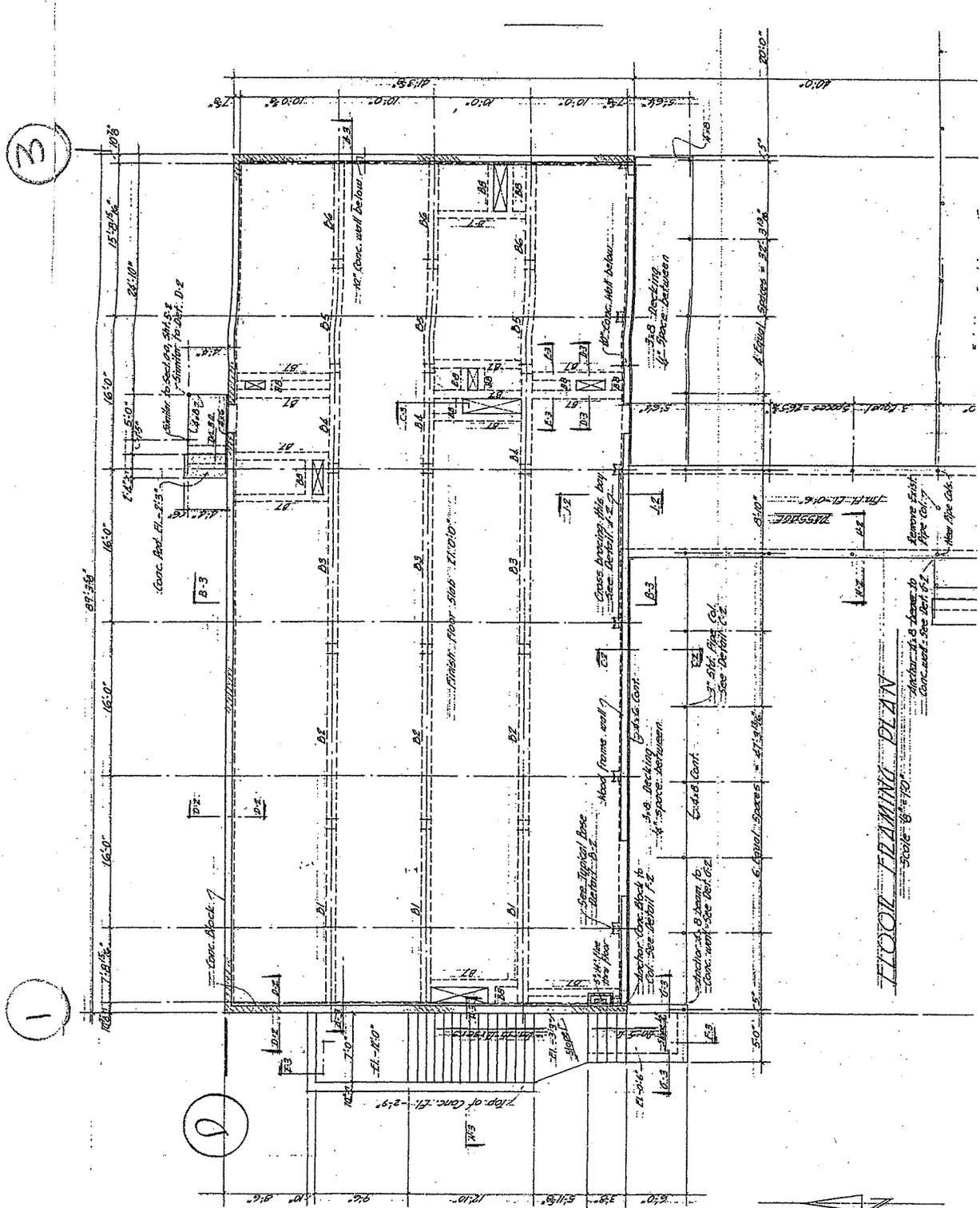
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BUILDING 115 B

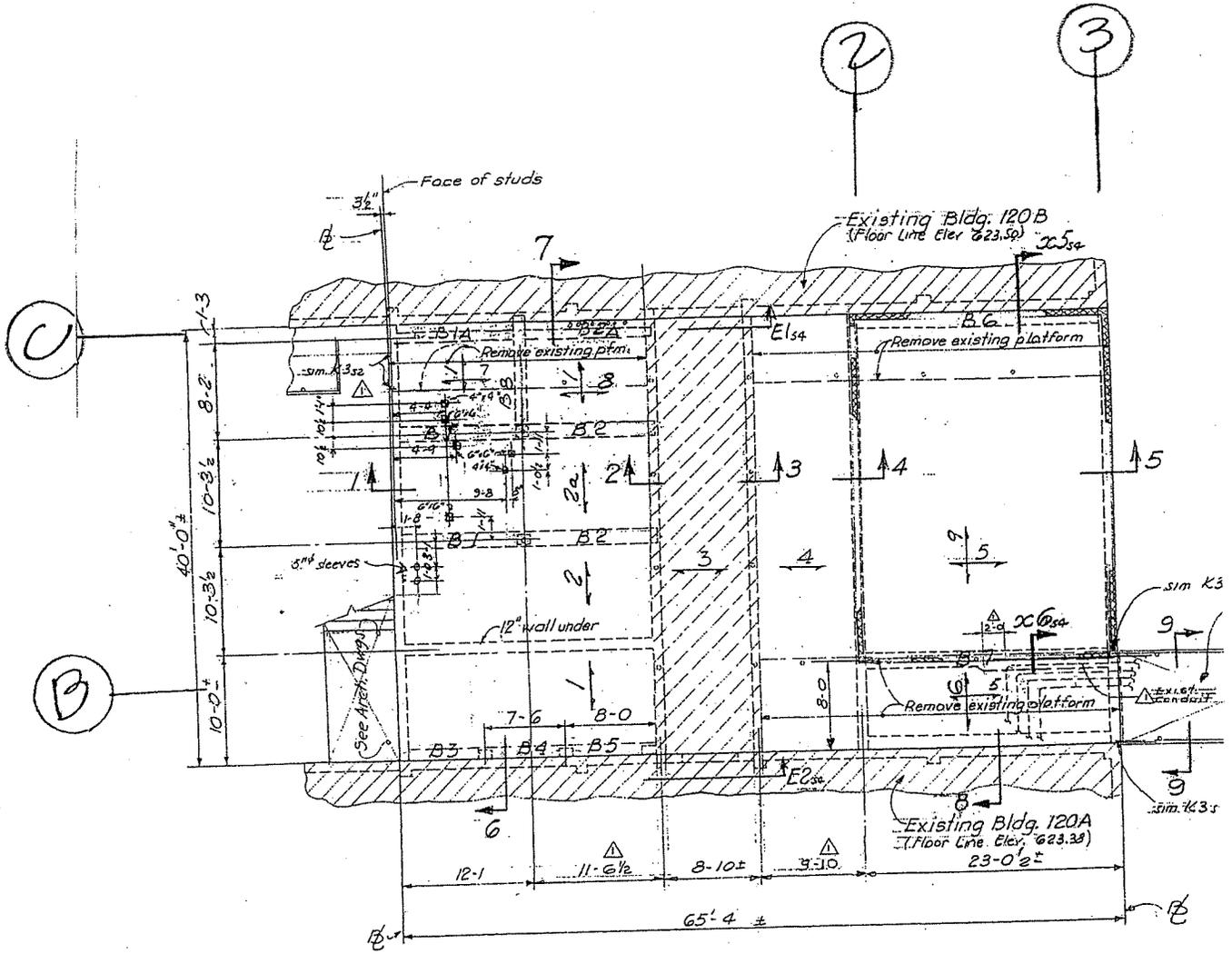


## ROOF PLAN



ROOF PLAN  
Scale: 1/8" = 1'-0"

**BUILDING PLAN**

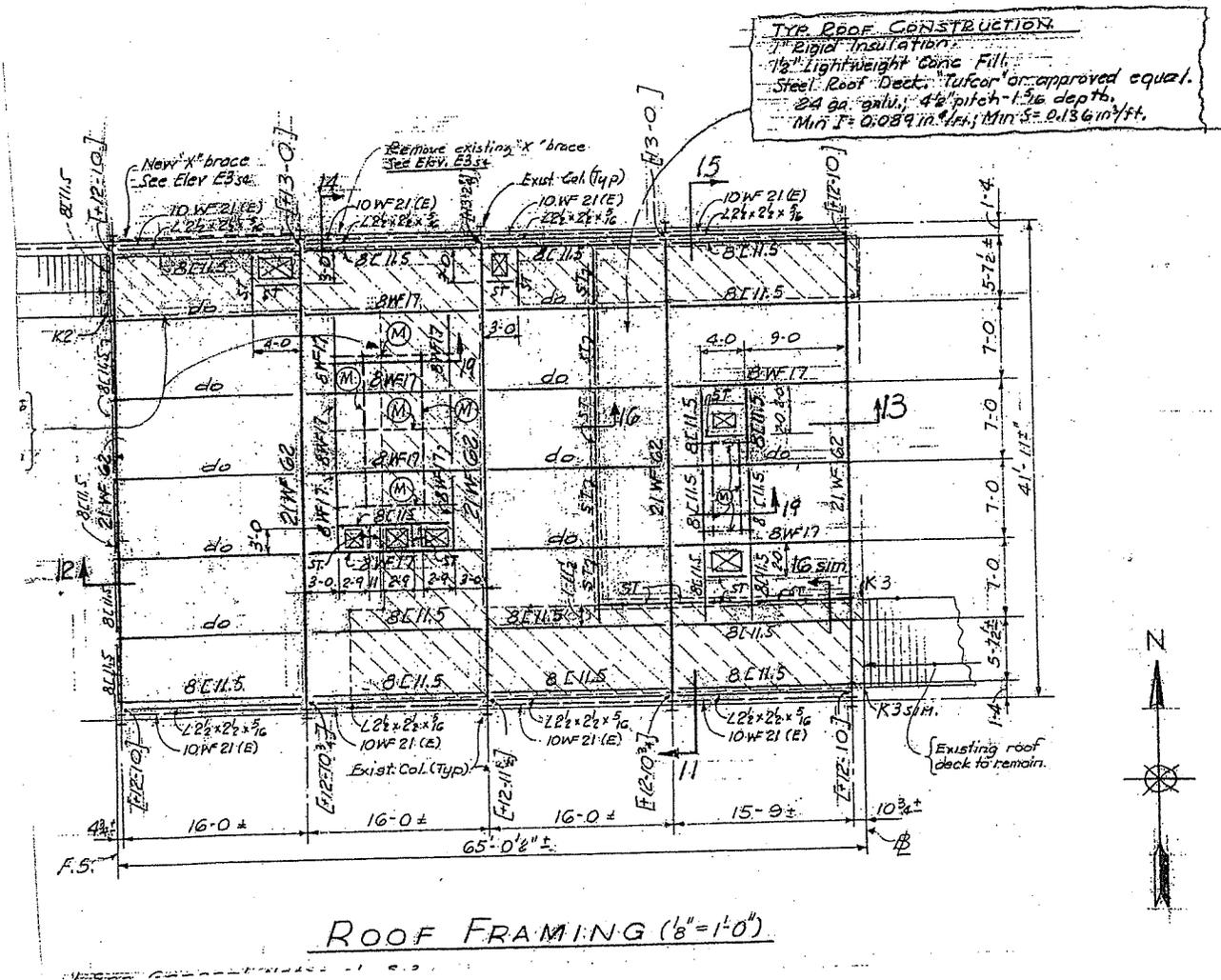


FLOOR FRAMING (8"=1'-0")  
sh. 5-3



BUILDING 115 AB

# ROOF PLAN



### **Building 116**

Building 116 is a two-story concrete bearing wall building. The structure consists of a 6" thick concrete flat slab at the roof and 7" thick concrete flat slab at the floor level. The slabs are supported by concrete beams, which are supported by interior and exterior concrete columns and perimeter reinforced concrete shear walls. The shear walls are located on the East, West and South sides of the building. The North side of the building consists of only concrete columns.

The potential structural deficiencies noted for Building 116 are as follows: 1) There is no redundancy in the lateral-force-resisting system in the east-west direction; 2) There is a significant torsional issue based on the shear wall layout; 3) The concrete columns do not have ductile detailing to withstand large deformations; and 4) The shear walls in the east-west direction are overstressed.

For the building to meet life-safety requirements, we recommend adding a brace frame at the North side of the building, infilling window openings on the East and West sides of the building, and perform a more detailed analysis of the concrete columns to examine whether they can withstand seismic demands.

Building Name: Building 116

Date: July 25, 2003

Building Address: Lawrence Livermore National Laboratory

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Job Number: A20047.08

Job Name: LLNL Prioritization

By: JYF Checked: JEH

## PRIORITIZATION BUILDING DATA SHEET

### BUILDING DATA

Year Built:	1958	Year(s) Remodeled:	UBC Zone: 4 – Type B Near Field
Area (sf):	7,500	Length (ft):	120'-10"      Width (ft): 30'-8"
No. Stories:	2	Story Height:	10'-4"      Total Height: 20'-5"

### CONSTRUCTION DATA

Gravity Load Structural System: 6" concrete flat slab at roof, 7" concrete flat slab at floor. Slab is supported by concrete beams, which are supported by interior and exterior 12"x12" concrete columns and perimeter reinforced concrete shear walls.

Exterior Transverse Walls: 10" concrete shear walls	Openings?: Door and window openings
Exterior Longitudinal Walls: 10" concrete shear walls	Openings?: Door and window openings

Roof Framing: 6" concrete flat slab supported by 14"x20" concrete beams typ.

Intermediate Floor Framing: 7" concrete flat slab supported by 23"x18" concrete beams typ.

Ground Floor: 5" slab on 7" pervious fill w/ 6x6-6/6 EWWF

Columns: 12"x12" concrete columns

Foundation: Concrete strip footing and spread footings

### LATERAL-FORCE-RESISTING SYSTEM

	Longitudinal	Transverse
System Classification:	Type 9 (Concrete shear wall building w/ stiff diaphragm)	Type 8 (Concrete shear wall building w/ stiff diaphragm)
Vertical Elements:	Concrete beams and columns, concrete shear walls.	Concrete beams and columns, concrete shear walls.
Diaphragms:	6" concrete flat slab at roof, 7" concrete flat slab at floor	6" concrete flat slab at roof, 7" concrete flat slab at floor

SEISMIC EVALUATION PERFORMED? Yes EVALUATION: Rapid Evaluation YEAR: 2003

SEISMIC EVALUATION CRITERIA: Life Safety/ ASCE 31-02

VULNERABILITY RATING: 7  
(1=low to 10=high)

PRIORITIZATION CLASSIFICATION: CLASS B

Building Name: **Building 116**

Date: **July 25, 2003**

Building Address: **Lawrence Livermore National Laboratory**

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Job Number: **A20047.08**

Job Name: **LLNL Prioritization**

By: **JYF** Checked: **JEH**

## **PRIORITIZATION BUILDING DATA SHEET**

### **POTENTIAL LIFE SAFETY DEFICIENCIES:**

THIS BUILDING WAS EVALUATED FOR THE 10% IN 50 YR. EARTHQUAKE.

#### **REDUNDANCY**

*There are two lines of shear walls for the NS direction of loading. For loads in the EW direction, there is only one line of shear walls at Line A (south elevation of bldg). At Line C (north elevation of bldg), there is only one line of concrete frames.*

#### **TORSION**

*There are no concrete shear walls at the north elevation of the building*

#### **DEFLECTION COMPATIBILITY**

*Shear reinforcement in gravity columns is not adequate to develop the flexure capacity of the columns*

### **PRELIMINARY STRENGTHENING SCHEMES OR MITIGATION MEASURES:**

Add a brace frame or another lateral-force-resisting element at the north side of the building.  
Perform a detail analysis of the columns for deflection compatibility or strengthen the columns.

Building Name: Building 116

Date: July 25, 2003

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Job Number: A20047.08

Job Name: LLNL Prioritization

By: JYF Checked: JEH

## ASCE 31\* BASIC CHECKLIST C2: CONCRETE SHEAR WALL BUILDINGS WITH RIGID OR STIFF DIAPHRAGMS

C NC N/A

Comments

### BUILDING SYSTEM

<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.1.1	LOAD PATH: The structure shall contain a minimum of one complete load path for Life Safety and Immediate Occupancy for seismic force effects from any horizontal direction that serves to transfer the inertial forces from the mass to the foundation.	Seismic load is transferred from the concrete slab to the concrete beams. The concrete beams are connected to the perimeter and interior concrete shear walls. The shear walls are doweled into the concrete strip footing foundation.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.1.3	MEZZANINES: Interior mezzanine levels shall be braced independently from the main structure, or shall be anchored to the lateral-force-resisting elements of the main structure.	There are no mezzanines.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.2.1	WEAK STORY: The strength of the lateral-force-resisting system in any story shall not be less than 80% of the strength in an adjacent story above or below for Life-Safety and Immediate Occupancy.	The length of concrete shear wall at the 1st floor is shorter by 5'4" than the 2nd floor in the transverse direction. Total length of shear wall in transverse direction = 80.7'. Decrease in strength = 7% < 20%.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.2.2	SOFT STORY: The stiffness of the lateral-force-resisting-system in any story shall not be less than 70% of the lateral-force-resisting system stiffness in an adjacent story above or below, or less than 80% of the average lateral-force-resisting system stiffness of the three stories above or below for Life Safety and Immediate Occupancy.	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.2.3	GEOMETRY: There shall be no changes in horizontal dimension of the lateral-force-resisting system of more than 30% in a story relative to adjacent stories for Life Safety and Immediate Occupancy, excluding one-story penthouses and mezzanines.	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.2.4	VERTICAL DISCONTINUITIES: All vertical elements in the lateral-force-resisting system shall be continuous to the foundation.	The shear walls are doweled into the concrete strip footing foundation.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.2.5	MASS: There shall be no change in effective mass of more than 50% from one story to the next for Life Safety and Immediate Occupancy. Light roofs, penthouses and mezzanines need not be considered.	
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	4.3.2.6	TORSION: The estimated distance between the story center of mass and the story center of rigidity shall be less than 20% of the building width in either plan dimension for Life Safety and Immediate Occupancy.	There are no concrete shear walls at the north elevation of the building.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.3.4	DETERIORATION OF CONCRETE: There shall be no visible deterioration of concrete or reinforcing steel in any of the vertical- or lateral-force-resisting elements.	Site visit made on 7/22/03. No signs of deterioration were observed.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.3.5	POST-TENSIONING ANCHORS: There shall be no evidence of corrosion or spalling in the vicinity of post-tensioning or end fittings. Coil anchors shall not have been used.	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.3.9	CONCRETE WALL CRACKS: All existing diagonal cracks in wall elements shall be less than 1/8" for Life Safety and 1/16" for Immediate Occupancy, shall not be concentrated in one location, and shall not form an X pattern.	Site visit made on 7/22/03. There are no cracks >1/8".

Building Name: Building 116

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Job Number: A20047.08

Job Name: LLNL Prioritization

By: JYF Checked: JEH

## ASCE 31\* BASIC CHECKLIST C2: CONCRETE SHEAR WALL BUILDINGS WITH RIGID OR STIFF DIAPHRAGMS

C NC N/A

Comments

### LATERAL-FORCE-RESISTING SYSTEM

- |                                     |                                     |                          |   |  |
|-------------------------------------|-------------------------------------|--------------------------|---|--|
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/> | <p>4.4.1.6.1 COMPLETE FRAMES: Steel or concrete frames classified as secondary components shall form a complete vertical load carrying system.</p>  | <p>The slab is tied to the concrete beams, which are doweled into the concrete columns.</p>  |
| <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <p>4.4.2.1.1 REDUNDANCY: The number of lines of shear walls in each principal direction shall be greater than or equal to 2 for Life Safety and Immediate Occupancy.</p>  | <p>There are two lines of shear walls for the NS direction of loading. For loads in the EW direction, there is only one line of shear walls at Line A (south elevation of bldg). At Line C (north elevation of bldg), there is only a line of concrete frames.</p>                             |
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/> | <p>4.4.2.2.1 SHEAR STRESS CHECK: The shear stress in the concrete shear walls, calculated using the Quick Check procedure of Section 3.5.3.3, shall be less than 100 psi or <math>2\sqrt{f'_c}</math> for Life Safety and Immediate Occupancy.</p>  | <p>Maximum average shear stress is in transverse direction, 98 psi &lt; 100 psi. Note: <math>2\sqrt{f'_c} = 110</math> psi for <math>f'_c = 3,000</math> psi.</p>  |
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/> | <p>4.4.2.2.2 REINFORCING STEEL: The ratio of reinforcing steel area to gross concrete area shall be not less than 0.0015 in the vertical direction and 0.0025 in the horizontal direction for Life Safety and Immediate Occupancy. The spacing of reinforcing steel shall be equal to or less than 18" for Life Safety and Immediate Occupancy.</p> | <p>Typ. reinforcement in reinforced concrete walls:<br/>           Vertical Reinforcing = 2#4@16" o.c.: reinforcing ratio = 0.0025 &gt; 0.0015<br/>           Horizontal Reinforcing = 2#4@16" o.c.: reinforcing ratio = 0.0025 &gt; 0.0015.</p> <p>Spacing of rebar at 16" o.c. &lt; 18".</p> |

### CONNECTIONS

- |                                     |                          |                          |  |   |
|-------------------------------------|--------------------------|--------------------------|--|---|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <p>4.6.2.1 TRANSFER TO SHEAR WALLS: Diaphragms shall be connected for transfer of loads to the shear walls for Life Safety and the connections shall be able to develop the lesser of the shear strength of the walls or diaphragms for Immediate Occupancy.</p> | <p>At the roof and 2nd floor: 2#4 @ 18" o.c. typ. dowel into the walls from the slab. 2#5's dowel into the walls from the concrete beams (EW direction only).</p> |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <p>4.6.3.5 FOUNDATION DOWELS: Wall reinforcement shall be doweled into the foundation for Life Safety and the dowels shall be able to develop the lesser of the strength of the walls or the uplift capacity of the foundation for Immediate Occupancy.</p>      | <p>#4 dowels into concrete foundation to match vertical rebar in the concrete shear wall.</p>   |

\* - Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.

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 Job Number: **A20047.08**

 Job Name: **LLNL Prioritization**

 By: **JYF** Checked: **JEH**

## ASCE 31\* SUPPLEMENTAL CHECKLIST C2: CONCRETE SHEAR WALL BUILDINGS WITH RIGID OR STIFF DIAPHRAGMS

C	NC	N/A		Comments
<b>LATERAL-FORCE-RESISTING SYSTEM</b>				
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	4.4.1.6.2 DEFLECTION COMPATIBILITY: Secondary components shall have the shear capacity to develop the flexural strength of the components for Life Safety and shall meet the requirements of 4.4.1.4.9, 4.4.1.4.10, 4.4.1.4.11, 4.4.1.4.12 and 4.4.1.4.15 for Immediate Occupancy.	Columns: 4#6 longitudinal bars and #3 stirrups @12" o.c.. $1.25 \cdot Mn = 1.25 \cdot 36 \cdot 4 \cdot .44 \cdot 9 = 59.4$ kip-ft. $\phi Vn = 0.85 \cdot 36 \cdot 2 \cdot .11 \cdot 9 / 12 = 5$ kip < 5.94 kips.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.4.1.6.3 FLAT SLABS: Flat slabs/plates not part of lateral-force-resisting system shall have continuous bottom steel through the column joints for Life Safety.	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.4.2.2.3 COUPLING BEAMS: The stirrups in coupling beams over means of egress shall be spaced at or less than $d/2$ and shall be anchored into the confined core of the beam with hooks of $135^\circ$ or more for Life Safety. All coupling beams shall comply with the requirements above and shall have the capacity in shear to develop the uplift capacity of the adjacent wall for Immediate Occupancy.	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.4.2.2.4 OVERTURNING: All shear walls shall have aspect ratios less than 4 to 1. Wall piers need not be considered. This statement shall apply to the Immediate Occupancy Performance Level only.	Life Safety Performance Level.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.4.2.2.5 CONFINEMENT REINFORCING: For shear walls with aspect ratios greater than 2 to 1, the boundary elements shall be confined with spirals or ties with spacing less than $8d_b$ . This statement shall apply to the Immediate Occupancy Performance Level only.	Life Safety Performance Level.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.4.2.2.6 REINFORCING AT OPENINGS: There shall be added trim reinforcement around all wall openings greater than three times the thickness of the wall. This statement shall apply to the Immediate Occupancy Performance Level only.	Life Safety Performance Level.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.4.2.2.7 WALL THICKNESS: Thickness of bearing walls shall not be less than $1/25$ the unsupported height or length, whichever is shorter, nor less than 4". This statement shall apply to the Immediate Occupancy Performance Level only.	Life Safety Performance Level.
<b>DIAPHRAGMS</b>				
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.5.1.1 DIAPHRAGM CONTINUITY: The diaphragms shall not be composed of split-level floors and shall not have expansion joints.	There are no split level floors or expansion joints.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.5.1.4 OPENINGS AT SHEAR WALLS: Diaphragm openings immediately adjacent to the shear walls shall be less than 25% of the wall length for Life Safety and 15% of the wall length for Immediate Occupancy.	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.5.1.7 PLAN IRREGULARITIES: There shall be tensile capacity to develop the strength of the diaphragm at re-entrant corners or other locations of plan irregularities. This statement shall apply to the Immediate Occupancy Performance Level only.	Life Safety Performance Level.

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Job Number: **A20047.08**

Job Name: **LLNL Prioritization**

By: **JYF** Checked: **JEH**

**ASCE 31\* SUPPLEMENTAL CHECKLIST C2: CONCRETE SHEAR WALL BUILDINGS WITH RIGID OR STIFF DIAPHRAGMS**

**C NC N/A**

**Comments**

**DIAPHRAGMS**

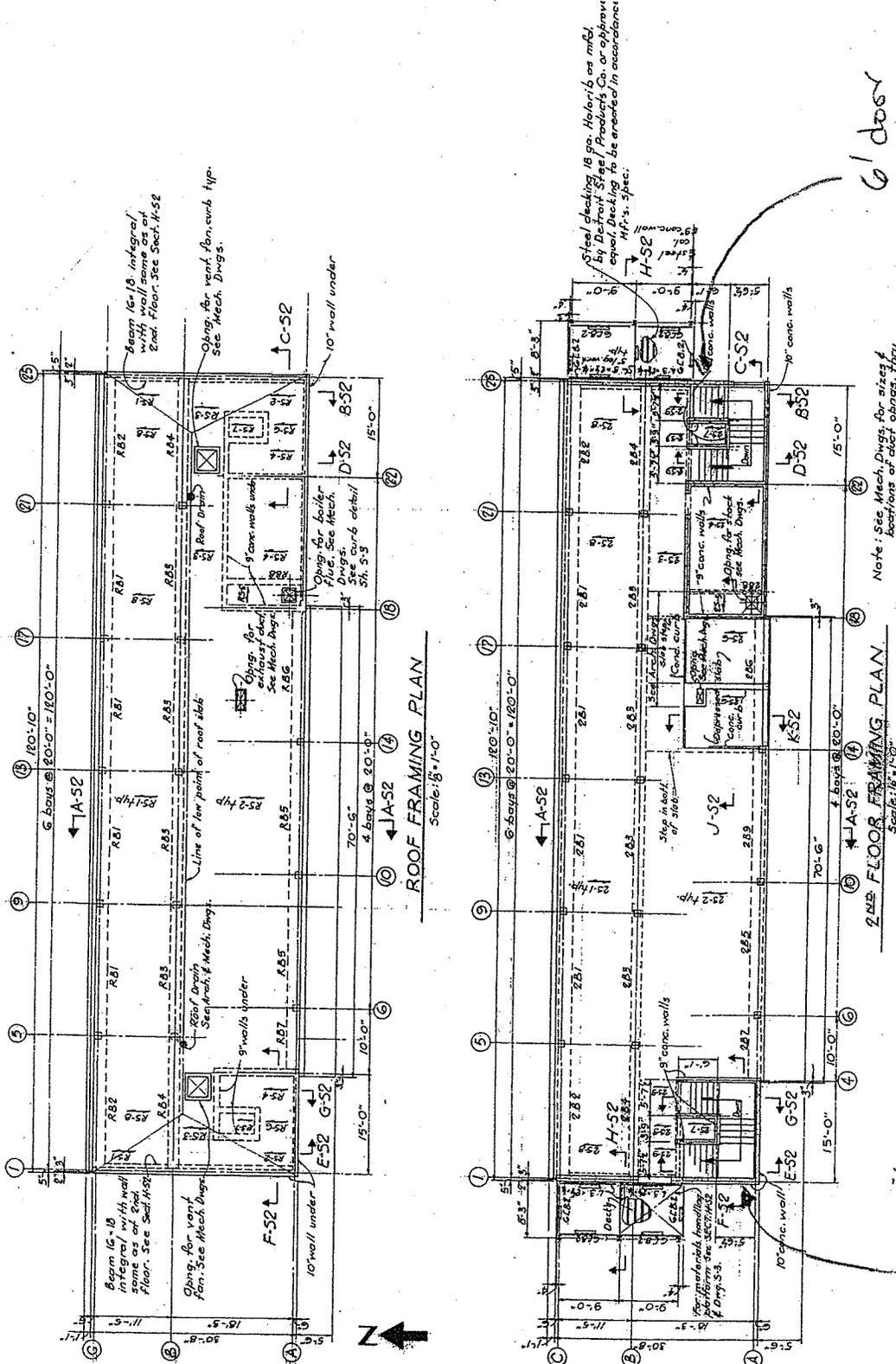
- 4.5.1.8 DIAPHRAGM REINFORCEMENT AT OPENINGS:** There shall be reinforcing around all diaphragm openings larger than 50% of the building width in either major plan dimension. This statement shall apply to the Immediate Occupancy Performance Level only. **Life Safety Performance Level.**

**CONNECTIONS**

- 4.6.3.10 UPLIFT AT PILE CAPS:** Pile caps shall have top reinforcement and piles shall be anchored to the pile caps for Life Safety, and the pile cap reinforcement and pile anchorage shall be able to develop the tensile capacity of the piles for Immediate Occupancy.

\* – Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.

**BUILDING PLAN**



6' door  
opening  
discovered  
on 8/16/03  
site  
visit

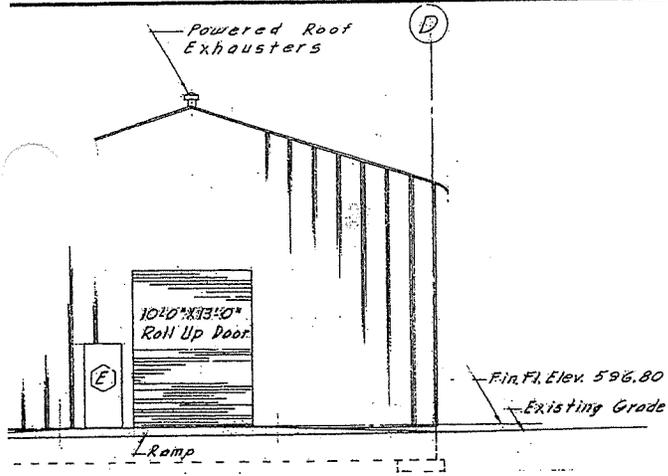
Window  
opening  
discovered  
on 8/16/03  
site  
visit

### **Building 166C**

Building 166C is a one-story bearing wall structure. The roof consists of a series of 6x12s bolted together that spans to the perimeter bearing walls. The bearing walls consist of 3 feet thick concrete blocks grouted together. At each joint in the wall, there are two continuous lag studs that are embedded into the foundation. The intent of the original construction was that this would be a temporary building.

The potential structural deficiencies noted for Building 166C are as follows: 1) The anchorage of the concrete block wall into the diaphragm is insufficient to resist the out-of-plane loads of the heavy wall; and 2). There are no secondary vertical supports of the roof.

For the building to meet life-safety requirements, we recommend providing additional anchorage of the concrete block walls to the diaphragm.

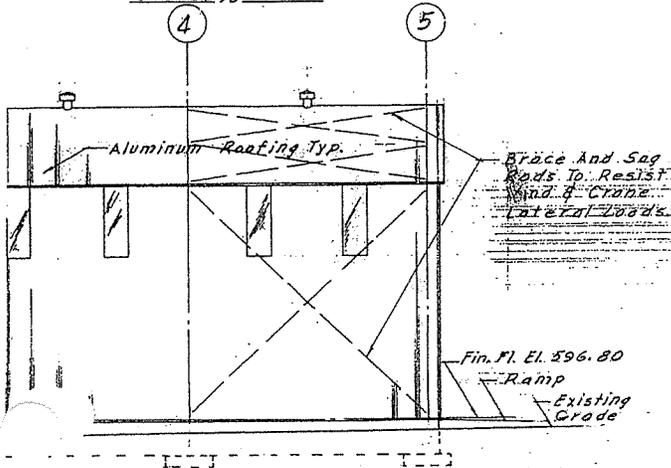


**LEGEND**

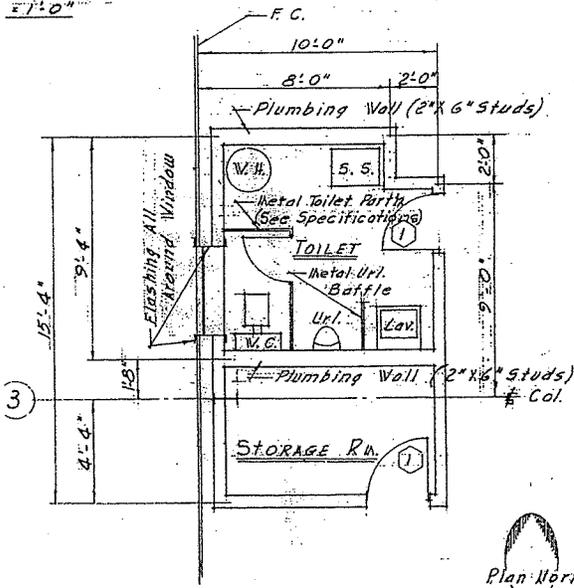
① - - - - Indicates Interior Doors (3'-0" X 7'-0") Flush, Wood

② - - - - Indicates Exterior Doors (3'-0" X 7'-0") Flush, Hollow Metal

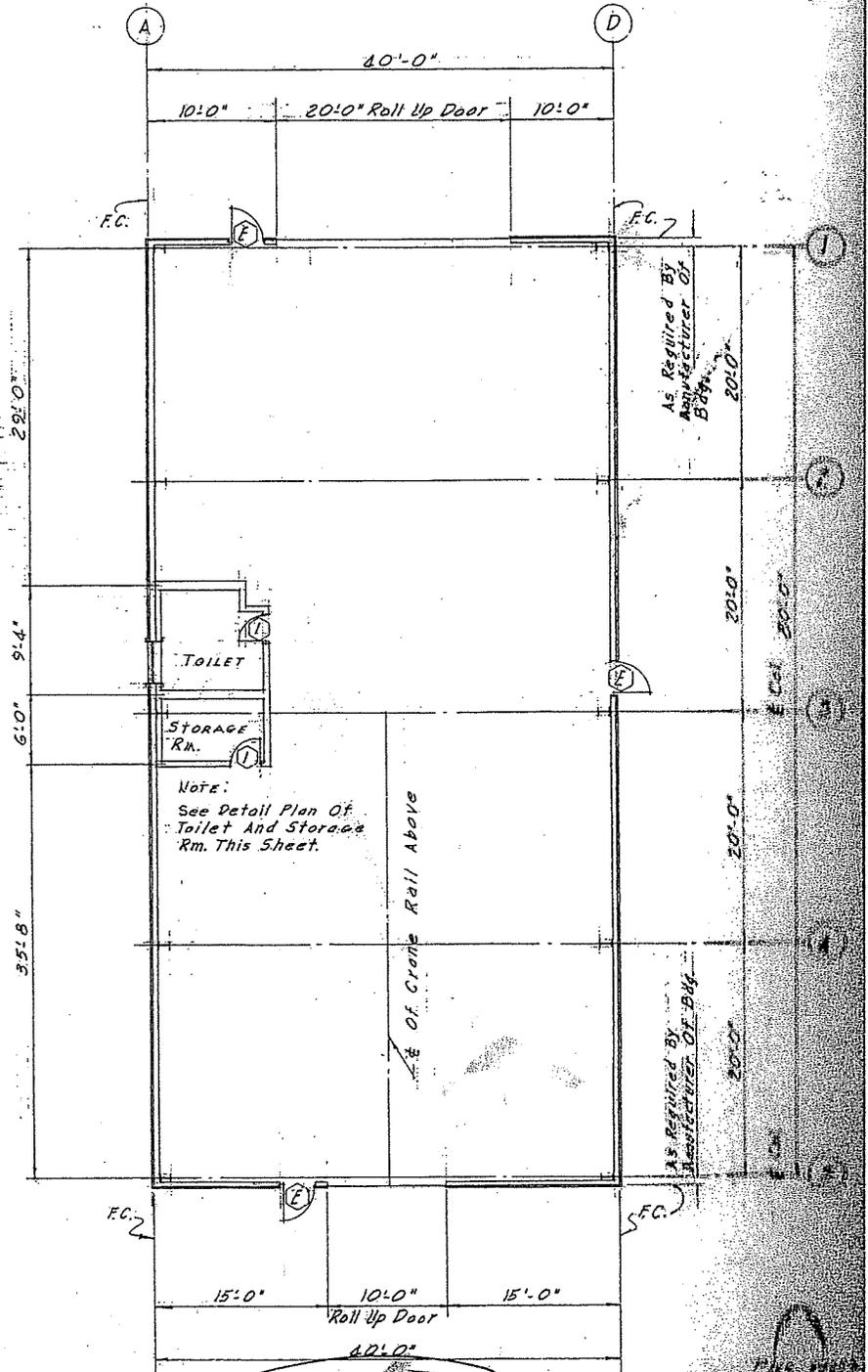
**SOUTH ELEVATION**  
Scale: 1/8" = 1'-0"



**SECTION**  
Scale: 1/4" = 1'-0"



**DETAIL PLAN OF STORAGE RM. AND TOILET**  
Scale: 1/4" = 1'-0"



**FLOOR PLAN**  
Scale: 1/8" = 1'-0"

<b>SPECIAL RESEARCH BLDG. 182A</b>				SHRIT NO.
Floor Plan, Elevations & Section				<b>A-1</b>
DRAWN BY: J.J.V.	DATE:	APPR. BY: JAV	DATE: 5-7-59	SCALE: As Noted
		CD BY: JAV	DATE: 5-13-59	NO. OF SHEETS:
UNIVERSITY OF CALIFORNIA RADIATION LABORATORY				
PLANT ENGINEERING				

CHANGE LETTER	DRAWN BY	CHECK BY	DATE	REVISIONS	DWG. NO.	CHANGED FROM	DATE



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Job Number: A20047.08

Job Name: LLNL Prioritization

By: AK Checked: \_\_\_\_\_

## PRIORITIZATION BUILDING DATA SHEET

### POTENTIAL LIFE SAFETY DEFICIENCIES:

THIS BUILDING WAS EVALUATED FOR THE 10% IN 50 YR. EARTHQUAKE.

#### WALL ANCHORAGE

*The connection of the concrete blocks into the diaphragm is insufficient for out-of-plane loads.*

#### STIFFNESS OF WALL ANCHORS

*Anchorage of wood diaphragm into concrete block wall consists of either concrete pins spaced at 4'0".*

### PRELIMINARY STRENGTHENING SCHEMES OR MITIGATION MEASURES:

Add out-of-plane anchorage between the 6x12 roof framing and the concrete blocks.

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## ASCE 31\* BASIC CHECKLIST RM1: REINFORCED MASONRY BEARING WALL BUILDINGS WITH FLEXIBLE DIAPHRAGMS

C NC N/A

Comments

### BUILDING SYSTEM

<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.1.1	LOAD PATH: The structure shall contain a minimum of one complete load path for Life Safety and Immediate Occupancy for seismic force effects from any horizontal direction that serves to transfer the inertial forces from the mass to the foundation.	The load path consists of concrete block wall located along the entire perimeter.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.1.2	ADJACENT BUILDINGS: The clear distance between the building being evaluated and any adjacent building shall be greater than 4% of the height of the shorter building for Life Safety and Immediate Occupancy.	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.1.3	MEZZANINES: Interior mezzanine levels shall be braced independently from the main structure, or shall be anchored to the lateral-force-resisting elements of the main structure.	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.2.1	WEAK STORY: The strength of the lateral-force-resisting system in any story shall not be less than 80% of the strength in an adjacent story above or below for Life-Safety and Immediate Occupancy.	Single story structure.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.2.2	SOFT STORY: The stiffness of the lateral-force-resisting-system in any story shall not be less than 70% of the lateral-force-resisting system stiffness in an adjacent story above or below, or less than 80% of the average lateral-force-resisting system stiffness of the three stories above or below for Life Safety and Immediate Occupancy.	Single story structure.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.2.3	GEOMETRY: There shall be no changes in horizontal dimension of the lateral-force-resisting system of more than 30% in a story relative to adjacent stories for Life Safety and Immediate Occupancy, excluding one-story penthouses and mezzanines.	Single story structure.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.2.4	VERTICAL DISCONTINUITIES: All vertical elements in the lateral-force-resisting system shall be continuous to the foundation.	Walls continuous to ground
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.2.5	MASS: There shall be no change in effective mass of more than 50% from one story to the next for Life Safety and Immediate Occupancy. Light roofs, penthouses and mezzanines need not be considered.	Single story structure.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.3.1	DETERIORATION OF WOOD: There shall be no signs of decay, shrinkage, splitting, fire damage, or sagging in any of the wood members and none of the metal connection hardware shall be deteriorated, broken, or loose.	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.3.7	MASONRY UNITS: There shall be no visible deterioration of masonry units.	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.3.8	MASONRY JOINTS: The mortar shall not be easily scraped away from the joints by hand with a metal tool, and there shall be no areas of eroded mortar.	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.3.10	REINFORCED MASONRY WALL CRACKS: All existing diagonal cracks in wall elements shall be less than 1/8" for Life Safety and 1/16" for Immediate Occupancy, shall not be concentrated in one location, and shall not form an X pattern.	No observed cracks

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By: AK Checked: \_\_\_\_\_

## ASCE 31\* BASIC CHECKLIST RM1: REINFORCED MASONRY BEARING WALL BUILDINGS WITH FLEXIBLE DIAPHRAGMS

**C NC N/A**

**Comments**

### LATERAL-FORCE-RESISTING SYSTEM

- |                                     |                          |                                     |   |   |
|-------------------------------------|--------------------------|-------------------------------------|---|---|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.4.2.1.1 REDUNDANCY: The number of lines of shear walls in each principal direction shall be greater than or equal to 2 for Life Safety and Immediate Occupancy.   |   |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.4.2.4.1 SHEAR STRESS CHECK: The shear stress in the reinforced masonry shear walls, calculated using the Quick Check Procedure of Section 3.5.3.3, shall be less than 70 psi for Life Safety and Immediate Occupancy.   | <b>Very low concrete shear stress. Stress is only 8 psi due to very thick walls (3' thick blocks)</b> |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.2.4.2 REINFORCING STEEL: The total vertical and horizontal reinforcing steel ratio in reinforced masonry walls shall be greater than 0.002 for Life Safety and Immediate Occupancy of the wall with the minimum of 0.0007 for Life Safety and Immediate Occupancy in either of the two directions; the spacing of reinforcing steel shall be less than 48" for Life Safety and Immediate Occupancy; and all vertical bars shall extend to the top of the walls. |   |

### CONNECTIONS

- |                                     |                                     |                                     |   |  |
|-------------------------------------|-------------------------------------|-------------------------------------|---|--|
| <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | 4.6.1.1 WALL ANCHORAGE: Exterior concrete or masonry walls, that are dependent on the diaphragm for lateral support, shall be anchored for out-of-plane forces at each diaphragm level with steel anchors, reinforcing dowels, or straps that are developed into the diaphragm. Connections shall have adequate strength to resist the connection force calculated in the Quick Check Procedure of Section 3.5.3.7. | <b>Diaphragm anchorage to wall consists of anchors / pins spaced at 4'-0" o.c.</b>           |
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/>            | 4.6.1.2 WOOD LEDGERS: The connection between the wall panels and the diaphragm shall not induce cross-grain bending or tension in the wood ledgers.   |  |
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/>            | 4.6.2.1 TRANSFER TO SHEAR WALLS: Diaphragms shall be connected for transfer of loads to the shear walls for Life Safety and the connections shall be able to develop the lesser of the shear strength of the walls or diaphragms for Immediate Occupancy.   | <b>Diaphragm is connected to shear walls with anchors / pins spaced at 4'-0" o.c.</b>        |
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/>            | 4.6.3.5 FOUNDATION DOWELS: Wall reinforcement shall be doweled into the foundation for Life Safety and the dowels shall be able to develop the lesser of the strength of the walls or the uplift capacity of the foundation for Immediate Occupancy.  | <b>There are lagstuds in between the blocks that are embedded 1'-3" into the grade beam.</b> |
| <input type="checkbox"/>            | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | 4.6.4.1 GIRDER/COLUMN CONNECTION: There shall be a positive connection utilizing plates, connection hardware, or straps between the girder and the column support.  |  |

\* - Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.

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 By: AK Checked: \_\_\_\_\_

## ASCE 31\* SUPPLEMENTAL CHECKLIST RM1: REINFORCED MASONRY BEARING WALL BUILDINGS WITH FLEXIBLE DIAPHRAGMS

C	NC	N/A		Comments
<b>LATERAL-FORCE-RESISTING SYSTEM</b>				
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.4.2.4.3 REINFORCING AT OPENINGS: All wall openings that interrupt rebar shall have trim reinforcing on all sides. This statement shall apply to the Immediate Occupancy Performance Level only.	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.4.2.4.4 PROPORTIONS: The height-to-thickness ratio of the shear walls at each story shall be less than 30. This statement shall apply to the Immediate Occupancy Performance Level only.	Height / thickness = 12' / 3' = 4
<b>DIAPHRAGMS</b>				
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.5.1.2 CROSS TIES: There shall be continuous cross ties between diaphragm chords.	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.5.1.4 OPENINGS AT SHEAR WALLS: Diaphragm openings immediately adjacent to the shear walls shall be less than 25% of the wall length for Life Safety and 15% of the wall length for Immediate Occupancy.	No openings
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.5.1.6 OPENINGS AT EXTERIOR MASONRY SHEAR WALLS: Diaphragm openings immediately adjacent to exterior masonry shear walls shall not be greater than 8 ft long for Life Safety and 4 ft long for Immediate Occupancy.	No openings
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.5.1.7 PLAN IRREGULARITIES: There shall be tensile capacity to develop the strength of the diaphragm at re-entrant corners or other locations of plan irregularities. This statement shall apply to the Immediate Occupancy Performance Level only.	Life Safety Evaluation Only.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.5.1.8 DIAPHRAGM REINFORCEMENT AT OPENINGS: There shall be reinforcing around all diaphragm openings larger than 50% of the building width in either major plan dimension. This statement shall apply to the Immediate Occupancy Performance Level only.	Life Safety Evaluation Only.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.5.2.1 STRAIGHT SHEATHING: All straight sheathed diaphragms shall have aspect ratios less than 2 to 1 for Life Safety and 1 to 1 for Immediate Occupancy in the direction being considered.	Plywood sheathed roof diaphragm.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.5.2.2 SPANS: All wood diaphragms with spans greater than 24 ft for Life Safety and 12 ft for Immediate Occupancy shall consist of wood structural panels or diagonal sheathing.	Plywood sheathed roof diaphragm
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.5.2.3 UNBLOCKED DIAPHRAGMS: All diagonally sheathed and unblocked wood structural panel diaphragms shall have horizontal spans less than 40 ft for Life Safety and 30 ft for Immediate Occupancy and shall have aspect ratios less than or equal to 4 to 1 for Life Safety and 3 to 1 for Immediate Occupancy.	Diaphragms blocked.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.5.3.1 NON-CONCRETE FILLED DIAPHRAGMS: Untopped metal deck diaphragms or metal deck diaphragms with fill other than concrete shall consist of horizontal spans of less than 40 ft and shall have aspect ratios less than 4 to 1. This statement shall apply to the Immediate Occupancy Performance Level only.	

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 Job Number: A20047.08 Job Name: LLNL Prioritization By: AK Checked: \_\_\_\_\_

**ASCE 31\* SUPPLEMENTAL CHECKLIST RM1: REINFORCED MASONRY BEARING WALL BUILDINGS WITH FLEXIBLE DIAPHRAGMS**

**C    NC    N/A** **Comments**

**DIAPHRAGMS**

4.5.7.1 OTHER DIAPHRAGMS: The diaphragm shall not consist of a system other than wood, metal deck, concrete or horizontal bracing.

**CONNECTIONS**

4.6.1.4 STIFFNESS OF WALL ANCHORS: Anchors of concrete or masonry walls to wood structural elements shall be installed taut and shall be stiff enough to limit the relative movement between the wall and the diaphragm to no greater than 1/8". Diaphragm is connected to shear walls with anchors / pins spaced at 4'-0" o.c.

\* – Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.



### ***Building 253, Increment 2***

Building 253, Increment 2 is a one-story reinforced masonry bearing shear wall building. The structure consists of a 3" thick concrete fill over metal deck supported by open web joists, which are supported by interior and exterior concrete block walls. The shear walls are located on the east, west and south sides of the building. The north side of the building consists of steel wide flange beams and square tube columns.

The potential structural deficiencies noted for Building 253, Increment 2 are as follows:

- 1) There is no redundancy in the lateral-force-resisting system in the east-west direction;
- 2) There is a significant torsional issue based on the shear wall layout on three sides of the building; and
- 3) The out-of-plane anchorage connections are not adequate.

For the building to meet life-safety requirements, we recommend adding a brace frame at the North side of the building and strengthening the out-of-plane anchorage connections.

Building Name: **Building 253, Increment 2**

Date: **July 18, 2003**

Building Address: **Lawrence Livermore National Laboratory**

Page: **1** of **2**

Job Number: **A20047.08**

Job Name: **LLNL Prioritization**

By: **JYF** Checked: **JEH**

## PRIORITIZATION BUILDING DATA SHEET

### BUILDING DATA

Year Built:	1964	Year(s) Remodeled:	None	UBC Zone:	4 – Type B Near Field
Area (sf):	20,900	Length (ft):	222	Width (ft):	87
No. Stories:	1+Mech. Penthouse	Story Height:	14'-4"	Total Height:	23'-4"

### CONSTRUCTION DATA

Gravity Load Structural System: Concrete slab supported by open web joists. The joists are supported by 16WF40/45 @ interior and concrete block walls at exterior. At the North side of the bldg, open web joists are supported by 15C33.9 and TS4x6.

Exterior Transverse Walls: 8" concrete block walls      Openings?: Door and window openings

Exterior Longitudinal Walls: 8" concrete block walls      Openings?: Door and window openings

Roof Framing: 3" concrete slab on Fenestra-Holorib Deck supported by 18" deep open web joists, which are supported by WF or channels.

Intermediate Floor Framing: None

Ground Floor: 6" concrete slab on grade w/ #4 @ 16" o.c. E.W.

Columns: TS5x5 or TS4x6

Foundation: Spread and strip footings

### LATERAL-FORCE-RESISTING SYSTEM

	Longitudinal	Transverse
System Classification:	Type 14 (Reinforced concrete block walls w/ stiff diaphragm)	Type 14 (Reinforced concrete block walls w/ stiff diaphragm)
Vertical Elements:	Open web joists, steel beams and channels, tube steel columns, concrete block walls	Open web joists, steel beams and channels, tube steel columns, concrete block walls
Diaphragms:	3" concrete slab on Fenestra-Holorib Deck	3" concrete slab on Fenestra-Holorib Deck

SEISMIC EVALUATION PERFORMED? Yes      EVALUATION: Rapid Evaluation      YEAR: 2003

SEISMIC EVALUATION CRITERIA: Life Safety/ ASCE 31-02

VULNERABILITY RATING: 7  
(1=low to 10=high)

PRIORITIZATION CLASSIFICATION: CLASS B

### POTENTIAL LIFE SAFETY DEFICIENCIES:

THIS BUILDING WAS EVALUATED FOR THE 10% IN 50 YR. EARTHQUAKE.

#### REDUNDANCY

*There is only one line of shear walls in the longitudinal direction. There are two lines of shear walls in the transverse direction.*

#### TORSION

*There are no shear walls on the North side of the building*

#### WALL ANCHORAGE

*Out of plane anchorage for the concrete block walls is not adequate. D/C = 1.04.*

### PRELIMINARY STRENGTHENING SCHEMES OR MITIGATION MEASURES:

Add brace frame or another lateral force resisting element on the North side of the building  
Strengthen the out of plane anchorage



**Degenkolb**

DEGENKOLB ENGINEERS

Building Name: **Building 253, Increment 2**

Date: **July 18, 2003**

Building Address: **Lawrence Livermore National Laboratory**

Page: **2** of **2**

Job Number: **A20047.08**

Job Name: **LLNL Prioritization**

By: **JYF**

Checked: **JEH**

## **PRIORITIZATION BUILDING DATA SHEET**

Building Name: **Building 253, Increment 2**

Date: **July 18, 2003**

Building Address: **Lawrence Livermore National Laboratory**

Page: **1** of **3**

Job Number: **A20047.08**

Job Name: **LLNL Prioritization**

By: **JYF** Checked: **JEH**

## ASCE 31\* BASIC CHECKLIST RM2: REINFORCED MASONRY BEARING WALL BUILDINGS WITH RIGID OR STIFF DIAPHRAGMS

**C NC N/A**

**Comments**

### BUILDING SYSTEM

<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<b>4.3.1.1</b> LOAD PATH: The structure shall contain a minimum of one complete load path for Life Safety and Immediate Occupancy for seismic force effects from any horizontal direction that serves to transfer the inertial forces from the mass to the foundation.	The 3" concrete slab on metal deck delivers load to the open web joists. The load is then transfer to WF girders, which are supported by the perimeter reinforced concrete block walls. The concrete block walls are doveled into the concrete strip foundation system.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<b>4.3.1.3</b> MEZZANINES: Interior mezzanine levels shall be braced independently from the main structure, or shall be anchored to the lateral-force-resisting elements of the main structure.	There are no mezzanines.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<b>4.3.2.1</b> WEAK STORY: The strength of the lateral-force-resisting system in any story shall not be less than 80% of the strength in an adjacent story above or below for Life-Safety and Immediate Occupancy.	One story building.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<b>4.3.2.2</b> SOFT STORY: The stiffness of the lateral-force-resisting-system in any story shall not be less than 70% of the lateral-force-resisting system stiffness in an adjacent story above or below, or less than 80% of the average lateral-force-resisting system stiffness of the three stories above or below for Life Safety and Immediate Occupancy.	One story building.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<b>4.3.2.3</b> GEOMETRY: There shall be no changes in horizontal dimension of the lateral-force-resisting system of more than 30% in a story relative to adjacent stories for Life Safety and Immediate Occupancy, excluding one-story penthouses and mezzanines.	One story building.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<b>4.3.2.4</b> VERTICAL DISCONTINUITIES: All vertical elements in the lateral-force-resisting system shall be continuous to the foundation.	One story building.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<b>4.3.2.5</b> MASS: There shall be no change in effective mass of more than 50% from one story to the next for Life Safety and Immediate Occupancy. Light roofs, penthouses and mezzanines need not be considered.	One story building.
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<b>4.3.2.6</b> TORSION: The estimated distance between the story center of mass and the story center of rigidity shall be less than 20% of the building width in either plan dimension for Life Safety and Immediate Occupancy.	There are no shear walls on the North side of the building.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<b>4.3.3.4</b> DETERIORATION OF CONCRETE: There shall be no visible deterioration of concrete or reinforcing steel in any of the vertical- or lateral-force-resisting elements.	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<b>4.3.3.7</b> MASONRY UNITS: There shall be no visible deterioration of masonry units.	Site visit made on 7/30/03. No signs of deterioration were observed.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<b>4.3.3.8</b> MASONRY JOINTS: The mortar shall not be easily scraped away from the joints by hand with a metal-tool, and there shall be no areas of eroded mortar.	Site visit made on 7/30/03. No eroded mortar was observed

Building Name: **Building 253, Increment 2**

Date: **July 18, 2003**

Building Address: **Lawrence Livermore National Laboratory**

Page: **2** of **3**

Job Number: **A20047.08**

Job Name: **LLNL Prioritization**

By: **JYF** Checked: **JEH**

## ASCE 31\* BASIC CHECKLIST RM2: REINFORCED MASONRY BEARING WALL BUILDINGS WITH RIGID OR STIFF DIAPHRAGMS

**C NC N/A**

**Comments**

### BUILDING SYSTEM

- |                                     |                          |                          |  |  |
|-------------------------------------|--------------------------|--------------------------|--|--|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <b>4.3.3.10 REINFORCED MASONRY WALL CRACKS:</b> All existing diagonal cracks in wall elements shall be less than 1/8" for Life Safety and 1/16" for Immediate Occupancy, shall not be concentrated in one location, and shall not form an X pattern. | <b>Site visit made on 7/30/03. There are no cracks &gt;1/8".</b> |
|-------------------------------------|--------------------------|--------------------------|--|--|

### LATERAL-FORCE-RESISTING SYSTEM

- |                                     |                                     |                          |  |   |
|-------------------------------------|-------------------------------------|--------------------------|--|---|
| <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <b>4.4.2.1.1 REDUNDANCY:</b> The number of lines of shear walls in each principal direction shall be greater than or equal to 2 for Life Safety and Immediate Occupancy.   | <b>There is only one line of shear walls in the longitudinal direction. There are two lines of shear walls in the transverse direction.</b>   |
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/> | <b>4.4.2.4.1 SHEAR STRESS CHECK:</b> The shear stress in the reinforced masonry shear walls, calculated using the Quick Check Procedure of Section 3.5.3.3, shall be less than 70 psi for Life Safety and Immediate Occupancy.   | <b>The max. shear stress at Line E = 63 psi &lt; 70 psi.</b>  |
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/> | <b>4.4.2.4.2 REINFORCING STEEL:</b> The total vertical and horizontal reinforcing steel ratio in reinforced masonry walls shall be greater than 0.002 for Life Safety and Immediate Occupancy of the wall with the minimum of 0.0007 for Life Safety and Immediate Occupancy in either of the two directions; the spacing of reinforcing steel shall be less than 48" for Life Safety and Immediate Occupancy; and all vertical bars shall extend to the top of the walls. | <b>Typ. reinforcement in reinforced concrete block walls:<br/>         Vertical Reinforcing = #4@16" o.c.:<br/>         reinforcing ratio = 0.0016 &gt; 0.0007<br/>         Horizontal Reinforcing = 2#4@48" o.c.<br/>         horizontal: reinforcing ratio = 0.001 &gt; 0.0007.</b><br><br><b>Total reinforcing steel ratio =<br/>         (0.2*24/16+0.2)in^2/(24**8") = 0.0026 &gt; 0.002</b> |

### DIAPHRAGMS

- |                          |                          |                                     |  |                                  |
|--------------------------|--------------------------|-------------------------------------|--|----------------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <b>4.5.5.1 TOPPING SLAB:</b> Precast concrete diaphragm elements shall be interconnected by a continuous reinforced concrete topping slab. | <b>There is no topping slab.</b> |
|--------------------------|--------------------------|-------------------------------------|--|----------------------------------|

### CONNECTIONS

- |                                     |                                     |                          |  |   |
|-------------------------------------|-------------------------------------|--------------------------|--|---|
| <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <b>4.6.1.1 WALL ANCHORAGE:</b> Exterior concrete or masonry walls, that are dependent on the diaphragm for lateral support, shall be anchored for out-of-plane forces at each diaphragm level with steel anchors, reinforcing dowels, or straps that are developed into the diaphragm. Connections shall have adequate strength to resist the connection force calculated in the Quick Check Procedure of Section 3.5.3.7. | <b>Out of plane anchorage: EW walls: 3/4" diameter bolts @ 4' o.c.; NS walls: 1/2" diameter bolts at 18" o.c.</b><br><br><b>D/C = 1.04.</b> |
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/> | <b>4.6.2.1 TRANSFER TO SHEAR WALLS:</b> Diaphragms shall be connected for transfer of loads to the shear walls for Life Safety and the connections shall be able to develop the lesser of the shear strength of the walls or diaphragms for Immediate Occupancy.   | <b>#4 bars @ 18" o.c. from concrete slab are doweled into concrete block walls.</b>   |

Building Name: **Building 253, Increment 2**

Date: **July 18, 2003**

Building Address: **Lawrence Livermore National Laboratory**

Page: **3** of **3**

Job Number: **A20047.08**

Job Name: **LLNL Prioritization**

By: **JYF** Checked: **JEH**

## ASCE 31\* BASIC CHECKLIST RM2: REINFORCED MASONRY BEARING WALL BUILDINGS WITH RIGID OR STIFF DIAPHRAGMS

**C NC N/A**

**Comments**

### CONNECTIONS

- |                                     |                          |                                     |   |  |
|-------------------------------------|--------------------------|-------------------------------------|---|--|
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <p><b>4.6.2.3 TOPPING SLAB TO WALLS OR FRAMES:</b> Reinforced concrete topping slabs that interconnect the precast concrete diaphragm elements shall be doweled for transfer of forces into the shear wall or frame elements for Life Safety and the dowels shall be able to develop the lesser of the shear strength of the walls, frames, or slabs for Immediate Occupancy.</p> | <p><b>There is no topping slab.</b></p>  |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | <p><b>4.6.3.5 FOUNDATION DOWELS:</b> Wall reinforcement shall be doweled into the foundation for Life Safety and the dowels shall be able to develop the lesser of the strength of the walls or the uplift capacity of the foundation for Immediate Occupancy.</p>  | <p><b>#4 @ 16" o.c. dowels into the foundation to match vertical reinforcement in concrete block wall.</b></p> |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | <p><b>4.6.4.1 GIRDER/COLUMN CONNECTION:</b> There shall be a positive connection utilizing plates, connection hardware, or straps between the girder and the column support.</p>  | <p><b>Girders are bolted to the TS columns.</b></p>  |

\* – Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.



Building Name: **Building 253, Increment 2**

Date: **July 21, 2003**

Building Address: **Lawrence Livermore National Laboratory**

Page: **1** of **1**

Job Number: **A20047.08**

Job Name: **LLNL Prioritization**

By: **JYF** Checked: **JEH**

## ASCE 31\* SUPPLEMENTAL CHECKLIST RM2: REINFORCED MASONRY BEARING WALL BUILDINGS WITH RIGID OR STIFF DIAPHRAGMS

**C NC N/A**

**Comments**

### LATERAL-FORCE-RESISTING SYSTEM

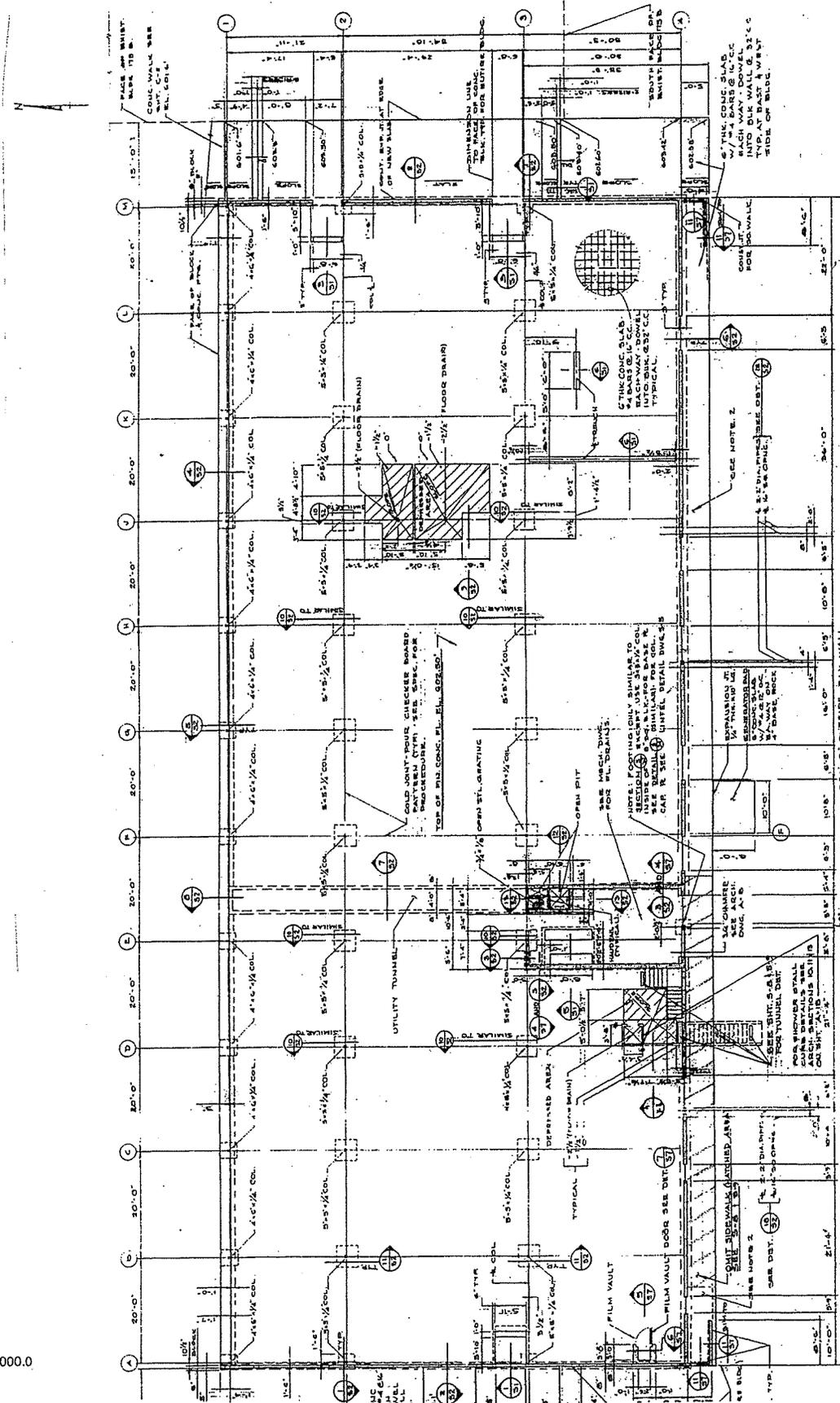
- 4.4.2.2.6 REINFORCING AT OPENINGS: There shall be added trim reinforcement around all wall openings greater than three times the thickness of the wall. This statement shall apply to the Immediate Occupancy Performance Level only. **Life Safety Performance Level.**
- 4.4.2.4.4 PROPORTIONS: The height-to-thickness ratio of the shear walls at each story shall be less than 30. This statement shall apply to the Immediate Occupancy Performance Level only. **Life Safety Performance Level.**

### DIAPHRAGMS

- 4.5.1.4 OPENINGS AT SHEAR WALLS: Diaphragm openings immediately adjacent to the shear walls shall be less than 25% of the wall length for Life Safety and 15% of the wall length for Immediate Occupancy. **There are no diaphragm openings adjacent to the shear walls.**
- 4.5.1.6 OPENINGS AT EXTERIOR MASONRY SHEAR WALLS: Diaphragm openings immediately adjacent to exterior masonry shear walls shall not be greater than 8 ft long for Life Safety and 4 ft long for Immediate Occupancy. **There are no diaphragm openings adjacent to the shear walls.**
- 4.5.1.7 PLAN IRREGULARITIES: There shall be tensile capacity to develop the strength of the diaphragm at re-entrant corners or other locations of plan irregularities. This statement shall apply to the Immediate Occupancy Performance Level only. **Life Safety Performance Level.**
- 4.5.1.8 DIAPHRAGM REINFORCEMENT AT OPENINGS: There shall be reinforcing around all diaphragm openings larger than 50% of the building width in either major plan dimension. This statement shall apply to the Immediate Occupancy Performance Level only. **Life Safety Performance Level.**

\* – Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.

**BUILDING PLAN**



FOUNDATION PLAN  
A20047.08

### **Building 326**

Building 326 is a two-story reinforced masonry bearing wall building. The structure consists of 1" diagonal sheathing supported by wood joists and wood trusses. The joists and trusses are supported by concrete pilasters and perimeter 8" thick concrete block walls.

Structural drawings for Building 326 were not available for review. The deficiencies identified and proposed vulnerability rating are based on the findings of the LLNL Seismic Safety Evaluation of B326 Report dated March 13, 2001 and our site visit on July 30, 2003. The primary structural deficiencies noted for Building 326 are as follows: 1) The diaphragm cannot adequately transfer seismic loads to the shear walls; 2) The connections between the top of the pilasters and roof trusses are non-ductile and overstressed; and 3) The roof diaphragm chords are inadequate.

For the building to meet life-safety requirements, we recommend performing a more detailed on-site evaluation to determine the location of the lateral-force-resisting-system and to observe the interconnection of elements in the structure, strengthening or replacing the roof diaphragm, and reinforcing the connections at the concrete pilasters.



Building Name: **Building 326**

Date: **August 6, 2003**

Building Address: **Lawrence Livermore National Laboratory**

Page: **1** of **2**

Job Number: **A20047.08**

Job Name: **LLNL Prioritization**

By: **JYF**

Checked: **JEH**

## PRIORITIZATION BUILDING DATA SHEET

### BUILDING DATA

Year Built:	1953	Year(s) Remodeled:	None	UBC Zone:	4 – Type B Near Field
Area (sf):	3,386	Length (ft):	50'-8"	Width (ft):	50'-8"
No. Stories:	1	Story Height:	32'-4"	Total Height:	32'-4"

### CONSTRUCTION DATA

Gravity Load Structural System: 1" diagonal sheathing supported by 2x8 joists @ 24" o.c.. The joists span to wood trusses, which are supported concrete pilasters and 8" thick concrete block walls

Exterior Transverse Walls: 8" concrete block walls      Openings?: Door and window openings

Exterior Longitudinal Walls: 8" concrete block walls      Openings?: Door and window openings

Roof Framing: 1" diagonal sheathing supported by 2x8 joists @ 24" o.c.. The joists span to wood trusses.

Intermediate Floor Framing: None. There is a light weight wood floor and wall framing. Part of the mezzanine floor consists of a 12" thick concrete slab.

Ground Floor: concrete slab on grade

Columns: 16"x16" concrete pilaster

Foundation: Concrete strip footings

### LATERAL-FORCE-RESISTING SYSTEM

	Longitudinal	Transverse
System Classification:	Type 13 (Reinforced concrete block walls w/ flexible diaphragm)	Type 13 (Reinforced concrete block walls w/ flexible diaphragm)
Vertical Elements:	2x8 joists, 2x6 interior stud walls, exterior concrete block walls, concrete pilaster	2x8 joists, 2x6 interior stud walls, exterior concrete block walls, concrete pilaster
Diaphragms:	1" diagonal sheathing	1" diagonal sheathing

SEISMIC EVALUATION PERFORMED? No      EVALUATION: Rapid Evaluation      YEAR: 2001

SEISMIC EVALUATION CRITERIA: Life Safety/ UCBC 1991

VULNERABILITY RATING: 7  
(1=low to 10=high)

PRIORITIZATION CLASSIFICATION: CLASS B

Note: This building summary sheet has been prepared based on the information from the Seismic Safety Evaluation of B326 report prepared by LLNL dated March 13, 2001. No structural drawings are available for review. The potential deficiencies identified and proposed vulnerability rating are based on the findings of the LLNL 2001 report and a site visit by Degenkolb Engineers on 7/30/03.



Building Name: **Building 326**

Date: **August 6, 2003**

Building Address: **Lawrence Livermore National Laboratory**

Page: **2** of **2**

Job Number: **A20047.08**

Job Name: **LLNL Prioritization**

By: **JYF** Checked: **JEH**

## PRIORITIZATION BUILDING DATA SHEET

### POTENTIAL LIFE SAFETY DEFICIENCIES IDENTIFIED:

The following potential deficiencies were identified in the Seismic Safety Evaluation of B326 report prepared by LLNL dated March 13, 2001.

**TRANSFER TO SHEAR WALLS**

*The diaphragm cannot adequately transfer seismic loads to the shear walls.*

**MASONRY JOINTS**

*Mortar joints at the top of the east wall appear to have been re-pointed (repaired by applying new mortar of the joints)*

**REINFORCED MASONRY WALL CRACKS**

*Numerous vertical and diagonal cracks were noticeable. The east wall show evidence of extensive repairs.*

**GIRDER/COLUMN CONNECTION**

*The connection between top of pilaster and roof trusses is non-ductile and overstressed.*

**DIAPHRAGM CHORDS**

*The roof diaphragm chords are inadequate*

The following potential deficiencies were identified per Degenkolb's site visit on July 30, 2003. Photos from the site visit are attached.

**OUT OF PLANE BENDING**

*Concrete block walls are very tall and narrow. Concrete block walls may not have adequate capacity for out of plane bending.*

**WALL ANCHORAGE**

*Out of plane anchorage may not be adequate.*

### PRELIMINARY STRENGTHENING SCHEMES OR MITIGATION MEASURES:

A detail on-site evaluation is recommended to determine the location of the lateral-force-resisting-system and to observe the interconnection of elements in the structure.

Without further analysis, the recommended strengthening schemes are as those recommended in the Seismic Safety Evaluation of B326 report:

Strengthen the roof diaphragm

Reinforce the connections at the concrete pilasters

Repair existing cracks and deterioration of the masonry joints

### **Building 327**

Building 327 consists of a two-story steel braced frame structure above grade and a two-story basement below grade. The roof consists of a 1-1/2" bare metal deck with concrete insulation and built-up roofing supported on steel beams and columns. The second floor was originally constructed as a mezzanine level but has been enlarged in subsequent remodels. The second floor consists of a 5" concrete slab supported on steel beams and columns. The lateral system consists of 2"x1" bar braces in each principle direction.

The primary structural deficiencies noted for Building 327 are as follows: 1) The lack of redundancy in the structure as there is only one tension-only bar along each line of seismic resistance; 2) Axial stresses in the braces exceed allowable; and 3) The second floor diaphragm cannot transfer seismic forces into the braced frames due to a large opening that takes up half of the length of the braced frame.

For the building to meet life-safety requirements, we recommend replacing the existing bar braces with tube steel. We also recommend performing a detailed analysis to determine the adequacy of the existing collector beams to transfer the diaphragm loads into the braced frames.



Building Name: Building 327

Date: July 16, 2003

Building Address: Lawrence Livermore National Laboratory

Page: 2 of 2

Job Number: A20047.08

Job Name: LLNL Prioritization

By: AK Checked: \_\_\_\_\_

## PRIORITIZATION BUILDING DATA SHEET

### POTENTIAL LIFE SAFETY DEFICIENCIES:

THIS BUILDING WAS EVALUATED FOR THE 10% IN 50 YR. EARTHQUAKE.

#### REDUNDANCY

*There is only a single tension brace along each line to resist seismic forces. There is no redundancy in the lateral system.*

#### AXIAL STRESS CHECK

*Axial stress in braced frame is higher than allowed by quick check. 2"x1" bar braces are incapable of carrying compressive forces. Braced frame is tension only.*

#### OPENINGS AT BRACED FRAME

*Diaphragm opening in the 2<sup>nd</sup> floor along the north braced frame extend 50% of the frame length.*

#### COMPACT MEMBERS

*Low bay columns (W10x33) are not compact.*

### PRELIMINARY STRENGTHENING SCHEMES OR MITIGATION MEASURES:

Replace existing bar braces with tube steel that can act as both tension and compression members. Perform detailed analysis to verify whether the existing diaphragm and collectors are capable of transferring the seismic loads into the braced frame.

### OTHER COMMENTS:

Addition has been added to the northwest corner of the building. Addition is designated as room 1275. Room 1275 is a 600 square feet steel light frame structure and is exempt from evaluation.

Building Name: Building 327

Date: July 16, 2003

Building Address: Lawrence Livermore National Laboratory

Page: 1 of 2

Job Number: A20047.08

Job Name: LLNL Prioritization

By: AK Checked: \_\_\_\_\_

## ASCE 31\* BASIC CHECKLIST S2: STEEL BRACED FRAMES WITH RIGID OR STIFF DIAPHRAGMS

C	NC	N/A		Comments
<b>BUILDING SYSTEM</b>				
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.1.1 LOAD PATH: The structure shall contain a minimum of one complete load path for Life Safety and Immediate Occupancy for seismic force effects from any horizontal direction that serves to transfer the inertial forces from the mass to the foundation.	Lateral force resisting system consists of braced frames along the perimeter.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.1.2 ADJACENT BUILDINGS: The clear distance between the building being evaluated and any adjacent building shall be greater than 4% of the height of the shorter building for Life Safety and Immediate Occupancy.	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.1.3 MEZZANINES: Interior mezzanine levels shall be braced independently from the main structure, or shall be anchored to the lateral-force-resisting elements of the main structure.	Original construction documents show the size of the mezzanine to be about 1/2 of the floor plan. It has been remodeled and extended to cover > 3/4 of the floor plan. It is now being considered as a 2 <sup>nd</sup> floor with a large opening.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.2.1 WEAK STORY: The strength of the lateral-force-resisting system in any story shall not be less than 80% of the strength in an adjacent story above or below for Life-Safety and Immediate Occupancy.	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.2.2 SOFT STORY: The stiffness of the lateral-force-resisting-system in any story shall not be less than 70% of the lateral-force-resisting system stiffness in an adjacent story above or below, or less than 80% of the average lateral-force-resisting system stiffness of the three stories above or below for Life Safety and Immediate Occupancy.	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.2.3 GEOMETRY: There shall be no changes in horizontal dimension of the lateral-force-resisting system of more than 30% in a story relative to adjacent stories for Life Safety and Immediate Occupancy, excluding one-story penthouses and mezzanines.	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.2.4 VERTICAL DISCONTINUITIES: All vertical elements in the lateral-force-resisting system shall be continuous to the foundation.	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.2.5 MASS: There shall be no change in effective mass of more than 50% from one story to the next for Life Safety and Immediate Occupancy. Light roofs, penthouses and mezzanines need not be considered.	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.2.6 TORSION: The estimated distance between the story center of mass and the story center of rigidity shall be less than 20% of the building width in either plan dimension for Life Safety and Immediate Occupancy.	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.3.3 DETERIORATION OF STEEL: There shall be no visible rusting, corrosion, cracking, or other deterioration in any of the steel elements or connections in the vertical- or lateral-force-resisting systems.	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.3.4 DETERIORATION OF CONCRETE: There shall be no visible deterioration of concrete or reinforcing steel in any of the vertical- or lateral-force-resisting elements.	

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Job Number: A20047.08

Job Name: LLNL Prioritization

By: AK Checked: \_\_\_\_\_

## ASCE 31\* BASIC CHECKLIST S2: STEEL BRACED FRAMES WITH RIGID OR STIFF DIAPHRAGMS

C NC N/A

Comments

### LATERAL-FORCE-RESISTING SYSTEM

- |                                     |                                     |                                     |   |  |
|-------------------------------------|-------------------------------------|-------------------------------------|---|--|
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/>            | <p>4.4.1.3.2 AXIAL STRESS CHECK: The axial stress due to gravity loads in columns subjected to overturning forces shall be less than <math>0.10F_y</math> for Life Safety and Immediate Occupancy. Alternatively, the axial stress due to overturning forces alone, calculated using the Quick Check Procedure of Section 3.5.3.6, shall be less than <math>0.30F_y</math> for Life Safety and Immediate Occupancy.</p> | <p>Axial stress in braced frame columns due to gravity load alone is <math>0.095F_y</math>.</p>  |
| <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <p>4.4.3.1.1 REDUNDANCY: The number of lines of braced frames in each principal direction shall be greater than or equal to 2 for Life Safety and Immediate Occupancy. The number of braced bays in each line shall be greater than 2 for Life Safety and 3 for Immediate Occupancy.</p>  | <p>There are 2 lines of braced frames in each direction. Along each line, there is only a single effective brace taking load. Braces are tension only.</p> |
| <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <p>4.4.3.1.2 AXIAL STRESS CHECK: The axial stress in the diagonals, calculated using the Quick Check Procedure of Section 3.5.3.4, shall be less than <math>0.50F_y</math> for Life Safety and for Immediate Occupancy.</p>   | <p>Braces consist of 2" x 1" bars. Axial stress in bars = <math>2.0F_y</math>. DCR = 4.0</p>   |
| <input type="checkbox"/>            | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <p>4.4.3.1.3 COLUMN SPLICES: All column splice details located in braced frames shall develop the tensile strength of the column. This statement shall apply to the Immediate Occupancy Performance Level only.</p>   | <p>Life Safety Evaluation</p>  |

### CONNECTIONS

- |                                     |                          |                          |   |  |
|-------------------------------------|--------------------------|--------------------------|---|--|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <p>4.6.2.2 TRANSFER TO STEEL FRAMES: Diaphragms shall be connected for transfer of loads to the steel frames for Life Safety and the connections shall be able to develop the lesser of the strength of the frames or the diaphragms for Immediate Occupancy.</p>   |  |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <p>4.6.3.1 STEEL COLUMNS: The columns in lateral-force-resisting frames shall be anchored to the building foundation for Life Safety and the anchorage shall be able to develop the lesser of the tensile capacity of the column, the tensile capacity of the lowest level column splice (if any), or the uplift capacity of the foundation, for Immediate Occupancy.</p> | <p>Steel columns anchored into the pilasters of the retaining walls below.</p> |

\* - Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.

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Job Number: A20047.08

Job Name: LLNL Prioritization

By: AK Checked: \_\_\_\_\_

## ASCE 31\* SUPPLEMENTAL CHECKLIST S2: STEEL BRACED FRAMES WITH RIGID OR STIFF DIAPHRAGMS

C	NC	N/A		Comments
<b>LATERAL-FORCE-RESISTING SYSTEM</b>				
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	4.4.1.3.7 COMPACT MEMBERS: All frame elements shall meet section requirements set forth by Table I-9-1 of <i>Seismic Provisions for Structural Steel Buildings</i> (AISC, 1997).	W10x33 – braced frame columns not considered compact.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.4.3.1.4 SLENDERNESS OF DIAGONALS: All diagonal elements required to carry compression shall have $K/r$ ratios less than 120.	Braces consist of 2" x 1" bars. Considered tension only.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.4.3.1.5 CONNECTION STRENGTH: All the brace connections shall develop the yield capacity of the diagonals.	2" x 1" bars are welded to the structure.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.4.3.1.6 OUT-OF-PLANE BRACING: Braced frame connections attached to beam bottom flanges located away from beam-column joints shall be braced out-of-plane at the bottom flange of the beams. This statement shall apply to the Immediate Occupancy Performance Level only.	Life Safety Evaluation
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.4.3.2.1 K-BRACING: The bracing system shall not include K-braced bays.	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.4.3.2.2 TENSION-ONLY BRACES: Tension-only braces shall not comprise more than 70% of the total lateral-force-resisting capacity in structures over two stories in height. This statement shall apply to the Immediate Occupancy Performance Level only.	Life Safety Evaluation
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.4.3.2.3 CHEVRON BRACING: The bracing system shall not include chevron, or V-braced bays. This statement shall apply to the Immediate Occupancy Performance Level only.	Life Safety Evaluation
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.4.3.2.4 CONCENTRICALLY BRACED FRAME JOINTS: All the diagonal braces shall frame into the beam-column joints concentrically. This statement shall apply to the Immediate Occupancy Performance Level only.	Life Safety Evaluation
<b>DIAPHRAGMS</b>				
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	4.5.1.5 OPENINGS AT BRACED FRAMES: Diaphragm openings immediately adjacent to the braced frames shall extend less than 25% of the frame length for Life Safety and 15% of the frame length for Immediate Occupancy.	Diaphragm opening in the 2 <sup>nd</sup> floor along the north braced frame extend 50% of the frame length.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.5.1.7 PLAN IRREGULARITIES: There shall be tensile capacity to develop the strength of the diaphragm at re-entrant corners or other locations of plan irregularities. This statement shall apply to the Immediate Occupancy Performance Level only.	Life Safety Evaluation
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.5.1.8 DIAPHRAGM REINFORCEMENT AT OPENINGS: There shall be reinforcing around all diaphragm openings larger than 50% of the building width in either major plan dimension. This statement shall apply to the Immediate Occupancy Performance Level only.	Life Safety Evaluation

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Job Name: LLNL Prioritization

By: AK Checked: \_\_\_\_\_

**ASCE 31\* SUPPLEMENTAL CHECKLIST S2: STEEL BRACED FRAMES WITH RIGID OR STIFF DIAPHRAGMS**

C NC N/A

Comments

**CONNECTIONS**

- |   |   |                                      |
|---|---|--------------------------------------|
| <input type="checkbox"/> <input type="checkbox"/> <input checked="" type="checkbox"/> | <p>4.6.3.10 UPLIFT AT PILE CAPS: Pile caps shall have top reinforcement and piles shall be anchored to the pile caps for Life Safety, and the pile cap reinforcement and pile anchorage shall be able to develop the tensile capacity of the piles for Immediate Occupancy.</p> | <p><b>Life Safety Evaluation</b></p> |
|---|---|--------------------------------------|

\* – Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.



### ***Building 435, Fusion Research***

Building 435 is a steel braced frame structure. The building consists of a 60-foot wide long-span truss high bay and a 40-foot wide low bay connected on each side. The building was originally constructed as a single story structure with a 30' x 40' mezzanine in the north low bay. Subsequent remodels have added a substantial amount of mezzanine space in the high and south low bay areas.

The roof diaphragm consists of a 1-1/2" bare metal deck with insulation and roofing. In the high bay, the roof is supported on a long span steel truss that spans to steel columns. In the low bay, the roof is supported on steel beams and girders that span to steel columns. The lateral system consists of double angle braces in both the transverse and longitudinal directions.

The primary structural deficiencies noted for Building 435 are as follows: 1) There is an insufficient number of braces in the structure. In addition, the existing double-angle braces are slender and cannot resist compressive forces; 2) The low bay is inadequately braced in the longitudinal direction because braces are located on only one side of the low bay; and 3) The concrete blocks that frame the perimeter of the 60'x60' pit in the high bay do not have sufficient anchorage to the diaphragms and pose a potential falling hazard.

For the building to meet life-safety requirements, we recommend providing new steel tube braces along the north and south faces of the building to brace the low bays. In addition the existing double angle braces should be replaced with structural steel tubes. Anchor the concrete blocks at the pit to the slab on grade.

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 Job Number: A20047.08 Job Name: LLNL Prioritization By: AK Checked: \_\_\_\_\_

**PRIORITIZATION BUILDING DATA SHEET**

**BUILDING DATA**

Year Built:	1958	Year(s) Remodeled:	-	UBC Zone:	4 – Type B Near Field
Area (sf):	32,000 sf	Length (ft):	220'	Width (ft):	140'
No. Stories:	3	Story Height:	11' 1-1/2" to 26' 7"	Total Height:	48' 10"

**CONSTRUCTION DATA**

Gravity Load Structural System: Structural steel framing with long span truss at high bay.  
 At low bay roof, framing consists of steel beams and girders that span to wide flange columns.

Exterior Transverse Walls: Insulated metal wall panels at high bay. Openings?: None

Exterior Longitudinal Walls: Insulated metal wall panels at high bay. Openings?: Windows  
 Cement asbestos panels at low bay.

Roof Framing: Steel beams and girders at low bay. Steel truss at high bay.

Intermediate Floor Framing: North Mezzanine (Low Bay) is framed with structural steel girders and 2x8 joists. Additional mezzanine space has subsequently been added in remodels. No structural drawings available for new mezzanine space.

Ground Floor: 6" – 8" concrete slab on grade.

Columns: Steel wide flange columns

Foundation: Building perimeter is tied together with a continuous grade beam. Steel columns are supported on reinforced concrete stub columns with spread footings. There is a series of reinforced concrete tunnels beneath the finished slab on grade.  
 In remodel, a large 60' x 60' hole was excavated from the slab on grade. Large concrete blocks were added to the perimeter of the excavated holes.

**LATERAL-FORCE-RESISTING SYSTEM**

	<u>Longitudinal (W-E)</u>	<u>Transverse (N-S)</u>
System Classification:	S2A – Steel Braced Frames with Flexible Diaphragms.	S2A – Steel Braced Frames with Flexible Diaphragms.
Vertical Elements:	Steel wide flange columns	Steel wide flange columns
Diaphragms:	Bare metal deck + insulation at roof, Plywood Diaphragm at Mezzanine	Bare metal deck + insulation at roof, Plywood Diaphragm at Mezzanine

**SEISMIC EVALUATION PERFORMED?** Yes **EVALUATION:** Rapid Evaluation **YEAR:** 2003

**SEISMIC EVALUATION CRITERIA:** Life Safety/ ASCE 31-02

**VULNERABILITY RATING:** 8  
 (1=low to 10=high)

**PRIORITIZATION CLASSIFICATION:** CLASS B

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Building Address: **Lawrence Livermore National Laboratory**

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Job Number: **A20047.08**

Job Name: **LLNL Prioritization**

By: **AK** Checked: \_\_\_\_\_

## PRIORITIZATION BUILDING DATA SHEET

### POTENTIAL LIFE SAFETY DEFICIENCIES:

THIS BUILDING WAS EVALUATED FOR THE 10% IN 50 YR. EARTHQUAKE.

#### AXIAL STRESS CHECK

*Axial stress in braced frame is higher than allowed by quick check. Double angle braces are incapable of carrying compressive forces. Braced frame is tension only.*

#### DEFLECTION COMPATIBILITY

*The low bays are braced along the interior only. The deflection at the exterior along lines A & F will be much larger than the high bay.*

#### FALLING HAZARD AT THE CONCRETE BLOCKS AROUND EXCAVATED HOLE

*Concrete blocks are anchored at the floor with anchor bolts only. There are no connections at the top of the blocks.*

#### CONNECTION STRENGTH

*Brace connections cannot develop yield strength of doubled angle braces.*

#### COMPACT MEMBERS

*Low bay columns (W10x33) are not compact.*

### PRELIMINARY STRENGTHENING SCHEMES OR MITIGATION MEASURES:

Provide additional braces in the lateral system. Add new braces along lines a & f to brace the low bay.

Anchor the top of the concrete blocks into the slab on grade.

Replace the existing braces with tubes.

### OTHER COMMENTS:

Only the original building with the small mezzanine on the north end was evaluated. Information for the additional mezzanine levels in the high bay and low bay (south) are not available.

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## ASCE 31\* BASIC CHECKLIST S2A: STEEL BRACED FRAMES WITH FLEXIBLE DIAPHRAGMS

C   NC   N/A

Comments

### BUILDING SYSTEM

<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.1.1	<p><b>LOAD PATH:</b> The structure shall contain a minimum of one complete load path for Life Safety and Immediate Occupancy for seismic force effects from any horizontal direction that serves to transfer the inertial forces from the mass to the foundation.</p>
<p>Braced frames are located at the ends in the transverse direction. In the longitudinal direction, braced frames are located on grid lines C and D only. There are no braced frames on the north and south elevations to provide lateral resistance to the low bays. Low bay diaphragms (roof &amp; mezzanine) are required to cantilever off the high bay braced frames.</p>				
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.1.2	<p><b>ADJACENT BUILDINGS:</b> The clear distance between the building being evaluated and any adjacent building shall be greater than 4% of the height of the shorter building for Life Safety and Immediate Occupancy.</p>
<p>No adjacent Buildings.</p>				
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	4.3.1.3	<p><b>MEZZANINES:</b> Interior mezzanine levels shall be braced independently from the main structure, or shall be anchored to the lateral-force-resisting elements of the main structure.</p>
<p>Mezzanine in original construction (North – low bay) is braced on one side only.</p>				
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.2.1	<p><b>WEAK STORY:</b> The strength of the lateral-force-resisting system in any story shall not be less than 80% of the strength in an adjacent story above or below for Life-Safety and Immediate Occupancy.</p>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.2.2	<p><b>SOFT STORY:</b> The stiffness of the lateral-force-resisting-system in any story shall not be less than 70% of the lateral-force-resisting system stiffness in an adjacent story above or below, or less than 80% of the average lateral-force-resisting system stiffness of the three stories above or below for Life Safety and Immediate Occupancy.</p>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.2.3	<p><b>GEOMETRY:</b> There shall be no changes in horizontal dimension of the lateral-force-resisting system of more than 30% in a story relative to adjacent stories for Life Safety and Immediate Occupancy, excluding one-story penthouses and mezzanines.</p>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.2.4	<p><b>VERTICAL DISCONTINUITIES:</b> All vertical elements in the lateral-force-resisting system shall be continuous to the foundation.</p>
<p>Existing braced frames are continuous to the foundation.</p>				
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.2.5	<p><b>MASS:</b> There shall be no change in effective mass of more than 50% from one story to the next for Life Safety and Immediate Occupancy. Light roofs, penthouses and mezzanines need not be considered.</p>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.3.1	<p><b>DETERIORATION OF WOOD:</b> There shall be no signs of decay, shrinkage, splitting, fire damage, or sagging in any of the wood members and none of the metal connection hardware shall be deteriorated, broken, or loose.</p>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.3.3	<p><b>DETERIORATION OF STEEL:</b> There shall be no visible rusting, corrosion, cracking, or other deterioration in any of the steel elements or connections in the vertical- or lateral-force-resisting systems.</p>

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## ASCE 31\* BASIC CHECKLIST S2A: STEEL BRACED FRAMES WITH FLEXIBLE DIAPHRAGMS

C NC N/A

Comments

### LATERAL-FORCE-RESISTING SYSTEM

- |                                     |                                     |                                     |  |  |
|-------------------------------------|-------------------------------------|-------------------------------------|--|--|
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/>            | 4.4.1.3.2 AXIAL STRESS CHECK: The axial stress due to gravity loads in columns subjected to overturning forces shall be less than $0.10F_y$ for Life Safety and Immediate Occupancy. Alternatively, the axial stress due to overturning forces alone, calculated using the Quick Check Procedure of Section 3.5.3.6, shall be less than $0.30F_y$ for Life Safety and Immediate Occupancy. | Maximum axial load in column due to gravity loads (including crane) is $0.07F_y$ . |
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/>            | 4.4.3.1.1 REDUNDANCY: The number of lines of braced frames in each principal direction shall be greater than or equal to 2 for Life Safety and Immediate Occupancy. The number of braced bays in each line shall be greater than 2 for Life Safety and 3 for Immediate Occupancy.  |  |
| <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | 4.4.3.1.2 AXIAL STRESS CHECK: The axial stress in the diagonals, calculated using the Quick Check Procedure of Section 3.5.3.4, shall be less than $0.50F_y$ for Life Safety and for Immediate Occupancy.  | Calculated axial stress in brace is $0.74F_y$ .<br>DCR = 1.48                      |
| <input type="checkbox"/>            | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | 4.4.3.1.3 COLUMN SPLICES: All column splice details located in braced frames shall develop the tensile strength of the column. This statement shall apply to the Immediate Occupancy Performance Level only.   | Life Safety Evaluation   |

### CONNECTIONS

- |                                     |                          |                          |  |  |
|-------------------------------------|--------------------------|--------------------------|--|--|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 4.6.2.2 TRANSFER TO STEEL FRAMES: Diaphragms shall be connected for transfer of loads to the steel frames for Life Safety and the connections shall be able to develop the lesser of the strength of the frames or the diaphragms for Immediate Occupancy.   | Decks welded to structural steel framing.  |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 4.6.3.1 STEEL COLUMNS: The columns in lateral-force-resisting frames shall be anchored to the building foundation for Life Safety and the anchorage shall be able to develop the lesser of the tensile capacity of the column, the tensile capacity of the lowest level column splice (if any), or the uplift capacity of the foundation, for Immediate Occupancy. | Columns anchored into reinforced concrete stub column supported on spread footing. |

\* – Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.

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## ASCE 31\* SUPPLEMENTAL CHECKLIST S2A: STEEL BRACED FRAMES WITH FLEXIBLE DIAPHRAGMS

C	NC	N/A		Comments
<b>LATERAL-FORCE-RESISTING SYSTEM</b>				
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	4.4.1.3.7 COMPACT MEMBERS: All frame elements shall meet section requirements set forth by Table I-9-1 of <i>Seismic Provisions for Structural Steel Buildings</i> (AISC, 1997).	Required compactness $52/\sqrt{F_y} = 8.67$ Low bay columns are not compact – $W8 \times 31$ $b/2t = 9.2$
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.4.3.1.4 SLENDERNESS OF DIAGONALS: All diagonal elements required to carry compression shall have $Kl/r$ ratios less than 120.	Braces consist of double angles. Assumed to be tension only.
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	4.4.3.1.5 CONNECTION STRENGTH: All the brace connections shall develop the yield capacity of the diagonals.	Brace connections consist of bolted connections using machine bolts.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.4.3.1.6 OUT-OF-PLANE BRACING: Braced frame connections attached to beam bottom flanges located away from beam-column joints shall be braced out-of-plane at the bottom flange of the beams. This statement shall apply to the Immediate Occupancy Performance Level only.	Life Safety Evaluation
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.4.3.2.1 K-BRACING: The bracing system shall not include K-braced bays.	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.4.3.2.2 TENSION-ONLY BRACES: Tension-only braces shall not comprise more than 70% of the total lateral-force-resisting capacity in structures over two stories in height. This statement shall apply to the Immediate Occupancy Performance Level only.	Life Safety Evaluation
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.4.3.2.3 CHEVRON BRACING: The bracing system shall not include chevron, or V-braced bays. This statement shall apply to the Immediate Occupancy Performance Level only.	Life Safety Evaluation
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.4.3.2.4 CONCENTRICALLY BRACED FRAME JOINTS: All the diagonal braces shall frame into the beam-column joints concentrically. This statement shall apply to the Immediate Occupancy Performance Level only.	Life Safety Evaluation
<b>Frames Not Part of the Lateral-Force-Resisting System</b>				
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	4.4.1.6.2 DEFLECTION COMPATIBILITY: Secondary components shall have the shear capacity to develop the flexural strength of the components for Life Safety and shall meet the requirements of 4.4.1.4.9, 4.4.1.4.10, 4.4.1.4.11, 4.4.1.4.12 and 4.4.1.4.15 for Immediate Occupancy.	The low bays are braced to the high bay along the interior only. The deflection at the exterior on lines A & F will be considerably larger than the high bay.
<b>DIAPHRAGMS</b>				
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.5.1.2 CROSS TIES: There shall be continuous cross ties between diaphragm chords.	Typical diaphragm consists of bare metal deck / plywood sheathing connected to structural steel beams and girders.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.5.1.5 OPENINGS AT BRACED FRAMES: Diaphragm openings immediately adjacent to the braced frames shall extend less than 25% of the frame length for Life Safety and 15% of the frame length for Immediate Occupancy.	No diaphragm openings adjacent.

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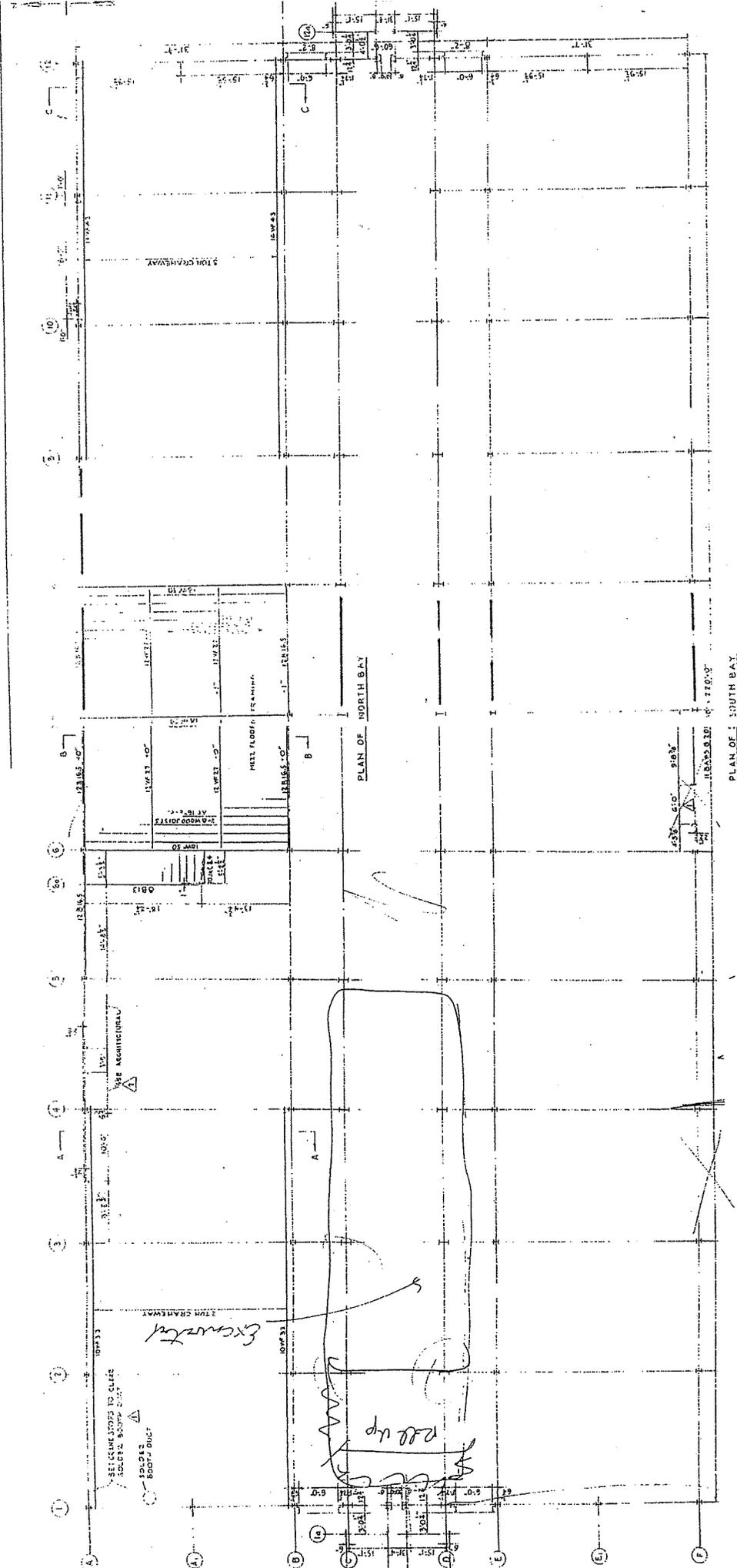
Job Number: A20047.08 Job Name: LLNL Prioritization

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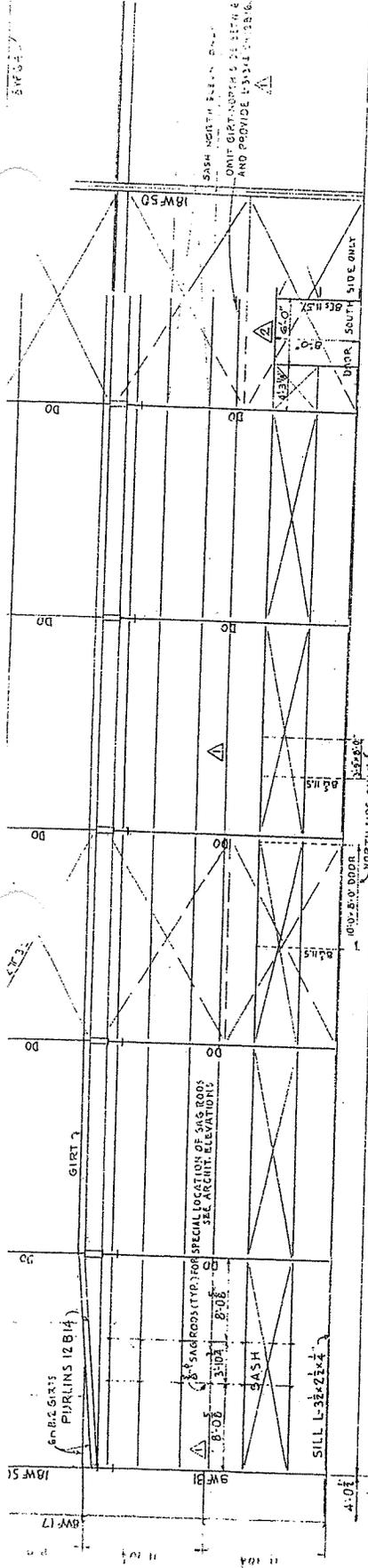
## ASCE 31\* SUPPLEMENTAL CHECKLIST S2A: STEEL BRACED FRAMES WITH FLEXIBLE DIAPHRAGMS

C	NC	N/A		Comments
<b>DIAPHRAGMS</b>				
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.5.1.7 PLAN IRREGULARITIES: There shall be tensile capacity to develop the strength of the diaphragm at re-entrant corners or other locations of plan irregularities. This statement shall apply to the Immediate Occupancy Performance Level only.	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.5.1.8 DIAPHRAGM REINFORCEMENT AT OPENINGS: There shall be reinforcing around all diaphragm openings larger than 50% of the building width in either major plan dimension. This statement shall apply to the Immediate Occupancy Performance Level only.	Life Safety Evaluation
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.5.2.1 STRAIGHT SHEATHING: All straight sheathed diaphragms shall have aspect ratios less than 2 to 1 for Life Safety and 1 to 1 for Immediate Occupancy in the direction being considered.	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.5.2.2 SPANS: All wood diaphragms with spans greater than 24 ft for Life Safety and 12 ft for Immediate Occupancy shall consist of wood structural panels or diagonal sheathing.	Spans at mezzanine (wood diaphragms) span 20 ft only.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.5.2.3 UNBLOCKED DIAPHRAGMS: All diagonally sheathed and unblocked wood structural panel diaphragms shall have horizontal spans less than 40 ft for Life Safety and 30 ft for Immediate Occupancy and shall have aspect ratios less than or equal to 4 to 1 for Life Safety and 3 to 1 for Immediate Occupancy.	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.5.3.1 NON-CONCRETE FILLED DIAPHRAGMS: Untopped metal deck diaphragms or metal deck diaphragms with fill other than concrete shall consist of horizontal spans of less than 40 ft and shall have aspect ratios less than 4 to 1. This statement shall apply to the Immediate Occupancy Performance Level only.	Life Safety Evaluation
<b>CONNECTIONS</b>				
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.6.3.10 UPLIFT AT PILE CAPS: Pile caps shall have top reinforcement and piles shall be anchored to the pile caps for Life Safety, and the pile cap reinforcement and pile anchorage shall be able to develop the tensile capacity of the piles for Immediate Occupancy.	Life Safety Evaluation

\* - Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.



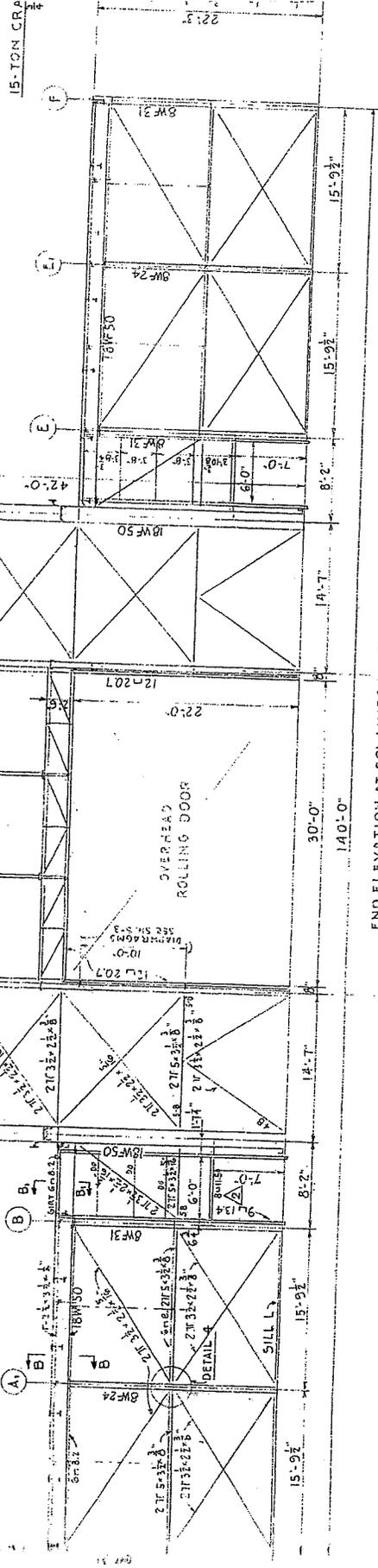
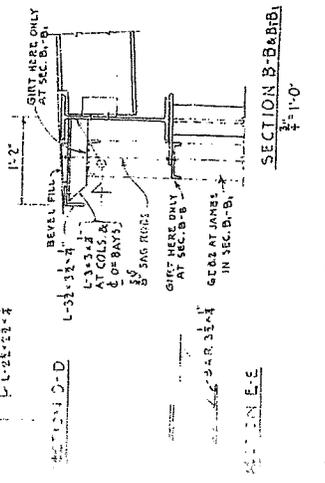
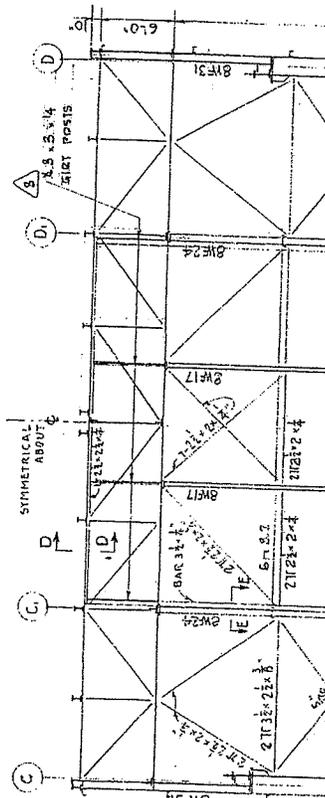
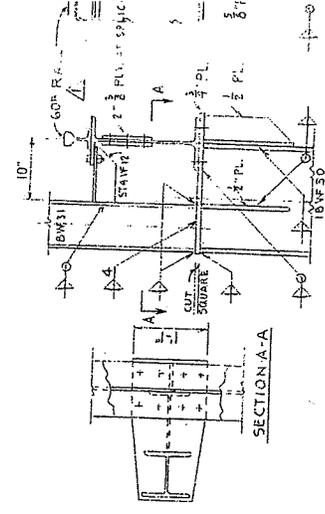
TRP. Floor Plan



11 BAYS @ 20'-0" = 220'-0"

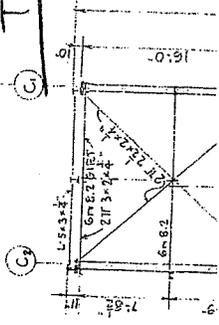
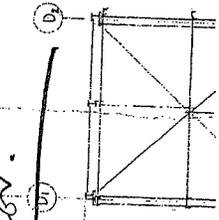
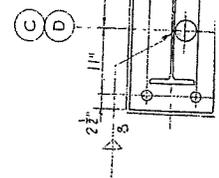
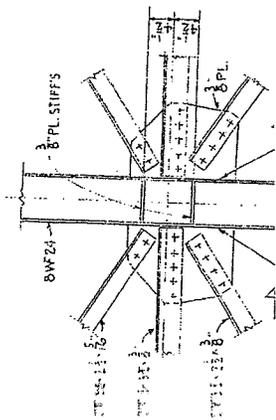
SOUTH SIDE SHOWN  
NORTH SIDE SIMILAR EXCEPT AS NOTED

HALF SIDE ELEVATION  
8" = 1'-0"



END ELEVATION AT COL LINES 1 & 12  
8" = 1'-0"

TYP. END ELEV.



**Appendix B      Building Data Sheets**  
**Class C – Medium Priority Buildings**

***Building 041, Office Area***

Building 041, Office Area, is a one-story wood framed building. The building is L-shaped in plan. The framing consists of 2x4 joists with plywood sheathing that is supported by structural steel girders and columns and bearing plywood shear walls. The primary potential deficiency noted for Building 041, Office Area, is the wood sill anchorage at the shear walls cannot be confirmed. The original construction documents were not available for review and the anchorage was not visible during the site visit. For the building to meet life-safety requirements, we recommend that LLNL verify that there are existing anchors to bolt down the wood sill to the foundation.





**Degenkolb**

DEGENKOLB ENGINEERS

Building Name: Building 041 - Office Date: July 25, 2003

Building Address: Lawrence Livermore National Laboratory Page: 2 of 2

Job Number: A20047.08 Job Name: LLNL Prioritization By: AK Checked: \_\_\_\_\_

**PRIORITIZATION BUILDING DATA SHEET**

**POTENTIAL LIFE SAFETY DEFICIENCIES:**

THIS BUILDING WAS EVALUATED FOR THE 10% IN 50 YR. EARTHQUAKE.

WOOD SILLS

*No available structural drawings. Unable to verify wood sill anchorage.*

**PRELIMINARY STRENGTHENING SCHEMES OR MITIGATION MEASURES:**

Verify wood sill plate anchorage.



Building Name: Building 041 – Office

Date: August 4, 2003

Building Address: Lawrence Livermore National Laboratory

Page: 1 of 3

Job Number: A20047.08

Job Name: LLNL Prioritization

By: Checked:

ASCE 31\* BASIC CHECKLIST W2: WOOD FRAMES, COMMERCIAL AND INDUSTRIAL

C NC N/A

Comments

BUILDING SYSTEM

- 4.3.1.1 LOAD PATH: The structure shall contain a minimum of one complete load path for Life Safety and Immediate Occupancy for seismic force effects from any horizontal direction that serves to transfer the inertial forces from the mass to the foundation. Office area is L-shaped in plan with interior and perimeter plywood shear walls.
4.3.1.3 MEZZANINES: Interior mezzanine levels shall be braced independently from the main structure, or shall be anchored to the lateral-force-resisting elements of the main structure. Single story. No mezzanines.
4.3.2.1 WEAK STORY: The strength of the lateral-force-resisting system in any story shall not be less than 80% of the strength in an adjacent story above or below for Life-Safety and Immediate Occupancy. Single story.
4.3.2.2 SOFT STORY: The stiffness of the lateral-force-resisting-system in any story shall not be less than 70% of the lateral-force-resisting system stiffness in an adjacent story above or below, or less than 80% of the average lateral-force-resisting system stiffness of the three stories above or below for Life Safety and Immediate Occupancy. Single story.
4.3.2.3 GEOMETRY: There shall be no changes in horizontal dimension of the lateral-force-resisting system of more than 30% in a story relative to adjacent stories for Life Safety and Immediate Occupancy, excluding one-story penthouses and mezzanines.
4.3.2.4 VERTICAL DISCONTINUITIES: All vertical elements in the lateral-force-resisting system shall be continuous to the foundation.
4.3.2.5 MASS: There shall be no change in effective mass of more than 50% from one story to the next for Life Safety and Immediate Occupancy. Light roofs, penthouses and mezzanines need not be considered. Single story.
4.3.3.1 DETERIORATION OF WOOD: There shall be no signs of decay, shrinkage, splitting, fire damage, or sagging in any of the wood members and none of the metal connection hardware shall be deteriorated, broken, or loose.
4.3.3.2 WOOD STRUCTURAL PANEL SHEAR WALL FASTENERS: There shall be no more than 15% of inadequate fastening such as overdriven fasteners, omitted blocking, excessive fastening spacing, or inadequate edge distance. This statement shall apply to the Immediate Occupancy Performance Level only. Life Safety Evaluation.

LATERAL-FORCE-RESISTING SYSTEM

- 4.4.2.1.1 REDUNDANCY: The number of lines of shear walls in each principal direction shall be greater than or equal to 2 for Life Safety and Immediate Occupancy.



Building Name: Building 041 – Office

Date: August 4, 2003

Building Address: Lawrence Livermore National Laboratory

Page: 2 of 3

Job Number: A20047.08

Job Name: LLNL Prioritization

By: \_\_\_\_\_ Checked: \_\_\_\_\_

## ASCE 31\* BASIC CHECKLIST W2: WOOD FRAMES, COMMERCIAL AND INDUSTRIAL

C NC N/A

Comments

### LATERAL-FORCE-RESISTING SYSTEM

- |   |   |  |
|---|---|--|
| <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> | 4.4.2.7.1 SHEAR STRESS CHECK: The shear stress in the shear walls, calculated using the Quick Check procedure of Section 3.5.3.3, shall be less than the following values for Life Safety and Immediate Occupancy:  | Shear wall stresses low. Total base shear = 190 kips. 48 feet of wall required.        |
|   | Structural panel sheathing: 1000 plf  |  |
|   | Diagonal sheathing: 700 plf   |  |
|   | Straight sheathing: 100 plf   |  |
|   | All other conditions: 100 plf   |  |
| <input type="checkbox"/> <input type="checkbox"/> <input checked="" type="checkbox"/> | 4.4.2.7.2 STUCCO (EXTERIOR PLASTER) SHEAR WALLS: Multistory buildings shall not rely on exterior stucco walls as the primary lateral-force-resisting system.  | Approximate Wall Length Available:<br>Longitudinal – 140 feet<br>Transverse – 100 feet |
| <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> | 4.4.2.7.3 GYPSUM WALLBOARD OR PLASTER SHEAR WALLS: Interior plaster or gypsum wallboard shall not be used as shear walls on buildings over one story in height with the exception of the uppermost level of a multistory building.  | Single story building with plywood sheathed shear walls.                               |
| <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> | 4.4.2.7.4 NARROW WOOD SHEAR WALLS: Narrow wood shear walls with an aspect ratio greater than 2 to 1 for Life Safety and 1.5 to 1 for Immediate Occupancy shall not be used to resist lateral forces developed in the building in levels of moderate and high seismicity. Narrow wood shear walls with an aspect ratio greater than 2 to 1 for Immediate Occupancy shall not be used to resist lateral forces developed in the building in levels of low seismicity. | Building consists of plywood sheathed shear walls.                                     |
| <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> | 4.4.2.7.5 WALLS CONNECTED THROUGH FLOORS: Shear walls shall have interconnection between stories to transfer overturning and shear forces through the floor.  | Aspect ratio of walls less than 2 to 1.  |
| <input type="checkbox"/> <input type="checkbox"/> <input checked="" type="checkbox"/> | 4.4.2.7.6 HILLSIDE SITE: For structures that are taller on at least one side by more than half of a story due to a sloping site, all shear walls on the downhill slope shall have an aspect ratio less than 1 to 1 for Life Safety and 1 to 2 for Immediate Occupancy.  | Single story building.   |
| <input type="checkbox"/> <input type="checkbox"/> <input checked="" type="checkbox"/> | 4.4.2.7.7 CRIPPLE WALLS: Cripple walls below first floor level shear walls shall be braced to the foundation with wood structural panels.   | Flat topography.   |
| <input type="checkbox"/> <input type="checkbox"/> <input checked="" type="checkbox"/> | 4.4.2.7.8 OPENINGS: Walls with openings greater than 80% of the length shall be braced with wood structural panel shear walls with aspect ratios of not more than 1.5 to 1 or shall be supported by adjacent construction through positive ties capable of transferring the lateral forces.   |  |

### CONNECTIONS

- |   |   |   |
|---|---|---|
| <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> | 4.6.3.3 WOOD POSTS: There shall be a positive connection of wood posts to the foundation. | No interior posts. Floor beams span to perimeter walls. Shear wall posts are connected to pipe columns that are anchored into the foundation. |
| <input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/> | 4.6.3.4 WOOD SILLS: All wood sills shall be bolted to the foundation.                     | No foundation bolts at the wood sills shown on the drawings. Unable to verify at site.  |

Building Name: Building 041 – Office

Date: August 4, 2003

Building Address: Lawrence Livermore National Laboratory

Page: 3 of 3

Job Number: A20047.08 Job Name: LLNL Prioritization

By: \_\_\_\_\_ Checked: \_\_\_\_\_

## ASCE 31\* BASIC CHECKLIST W2: WOOD FRAMES, COMMERCIAL AND INDUSTRIAL

C	NC	N/A		Comments
---	----	-----	--	----------

### CONNECTIONS

- |                                     |                          |                          |  |  |
|-------------------------------------|--------------------------|--------------------------|--|--|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 4.6.4.1 GIRDER/COLUMN CONNECTION: There shall be a positive connection utilizing plates, connection hardware, or straps between the girder and the column support. |  |
|-------------------------------------|--------------------------|--------------------------|--|--|

\* – Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.

Building Name: Building 041 – Office

 Date: August 4, 2003

 Building Address: Lawrence Livermore National Laboratory

 Page: 1 of 1

 Job Number: A20047.08 Job Name: LLNL Prioritization

By: \_\_\_\_\_ Checked: \_\_\_\_\_

## ASCE 31\* SUPPLEMENTAL CHECKLIST W2: WOOD FRAMES, COMMERCIAL AND INDUSTRIAL

C NC N/A

Comments

### LATERAL-FORCE-RESISTING SYSTEM

- |                          |                          |                                     |   |  |
|--------------------------|--------------------------|-------------------------------------|---|--|
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.2.7.9 HOLD-DOWN ANCHORS: All shear walls shall have hold-down anchors constructed per acceptable construction practices, attached to the end studs. This statement shall apply to the Immediate Occupancy Performance Level only. | <b>Life Safety Evaluation only. Shear wall posts are attached to pipe columns that are anchored into the foundation.</b> |
|--------------------------|--------------------------|-------------------------------------|---|--|

### DIAPHRAGMS

- |                                     |                          |                                     |  |                                     |
|-------------------------------------|--------------------------|-------------------------------------|--|-------------------------------------|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.5.1.1 DIAPHRAGM CONTINUITY: The diaphragms shall not be composed of split-level floors and shall not have expansion joints.  |                                     |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.5.1.3 ROOF CHORD CONTINUITY: All chord elements shall be continuous, regardless of changes in roof elevation.  |                                     |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.5.1.7 PLAN IRREGULARITIES: There shall be tensile capacity to develop the strength of the diaphragm at re-entrant corners or other locations of plan irregularities. This statement shall apply to the Immediate Occupancy Performance Level only.   | <b>Life Safety Evaluation only.</b> |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.5.1.8 DIAPHRAGM REINFORCEMENT AT OPENINGS: There shall be reinforcing around all diaphragm openings larger than 50% of the building width in either major plan dimension. This statement shall apply to the Immediate Occupancy Performance Level only.  | <b>Life Safety Evaluation only.</b> |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.5.2.1 STRAIGHT SHEATHING: All straight sheathed diaphragms shall have aspect ratios less than 2 to 1 for Life Safety and 1 to 1 for Immediate Occupancy in the direction being considered.   |                                     |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.5.2.2 SPANS: All wood diaphragms with spans greater than 24 ft for Life Safety and 12 ft for Immediate Occupancy shall consist of wood structural panels or diagonal sheathing. Wood commercial and industrial buildings may have rod-braced systems.  |                                     |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.5.2.3 UNBLOCKED DIAPHRAGMS: All diagonally sheathed and unblocked wood structural panel diaphragms shall have horizontal spans less than 40 ft for Life Safety and 30 ft for Immediate Occupancy and shall have aspect ratios less than or equal to 4 to 1 for Life Safety and 3 to 1 for Immediate Occupancy. |                                     |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.5.7.1 OTHER DIAPHRAGMS: The diaphragm shall not consist of a system other than wood, metal deck, concrete or horizontal bracing.   |                                     |

### CONNECTIONS

- |                          |                                     |                          |   |   |
|--------------------------|-------------------------------------|--------------------------|---|---|
| <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | 4.6.3.9 WOOD SILL BOLTS: Sill bolts shall be spaced at 6 ft or less for Life Safety and 4 ft or less for Immediate Occupancy, with proper edge and end distance provided for wood and concrete. | <b>No foundation bolts at the wood sills shown on the drawings. Unable to verify at site.</b> |
|--------------------------|-------------------------------------|--------------------------|---|---|

\* – Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.





Building Name: Building 041 - Warehouse

Date: July 25, 2003

Building Address: Lawrence Livermore National Laboratory

Page: 2 of 2

Job Number: A20047.08

Job Name: LLNL Prioritization

By: AK Checked: \_\_\_\_\_

## PRIORITIZATION BUILDING DATA SHEET

### POTENTIAL LIFE SAFETY DEFICIENCIES:

THIS BUILDING WAS EVALUATED FOR THE 10% IN 50 YR. EARTHQUAKE.

#### AXIAL STRESS CHECK

*Axial stress in rods is higher than allowed by quick check. Braced frame is tension only.*

#### MOMENT RESISTING CONNECTIONS

*Beam splices unable to develop beam capacity.*

#### WALL PANELS

*Wall panels are not attached to steel frame. Panels are independently anchored to the foundation.*

### PRELIMINARY STRENGTHENING SCHEMES OR MITIGATION MEASURES:

Replace existing bar braces with tube steel that can act as both tension and compression members.

Weld together existing beam splices.

Building Name: Building 041 - Warehouse Date: August 4, 2003  
 Building Address: Lawrence Livermore National Laboratory Page: 1 of 2  
 Job Number: A20047.08 Job Name: LLNL Prioritization By: \_\_\_\_\_ Checked: \_\_\_\_\_

**ASCE 31\* BASIC CHECKLIST S3: STEEL LIGHT FRAMES**

**C NC N/A** **Comments**

**BUILDING SYSTEM**

- |                                     |                          |                          |         |   |  |
|-------------------------------------|--------------------------|--------------------------|---------|---|--|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 4.3.1.1 | LOAD PATH: The structure shall contain a minimum of one complete load path for Life Safety and Immediate Occupancy for seismic force effects from any horizontal direction that serves to transfer the inertial forces from the mass to the foundation. | There are steel moment frames in the transverse direction and rod braced frames in the longitudinal direction. |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 4.3.1.3 | MEZZANINES: Interior mezzanine levels shall be braced independently from the main structure, or shall be anchored to the lateral-force-resisting elements of the main structure.  | Within the warehouse, there is an independently supported and plywood sheathed elevated area.                  |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 4.3.2.4 | VERTICAL DISCONTINUITIES: All vertical elements in the lateral-force-resisting system shall be continuous to the foundation.  |  |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 4.3.2.6 | TORSION: The estimated distance between the story center of mass and the story center of rigidity shall be less than 20% of the building width in either plan dimension for Life Safety and Immediate Occupancy.  |  |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 4.3.3.3 | DETERIORATION OF STEEL: There shall be no visible rusting, corrosion, cracking, or other deterioration in any of the steel elements or connections in the vertical- or lateral-force-resisting systems.   |  |

**LATERAL-FORCE-RESISTING SYSTEM**

- |                          |                                     |                          |           |   |  |
|--------------------------|-------------------------------------|--------------------------|-----------|---|--|
| <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | 4.4.3.1.2 | AXIAL STRESS CHECK: The axial stress in the diagonals, calculated using the Quick Check Procedure of Section 3.5.3.4, shall be less than $0.50F_y$ for Life Safety and for Immediate Occupancy. | Calculated axial stress in rods exceeds allowable. $F_a = 110$ ksi |
|--------------------------|-------------------------------------|--------------------------|-----------|---|--|

**CONNECTIONS**

- |                                     |                          |                          |         |  |  |
|-------------------------------------|--------------------------|--------------------------|---------|--|--|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 4.6.2.2 | TRANSFER TO STEEL FRAMES: Diaphragms shall be connected for transfer of loads to the steel frames for Life Safety and the connections shall be able to develop the lesser of the strength of the frames or the diaphragms for Immediate Occupancy.   | Metal deck roof connected to the roof beams.   |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 4.6.3.1 | STEEL COLUMNS: The columns in lateral-force-resisting frames shall be anchored to the building foundation for Life Safety and the anchorage shall be able to develop the lesser of the tensile capacity of the column, the tensile capacity of the lowest level column splice (if any), or the uplift capacity of the foundation, for Immediate Occupancy. | Column is anchored into the building footings with anchor bolts.   |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 4.6.3.8 | WALL PANELS: Metal, fiberglass or cementitious wall panels shall be positively attached to the foundation for Life Safety and Immediate Occupancy.   | Warehouse perimeter walls consists of metal panels supported on a 4 feet high CMU block wall. Walls not attached to steel frame. |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 4.6.5.1 | ROOF PANELS: Metal, plastic, or cementitious roof panels shall be positively attached to the roof framing to resist seismic forces for Life Safety and Immediate Occupancy.  |  |



Building Name: Building 041 - Warehouse

Date: August 4, 2003

Building Address: Lawrence Livermore National Laboratory

Page: 2 of 2

Job Number: A20047.08 Job Name: LLNL Prioritization

By: \_\_\_\_\_ Checked: \_\_\_\_\_

## ASCE 31\* BASIC CHECKLIST S3: STEEL LIGHT FRAMES

C NC N/A

Comments

### CONNECTIONS

- |                          |                                     |                          |  |                                      |
|--------------------------|-------------------------------------|--------------------------|--|--------------------------------------|
| <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | 4.6.5.2 WALL PANELS: Metal, fiberglass or cementitious wall panels shall be positively attached to the framing to resist seismic forces for Life Safety and Immediate Occupancy. | Walls not attached to steel framing. |
|--------------------------|-------------------------------------|--------------------------|--|--------------------------------------|

\* - Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.



Building Name: Building 041 - Warehouse

Date: August 4, 2003

Building Address: Lawrence Livermore National Laboratory

Page: 1 of 1

Job Number: A20047.08 Job Name: LLNL Prioritization

By: \_\_\_\_\_ Checked: \_\_\_\_\_

## ASCE 31\* SUPPLEMENTAL CHECKLIST S3: STEEL LIGHT FRAMES

C	NC	N/A	Comments
---	----	-----	----------

### LATERAL-FORCE-RESISTING SYSTEM

- |                          |                                     |                                     |   |   |
|--------------------------|-------------------------------------|-------------------------------------|---|---|
| <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | 4.4.1.3.3 MOMENT-RESISTING CONNECTIONS: All moment connections shall be able to develop the strength of the adjoining members or panel zones.   | Transverse pre-manufactured steel frames are constructed in segments that are bolted together. Bolts are unable to develop the yield strength of the adjoining members. |
| <input type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/>            | 4.4.1.3.7 COMPACT MEMBERS: All frame elements shall meet section requirements set forth by Table I-9-1 of <i>Seismic Provisions for Structural Steel Buildings</i> (AISC, 1997).  | Can not determine. Beams are tapered. There are no drawings to determine actual size of elements.   |
| <input type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | 4.4.1.3.8 BEAM PENETRATIONS: All openings in frame-beam webs shall be less than 1/4 of the beam depth and shall be located in the center half of the beams. This statement shall apply to the Immediate Occupancy Performance Level only. | Life Safety Evaluation  |
| <input type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | 4.4.1.3.10 OUT-OF-PLANE BRACING: Beam-column joints shall be braced out-of-plane. This statement shall apply to the Immediate Occupancy Performance Level only.   | Life Safety Evaluation  |
| <input type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | 4.4.1.3.11 BOTTOM FLANGE BRACING: The bottom flanges of beams shall be braced out-of-plane. This statement shall apply to the Immediate Occupancy Performance Level only.   | This is a Life Safety Evaluation only. However, the bottom flange of beams is braced for out-of-plane.  |

### DIAPHRAGMS

- |                                     |                          |                                     |   |   |
|-------------------------------------|--------------------------|-------------------------------------|---|---|
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.5.1.7 PLAN IRREGULARITIES: There shall be tensile capacity to develop the strength of the diaphragm at re-entrant corners or other locations of plan irregularities. This statement shall apply to the Immediate Occupancy Performance Level only.      | Life Safety Evaluation. However, there are no re-entrant corners. |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.5.1.8 DIAPHRAGM REINFORCEMENT AT OPENINGS: There shall be reinforcing around all diaphragm openings larger than 50% of the building width in either major plan dimension. This statement shall apply to the Immediate Occupancy Performance Level only. | Life Safety Evaluation. No significant openings in roof diaphragm |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.5.7.1 OTHER DIAPHRAGMS: The diaphragm shall not consist of a system other than wood, metal deck, concrete or horizontal bracing.  | Metal deck roof.  |

### CONNECTIONS

- |                                     |                          |                                     |  |
|-------------------------------------|--------------------------|-------------------------------------|--|
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.6.3.10 UPLIFT AT PILE CAPS: Pile caps shall have top reinforcement and piles shall be anchored to the pile caps for Life Safety, and the pile cap reinforcement and pile anchorage shall be able to develop the tensile capacity of the piles for Immediate Occupancy. |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.6.5.3 ROOF PANEL CONNECTIONS: Roof panel connections shall be spaced at or less than 12" for Life Safety and 8" for Immediate Occupancy.   |

\* - Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.

### ***Building 115, Magnetic Vault***

Building 115, Magnetic Vault is approximately 1,000-sq. ft. and is a dual system of a concrete bearing wall on the west face and moment-resisting frames on the remaining faces. The structure consists of a metal deck at the roof without a concrete fill. The deck spans the east-west direction and is supported by beams in the center and on the east face and by a concrete bearing wall on the west face. The columns are hollow structural sections, which are bolted to the foundation.

The primary structural deficiencies are the lack of cross ties between the concrete bearing wall and the opposite frame. This can be mitigated by adding continuous ties at the roof in the transverse direction of the building.

Building Name: **Building 115 Magnetic Tape Vault**

Date: **Sept 4, 2003**

Building Address: **Lawrence Livermore National Laboratory**

Page: **1** of **2**

Job Number: **A20047.08**

Job Name: **LLNL Prioritization**

By: **GGW** Checked: **JEH**

## PRIORITIZATION BUILDING DATA SHEET

### BUILDING DATA

Year Built:	1985	Year(s) Remodeled:		UBC Zone:	4 – Type B Near Field
Area (sf):	1040	Length (ft):	40	Width (ft):	26
No. Stories:	1	Story Height:	14'	Total Height:	14'

### CONSTRUCTION DATA

Gravity Load Structural System: Metal deck roof, supported by W12 beam in the center, W10 on the east face, and block wall on the west face. Columns are TS 12x6. Wood floor supported by TS 4x6 joists. Concrete slab at grade is supported on 6 - 24" diameter concrete piers, 17' deep. 8" block wall on west face.

Exterior Transverse Walls: Tube steel moment frame	Openings?: Door openings
Exterior Longitudinal Walls: 8" concrete block wall on west face Tube steel moment frame on east face	Openings?: No openings in block wall

Roof Framing: 3" 18 gauge roof metal decking

Intermediate Floor Framing: Wood sub-floor on TS 4x6 joists

Ground Floor: 12" slab

Columns: TS 12x6

Foundation: 6 - 24" diameter piers, 17' deep

### LATERAL-FORCE-RESISTING SYSTEM

	Longitudinal	Transverse
System Classification:	Type 3 (Steel Moment Frame Building w/ Flexible Diaphragm) and Type 13 (Reinforced Masonry Bearing Wall Building w/ Flexible Diaphragm)	Type 3 (Steel Moment Frame Building w/ Flexible Diaphragm)
Vertical Elements:	Metal deck, steel beams, reinforced concrete block wall, steel columns	Metal deck, steel beams, reinforced concrete block wall, steel columns
Diaphragms:	3" 18 gauge roof metal decking	3" 18 gauge roof metal decking

SEISMIC EVALUATION PERFORMED? Yes EVALUATION: Rapid Evaluation YEAR: 2003

SEISMIC EVALUATION CRITERIA: Life Safety/ ASCE 31-02

VULNERABILITY RATING: 5  
(1=low to 10=high)

PRIORITIZATION CLASSIFICATION: CLASS C



Building Name: **Building 115 Magnetic Tape Vault**

Date: **Sept 4, 2003**

Building Address: **Lawrence Livermore National Laboratory**

Page: **2** of **2**

Job Number: **A20047.08**

Job Name: **LLNL Prioritization**

By: **GGW** Checked: **JEH**

**PRIORITIZATION BUILDING DATA SHEET**

**POTENTIAL LIFE SAFETY DEFICIENCIES:**

THIS BUILDING WAS EVALUATED FOR THE 10% IN 50 YR. EARTHQUAKE.

**DRIFT CHECK**

*Frames do not meet drift limits due to increased effective height attributed to a pinned base.*

**PANEL ZONES**

*Panel zones are insufficient*

**CROSS TIES**

*No cross ties on diaphragm*

**PRELIMINARY STRENGTHENING SCHEMES OR MITIGATION MEASURES:**

Add cross ties in the east-west direction from the concrete block wall to the opposite W10x33 beam. Demand on the building is low. Potential deficiencies identified for drift and panel zones can be mitigated through detailed analysis.

Building Name: Building 115, Magnetic Tape Vault Date: Sept 5, 2003  
 Building Address: Lawrence Livermore National Laboratory Page: 1 of 2  
 Job Number: A20047.08 Job Name: LLNL Prioritization By: GGW Checked: JEH

## ASCE 31\* BASIC CHECKLIST RM1: REINFORCED MASONRY BEARING WALL BUILDINGS WITH FLEXIBLE DIAPHRAGMS

C	NC	N/A		Comments
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### BUILDING SYSTEM

<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.1.1	LOAD PATH: The structure shall contain a minimum of one complete load path for Life Safety and Immediate Occupancy for seismic force effects from any horizontal direction that serves to transfer the inertial forces from the mass to the foundation.	Metal deck is welded to a C8x11.5, which is bolted to concrete block wall. Wall is doweled into the foundation.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.1.2	ADJACENT BUILDINGS: The clear distance between the building being evaluated and any adjacent building shall be greater than 4% of the height of the shorter building for Life Safety and Immediate Occupancy.	However, the adjacent building is at the same height as the building being evaluated so pounding is not an issue.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.1.3	MEZZANINES: Interior mezzanine levels shall be braced independently from the main structure, or shall be anchored to the lateral-force-resisting elements of the main structure.	There are no mezzanines.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.1	WEAK STORY: The strength of the lateral-force-resisting system in any story shall not be less than 80% of the strength in an adjacent story above or below for Life-Safety and Immediate Occupancy.	One story building
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.2	SOFT STORY: The stiffness of the lateral-force-resisting-system in any story shall not be less than 70% of the lateral-force-resisting system stiffness in an adjacent story above or below, or less than 80% of the average lateral-force-resisting system stiffness of the three stories above or below for Life Safety and Immediate Occupancy.	One story building
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.3	GEOMETRY: There shall be no changes in horizontal dimension of the lateral-force-resisting system of more than 30% in a story relative to adjacent stories for Life Safety and Immediate Occupancy, excluding one-story penthouses and mezzanines.	One story building
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.2.4	VERTICAL DISCONTINUITIES: All vertical elements in the lateral-force-resisting system shall be continuous to the foundation.	Wall is doweled into the concrete strip footing foundation.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.5	MASS: There shall be no change in effective mass of more than 50% from one story to the next for Life Safety and Immediate Occupancy. Light roofs, penthouses and mezzanines need not be considered.	One story building
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.3.1	DETERIORATION OF WOOD: There shall be no signs of decay, shrinkage, splitting, fire damage, or sagging in any of the wood members and none of the metal connection hardware shall be deteriorated, broken, or loose.	Site visit on 7/30/03. No signs of deterioration were observed.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.3.7	MASONRY UNITS: There shall be no visible deterioration of masonry units.	Site visit on 7/30/03. No signs of deterioration were observed.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.3.8	MASONRY JOINTS: The mortar shall not be easily scraped away from the joints by hand with a metal tool, and there shall be no areas of eroded mortar.	Site visit on 7/30/03. No signs of eroded mortar.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.3.10	REINFORCED MASONRY WALL CRACKS: All existing diagonal cracks in wall elements shall be less than 1/8" for Life Safety and 1/16" for Immediate Occupancy, shall not be concentrated in one location, and shall not form an X pattern.	Site visit on 7/30/03. No visible cracks observed.

Building Name: Building 115, Magnetic Tape Vault

Date: Sept 5, 2003

Building Address: Lawrence Livermore National Laboratory

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Job Number: A20047.08 Job Name: LLNL Prioritization

By: GGW Checked: JEH

## ASCE 31\* BASIC CHECKLIST RM1: REINFORCED MASONRY BEARING WALL BUILDINGS WITH FLEXIBLE DIAPHRAGMS

C	NC	N/A		Comments
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### LATERAL-FORCE-RESISTING SYSTEM

- |                                     |                          |                          |   |   |
|-------------------------------------|--------------------------|--------------------------|---|---|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 4.4.2.1.1 REDUNDANCY: The number of lines of shear walls in each principal direction shall be greater than or equal to 2 for Life Safety and Immediate Occupancy.   | Moment frame on the east face and masonry shearwall on the west face. |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 4.4.2.4.1 SHEAR STRESS CHECK: The shear stress in the reinforced masonry shear walls, calculated using the Quick Check Procedure of Section 3.5.3.3, shall be less than 70 psi for Life Safety and Immediate Occupancy.   | Average shear stress = 2.2 psi << 70 psi                              |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 4.4.2.4.2 REINFORCING STEEL: The total vertical and horizontal reinforcing steel ratio in reinforced masonry walls shall be greater than 0.002 for Life Safety and Immediate Occupancy of the wall with the minimum of 0.0007 for Life Safety and Immediate Occupancy in either of the two directions; the spacing of reinforcing steel shall be less than 48" for Life Safety and Immediate Occupancy; and all vertical bars shall extend to the top of the walls. |   |

### CONNECTIONS

- |                                     |                          |                                     |   |  |
|-------------------------------------|--------------------------|-------------------------------------|---|--|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.6.1.1 WALL ANCHORAGE: Exterior concrete or masonry walls, that are dependent on the diaphragm for lateral support, shall be anchored for out-of-plane forces at each diaphragm level with steel anchors, reinforcing dowels, or straps that are developed into the diaphragm. Connections shall have adequate strength to resist the connection force calculated in the Quick Check Procedure of Section 3.5.3.7. | Welds between metal deck and channel and bolts from the channel to the wall are sufficient to develop loads from the wall. |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.6.1.2 WOOD LEDGERS: The connection between the wall panels and the diaphragm shall not induce cross-grain bending or tension in the wood ledgers.   |  |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.6.2.1 TRANSFER TO SHEAR WALLS: Diaphragms shall be connected for transfer of loads to the shear walls for Life Safety and the connections shall be able to develop the lesser of the shear strength of the walls or diaphragms for Immediate Occupancy.   |  |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.6.3.5 FOUNDATION DOWELS: Wall reinforcement shall be doweled into the foundation for Life Safety and the dowels shall be able to develop the lesser of the strength of the walls or the uplift capacity of the foundation for Immediate Occupancy.  |  |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.6.4.1 GIRDER/COLUMN CONNECTION: There shall be a positive connection utilizing plates, connection hardware, or straps between the girder and the column support.  |  |

\* – Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.

Building Name: Building 115, Magnetic Tape Vault

Date: Sept 5, 2003

Building Address: Lawrence Livermore National Laboratory

Page: 1 of 2

Job Number: A20047.08 Job Name: LLNL Prioritization

By: GGW Checked: JEH

## ASCE 31\* SUPPLEMENTAL CHECKLIST RM1: REINFORCED MASONRY BEARING WALL BUILDINGS WITH FLEXIBLE DIAPHRAGMS

**C NC N/A**

**Comments**

### LATERAL-FORCE-RESISTING SYSTEM

- 4.4.2.4.3 REINFORCING AT OPENINGS: All wall openings that interrupt rebar shall have trim reinforcing on all sides. This statement shall apply to the Immediate Occupancy Performance Level only.
- 4.4.2.4.4 PROPORTIONS: The height-to-thickness ratio of the shear walls at each story shall be less than 30. This statement shall apply to the Immediate Occupancy Performance Level only.

### DIAPHRAGMS

- 4.5.1.2 CROSS TIES: There shall be continuous cross ties between diaphragm chords. **No cross ties in diaphragm**
- 4.5.1.4 OPENINGS AT SHEAR WALLS: Diaphragm openings immediately adjacent to the shear walls shall be less than 25% of the wall length for Life Safety and 15% of the wall length for Immediate Occupancy. **No openings in shear walls**
- 4.5.1.6 OPENINGS AT EXTERIOR MASONRY SHEAR WALLS: Diaphragm openings immediately adjacent to exterior masonry shear walls shall not be greater than 8 ft long for Life Safety and 4 ft long for Immediate Occupancy.
- 4.5.1.7 PLAN IRREGULARITIES: There shall be tensile capacity to develop the strength of the diaphragm at re-entrant corners or other locations of plan irregularities. This statement shall apply to the Immediate Occupancy Performance Level only.
- 4.5.1.8 DIAPHRAGM REINFORCEMENT AT OPENINGS: There shall be reinforcing around all diaphragm openings larger than 50% of the building width in either major plan dimension. This statement shall apply to the Immediate Occupancy Performance Level only.
- 4.5.2.1 STRAIGHT SHEATHING: All straight sheathed diaphragms shall have aspect ratios less than 2 to 1 for Life Safety and 1 to 1 for Immediate Occupancy in the direction being considered.
- 4.5.2.2 SPANS: All wood diaphragms with spans greater than 24 ft for Life Safety and 12 ft for Immediate Occupancy shall consist of wood structural panels or diagonal sheathing.
- 4.5.2.3 UNBLOCKED DIAPHRAGMS: All diagonally sheathed and unblocked wood structural panel diaphragms shall have horizontal spans less than 40 ft for Life Safety and 30 ft for Immediate Occupancy and shall have aspect ratios less than or equal to 4 to 1 for Life Safety and 3 to 1 for Immediate Occupancy.
- 4.5.3.1 NON-CONCRETE FILLED DIAPHRAGMS: Untopped metal deck diaphragms or metal deck diaphragms with fill other than concrete shall consist of horizontal spans of less than 40 ft and shall have aspect ratios less than 4 to 1. This statement shall apply to the Immediate Occupancy Performance Level only.

Building Name: Building 115, Magnetic Tape Vault

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Job Number: A20047.08 Job Name: LLNL Prioritization

By: GGW Checked: JEH

## ASCE 31\* SUPPLEMENTAL CHECKLIST RM1: REINFORCED MASONRY BEARING WALL BUILDINGS WITH FLEXIBLE DIAPHRAGMS

**C NC N/A**

**Comments**

### DIAPHRAGMS

- |   |   |  |
|---|---|--|
| <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> | <b>4.5.7.1 OTHER DIAPHRAGMS:</b> The diaphragm shall not consist of a system other than wood, metal deck, concrete or horizontal bracing. | <b>Metal Deck is used as diaphragm</b> |
|---|---|--|

### CONNECTIONS

- |   |   |   |
|---|---|---|
| <input type="checkbox"/> <input type="checkbox"/> <input checked="" type="checkbox"/> | <b>4.6.1.4 STIFFNESS OF WALL ANCHORS:</b> Anchors of concrete or masonry walls to wood structural elements shall be installed taut and shall be stiff enough to limit the relative movement between the wall and the diaphragm to no greater than 1/8". | <b>Wall does not connect to wood structural elements.</b> |
|---|---|---|

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Building Name: Building 115, Magnetic Tape Vault Date: Sept 4, 2003  
 Building Address: Lawrence Livermore National Laboratory Page: 1 of 2  
 Job Number: A20047.08 Job Name: LLNL Prioritization By: GGW Checked: JEH

## ASCE 31\* BASIC CHECKLIST S1A: STEEL MOMENT FRAMES WITH FLEXIBLE DIAPHRAGMS

C	NC	N/A		Comments
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### BUILDING SYSTEM

<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.1.1 LOAD PATH: The structure shall contain a minimum of one complete load path for Life Safety and Immediate Occupancy for seismic force effects from any horizontal direction that serves to transfer the inertial forces from the mass to the foundation.	Seismic load is transferred from metal deck to the moment frame. The columns are bolted to the slab.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.1.2 ADJACENT BUILDINGS: The clear distance between the building being evaluated and any adjacent building shall be greater than 4% of the height of the shorter building for Life Safety and Immediate Occupancy.	Adjacent building apparently 2-1/4" from the edge of the columns of the building being evaluated. 4% of the building height allows for 6-3/4". However, the adjacent building is at the same height as the building being evaluated so pounding is not an issue.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.1.3 MEZZANINES: Interior mezzanine levels shall be braced independently from the main structure, or shall be anchored to the lateral-force-resisting elements of the main structure.	There are no mezzanines.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.1 WEAK STORY: The strength of the lateral-force-resisting system in any story shall not be less than 80% of the strength in an adjacent story above or below for Life-Safety and Immediate Occupancy.	One story building
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.2 SOFT STORY: The stiffness of the lateral-force-resisting-system in any story shall not be less than 70% of the lateral-force-resisting system stiffness in an adjacent story above or below, or less than 80% of the average lateral-force-resisting system stiffness of the three stories above or below for Life Safety and Immediate Occupancy.	One story building
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.3 GEOMETRY: There shall be no changes in horizontal dimension of the lateral-force-resisting system of more than 30% in a story relative to adjacent stories for Life Safety and Immediate Occupancy, excluding one-story penthouses and mezzanines.	One story building
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.2.4 VERTICAL DISCONTINUITIES: All vertical elements in the lateral-force-resisting system shall be continuous to the foundation.	The moment frames are bolted to the foundation
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.5 MASS: There shall be no change in effective mass of more than 50% from one story to the next for Life Safety and Immediate Occupancy. Light roofs, penthouses and mezzanines need not be considered.	One story building
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.3.1 DETERIORATION OF WOOD: There shall be no signs of decay, shrinkage, splitting, fire damage, or sagging in any of the wood members and none of the metal connection hardware shall be deteriorated, broken, or loose.	Site visit on 7/30/03. No signs of deterioration were observed.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.3.3 DETERIORATION OF STEEL: There shall be no visible rusting, corrosion, cracking, or other deterioration in any of the steel elements or connections in the vertical- or lateral-force-resisting systems.	Site visit on 7/30/03. No signs of deterioration were observed.

Building Name: Building 115, Magnetic Tape Vault

 Date: Sept 4, 2003

 Building Address: Lawrence Livermore National Laboratory

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 Job Number: A20047.08 Job Name: LLNL Prioritization

 By: GGW Checked: JEH

## ASCE 31\* BASIC CHECKLIST S1A: STEEL MOMENT FRAMES WITH FLEXIBLE DIAPHRAGMS

C	NC	N/A	Comments
<b>LATERAL-FORCE-RESISTING SYSTEM</b>			
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.4.1.1.1 REDUNDANCY: The number of lines of moment frames in each principal direction shall be greater than or equal to 2 for Life Safety and Immediate Occupancy. The number of bays of moment frames in each line shall be greater than or equal to 2 for Life Safety and 3 for Immediate Occupancy.
			One moment frame on each of the north and south faces, moment frame on the east face and masonry shearwall on the west face.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.4.1.2.1 INTERFERING WALLS: All concrete and masonry infill walls placed in moment frames shall be isolated from structural elements.
			No infill walls
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	4.4.1.3.1 DRIFT CHECK: The drift ratio of the steel moment frames, calculated using the Quick Check procedure of Section 3.5.3.1, shall be less than 0.025 for Life Safety and 0.015 for Immediate Occupancy.
			Frames do not meet drift limits due to increased effective height attributed to a pinned base, but shall be mitigated through a more detailed analysis.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.4.1.3.2 AXIAL STRESS CHECK: The axial stress due to gravity loads in columns subjected to overturning forces shall be less than $0.10F_y$ for Life Safety and Immediate Occupancy. Alternatively, the axial stress due to overturning forces alone, calculated using the Quick Check Procedure of Section 3.5.3.6, shall be less than $0.30F_y$ for Life Safety and Immediate Occupancy.
			Frame complies with axial stress check
<b>CONNECTIONS</b>			
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.6.2.2 TRANSFER TO STEEL FRAMES: Diaphragms shall be connected for transfer of loads to the steel frames for Life Safety and the connections shall be able to develop the lesser of the strength of the frames or the diaphragms for Immediate Occupancy.
			Metal deck is welded to moment frame and to channel connected to block wall
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.6.3.1 STEEL COLUMNS: The columns in lateral-force-resisting frames shall be anchored to the building foundation for Life Safety and the anchorage shall be able to develop the lesser of the tensile capacity of the column, the tensile capacity of the lowest level column splice (if any), or the uplift capacity of the foundation, for Immediate Occupancy.
			Columns are welded to the base plates and base plates are bolted to the foundation.

\* – Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.

Building Name: Building 115, Magnetic Tape Vault

Date: Sept 5, 2003

Building Address: Lawrence Livermore National Laboratory

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Job Number: A20047.08 Job Name: LLNL Prioritization

By: GGW Checked: JEH

## ASCE 31\* SUPPLEMENTAL CHECKLIST S1A: STEEL MOMENT FRAMES WITH FLEXIBLE DIAPHRAGMS

C	NC	N/A		Comments
<b>LATERAL-FORCE-RESISTING SYSTEM</b>				
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.4.1.3.3 MOMENT-RESISTING CONNECTIONS: All moment connections shall be able to develop the strength of the adjoining members or panel zones.	Full penetration welds are capable of developing the strength of adjoining members
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	4.4.1.3.4 PANEL ZONES: All panel zones shall have the shear capacity to resist the shear demand required to develop 0.8 times the sum of the flexural strengths of the girders framing in at the face of the column.	Panel zones are insufficient, but shall be mitigated through a more detailed analysis.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.4.1.3.5 COLUMN SPLICES: All column splice details located in moment resisting frames shall include connection of both flanges and the web for Life Safety and the splice shall develop the strength of the column for Immediate Occupancy.	No Column Splices
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.4.1.3.6 STRONG COLUMN/WEAK BEAM: The percent of strong column/weak beam joints in each story of each line of moment resisting frames shall be greater than 50% for Life Safety and Immediate Occupancy.	Strong Column/weak beam does not apply on a one story building
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.4.1.3.7 COMPACT MEMBERS: All frame elements shall meet section requirements set forth by Table I-9-1 of <i>Seismic Provisions for Structural Steel Buildings</i> (AISC, 1997).	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.4.1.3.8 BEAM PENETRATIONS: All openings in frame-beam webs shall be less than 1/4 of the beam depth and shall be located in the center half of the beams. This statement shall apply to the Immediate Occupancy Performance Level only.	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.4.1.3.9 GIRDER FLANGE CONTINUITY PLATES: There shall be girder flange continuity plates at all moment-resisting frame joints. This statement shall apply to the Immediate Occupancy Performance Level only.	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.4.1.3.10 OUT-OF-PLANE BRACING: Beam-column joints shall be braced out-of-plane. This statement shall apply to the Immediate Occupancy Performance Level only.	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.4.1.3.11 BOTTOM FLANGE BRACING: The bottom flanges of beams shall be braced out-of-plane. This statement shall apply to the Immediate Occupancy Performance Level only.	
<b>DIAPHRAGMS</b>				
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	4.5.1.2 CROSS TIES: There shall be continuous cross ties between diaphragm chords.	No cross ties on diaphragm
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.5.1.7 PLAN IRREGULARITIES: There shall be tensile capacity to develop the strength of the diaphragm at re-entrant corners or other locations of plan irregularities. This statement shall apply to the Immediate Occupancy Performance Level only.	

Building Name: Building 115, Magnetic Tape Vault Date: Sept 5, 2003  
 Building Address: Lawrence Livermore National Laboratory Page: 2 of 2  
 Job Number: A20047.08 Job Name: LLNL Prioritization By: GGW Checked: JEH

## ASCE 31\* SUPPLEMENTAL CHECKLIST S1A: STEEL MOMENT FRAMES WITH FLEXIBLE DIAPHRAGMS

C	NC	N/A		Comments
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### DIAPHRAGMS

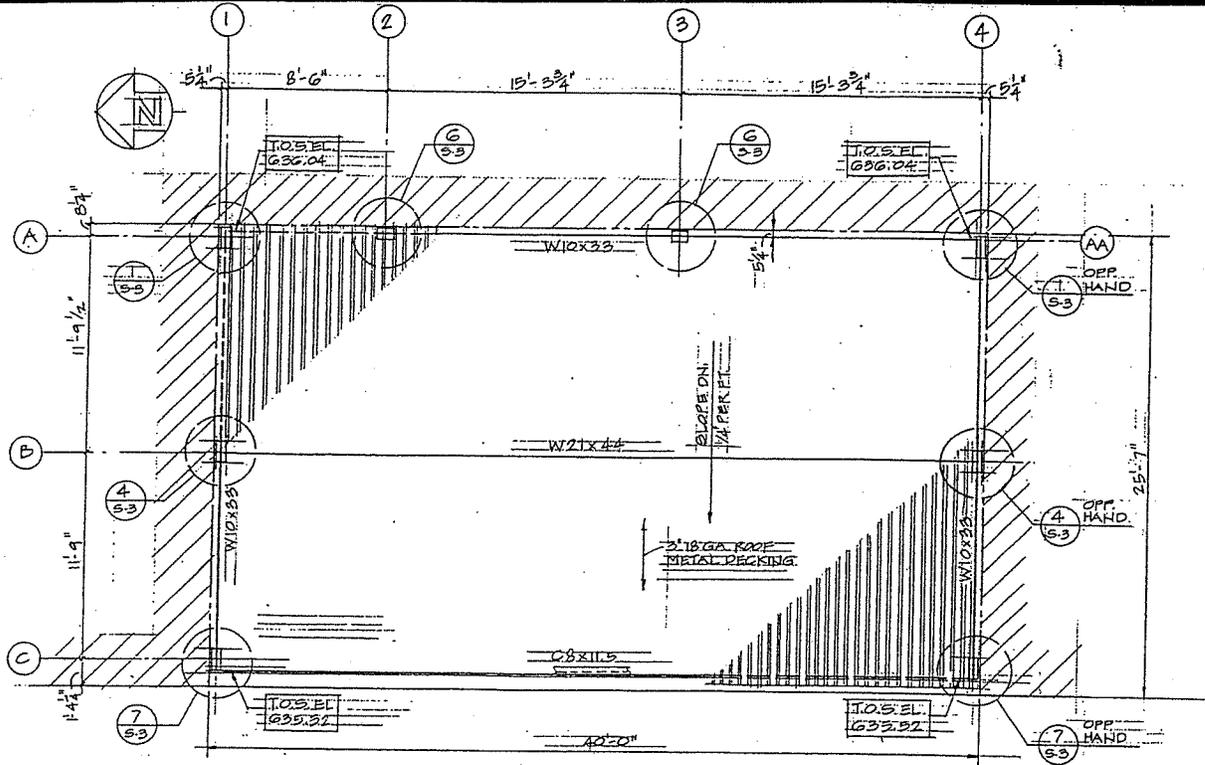
- |                                     |                          |                                     |  |  |
|-------------------------------------|--------------------------|-------------------------------------|--|--|
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.5.1.8 DIAPHRAGM REINFORCEMENT AT OPENINGS: There shall be reinforcing around all diaphragm openings larger than 50% of the building width in either major plan dimension. This statement shall apply to the Immediate Occupancy Performance Level only.  |  |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.5.2.1 STRAIGHT SHEATHING: All straight sheathed diaphragms shall have aspect ratios less than 2 to 1 for Life Safety and 1 to 1 for Immediate Occupancy in the direction being considered.   |  |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.5.2.2 SPANS: All wood diaphragms with spans greater than 24 ft for Life Safety and 12 ft for Immediate Occupancy shall consist of wood structural panels or diagonal sheathing.  |  |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.5.2.3 UNBLOCKED DIAPHRAGMS: All diagonally sheathed and unblocked wood structural panel diaphragms shall have horizontal spans less than 40 ft for Life Safety and 30 ft for Immediate Occupancy and shall have aspect ratios less than or equal to 4 to 1 for Life Safety and 3 to 1 for Immediate Occupancy. |  |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.5.3.1 NON-CONCRETE FILLED DIAPHRAGMS: Untopped metal deck diaphragms or metal deck diaphragms with fill other than concrete shall consist of horizontal spans of less than 40 ft and shall have aspect ratios less than 4 to 1. This statement shall apply to the Immediate Occupancy Performance Level only.  |  |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.5.7.1 OTHER DIAPHRAGMS: The diaphragm shall not consist of a system other than wood, metal deck, concrete or horizontal bracing.   | <b>Metal Deck is used as diaphragm</b> |

### CONNECTIONS

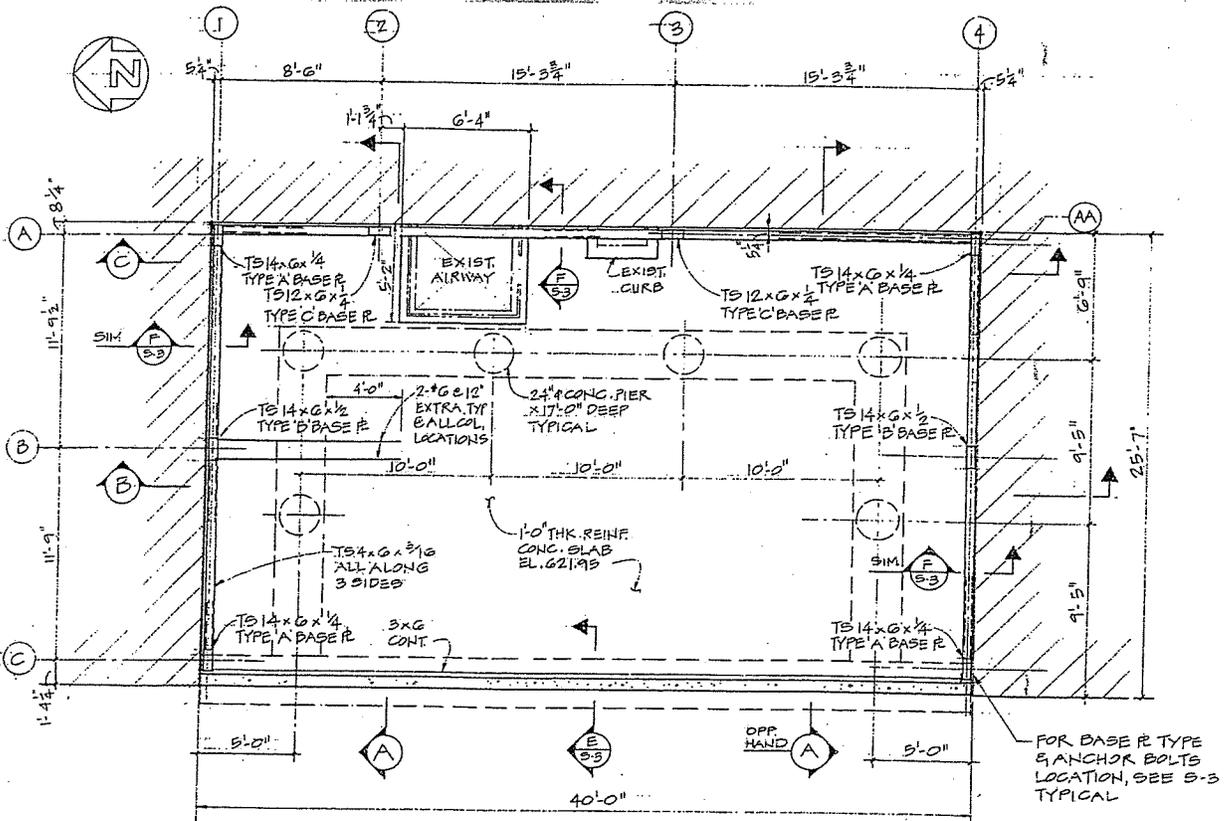
- |                          |                          |                                     |  |  |
|--------------------------|--------------------------|-------------------------------------|--|--|
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.6.3.10 UPLIFT AT PILE CAPS: Pile caps shall have top reinforcement and piles shall be anchored to the pile caps for Life Safety, and the pile cap reinforcement and pile anchorage shall be able to develop the tensile capacity of the piles for Immediate Occupancy. |  |
|--------------------------|--------------------------|-------------------------------------|--|--|

\* – Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.

**BUILDING PLAN**



**ROOF FRAMING PLAN**



**FOUNDATION PLAN**

### **Building 117B**

Building 117B is a one-story reinforced masonry bearing wall building. The structure consists of bare metal deck supported by steel wide flange beams and girders, which are supported on the perimeter 8" thick reinforced masonry block walls. On the south side, there is an additional double-angle braced frame. At the ground level, there is an access floor that is supported by vertical pipe columns. The access floor bears on steel ledger angles.

The primary structural deficiencies noted for Building 117B are as follows: 1) There are no connections for shear transfer at the access floor. The access floor does not have a positive connection to the lateral-force-resisting system; and 2) The double-angle braces are overstressed and the connection of the braces do not develop the yield capacity of the braces.

For the building to meet life-safety requirements, we recommend providing a positive connection of the access floor into the structure. Alternatively, brace the access floor independently from the main structure by adding new braces at the vertical pipe columns. A more detailed analysis is recommended to verify the actual force distribution to the braced frames. Even though the braces appear to be overstressed, there is excess capacity in the masonry shear walls.

Building Name: **Building 117B**

Date: **July 16, 2003**

Building Address: **Lawrence Livermore National Laboratory**

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Job Number: **A20047.08**

Job Name: **LLNL Prioritization**

By: **AK** Checked: \_\_\_\_\_

## PRIORITIZATION BUILDING DATA SHEET

### BUILDING DATA

Year Built:	1959	Year(s) Remodeled:	-	UBC Zone:	4 – Type B Near Field
Area (sf):	7,400 sf	Length (ft):	86'	Width (ft):	85'-10"
No. Stories:	1	Story Height:	Average 11.5'	Total Height:	Average 11.5'

### CONSTRUCTION DATA

Gravity Load Structural System: Steel framed beams and girders supported on pipe columns

Exterior Transverse Walls: Reinforced masonry concrete blocks      Openings?: None

Exterior Longitudinal Walls: Reinforced masonry concrete blocks      Openings?: None

Roof Framing: Steel beams and girders with 1-1/2" bare metal deck & insulation.

Intermediate Floor Framing: None

6" concrete slab on grade in the S-W and S-E corner.

Ground Floor: During remodel, original metal deck flooring has been replaced with an access floor in the central portion of the floor slab. Access floor is supported on vertical pipe columns anchored to the rat slab below. Pipe columns are unbraced. Access floor bears on the existing ledger angles around the concrete / masonry perimeter (no positive connection).

Columns: 6" pipe columns

Masonry walls are supported on a retaining wall with grade beams, pipe columns are supported on a 18" square concrete stub column with spread footings, and the access floor at the ground floor is supported on pipe columns at 4' o.c. each way.

### LATERAL-FORCE-RESISTING SYSTEM

	Longitudinal (W-E)	Transverse (N-S)
System Classification:	S2 / S4 / RM1 – Steel Frames with Reinforced Masonry Shear Walls & Steel Braced Frames with Flexible Diaphragms.	S4 / RM1 – Steel Frames with Reinforced Masonry Shear Walls with Flexible Diaphragms.
Vertical Elements:	Steel pipe columns	Steel pipe columns
Diaphragms:	Bare metal deck with insulation (roof)	Bare metal deck with insulation (roof)

SEISMIC EVALUATION PERFORMED? Yes      EVALUATION: Rapid Evaluation      YEAR: 2003

SEISMIC EVALUATION CRITERIA: Life Safety/ ASCE 31-02

VULNERABILITY RATING: 5  
(1=low to 10=high)

PRIORITIZATION CLASSIFICATION: CLASS C



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By: **AK** Checked: \_\_\_\_\_

## PRIORITIZATION BUILDING DATA SHEET

### POTENTIAL LIFE SAFETY DEFICIENCIES:

THIS BUILDING WAS EVALUATED FOR THE 10% IN 50 YR. EARTHQUAKE.

#### TRANSFER TO SHEAR WALLS

*The remodeled access floor on the ground floor is not positively attached to the lateral force resisting system or independently braced.*

#### DIAPHRAGM CONTINUITY

*The remodeled access floor on the ground floor is not positively attached to the lateral force resisting system. The floor bears on the existing ledger angle.*

#### CONNECTION STRENGTH

*Braced Frame connection unable to develop the full yield strength of the braces.*

#### AXIAL STRESS CHECK

*Axial stress in braced frame is higher than allowed by quick check. Double angle braces are incapable of carrying compressive forces. Braced frame is tension only. This may be mitigated with detailed analysis. There is excess capacity found in the masonry shear walls.*

### PRELIMINARY STRENGTHENING SCHEMES OR MITIGATION MEASURES:

Provide positive connection of access floor to existing ledger angle or brace independently to the foundation.

Perform detailed analysis to verify the demand and strength of the existing braces and connections. Alternatively, stiffen the existing braces to act as both tension & compression elements.

### OTHER COMMENTS:

- THERE ARE 3 DIFFERENT SECTORS TO THE BUILDING. EVALUATION HAS BEEN COMPLETED FOR THE CENTER PORTION (117B) ONLY. OTHER SECTORS HAVE NOT BEEN EVALUATED.



Building Name: Building 117

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Job Number: A20047.08 Job Name: LLNL Prioritization

By: AK Checked: \_\_\_\_\_

## ASCE 31\* GENERAL BASIC STRUCTURAL CHECKLIST

**C NC N/A**

**Comments**

### BUILDING SYSTEM

#### General

- |                                     |                          |                                     |         |   |   |
|-------------------------------------|--------------------------|-------------------------------------|---------|---|---|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.3.1.1 | LOAD PATH: The structure shall contain a minimum of one complete load path for Life Safety and Immediate Occupancy for seismic force effects from any horizontal direction that serves to transfer the inertial forces from the mass to the foundation. | The lateral system consists of reinforced grouted masonry blocks in both principal directions. On the south side, in lieu of the masonry walls, there is a single bay steel braced frame. |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.3.1.2 | ADJACENT BUILDINGS: The clear distance between the building being evaluated and any adjacent building shall be greater than 4% of the height of the shorter building for Life Safety and Immediate Occupancy.   | On the south, the adjacent building is separated at the roof diaphragm by 1". Adjacent floor slab elevations align, pounding concern is not high. Item can be considered mitigated.       |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.3.1.3 | MEZZANINES: Interior mezzanine levels shall be braced independently from the main structure, or shall be anchored to the lateral-force-resisting elements of the main structure.  | No Mezzanines.  |

#### Configuration

- |                                     |                          |                                     |         |  |   |
|-------------------------------------|--------------------------|-------------------------------------|---------|--|---|
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.3.2.1 | WEAK STORY: The strength of the lateral-force-resisting system in any story shall not be less than 80% of the strength in an adjacent story above or below for Life-Safety and Immediate Occupancy.  | Single Story  |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.3.2.2 | SOFT STORY: The stiffness of the lateral-force-resisting-system in any story shall not be less than 70% of the lateral-force-resisting system stiffness in an adjacent story above or below, or less than 80% of the average lateral-force-resisting system stiffness of the three stories above or below for Life Safety and Immediate Occupancy. | Single Story  |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.3.2.3 | GEOMETRY: There shall be no changes in horizontal dimension of the lateral-force-resisting system of more than 30% in a story relative to adjacent stories for Life Safety and Immediate Occupancy, excluding one-story penthouses and mezzanines.   | Single Story  |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.3.2.4 | VERTICAL DISCONTINUITIES: All vertical elements in the lateral-force-resisting system shall be continuous to the foundation.   | Masonry Walls/braced frame are continuous to the foundation           |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.3.2.5 | MASS: There shall be no change in effective mass of more than 50% from one story to the next for Life Safety and Immediate Occupancy. Light roofs, penthouses and mezzanines need not be considered.   | Single Story  |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.3.2.6 | TORSION: The estimated distance between the story center of mass and the story center of rigidity shall be less than 20% of the building width in either plan dimension for Life Safety and Immediate Occupancy.   | Lateral system symmetrically located on perimeter of square building. |

#### Condition of Materials

- |                                     |                          |                          |         |   |  |
|-------------------------------------|--------------------------|--------------------------|---------|---|--|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 4.3.3.3 | DETERIORATION OF STEEL: There shall be no visible rusting, corrosion, cracking, or other deterioration in any of the steel elements or connections in the vertical- or lateral-force-resisting systems. |  |
|-------------------------------------|--------------------------|--------------------------|---------|---|--|

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## ASCE 31\* GENERAL BASIC STRUCTURAL CHECKLIST

**C NC N/A**

**Comments**

### BUILDING SYSTEM

- |                                     |                          |                          |          |  |
|-------------------------------------|--------------------------|--------------------------|----------|--|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 4.3.3.7  | MASONRY UNITS: There shall be no visible deterioration of masonry units.   |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 4.3.3.8  | MASONRY JOINTS: The mortar shall not be easily scraped away from the joints by hand with a metal tool, and there shall be no areas of eroded mortar.   |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 4.3.3.10 | REINFORCED MASONRY WALL CRACKS: All existing diagonal cracks in wall elements shall be less than 1/8" for Life Safety and 1/16" for Immediate Occupancy, shall not be concentrated in one location, and shall not form an X pattern. |

### LATERAL-FORCE-RESISTING SYSTEM

#### Frames Not Part of the Lateral-Force-Resisting System

- |                                     |                          |                          |           |   |
|-------------------------------------|--------------------------|--------------------------|-----------|---|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 4.4.1.6.1 | COMPLETE FRAMES: Steel or concrete frames classified as secondary components shall form a complete vertical load carrying system. |
|-------------------------------------|--------------------------|--------------------------|-----------|---|

#### Shear Walls – General

- |                                     |                          |                          |           |   |   |
|-------------------------------------|--------------------------|--------------------------|-----------|---|---|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 4.4.2.1.1 | REDUNDANCY: The number of lines of shear walls in each principal direction shall be greater than or equal to 2 for Life Safety and Immediate Occupancy. | <p><b>Along the East-West direction, there is only a single line of masonry shear walls on the north side. However, there is a steel braced frame on the south side. Adequate redundancy in lateral system can be considered mitigated.</b></p> |
|-------------------------------------|--------------------------|--------------------------|-----------|---|---|

#### Reinforced Masonry Shear Walls

- |                                     |                          |                          |           |   |   |
|-------------------------------------|--------------------------|--------------------------|-----------|---|---|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 4.4.2.4.1 | SHEAR STRESS CHECK: The shear stress in the reinforced masonry shear walls, calculated using the Quick Check Procedure of Section 3.5.3.3, shall be less than 70 psi for Life Safety and Immediate Occupancy.   | <p><b>Maximum Shear Stress based on the quick check procedure is ~60 psi.</b></p>   |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 4.4.2.4.2 | REINFORCING STEEL: The total vertical and horizontal reinforcing steel ratio in reinforced masonry walls shall be greater than 0.002 for Life Safety and Immediate Occupancy of the wall with the minimum of 0.0007 for Life Safety and Immediate Occupancy in either of the two directions; the spacing of reinforcing steel shall be less than 48" for Life Safety and Immediate Occupancy; and all vertical bars shall extend to the top of the walls. | <p><b>Horiz. Bar: #4 @ 2' o.c. maximum</b><br/> <b>Vert. Bar: #4 @16" o.c. maximum</b><br/> <math display="block">\rho = (0.20)/(24" \times 8") + (0.20)/(16" \times 8")</math> <math display="block">= 0.0026</math></p> |

#### Braced Frames – General

- |                                     |                          |                          |           |   |   |
|-------------------------------------|--------------------------|--------------------------|-----------|---|---|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 4.4.3.1.1 | REDUNDANCY: The number of lines of braced frames in each principal direction shall be greater than or equal to 2 for Life Safety and Immediate Occupancy. The number of braced bays in each line shall be greater than 2 for Life Safety and 3 for Immediate Occupancy. | <p><b>Along the East-West direction, there is only a single line of braced frame on the south side. However, there is a line of masonry shear walls on the north side. Adequate redundancy in lateral system can be considered mitigated.</b></p> |
|-------------------------------------|--------------------------|--------------------------|-----------|---|---|

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## ASCE 31\* GENERAL BASIC STRUCTURAL CHECKLIST

C    NC    N/A Comments

### LATERAL-FORCE-RESISTING SYSTEM

- |                          |                                     |                                     |  |   |
|--------------------------|-------------------------------------|-------------------------------------|--|---|
| <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | 4.4.3.1.2 AXIAL STRESS CHECK: The axial stress in the diagonals, calculated using the Quick Check Procedure of Section 3.5.3.4, shall be less than $0.50F_y$ for Life Safety and for Immediate Occupancy.    | Braces consist of double angles (2-L3x2-1/2x1/4). Maximum axial stress in brace is $1.14F_y$ . $KL/r > 120$ , braces are considered tension only. |
| <input type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | 4.4.3.1.3 COLUMN SPLICES: All column splice details located in braced frames shall develop the tensile strength of the column. This statement shall apply to the Immediate Occupancy Performance Level only. | Columns are not spliced.  |

### CONNECTIONS

#### Anchorage for Normal Forces

- |                                     |                          |                          |   |  |
|-------------------------------------|--------------------------|--------------------------|---|--|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 4.6.1.1 WALL ANCHORAGE: Exterior concrete or masonry walls, that are dependent on the diaphragm for lateral support, shall be anchored for out-of-plane forces at each diaphragm level with steel anchors, reinforcing dowels, or straps that are developed into the diaphragm. Connections shall have adequate strength to resist the connection force calculated in the Quick Check Procedure of Section 3.5.3.7. | At the top of the masonry wall, there are both tension and shear anchor bolts embedded into the walls and tied back into the roof beams. |
|-------------------------------------|--------------------------|--------------------------|---|--|

#### Shear Transfer

- |                          |                                     |                                     |   |  |
|--------------------------|-------------------------------------|-------------------------------------|---|--|
| <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | 4.6.2.1 TRANSFER TO SHEAR WALLS: Diaphragms shall be connected for transfer of loads to the shear walls for Life Safety and the connections shall be able to develop the lesser of the shear strength of the walls or diaphragms for Immediate Occupancy.   | The remodeled access floor on the ground floor is not positively attached to the lateral system. Floor bears on the existing ledger angle. |
| <input type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | 4.6.2.2 TRANSFER TO STEEL FRAMES: Diaphragms shall be connected for transfer of loads to the steel frames for Life Safety and the connections shall be able to develop the lesser of the strength of the frames or the diaphragms for Immediate Occupancy.  |  |
| <input type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | 4.6.2.3 TOPPING SLAB TO WALLS OR FRAMES: Reinforced concrete topping slabs that interconnect the precast concrete diaphragm elements shall be doweled for transfer of forces into the shear wall or frame elements for Life Safety and the dowels shall be able to develop the lesser of the shear strength of the walls, frames, or slabs for Immediate Occupancy. |  |

#### Vertical Components

- |                                     |                          |                                     |  |  |
|-------------------------------------|--------------------------|-------------------------------------|--|--|
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.6.3.1 STEEL COLUMNS: The columns in lateral-force-resisting frames shall be anchored to the building foundation for Life Safety and the anchorage shall be able to develop the lesser of the tensile capacity of the column, the tensile capacity of the lowest level column splice (if any), or the uplift capacity of the foundation, for Immediate Occupancy. |  |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.6.3.5 FOUNDATION DOWELS: Wall reinforcement shall be doweled into the foundation for Life Safety and the dowels shall be able to develop the lesser of the strength of the walls or the uplift capacity of the foundation for Immediate Occupancy.   | Masonry wall reinforcement is doweled and hooked into grade beam foundation. |



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## ASCE 31\* GENERAL BASIC STRUCTURAL CHECKLIST

C NC N/A

Comments

### CONNECTIONS

#### Interconnection of Elements

- 4.6.4.1 GIRDER/COLUMN CONNECTION: There shall be a positive connection utilizing plates, connection hardware, or straps between the girder and the column support.

\* - Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.

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## ASCE 31\* GENERAL SUPPLEMENTAL STRUCTURAL CHECKLIST

**C NC N/A**

**Comments**

### LATERAL-FORCE-RESISTING SYSTEM

#### Frames Not Part of the Lateral-Force-Resisting System

- |                                     |                          |                                     |  |  |
|-------------------------------------|--------------------------|-------------------------------------|--|--|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.4.1.6.2 DEFLECTION COMPATIBILITY: Secondary components shall have the shear capacity to develop the flexural strength of the components for Life Safety and shall meet the requirements of 4.4.1.4.9, 4.4.1.4.10, 4.4.1.4.11, 4.4.1.4.12 and 4.4.1.4.15 for Immediate Occupancy. | Gravity steel framing has a higher deflection capacity than the masonry shear walls. |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.1.6.3 FLAT SLABS: Flat slabs/plates not part of lateral-force-resisting system shall have continuous bottom steel through the column joints for Life Safety.   |  |

#### Reinforced Masonry Shear Walls

- |                                     |                          |                                     |   |                                    |
|-------------------------------------|--------------------------|-------------------------------------|---|------------------------------------|
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.2.4.3 REINFORCING AT OPENINGS: All wall openings that interrupt rebar shall have trim reinforcing on all sides. This statement shall apply to the Immediate Occupancy Performance Level only. | Life Safety Evaluation             |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.4.2.4.4 PROPORTIONS: The height-to-thickness ratio of the shear walls at each story shall be less than 30. This statement shall apply to the Immediate Occupancy Performance Level only.        | Height/thickness = 11' / 8" = 16.5 |

#### Braced Frames – General

- |                          |                                     |                                     |   |   |
|--------------------------|-------------------------------------|-------------------------------------|---|---|
| <input type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | 4.4.3.1.4 SLENDERNESS OF DIAGONALS: All diagonal elements required to carry compression shall have Kl/r ratios less than 120.   | Double angle braces, evaluated as tension only.                         |
| <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | 4.4.3.1.5 CONNECTION STRENGTH: All the brace connections shall develop the yield capacity of the diagonals.   | Brace connection consists of 2-3/4" bolts ("B" series) in double shear. |
| <input type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | 4.4.3.1.6 OUT-OF-PLANE BRACING: Braced frame connections attached to beam bottom flanges located away from beam-column joints shall be braced out-of-plane at the bottom flange of the beams. This statement shall apply to the Immediate Occupancy Performance Level only. | Life Safety Evaluation  |

#### Concentrically Braced Frames

- |                                     |                          |                                     |   |                             |
|-------------------------------------|--------------------------|-------------------------------------|---|-----------------------------|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.4.3.2.1 K-BRACING: The bracing system shall not include K-braced bays.  | Braces are oriented in "X". |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.3.2.2 TENSION-ONLY BRACES: Tension-only braces shall not comprise more than 70% of the total lateral-force-resisting capacity in structures over two stories in height. This statement shall apply to the Immediate Occupancy Performance Level only. | Life Safety Evaluation      |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.3.2.3 CHEVRON BRACING: The bracing system shall not include chevron, or V-braced bays. This statement shall apply to the Immediate Occupancy Performance Level only.  | Life Safety Evaluation      |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.3.2.4 CONCENTRICALLY BRACED FRAME JOINTS: All the diagonal braces shall frame into the beam-column joints concentrically. This statement shall apply to the Immediate Occupancy Performance Level only.   | Life Safety Evaluation      |

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## ASCE 31\* GENERAL SUPPLEMENTAL STRUCTURAL CHECKLIST

**C NC N/A**

**Comments**

### DIAPHRAGMS

#### General

- |                                     |                                     |                                     |         |   |   |
|-------------------------------------|-------------------------------------|-------------------------------------|---------|---|---|
| <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | 4.5.1.1 | DIAPHRAGM CONTINUITY: The diaphragms shall not be composed of split-level floors and shall not have expansion joints.   | Roof Diaphragm is continuous.<br>A portion of the ground floor diaphragm consists of an access floor that is not positively attached to the concrete slab on grade. |
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/>            | 4.5.1.2 | CROSS TIES: There shall be continuous cross ties between diaphragm chords.  | Roof diaphragm is framed with conventional steel beams and girders.   |
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/>            | 4.5.1.3 | ROOF CHORD CONTINUITY: All chord elements shall be continuous, regardless of changes in roof elevation.   |   |
| <input type="checkbox"/>            | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | 4.5.1.6 | OPENINGS AT EXTERIOR MASONRY SHEAR WALLS: Diaphragm openings immediately adjacent to exterior masonry shear walls shall not be greater than 8 ft long for Life Safety and 4 ft long for Immediate Occupancy.                                      | No diaphragm openings adjacent shear walls.   |
| <input type="checkbox"/>            | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | 4.5.1.7 | PLAN IRREGULARITIES: There shall be tensile capacity to develop the strength of the diaphragm at re-entrant corners or other locations of plan irregularities. This statement shall apply to the Immediate Occupancy Performance Level only.      | Plan of diaphragm is a square. No re-entrant corners.   |
| <input type="checkbox"/>            | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | 4.5.1.8 | DIAPHRAGM REINFORCEMENT AT OPENINGS: There shall be reinforcing around all diaphragm openings larger than 50% of the building width in either major plan dimension. This statement shall apply to the Immediate Occupancy Performance Level only. |   |

#### Metal Deck Diaphragms

- |                          |                          |                                     |         |   |                        |
|--------------------------|--------------------------|-------------------------------------|---------|---|------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.5.3.1 | NON-CONCRETE FILLED DIAPHRAGMS: Untopped metal deck diaphragms or metal deck diaphragms with fill other than concrete shall consist of horizontal spans of less than 40 ft and shall have aspect ratios less than 4 to 1. This statement shall apply to the Immediate Occupancy Performance Level only. | Life Safety Evaluation |
|--------------------------|--------------------------|-------------------------------------|---------|---|------------------------|

### CONNECTIONS

#### Anchorage for Normal Forces

- |                                     |                          |                          |         |  |  |
|-------------------------------------|--------------------------|--------------------------|---------|--|--|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 4.6.1.3 | PRECAST PANEL CONNECTIONS: There shall be at least two anchors from each precast wall panel into the diaphragm elements for Life Safety and the anchors shall be able to develop the strength of the panels for Immediate Occupancy. | At the top of the masonry wall, there are both tension and shear anchor bolts embedded into the walls and tied back into the roof beams. |
|-------------------------------------|--------------------------|--------------------------|---------|--|--|

#### Vertical Components

- |                          |                          |                                     |          |   |  |
|--------------------------|--------------------------|-------------------------------------|----------|---|--|
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.6.3.10 | UPLIFT AT PILE CAPS: Pile caps shall have top reinforcement and piles shall be anchored to the pile caps for Life Safety, and the pile cap reinforcement and pile anchorage shall be able to develop the tensile capacity of the piles for Immediate Occupancy. |  |
|--------------------------|--------------------------|-------------------------------------|----------|---|--|



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## ASCE 31\* GENERAL SUPPLEMENTAL STRUCTURAL CHECKLIST

C NC N/A

Comments

### CONNECTIONS

#### Interconnection of Elements

- |                          |                          |                                     |         |  |   |
|--------------------------|--------------------------|-------------------------------------|---------|--|---|
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.6.4.2 | GIRDERS: Girders supported by walls or pilasters shall have at least two ties securing the anchor bolts for Life Safety and Immediate Occupancy.   | <b>Girders are not supported on walls or pilasters.</b> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.6.4.3 | CORBEL BEARING: If the frame girders bear on column corbels, the length of bearing shall be greater than 3" for Life Safety and Immediate Occupancy.                                     |   |
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.6.4.4 | CORBEL CONNECTIONS: The frame girders shall not be connected to corbels with welded elements.  |   |
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.6.4.5 | BEAM, GIRDER AND TRUSS SUPPORTS: Beams, girders and trusses supported by unreinforced masonry walls or pilasters shall have independent secondary columns for support of vertical loads. | <b>Girders are not supported on walls or pilasters.</b> |

\* - Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.

***Building 165, Annex***

Building 165, Annex is a concrete block wall building, consisting of a concrete slab and concrete walls. A structural evaluation of the building was not completed because structural drawings were not available for review. A detailed on-site evaluation is required to conclusively determine the structural deficiencies in the building. However, based on our site visit observations and judgement, Building 165 is not life-safe. The 3' thick concrete blocks at the exterior of the building are not interconnected which present a falling hazard.



Building Name: Building 233 (Increment 1 and 2)

Date: July 23, 2003

Building Address: Lawrence Livermore National Laboratory

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Job Number: A20047.08

Job Name: LLNL Prioritization

By: JYF Checked: JEH

**PRIORITIZATION BUILDING DATA SHEET**

**BUILDING DATA**

Year Built:	1960	Year(s) Remodeled:	1966, 1995	UBC Zone:	4 – Type B Near Field
Area (sf):	4,900	Length (ft):	98	Width (ft):	50
No. Stories:	1	Story Height:	15'-3"	Total Height:	15'-3"

**CONSTRUCTION DATA**

Gravity Load Structural System: Bare metal deck supported by open web joists and WF girders, which are supported by perimeter and interior concrete block walls. There are also reinforced concrete bearing walls at the interior.

Exterior Transverse Walls: 8" concrete block walls      Openings?: Door and window openings

Exterior Longitudinal Walls: 8" concrete block walls      Openings?: Door and window openings

Roof Framing: Bare metal deck supported by 16" deep open web joists and 10WF girders

Intermediate Floor Framing: None

Ground Floor: 6" concrete slab on grade w/ #3 @ 14" o.c., E.W.

Columns: None

Foundation: Strip footing @ concrete block walls and reinforced concrete walls

**LATERAL-FORCE-RESISTING SYSTEM**

	<u>Longitudinal</u>	<u>Transverse</u>
System Classification:	Type 13 (Reinforced Masonry Bearing Wall Building w/ Flexible Diaphragm) and Type 9 (Concrete Shear Wall Building w/ Flexible Diaphragm)	Type 13 (Reinforced Masonry Bearing Wall Building w/ Flexible Diaphragm) and Type 9 (Concrete Shear Wall Building w/ Flexible Diaphragm)
Vertical Elements:	Open web joists, steel girders, reinforced concrete block walls @ interior and perimeter. There are also reinforced concrete walls at interior.	Open web joists, steel girders, reinforced concrete block walls @ interior and perimeter. There are also reinforced concrete walls at interior.
Diaphragms:	Bare metal deck	Bare metal deck

SEISMIC EVALUATION PERFORMED? Yes      EVALUATION: Rapid Evaluation      YEAR: 2003

SEISMIC EVALUATION CRITERIA: Life Safety/ ASCE 31-02

VULNERABILITY RATING: 5  
(1=low to 10=high)

PRIORITIZATION CLASSIFICATION: CLASS C

**POTENTIAL LIFE SAFETY DEFICIENCIES:**

THIS BUILDING WAS EVALUATED FOR THE 10% IN 50 YR. EARTHQUAKE.

**WALL ANCHORAGE**

*Out of plane anchorage for the concrete block walls is not adequate. D/C = 1.15.*

**GIRDERS**

*There are no ties securing the anchor bolts.*

**PRELIMINARY STRENGTHENING SCHEMES OR MITIGATION MEASURES:**

- Strengthen out of plane anchorage
- Strength connection of girders at the walls

Building Name: **Building 233 (Increment 1 and 2)**

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Job Number: **A20047.08**

Job Name: **LLNL Prioritization**

By: **JYF** Checked: **JEH**

## ASCE 31\* GENERAL BASIC STRUCTURAL CHECKLIST

**C NC N/A**

**Comments**

### BUILDING SYSTEM

#### General

- |                                     |                          |                                     |   |  |
|-------------------------------------|--------------------------|-------------------------------------|---|--|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | <p>4.3.1.1 <b>LOAD PATH:</b> The structure shall contain a minimum of one complete load path for Life Safety and Immediate Occupancy for seismic force effects from any horizontal direction that serves to transfer the inertial forces from the mass to the foundation.</p> | <p>The bare metal deck delivers load to the open web joists and WF girders, which are supported by the perimeter and interior reinforced concrete block walls. There are also reinforced concrete bearing walls at the interior of the building. The concrete block walls and reinforced concrete shear walls are doweled into the concrete strip foundation system.</p> |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | <p>4.3.1.2 <b>ADJACENT BUILDINGS:</b> The clear distance between the building being evaluated and any adjacent building shall be greater than 4% of the height of the shorter building for Life Safety and Immediate Occupancy.</p>   | <p>There are no adjacent buildings.</p>  |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <p>4.3.1.3 <b>MEZZANINES:</b> Interior mezzanine levels shall be braced independently from the main structure, or shall be anchored to the lateral-force-resisting elements of the main structure.</p>  | <p>No Mezzanines.</p>  |

#### Configuration

- |                                     |                          |                                     |  |  |
|-------------------------------------|--------------------------|-------------------------------------|--|--|
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <p>4.3.2.1 <b>WEAK STORY:</b> The strength of the lateral-force-resisting system in any story shall not be less than 80% of the strength in an adjacent story above or below for Life-Safety and Immediate Occupancy.</p>  | <p>One story building</p>  |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <p>4.3.2.2 <b>SOFT STORY:</b> The stiffness of the lateral-force-resisting-system in any story shall not be less than 70% of the lateral-force-resisting system stiffness in an adjacent story above or below, or less than 80% of the average lateral-force-resisting system stiffness of the three stories above or below for Life Safety and Immediate Occupancy.</p> | <p>One story building</p>  |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <p>4.3.2.3 <b>GEOMETRY:</b> There shall be no changes in horizontal dimension of the lateral-force-resisting system of more than 30% in a story relative to adjacent stories for Life Safety and Immediate Occupancy, excluding one-story penthouses and mezzanines.</p>   | <p>One story building</p>  |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | <p>4.3.2.4 <b>VERTICAL DISCONTINUITIES:</b> All vertical elements in the lateral-force-resisting system shall be continuous to the foundation.</p>   | <p>Concrete block and reinforced concrete shear walls are continuous to the foundation</p> |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <p>4.3.2.5 <b>MASS:</b> There shall be no change in effective mass of more than 50% from one story to the next for Life Safety and Immediate Occupancy. Light roofs, penthouses and mezzanines need not be considered.</p>   | <p>One story building</p>  |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <p>4.3.2.6 <b>TORSION:</b> The estimated distance between the story center of mass and the story center of rigidity shall be less than 20% of the building width in either plan dimension for Life Safety and Immediate Occupancy.</p>   | <p>Flexible Diaphragm (Bare metal deck)</p>  |

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By: JYF Checked: JEH

## ASCE 31\* GENERAL BASIC STRUCTURAL CHECKLIST

C NC N/A

Comments

### Condition of Materials

- |                                     |                          |                                     |          |  |   |
|-------------------------------------|--------------------------|-------------------------------------|----------|--|---|
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.3.3.1  | <p>DETERIORATION OF WOOD: There shall be no signs of decay, shrinkage, splitting, fire damage, or sagging in any of the wood members and none of the metal connection hardware shall be deteriorated, broken, or loose.</p>  |   |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.3.3.2  | <p>WOOD STRUCTURAL PANEL SHEAR WALL FASTENERS: There shall be no more than 15% of inadequate fastening such as overdriven fasteners, omitted blocking, excessive fastening spacing, or inadequate edge distance. This statement shall apply to the Immediate Occupancy Performance Level only.</p>                           |   |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.3.3.3  | <p>DETERIORATION OF STEEL: There shall be no visible rusting, corrosion, cracking, or other deterioration in any of the steel elements or connections in the vertical- or lateral-force-resisting systems.</p>   | <p>Site visit made on 8/6/03. No signs of deterioration were observed.</p>  |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.3.3.4  | <p>DETERIORATION OF CONCRETE: There shall be no visible deterioration of concrete or reinforcing steel in any of the vertical- or lateral-force-resisting elements.</p>  | <p>Site visit made on 7/22/03. No signs of deterioration were observed.</p> |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.3.3.5  | <p>POST-TENSIONING ANCHORS: There shall be no evidence of corrosion or spalling in the vicinity of post-tensioning or end fittings. Coil anchors shall not have been used.</p>   |   |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.3.3.6  | <p>PRECAST CONCRETE WALLS: There shall be no visible deterioration of concrete or reinforcing steel or evidence of distress, especially at the connections.</p>  |   |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.3.3.7  | <p>MASONRY UNITS: There shall be no visible deterioration of masonry units.</p>  | <p>Site visit made on 8/6/03. No signs of deterioration were observed.</p>  |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.3.3.8  | <p>MASONRY JOINTS: The mortar shall not be easily scraped away from the joints by hand with a metal tool, and there shall be no areas of eroded mortar.</p>  | <p>Site visit made on 8/6/03. No eroded mortar was observed.</p>            |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.3.3.9  | <p>CONCRETE WALL CRACKS: All existing diagonal cracks in wall elements shall be less than 1/8" for Life Safety and 1/16" for Immediate Occupancy, shall not be concentrated in one location, and shall not form an X pattern.</p>  | <p>Site visit made on 8/6/03. There are no cracks &gt;1/8".</p>             |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.3.3.10 | <p>REINFORCED MASONRY WALL CRACKS: All existing diagonal cracks in wall elements shall be less than 1/8" for Life Safety and 1/16" for Immediate Occupancy, shall not be concentrated in one location, and shall not form an X pattern.</p>  | <p>Site visit made on 8/6/03. There are no cracks &gt;1/8".</p>             |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.3.3.11 | <p>UNREINFORCED MASONRY WALL CRACKS: There shall be no existing diagonal cracks in the wall elements greater than 1/8" for Life Safety and 1/16" for Immediate Occupancy, or out-of-plane offsets in the bed joint greater than 1/8" for Life Safety and 1/16" for Immediate Occupancy, and shall not form an X pattern.</p> |   |

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## ASCE 31\* GENERAL BASIC STRUCTURAL CHECKLIST

C	NC	N/A		Comments
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<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.3.12 CRACKS IN INFILL WALLS: There shall be no existing diagonal cracks in the infilled walls that extend throughout a panel, greater than 1/8" for Life Safety and 1/16" for Immediate Occupancy, or out-of-plane offsets in the bed joint greater than 1/8" for Life Safety and 1/16" for Immediate Occupancy.	
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<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.3.13 CRACKS IN BOUNDARY COLUMNS: There shall be no existing diagonal cracks wider than 1/8" for Life Safety and 1/16" for Immediate Occupancy in concrete columns that encase masonry infills.	
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### LATERAL-FORCE-RESISTING SYSTEM

#### Shear Walls – General

<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.4.2.1.1 REDUNDANCY: The number of lines of shear walls in each principal direction shall be greater than or equal to 2 for Life Safety and Immediate Occupancy.	<b>There are at least two lines of shear walls in both the longitudinal and transverse directions.</b>
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#### Concrete Shear Walls

<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.4.2.2.1 SHEAR STRESS CHECK: The shear stress in the concrete shear walls, calculated using the Quick Check procedure of Section 3.5.3.3, shall be less than 100 psi or $2\sqrt{f'_c}$ for Life Safety and Immediate Occupancy.	<b>The maximum shear stress is 47 psi &lt; 100 psi at Line 2. See Building Plan. Note: <math>2\sqrt{f'_c} = 110</math> psi for <math>f'_c = 3,000</math> psi.</b>
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<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.4.2.2.2 REINFORCING STEEL: The ratio of reinforcing steel area to gross concrete area shall be not less than 0.0015 in the vertical direction and 0.0025 in the horizontal direction for Life Safety and Immediate Occupancy. The spacing of reinforcing steel shall be equal to or less than 18" for Life Safety and Immediate Occupancy.	<b>Typ. reinforcement in reinforced concrete walls:            Vertical Reinforcing = #5@12" o.c.:            reinforcing ratio = 0.003 &gt; 0.0015            Horizontal Reinforcing = #5@12" o.c.            reinforcing ratio = 0.003 &gt; 0.0025.</b>
-------------------------------------	--------------------------	--------------------------	--	---

The spacing = 12" < 18".

<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.4.2.2.9 COLUMN SPLICES: Steel columns encased in shear wall boundary elements shall have splices that develop the tensile strength of the column. This statement shall apply to the Immediate Occupancy Performance Level only.	<b>Life Safety Performance Level.</b>
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#### Reinforced Masonry Shear Walls

<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.4.2.4.1 SHEAR STRESS CHECK: The shear stress in the reinforced masonry shear walls, calculated using the Quick Check Procedure of Section 3.5.3.3, shall be less than 70 psi for Life Safety and Immediate Occupancy.	<b>The maximum shear stress in the concrete block wall is 26 psi &lt; 70 psi at Line A. See Building Plan.</b>
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## ASCE 31\* GENERAL BASIC STRUCTURAL CHECKLIST

**C NC N/A**
**Comments**

### LATERAL-FORCE-RESISTING SYSTEM

- |   |   |   |
|---|---|---|
| <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> | <p><b>4.4.2.4.2 REINFORCING STEEL:</b> The total vertical and horizontal reinforcing steel ratio in reinforced masonry walls shall be greater than 0.002 for Life Safety and Immediate Occupancy of the wall with the minimum of 0.0007 for Life Safety and Immediate Occupancy in either of the two directions; the spacing of reinforcing steel shall be less than 48" for Life Safety and Immediate Occupancy; and all vertical bars shall extend to the top of the walls.</p> | <p><b>Typ. reinforcement in reinforced concrete block walls:</b><br/> <b>Vertical Reinforcing = #5@32" o.c.:</b><br/>                 reinforcing ratio = 0.0012 &gt; 0.0007<br/> <b>Horizontal Reinforcing = #4@24" o.c.</b><br/>                 horizontal: reinforcing ratio = 0.001 &gt; 0.0007.</p> <p style="text-align: right;"><b>Total reinforcing steel ratio =</b><br/> <math>(0.31 + 0.2 \cdot 32 / 24) \text{ in}^2 / (32 \cdot 8) = 0.0023 &gt; 0.002</math></p> |
|---|---|---|

### CONNECTIONS

#### Anchorage for Normal Forces

- |   |   |  |
|---|---|--|
| <input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/> | <p><b>4.6.1.1 WALL ANCHORAGE:</b> Exterior concrete or masonry walls, that are dependent on the diaphragm for lateral support, shall be anchored for out-of-plane forces at each diaphragm level with steel anchors, reinforcing dowels, or straps that are developed into the diaphragm. Connections shall have adequate strength to resist the connection force calculated in the Quick Check Procedure of Section 3.5.3.7.</p> | <p><b>At NS walls: (2) 1/2" diameter x 12" bolts @ 5'5" at joists. At EW walls: (2) 5/8" diameter x 18" bolts @ 27'-8" at beam and 5/8" diameter @ 3' o.c. in betw. beams</b></p> <p style="text-align: right;"><b>D/C = 1.15.</b></p> |
| <input type="checkbox"/> <input type="checkbox"/> <input checked="" type="checkbox"/> | <p><b>4.6.1.2 WOOD LEDGERS:</b> The connection between the wall panels and the diaphragm shall not induce cross-grain bending or tension in the wood ledgers.</p>   | <p><b>There are no wood ledgers.</b></p>   |

#### Shear Transfer

- |   |   |  |
|---|---|--|
| <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> | <p><b>4.6.2.1 TRANSFER TO SHEAR WALLS:</b> Diaphragms shall be connected for transfer of loads to the shear walls for Life Safety and the connections shall be able to develop the lesser of the shear strength of the walls or diaphragms for Immediate Occupancy.</p>   | <p><b>Metal deck is welded to bar joists and steel beams. The joists and beams are bolted to the concrete block walls/reinforced concrete walls w/ 1/2" or 5/8" diameter bolts. At the interface of Increment 1 and Increment 2, the deck is attached to the existing concrete block wall w/ L3x3's and 5/8" diameter expansion anchors.</b></p> |
| <input type="checkbox"/> <input type="checkbox"/> <input checked="" type="checkbox"/> | <p><b>4.6.2.2 TRANSFER TO STEEL FRAMES:</b> Diaphragms shall be connected for transfer of loads to the steel frames for Life Safety and the connections shall be able to develop the lesser of the strength of the frames or the diaphragms for Immediate Occupancy.</p>  |  |
| <input type="checkbox"/> <input type="checkbox"/> <input checked="" type="checkbox"/> | <p><b>4.6.2.3 TOPPING SLAB TO WALLS OR FRAMES:</b> Reinforced concrete topping slabs that interconnect the precast concrete diaphragm elements shall be doweled for transfer of forces into the shear wall or frame elements for Life Safety and the dowels shall be able to develop the lesser of the shear strength of the walls, frames, or slabs for Immediate Occupancy.</p> |  |

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## ASCE 31\* GENERAL BASIC STRUCTURAL CHECKLIST

**C NC N/A**

**Comments**

### CONNECTIONS

#### Vertical Components

- |                          |                          |                                     |         |  |  |  |
|--------------------------|--------------------------|-------------------------------------|---------|--|--|--|
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.6.3.1 | <p><b>STEEL COLUMNS:</b> The columns in lateral-force-resisting frames shall be anchored to the building foundation for Life Safety and the anchorage shall be able to develop the lesser of the tensile capacity of the column, the tensile capacity of the lowest level column splice (if any), or the uplift capacity of the foundation, for Immediate Occupancy.</p> |  |  |
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.6.3.2 | <p><b>CONCRETE COLUMNS:</b> All concrete columns shall be doweled into the foundation for Life Safety and the dowels shall be able to develop the tensile capacity of reinforcement in columns of lateral-force-resisting system for Immediate Occupancy.</p>  |  |  |
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.6.3.3 | <p><b>WOOD POSTS:</b> There shall be a positive connection of wood posts to the foundation.</p>  |  |  |
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.6.3.4 | <p><b>WOOD SILLS:</b> All wood sills shall be bolted to the foundation.</p>  |  |  |
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.6.3.5 | <p><b>FOUNDATION DOWELS:</b> Wall reinforcement shall be doweled into the foundation for Life Safety and the dowels shall be able to develop the lesser of the strength of the walls or the uplift capacity of the foundation for Immediate Occupancy.</p>   | <p><b>#5 L-dowels @ 32" o.c. into the concrete foundation to match vertical reinforcing in the concrete block walls.</b></p> |  |
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.6.3.6 | <p><b>SHEAR-WALL-BOUNDARY COLUMNS:</b> The shear wall boundary columns shall be anchored to the building for Life Safety and the anchorage shall be able to develop the tensile capacity of the column for Immediate Occupancy.</p>  |  |  |
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.6.3.7 | <p><b>PRECAST WALL PANELS:</b> Precast wall panels shall be connected to the foundation for Life Safety and the connections shall be able to develop the strength of the walls for Immediate Occupancy.</p>  |  |  |
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.6.3.8 | <p><b>WALL PANELS:</b> Metal, fiberglass or cementitious wall panels shall be positively attached to the foundation for Life Safety and Immediate Occupancy.</p>   |  |  |

#### Interconnection of Elements

- |                          |                          |                                     |         |  |  |   |
|--------------------------|--------------------------|-------------------------------------|---------|--|--|---|
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.6.4.1 | <p><b>GIRDER/COLUMN CONNECTION:</b> There shall be a positive connection utilizing plates, connection hardware, or straps between the girder and the column support.</p> |  | <p><b>There are no columns in the building. Girders are connected to the concrete block walls w/ bolts.</b></p> |
|--------------------------|--------------------------|-------------------------------------|---------|--|--|---|

\* - Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.

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Job Number: **A20047.08**

Job Name: **LLNL Prioritization**

By: **JYF** Checked: **JEH**

## ASCE 31\* GENERAL SUPPLEMENTAL STRUCTURAL CHECKLIST

**C NC N/A**

**Comments**

### LATERAL-FORCE-RESISTING SYSTEM

#### Concrete Shear Walls

- |                                     |                          |                                     |   |   |
|-------------------------------------|--------------------------|-------------------------------------|---|---|
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.2.2.3 COUPLING BEAMS: The stirrups in coupling beams over means of egress shall be spaced at or less than $d/2$ and shall be anchored into the confined core of the beam with hooks of $135^\circ$ or more for Life Safety. All coupling beams shall comply with the requirements above and shall have the capacity in shear to develop the uplift capacity of the adjacent wall for Immediate Occupancy. |   |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.2.2.4 OVERTURNING: All shear walls shall have aspect ratios less than 4 to 1. Wall piers need not be considered. This statement shall apply to the Immediate Occupancy Performance Level only.  | Life Safety Performance Level.                      |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.2.2.5 CONFINEMENT REINFORCING: For shear walls with aspect ratios greater than 2 to 1, the boundary elements shall be confined with spirals or ties with spacing less than $8d_b$ . This statement shall apply to the Immediate Occupancy Performance Level only.   | Life Safety Performance Level.                      |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.2.2.6 REINFORCING AT OPENINGS: There shall be added trim reinforcement around all wall openings greater than three times the thickness of the wall. This statement shall apply to the Immediate Occupancy Performance Level only.   | Life Safety Performance Level.                      |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.2.2.7 WALL THICKNESS: Thickness of bearing walls shall not be less than $1/25$ the unsupported height or length, whichever is shorter, nor less than 4". This statement shall apply to the Immediate Occupancy Performance Level only.  | Life Safety Performance Level.                      |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.4.2.2.8 WALL CONNECTIONS: There shall be a positive connection between the shear walls and the steel beams and columns for Life Safety and the connection shall be able to develop the strength of the walls for Immediate Occupancy.   | Steel beams are bolted to the concrete shear walls. |

#### Reinforced Masonry Shear Walls

- |                          |                          |                                     |   |                                |
|--------------------------|--------------------------|-------------------------------------|---|--------------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.2.4.3 REINFORCING AT OPENINGS: All wall openings that interrupt rebar shall have trim reinforcing on all sides. This statement shall apply to the Immediate Occupancy Performance Level only. | Life Safety Performance Level. |
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.2.4.4 PROPORTIONS: The height-to-thickness ratio of the shear walls at each story shall be less than 30. This statement shall apply to the Immediate Occupancy Performance Level only.        | Life Safety Performance Level. |

### DIAPHRAGMS

#### General

- |                                     |                          |                          |   |  |
|-------------------------------------|--------------------------|--------------------------|---|--|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 4.5.1.1 DIAPHRAGM CONTINUITY: The diaphragms shall not be composed of split-level floors and shall not have expansion joints. | There are no split-level floors or expansion joints in the diaphragm.                |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 4.5.1.2 CROSS TIES: There shall be continuous cross ties between diaphragm chords.  | Steel beams serve as the cross ties.   |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 4.5.1.3 ROOF CHORD CONTINUITY: All chord elements shall be continuous, regardless of changes in roof elevation.               | Chord elements: At EW elevations: L3x3 continuous angle. At NS elevations: WF beams. |

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 By: **JYF** Checked: **JEH**

## ASCE 31\* GENERAL SUPPLEMENTAL STRUCTURAL CHECKLIST

**C NC N/A**
**Comments**

### LATERAL-FORCE-RESISTING SYSTEM

- |                                     |                          |                                     |         |   |   |
|-------------------------------------|--------------------------|-------------------------------------|---------|---|---|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.5.1.4 | OPENINGS AT SHEAR WALLS: Diaphragm openings immediately adjacent to the shear walls shall be less than 25% of the wall length for Life Safety and 15% of the wall length for Immediate Occupancy.   | <b>Biggest opening at roof for HVAC unit. Opening = 4 ft. Shear wall length = 20 ft. 4/20 = 20% &lt; 25% of the wall lengths.</b> |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.5.1.5 | OPENINGS AT BRACED FRAMES: Diaphragm openings immediately adjacent to the braced frames shall extend less than 25% of the frame length for Life Safety and 15% of the frame length for Immediate Occupancy.                                       |   |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.5.1.6 | OPENINGS AT EXTERIOR MASONRY SHEAR WALLS: Diaphragm openings immediately adjacent to exterior masonry shear walls shall not be greater than 8 ft long for Life Safety and 4 ft long for Immediate Occupancy.                                      |   |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.5.1.7 | PLAN IRREGULARITIES: There shall be tensile capacity to develop the strength of the diaphragm at re-entrant corners or other locations of plan irregularities. This statement shall apply to the Immediate Occupancy Performance Level only.      | <b>Life Safety Performance Level.</b>   |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.5.1.8 | DIAPHRAGM REINFORCEMENT AT OPENINGS: There shall be reinforcing around all diaphragm openings larger than 50% of the building width in either major plan dimension. This statement shall apply to the Immediate Occupancy Performance Level only. | <b>Life Safety Performance Level.</b>   |

### Metal Deck Diaphragms

- |                          |                          |                                     |         |   |                                       |
|--------------------------|--------------------------|-------------------------------------|---------|---|---------------------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.5.3.1 | NON-CONCRETE FILLED DIAPHRAGMS: Untopped metal deck diaphragms or metal deck diaphragms with fill other than concrete shall consist of horizontal spans of less than 40 ft and shall have aspect ratios less than 4 to 1. This statement shall apply to the Immediate Occupancy Performance Level only. | <b>Life Safety Performance Level.</b> |
|--------------------------|--------------------------|-------------------------------------|---------|---|---------------------------------------|

### Other Diaphragms

- |                          |                          |                                     |         |  |  |
|--------------------------|--------------------------|-------------------------------------|---------|--|--|
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.5.7.1 | OTHER DIAPHRAGMS: The diaphragm shall not consist of a system other than wood, metal deck, concrete or horizontal bracing. |  |
|--------------------------|--------------------------|-------------------------------------|---------|--|--|

### CONNECTIONS

#### Anchorage for Normal Forces

- |                          |                          |                                     |         |  |  |
|--------------------------|--------------------------|-------------------------------------|---------|--|--|
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.6.1.3 | PRECAST PANEL CONNECTIONS: There shall be at least two anchors from each precast wall panel into the diaphragm elements for Life Safety and the anchors shall be able to develop the strength of the panels for Immediate Occupancy.     |  |
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.6.1.4 | STIFFNESS OF WALL ANCHORS: Anchors of concrete or masonry walls to wood structural elements shall be installed taut and shall be stiff enough to limit the relative movement between the wall and the diaphragm to no greater than 1/8". |  |



Building Name: Building 233 (Increment 1 and 2)

Date: July 23, 2003

Building Address: Lawrence Livermore National Laboratory

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Job Number: A20047.08

Job Name: LLNL Prioritization

By: JYF Checked: JEH

## ASCE 31\* GENERAL SUPPLEMENTAL STRUCTURAL CHECKLIST

C NC N/A

Comments

### CONNECTIONS

#### Vertical Components

- 4.6.3.9 WOOD SILL BOLTS: Sill bolts shall be spaced at 6 ft or less for Life Safety and 4 ft or less for Immediate Occupancy, with proper edge and end distance provided for wood and concrete.
- 4.6.3.10 UPLIFT AT PILE CAPS: Pile caps shall have top reinforcement and piles shall be anchored to the pile caps for Life Safety, and the pile cap reinforcement and pile anchorage shall be able to develop the tensile capacity of the piles for Immediate Occupancy.

#### Interconnection of Elements

- 4.6.4.2 GIRDERS: Girders supported by walls or pilasters shall have at least two ties securing the anchor bolts for Life Safety and Immediate Occupancy. There are no ties securing the anchor bolts.
- 4.6.4.3 CORBEL BEARING: If the frame girders bear on column corbels, the length of bearing shall be greater than 3" for Life Safety and Immediate Occupancy.
- 4.6.4.4 CORBEL CONNECTIONS: The frame girders shall not be connected to corbels with welded elements.
- 4.6.4.5 BEAM, GIRDER AND TRUSS SUPPORTS: Beams, girders and trusses supported by unreinforced masonry walls or pilasters shall have independent secondary columns for support of vertical loads.

#### Panel Connections

- 4.6.5.3 ROOF PANEL CONNECTIONS: Roof panel connections shall be spaced at or less than 12" for Life Safety and 8" for Immediate Occupancy.

\* - Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.





### ***Building 281, Original Building***

Building 281 is a one-story reinforced concrete block wall building. There are concrete shear walls in both directions of loading. The roof consists of gypsum board or formboard supported on steel bar joists. A structural evaluation of Building 281, Original Building was not completed because structural drawings were not available for review. A detailed on-site evaluation is required to conclusively determine the structural deficiencies in the building. However, based on our site visit observations, experience and judgement, we identified the following potential deficiencies for the building: 1) The diaphragm cannot adequately transfer seismic loads to the shear walls; 2) The out-of-plane anchorage connections could not be verified on the site visit.

For the building to meet life-safety requirements, we recommend a detailed on-site evaluation of the building. Most likely, rod bracing at the roof level and strengthening of the out-of-plane anchorage connections will be required.



Building Name: Building 281, Increment 1 (Original)

Date: July 23, 2003

Building Address: Lawrence Livermore National Laboratory

Page: 1 of 1

Job Number: A20047.08

Job Name: LLNL Prioritization

By: JYF Checked: JEH

**PRIORITIZATION BUILDING DATA SHEET**

**BUILDING DATA**

Year Built:	~1950	Year(s) Remodeled:	None	UBC Zone:	4 – Type B Near Field
Area (sf):	5,400	Length (ft):	95	Width (ft):	57
No. Stories:	1	Story Height:	12.5 ft	Total Height:	12.5 ft

**CONSTRUCTION DATA**

Gravity Load Structural System: 2" poured gypsum o/ gypsum board supported by open web joists, which are supported by perimeter and interior reinforced concrete block walls

Exterior Transverse Walls: 8" concrete block walls      Openings?: Door and window openings

Exterior Longitudinal Walls: 8" concrete block walls      Openings?: Door and window openings

Roof Framing: 2" poured gypsum o/ gypsum board supported by open web joists

Intermediate Floor Framing: None

Ground Floor: Concrete slab on grade

Columns: None

Foundation: Strip footing @ concrete block walls

**LATERAL-FORCE-RESISTING SYSTEM**

	Longitudinal	Transverse
System Classification:	Type 13 (Reinforced concrete block walls w/ flexible diaphragm)	Type 13 (Reinforced concrete block walls w/ flexible diaphragm)
Vertical Elements:	Open web joists, reinforced concrete block walls @ perimeter and interior	Open web joists, reinforced concrete block walls @ perimeter and interior
Diaphragms:	2" poured gypsum o/ gypsum board	2" poured gypsum o/ gypsum board

**SEISMIC EVALUATION PERFORMED?** No      **EVALUATION:** None      **YEAR:** 2003

**SEISMIC EVALUATION CRITERIA:**

**VULNERABILITY RATING:** 6  
(1=low to 10=high)

**PRIORITIZATION CLASSIFICATION:** CLASS C

Drawings are not available for review. This building summary has been completed based on observations of the structure made on 7/22/03-site visit with Madhu Kamath of LLNL.

Based on our site visit observations, experience and judgement, we identified the following deficiencies for the building: 1) The diaphragm cannot adequately transfer seismic loads to the shear walls; 2) The out-of-plane anchorage connections could not be verified on the site visit and therefore are deemed inadequate.

For the building to meet life-safety requirements, a detail on-site evaluation is recommended to determine the location of the lateral-force-resisting-system and to observe the interconnection of elements in the structure. Most likely, rod bracing at the roof level and strengthening of the out-of-plane anchorage connections will be required.

### ***Building 322***

Building 322 is a one-story reinforced masonry bearing wall building. The structure consists of metal deck supported by steel wide flange girders, which are supported by perimeter 8" thick concrete block walls. The only potential deficiency noted for Building 322 is inadequate out-of-plane wall anchorage. For the building to meet life-safety requirements, we recommend that the out-of-plane anchorage be strengthened.

Building Name: Building 322 Date: July 22, 2003  
 Building Address: Lawrence Livermore National Laboratory Page: 1 of 1  
 Job Number: A20047.08 Job Name: LLNL Prioritization By: JYF Checked: JEH

**PRIORITIZATION BUILDING DATA SHEET**

**BUILDING DATA**

Year Built:	1962	Year(s) Remodeled:	1974, 1984	UBC Zone:	4 – Type B Near Field
Area (sf):	5,800	Length (ft):	80	Width (ft):	60
No. Stories:	1 + Mezz.	Story Height:	16 ft	Total Height:	16 ft

**CONSTRUCTION DATA**

Gravity Load Structural System: Bare metal deck supported by WF beams, which are supported by perimeter reinforced concrete block walls

Exterior Transverse Walls: 8" concrete block walls      Openings?: Door and window openings

Exterior Longitudinal Walls: 8" concrete block walls      Openings?: Door and window openings

Roof Framing: Bare metal deck supported by 10B15 beams and tapered WF girders

Intermediate Floor Framing: @ mezz.: 5/8" plywood sheathing supported by timber joists and 2x6 stud walls

Ground Floor: 6" concrete slab on grade typ., @ plating shop area, the ground flr consists of steel grating supported by steel beams and TS columns, which are supported by 9" concrete slab on grade

Columns: None

Foundation: Strip footing @ concrete block walls. @ plating shop area: 6" steel grating floor system supported by C6's and W8's. The steel beams are supported by TS4x4 columns, which are supported by a 9" slab on grade. The grating floor system is tied back to the 6" concrete slab on grade outside the plating area w/ bolts and welded studs.

**LATERAL-FORCE-RESISTING SYSTEM**

	Longitudinal	Transverse
System Classification:	Type 13 (Reinforced Masonry Bearing Wall Building w/ Flexible Diaphragm)	Type 13 (Reinforced Masonry Bearing Wall Building w/ Flexible Diaphragm)
Vertical Elements:	Steel beams, tapered steel girders, reinforced concrete block walls @ perimeter	Steel beams, tapered steel girders, reinforced concrete block walls @ perimeter
Diaphragms:	Bare metal deck	Bare metal deck

**SEISMIC EVALUATION PERFORMED?** Yes      **EVALUATION:** Rapid Evaluation      **YEAR:** 2003

**SEISMIC EVALUATION CRITERIA:** Life Safety/ ASCE 31-02

**VULNERABILITY RATING:** 4  
(1=low to 10=high)

**PRIORITIZATION CLASSIFICATION:** CLASS C

**POTENTIAL LIFE SAFETY DEFICIENCIES:**  
THIS BUILDING WAS EVALUATED FOR THE 10% IN 50 YR. EARTHQUAKE.

WALL ANCHORAGE  
*Worst case: NS walls, out of plane anchorage for the concrete block walls is not adequate. D/C = 1.95.*

**PRELIMINARY STRENGTHENING SCHEMES OR MITIGATION MEASURES:**  
Strengthen out of plane anchorage.

Building Name: Building 322

Date: July 22, 2003

Building Address: Lawrence Livermore National Laboratory

Page: 1 of 3

Job Number: A20047.08

Job Name: LLNL Prioritization

By: JYF Checked: JEH

## ASCE 31\* BASIC CHECKLIST RM1: REINFORCED MASONRY BEARING WALL BUILDINGS WITH FLEXIBLE DIAPHRAGMS

**C NC N/A**

**Comments**

### BUILDING SYSTEM

<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.1.1	LOAD PATH: The structure shall contain a minimum of one complete load path for Life Safety and Immediate Occupancy for seismic force effects from any horizontal direction that serves to transfer the inertial forces from the mass to the foundation.	The bare metal deck delivers load to the WF beams and girders, which are supported by the perimeter reinforced concrete block walls. The concrete block walls are doveled into the concrete strip foundation system.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.1.2	ADJACENT BUILDINGS: The clear distance between the building being evaluated and any adjacent building shall be greater than 4% of the height of the shorter building for Life Safety and Immediate Occupancy.	There are no adjacent buildings.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.1.3	MEZZANINES: Interior mezzanine levels shall be braced independently from the main structure, or shall be anchored to the lateral-force-resisting elements of the main structure.	Details on the as-built dwgs do not show anchorage of the mezzanine to the lateral force resisting elements of the main building. However, there are gypsum board walls supporting the mezzanine level. To be conservative, the load from the mezzanine has been included in the evaluation of the lateral force resisting system.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.1	WEAK STORY: The strength of the lateral-force-resisting system in any story shall not be less than 80% of the strength in an adjacent story above or below for Life-Safety and Immediate Occupancy.	One story building
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.2	SOFT STORY: The stiffness of the lateral-force-resisting-system in any story shall not be less than 70% of the lateral-force-resisting system stiffness in an adjacent story above or below, or less than 80% of the average lateral-force-resisting system stiffness of the three stories above or below for Life Safety and Immediate Occupancy.	One story building
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.3	GEOMETRY: There shall be no changes in horizontal dimension of the lateral-force-resisting system of more than 30% in a story relative to adjacent stories for Life Safety and Immediate Occupancy, excluding one-story penthouses and mezzanines.	One story building
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.2.4	VERTICAL DISCONTINUITIES: All vertical elements in the lateral-force-resisting system shall be continuous to the foundation.	The concrete block walls are doveled into the concrete strip foundation system.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.5	MASS: There shall be no change in effective mass of more than 50% from one story to the next for Life Safety and Immediate Occupancy. Light roofs, penthouses and mezzanines need not be considered.	One story building
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.3.1	DETERIORATION OF WOOD: There shall be no signs of decay, shrinkage, splitting, fire damage, or sagging in any of the wood members and none of the metal connection hardware shall be deteriorated, broken, or loose.	Site visit made on 7/22/03. No signs of deterioration were observed.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.3.7	MASONRY UNITS: There shall be no visible deterioration of masonry units.	Site visit made on 7/22/03. No signs of deterioration were observed.

Building Name: Building 322

Date: July 22, 2003

Building Address: Lawrence Livermore National Laboratory

Page: 2 of 3

Job Number: A20047.08

Job Name: LLNL Prioritization

By: JYF Checked: JEH

## ASCE 31\* BASIC CHECKLIST RM1: REINFORCED MASONRY BEARING WALL BUILDINGS WITH FLEXIBLE DIAPHRAGMS

C	NC	N/A		Comments
<b>BUILDING SYSTEM</b>				
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.3.8 MASONRY JOINTS: The mortar shall not be easily scraped away from the joints by hand with a metal tool, and there shall be no areas of eroded mortar.	Site visit made on 7/22/03. No eroded mortar was observed.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.3.10 REINFORCED MASONRY WALL CRACKS: All existing diagonal cracks in wall elements shall be less than 1/8" for Life Safety and 1/16" for Immediate Occupancy, shall not be concentrated in one location, and shall not form an X pattern.	Site visit made on 7/22/03. There are no cracks >1/8".
<b>LATERAL-FORCE-RESISTING SYSTEM</b>				
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.4.2.1.1 REDUNDANCY: The number of lines of shear walls in each principal direction shall be greater than or equal to 2 for Life Safety and Immediate Occupancy.	There are two lines of shear walls in both the longitudinal and transverse directions.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.4.2.4.1 SHEAR STRESS CHECK: The shear stress in the reinforced masonry shear walls, calculated using the Quick Check Procedure of Section 3.5.3.3, shall be less than 70 psi for Life Safety and Immediate Occupancy.	The maximum shear stress in the concrete block wall is 11 psi < 70 psi at the south wall.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.4.2.4.2 REINFORCING STEEL: The total vertical and horizontal reinforcing steel ratio in reinforced masonry walls shall be greater than 0.002 for Life Safety and Immediate Occupancy of the wall with the minimum of 0.0007 for Life Safety and Immediate Occupancy in either of the two directions; the spacing of reinforcing steel shall be less than 48" for Life Safety and Immediate Occupancy; and all vertical bars shall extend to the top of the walls.	Typ. reinforcement in reinforced concrete block walls: Vertical Reinforcing = #5@24" o.c.: reinforcing ratio = 0.0016 > 0.0007 Horizontal Reinforcing = #4@24" o.c. horizontal: reinforcing ratio = 0.001 > 0.0007.  Total reinforcing steel ratio = $(0.31+0.2)in^2/(24"*8") = 0.0027 > 0.002$
<b>CONNECTIONS</b>				
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	4.6.1.1 WALL ANCHORAGE: Exterior concrete or masonry walls, that are dependent on the diaphragm for lateral support, shall be anchored for out-of-plane forces at each diaphragm level with steel anchors, reinforcing dowels, or straps that are developed into the diaphragm. Connections shall have adequate strength to resist the connection force calculated in the Quick Check Procedure of Section 3.5.3.7.	At the East and West elevations: (2) 7/8" diameter x 16" bolts w/ max. spacing @ 20' o.c. In addition, detail show the deck welded to 3/8" x 3" plates w/ 1/2" diameter L bolts into the concrete block wall @ 24" o.c. at the East and West elevations. Worst case out of plane anchorage, North and South elevations: (2) 5/8" diameter x 12" bolts. Maximum spacing of anchorage @ 10'.  D/C = 1.95.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.6.1.2 WOOD LEDGERS: The connection between the wall panels and the diaphragm shall not induce cross-grain bending or tension in the wood ledgers.	There are no wood ledgers.

Building Name: Building 322

Date: July 22, 2003

Building Address: Lawrence Livermore National Laboratory

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Job Number: A20047.08

Job Name: LLNL Prioritization

By: JYF Checked: JEH

## ASCE 31\* BASIC CHECKLIST RM1: REINFORCED MASONRY BEARING WALL BUILDINGS WITH FLEXIBLE DIAPHRAGMS

C NC N/A

Comments

### CONNECTIONS

- |                                     |                          |                                     |         |   |   |
|-------------------------------------|--------------------------|-------------------------------------|---------|---|---|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.6.2.1 | TRANSFER TO SHEAR WALLS: Diaphragms shall be connected for transfer of loads to the shear walls for Life Safety and the connections shall be able to develop the lesser of the shear strength of the walls or diaphragms for Immediate Occupancy. | Details shows the metal deck to be screwed to 2x4 members which are connected to 3/8"x3" plates by welded 1/2" diameter studs @ 24" o.c. Welded to the plate are 1/2" diameterx6" L anchors embedded in the concrete block walls. |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.6.3.5 | FOUNDATION DOWELS: Wall reinforcement shall be doweled into the foundation for Life Safety and the dowels shall be able to develop the lesser of the strength of the walls or the uplift capacity of the foundation for Immediate Occupancy.      | #5x 4'-0" dowels @ 2'-0" o.c. into the concrete foundation to match vertical reinforcing in the concrete block walls.   |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.6.4.1 | GIRDER/COLUMN CONNECTION: There shall be a positive connection utilizing plates, connection hardware, or straps between the girder and the column support.  | There are no columns in the building. Girders are connected to the concrete block walls w/ bolts and welded rebar.  |

\* – Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.

Building Name: Building 322

 Date: July 22, 2003

 Building Address: Lawrence Livermore National Laboratory

 Page: 1 of 2

 Job Number: A20047.08

 Job Name: LLNL Prioritization

 By: JYF Checked: JEH

## ASCE 31\* SUPPLEMENTAL CHECKLIST RM1: REINFORCED MASONRY BEARING WALL BUILDINGS WITH FLEXIBLE DIAPHRAGMS

C NC N/A

Comments

### LATERAL-FORCE-RESISTING SYSTEM

- |                          |                          |                                     |   |                                |
|--------------------------|--------------------------|-------------------------------------|---|--------------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.2.4.3 REINFORCING AT OPENINGS: All wall openings that interrupt rebar shall have trim reinforcing on all sides. This statement shall apply to the Immediate Occupancy Performance Level only. | Life Safety Performance Level. |
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.2.4.4 PROPORTIONS: The height-to-thickness ratio of the shear walls at each story shall be less than 30. This statement shall apply to the Immediate Occupancy Performance Level only.        | Life Safety Performance Level. |

### DIAPHRAGMS

- |                                     |                          |                                     |  |  |
|-------------------------------------|--------------------------|-------------------------------------|--|--|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.5.1.2 CROSS TIES: There shall be continuous cross ties between diaphragm chords.   | Steel beams serve as the cross ties.   |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.5.1.4 OPENINGS AT SHEAR WALLS: Diaphragm openings immediately adjacent to the shear walls shall be less than 25% of the wall length for Life Safety and 15% of the wall length for Immediate Occupancy.  | Diaphragm openings adjacent to shear walls are less than 25% of the wall length. |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.5.1.6 OPENINGS AT EXTERIOR MASONRY SHEAR WALLS: Diaphragm openings immediately adjacent to exterior masonry shear walls shall not be greater than 8 ft long for Life Safety and 4 ft long for Immediate Occupancy.   | Openings adjacent to shear walls are ~4' wide for AC units.                      |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.5.1.7 PLAN IRREGULARITIES: There shall be tensile capacity to develop the strength of the diaphragm at re-entrant corners or other locations of plan irregularities. This statement shall apply to the Immediate Occupancy Performance Level only.   | Life Safety Performance Level.   |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.5.1.8 DIAPHRAGM REINFORCEMENT AT OPENINGS: There shall be reinforcing around all diaphragm openings larger than 50% of the building width in either major plan dimension. This statement shall apply to the Immediate Occupancy Performance Level only.  | Life Safety Performance Level.   |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.5.2.1 STRAIGHT SHEATHING: All straight sheathed diaphragms shall have aspect ratios less than 2 to 1 for Life Safety and 1 to 1 for Immediate Occupancy in the direction being considered.   | Bare metal deck.   |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.5.2.2 SPANS: All wood diaphragms with spans greater than 24 ft for Life Safety and 12 ft for Immediate Occupancy shall consist of wood structural panels or diagonal sheathing.  | Bare metal deck.   |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.5.2.3 UNBLOCKED DIAPHRAGMS: All diagonally sheathed and unblocked wood structural panel diaphragms shall have horizontal spans less than 40 ft for Life Safety and 30 ft for Immediate Occupancy and shall have aspect ratios less than or equal to 4 to 1 for Life Safety and 3 to 1 for Immediate Occupancy. | Bare metal deck.   |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.5.3.1 NON-CONCRETE FILLED DIAPHRAGMS: Untopped metal deck diaphragms or metal deck diaphragms with fill other than concrete shall consist of horizontal spans of less than 40 ft and shall have aspect ratios less than 4 to 1. This statement shall apply to the Immediate Occupancy Performance Level only.  | Life Safety Performance Level.   |

Building Name: **Building 322**

Date: **July 22, 2003**

Building Address: **Lawrence Livermore National Laboratory**

Page: **2** of **2**

Job Number: **A20047.08**

Job Name: **LLNL Prioritization**

By: **JYF** Checked: **JEH**

**ASCE 31\* SUPPLEMENTAL CHECKLIST RM1: REINFORCED MASONRY BEARING WALL BUILDINGS WITH FLEXIBLE DIAPHRAGMS**

C	NC	N/A		Comments
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**DIAPHRAGMS**

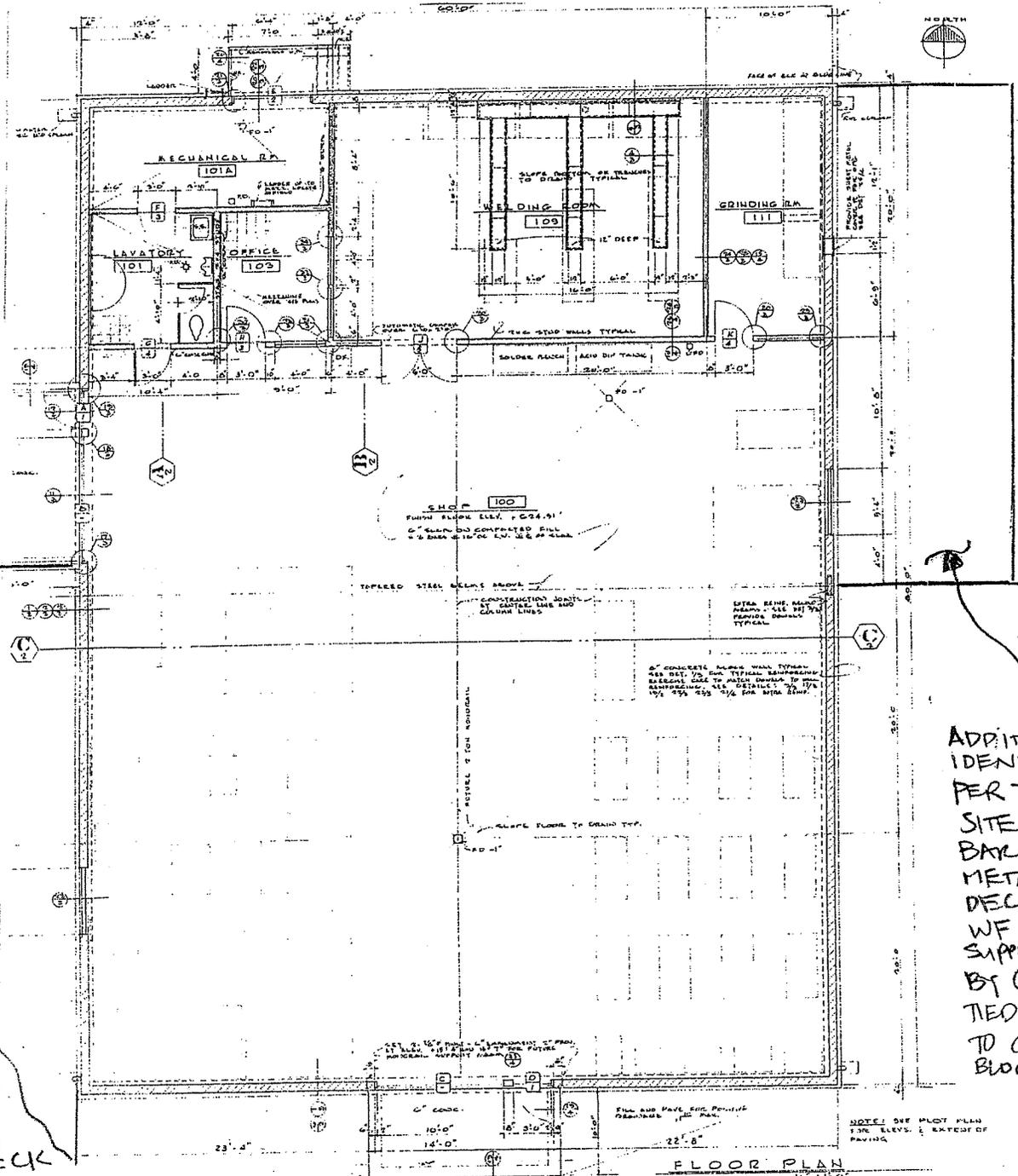
- |                                     |                          |                          |  |  |
|-------------------------------------|--------------------------|--------------------------|--|--|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 4.5.7.1 OTHER DIAPHRAGMS: The diaphragm shall not consist of a system other than wood, metal deck, concrete or horizontal bracing. |  |
|-------------------------------------|--------------------------|--------------------------|--|--|

**CONNECTIONS**

- |                          |                          |                                     |  |  |
|--------------------------|--------------------------|-------------------------------------|--|--|
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.6.1.4 STIFFNESS OF WALL ANCHORS: Anchors of concrete or masonry walls to wood structural elements shall be installed taut and shall be stiff enough to limit the relative movement between the wall and the diaphragm to no greater than 1/8". |  |
|--------------------------|--------------------------|-------------------------------------|--|--|

\* – Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.

**BUILDING PLAN**



CANOPY IDENTIFIED ON 7/22 SITE VISIT BRCE METAL DECK ON WF BEAMS AND HSS 4X4 COLLS

ADDITION IDENTIFIED PER 7/22 SITE VISIT BRCE METAL DECK ON WF BEAM SUPPORTED BY C-COLLS TIED BACK TO CONCR BLOCK WA

DATE	BY
8-11-02	

JOHN SARDIS & ASSOCIATES  
SAN FRANCISCO ENGINEERS

### ***Building 362***

Building 362 is a one-story reinforced masonry bearing wall building. The structure consists of 5/8" plywood sheathing supported by wood joists, which are supported by perimeter 8" thick concrete block walls and interior partition walls. Deficiencies noted for Building 362 are inadequate out-of-plane wall anchorage and the absence of cross ties in the building. For the building to meet life-safety requirements, we recommend that the out-of-plane anchorage be strengthened and that cross ties are added.

Building Name: Building 362

Date: July 21, 2003

Building Address: Lawrence Livermore National Laboratory

Page: 1 of 1

Job Number: A20047.08

Job Name: LLNL Prioritization

By: JYF Checked: JEH

## PRIORITIZATION BUILDING DATA SHEET

### BUILDING DATA

Year Built:	1964	Year(s) Remodeled:	1977	UBC Zone:	4 – Type B Near Field
Area (sf):	3,250	Length (ft):	74	Width (ft):	50'-8"
No. Stories:	1	Story Height:	14'-2"	Total Height:	14'-2"

### CONSTRUCTION DATA

Gravity Load Structural System: 5/8" Plywood sheathing supported by 2x12 wood joists @ 24" o.c. Joists are supported by interior partitions and exterior concrete block walls.

Exterior Transverse Walls: 8" concrete block walls      Openings?: Door and window openings

Exterior Longitudinal Walls: 8" concrete block walls      Openings?: Door and window openings

Roof Framing: 5/8" Plywood sheathing supported by 2x12 wood joists @ 24" o.c.

Intermediate Floor Framing: None

Ground Floor: 4" concrete slab on grade w/ 6x6-4/4 WWF (or 4x4-W2.9xW2.9 WWF) over 4" aggregate base

Columns: None

Foundation: Concrete strip footings

### LATERAL-FORCE-RESISTING SYSTEM

	Longitudinal	Transverse
System Classification:	Type 13 (Reinforced concrete block walls w/ flexible diaphragm)	Type 13 (Reinforced concrete block walls w/ flexible diaphragm)
Vertical Elements:	2x12 wood joists, 2x6 interior stud walls, exterior concrete block walls	2x12 wood joists, 2x6 interior stud walls, exterior concrete block walls
Diaphragms:	5/8" plywood	5/8" plywood

SEISMIC EVALUATION PERFORMED? Yes      EVALUATION: Rapid Evaluation      YEAR: 2003

SEISMIC EVALUATION CRITERIA: Life Safety/ ASCE 31-02

VULNERABILITY RATING: 5  
(1=low to 10=high)

PRIORITIZATION CLASSIFICATION: CLASS C

### POTENTIAL LIFE SAFETY DEFICIENCIES:

THIS BUILDING WAS EVALUATED FOR THE 10% IN 50 YR. EARTHQUAKE.

#### WALL ANCHORAGE

*Toe nail connection for out of plane anchorage is not adequate. D/C = 7.81.*

#### CROSS TIES

*There are no cross ties in the EW direction.*

### PRELIMINARY STRENGTHENING SCHEMES OR MITIGATION MEASURES:

Add out of plane anchorage and crossties.

Building Name: **Building 362**

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Job Number: **A20047.08**

Job Name: **LLNL Prioritization**

By: **JYF** Checked: **JEH**

## ASCE 31\* BASIC CHECKLIST RM1: REINFORCED MASONRY BEARING WALL BUILDINGS WITH FLEXIBLE DIAPHRAGMS

**C NC N/A**

**Comments**

### BUILDING SYSTEM

<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.1.1	LOAD PATH: The structure shall contain a minimum of one complete load path for Life Safety and Immediate Occupancy for seismic force effects from any horizontal direction that serves to transfer the inertial forces from the mass to the foundation.	The 5/8" plywood diaphragm transfers load to the 2x12 joists, which transfers load to the exterior concrete block walls. The concrete block walls are doweled into the foundation.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.1.2	ADJACENT BUILDINGS: The clear distance between the building being evaluated and any adjacent building shall be greater than 4% of the height of the shorter building for Life Safety and Immediate Occupancy.	There are no adjacent buildings.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.1.3	MEZZANINES: Interior mezzanine levels shall be braced independently from the main structure, or shall be anchored to the lateral-force-resisting elements of the main structure.	There are no mezzanines.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.1	WEAK STORY: The strength of the lateral-force-resisting system in any story shall not be less than 80% of the strength in an adjacent story above or below for Life-Safety and Immediate Occupancy.	One story building
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.2	SOFT STORY: The stiffness of the lateral-force-resisting-system in any story shall not be less than 70% of the lateral-force-resisting system stiffness in an adjacent story above or below, or less than 80% of the average lateral-force-resisting system stiffness of the three stories above or below for Life Safety and Immediate Occupancy.	One story building
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.3	GEOMETRY: There shall be no changes in horizontal dimension of the lateral-force-resisting system of more than 30% in a story relative to adjacent stories for Life Safety and Immediate Occupancy, excluding one-story penthouses and mezzanines.	One story building
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.2.4	VERTICAL DISCONTINUITIES: All vertical elements in the lateral-force-resisting system shall be continuous to the foundation.	The concrete block walls are doweled into the concrete strip foundation system.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.5	MASS: There shall be no change in effective mass of more than 50% from one story to the next for Life Safety and Immediate Occupancy. Light roofs, penthouses and mezzanines need not be considered.	One story building
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.3.1	DETERIORATION OF WOOD: There shall be no signs of decay, shrinkage, splitting, fire damage, or sagging in any of the wood members and none of the metal connection hardware shall be deteriorated, broken, or loose.	Site visit made on 8/6/03. No signs of deterioration were observed.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.3.7	MASONRY UNITS: There shall be no visible deterioration of masonry units.	Site visit made on 8/6/03. No signs of deterioration were observed.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.3.8	MASONRY JOINTS: The mortar shall not be easily scraped away from the joints by hand with a metal tool, and there shall be no areas of eroded mortar.	Site visit made on 8/6/03. No eroded mortar was observed.

Building Name: **Building 362**

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Job Number: **A20047.08** Job Name: **LLNL Prioritization**

By: **JYF** Checked: **JEH**

## ASCE 31\* BASIC CHECKLIST RM1: REINFORCED MASONRY BEARING WALL BUILDINGS WITH FLEXIBLE DIAPHRAGMS

**C NC N/A**

**Comments**

### BUILDING SYSTEM

- |                          |                          |                          |  |   |
|--------------------------|--------------------------|--------------------------|--|---|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <p>4.3.3.10 REINFORCED MASONRY WALL CRACKS: All existing diagonal cracks in wall elements shall be less than 1/8" for Life Safety and 1/16" for Immediate Occupancy, shall not be concentrated in one location, and shall not form an X pattern.</p> | <p>Site visit made on 8/6/03. There are no cracks &gt;1/8".</p> |
|--------------------------|--------------------------|--------------------------|--|---|

### LATERAL-FORCE-RESISTING SYSTEM

- |                                     |                          |                          |  |   |
|-------------------------------------|--------------------------|--------------------------|--|---|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <p>4.4.2.1.1 REDUNDANCY: The number of lines of shear walls in each principal direction shall be greater than or equal to 2 for Life Safety and Immediate Occupancy.</p>   | <p>There are two lines of shear walls in both the longitudinal and transverse directions.</p>   |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <p>4.4.2.4.1 SHEAR STRESS CHECK: The shear stress in the reinforced masonry shear walls, calculated using the Quick Check Procedure of Section 3.5.3.3, shall be less than 70 psi for Life Safety and Immediate Occupancy.</p>   | <p>The maximum shear stress in the concrete block wall is 10 psi &lt; 70 psi at the west elevation.</p>   |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <p>4.4.2.4.2 REINFORCING STEEL: The total vertical and horizontal reinforcing steel ratio in reinforced masonry walls shall be greater than 0.002 for Life Safety and Immediate Occupancy of the wall with the minimum of 0.0007 for Life Safety and Immediate Occupancy in either of the two directions; the spacing of reinforcing steel shall be less than 48" for Life Safety and Immediate Occupancy; and all vertical bars shall extend to the top of the walls.</p> | <p>Typ. reinforcement in reinforced concrete block walls:<br/>           Vertical Reinforcing = #5@24" o.c.:<br/>           reinforcing ratio = 0.0016 &gt; 0.0007<br/>           Horizontal Reinforcing = 2#3@24" o.c.<br/>           horizontal: reinforcing ratio = 0.0011 &gt; 0.0007.</p> <p>Total reinforcing steel ratio =<br/> <math>(0.31+0.22)in^2/(24"*8") = 0.0028 = 0.002</math></p> |

### CONNECTIONS

- |                                     |                                     |                                     |  |   |
|-------------------------------------|-------------------------------------|-------------------------------------|--|---|
| <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <p>4.6.1.1 WALL ANCHORAGE: Exterior concrete or masonry walls, that are dependent on the diaphragm for lateral support, shall be anchored for out-of-plane forces at each diaphragm level with steel anchors, reinforcing dowels, or straps that are developed into the diaphragm. Connections shall have adequate strength to resist the connection force calculated in the Quick Check Procedure of Section 3.5.3.7.</p> | <p>Out of plane wall anchorage: Blocking is toe nailed to 2x6 wood plates which are tied to the concrete block walls w/ 3/4" diameter bolts @ 4' o.c, typ.</p> <p>D/C=7.81.</p> |
| <input type="checkbox"/>            | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <p>4.6.1.2 WOOD LEDGERS: The connection between the wall panels and the diaphragm shall not induce cross-grain bending or tension in the wood ledgers.</p>   | <p>There are no wood ledgers.</p>   |
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/>            | <p>4.6.2.1 TRANSFER TO SHEAR WALLS: Diaphragms shall be connected for transfer of loads to the shear walls for Life Safety and the connections shall be able to develop the lesser of the shear strength of the walls or diaphragms for Immediate Occupancy.</p>   | <p>Plywood diaphragm is nailed to joists and blocking. These are nailed to a 3x6 plate, which is bolted to the concrete block wall w/ 3/4" diameter bolts at 4'-0" o.c.</p>     |
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/>            | <p>4.6.3.5 FOUNDATION DOWELS: Wall reinforcement shall be doweled into the foundation for Life Safety and the dowels shall be able to develop the lesser of the strength of the walls or the uplift capacity of the foundation for Immediate Occupancy.</p>  | <p>#5 L-dowels @ 24" o.c. into foundation to match vertical reinforcing in the concrete block walls.</p>  |



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Job Name: LLNL Prioritization

By: JYF Checked: JEH

**ASCE 31\* BASIC CHECKLIST RM1: REINFORCED MASONRY BEARING WALL BUILDINGS WITH FLEXIBLE DIAPHRAGMS**

C NC N/A

Comments

**CONNECTIONS**

4.6.4.1 GIRDER/COLUMN CONNECTION: There shall be a positive connection utilizing plates, connection hardware, or straps between the girder and the column support.

There are no columns.

\* – Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.

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Page: **1** of **2**

Job Number: **A20047.08**

Job Name: **LLNL Prioritization**

By: **JYF** Checked: **JEH**

## ASCE 31\* SUPPLEMENTAL CHECKLIST RM1: REINFORCED MASONRY BEARING WALL BUILDINGS WITH FLEXIBLE DIAPHRAGMS

**C NC N/A**

**Comments**

### LATERAL-FORCE-RESISTING SYSTEM

- |                          |                          |                                     |   |                                |
|--------------------------|--------------------------|-------------------------------------|---|--------------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.2.4.3 REINFORCING AT OPENINGS: All wall openings that interrupt rebar shall have trim reinforcing on all sides. This statement shall apply to the Immediate Occupancy Performance Level only. | Life Safety Performance Level. |
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.2.4.4 PROPORTIONS: The height-to-thickness ratio of the shear walls at each story shall be less than 30. This statement shall apply to the Immediate Occupancy Performance Level only.        | Life Safety Performance Level. |

### DIAPHRAGMS

- |                                     |                                     |                                     |  |  |
|-------------------------------------|-------------------------------------|-------------------------------------|--|--|
| <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | 4.5.1.2 CROSS TIES: There shall be continuous cross ties between diaphragm chords.   | There are no cross ties in the EW direction.             |
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/>            | 4.5.1.4 OPENINGS AT SHEAR WALLS: Diaphragm openings immediately adjacent to the shear walls shall be less than 25% of the wall length for Life Safety and 15% of the wall length for Immediate Occupancy.  | There are no diaphragm openings adjacent to shear walls. |
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/>            | 4.5.1.6 OPENINGS AT EXTERIOR MASONRY SHEAR WALLS: Diaphragm openings immediately adjacent to exterior masonry shear walls shall not be greater than 8 ft long for Life Safety and 4 ft long for Immediate Occupancy.   | There are no diaphragm openings adjacent to shear walls. |
| <input type="checkbox"/>            | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | 4.5.1.7 PLAN IRREGULARITIES: There shall be tensile capacity to develop the strength of the diaphragm at re-entrant corners or other locations of plan irregularities. This statement shall apply to the Immediate Occupancy Performance Level only.   | Life Safety Performance Level.                           |
| <input type="checkbox"/>            | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | 4.5.1.8 DIAPHRAGM REINFORCEMENT AT OPENINGS: There shall be reinforcing around all diaphragm openings larger than 50% of the building width in either major plan dimension. This statement shall apply to the Immediate Occupancy Performance Level only.  | Life Safety Performance Level.                           |
| <input type="checkbox"/>            | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | 4.5.2.1 STRAIGHT SHEATHING: All straight sheathed diaphragms shall have aspect ratios less than 2 to 1 for Life Safety and 1 to 1 for Immediate Occupancy in the direction being considered.   | 5/8" plywood sheathing.                                  |
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/>            | 4.5.2.2 SPANS: All wood diaphragms with spans greater than 24 ft for Life Safety and 12 ft for Immediate Occupancy shall consist of wood structural panels or diagonal sheathing.  | 5/8" plywood sheathing.                                  |
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/>            | 4.5.2.3 UNBLOCKED DIAPHRAGMS: All diagonally sheathed and unblocked wood structural panel diaphragms shall have horizontal spans less than 40 ft for Life Safety and 30 ft for Immediate Occupancy and shall have aspect ratios less than or equal to 4 to 1 for Life Safety and 3 to 1 for Immediate Occupancy. | Span = 2'-0". Diaphragm aspect ratio ~ 1 to 1.           |
| <input type="checkbox"/>            | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | 4.5.3.1 NON-CONCRETE FILLED DIAPHRAGMS: Untopped metal deck diaphragms or metal deck diaphragms with fill other than concrete shall consist of horizontal spans of less than 40 ft and shall have aspect ratios less than 4 to 1. This statement shall apply to the Immediate Occupancy Performance Level only.  | Life Safety Performance Level.                           |



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By: **JYF** Checked: **JEH**

## ASCE 31\* SUPPLEMENTAL CHECKLIST RM1: REINFORCED MASONRY BEARING WALL BUILDINGS WITH FLEXIBLE DIAPHRAGMS

C NC N/A

Comments

### DIAPHRAGMS

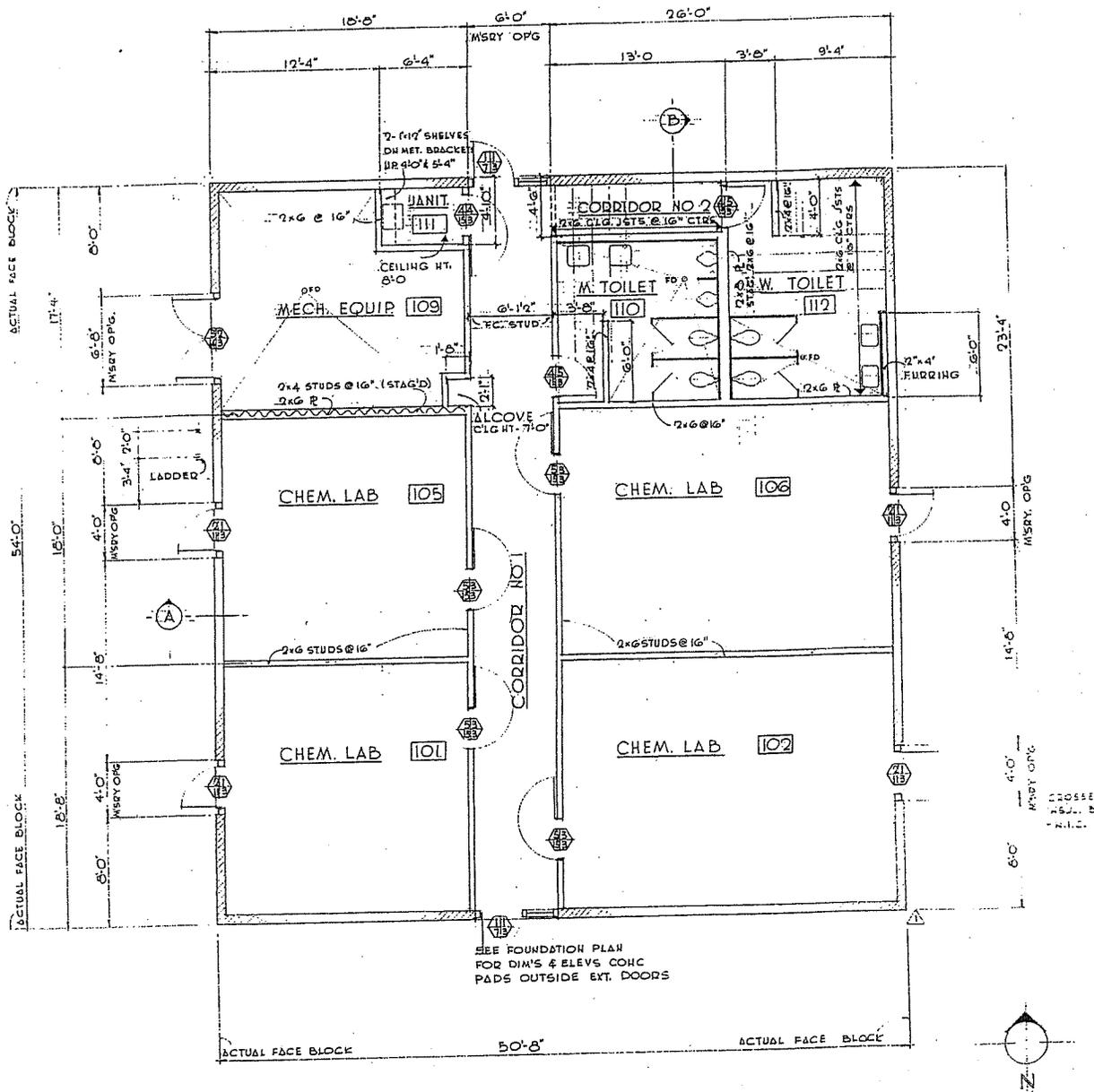
- 4.5.7.1 OTHER DIAPHRAGMS: The diaphragm shall not consist of a system other than wood, metal deck, concrete or horizontal bracing.

### CONNECTIONS

- 4.6.1.4 STIFFNESS OF WALL ANCHORS: Anchors of concrete or masonry walls to wood structural elements shall be installed taut and shall be stiff enough to limit the relative movement between the wall and the diaphragm to no greater than 1/8".

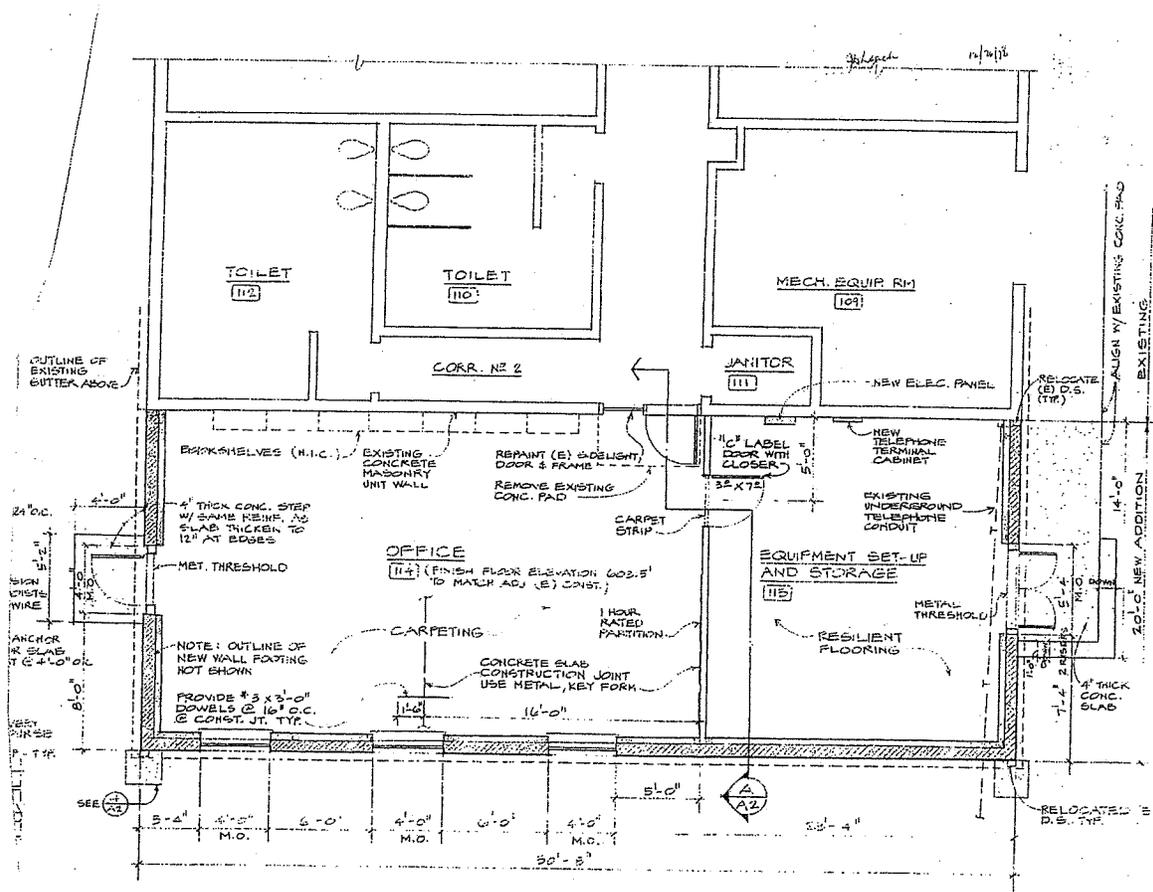
\* - Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.

**BUILDING PLAN**



ORIGINAL BUILDING C

# BUILDING PLAN



**FLOOR PLAN**  
SCALE 1/8" = 1'-0"

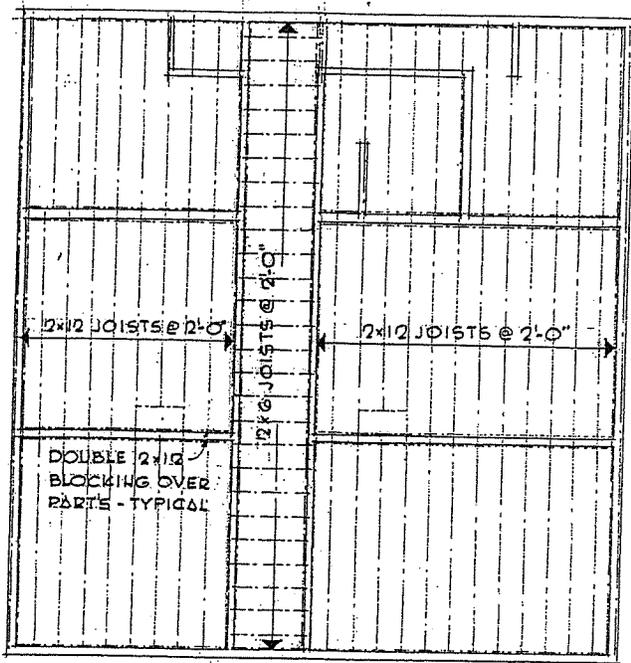


**LEGEND**

	EXISTING WALL
	NEW CONC. MASONRY UNIT WALL
	NEW ELEC.

1977 ADDITION

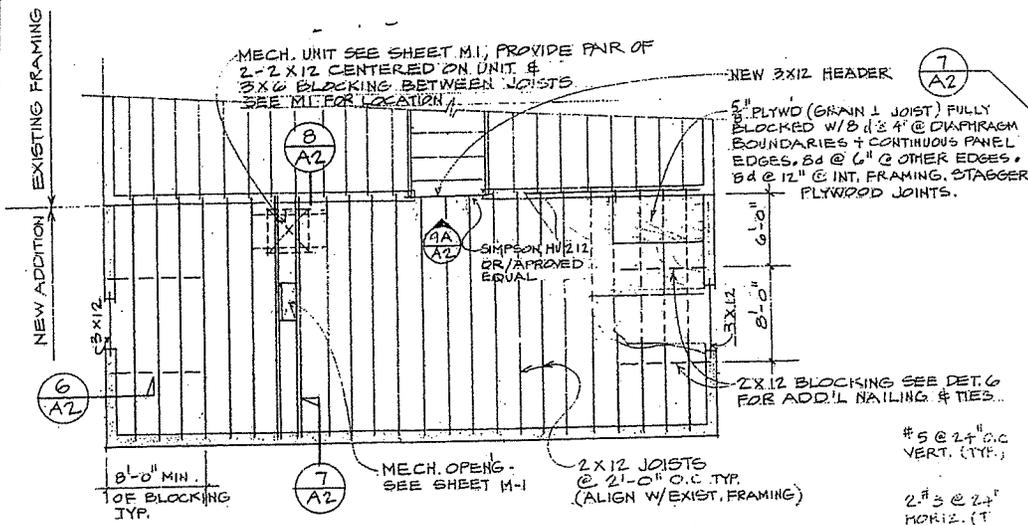
**ROOF PLAN**



ORIGINAL BUILDING

**ROOF FRAMING PLAN**

SCALE: 1/8" = 1'-0"



1977 ADDITION

**9 ROOF FRAMING PLAN**  
SCALE 1/8" = 1'-0"  
NORTH

NOTE: LAP ALL R/F BARS 4C UN2.

***Building 363***

Building 363 is a one-story reinforced masonry bearing wall building. The structure consists of 1/2" plywood sheathing supported by wood joists, which are supported by perimeter 8" thick concrete block walls and interior partition walls. Deficiencies noted for Building 363 are inadequate out-of-plane wall anchorage and the absence of cross ties in the building. For the building to meet life-safety requirements, we recommend that the out-of-plane anchorage be strengthened and that cross ties are added.

Building Name: **Building 363**

Date: **July 22, 2003**

Building Address: **Lawrence Livermore National Laboratory**

Page: **1** of **1**

Job Number: **A20047.08**

Job Name: **LLNL Prioritization**

By: **JYF** Checked: **JEH**

## PRIORITIZATION BUILDING DATA SHEET

### BUILDING DATA

Year Built:	1965	Year(s) Remodeled:	1989	UBC Zone:	4 – Type B Near Field
Area (sf):	1,590	Length (ft):	44	Width (ft):	36
No. Stories:	1	Story Height:	13'	Total Height:	13'

### CONSTRUCTION DATA

Gravity Load Structural System: 1/2" plyscord sheathing supported by wood joists and 2x4 or 2x6 stud walls

Exterior Transverse Walls:	8" Concrete block walls	Openings?:	Door and window openings
Exterior Longitudinal Walls:	8" Concrete block walls	Openings?:	Door and window openings
Roof Framing:	1/2" Plyscord sheathing supported by 2x14 joists @ 16" o.c.		
Intermediate Floor Framing:	None		

Ground Floor: 6" concrete slab on grade w/ 6x6x10 ga. WWM

Columns: None

Foundation: Thicken slab at interior partitions, strip footing at exterior concrete block shear walls

### LATERAL-FORCE-RESISTING SYSTEM

	Longitudinal	Transverse
System Classification:	Type 13 (Reinforced Masonry Bearing Wall Building w/ Flexible Diaphragm)	Type 13 (Reinforced Masonry Bearing Wall Building w/ Flexible Diaphragm)
Vertical Elements:	Wood joists supported by stud walls at interior and concrete block walls at exterior	Wood joists supported by stud walls at interior and concrete block walls at exterior
Diaphragms:	1/2" plyscord sheathing	1/2" plyscord sheathing

**SEISMIC EVALUATION PERFORMED?** Yes      **EVALUATION:** Rapid Evaluation      **YEAR:** 2003

**SEISMIC EVALUATION CRITERIA:** Life Safety/ ASCE 31-02

**VULNERABILITY RATING:** 5  
(1=low to 10=high)

**PRIORITIZATION CLASSIFICATION:** CLASS C

### POTENTIAL LIFE SAFETY DEFICIENCIES:

THIS BUILDING WAS EVALUATED FOR THE 10% IN 50 YR. EARTHQUAKE.

**WALL ANCHORAGE**

*Toe nail connection for out of plane anchorage is not adequate. D/C = 6.25.*

**CROSS TIES**

*There are no cross ties in the EW direction.*

### PRELIMINARY STRENGTHENING SCHEMES OR MITIGATION MEASURES:

Add out of plane anchorage.  
Add crossies in the EW direction.

Building Name: **Building 363**

 Date: **July 22, 2003**

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 Job Number: **A20047.08**

 Job Name: **LLNL Prioritization**

 By: **JYF** Checked: **JEH**

## ASCE 31\* BASIC CHECKLIST RM1: REINFORCED MASONRY BEARING WALL BUILDINGS WITH FLEXIBLE DIAPHRAGMS

C	NC	N/A		Comments
<b>BUILDING SYSTEM</b>				
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.1.1 LOAD PATH: The structure shall contain a minimum of one complete load path for Life Safety and Immediate Occupancy for seismic force effects from any horizontal direction that serves to transfer the inertial forces from the mass to the foundation.	<b>The 1/2" plyscord sheathing delivers load to the wood joists, which transfer the load to the perimeter reinforced concrete block walls. The concrete block walls are doweled into the concrete strip foundation system.</b>
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.1.2 ADJACENT BUILDINGS: The clear distance between the building being evaluated and any adjacent building shall be greater than 4% of the height of the shorter building for Life Safety and Immediate Occupancy.	<b>There are no adjacent buildings.</b>
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.1.3 MEZZANINES: Interior mezzanine levels shall be braced independently from the main structure, or shall be anchored to the lateral-force-resisting elements of the main structure.	<b>There are no mezzanines.</b>
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.1 WEAK STORY: The strength of the lateral-force-resisting system in any story shall not be less than 80% of the strength in an adjacent story above or below for Life-Safety and Immediate Occupancy.	<b>One story building</b>
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.2 SOFT STORY: The stiffness of the lateral-force-resisting-system in any story shall not be less than 70% of the lateral-force-resisting system stiffness in an adjacent story above or below, or less than 80% of the average lateral-force-resisting system stiffness of the three stories above or below for Life Safety and Immediate Occupancy.	<b>One story building</b>
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.3 GEOMETRY: There shall be no changes in horizontal dimension of the lateral-force-resisting system of more than 30% in a story relative to adjacent stories for Life Safety and Immediate Occupancy, excluding one-story penthouses and mezzanines.	<b>One story building</b>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.2.4 VERTICAL DISCONTINUITIES: All vertical elements in the lateral-force-resisting system shall be continuous to the foundation.	<b>The concrete block walls are doweled into the concrete strip foundation system.</b>
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.5 MASS: There shall be no change in effective mass of more than 50% from one story to the next for Life Safety and Immediate Occupancy. Light roofs, penthouses and mezzanines need not be considered.	<b>One story building</b>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.3.1 DETERIORATION OF WOOD: There shall be no signs of decay, shrinkage, splitting, fire damage, or sagging in any of the wood members and none of the metal connection hardware shall be deteriorated, broken, or loose.	<b>Site visit made on 7/22/03. No signs of deterioration were observed.</b>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.3.7 MASONRY UNITS: There shall be no visible deterioration of masonry units.	<b>Site visit made on 7/22/03. No signs of deterioration were observed.</b>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.3.8 MASONRY JOINTS: The mortar shall not be easily scraped away from the joints by hand with a metal tool, and there shall be no areas of eroded mortar.	<b>Site visit made on 7/22/03. No eroded mortar was observed.</b>

Building Name: **Building 363**

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 Job Number: **A20047.08**

 Job Name: **LLNL Prioritization**

 By: **JYF** Checked: **JEH**

## ASCE 31\* BASIC CHECKLIST RM1: REINFORCED MASONRY BEARING WALL BUILDINGS WITH FLEXIBLE DIAPHRAGMS

C	NC	N/A		Comments
<b>BUILDING SYSTEM</b>				
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<b>4.3.3.10 REINFORCED MASONRY WALL CRACKS:</b> All existing diagonal cracks in wall elements shall be less than 1/8" for Life Safety and 1/16" for Immediate Occupancy, shall not be concentrated in one location, and shall not form an X pattern.	<b>Site visit made on 7/22/03. There are no cracks &gt;1/8".</b>
<b>LATERAL-FORCE-RESISTING SYSTEM</b>				
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<b>4.4.2.1.1 REDUNDANCY:</b> The number of lines of shear walls in each principal direction shall be greater than or equal to 2 for Life Safety and Immediate Occupancy.	<b>There are two lines of shear walls in both the longitudinal and transverse directions.</b>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<b>4.4.2.4.1 SHEAR STRESS CHECK:</b> The shear stress in the reinforced masonry shear walls, calculated using the Quick Check Procedure of Section 3.5.3.3, shall be less than 70 psi for Life Safety and Immediate Occupancy.	<b>The maximum shear stress in the concrete block wall is 8 psi &lt; 70 psi at the east and west walls.</b>
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<b>4.4.2.4.2 REINFORCING STEEL:</b> The total vertical and horizontal reinforcing steel ratio in reinforced masonry walls shall be greater than 0.002 for Life Safety and Immediate Occupancy of the wall with the minimum of 0.0007 for Life Safety and Immediate Occupancy in either of the two directions; the spacing of reinforcing steel shall be less than 48" for Life Safety and Immediate Occupancy; and all vertical bars shall extend to the top of the walls.	<b>Typ. reinforcement in reinforced concrete block walls:</b> <b>Vertical Reinforcing = #4@32" o.c.:</b> <b>reinforcing ratio = 0.00078 &gt; 0.0007</b> <b>Horizontal Reinforcing = 2#4@48" o.c.</b> <b>horizontal: reinforcing ratio = 0.001 &gt; 0.0007.</b>  <b>Total reinforcing steel ratio =</b> <b><math>(0.2 \times 1.5 + 2 \times 0.2) \text{ in}^2 / (48 \times 8) = 0.0018 &lt; 0.002.</math></b>
<b>CONNECTIONS</b>				
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<b>4.6.1.1 WALL ANCHORAGE:</b> Exterior concrete or masonry walls, that are dependent on the diaphragm for lateral support, shall be anchored for out-of-plane forces at each diaphragm level with steel anchors, reinforcing dowels, or straps that are developed into the diaphragm. Connections shall have adequate strength to resist the connection force calculated in the Quick Check Procedure of Section 3.5.3.7.	<b>Blocking is toe nailed to 2x6 wood plates which are tied to the concrete block walls w/ 5/8" diameter bolts @ 32" o.c. D/C for out of plane anchorage = 6.25.</b>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<b>4.6.1.2 WOOD LEDGERS:</b> The connection between the wall panels and the diaphragm shall not induce cross-grain bending or tension in the wood ledgers.	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<b>4.6.2.1 TRANSFER TO SHEAR WALLS:</b> Diaphragms shall be connected for transfer of loads to the shear walls for Life Safety and the connections shall be able to develop the lesser of the shear strength of the walls or diaphragms for Immediate Occupancy.	<b>1/2" plyscord sheathing is nailed to 2x10 members, which are toe nailed to 2x6 redwood plates. The plates are bolted to the concrete block wall w/ 5/8" diameter bolts at 32" o.c.</b>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<b>4.6.3.5 FOUNDATION DOWELS:</b> Wall reinforcement shall be doweled into the foundation for Life Safety and the dowels shall be able to develop the lesser of the strength of the walls or the uplift capacity of the foundation for Immediate Occupancy.	<b>#4 L- dowels @ 32" o.c. into concrete foundation to match vertical reinforcing in the concrete block walls.</b>



Building Name: Building 363

Date: July 22, 2003

Building Address: Lawrence Livermore National Laboratory

Page: 3 of 3

Job Number: A20047.08

Job Name: LLNL Prioritization

By: JYF Checked: JEH

**ASCE 31\* BASIC CHECKLIST RM1: REINFORCED MASONRY BEARING WALL  
BUILDINGS WITH FLEXIBLE DIAPHRAGMS**

**C NC N/A** **Comments**

**CONNECTIONS**

- |   |   |                                     |
|---|---|-------------------------------------|
| <input type="checkbox"/> <input type="checkbox"/> <input checked="" type="checkbox"/> | <p>4.6.4.1 GIRDER/COLUMN CONNECTION: There shall be a positive connection utilizing plates, connection hardware, or straps between the girder and the column support.</p> | <p><b>There are no columns.</b></p> |
|---|---|-------------------------------------|

\* – Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.

Building Name: **Building 363**

 Date: **July 22, 2003**

 Building Address: **Lawrence Livermore National Laboratory**

 Page: **1** of **2**

 Job Number: **A20047.08**

 Job Name: **LLNL Prioritization**

 By: **JYF** Checked: **JEH**
**ASCE 31\* SUPPLEMENTAL CHECKLIST RM1: REINFORCED MASONRY BEARING WALL BUILDINGS WITH FLEXIBLE DIAPHRAGMS**

C	NC	N/A		Comments
<b>LATERAL-FORCE-RESISTING SYSTEM</b>				
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.4.2.4.3 REINFORCING AT OPENINGS: All wall openings that interrupt rebar shall have trim reinforcing on all sides. This statement shall apply to the Immediate Occupancy Performance Level only.	Life Safety Performance Level.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.4.2.4.4 PROPORTIONS: The height-to-thickness ratio of the shear walls at each story shall be less than 30. This statement shall apply to the Immediate Occupancy Performance Level only.	Life Safety Performance Level.
<b>DIAPHRAGMS</b>				
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	4.5.1.2 CROSS TIES: There shall be continuous cross ties between diaphragm chords.	There are no cross ties in the EW direction.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.5.1.4 OPENINGS AT SHEAR WALLS: Diaphragm openings immediately adjacent to the shear walls shall be less than 25% of the wall length for Life Safety and 15% of the wall length for Immediate Occupancy.	There are no openings in the diaphragm adjacent to the shear walls.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.5.1.6 OPENINGS AT EXTERIOR MASONRY SHEAR WALLS: Diaphragm openings immediately adjacent to exterior masonry shear walls shall not be greater than 8 ft long for Life Safety and 4 ft long for Immediate Occupancy.	There are no openings in the diaphragm adjacent to the exterior shear walls.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.5.1.7 PLAN IRREGULARITIES: There shall be tensile capacity to develop the strength of the diaphragm at re-entrant corners or other locations of plan irregularities. This statement shall apply to the Immediate Occupancy Performance Level only.	Life Safety Performance Level.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.5.1.8 DIAPHRAGM REINFORCEMENT AT OPENINGS: There shall be reinforcing around all diaphragm openings larger than 50% of the building width in either major plan dimension. This statement shall apply to the Immediate Occupancy Performance Level only.	Life Safety Performance Level.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.5.2.1 STRAIGHT SHEATHING: All straight sheathed diaphragms shall have aspect ratios less than 2 to 1 for Life Safety and 1 to 1 for Immediate Occupancy in the direction being considered.	1/2" plywood sheathing.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.5.2.2 SPANS: All wood diaphragms with spans greater than 24 ft for Life Safety and 12 ft for Immediate Occupancy shall consist of wood structural panels or diagonal sheathing.	1/2" plywood diaphragm.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.5.2.3 UNBLOCKED DIAPHRAGMS: All diagonally sheathed and unblocked wood structural panel diaphragms shall have horizontal spans less than 40 ft for Life Safety and 30 ft for Immediate Occupancy and shall have aspect ratios less than or equal to 4 to 1 for Life Safety and 3 to 1 for Immediate Occupancy.	Plywood diaphragm is blocked.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.5.3.1 NON-CONCRETE FILLED DIAPHRAGMS: Untopped metal deck diaphragms or metal deck diaphragms with fill other than concrete shall consist of horizontal spans of less than 40 ft and shall have aspect ratios less than 4 to 1. This statement shall apply to the Immediate Occupancy Performance Level only.	Life Safety Performance Level.



Building Name: Building 363

Date: July 22, 2003

Building Address: Lawrence Livermore National Laboratory

Page: 2 of 2

Job Number: A20047.08

Job Name: LLNL Prioritization

By: JYF Checked: JEH

**ASCE 31\* SUPPLEMENTAL CHECKLIST RM1: REINFORCED MASONRY BEARING WALL BUILDINGS WITH FLEXIBLE DIAPHRAGMS**

C NC N/A

Comments

**DIAPHRAGMS**

- 4.5.7.1 OTHER DIAPHRAGMS: The diaphragm shall not consist of a system other than wood, metal deck, concrete or horizontal bracing.

**CONNECTIONS**

- 4.6.1.4 STIFFNESS OF WALL ANCHORS: Anchors of concrete or masonry walls to wood structural elements shall be installed taut and shall be stiff enough to limit the relative movement between the wall and the diaphragm to no greater than 1/8".

\* – Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.



***Building 4675, Original Trailers + Addition #1***

Building 4675 consists of several one-story wood framed trailers. The original trailers were constructed in 1979 and Addition #1 was constructed as an extension in 1980. The roof consists of 2x4 joists with plywood sheathing. The roof spans to the perimeter plywood sheathed bearing walls. The typical trailer dimension is 24 feet wide by 60 feet long.

The primary structural deficiency found in Building 4675, Original Trailers is the absence of sill bolting along the plywood sheathed shear walls. The trailers are susceptible of sliding off their supports in the event of an earthquake. For the building to meet life-safety requirements, we recommend that the existing wood sills be bolted down to the foundation and/or typical lateral bracing be installed between the trailers and grade.

Building Name: Building 4675 – Original + Additions #1 Date: August 11, 2003  
 Building Address: Lawrence Livermore National Laboratory Page: 1 of 2  
 Job Number: A20047.08 Job Name: LLNL Prioritization By: AK Checked: \_\_\_\_\_

**PRIORITIZATION BUILDING DATA SHEET**

**BUILDING DATA**

Year Built:	-	Year(s) Remodeled:	1980-1991	UBC Zone:	4 – Type B Near Field
Area (sf):	8,720 sf	Length (ft):	120'	Width (ft):	96'
No. Stories:	1	Story Height:	Sloped Roof	Total Height:	~12'

**CONSTRUCTION DATA**

Gravity Load Structural System: 24' x 60' trailers. 2x4 roof framing with plywood sheathing spans to exterior bearing walls.

Exterior Transverse Walls:	Plywood sheathed bearing shear walls	Openings?:	Doors / Windows
Exterior Longitudinal Walls:	Plywood sheathed bearing shear walls	Openings?:	Doors / Windows
Roof Framing:	2x4 joists with plywood sheathing.		

Intermediate Floor Framing: -

Ground Floor: 1-1/8" T&G plywood over 4x6 girders @ 24" o.c. with intermediate supports

Columns: Bearing walls typical. In between trailers where bearing walls have been removed, timber posts provide vertical support.

Foundation: The floor is supported on steel jacks (supports located in the interior) and 3' pitwalls (2x4 studwalls with plywood sheathing along the exterior, except on the eastside. The eastern wall (60' long) is supported on a poured-in-place concrete wall with a footing. The original trailers do not have anchor bolts at the wood sills along the exterior walls.

**LATERAL-FORCE-RESISTING SYSTEM**

	<u>Longitudinal (W-E)</u>	<u>Transverse (N-S)</u>
System Classification:	W2 – Wood Frames	W2 – Wood Frames
Vertical Elements:	Bearing walls	Bearing walls
Diaphragms:	2x4 joists with plywood sheathing	2x4 joists with plywood sheathing

**SEISMIC EVALUATION PERFORMED?** Yes **EVALUATION:** Rapid Evaluation **YEAR:** 2003

**SEISMIC EVALUATION CRITERIA:** Life Safety/ ASCE 31-02

**VULNERABILITY RATING:** 4  
(1=low to 10=high)

**PRIORITIZATION CLASSIFICATION:** CLASS C



**Degenkolb**

DEGENKOLB ENGINEERS

Building Name: Building 4675 – Original + Additions #1

Date: August 11, 2003

Building Address: Lawrence Livermore National Laboratory

Page: 2 of 2

Job Number: A20047.08

Job Name: LLNL Prioritization

By: AK

Checked: \_\_\_\_\_

## PRIORITIZATION BUILDING DATA SHEET

### POTENTIAL LIFE SAFETY DEFICIENCIES:

THIS BUILDING WAS EVALUATED FOR THE 10% IN 50 YR. EARTHQUAKE.

#### WOOD SILLS

*The wood sills in the original trailers are not bolted to the foundation.*

### PRELIMINARY STRENGTHENING SCHEMES OR MITIGATION MEASURES:

Bolt down existing wood sills to foundation.

Building Name: Building 4675 – Original + Additions #1

Date: August 8, 2003

Building Address: Lawrence Livermore National Laboratory

Page: 1 of 3

Job Number: A20047.08

Job Name: LLNL Prioritization

By: AK Checked: \_\_\_\_\_

## ASCE 31\* BASIC CHECKLIST W2: WOOD FRAMES, COMMERCIAL AND INDUSTRIAL

**C NC N/A** **Comments**

### BUILDING SYSTEM

- |                                     |                          |                                     |  |   |
|-------------------------------------|--------------------------|-------------------------------------|--|---|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.3.1.1 LOAD PATH: The structure shall contain a minimum of one complete load path for Life Safety and Immediate Occupancy for seismic force effects from any horizontal direction that serves to transfer the inertial forces from the mass to the foundation.  | Perimeter and interior plywood shear walls. |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.3.1.3 MEZZANINES: Interior mezzanine levels shall be braced independently from the main structure, or shall be anchored to the lateral-force-resisting elements of the main structure.   |   |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.3.2.1 WEAK STORY: The strength of the lateral-force-resisting system in any story shall not be less than 80% of the strength in an adjacent story above or below for Life-Safety and Immediate Occupancy.  | Single story cafeteria                      |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.3.2.2 SOFT STORY: The stiffness of the lateral-force-resisting-system in any story shall not be less than 70% of the lateral-force-resisting system stiffness in an adjacent story above or below, or less than 80% of the average lateral-force-resisting system stiffness of the three stories above or below for Life Safety and Immediate Occupancy. | Single story cafeteria                      |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.3.2.3 GEOMETRY: There shall be no changes in horizontal dimension of the lateral-force-resisting system of more than 30% in a story relative to adjacent stories for Life Safety and Immediate Occupancy, excluding one-story penthouses and mezzanines.   | Single story cafeteria                      |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.3.2.4 VERTICAL DISCONTINUITIES: All vertical elements in the lateral-force-resisting system shall be continuous to the foundation.   |   |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.3.2.5 MASS: There shall be no change in effective mass of more than 50% from one story to the next for Life Safety and Immediate Occupancy. Light roofs, penthouses and mezzanines need not be considered.   | Single story cafeteria                      |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.3.3.1 DETERIORATION OF WOOD: There shall be no signs of decay, shrinkage, splitting, fire damage, or sagging in any of the wood members and none of the metal connection hardware shall be deteriorated, broken, or loose.   |   |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.3.3.2 WOOD STRUCTURAL PANEL SHEAR WALL FASTENERS: There shall be no more than 15% of inadequate fastening such as overdriven fasteners, omitted blocking, excessive fastening spacing, or inadequate edge distance. This statement shall apply to the Immediate Occupancy Performance Level only.  | Life Safety Evaluation                      |

### LATERAL-FORCE-RESISTING SYSTEM

- |                                     |                          |                          |   |  |
|-------------------------------------|--------------------------|--------------------------|---|--|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 4.4.2.1.1 REDUNDANCY: The number of lines of shear walls in each principal direction shall be greater than or equal to 2 for Life Safety and Immediate Occupancy. |  |
|-------------------------------------|--------------------------|--------------------------|---|--|

Building Name: Building 4675 – Original + Additions #1

Date: August 8, 2003

Building Address: Lawrence Livermore National Laboratory

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Job Number: A20047.08

Job Name: LLNL Prioritization

By: AK Checked: \_\_\_\_\_

## ASCE 31\* BASIC CHECKLIST W2: WOOD FRAMES, COMMERCIAL AND INDUSTRIAL

C	NC	N/A		Comments
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### LATERAL-FORCE-RESISTING SYSTEM

- |                                     |                          |                                     |   |   |
|-------------------------------------|--------------------------|-------------------------------------|---|---|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.4.2.7.1 SHEAR STRESS CHECK: The shear stress in the shear walls, calculated using the Quick Check procedure of Section 3.5.3.3, shall be less than the following values for Life Safety and Immediate Occupancy:<br><br><div style="margin-left: 40px;">             Structural panel sheathing: 1000 plf<br/>             Diagonal sheathing: 700 plf<br/>             Straight sheathing: 100 plf<br/>             All other conditions: 100 plf           </div> | Shear stresses low. DCR = 0.6                               |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.2.7.2 STUCCO (EXTERIOR PLASTER) SHEAR WALLS: Multistory buildings shall not rely on exterior stucco walls as the primary lateral-force-resisting system.  | Single story cafeteria                                      |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.2.7.3 GYPSUM WALLBOARD OR PLASTER SHEAR WALLS: Interior plaster or gypsum wallboard shall not be used as shear walls on buildings over one story in height with the exception of the uppermost level of a multistory building.  | Single story cafeteria                                      |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.4.2.7.4 NARROW WOOD SHEAR WALLS: Narrow wood shear walls with an aspect ratio greater than 2 to 1 for Life Safety and 1.5 to 1 for Immediate Occupancy shall not be used to resist lateral forces developed in the building in levels of moderate and high seismicity. Narrow wood shear walls with an aspect ratio greater than 2 to 1 for Immediate Occupancy shall not be used to resist lateral forces developed in the building in levels of low seismicity.   | All shear walls have an aspect ratio greater than 2 to 1.   |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.2.7.5 WALLS CONNECTED THROUGH FLOORS: Shear walls shall have interconnection between stories to transfer overturning and shear forces through the floor.  | Single story cafeteria                                      |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.2.7.6 HILLSIDE SITE: For structures that are taller on at least one side by more than half of a story due to a sloping site, all shear walls on the downhill slope shall have an aspect ratio less than 1 to 1 for Life Safety and 1 to 2 for Immediate Occupancy.  | Flat topography   |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.4.2.7.7 CRIPPLE WALLS: Cripple walls below first floor level shear walls shall be braced to the foundation with wood structural panels.   | Walls continuous to the foundation.                         |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.2.7.8 OPENINGS: Walls with openings greater than 80% of the length shall be braced with wood structural panel shear walls with aspect ratios of not more than 1.5 to 1 or shall be supported by adjacent construction through positive ties capable of transferring the lateral forces.   | Walls with openings not considered to resist lateral loads. |

### CONNECTIONS

- |                          |                                     |                          |   |                            |
|--------------------------|-------------------------------------|--------------------------|---|----------------------------|
| <input type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/> | 4.6.3.3 WOOD POSTS: There shall be a positive connection of wood posts to the foundation. |                            |
| <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | 4.6.3.4 WOOD SILLS: All wood sills shall be bolted to the foundation.                     | No sill anchor bolts found |



Building Name: Building 4675 – Original + Additions #1

Date: August 8, 2003

Building Address: Lawrence Livermore National Laboratory

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Job Number: A20047.08

Job Name: LLNL Prioritization

By: AK Checked: \_\_\_\_\_

**ASCE 31\* BASIC CHECKLIST W2: WOOD FRAMES, COMMERCIAL AND INDUSTRIAL**

C NC N/A Comments

**CONNECTIONS**

- 4.6.4.1 GIRDER/COLUMN CONNECTION: There shall be a positive connection utilizing plates, connection hardware, or straps between the girder and the column support.

\* – Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.

Building Name: Building 4675 – Original + Additions #1

Date: August 8, 2003

Building Address: Lawrence Livermore National Laboratory

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Job Number: A20047.08

Job Name: LLNL Prioritization

By: AK Checked: \_\_\_\_\_

## ASCE 31\* SUPPLEMENTAL CHECKLIST W2: WOOD FRAMES, COMMERCIAL AND INDUSTRIAL

C	NC	N/A		Comments
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### LATERAL-FORCE-RESISTING SYSTEM

- |                          |                          |                                     |   |                              |
|--------------------------|--------------------------|-------------------------------------|---|------------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.2.7.9 HOLD-DOWN ANCHORS: All shear walls shall have hold-down anchors constructed per acceptable construction practices, attached to the end studs. This statement shall apply to the Immediate Occupancy Performance Level only. | Life Safety Evaluation only. |
|--------------------------|--------------------------|-------------------------------------|---|------------------------------|

### DIAPHRAGMS

- |                                     |                          |                                     |  |   |
|-------------------------------------|--------------------------|-------------------------------------|--|---|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.5.1.1 DIAPHRAGM CONTINUITY: The diaphragms shall not be composed of split-level floors and shall not have expansion joints.  | Diaphragm across the original trailers and new addition #1 are tied together at the same elevation. |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.5.1.3 ROOF CHORD CONTINUITY: All chord elements shall be continuous, regardless of changes in roof elevation.  |   |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.5.1.7 PLAN IRREGULARITIES: There shall be tensile capacity to develop the strength of the diaphragm at re-entrant corners or other locations of plan irregularities. This statement shall apply to the Immediate Occupancy Performance Level only.   | Life Safety Evaluation only.  |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.5.1.8 DIAPHRAGM REINFORCEMENT AT OPENINGS: There shall be reinforcing around all diaphragm openings larger than 50% of the building width in either major plan dimension. This statement shall apply to the Immediate Occupancy Performance Level only.  | Life Safety Evaluation only.  |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.5.2.1 STRAIGHT SHEATHING: All straight sheathed diaphragms shall have aspect ratios less than 2 to 1 for Life Safety and 1 to 1 for Immediate Occupancy in the direction being considered.   | Diaphragms are sheathed with structural panels.   |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.5.2.2 SPANS: All wood diaphragms with spans greater than 24 ft for Life Safety and 12 ft for Immediate Occupancy shall consist of wood structural panels or diagonal sheathing. Wood commercial and industrial buildings may have rod-braced systems.  |   |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.5.2.3 UNBLOCKED DIAPHRAGMS: All diagonally sheathed and unblocked wood structural panel diaphragms shall have horizontal spans less than 40 ft for Life Safety and 30 ft for Immediate Occupancy and shall have aspect ratios less than or equal to 4 to 1 for Life Safety and 3 to 1 for Immediate Occupancy. | Diaphragms are blocked  |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.5.7.1 OTHER DIAPHRAGMS: The diaphragm shall not consist of a system other than wood, metal deck, concrete or horizontal bracing.   |   |

### CONNECTIONS

- |                          |                                     |                          |   |                            |
|--------------------------|-------------------------------------|--------------------------|---|----------------------------|
| <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | 4.6.3.9 WOOD SILL BOLTS: Sill bolts shall be spaced at 6 ft or less for Life Safety and 4 ft or less for Immediate Occupancy, with proper edge and end distance provided for wood and concrete. | No sill anchor bolts found |
|--------------------------|-------------------------------------|--------------------------|---|----------------------------|

\* – Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.

### ***Building 515***

Building 515 is a one-story steel light framed structure. The roof consists of bare metal deck with insulation and roofing. The lateral system in the transverse direction consists of steel moment frames. In the longitudinal direction, the lateral system consists of rod braces. The total square footage for this building is 7,200 square feet.

The primary structural deficiencies noted for Building 515 are as follows: 1) There is torsion in the building because the rod braced frames are located on one side only; and 2) the rod braces are overstressed.

Building Name: Building 515

Date: August 8, 2003

Building Address: Lawrence Livermore National Laboratory

Page: 1 of 2

Job Number: A20047.08

Job Name: LLNL Prioritization

By: AK Checked: \_\_\_\_\_

**PRIORITIZATION BUILDING DATA SHEET**

**BUILDING DATA**

Year Built:	-	Year(s) Remodeled:	-	UBC Zone:	4 – Type B Near Field
Area (sf):	7,200 sf	Length (ft):	147'	Width (ft):	49'
No. Stories:	1	Story Height:	Sloped Roof	Total Height:	14'

**CONSTRUCTION DATA**

Single story steel-light-frame structure. Bare metal deck supported on steel WF roof beams.  
 Gravity Load Structural System: The new addition consists of a truss made of galvanized steel pipes tied into the original WF roof beams

Exterior Transverse Walls: metal wall panels / Fabric at addition      Openings?: none

Exterior Longitudinal Walls: metal wall panels / Fabric at addition      Openings?: none

Roof Framing: Bare metal deck supported on steel roof beams / Fabric at addition

Intermediate Floor Framing: -

Ground Floor: Concrete slab on grade

Columns: Wide flange columns.

Foundation: No structural drawings available.

**LATERAL-FORCE-RESISTING SYSTEM**

	<u>Longitudinal (W-E)</u>	<u>Transverse (N-S)</u>
System Classification:	S3 – Steel Light Frames	S3 – Steel Light Frames
Vertical Elements:	Steel wide flange columns	Steel wide flange columns
Diaphragms:	Bare metal deck with roofing / Fabric	Bare metal deck with roofing / Fabric

**SEISMIC EVALUATION PERFORMED?** Yes      **EVALUATION:** Rapid Evaluation      **YEAR:** 2003

**SEISMIC EVALUATION CRITERIA:** Life Safety/ ASCE 31-02

**VULNERABILITY RATING:** 5  
 (1=low to 10=high)

**PRIORITIZATION CLASSIFICATION:** CLASS C



Building Name: Building 515

Date: August 8, 2003

Building Address: Lawrence Livermore National Laboratory

Page: 2 of 2

Job Number: A20047.08

Job Name: LLNL Prioritization

By: AK Checked: \_\_\_\_\_

## PRIORITIZATION BUILDING DATA SHEET

### POTENTIAL LIFE SAFETY DEFICIENCIES:

THIS BUILDING WAS EVALUATED FOR THE 10% IN 50 YR. EARTHQUAKE.

#### TORSION

*Rod braces are located on one line only in the longitudinal direction.*

#### AXIAL STRESS CHECK

*Existing rod braces are insufficient. The axial stress calculated is approximately 42 ksi.*

### PRELIMINARY STRENGTHENING SCHEMES OR MITIGATION MEASURES:

Building usage is primarily for storage with only 2 small cubicles to serve as office space.

Recommendation is to relocate occupancy and consider this a non-building. No strengthening required.

Building Name: Building 515 Date: August 8, 2003  
 Building Address: Lawrence Livermore National Laboratory Page: 1 of 2  
 Job Number: A20047.08 Job Name: LLNL Prioritization By: AK Checked: \_\_\_\_\_

## ASCE 31\* BASIC CHECKLIST S3: STEEL LIGHT FRAMES

C	NC	N/A		Comments
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### BUILDING SYSTEM

- |                                     |                                     |                                     |   |  |
|-------------------------------------|-------------------------------------|-------------------------------------|---|--|
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/>            | 4.3.1.1 LOAD PATH: The structure shall contain a minimum of one complete load path for Life Safety and Immediate Occupancy for seismic force effects from any horizontal direction that serves to transfer the inertial forces from the mass to the foundation. | There are steel moment frames in the transverse direction and rod braced frames in the longitudinal direction. |
| <input type="checkbox"/>            | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | 4.3.1.3 MEZZANINES: Interior mezzanine levels shall be braced independently from the main structure, or shall be anchored to the lateral-force-resisting elements of the main structure.  |  |
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/>            | 4.3.2.4 VERTICAL DISCONTINUITIES: All vertical elements in the lateral-force-resisting system shall be continuous to the foundation.  |  |
| <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | 4.3.2.6 TORSION: The estimated distance between the story center of mass and the story center of rigidity shall be less than 20% of the building width in either plan dimension for Life Safety and Immediate Occupancy.  | Rod bracing is located on one side only.   |
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/>            | 4.3.3.3 DETERIORATION OF STEEL: There shall be no visible rusting, corrosion, cracking, or other deterioration in any of the steel elements or connections in the vertical- or lateral-force-resisting systems.   |  |

### LATERAL-FORCE-RESISTING SYSTEM

- |                                     |                                     |                          |   |  |
|-------------------------------------|-------------------------------------|--------------------------|---|--|
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/> | 4.4.3.1.1 REDUNDANCY: The number of lines of braced frames in each principal direction shall be greater than or equal to 2 for Life Safety and Immediate Occupancy. The number of braced bays in each line shall be greater than 2 for Life Safety and 3 for Immediate Occupancy. |  |
| <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input type="checkbox"/> | 4.4.3.1.2 AXIAL STRESS CHECK: The axial stress in the diagonals, calculated using the Quick Check Procedure of Section 3.5.3.4, shall be less than $0.50F_y$ for Life Safety and for Immediate Occupancy.   | Calculated axial stress in rods is approximately 42 ksi. |

### CONNECTIONS

- |                                     |                          |                          |  |   |
|-------------------------------------|--------------------------|--------------------------|--|---|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 4.6.2.2 TRANSFER TO STEEL FRAMES: Diaphragms shall be connected for transfer of loads to the steel frames for Life Safety and the connections shall be able to develop the lesser of the strength of the frames or the diaphragms for Immediate Occupancy.   | Metal deck welded to roof beams.  |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 4.6.3.1 STEEL COLUMNS: The columns in lateral-force-resisting frames shall be anchored to the building foundation for Life Safety and the anchorage shall be able to develop the lesser of the tensile capacity of the column, the tensile capacity of the lowest level column splice (if any), or the uplift capacity of the foundation, for Immediate Occupancy. | No structural drawings. From site visit, columns were observed to have anchor bolts into the slab on grade. |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input type="checkbox"/> | 4.6.3.8 WALL PANELS: Metal, fiberglass or cementitious wall panels shall be positively attached to the foundation for Life Safety and Immediate Occupancy.   |   |

Building Name: Building 515 Date: August 8, 2003  
 Building Address: Lawrence Livermore National Laboratory Page: 2 of 2  
 Job Number: A20047.08 Job Name: LLNL Prioritization By: AK Checked: \_\_\_\_\_

**ASCE 31\* BASIC CHECKLIST S3: STEEL LIGHT FRAMES**

C	NC	N/A		Comments
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**CONNECTIONS**

- |                                     |                          |                          |   |   |
|-------------------------------------|--------------------------|--------------------------|---|---|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 4.6.5.1 ROOF PANELS: Metal, plastic, or cementitious roof panels shall be positively attached to the roof framing to resist seismic forces for Life Safety and Immediate Occupancy. | Roof consists of bare metal deck on steel roof beams. |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 4.6.5.2 WALL PANELS: Metal, fiberglass or cementitious wall panels shall be positively attached to the framing to resist seismic forces for Life Safety and Immediate Occupancy.    |   |

\* – Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.

Building Name: Building 515 Date: August 8, 2003  
 Building Address: Lawrence Livermore National Laboratory Page: 1 of 1  
 Job Number: A20047.08 Job Name: LLNL Prioritization By: AK Checked: \_\_\_\_\_

## ASCE 31\* SUPPLEMENTAL CHECKLIST S3: STEEL LIGHT FRAMES

C	NC	N/A		Comments
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### LATERAL-FORCE-RESISTING SYSTEM

- |                                     |                          |                                     |   |                                   |
|-------------------------------------|--------------------------|-------------------------------------|---|-----------------------------------|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.4.1.3.3 MOMENT-RESISTING CONNECTIONS: All moment connections shall be able to develop the strength of the adjoining members or panel zones.   |                                   |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.1.3.7 COMPACT MEMBERS: All frame elements shall meet section requirements set forth by Table I-9-1 of <i>Seismic Provisions for Structural Steel Buildings</i> (AISC, 1997).  | No structural drawings available. |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.1.3.8 BEAM PENETRATIONS: All openings in frame-beam webs shall be less than 1/4 of the beam depth and shall be located in the center half of the beams. This statement shall apply to the Immediate Occupancy Performance Level only. | Life Safety Evaluation.           |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.1.3.10 OUT-OF-PLANE BRACING: Beam-column joints shall be braced out-of-plane. This statement shall apply to the Immediate Occupancy Performance Level only.   | Life Safety Evaluation.           |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.1.3.11 BOTTOM FLANGE BRACING: The bottom flanges of beams shall be braced out-of-plane. This statement shall apply to the Immediate Occupancy Performance Level only.   | Life Safety Evaluation.           |

### DIAPHRAGMS

- |                                     |                          |                                     |   |                         |
|-------------------------------------|--------------------------|-------------------------------------|---|-------------------------|
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.5.1.7 PLAN IRREGULARITIES: There shall be tensile capacity to develop the strength of the diaphragm at re-entrant corners or other locations of plan irregularities. This statement shall apply to the Immediate Occupancy Performance Level only.      | Life Safety Evaluation. |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.5.1.8 DIAPHRAGM REINFORCEMENT AT OPENINGS: There shall be reinforcing around all diaphragm openings larger than 50% of the building width in either major plan dimension. This statement shall apply to the Immediate Occupancy Performance Level only. | Life Safety Evaluation. |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.5.7.1 OTHER DIAPHRAGMS: The diaphragm shall not consist of a system other than wood, metal deck, concrete or horizontal bracing.  |                         |

### CONNECTIONS

- |                                     |                          |                                     |  |   |
|-------------------------------------|--------------------------|-------------------------------------|--|---|
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.6.3.10 UPLIFT AT PILE CAPS: Pile caps shall have top reinforcement and piles shall be anchored to the pile caps for Life Safety, and the pile cap reinforcement and pile anchorage shall be able to develop the tensile capacity of the piles for Immediate Occupancy. | No structural drawings. But pile foundations not typical at site. |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.6.5.3 ROOF PANEL CONNECTIONS: Roof panel connections shall be spaced at or less than 12" for Life Safety and 8" for Immediate Occupancy.   | No structural drawings available.                                 |

\* – Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.

### ***Building 519A***

Building 519A is a one-story steel light framed structure. The roof consists of bare metal deck with insulation and roofing. The lateral system in the transverse direction consists of steel moment frames. In the longitudinal direction, the lateral system consists of rod braces. The total square footage for this building is 5,760 square feet.

The primary structural deficiencies noted for Building 519A are as follows: 1) There is an inadequate load path for lateral loads in the longitudinal direction because the tension-only rods are oriented in one direction only; 2) There is torsion in the building because the rod braced frames are located on one side only; and 3) The rod braces are overstressed.

For the building to meet life-safety requirements, we recommend replacing the existing rod braces with steel angles or tubes and providing braces in both longitudinal frames for symmetry.



Building Name: Building 519A

Date: August 8, 2003

Building Address: Lawrence Livermore National Laboratory

Page: 2 of 2

Job Number: A20047.08

Job Name: LLNL Prioritization

By: AK Checked: \_\_\_\_\_

## PRIORITIZATION BUILDING DATA SHEET

### POTENTIAL LIFE SAFETY DEFICIENCIES:

THIS BUILDING WAS EVALUATED FOR THE 10% IN 50 YR. EARTHQUAKE.

#### LOAD PATH

*The rod braces in the longitudinal direction are oriented in one direction only. For seismic / cyclic loading, tension-only braces are required in both directions.*

#### TORSION

*In the longitudinal direction, rod braces are located on one side only.*

#### AXIAL STRESS CHECK

*Existing rod braces are insufficient. The axial stress calculated is approximately 70 ksi.*

### PRELIMINARY STRENGTHENING SCHEMES OR MITIGATION MEASURES:

Replace existing rod braces with angles in both directions for cyclic resistance. Locate braces on both sides for symmetry.

Building Name: Building 519A

Date: August 8, 2003

Building Address: Lawrence Livermore National Laboratory

Page: 1 of 2

Job Number: A20047.08 Job Name: LLNL Prioritization

By: AK Checked: \_\_\_\_\_

## ASCE 31\* BASIC CHECKLIST S3: STEEL LIGHT FRAMES

**C NC N/A**

**Comments**

### BUILDING SYSTEM

- |                                     |                                     |                                     |         |   |   |
|-------------------------------------|-------------------------------------|-------------------------------------|---------|---|---|
| <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | 4.3.1.1 | LOAD PATH: The structure shall contain a minimum of one complete load path for Life Safety and Immediate Occupancy for seismic force effects from any horizontal direction that serves to transfer the inertial forces from the mass to the foundation. | Rod bracing along the longitudinal frames is in one direction only. Since braces are tension only, there is no cyclic resistance in the longitudinal direction. |
| <input type="checkbox"/>            | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | 4.3.1.3 | MEZZANINES: Interior mezzanine levels shall be braced independently from the main structure, or shall be anchored to the lateral-force-resisting elements of the main structure.  | No mezzanines.  |
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/>            | 4.3.2.4 | VERTICAL DISCONTINUITIES: All vertical elements in the lateral-force-resisting system shall be continuous to the foundation.  |   |
| <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | 4.3.2.6 | TORSION: The estimated distance between the story center of mass and the story center of rigidity shall be less than 20% of the building width in either plan dimension for Life Safety and Immediate Occupancy.  | Longitudinal rod braces are located on one side only.   |
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/>            | 4.3.3.3 | DETERIORATION OF STEEL: There shall be no visible rusting, corrosion, cracking, or other deterioration in any of the steel elements or connections in the vertical- or lateral-force-resisting systems.   |   |

### LATERAL-FORCE-RESISTING SYSTEM

- |                          |                                     |                          |           |   |  |
|--------------------------|-------------------------------------|--------------------------|-----------|---|--|
| <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | 4.4.3.1.2 | AXIAL STRESS CHECK: The axial stress in the diagonals, calculated using the Quick Check Procedure of Section 3.5.3.4, shall be less than $0.50F_y$ for Life Safety and for Immediate Occupancy. | Calculated axial stress in rods is over 150 ksi. |
|--------------------------|-------------------------------------|--------------------------|-----------|---|--|

### CONNECTIONS

- |                                     |                          |                          |         |  |   |
|-------------------------------------|--------------------------|--------------------------|---------|--|---|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 4.6.2.2 | TRANSFER TO STEEL FRAMES: Diaphragms shall be connected for transfer of loads to the steel frames for Life Safety and the connections shall be able to develop the lesser of the strength of the frames or the diaphragms for Immediate Occupancy.   | Metal deck welded to roof beams.  |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 4.6.3.1 | STEEL COLUMNS: The columns in lateral-force-resisting frames shall be anchored to the building foundation for Life Safety and the anchorage shall be able to develop the lesser of the tensile capacity of the column, the tensile capacity of the lowest level column splice (if any), or the uplift capacity of the foundation, for Immediate Occupancy. | No structural drawings. From site visit, columns were observed to have anchor bolts into the slab on grade. |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input type="checkbox"/> | 4.6.3.8 | WALL PANELS: Metal, fiberglass or cementitious wall panels shall be positively attached to the foundation for Life Safety and Immediate Occupancy.   |   |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 4.6.5.1 | ROOF PANELS: Metal, plastic, or cementitious roof panels shall be positively attached to the roof framing to resist seismic forces for Life Safety and Immediate Occupancy.  | Roof consists of bare metal deck on steel roof beams.   |

Building Name: Building 519A Date: August 8, 2003  
 Building Address: Lawrence Livermore National Laboratory Page: 2 of 2  
 Job Number: A20047.08 Job Name: LLNL Prioritization By: AK Checked: \_\_\_\_\_

**ASCE 31\* BASIC CHECKLIST S3: STEEL LIGHT FRAMES**

C NC N/A Comments

**CONNECTIONS**

- 4.6.5.2 WALL PANELS: Metal, fiberglass or cementitious wall panels shall be positively attached to the framing to resist seismic forces for Life Safety and Immediate Occupancy.

\* – Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.

Building Name: Building 519A

Date: August 8, 2003

Building Address: Lawrence Livermore National Laboratory

Page: 1 of 1

Job Number: A20047.08

Job Name: LLNL Prioritization

By: AK Checked: \_\_\_\_\_

## ASCE 31\* SUPPLEMENTAL CHECKLIST S3: STEEL LIGHT FRAMES

**C NC N/A**

**Comments**

### LATERAL-FORCE-RESISTING SYSTEM

- |                                     |                          |                                     |   |                                   |
|-------------------------------------|--------------------------|-------------------------------------|---|-----------------------------------|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.4.1.3.3 MOMENT-RESISTING CONNECTIONS: All moment connections shall be able to develop the strength of the adjoining members or panel zones.   |                                   |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input type="checkbox"/>            | 4.4.1.3.7 COMPACT MEMBERS: All frame elements shall meet section requirements set forth by Table I-9-1 of <i>Seismic Provisions for Structural Steel Buildings</i> (AISC, 1997).  | No structural drawings available. |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.1.3.8 BEAM PENETRATIONS: All openings in frame-beam webs shall be less than 1/4 of the beam depth and shall be located in the center half of the beams. This statement shall apply to the Immediate Occupancy Performance Level only. | Life Safety Evaluation.           |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.1.3.10 OUT-OF-PLANE BRACING: Beam-column joints shall be braced out-of-plane. This statement shall apply to the Immediate Occupancy Performance Level only.   | Life Safety Evaluation.           |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.1.3.11 BOTTOM FLANGE BRACING: The bottom flanges of beams shall be braced out-of-plane. This statement shall apply to the Immediate Occupancy Performance Level only.   | Life Safety Evaluation.           |

### DIAPHRAGMS

- |                                     |                          |                                     |   |                         |
|-------------------------------------|--------------------------|-------------------------------------|---|-------------------------|
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.5.1.7 PLAN IRREGULARITIES: There shall be tensile capacity to develop the strength of the diaphragm at re-entrant corners or other locations of plan irregularities. This statement shall apply to the Immediate Occupancy Performance Level only.      | Life Safety Evaluation. |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.5.1.8 DIAPHRAGM REINFORCEMENT AT OPENINGS: There shall be reinforcing around all diaphragm openings larger than 50% of the building width in either major plan dimension. This statement shall apply to the Immediate Occupancy Performance Level only. | Life Safety Evaluation. |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.5.7.1 OTHER DIAPHRAGMS: The diaphragm shall not consist of a system other than wood, metal deck, concrete or horizontal bracing.  |                         |

### CONNECTIONS

- |                          |                          |                                     |  |   |
|--------------------------|--------------------------|-------------------------------------|--|---|
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.6.3.10 UPLIFT AT PILE CAPS: Pile caps shall have top reinforcement and piles shall be anchored to the pile caps for Life Safety, and the pile cap reinforcement and pile anchorage shall be able to develop the tensile capacity of the piles for Immediate Occupancy. | No structural drawings. But pile foundations not typical at site. |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.6.5.3 ROOF PANEL CONNECTIONS: Roof panel connections shall be spaced at or less than 12" for Life Safety and 8" for Immediate Occupancy.   | No structural drawings available.                                 |

\* – Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.

### ***Building 519B***

Building 519B is a one-story steel light framed structure. The roof consists of bare metal deck with insulation and roofing. The lateral system in the transverse direction consists of steel moment frames. In the longitudinal direction, the lateral system consists of 4 bays of ½" diameter rods. The total square footage for this building is 3,200 square feet. the rod braces with steel angles or tubes.

Structural drawings were not available. The only potential deficiency is the ability of the moment connections to develop the strength of the adjoining connections. A detailed evaluation will likely show that moment frame connection meets the life-safety performance level. These buildings are rated Class D – Low Priority pending detailed evaluation.



Building Name: Building 519B Date: August 8, 2003

Building Address: Lawrence Livermore National Laboratory Page: 2 of 2

Job Number: A20047.08 Job Name: LLNL Prioritization By: AK Checked: \_\_\_\_\_

## PRIORITIZATION BUILDING DATA SHEET

### POTENTIAL LIFE SAFETY DEFICIENCIES:

THIS BUILDING WAS EVALUATED FOR THE 10% IN 50 YR. EARTHQUAKE.

#### MEZZANINE

*Mezzanine is attached to the structure on 3 sides only.*

*All moment connections shall be able to develop strength of adjoining members.*

### PRELIMINARY STRENGTHENING SCHEMES OR MITIGATION MEASURES:

Provide angle braces at mezzanine.

Detailed evaluation of moment connections.

Building Name: Building 519B

Date: August 8, 2003

Building Address: Lawrence Livermore National Laboratory

Page: 1 of 2

Job Number: A20047.08 Job Name: LLNL Prioritization

By: AK Checked: \_\_\_\_\_

## ASCE 31\* BASIC CHECKLIST S3: STEEL LIGHT FRAMES

C	NC	N/A		Comments
<b>BUILDING SYSTEM</b>				
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.1.1 LOAD PATH: The structure shall contain a minimum of one complete load path for Life Safety and Immediate Occupancy for seismic force effects from any horizontal direction that serves to transfer the inertial forces from the mass to the foundation.	There are steel moment frames in the transverse direction and rod braced frames in the longitudinal direction.
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	4.3.1.3 MEZZANINES: Interior mezzanine levels shall be braced independently from the main structure, or shall be anchored to the lateral-force-resisting elements of the main structure.	The mezzanine is attached to the main structure on 3 sides.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.2.4 VERTICAL DISCONTINUITIES: All vertical elements in the lateral-force-resisting system shall be continuous to the foundation.	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.2.6 TORSION: The estimated distance between the story center of mass and the story center of rigidity shall be less than 20% of the building width in either plan dimension for Life Safety and Immediate Occupancy.	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.3.3 DETERIORATION OF STEEL: There shall be no visible rusting, corrosion, cracking, or other deterioration in any of the steel elements or connections in the vertical- or lateral-force-resisting systems.	
<b>LATERAL-FORCE-RESISTING SYSTEM</b>				
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.4.3.1.2 AXIAL STRESS CHECK: The axial stress in the diagonals, calculated using the Quick Check Procedure of Section 3.5.3.4, shall be less than $0.50F_y$ for Life Safety and for Immediate Occupancy.	Calculated axial stress in rods is approximately 30 ksi < 36 ksi
<b>CONNECTIONS</b>				
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.6.2.2 TRANSFER TO STEEL FRAMES: Diaphragms shall be connected for transfer of loads to the steel frames for Life Safety and the connections shall be able to develop the lesser of the strength of the frames or the diaphragms for Immediate Occupancy.	Metal deck welded to roof beams.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.6.3.1 STEEL COLUMNS: The columns in lateral-force-resisting frames shall be anchored to the building foundation for Life Safety and the anchorage shall be able to develop the lesser of the tensile capacity of the column, the tensile capacity of the lowest level column splice (if any), or the uplift capacity of the foundation, for Immediate Occupancy.	No structural drawings. From site visit, columns were observed to have anchor bolts into the slab on grade.
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.6.3.8 WALL PANELS: Metal, fiberglass or cementitious wall panels shall be positively attached to the foundation for Life Safety and Immediate Occupancy.	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.6.5.1 ROOF PANELS: Metal, plastic, or cementitious roof panels shall be positively attached to the roof framing to resist seismic forces for Life Safety and Immediate Occupancy.	Roof consists of bare metal deck on steel roof beams.

Building Name: Building 519B

Date: August 8, 2003

Building Address: Lawrence Livermore National Laboratory

Page: 2 of 2

Job Number: A20047.08

Job Name: LLNL Prioritization

By: AK Checked: \_\_\_\_\_

## ASCE 31\* BASIC CHECKLIST S3: STEEL LIGHT FRAMES

**C NC N/A**

**Comments**

### CONNECTIONS

- |                          |                          |                          |   |
|--------------------------|--------------------------|--------------------------|---|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <p>4.6.5.2 WALL PANELS: Metal, fiberglass or cementitious wall panels shall be positively attached to the framing to resist seismic forces for Life Safety and Immediate Occupancy.</p> |
|--------------------------|--------------------------|--------------------------|---|

\* – Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.

Building Name: Building 519I

Date: August 8, 2003

Building Address: Lawrence Livermore National Laboratory

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Job Number: A20047.08

Job Name: LLNL Prioritization

By: AK Checked: \_\_\_\_\_

## ASCE 31\* SUPPLEMENTAL CHECKLIST S3: STEEL LIGHT FRAMES

**C NC N/A**

**Comments**

### LATERAL-FORCE-RESISTING SYSTEM

- |                          |                                     |                                     |   |                                   |
|--------------------------|-------------------------------------|-------------------------------------|---|-----------------------------------|
| <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | 4.4.1.3.3 MOMENT-RESISTING CONNECTIONS: All moment connections shall be able to develop the strength of the adjoining members or panel zones.   |                                   |
| <input type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/>            | 4.4.1.3.7 COMPACT MEMBERS: All frame elements shall meet section requirements set forth by Table I-9-1 of <i>Seismic Provisions for Structural Steel Buildings</i> (AISC, 1997).  | No structural drawings available. |
| <input type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | 4.4.1.3.8 BEAM PENETRATIONS: All openings in frame-beam webs shall be less than 1/4 of the beam depth and shall be located in the center half of the beams. This statement shall apply to the Immediate Occupancy Performance Level only. | Life Safety Evaluation.           |
| <input type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | 4.4.1.3.10 OUT-OF-PLANE BRACING: Beam-column joints shall be braced out-of-plane. This statement shall apply to the Immediate Occupancy Performance Level only.   | Life Safety Evaluation.           |
| <input type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | 4.4.1.3.11 BOTTOM FLANGE BRACING: The bottom flanges of beams shall be braced out-of-plane. This statement shall apply to the Immediate Occupancy Performance Level only.   | Life Safety Evaluation.           |

### DIAPHRAGMS

- |                                     |                          |                                     |   |                         |
|-------------------------------------|--------------------------|-------------------------------------|---|-------------------------|
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.5.1.7 PLAN IRREGULARITIES: There shall be tensile capacity to develop the strength of the diaphragm at re-entrant corners or other locations of plan irregularities. This statement shall apply to the Immediate Occupancy Performance Level only.      | Life Safety Evaluation. |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.5.1.8 DIAPHRAGM REINFORCEMENT AT OPENINGS: There shall be reinforcing around all diaphragm openings larger than 50% of the building width in either major plan dimension. This statement shall apply to the Immediate Occupancy Performance Level only. | Life Safety Evaluation. |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.5.7.1 OTHER DIAPHRAGMS: The diaphragm shall not consist of a system other than wood, metal deck, concrete or horizontal bracing.  |                         |

### CONNECTIONS

- |                          |                          |                                     |  |   |
|--------------------------|--------------------------|-------------------------------------|--|---|
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.6.3.10 UPLIFT AT PILE CAPS: Pile caps shall have top reinforcement and piles shall be anchored to the pile caps for Life Safety, and the pile cap reinforcement and pile anchorage shall be able to develop the tensile capacity of the piles for Immediate Occupancy. | No structural drawings. But pile foundations not typical at site. |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.6.5.3 ROOF PANEL CONNECTIONS: Roof panel connections shall be spaced at or less than 12" for Life Safety and 8" for Immediate Occupancy.   | No structural drawings available.                                 |

\* - Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.



Building Name: Building 805

Date: July 29, 2003

Building Address: Lawrence Livermore National Laboratory

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Job Number: A20047.08

Job Name: LLNL Prioritization

By: LKF Checked: \_\_\_\_\_

### PRIORITIZATION BUILDING DATA SHEET

#### BUILDING DATA

Year Built:	1956	Year(s) Remodeled:	1958, 1974	UBC Zone:	4 – Type B Near Field
Area (sf):	2400	Length (ft):	130'	Width (ft):	50'
No. Stories:	1	Story Height:	~17'	Total Height:	~17' max

#### CONSTRUCTION DATA

Gravity Load Structural System: Corrugated cement asbestos roofing over flat cement asbestos panel insulation over steel channel purlin spanning to steel WF roof beams –OR– Bare metal deck over steel WF roof framing, spanning to concrete bearing walls and steel columns, with strip and spread footings.

Exterior Transverse Walls: Reinforced concrete & precast panels      Openings?: No  
 Exterior Longitudinal Walls: Reinforced concrete & precast panels      Openings?: Doors on east and west walls

Roof Framing: Steel beams: WF and channels

Intermediate Floor Framing: N/A

4" S.O.G. with 4 x 4 - 10/10 wire mesh, OR  
 Ground Floor: 6" S.O.G. with #3@9 top e.w. and #4@18 bot e.w., OR  
 6" S.O.G. with #4 @15 e.w.

Columns: Steel WF

Foundation: Strip footings under walls, spread footings under columns

#### LATERAL-FORCE-RESISTING SYSTEM

	Longitudinal	Transverse
System Classification:	C2A: Concrete Shear Wall Building with Flexible Diaphragm; also PC1: Precast/Tilt-up Concrete Shear Wall Buildings with Flexible Diaphragm	C2A: Concrete Shear Wall Building with Flexible Diaphragm; also PC1: Precast/Tilt-up Concrete Shear Wall Buildings with Flexible Diaphragm
Vertical Elements:	Reinforced concrete shear walls and Precast concrete panels	Reinforced concrete shear walls and Precast concrete panels
Diaphragms:	Corrugated cement asbestos roofing over flat cement asbestos panel insulation over steel roof framing OR bare metal deck over steel WF framing	Corrugated cement asbestos roofing over flat cement asbestos panel insulation over steel roof framing OR bare metal deck over steel WF framing

SEISMIC EVALUATION PERFORMED? Yes EVALUATION: Rapid Evaluation YEAR: 2003

SEISMIC EVALUATION CRITERIA: Life Safety/ ASCE 31-02

VULNERABILITY RATING: 5

(1=low to 10=high)

PRIORITIZATION CLASSIFICATION: CLASS C

Building Name: **Building 805**

Date: **July 29, 2003**

Building Address: **Lawrence Livermore National Laboratory**

Page: **2** of **2**

Job Number: **A20047.08**

Job Name: **LLNL Prioritization**

By: **LKF** Checked: \_\_\_\_\_

## PRIORITIZATION BUILDING DATA SHEET

### POTENTIAL LIFE SAFETY DEFICIENCIES:

THIS BUILDING WAS EVALUATED FOR THE 10% IN 50 YR. EARTHQUAKE.

#### LOAD PATH/ WALL ANCHORAGE

*The wall anchorage of the transverse walls to the diaphragm in the original building is not shown on the drawings and could not be confirmed at the site visit.*

#### LOAD PATH/ OPENINGS AT SHEAR WALLS/ OTHER DIAPHRAGMS

*Roof system consists of corrugated cement asbestos roofing over cement asbestos panel insulation over steel framing. We cannot assume that the cement asbestos panels at roof act as a diaphragm.*

#### CROSS TIES

*There are continuous beams in the E-W direction with spans of 8'-18', but there are none in N-S to break up the 31' span in the 1974 addition. This is not sufficient to tie the diaphragm together.*

### PRELIMINARY STRENGTHENING SCHEMES OR MITIGATION MEASURES:

#### LOAD PATH/ WALL ANCHORAGE

*Provide connection of the transverse walls to the diaphragm.*

#### LOAD PATH/ OPENINGS AT SHEAR WALLS/ OTHER DIAPHRAGMS

*Replace existing diaphragm with either rod bracing or bare metal deck.*

#### CROSS TIES

*Further analysis is required to determine if this issue is a life-safety deficiency; it is a low priority potential deficiency. A new cross in this direction may be required.*

Building Name: Building 805 Date: July 29, 2003  
 Building Address: Lawrence Livermore National Laboratory Page: 1 of 2  
 Job Number: A20047.08 Job Name: LLNL Prioritization By: LKF Checked: \_\_\_\_\_

## ASCE 31\* BASIC CHECKLIST C2A: CONCRETE SHEAR WALL BUILDINGS WITH FLEXIBLE DIAPHRAGMS

C	NC	N/A		Comments
<b>BUILDING SYSTEM</b>				
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	4.3.1.1 LOAD PATH: The structure shall contain a minimum of one complete load path for Life Safety and Immediate Occupancy for seismic force effects from any horizontal direction that serves to transfer the inertial forces from the mass to the foundation.	We cannot assume that the cement asbestos panels at roof act as a diaphragm. Also the wall anchorage of the transverse walls in the original building is not shown.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.1.2 ADJACENT BUILDINGS: The clear distance between the building being evaluated and any adjacent building shall be greater than 4% of the height of the shorter building for Life Safety and Immediate Occupancy.	No immediately adjacent buildings.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.1.3 MEZZANINES: Interior mezzanine levels shall be braced independently from the main structure, or shall be anchored to the lateral-force-resisting elements of the main structure.	No interior mezzanines.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.1 WEAK STORY: The strength of the lateral-force-resisting system in any story shall not be less than 80% of the strength in an adjacent story above or below for Life-Safety and Immediate Occupancy.	One story building.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.2 SOFT STORY: The stiffness of the lateral-force-resisting-system in any story shall not be less than 70% of the lateral-force-resisting system stiffness in an adjacent story above or below, or less than 80% of the average lateral-force-resisting system stiffness of the three stories above or below for Life Safety and Immediate Occupancy.	One story building.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.3 GEOMETRY: There shall be no changes in horizontal dimension of the lateral-force-resisting system of more than 30% in a story relative to adjacent stories for Life Safety and Immediate Occupancy, excluding one-story penthouses and mezzanines.	One story building.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.2.4 VERTICAL DISCONTINUITIES: All vertical elements in the lateral-force-resisting system shall be continuous to the foundation.	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.5 MASS: There shall be no change in effective mass of more than 50% from one story to the next for Life Safety and Immediate Occupancy. Light roofs, penthouses and mezzanines need not be considered.	One story building.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.3.1 DETERIORATION OF WOOD: There shall be no signs of decay, shrinkage, splitting, fire damage, or sagging in any of the wood members and none of the metal connection hardware shall be deteriorated, broken, or loose.	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.3.4 DETERIORATION OF CONCRETE: There shall be no visible deterioration of concrete or reinforcing steel in any of the vertical- or lateral-force-resisting elements.	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.3.5 POST-TENSIONING ANCHORS: There shall be no evidence of corrosion or spalling in the vicinity of post-tensioning or end fittings. Coil anchors shall not have been used.	No post-tensioning anchors.

Building Name: Building 805

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Job Number: A20047.08 Job Name: LLNL Prioritization

By: LKF Checked: \_\_\_\_\_

## ASCE 31\* BASIC CHECKLIST C2A: CONCRETE SHEAR WALL BUILDINGS WITH FLEXIBLE DIAPHRAGMS

C	NC	N/A		Comments
---	----	-----	--	----------

### BUILDING SYSTEM

- |                                     |                          |                          |   |                             |
|-------------------------------------|--------------------------|--------------------------|---|-----------------------------|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <p>4.3.3.9 CONCRETE WALL CRACKS: All existing diagonal cracks in wall elements shall be less than 1/8" for Life Safety and 1/16" for Immediate Occupancy, shall not be concentrated in one location, and shall not form an X pattern.</p> | <p>VERIFY @ SITE VISIT.</p> |
|-------------------------------------|--------------------------|--------------------------|---|-----------------------------|

### LATERAL-FORCE-RESISTING SYSTEM

- |                                     |                          |                          |   |  |
|-------------------------------------|--------------------------|--------------------------|---|--|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <p>4.4.2.1.1 REDUNDANCY: The number of lines of shear walls in each principal direction shall be greater than or equal to 2 for Life Safety and Immediate Occupancy.</p>  |  |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <p>4.4.2.2.1 SHEAR STRESS CHECK: The shear stress in the concrete shear walls, calculated using the Quick Check procedure of Section 3.5.3.3, shall be less than 100 psi or <math>2\sqrt{f'_c}</math> for Life Safety and Immediate Occupancy.</p>  | <p><math>v_j^{avg} = 13</math> psi (for 12" cast-in-place concrete walls and 6" precast panels combined)<br/>&lt;&lt; 100 psi allowed.</p>   |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <p>4.4.2.2.2 REINFORCING STEEL: The ratio of reinforcing steel area to gross concrete area shall be not less than 0.0015 in the vertical direction and 0.0025 in the horizontal direction for Life Safety and Immediate Occupancy. The spacing of reinforcing steel shall be equal to or less than 18" for Life Safety and Immediate Occupancy.</p> | <p>Max spacing is 18".<br/>12" wall: #4@12" min e.w.e.f. → 0.0027 <u>OK</u><br/>8" wall: #4@24" vert e.f. → 0.0020 <u>OK</u><br/>8" wall: #4@18" horiz e.f. → 0.0027 <u>OK</u></p> |

### CONNECTIONS

- |                                     |                                     |                          |  |  |
|-------------------------------------|-------------------------------------|--------------------------|--|--|
| <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <p>4.6.1.1 WALL ANCHORAGE: Exterior concrete or masonry walls, that are dependent on the diaphragm for lateral support, shall be anchored for out-of-plane forces at each diaphragm level with steel anchors, reinforcing dowels, or straps that are developed into the diaphragm. Connections shall have adequate strength to resist the connection force calculated in the Quick Check Procedure of Section 3.5.3.7.</p> | <p>Positive connection exists in 1958 (original) building segment, such that separation of the walls and collapse of the roof is not a concern.<br/>There are no applicable details for the 1956 segment. At the site, we observed a channel sitting on top of the wall, but could not verify any connection of the channel to the wall.<br/>1974 Addition is adequate. See attached calculations.</p> |
| <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <p>4.6.2.1 TRANSFER TO SHEAR WALLS: Diaphragms shall be connected for transfer of loads to the shear walls for Life Safety and the connections shall be able to develop the lesser of the shear strength of the walls or diaphragms for Immediate Occupancy.</p>   | <p>We cannot assume that the cement asbestos panels at roof act as a diaphragm. Unable to verify connection of corrugated asbestos cement roofing to concrete walls.</p>   |
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/> | <p>4.6.3.5 FOUNDATION DOWELS: Wall reinforcement shall be doweled into the foundation for Life Safety and the dowels shall be able to develop the lesser of the strength of the walls or the uplift capacity of the foundation for Immediate Occupancy.</p>  | <p>Walls are doweled to strip footings.</p>  |

\* – Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.

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Job Number: A20047.08 Job Name: LLNL Prioritization

By: LKF Checked: \_\_\_\_\_

## ASCE 31\* SUPPLEMENTAL CHECKLIST C2A: CONCRETE SHEAR WALL BUILDINGS WITH FLEXIBLE DIAPHRAGMS

**C NC N/A**

**Comments**

### LATERAL-FORCE-RESISTING SYSTEM

- |   |                  |  |   |
|---|------------------|--|---|
| <input type="checkbox"/> <input type="checkbox"/> <input checked="" type="checkbox"/> | <b>4.4.2.2.3</b> | <b>COUPLING BEAMS:</b> The stirrups in coupling beams over means of egress shall be spaced at or less than $d/2$ and shall be anchored into the confined core of the beam with hooks of $135^\circ$ or more for Life Safety. All coupling beams shall comply with the requirements above and shall have the capacity in shear to develop the uplift capacity of the adjacent wall for Immediate Occupancy. | <b>No separately detailed coupling beams.</b>                           |
| <input type="checkbox"/> <input type="checkbox"/> <input checked="" type="checkbox"/> | <b>4.4.2.2.4</b> | <b>OVERTURNING:</b> All shear walls shall have aspect ratios less than 4 to 1. Wall piers need not be considered. This statement shall apply to the Immediate Occupancy Performance Level only.  | <b>Statement applies to Immediate Occupancy Performance Level only.</b> |
| <input type="checkbox"/> <input type="checkbox"/> <input checked="" type="checkbox"/> | <b>4.4.2.2.5</b> | <b>CONFINEMENT REINFORCING:</b> For shear walls with aspect ratios greater than 2 to 1, the boundary elements shall be confined with spirals or ties with spacing less than $8d_b$ . This statement shall apply to the Immediate Occupancy Performance Level only.   | <b>Statement applies to Immediate Occupancy Performance Level only.</b> |
| <input type="checkbox"/> <input type="checkbox"/> <input checked="" type="checkbox"/> | <b>4.4.2.2.6</b> | <b>REINFORCING AT OPENINGS:</b> There shall be added trim reinforcement around all wall openings greater than three times the thickness of the wall. This statement shall apply to the Immediate Occupancy Performance Level only.   | <b>Statement applies to Immediate Occupancy Performance Level only.</b> |
| <input type="checkbox"/> <input type="checkbox"/> <input checked="" type="checkbox"/> | <b>4.4.2.2.7</b> | <b>WALL THICKNESS:</b> Thickness of bearing walls shall not be less than $1/25$ the unsupported height or length, whichever is shorter, nor less than 4". This statement shall apply to the Immediate Occupancy Performance Level only.  | <b>Statement applies to Immediate Occupancy Performance Level only.</b> |

### DIAPHRAGMS

- |   |                |  |  |
|---|----------------|--|--|
| <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> | <b>4.5.1.1</b> | <b>DIAPHRAGM CONTINUITY:</b> The diaphragms shall not be composed of split-level floors and shall not have expansion joints.   | <b>Roof does not have a split level or expansion joints.</b>   |
| <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> | <b>4.5.1.2</b> | <b>CROSS TIES:</b> There shall be continuous cross ties between diaphragm chords.  |  |
| <input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/> | <b>4.5.1.4</b> | <b>OPENINGS AT SHEAR WALLS:</b> Diaphragm openings immediately adjacent to the shear walls shall be less than 25% of the wall length for Life Safety and 15% of the wall length for Immediate Occupancy.   | <b>There is only corrugated asbestos cement insulation and roofing over steel framing; this may not act as a diaphragm, and its connection to the walls is not shown. We have been unable to verify many of the connections at the roof level.</b> |
| <input type="checkbox"/> <input type="checkbox"/> <input checked="" type="checkbox"/> | <b>4.5.1.7</b> | <b>PLAN IRREGULARITIES:</b> There shall be tensile capacity to develop the strength of the diaphragm at re-entrant corners or other locations of plan irregularities. This statement shall apply to the Immediate Occupancy Performance Level only.      | <b>Statement applies to Immediate Occupancy Performance Level only.</b>  |
| <input type="checkbox"/> <input type="checkbox"/> <input checked="" type="checkbox"/> | <b>4.5.1.8</b> | <b>DIAPHRAGM REINFORCEMENT AT OPENINGS:</b> There shall be reinforcing around all diaphragm openings larger than 50% of the building width in either major plan dimension. This statement shall apply to the Immediate Occupancy Performance Level only. | <b>Statement applies to Immediate Occupancy Performance Level only.</b>  |

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 Job Number: A20047.08

 Job Name: LLNL Prioritization

 By: LKF Checked: \_\_\_\_\_

## ASCE 31\* SUPPLEMENTAL CHECKLIST C2A: CONCRETE SHEAR WALL BUILDINGS WITH FLEXIBLE DIAPHRAGMS

C	NC	N/A		Comments
<b>DIAPHRAGMS</b>				
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.5.2.1 STRAIGHT SHEATHING: All straight sheathed diaphragms shall have aspect ratios less than 2 to 1 for Life Safety and 1 to 1 for Immediate Occupancy in the direction being considered.	No straight sheathing.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.5.2.2 SPANS: All wood diaphragms with spans greater than 24 ft for Life Safety and 12 ft for Immediate Occupancy shall consist of wood structural panels or diagonal sheathing.	No wood diaphragms.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.5.2.3 UNBLOCKED DIAPHRAGMS: All diagonally sheathed and unblocked wood structural panel diaphragms shall have horizontal spans less than 40 ft for Life Safety and 30 ft for Immediate Occupancy and shall have aspect ratios less than or equal to 4 to 1 for Life Safety and 3 to 1 for Immediate Occupancy.	No wood diaphragms.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.5.3.1 NON-CONCRETE FILLED DIAPHRAGMS: Untopped metal deck diaphragms or metal deck diaphragms with fill other than concrete shall consist of horizontal spans of less than 40 ft and shall have aspect ratios less than 4 to 1. This statement shall apply to the Immediate Occupancy Performance Level only.	Statement applies to Immediate Occupancy Performance Level only.
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	4.5.7.1 OTHER DIAPHRAGMS: The diaphragm shall not consist of a system other than wood, metal deck, concrete or horizontal bracing.	Roof system consists of corrugated cement asbestos roofing over cement asbestos panel insulation over steel framing.
<b>CONNECTIONS</b>				
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.6.3.10 UPLIFT AT PILE CAPS: Pile caps shall have top reinforcement and piles shall be anchored to the pile caps for Life Safety, and the pile cap reinforcement and pile anchorage shall be able to develop the tensile capacity of the piles for Immediate Occupancy.	Statement applies to Immediate Occupancy Performance Level only.

\* – Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.

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Job Number: A20047.08 Job Name: LLNL Prioritization

By: LKF Checked: \_\_\_\_\_

## ASCE 31\* BASIC CHECKLIST PC1: PRECAST/TILT-UP CONCRETE SHEAR WALL BUILDINGS WITH FLEXIBLE DIAPHRAGMS

C	NC	N/A		Comments
<b>BUILDING SYSTEM</b>				
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	4.3.1.1 LOAD PATH: The structure shall contain a minimum of one complete load path for Life Safety and Immediate Occupancy for seismic force effects from any horizontal direction that serves to transfer the inertial forces from the mass to the foundation.	See comments in C2A checklist.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.1.2 ADJACENT BUILDINGS: The clear distance between the building being evaluated and any adjacent building shall be greater than 4% of the height of the shorter building for Life Safety and Immediate Occupancy.	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.1.3 MEZZANINES: Interior mezzanine levels shall be braced independently from the main structure, or shall be anchored to the lateral-force-resisting elements of the main structure.	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.1 WEAK STORY: The strength of the lateral-force-resisting system in any story shall not be less than 80% of the strength in an adjacent story above or below for Life-Safety and Immediate Occupancy.	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.2 SOFT STORY: The stiffness of the lateral-force-resisting-system in any story shall not be less than 70% of the lateral-force-resisting system stiffness in an adjacent story above or below, or less than 80% of the average lateral-force-resisting system stiffness of the three stories above or below for Life Safety and Immediate Occupancy.	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.3 GEOMETRY: There shall be no changes in horizontal dimension of the lateral-force-resisting system of more than 30% in a story relative to adjacent stories for Life Safety and Immediate Occupancy, excluding one-story penthouses and mezzanines.	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.2.4 VERTICAL DISCONTINUITIES: All vertical elements in the lateral-force-resisting system shall be continuous to the foundation.	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.5 MASS: There shall be no change in effective mass of more than 50% from one story to the next for Life Safety and Immediate Occupancy. Light roofs, penthouses and mezzanines need not be considered.	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.3.1 DETERIORATION OF WOOD: There shall be no signs of decay, shrinkage, splitting, fire damage, or sagging in any of the wood members and none of the metal connection hardware shall be deteriorated, broken, or loose.	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.3.6 PRECAST CONCRETE WALLS: There shall be no visible deterioration of concrete or reinforcing steel or evidence of distress, especially at the connections.	
<b>LATERAL-FORCE-RESISTING SYSTEM</b>				
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.4.2.1.1 REDUNDANCY: The number of lines of shear walls in each principal direction shall be greater than or equal to 2 for Life Safety and Immediate Occupancy.	

Building Name: Building 805 Date: August 5, 2003  
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## ASCE 31\* BASIC CHECKLIST PC1: PRECAST/TILT-UP CONCRETE SHEAR WALL BUILDINGS WITH FLEXIBLE DIAPHRAGMS

**C   NC   N/A** **Comments**

### LATERAL-FORCE-RESISTING SYSTEM

- |                                     |                          |                          |  |  |
|-------------------------------------|--------------------------|--------------------------|--|--|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 4.4.2.3.1 SHEAR STRESS CHECK: The shear stress in the precast panels, calculated using the Quick Check procedure of Section 3.5.3.3, shall be less than 100 psi or $2\sqrt{f'_c}$ for Life Safety and Immediate Occupancy.   | $v_j^{avg} = 13$ psi (for 12" cast-in-place concrete walls and 6" precast panels combined) << 100 psi allowed.   |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 4.4.2.3.2 REINFORCING STEEL: The ratio of reinforcing steel area to gross concrete area shall be not less than 0.0015 in the vertical direction and 0.0025 in the horizontal direction for Life Safety and Immediate Occupancy. The spacing of reinforcing steel shall be equal to or less than 18" for Life Safety and Immediate Occupancy. | Max spacing is 18".<br>6" wall: #4@15" e.w. → 0.0022<br>OK vertical, but technically NO GOOD for horizontal. However, because the walls are lowly stressed (D/C = 0.10) and the reinforcing ratio is only 12% less than required, do not consider this a deficiency. |

### CONNECTIONS

- |                                     |                          |                                     |   |   |
|-------------------------------------|--------------------------|-------------------------------------|---|---|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.6.1.1 WALL ANCHORAGE: Exterior concrete or masonry walls, that are dependent on the diaphragm for lateral support, shall be anchored for out-of-plane forces at each diaphragm level with steel anchors, reinforcing dowels, or straps that are developed into the diaphragm. Connections shall have adequate strength to resist the connection force calculated in the Quick Check Procedure of Section 3.5.3.7. | See attached calculations for 1974 Addition   |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.6.1.2 WOOD LEDGERS: The connection between the wall panels and the diaphragm shall not induce cross-grain bending or tension in the wood ledgers.   | No wood ledgers   |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.6.2.1 TRANSFER TO SHEAR WALLS: Diaphragms shall be connected for transfer of loads to the shear walls for Life Safety and the connections shall be able to develop the lesser of the shear strength of the walls or diaphragms for Immediate Occupancy.   | Typically 1/2" φ x 4" studs in precast panels @ 1'-6" o.c. @ diaphragm level.                       |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.6.3.7 PRECAST WALL PANELS: Precast wall panels shall be connected to the foundation for Life Safety and the connections shall be able to develop the strength of the walls for Immediate Occupancy.   | Per A/S1 on 1974 drawings- wall is welded to thickened slab edge and slab is doweled to grade beam. |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.6.4.1 GIRDER/COLUMN CONNECTION: There shall be a positive connection utilizing plates, connection hardware, or straps between the girder and the column support.  |   |

\* - Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.



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Job Number: A20047.08

Job Name: LLNL Prioritization

By: LKF Checked: \_\_\_\_\_

**ASCE 31\* SUPPLEMENTAL CHECKLIST PC1: PRECAST/TILT-UP CONCRETE SHEAR WALL BUILDINGS WITH FLEXIBLE DIAPHRAGMS**

C NC N/A

Comments

**LATERAL-FORCE-RESISTING SYSTEM**

- 4.4.2.2.3 COUPLING BEAMS: The stirrups in coupling beams over means of egress shall be spaced at or less than  $d/2$  and shall be anchored into the confined core of the beam with hooks of  $135^\circ$  or more for Life Safety. All coupling beams shall comply with the requirements above and shall have the capacity in shear to develop the uplift capacity of the adjacent wall for Immediate Occupancy.
- 4.4.2.3.3 WALL OPENINGS: The total width of openings along any perimeter wall line shall constitute less than 75% of the length of any perimeter wall for Life Safety and 50% for Immediate Occupancy with the wall piers having aspect ratios of less than 2 to 1 for Life Safety and Immediate Occupancy. Precast panels are only along the south and west faces. Openings are minimal.
- 4.4.2.3.4 CORNER OPENINGS: Walls with openings at a building corner larger than the width of a typical panel shall be connected to the remainder of the wall with collector reinforcing. Only applicable corner is the southwest corner, which has no openings.
- 4.4.2.3.5 PANEL-TO-PANEL CONNECTIONS: Adjacent wall panels shall be interconnected to transfer overturning forces between panels by methods other than welded steel inserts. This statement shall apply to the Immediate Occupancy Performance Level only. Statement applies to Immediate Occupancy Performance Level only.
- 4.4.2.3.6 WALL THICKNESS: Thickness of bearing walls shall not be less than  $1/25$  the unsupported height or length, whichever is shorter, nor less than 4". This statement shall apply to the Immediate Occupancy Performance Level only. Statement applies to Immediate Occupancy Performance Level only.

**DIAPHRAGMS**

- 4.5.1.2 CROSS TIES: There shall be continuous cross ties between diaphragm chords. There are continuous beams in the E-W direction with spans of 8'-18', but there are none in N-S to break up the 31' span in the 1974 addition. This is not sufficient to tie the diaphragm together. Further analysis is required to determine if this issue is a life-safety deficiency; it is a low priority potential deficiency.
- 4.5.1.7 PLAN IRREGULARITIES: There shall be tensile capacity to develop the strength of the diaphragm at re-entrant corners or other locations of plan irregularities. This statement shall apply to the Immediate Occupancy Performance Level only. Statement applies to Immediate Occupancy Performance Level only.
- 4.5.1.8 DIAPHRAGM REINFORCEMENT AT OPENINGS: There shall be reinforcing around all diaphragm openings larger than 50% of the building width in either major plan dimension. This statement shall apply to the Immediate Occupancy Performance Level only. Statement applies to Immediate Occupancy Performance Level only.
- 4.5.2.1 STRAIGHT SHEATHING: All straight sheathed diaphragms shall have aspect ratios less than 2 to 1 for Life Safety and 1 to 1 for Immediate Occupancy in the direction being considered. Metal deck diaphragm in the 1974 portion of the building.

Building Name: Building 805

 Date: August 5, 2003

 Building Address: Lawrence Livermore National Laboratory

 Page: 2 of 2

 Job Number: A20047.08

 Job Name: LLNL Prioritization

 By: LKF Checked: \_\_\_\_\_

## ASCE 31\* SUPPLEMENTAL CHECKLIST PC1: PRECAST/TILT-UP CONCRETE SHEAR WALL BUILDINGS WITH FLEXIBLE DIAPHRAGMS

C	NC	N/A		Comments
<b>DIAPHRAGMS</b>				
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.5.2.2 SPANS: All wood diaphragms with spans greater than 24 ft for Life Safety and 12 ft for Immediate Occupancy shall consist of wood structural panels or diagonal sheathing.	Metal deck diaphragm in the 1974 portion of the building.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.5.2.3 UNBLOCKED DIAPHRAGMS: All diagonally sheathed and unblocked wood structural panel diaphragms shall have horizontal spans less than 40 ft for Life Safety and 30 ft for Immediate Occupancy and shall have aspect ratios less than or equal to 4 to 1 for Life Safety and 3 to 1 for Immediate Occupancy.	Metal deck diaphragm in the 1974 portion of the building.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.5.7.1 OTHER DIAPHRAGMS: The diaphragm shall not consist of a system other than wood, metal deck, concrete or horizontal bracing.	Metal deck diaphragm in the 1974 portion of the building.
<b>CONNECTIONS</b>				
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.6.1.3 PRECAST PANEL CONNECTIONS: There shall be at least two anchors from each precast wall panel into the diaphragm elements for Life Safety and the anchors shall be able to develop the strength of the panels for Immediate Occupancy.	8'-0" panels, with studs typically @ 1'-6" o.c. Thus, at least two studs per panel.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.6.3.10 UPLIFT AT PILE CAPS: Pile caps shall have top reinforcement and piles shall be anchored to the pile caps for Life Safety, and the pile cap reinforcement and pile anchorage shall be able to develop the tensile capacity of the piles for Immediate Occupancy.	No piles.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.6.4.2 GIRDERS: Girders supported by walls or pilasters shall have at least two ties securing the anchor bolts for Life Safety and Immediate Occupancy.	

\* – Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.



Building Name: **Building 805**

Building Address: **Lawrence Livermore National Laboratory**

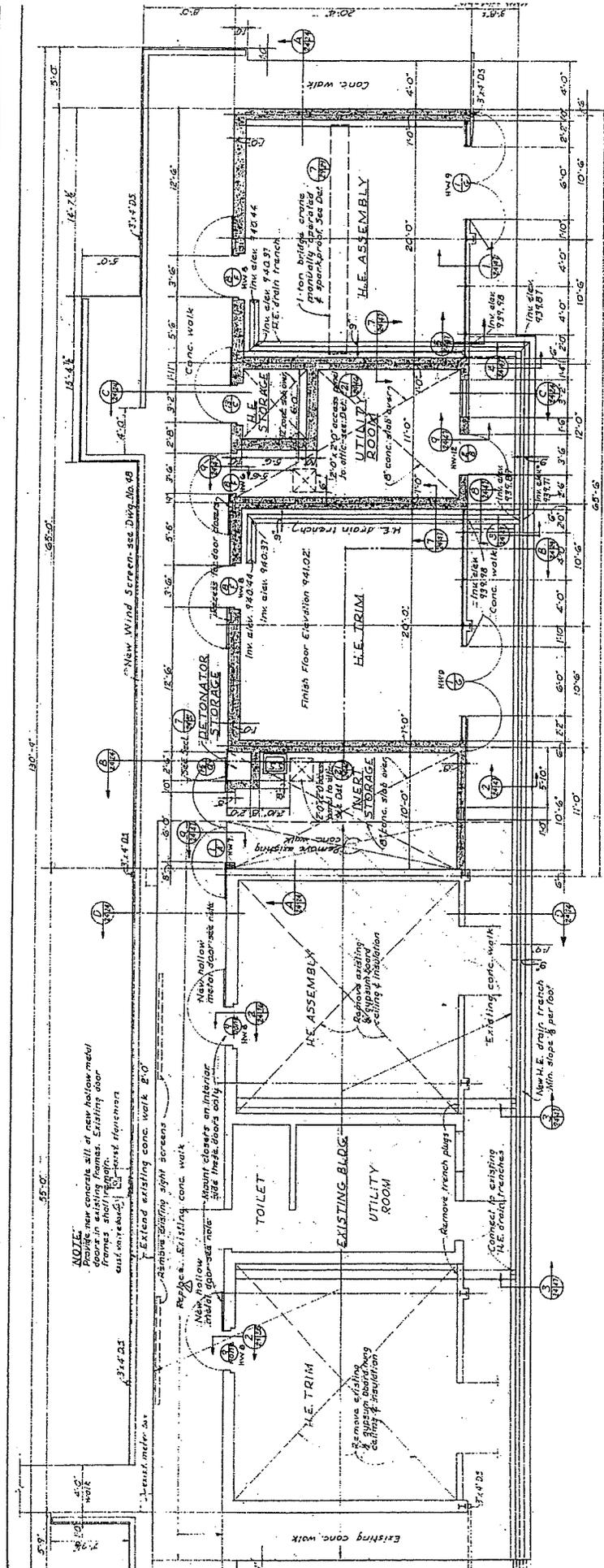
Job Number: **A20047.08** Job Name: **LLNL Prioritization**

Date: **July 29, 2003**

Page: **1** of **5**

By: **LKF** Checked: **DBH**

# BUILDING PLAN



FLOOR PLAN  
Scale: 1/8" = 1'-0"

NOTES:  
 1) For Door Elevations, see Chg. No. 78. Symbols/Door from  
 2) For Head wall/tilt default, see Chg. No. 40.

1956 and 1958 Building Segments



Building Name: Building 805

Building Address: Lawrence Livermore National Laboratory

Job Number: A20047.08

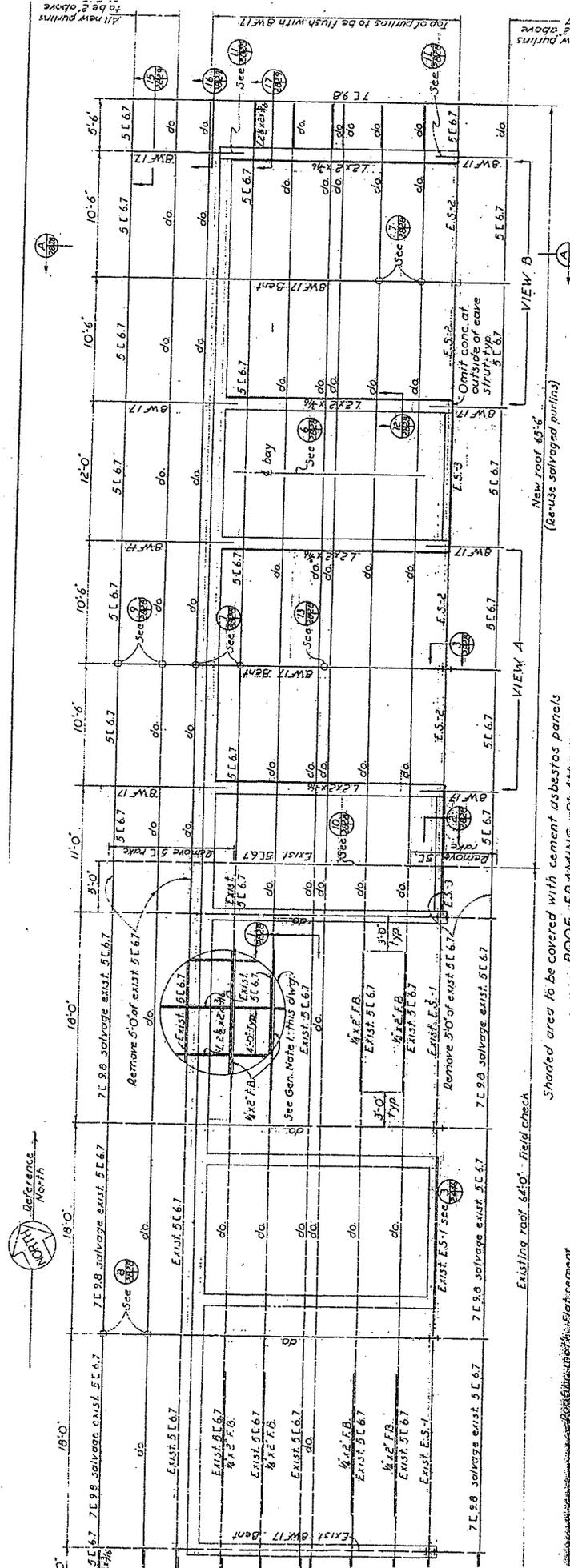
Job Name: LLNL Prioritization

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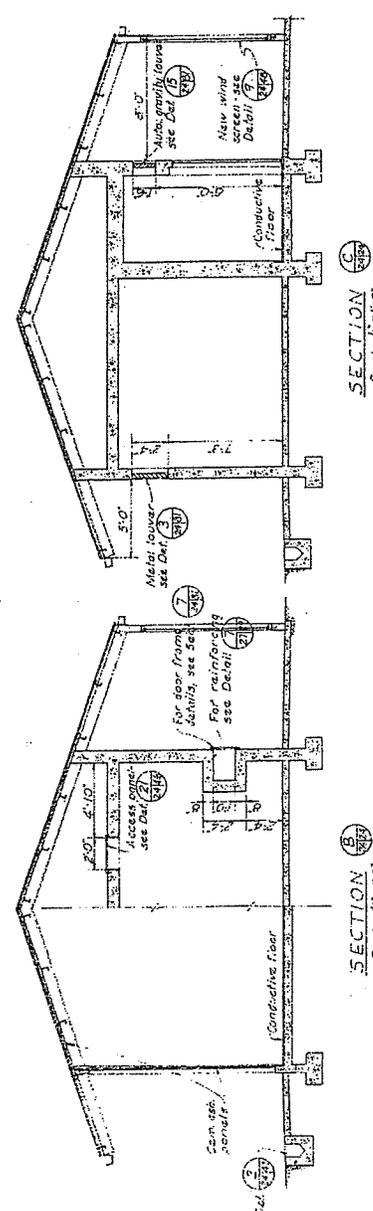
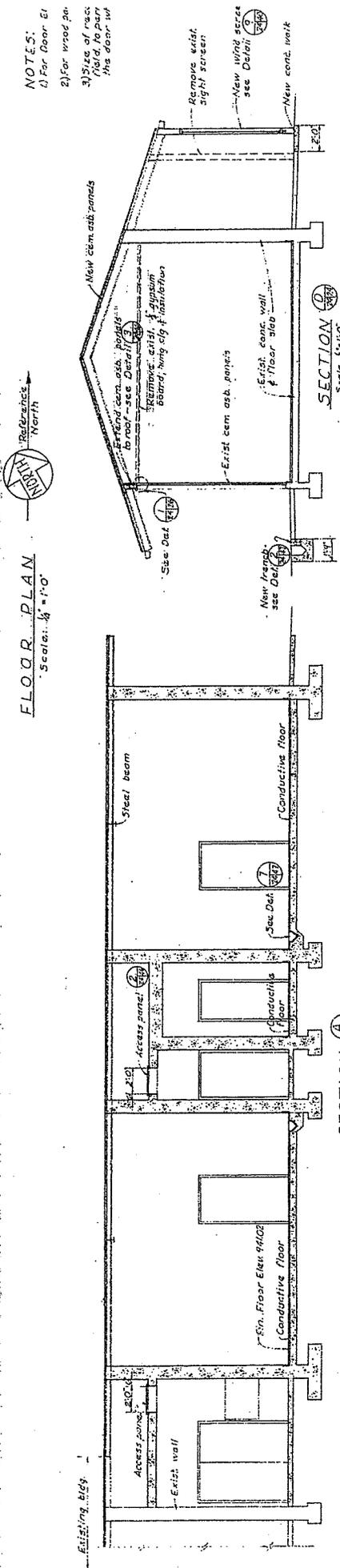
By: LKF Checked:

# BUILDING PLAN



1956 and 1958 Building Segments

**BUILDING PLAN**

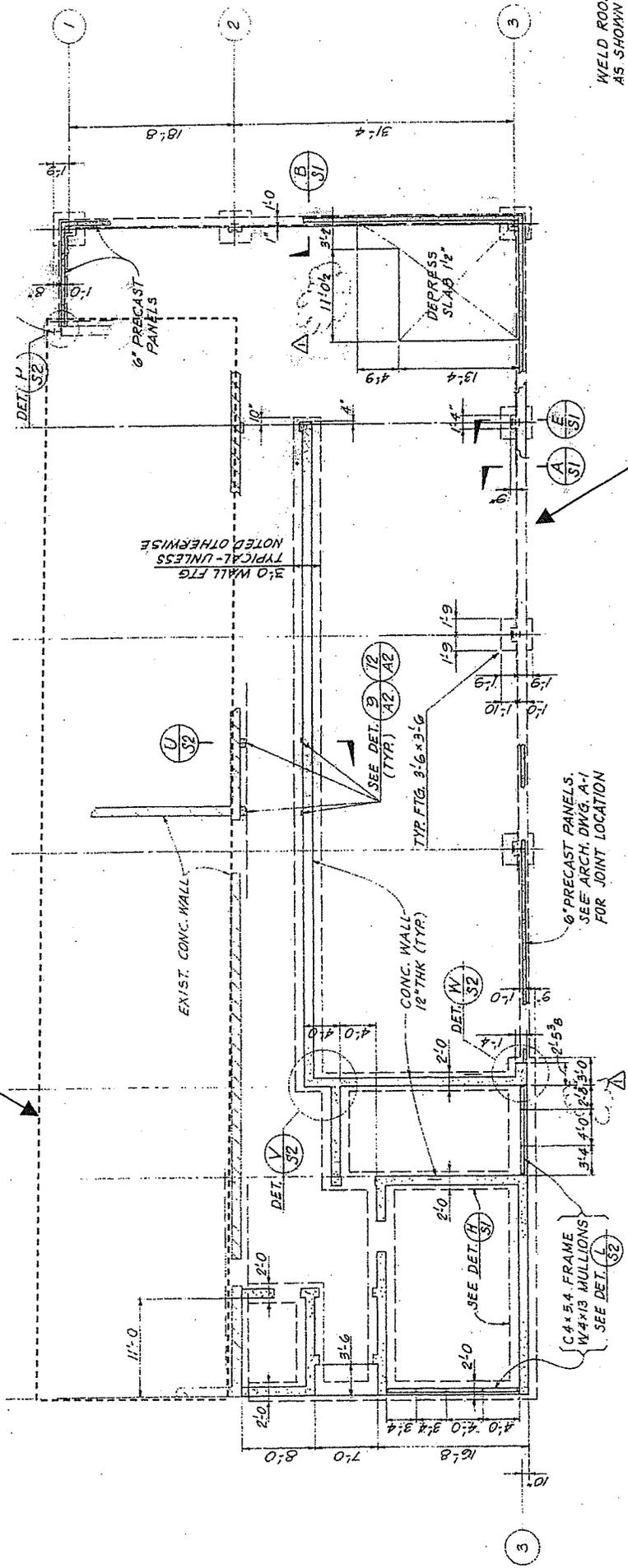


**1958 Building Segment- Sections**

**BUILDING PLAN**

1956 and 1958 Building Segments

1974 Addition



FLOOR & FOUNDATION PLAN

NOTE:

WELD ROOF AS SHOWN



Building Name: **Building 806**

 Date: **July 28, 2003**

 Building Address: **Lawrence Livermore National Laboratory**

 Page: **1** of **1**

 Job Number: **A20047.08** Job Name: **LLNL Prioritization**

 By: **LKF** Checked:

## PRIORITIZATION BUILDING DATA SHEET

### BUILDING DATA

Year Built:	1956	Year(s) Remodeled:	None known	UBC Zone:	4 – Type B Near Field
Area (sf):	2800	Length (ft):	106'	Width (ft):	26'
No. Stories:	1	Story Height:	~17'	Total Height:	~17' max

### CONSTRUCTION DATA

Gravity Load Structural System: Steel channel purlins spanning to steel WF roof beams, spanning to concrete bearing walls and steel columns, with strip and spread footings.

Exterior Transverse Walls: Reinforced concrete  
 Exterior Longitudinal Walls: Reinforced concrete  
 Roof Framing: Steel beams: WF and channels  
 Intermediate Floor Framing: N/A  
 Ground Floor: 4" S.O.G. with 4 x 4 - 10/10 wire mesh  
 Columns: Steel WF  
 Foundation: Strip footings under walls, spread footings under columns

Openings?: Doors on south face  
 Openings?: Doors and windows

### LATERAL-FORCE-RESISTING SYSTEM

	Longitudinal	Transverse
System Classification:	C2A: Concrete Shear Wall Building with Flexible Diaphragm	C2A: Concrete Shear Wall Building with Flexible Diaphragm
Vertical Elements:	Reinforced concrete shear walls	Reinforced concrete shear walls
Diaphragms:	Corrugated asbestos cement roofing over steel framing	Corrugated asbestos cement roofing over steel framing

SEISMIC EVALUATION PERFORMED? Yes EVALUATION: Rapid Evaluation YEAR: 2003

SEISMIC EVALUATION CRITERIA: Life Safety/ ASCE 31-02

VULNERABILITY RATING: 6  
 (1=low to 10=high)

PRIORITIZATION CLASSIFICATION: CLASS C

### POTENTIAL LIFE SAFETY DEFICIENCIES:

THIS BUILDING WAS EVALUATED FOR THE 10% IN 50 YR. EARTHQUAKE.

#### REDUNDANCY

*There is only one shear wall in the longitudinal direction.*

#### WALL ANCHORAGE/TRANSFER TO SHEAR WALLS/ OTHER DIAPHRAGMS/ OPENINGS AT SHEAR WALLS

*Along the longitudinal wall, the beams are embedded in the wall and attached with anchor bolts. This connection is expected to be sufficient. However, there is only corrugated asbestos cement roofing over steel framing; this may not act as a diaphragm. In addition, along the transverse walls, the connection of diaphragm to transverse walls for out-of-plane forces is not shown on drawings and could not be confirmed at site visit.*

### PRELIMINARY STRENGTHENING SCHEMES OR MITIGATION MEASURES:

#### REDUNDANCY

*Further evaluation is required to determine if the columns that form the other longitudinal frames can resist the lateral forces at the diaphragm level on the northwest side.*

#### WALL ANCHORAGE/ TRANSFER TO SHEAR WALLS/ OTHER DIAPHRAGMS/ OPENINGS AT SHEAR WALLS

*Replace existing roof with rod bracing or bare metal deck.*

Building Name: Building 806

 Date: July 29, 2003

 Building Address: Lawrence Livermore National Laboratory

 Page: 1 of 2

 Job Number: A20047.08

 Job Name: LLNL Prioritization

 By: LKF Checked: \_\_\_\_\_

## ASCE 31\* BASIC CHECKLIST C2A: CONCRETE SHEAR WALL BUILDINGS WITH FLEXIBLE DIAPHRAGMS

C	NC	N/A		Comments
<b>BUILDING SYSTEM</b>				
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.1.1 LOAD PATH: The structure shall contain a minimum of one complete load path for Life Safety and Immediate Occupancy for seismic force effects from any horizontal direction that serves to transfer the inertial forces from the mass to the foundation.	The load path exists but may not have sufficient strength. Refer to other deficient statements for explanation.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.1.2 ADJACENT BUILDINGS: The clear distance between the building being evaluated and any adjacent building shall be greater than 4% of the height of the shorter building for Life Safety and Immediate Occupancy.	No immediately adjacent buildings.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.1.3 MEZZANINES: Interior mezzanine levels shall be braced independently from the main structure, or shall be anchored to the lateral-force-resisting elements of the main structure.	No interior mezzanines.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.1 WEAK STORY: The strength of the lateral-force-resisting system in any story shall not be less than 80% of the strength in an adjacent story above or below for Life-Safety and Immediate Occupancy.	One story building.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.2 SOFT STORY: The stiffness of the lateral-force-resisting-system in any story shall not be less than 70% of the lateral-force-resisting system stiffness in an adjacent story above or below, or less than 80% of the average lateral-force-resisting system stiffness of the three stories above or below for Life Safety and Immediate Occupancy.	One story building.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.3 GEOMETRY: There shall be no changes in horizontal dimension of the lateral-force-resisting system of more than 30% in a story relative to adjacent stories for Life Safety and Immediate Occupancy, excluding one-story penthouses and mezzanines.	One story building.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.2.4 VERTICAL DISCONTINUITIES: All vertical elements in the lateral-force-resisting system shall be continuous to the foundation.	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.5 MASS: There shall be no change in effective mass of more than 50% from one story to the next for Life Safety and Immediate Occupancy. Light roofs, penthouses and mezzanines need not be considered.	One story building.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.3.1 DETERIORATION OF WOOD: There shall be no signs of decay, shrinkage, splitting, fire damage, or sagging in any of the wood members and none of the metal connection hardware shall be deteriorated, broken, or loose.	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.3.4 DETERIORATION OF CONCRETE: There shall be no visible deterioration of concrete or reinforcing steel in any of the vertical- or lateral-force-resisting elements.	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.3.5 POST-TENSIONING ANCHORS: There shall be no evidence of corrosion or spalling in the vicinity of post-tensioning or end fittings. Coil anchors shall not have been used.	No post-tensioning anchors.

Building Name: Building 806

Date: July 29, 2003

Building Address: Lawrence Livermore National Laboratory

Page: 2 of 2

Job Number: A20047.08 Job Name: LLNL Prioritization

By: LKF Checked: \_\_\_\_\_

## ASCE 31\* BASIC CHECKLIST C2A: CONCRETE SHEAR WALL BUILDINGS WITH FLEXIBLE DIAPHRAGMS

C	NC	N/A		Comments
<b>BUILDING SYSTEM</b>				
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.3.9 CONCRETE WALL CRACKS: All existing diagonal cracks in wall elements shall be less than 1/8" for Life Safety and 1/16" for Immediate Occupancy, shall not be concentrated in one location, and shall not form an X pattern.	
<b>LATERAL-FORCE-RESISTING SYSTEM</b>				
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	4.4.2.1.1 REDUNDANCY: The number of lines of shear walls in each principal direction shall be greater than or equal to 2 for Life Safety and Immediate Occupancy.	There is only one shear wall in the longitudinal direction. Further evaluation is required to determine if the columns that form the other longitudinal frames can resist the lateral forces at the diaphragm level on the northwest side.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.4.2.2.1 SHEAR STRESS CHECK: The shear stress in the concrete shear walls, calculated using the Quick Check procedure of Section 3.5.3.3, shall be less than 100 psi or $2\sqrt{f'_c}$ for Life Safety and Immediate Occupancy.	$v_j^{avg} = 21 \text{ psi} \ll 100 \text{ psi}$
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.4.2.2.2 REINFORCING STEEL: The ratio of reinforcing steel area to gross concrete area shall be not less than 0.0015 in the vertical direction and 0.0025 in the horizontal direction for Life Safety and Immediate Occupancy. The spacing of reinforcing steel shall be equal to or less than 18" for Life Safety and Immediate Occupancy.	Max spacing is 18". Typical wall is 12", with #4@12" e.w.e.f. → 0.0027. <u>OK</u>
<b>CONNECTIONS</b>				
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	4.6.1.1 WALL ANCHORAGE: Exterior concrete or masonry walls, that are dependent on the diaphragm for lateral support, shall be anchored for out-of-plane forces at each diaphragm level with steel anchors, reinforcing dowels, or straps that are developed into the diaphragm. Connections shall have adequate strength to resist the connection force calculated in the Quick Check Procedure of Section 3.5.3.7.	Along the longitudinal wall, the beams are embedded in the wall and attached with anchor bolts. This connection is expected to be sufficient. Along the end walls, the connection of diaphragm to transverse end walls for out-of-plane forces is not shown and could not be confirmed at the site visit. (The asbestos cannot be assumed to be a sufficient diaphragm, either.)
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	4.6.2.1 TRANSFER TO SHEAR WALLS: Diaphragms shall be connected for transfer of loads to the shear walls for Life Safety and the connections shall be able to develop the lesser of the shear strength of the walls or diaphragms for Immediate Occupancy.	The asbestos cement roof cannot be assumed to be sufficient as a diaphragm. Even if it were, we are unable to verify connection of corrugated asbestos cement roofing to concrete walls.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.6.3.5 FOUNDATION DOWELS: Wall reinforcement shall be doweled into the foundation for Life Safety and the dowels shall be able to develop the lesser of the strength of the walls or the uplift capacity of the foundation for Immediate Occupancy.	Walls are doweled to strip footings.

\* - Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.

Building Name: Building 806

Date: July 29, 2003

Building Address: Lawrence Livermore National Laboratory

Page: 1 of 2

Job Number: A20047.08 Job Name: LLNL Prioritization

By: LKF Checked: \_\_\_\_\_

## ASCE 31\* SUPPLEMENTAL CHECKLIST C2A: CONCRETE SHEAR WALL BUILDINGS WITH FLEXIBLE DIAPHRAGMS

C	NC	N/A		Comments
<b>LATERAL-FORCE-RESISTING SYSTEM</b>				
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.4.2.2.3 COUPLING BEAMS: The stirrups in coupling beams over means of egress shall be spaced at or less than $d/2$ and shall be anchored into the confined core of the beam with hooks of 135° or more for Life Safety. All coupling beams shall comply with the requirements above and shall have the capacity in shear to develop the uplift capacity of the adjacent wall for Immediate Occupancy.	No coupling beams.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.4.2.2.4 OVERTURNING: All shear walls shall have aspect ratios less than 4 to 1. Wall piers need not be considered. This statement shall apply to the Immediate Occupancy Performance Level only.	Statement applies to Immediate Occupancy Performance Level only.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.4.2.2.5 CONFINEMENT REINFORCING: For shear walls with aspect ratios greater than 2 to 1, the boundary elements shall be confined with spirals or ties with spacing less than $8d_b$ . This statement shall apply to the Immediate Occupancy Performance Level only.	Statement applies to Immediate Occupancy Performance Level only.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.4.2.2.6 REINFORCING AT OPENINGS: There shall be added trim reinforcement around all wall openings greater than three times the thickness of the wall. This statement shall apply to the Immediate Occupancy Performance Level only.	Statement applies to Immediate Occupancy Performance Level only.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.4.2.2.7 WALL THICKNESS: Thickness of bearing walls shall not be less than 1/25 the unsupported height or length, whichever is shorter, nor less than 4". This statement shall apply to the Immediate Occupancy Performance Level only.	Statement applies to Immediate Occupancy Performance Level only.
<b>DIAPHRAGMS</b>				
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.5.1.1 DIAPHRAGM CONTINUITY: The diaphragms shall not be composed of split-level floors and shall not have expansion joints.	Roof does not have a split level or expansion joints.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.5.1.2 CROSS TIES: There shall be continuous cross ties between diaphragm chords.	Steel WF bents (welded at roof peak) are continuous across the width of the building. Channels span between WFs.
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	4.5.1.4 OPENINGS AT SHEAR WALLS: Diaphragm openings immediately adjacent to the shear walls shall be less than 25% of the wall length for Life Safety and 15% of the wall length for Immediate Occupancy.	There is only corrugated asbestos cement roofing over steel framing; this cannot be assumed to be sufficient as a diaphragm.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.5.1.7 PLAN IRREGULARITIES: There shall be tensile capacity to develop the strength of the diaphragm at re-entrant corners or other locations of plan irregularities. This statement shall apply to the Immediate Occupancy Performance Level only.	Statement applies to Immediate Occupancy Performance Level only.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.5.1.8 DIAPHRAGM REINFORCEMENT AT OPENINGS: There shall be reinforcing around all diaphragm openings larger than 50% of the building width in either major plan dimension. This statement shall apply to the Immediate Occupancy Performance Level only.	Statement applies to Immediate Occupancy Performance Level only.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.5.2.1 STRAIGHT SHEATHING: All straight sheathed diaphragms shall have aspect ratios less than 2 to 1 for Life Safety and 1 to 1 for Immediate Occupancy in the direction being considered.	No straight sheathing.



Building Name: Building 806

Date: July 29, 2003

Building Address: Lawrence Livermore National Laboratory

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Job Number: A20047.08

Job Name: LLNL Prioritization

By: LKF Checked: \_\_\_\_\_

## ASCE 31\* SUPPLEMENTAL CHECKLIST C2A: CONCRETE SHEAR WALL BUILDINGS WITH FLEXIBLE DIAPHRAGMS

**C NC N/A**

**Comments**

### DIAPHRAGMS

- |                          |                                     |                                     |         |  |   |
|--------------------------|-------------------------------------|-------------------------------------|---------|--|---|
| <input type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | 4.5.2.2 | SPANS: All wood diaphragms with spans greater than 24 ft for Life Safety and 12 ft for Immediate Occupancy shall consist of wood structural panels or diagonal sheathing.  | No wood diaphragms.   |
| <input type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | 4.5.2.3 | UNBLOCKED DIAPHRAGMS: All diagonally sheathed and unblocked wood structural panel diaphragms shall have horizontal spans less than 40 ft for Life Safety and 30 ft for Immediate Occupancy and shall have aspect ratios less than or equal to 4 to 1 for Life Safety and 3 to 1 for Immediate Occupancy. | No wood diaphragms.   |
| <input type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | 4.5.3.1 | NON-CONCRETE FILLED DIAPHRAGMS: Untopped metal deck diaphragms or metal deck diaphragms with fill other than concrete shall consist of horizontal spans of less than 40 ft and shall have aspect ratios less than 4 to 1. This statement shall apply to the Immediate Occupancy Performance Level only.  | Statement applies to Immediate Occupancy Performance Level only.              |
| <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | 4.5.7.1 | OTHER DIAPHRAGMS: The diaphragm shall not consist of a system other than wood, metal deck, concrete or horizontal bracing.   | Roof system consists of corrugated cemen asbestos roofing over steel framing. |

### CONNECTIONS

- |                          |                          |                                     |          |   |  |
|--------------------------|--------------------------|-------------------------------------|----------|---|--|
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.6.3.10 | UPLIFT AT PILE CAPS: Pile caps shall have top reinforcement and piles shall be anchored to the pile caps for Life Safety, and the pile cap reinforcement and pile anchorage shall be able to develop the tensile capacity of the piles for Immediate Occupancy. | Statement applies to Immediate Occupancy Performance Level only. |
|--------------------------|--------------------------|-------------------------------------|----------|---|--|

\* – Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.

Building Name: **Building 806**

Date: **July 28, 2003**

Building Address: **Lawrence Livermore National Laboratory**

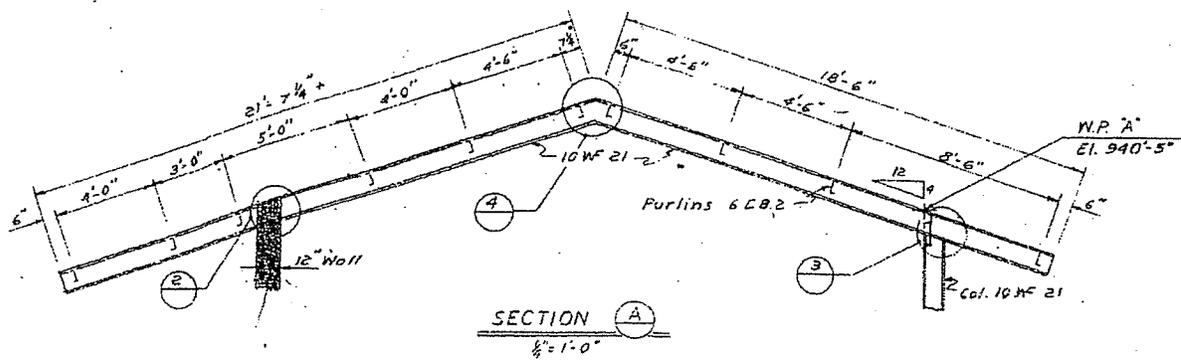
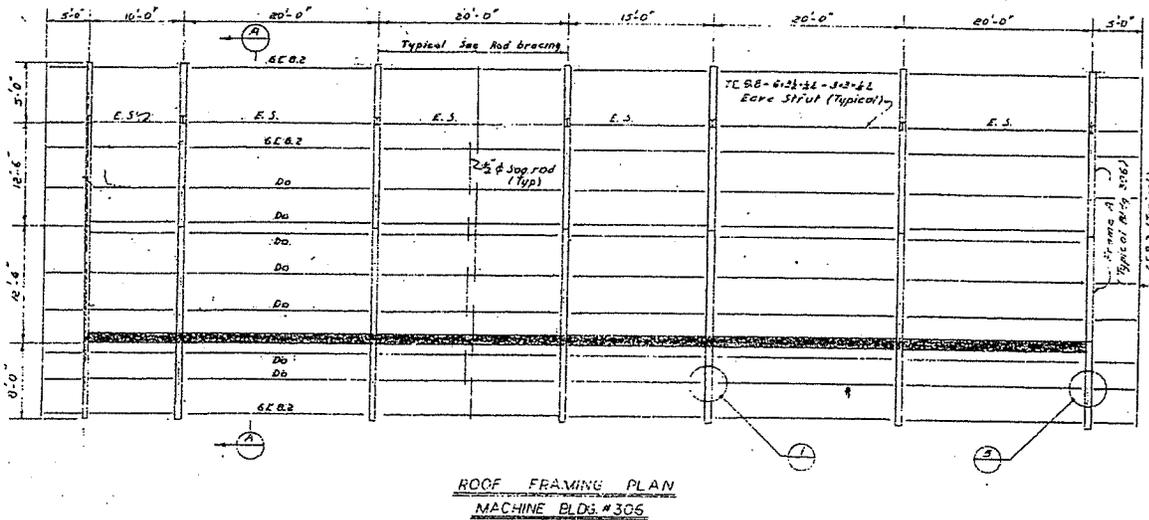
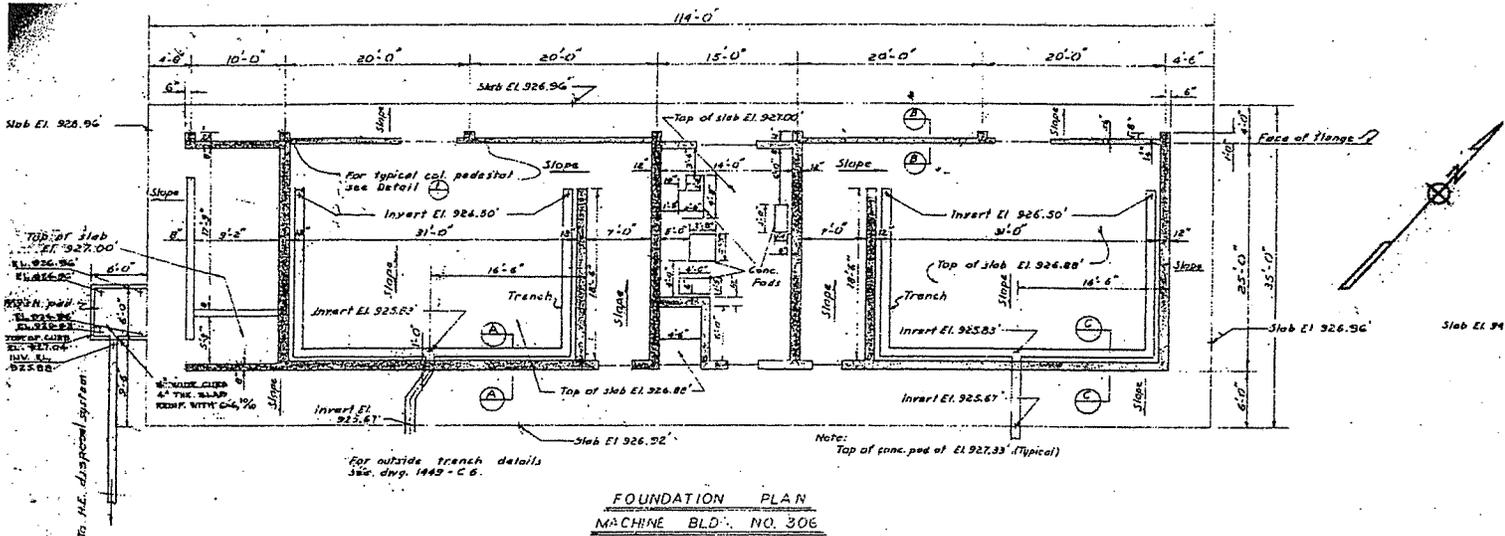
Page: **1** of **1**

Job Number: **A20047.08**

Job Name: **LLNL Prioritization**

By: **LKF** Checked: **DBH**

# BUILDING PLAN





Building Name: Building 807

Date: July 29, 2003

Building Address: Lawrence Livermore National Laboratory

Page: 1 of 1

Job Number: A20047.08

Job Name: LLNL Prioritization

By: JYF Checked: JEH

### PRIORITIZATION BUILDING DATA SHEET

#### BUILDING DATA

Year Built:	1960	Year(s) Remodeled:	1999	UBC Zone:	4 – Type B Near Field
Area (sf):	2,900	Length (ft):	85	Width (ft):	34
No. Stories:	1	Story Height:	13'	Total Height:	13'

#### CONSTRUCTION DATA

Gravity Load Structural System: Bare metal deck over 2" cement asbestos panel supported by L2 1/2 x 2 x 3/16 angles and 8C11.5. The steel members span to exterior and interior concrete shear walls.

Exterior Transverse Walls: 8" to 12" thick reinforced concrete shear walls      Openings?: Door and window openings  
 Exterior Longitudinal Walls: 8" to 12" thick reinforced concrete shear walls      Openings?: Door and window openings  
 Roof Framing: KLIP-Rib 24 gage metal roof deck over 2" cement asbestos panel supported by L2 1/2 x 2 x 3/16 angles and 8C11.5. The metal deck was added in 1999 (ref: Drawings by Dick Ling, 1999). Per LLNL personnel, John Scott, the retrofit construction has not been completed.

Intermediate Floor Framing: None

Ground Floor: 6" concrete slab on grade w/ #3 @ 18" o.c. E.W.

Columns: None

Foundation: Concrete strip footing

#### LATERAL-FORCE-RESISTING SYSTEM

	Longitudinal	Transverse
System Classification:	Type 9 (Concrete Shear Wall Building w/ Flexible Diaphragm)	Type 9 (Concrete Shear Wall Building w/ Flexible Diaphragm)
Vertical Elements:	L2 1/2 x 2 x 3/16 angles and 8C11., concrete shear walls	L2 1/2 x 2 x 3/16 angles and 8C11., concrete shear walls
Diaphragms:	Bare metal deck	Bare metal deck

SEISMIC EVALUATION PERFORMED? Yes EVALUATION: Rapid Evaluation YEAR: 2003

SEISMIC EVALUATION CRITERIA: Life Safety/ ASCE 31-02

VULNERABILITY RATING: 5  
(1=low to 10=high)

PRIORITIZATION CLASSIFICATION: CLASS C

#### POTENTIAL LIFE SAFETY DEFICIENCIES:

THIS BUILDING WAS EVALUATED FOR THE 10% IN 50 YR. EARTHQUAKE.

OTHER DIAPHRAGMS  
*Asbestos cement roof diaphragm.*  
 WALL ANCHORAGE  
*D/C = 1.31.*

#### PRELIMINARY STRENGTHENING SCHEMES OR MITIGATION MEASURES:

Add out of plane wall anchorage.  
 Add diagonal rod bracing or metal deck at the diaphragm.

Building Name: **Building 807**

Date: **July 29, 2003**

Building Address: **Lawrence Livermore National Laboratory**

Page: **1** of **3**

Job Number: **A20047.08**

Job Name: **LLNL Prioritization**

By: **JYF** Checked: **JEH**

## ASCE 31\* BASIC CHECKLIST C2A: CONCRETE SHEAR WALL BUILDINGS WITH FLEXIBLE DIAPHRAGMS

C	NC	N/A		Comments
<b>BUILDING SYSTEM</b>				
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.1.1 LOAD PATH: The structure shall contain a minimum of one complete load path for Life Safety and Immediate Occupancy for seismic force effects from any horizontal direction that serves to transfer the inertial forces from the mass to the foundation.	Load is transferred from the asbestos cement deck to the exterior and interior concrete shear walls. The concrete shear walls are doweled into the foundation system.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.1.2 ADJACENT BUILDINGS: The clear distance between the building being evaluated and any adjacent building shall be greater than 4% of the height of the shorter building for Life Safety and Immediate Occupancy.	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.1.3 MEZZANINES: Interior mezzanine levels shall be braced independently from the main structure, or shall be anchored to the lateral-force-resisting elements of the main structure.	The lower level consists of a concrete flat slab doweled into the main building's concrete shear walls on all four sides.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.1 WEAK STORY: The strength of the lateral-force-resisting system in any story shall not be less than 80% of the strength in an adjacent story above or below for Life-Safety and Immediate Occupancy.	One story building.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.2 SOFT STORY: The stiffness of the lateral-force-resisting-system in any story shall not be less than 70% of the lateral-force-resisting system stiffness in an adjacent story above or below, or less than 80% of the average lateral-force-resisting system stiffness of the three stories above or below for Life Safety and Immediate Occupancy.	One story building.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.3 GEOMETRY: There shall be no changes in horizontal dimension of the lateral-force-resisting system of more than 30% in a story relative to adjacent stories for Life Safety and Immediate Occupancy, excluding one-story penthouses and mezzanines.	One story building.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.2.4 VERTICAL DISCONTINUITIES: All vertical elements in the lateral-force-resisting system shall be continuous to the foundation.	The concrete shear walls are doweled into the foundation system.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.5 MASS: There shall be no change in effective mass of more than 50% from one story to the next for Life Safety and Immediate Occupancy. Light roofs, penthouses and mezzanines need not be considered.	One story building.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.3.1 DETERIORATION OF WOOD: There shall be no signs of decay, shrinkage, splitting, fire damage, or sagging in any of the wood members and none of the metal connection hardware shall be deteriorated, broken, or loose.	Site visit made on 8/11/03. No signs of deterioration were observed.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.3.4 DETERIORATION OF CONCRETE: There shall be no visible deterioration of concrete or reinforcing steel in any of the vertical- or lateral-force-resisting elements.	Site visit made on 8/11/03. No signs of deterioration were observed.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.3.5 POST-TENSIONING ANCHORS: There shall be no evidence of corrosion or spalling in the vicinity of post-tensioning or end fittings. Coil anchors shall not have been used.	

Building Name: Building 807

Date: July 29, 2003

Building Address: Lawrence Livermore National Laboratory

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Job Number: A20047.08

Job Name: LLNL Prioritization

By: JYF Checked: JEH

## ASCE 31\* BASIC CHECKLIST C2A: CONCRETE SHEAR WALL BUILDINGS WITH FLEXIBLE DIAPHRAGMS

**C NC N/A**

**Comments**

### BUILDING SYSTEM

- |                                     |                          |                          |   |  |
|-------------------------------------|--------------------------|--------------------------|---|--|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <p>4.3.3.9 CONCRETE WALL CRACKS: All existing diagonal cracks in wall elements shall be less than 1/8" for Life Safety and 1/16" for Immediate Occupancy, shall not be concentrated in one location, and shall not form an X pattern.</p> | <p>Site visit made on 8/11/03. There are no cracks &gt;1/8".</p> |
|-------------------------------------|--------------------------|--------------------------|---|--|

### LATERAL-FORCE-RESISTING SYSTEM

- |                                     |                          |                          |   |   |
|-------------------------------------|--------------------------|--------------------------|---|---|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <p>4.4.2.1.1 REDUNDANCY: The number of lines of shear walls in each principal direction shall be greater than or equal to 2 for Life Safety and Immediate Occupancy.</p>  | <p>There are at least 2 lines of shear walls in each direction of loading.</p>  |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <p>4.4.2.2.1 SHEAR STRESS CHECK: The shear stress in the concrete shear walls, calculated using the Quick Check procedure of Section 3.5.3.3, shall be less than 100 psi or <math>2\sqrt{f'_c}</math> for Life Safety and Immediate Occupancy.</p>  | <p>Maximum average shear stress is 14 psi &lt; 100 psi. Note: <math>2\sqrt{f'_c} = 122</math> psi for <math>f'_c = 3,750</math> psi.</p>  |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <p>4.4.2.2.2 REINFORCING STEEL: The ratio of reinforcing steel area to gross concrete area shall be not less than 0.0015 in the vertical direction and 0.0025 in the horizontal direction for Life Safety and Immediate Occupancy. The spacing of reinforcing steel shall be equal to or less than 18" for Life Safety and Immediate Occupancy.</p> | <p>Typ. reinforcement in reinforced concrete walls:<br/>           12" wall: Reinforcing = 2#4@12" o.c.: reinforcing ratio = 0.0028 &gt; 0.0025<br/>           8" wall:<br/>           Vertical Reinforcing = 2#4@24" o.c. reinforcing ratio = 0.0021 &gt; 0.0015<br/>           Horizontal Reinforcing = 2#4@18" o.c. reinforcing ratio = 0.0028 &gt; 0.0025.</p> <p>Spacing of rebar at 24" o.c. &gt; 18". However, the stresses are very low. The 24" spacing of the rebar is not a concern.</p> |

### CONNECTIONS

- |                                     |                                     |                          |  |  |
|-------------------------------------|-------------------------------------|--------------------------|--|--|
| <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <p>4.6.1.1 WALL ANCHORAGE: Exterior concrete or masonry walls, that are dependent on the diaphragm for lateral support, shall be anchored for out-of-plane forces at each diaphragm level with steel anchors, reinforcing dowels, or straps that are developed into the diaphragm. Connections shall have adequate strength to resist the connection force calculated in the Quick Check Procedure of Section 3.5.3.7.</p> | <p>Out of plane anchorage: (2) 5/8" diameter x 8" M.B. @ 8' o.c. at the NS walls. Channels run through government anchors at the EW walls.</p> <p>D/C = 1.31 for NS walls.</p> |
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/> | <p>4.6.2.1 TRANSFER TO SHEAR WALLS: Diaphragms shall be connected for transfer of loads to the shear walls for Life Safety and the connections shall be able to develop the lesser of the shear strength of the walls or diaphragms for Immediate Occupancy.</p>   | <p>The metal deck is screwed to Z-clips, which are screwed to the steel framing. The steel framing is bolted to the concrete shear walls.</p>                                  |

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Job Name: **LLNL Prioritization**

By: **JYF** Checked: **JEH**

## ASCE 31\* BASIC CHECKLIST C2A: CONCRETE SHEAR WALL BUILDINGS WITH FLEXIBLE DIAPHRAGMS

**C NC N/A**

**Comments**

### CONNECTIONS

- |   |  |   |
|---|--|---|
| <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> | <p><b>4.6.3.5</b> FOUNDATION DOWELS: Wall reinforcement shall be doweled into the foundation for Life Safety and the dowels shall be able to develop the lesser of the strength of the walls or the uplift capacity of the foundation for Immediate Occupancy.</p> | <p><b>Vertical rebar in the shear walls is doweled into the foundation.</b></p> |
|---|--|---|

\* – Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.

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Job Number: **A20047.08**

Job Name: **LLNL Prioritization**

By: **JYF** Checked: **JEH**

## ASCE 31\* SUPPLEMENTAL CHECKLIST C2A: CONCRETE SHEAR WALL BUILDINGS WITH FLEXIBLE DIAPHRAGMS

**C NC N/A**

**Comments**

### LATERAL-FORCE-RESISTING SYSTEM

- |                          |                          |                                     |   |                                |
|--------------------------|--------------------------|-------------------------------------|---|--------------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.2.2.3 COUPLING BEAMS: The stirrups in coupling beams over means of egress shall be spaced at or less than $d/2$ and shall be anchored into the confined core of the beam with hooks of $135^\circ$ or more for Life Safety. All coupling beams shall comply with the requirements above and shall have the capacity in shear to develop the uplift capacity of the adjacent wall for Immediate Occupancy. |                                |
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.2.2.4 OVERTURNING: All shear walls shall have aspect ratios less than 4 to 1. Wall piers need not be considered. This statement shall apply to the Immediate Occupancy Performance Level only.  | Life Safety Performance Level. |
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.2.2.5 CONFINEMENT REINFORCING: For shear walls with aspect ratios greater than 2 to 1, the boundary elements shall be confined with spirals or ties with spacing less than $8d_b$ . This statement shall apply to the Immediate Occupancy Performance Level only.   | Life Safety Performance Level. |
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.2.2.6 REINFORCING AT OPENINGS: There shall be added trim reinforcement around all wall openings greater than three times the thickness of the wall. This statement shall apply to the Immediate Occupancy Performance Level only.   | Life Safety Performance Level. |
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.2.2.7 WALL THICKNESS: Thickness of bearing walls shall not be less than $1/25$ the unsupported height or length, whichever is shorter, nor less than 4". This statement shall apply to the Immediate Occupancy Performance Level only.  | Life Safety Performance Level. |

### DIAPHRAGMS

- |                                     |                          |                                     |   |  |
|-------------------------------------|--------------------------|-------------------------------------|---|--|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.5.1.1 DIAPHRAGM CONTINUITY: The diaphragms shall not be composed of split-level floors and shall not have expansion joints.   |  |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.5.1.2 CROSS TIES: There shall be continuous cross ties between diaphragm chords.  | L2 1/2 x 2 x 3/16 angles and 8C11.5 serve as cross ties. |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.5.1.4 OPENINGS AT SHEAR WALLS: Diaphragm openings immediately adjacent to the shear walls shall be less than 25% of the wall length for Life Safety and 15% of the wall length for Immediate Occupancy.   |  |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.5.1.7 PLAN IRREGULARITIES: There shall be tensile capacity to develop the strength of the diaphragm at re-entrant corners or other locations of plan irregularities. This statement shall apply to the Immediate Occupancy Performance Level only.      | Life Safety Performance Level.                           |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.5.1.8 DIAPHRAGM REINFORCEMENT AT OPENINGS: There shall be reinforcing around all diaphragm openings larger than 50% of the building width in either major plan dimension. This statement shall apply to the Immediate Occupancy Performance Level only. | Life Safety Performance Level.                           |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.5.2.1 STRAIGHT SHEATHING: All straight sheathed diaphragms shall have aspect ratios less than 2 to 1 for Life Safety and 1 to 1 for Immediate Occupancy in the direction being considered.  |  |

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By: JYF Checked: JEH

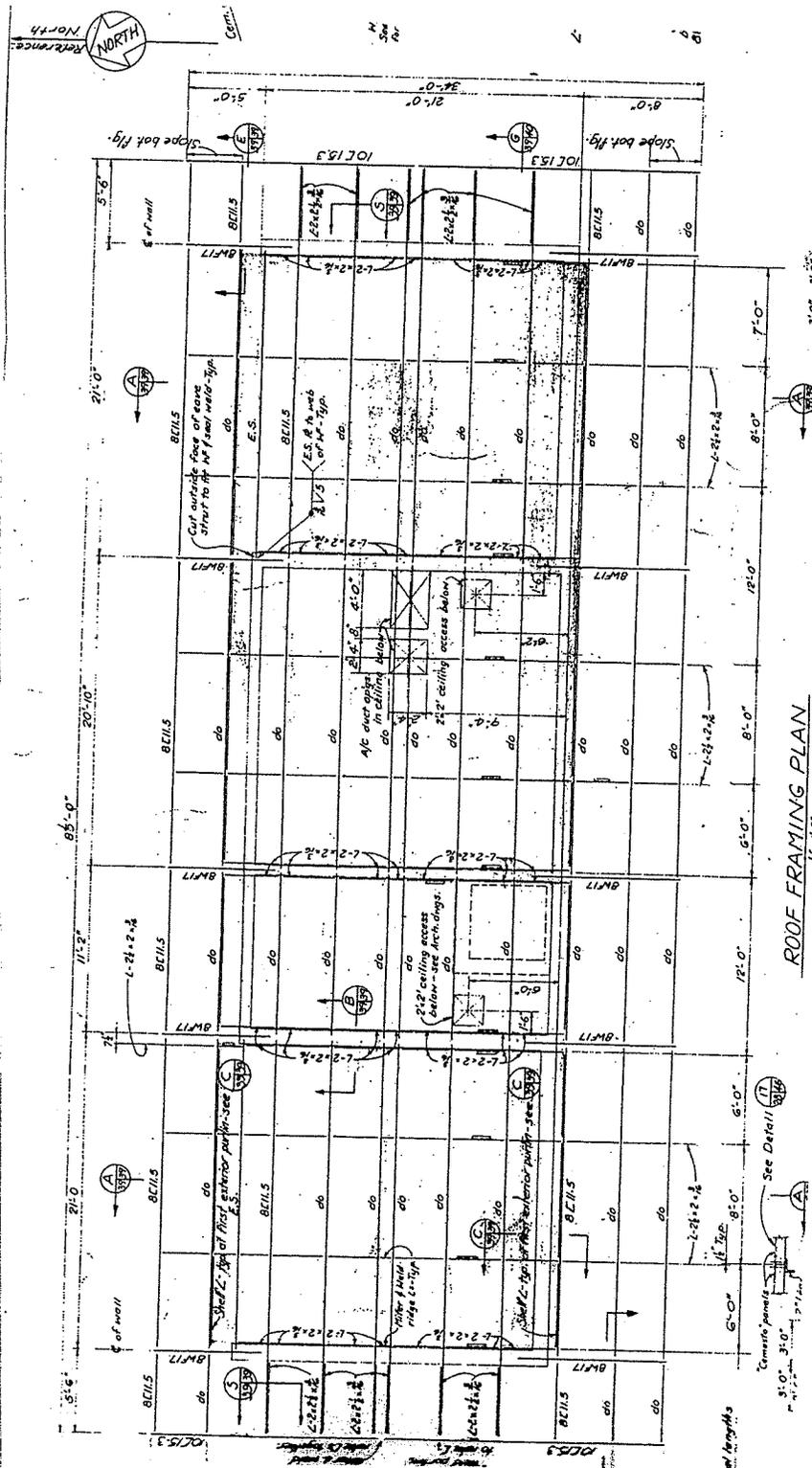
## ASCE 31\* SUPPLEMENTAL CHECKLIST C2A: CONCRETE SHEAR WALL BUILDINGS WITH FLEXIBLE DIAPHRAGMS

C	NC	N/A		Comments
<b>DIAPHRAGMS</b>				
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.5.2.2 SPANS: All wood diaphragms with spans greater than 24 ft for Life Safety and 12 ft for Immediate Occupancy shall consist of wood structural panels or diagonal sheathing.	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.5.2.3 UNBLOCKED DIAPHRAGMS: All diagonally sheathed and unblocked wood structural panel diaphragms shall have horizontal spans less than 40 ft for Life Safety and 30 ft for Immediate Occupancy and shall have aspect ratios less than or equal to 4 to 1 for Life Safety and 3 to 1 for Immediate Occupancy.	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.5.3.1 NON-CONCRETE FILLED DIAPHRAGMS: Untopped metal deck diaphragms or metal deck diaphragms with fill other than concrete shall consist of horizontal spans of less than 40 ft and shall have aspect ratios less than 4 to 1. This statement shall apply to the Immediate Occupancy Performance Level only.	Life Safety Performance Level.
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	4.5.7.1 OTHER DIAPHRAGMS: The diaphragm shall not consist of a system other than wood, metal deck, concrete or horizontal bracing.	Retrofit drawings show KLIP-Rib 24 gage metal roof deck over 2" cement asbestos panels. The metal deck was added in 1999 (ref: Drawings by Dick Ling, 1999). However, per LLNL personnel, John Scott, the retrofit construction has not been completed. On the 8/11/03 site visit, part of the exterior eave at the canopy has been blown off due to high winds.
<b>CONNECTIONS</b>				
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.6.3.10 UPLIFT AT PILE CAPS: Pile caps shall have top reinforcement and piles shall be anchored to the pile caps for Life Safety, and the pile cap reinforcement and pile anchorage shall be able to develop the tensile capacity of the piles for Immediate Occupancy.	

\* - Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.



**ROOF PLAN**



ROOF FRAMING PLAN  
8-140

**Building 809**

Building 809 is a one-story reinforced concrete bearing wall building. The structure consists of a reinforced concrete roof deck in one area, and 2" insulated cement asbestos roof deck over steel roof framing in the other area, and reinforced concrete walls support both roofs. Deficiencies noted for Building 809 include potential falling hazard from concrete shielding blocks (which present a falling hazard). For the building to meet life-safety requirements, we recommend that the blocks be removed or braced.

Building Name: **Building 809**

 Date: **July 24, 2003**

 Building Address: **Lawrence Livermore National Laboratory**

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 Job Number: **A20047.08** Job Name: **LLNL Prioritization**

 By: **LKF** Checked: \_\_\_\_\_

## PRIORITIZATION BUILDING DATA SHEET

### BUILDING DATA

Year Built:	1958	Year(s) Remodeled:	1997	UBC Zone:	4 – Type B Near Field
Area (sf):	2600	Length (ft):	98'-0"	Width (ft):	53'-6"
No. Stories:	1	Story Height:	9'-3" to 16'-10"	Total Height:	17'-1"

### CONSTRUCTION DATA

Gravity Load Structural System: 2" insulated cement asbestos roof deck over steel roof framing over high roof, 8" reinforced concrete slab over low roof; reinforced concrete bearing walls

Exterior Transverse Walls: Reinforced concrete      Openings?: Doors and windows

Exterior Longitudinal Walls: Reinforced concrete      Openings?: None significant. No wall at east face.

Roof Framing: Steel beams in high roof, concrete slab in low roof

Intermediate Floor Framing: N/A

Ground Floor: 5" slab, 4 x 4 - 6/6 W.W.F.

Columns: 2-L's 5x5x3/8 with 3/16" fillet welds

Foundation: Spread footings under columns; concrete retaining wall with strip footing at east and west sides; 12" slab with #5@12 @ center of bldg (at earth filled room) with 5" slab-on-grade elsewhere; strip footings for keyed shielding block walls at entryways; most walls bear directly on soil.

### LATERAL-FORCE-RESISTING SYSTEM

	Longitudinal	Transverse
System Classification:	C2: Concrete Shear Wall Building with Rigid or Stiff Diaphragm	C2: Concrete Shear Wall Building with Rigid or Stiff Diaphragm
Vertical Elements:	Reinforced concrete shear walls	Reinforced concrete shear walls
Diaphragms:	2" insulated cement asbestos roof deck over steel roof framing; 8" concrete slab	2" insulated cement asbestos roof deck over steel roof framing; 8" concrete slab

**SEISMIC EVALUATION PERFORMED?** Yes      **EVALUATION:** Rapid Evaluation      **YEAR:** 2003

**SEISMIC EVALUATION CRITERIA:** Life Safety/ ASCE 31-02

**VULNERABILITY RATING:** 5  
 (1=low to 10=high)

**PRIORITIZATION CLASSIFICATION:** CLASS C

### POTENTIAL LIFE SAFETY DEFICIENCIES:

THIS BUILDING WAS EVALUATED FOR THE 10% IN 50 YR. EARTHQUAKE.

#### NON STRUCTURAL ISSUE- FALLING HAZARD

*Portable 3' x 3' x 3' keyed concrete shielding blocks at the entrance present a potential life safety falling hazard.*

#### TRANSFER TO SHEAR WALLS/ OPENINGS AT SHEAR WALLS

*The cement asbestos panels at the high roof cannot be assumed to act as a diaphragm. However, the steel beams at high roof are closely spaced and well connected to the concrete walls with bolts that are embedded in the concrete and extend through the bottom flange of the beam. In addition, rod bracing was added to half of the building.*

### PRELIMINARY STRENGTHENING SCHEMES OR MITIGATION MEASURES:

NON STRUCTURAL ISSUE- FALLING HAZARD

*Brace or remove these blocks.*

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 By: LKF Checked: \_\_\_\_\_

## ASCE 31\* BASIC CHECKLIST C2: CONCRETE SHEAR WALL BUILDINGS WITH RIGID OR STIFF DIAPHRAGMS

C	NC	N/A		Comments
<b>BUILDING SYSTEM</b>				
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.1.1 LOAD PATH: The structure shall contain a minimum of one complete load path for Life Safety and Immediate Occupancy for seismic force effects from any horizontal direction that serves to transfer the inertial forces from the mass to the foundation.	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.1.3 MEZZANINES: Interior mezzanine levels shall be braced independently from the main structure, or shall be anchored to the lateral-force-resisting elements of the main structure.	No interior mezzanine levels.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.1 WEAK STORY: The strength of the lateral-force-resisting system in any story shall not be less than 80% of the strength in an adjacent story above or below for Life-Safety and Immediate Occupancy.	Building is only one story.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.2 SOFT STORY: The stiffness of the lateral-force-resisting-system in any story shall not be less than 70% of the lateral-force-resisting system stiffness in an adjacent story above or below, or less than 80% of the average lateral-force-resisting system stiffness of the three stories above or below for Life Safety and Immediate Occupancy.	Building is only one story.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.3 GEOMETRY: There shall be no changes in horizontal dimension of the lateral-force-resisting system of more than 30% in a story relative to adjacent stories for Life Safety and Immediate Occupancy, excluding one-story penthouses and mezzanines.	Building is only one story.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.2.4 VERTICAL DISCONTINUITIES: All vertical elements in the lateral-force-resisting system shall be continuous to the foundation.	Walls are continuous to the foundation where separate foundation elements exist.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.5 MASS: There shall be no change in effective mass of more than 50% from one story to the next for Life Safety and Immediate Occupancy. Light roofs, penthouses and mezzanines need not be considered.	Building is only one story.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.2.6 TORSION: The estimated distance between the story center of mass and the story center of rigidity shall be less than 20% of the building width in either plan dimension for Life Safety and Immediate Occupancy.	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.3.4 DETERIORATION OF CONCRETE: There shall be no visible deterioration of concrete or reinforcing steel in any of the vertical- or lateral-force-resisting elements.	Verify at site visit.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.3.5 POST-TENSIONING ANCHORS: There shall be no evidence of corrosion or spalling in the vicinity of post-tensioning or end fittings. Coil anchors shall not have been used.	No post-tensioning anchors.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.3.9 CONCRETE WALL CRACKS: All existing diagonal cracks in wall elements shall be less than 1/8" for Life Safety and 1/16" for Immediate Occupancy, shall not be concentrated in one location, and shall not form an X pattern.	

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Job Number: A20047.08

Job Name: LLNL Prioritization

By: LKF Checked: \_\_\_\_\_

## ASCE 31\* BASIC CHECKLIST C2: CONCRETE SHEAR WALL BUILDINGS WITH RIGID OR STIFF DIAPHRAGMS

C	NC	N/A		Comments
---	----	-----	--	----------

### LATERAL-FORCE-RESISTING SYSTEM

- |                                     |                          |                          |   |   |
|-------------------------------------|--------------------------|--------------------------|---|---|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <p>4.4.1.6.1 COMPLETE FRAMES: Steel or concrete frames classified as secondary components shall form a complete vertical load carrying system.</p>  | <p>The gravity-load-carrying frame is incomplete because there are no columns cast into the wall and no columns adjacent to the wall, and the beams frame directly into the wall. However, because the beams are bolted to wall (2 bolts per connection), and sit in a grouted pocket with a large bearing area (7" deep), it is unlikely that seismic forces would cause the wall and beam to pull away from each other and cause partial collapse. The support of framing by the walls alone should be adequate for combined vertical and seismic forces.</p> |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <p>4.4.2.1.1 REDUNDANCY: The number of lines of shear walls in each principal direction shall be greater than or equal to 2 for Life Safety and Immediate Occupancy.</p>  | <p>Three lines of walls in each direction.</p>  |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <p>4.4.2.2.1 SHEAR STRESS CHECK: The shear stress in the concrete shear walls, calculated using the Quick Check procedure of Section 3.5.3.3, shall be less than 100 psi or <math>2\sqrt{f'_c}</math> for Life Safety and Immediate Occupancy.</p>  | <p><math>V_j^{avg} = 15 \text{ psi max}</math><br/> <math>&lt; 100 \text{ psi}</math><br/> <math>&lt; (2\sqrt{f'_c} = 2\sqrt{3000} = 110 \text{ psi})</math></p>  |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <p>4.4.2.2.2 REINFORCING STEEL: The ratio of reinforcing steel area to gross concrete area shall be not less than 0.0015 in the vertical direction and 0.0025 in the horizontal direction for Life Safety and Immediate Occupancy. The spacing of reinforcing steel shall be equal to or less than 18" for Life Safety and Immediate Occupancy.</p> | <p>Max spacing is 18".<br/>           24" wall: #5@10" e.w.e.f. → 0.0026 OK<br/>           14" wall: #5@18" vert e.f. → 0.0024 OK<br/>           14" wall: #6@12" horiz e.f. → 0.0053 OK<br/>           12" wall: #4@12" e.w.e.f. → 0.0027 OK<br/>           12" wall: #4@12" vert 1 side,<br/>                     #5@18" vert 1 side, → 0.0028 OK</p>   |

### CONNECTIONS

- |                          |                                     |                          |  |   |
|--------------------------|-------------------------------------|--------------------------|--|---|
| <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <p>4.6.2.1 TRANSFER TO SHEAR WALLS: Diaphragms shall be connected for transfer of loads to the shear walls for Life Safety and the connections shall be able to develop the lesser of the shear strength of the walls or diaphragms for Immediate Occupancy.</p> | <p>The concrete diaphragm at the low roof is attached for shear transfer with continuous reinforcement.<br/><br/>           The cement asbestos panels at the high roof cannot be assumed to act as a diaphragm. However, the steel beams at high roof are closely spaced and well connected to the concrete walls with bolts that are embedded in the concrete and extend through the bottom flange of the beam. Also rod bracing has been added to half of the building at the roof. Rod bracing should be added to the other half of the building.</p> |
|--------------------------|-------------------------------------|--------------------------|--|---|



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By: LKF Checked: \_\_\_\_\_

**ASCE 31\* BASIC CHECKLIST C2: CONCRETE SHEAR WALL BUILDINGS WITH RIGID OR STIFF DIAPHRAGMS**

C NC N/A Comments

**CONNECTIONS**

4.6.3.5 FOUNDATION DOWELS: Wall reinforcement shall be doweled into the foundation for Life Safety and the dowels shall be able to develop the lesser of the strength of the walls or the uplift capacity of the foundation for Immediate Occupancy.

Wall dowels are continuous into footing in side retaining walls and in walls at center of building (at earth filled room). Most walls (24", 14") bear directly on soil and do not have separate footings to which to dowel, but these walls are unlikely to slide or tip over.

\* - Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.



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By: LKF Checked: \_\_\_\_\_

## ASCE 31\* SUPPLEMENTAL CHECKLIST C2: CONCRETE SHEAR WALL BUILDINGS WITH RIGID OR STIFF DIAPHRAGMS

C NC N/A

Comments

### LATERAL-FORCE-RESISTING SYSTEM

- |                                     |                          |                                     |  |  |
|-------------------------------------|--------------------------|-------------------------------------|--|--|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.4.1.6.2 DEFLECTION COMPATIBILITY: Secondary components shall have the shear capacity to develop the flexural strength of the components for Life Safety and shall meet the requirements of 4.4.1.4.9, 4.4.1.4.10, 4.4.1.4.11, 4.4.1.4.12 and 4.4.1.4.15 for Immediate Occupancy.   |  |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.1.6.3 FLAT SLABS: Flat slabs/plates not part of lateral-force-resisting system shall have continuous bottom steel through the column joints for Life Safety.   | No flat slabs/plates that are no a part of the lateral-force-resisting system. |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.2.2.3 COUPLING BEAMS: The stirrups in coupling beams over means of egress shall be spaced at or less than $d/2$ and shall be anchored into the confined core of the beam with hooks of 135° or more for Life Safety. All coupling beams shall comply with the requirements above and shall have the capacity in shear to develop the uplift capacity of the adjacent wall for Immediate Occupancy. |  |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.2.2.4 OVERTURNING: All shear walls shall have aspect ratios less than 4 to 1. Wall piers need not be considered. This statement shall apply to the Immediate Occupancy Performance Level only.   | Statement applies to Immediate Occupancy Performance Level only.               |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.2.2.5 CONFINEMENT REINFORCING: For shear walls with aspect ratios greater than 2 to 1, the boundary elements shall be confined with spirals or ties with spacing less than $8d_b$ . This statement shall apply to the Immediate Occupancy Performance Level only.  | Statement applies to Immediate Occupancy Performance Level only.               |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.2.2.6 REINFORCING AT OPENINGS: There shall be added trim reinforcement around all wall openings greater than three times the thickness of the wall. This statement shall apply to the Immediate Occupancy Performance Level only.  | Statement applies to Immediate Occupancy Performance Level only.               |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.2.2.7 WALL THICKNESS: Thickness of bearing walls shall not be less than $1/25$ the unsupported height or length, whichever is shorter, nor less than 4". This statement shall apply to the Immediate Occupancy Performance Level only.   | Statement applies to Immediate Occupancy Performance Level only.               |

### DIAPHRAGMS

- |                                     |                          |                          |   |  |
|-------------------------------------|--------------------------|--------------------------|---|--|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 4.5.1.1 DIAPHRAGM CONTINUITY: The diaphragms shall not be composed of split-level floors and shall not have expansion joints. | There are no expansion joints. The high cement asbestos roof deck is 7 feet higher than the low concrete roof. However, these two roofs can be treated as separate levels rather than a split-level diaphragm. |
|-------------------------------------|--------------------------|--------------------------|---|--|



Building Name: Building 809

Date: July 24, 2003

Building Address: Lawrence Livermore National Laboratory

Page: 2 of 2

Job Number: A20047.08 Job Name: LLNL Prioritization

By: LKF Checked: \_\_\_\_\_

## ASCE 31\* SUPPLEMENTAL CHECKLIST C2: CONCRETE SHEAR WALL BUILDINGS WITH RIGID OR STIFF DIAPHRAGMS

C NC N/A

Comments

### DIAPHRAGMS

- |                          |                                     |                                     |   |   |
|--------------------------|-------------------------------------|-------------------------------------|---|---|
| <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | 4.5.1.4 OPENINGS AT SHEAR WALLS: Diaphragm openings immediately adjacent to the shear walls shall be less than 25% of the wall length for Life Safety and 15% of the wall length for Immediate Occupancy.   | At the high roof, there is only insulated cement asbestos roof deck over steel framing; this deck cannot be assumed to act as a diaphragm, and its connection to the walls is not shown.<br>There are no apparent large diaphragm openings directly adjacent to the shear walls in the concrete slab.<br>There is a significant amount of wall per the size of building condition judged to be life safe. |
| <input type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | 4.5.1.7 PLAN IRREGULARITIES: There shall be tensile capacity to develop the strength of the diaphragm at re-entrant corners or other locations of plan irregularities. This statement shall apply to the Immediate Occupancy Performance Level only.      | Statement applies to Immediate Occupancy Performance Level only.  |
| <input type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | 4.5.1.8 DIAPHRAGM REINFORCEMENT AT OPENINGS: There shall be reinforcing around all diaphragm openings larger than 50% of the building width in either major plan dimension. This statement shall apply to the Immediate Occupancy Performance Level only. | Statement applies to Immediate Occupancy Performance Level only.  |

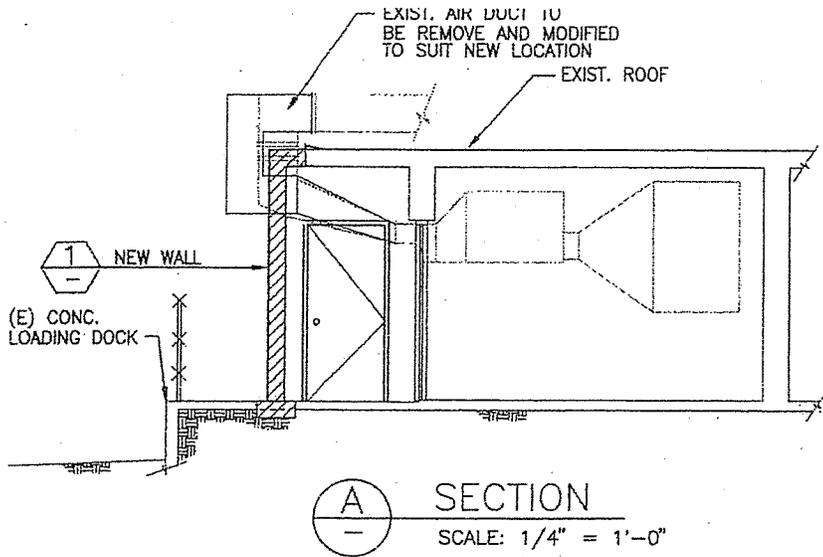
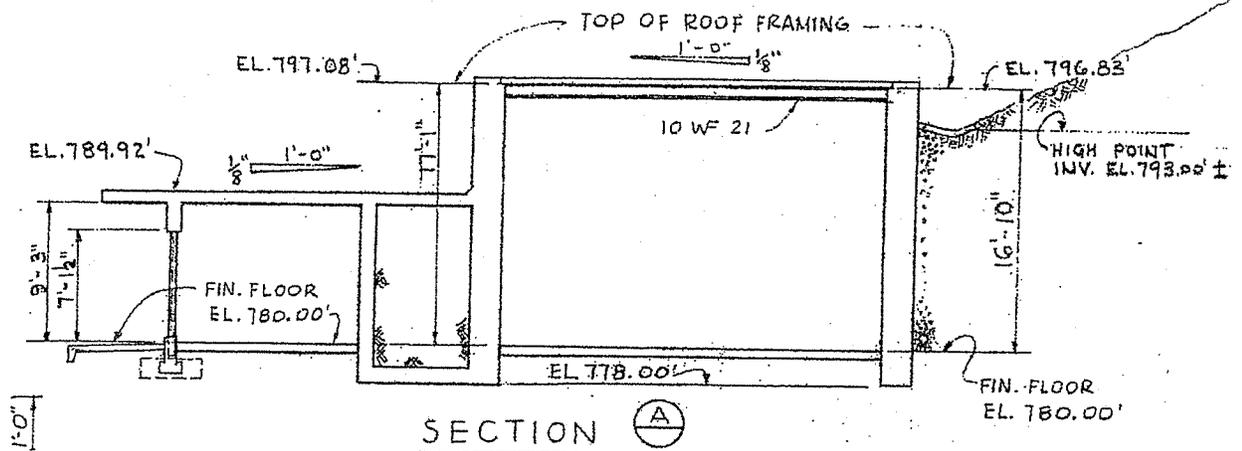
### CONNECTIONS

- |                          |                          |                                     |  |                         |
|--------------------------|--------------------------|-------------------------------------|--|-------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.6.3.10 UPLIFT AT PILE CAPS: Pile caps shall have top reinforcement and piles shall be anchored to the pile caps for Life Safety, and the pile cap reinforcement and pile anchorage shall be able to develop the tensile capacity of the piles for Immediate Occupancy. | There are no pile caps. |
|--------------------------|--------------------------|-------------------------------------|--|-------------------------|

\* - Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.



**BUILDING PLANS AND SECTIONS**



### ***Building 810A***

Building 810A is a one-story reinforced concrete bearing wall building. The structure consists of a reinforced concrete roof deck in one area, and 2" insulated cement asbestos panels over steel roof framing in the other area, and reinforced concrete walls support both roofs. Deficiencies noted for Building 810A are lack of a roof diaphragm and lack of a shear wall (open front) at the south face of the building. For the building to meet life-safety requirements, we recommend that rod bracing be added to the roof level, and a shear wall be added at the south entrance. Alternatively a detailed evaluation may show the existing condition meets life-safety.





Building Name: **Building 810A**

Date: **July 25, 2003**

Building Address: **Lawrence Livermore National Laboratory**

Page: **2** of **2**

Job Number: **A20047.08**

Job Name: **LLNL Prioritization**

By: **LKF** Checked: \_\_\_\_\_

## PRIORITIZATION BUILDING DATA SHEET

### POTENTIAL LIFE SAFETY DEFICIENCIES:

THIS BUILDING WAS EVALUATED FOR THE 10% IN 50 YR. EARTHQUAKE.

#### DEFLECTION COMPATIBILITY

*The concrete beam at the south exits is not properly detailed (no 135 degree hooks; #3 stirrups at 18" o.c.).*

#### OPENINGS AT SHEAR WALLS/ TRANSFER TO SHEAR WALLS

*The cement asbestos panels at the high roof cannot be assumed to act as a diaphragm. However, the steel beams at high roof are closely spaced and well connected to the concrete walls with bolts that are embedded in the concrete and extend through the bottom flange of the beam.*

#### TORSION

*In the South portion of the building, the only longitudinal wall is along the north side. There are no lateral force resisting elements along the south side of the south portion. Torsion might cause higher stresses in transverse walls, but walls are very lowly stressed. This is a low priority deficiency.*

### PRELIMINARY STRENGTHENING SCHEMES OR MITIGATION MEASURES:

#### DEFLECTION COMPATIBILITY/ TORSION

*A new shear wall at this location would mitigate this deficiency; alternatively, further evaluation may show that this beam is not a falling hazard.*

#### OPENINGS AT SHEAR WALLS/ TRANSFER TO SHEAR WALLS

*Add rod bracing to the roof level.*

Building Name: Building 810A

Date: July 25, 2003

Building Address: Lawrence Livermore National Laboratory

Page: 1 of 3

Job Number: A20047.08

Job Name: LLNL Prioritization

By: LKF Checked: \_\_\_\_\_

## ASCE 31\* BASIC CHECKLIST C2: CONCRETE SHEAR WALL BUILDINGS WITH RIGID OR STIFF DIAPHRAGMS

C	NC	N/A		Comments
<b>BUILDING SYSTEM</b>				
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.1.1 LOAD PATH: The structure shall contain a minimum of one complete load path for Life Safety and Immediate Occupancy for seismic force effects from any horizontal direction that serves to transfer the inertial forces from the mass to the foundation.	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.1.3 MEZZANINES: Interior mezzanine levels shall be braced independently from the main structure, or shall be anchored to the lateral-force-resisting elements of the main structure.	No interior mezzanine levels.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.1 WEAK STORY: The strength of the lateral-force-resisting system in any story shall not be less than 80% of the strength in an adjacent story above or below for Life-Safety and Immediate Occupancy.	Building is only one story.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.2 SOFT STORY: The stiffness of the lateral-force-resisting-system in any story shall not be less than 70% of the lateral-force-resisting system stiffness in an adjacent story above or below, or less than 80% of the average lateral-force-resisting system stiffness of the three stories above or below for Life Safety and Immediate Occupancy.	Building is only one story.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.3 GEOMETRY: There shall be no changes in horizontal dimension of the lateral-force-resisting system of more than 30% in a story relative to adjacent stories for Life Safety and Immediate Occupancy, excluding one-story penthouses and mezzanines.	Building is only one story.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.2.4 VERTICAL DISCONTINUITIES: All vertical elements in the lateral-force-resisting system shall be continuous to the foundation.	Walls are continuous to the foundation (where separate foundation elements exist).
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.5 MASS: There shall be no change in effective mass of more than 50% from one story to the next for Life Safety and Immediate Occupancy. Light roofs, penthouses and mezzanines need not be considered.	Building is only one story.
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	4.3.2.6 TORSION: The estimated distance between the story center of mass and the story center of rigidity shall be less than 20% of the building width in either plan dimension for Life Safety and Immediate Occupancy.	In the South portion of the building, the only longitudinal wall is along the north side. There are no lateral force resisting elements along the south side of the south portion. Torsion might cause higher stresses in transverse walls, but walls are very lowly stressed. This is a low priority deficiency.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.3.4 DETERIORATION OF CONCRETE: There shall be no visible deterioration of concrete or reinforcing steel in any of the vertical- or lateral-force-resisting elements.	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.3.5 POST-TENSIONING ANCHORS: There shall be no evidence of corrosion or spalling in the vicinity of post-tensioning or end fittings. Coil anchors shall not have been used.	No post-tensioning anchors.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.3.9 CONCRETE WALL CRACKS: All existing diagonal cracks in wall elements shall be less than 1/8" for Life Safety and 1/16" for Immediate Occupancy, shall not be concentrated in one location, and shall not form an X pattern.	

Building Name: Building 810A

Date: July 25, 2003

Building Address: Lawrence Livermore National Laboratory

Page: 2 of 3

Job Number: A20047.08

Job Name: LLNL Prioritization

By: LKF Checked: \_\_\_\_\_

## ASCE 31\* BASIC CHECKLIST C2: CONCRETE SHEAR WALL BUILDINGS WITH RIGID OR STIFF DIAPHRAGMS

**C NC N/A**

**Comments**

### LATERAL-FORCE-RESISTING SYSTEM

- |                                     |                          |                          |   |   |
|-------------------------------------|--------------------------|--------------------------|---|---|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <p>4.4.1.6.1 COMPLETE FRAMES: Steel or concrete frames classified as secondary components shall form a complete vertical load carrying system.</p>  | <p>The gravity-load-carrying frame is incomplete because there are no columns cast into the wall and no columns adjacent to the wall, and the beams frame directly into the wall. However, because the beams are bolted to wall (2 bolts per connection), and sit in a grouted pocket with a large bearing area (6" deep), it is unlikely that seismic forces would cause the wall and beam to pull away from each other and cause partial collapse. The support of framing by the walls alone should be adequate for combined vertical and seismic forces.</p> |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <p>4.4.2.1.1 REDUNDANCY: The number of lines of shear walls in each principal direction shall be greater than or equal to 2 for Life Safety and Immediate Occupancy.</p>  |   |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <p>4.4.2.2.1 SHEAR STRESS CHECK: The shear stress in the concrete shear walls, calculated using the Quick Check procedure of Section 3.5.3.3, shall be less than 100 psi or <math>2\sqrt{f'_c}</math> for Life Safety and Immediate Occupancy.</p>  | <p><math>V_j^{avg} = 17</math> psi max<br/> <math>&lt; 100</math> psi<br/> <math>&lt; (2\sqrt{f'_c} = 2\sqrt{3000} = 110</math> psi)</p>  |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <p>4.4.2.2.2 REINFORCING STEEL: The ratio of reinforcing steel area to gross concrete area shall be not less than 0.0015 in the vertical direction and 0.0025 in the horizontal direction for Life Safety and Immediate Occupancy. The spacing of reinforcing steel shall be equal to or less than 18" for Life Safety and Immediate Occupancy.</p> | <p>Max spacing is 18".<br/>                 24" wall: #5@10" horiz .e.f. → 0.0026 OK<br/>                 24" wall: #5@15" vert e.f. → 0.0017 OK<br/>                 8" wall: #4@9" horiz. → 0.0027 OK<br/>                 8" wall: #4@12" vert. → 0.0020 OK<br/>                 12" wall: #4@12" e.w.e.f. → 0.0027 OK</p>   |

### CONNECTIONS

- |                          |                                     |                          |  |  |
|--------------------------|-------------------------------------|--------------------------|--|--|
| <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <p>4.6.2.1 TRANSFER TO SHEAR WALLS: Diaphragms shall be connected for transfer of loads to the shear walls for Life Safety and the connections shall be able to develop the lesser of the shear strength of the walls or diaphragms for Immediate Occupancy.</p> | <p>The concrete diaphragm at the low roof is attached for shear transfer with continuous reinforcement.<br/>                 The cement asbestos panels at the high roof cannot be assumed to act as a diaphragm, and we cannot determine the connection from the panels to the beams to transfer the diaphragm forces to the walls. However, the steel beams at high roof are closely spaced and well connected to the concrete walls with bolts that are embedded in the concrete and extend through the bottom flange of the beam. Because the steel beams form a complete load path to transfer forces at the roof level, this is a low-priority deficiency.</p> |
|--------------------------|-------------------------------------|--------------------------|--|--|

Building Name: Building 810A

Date: July 25, 2003

Building Address: Lawrence Livermore National Laboratory

Page: 3 of 3

Job Number: A20047.08

Job Name: LLNL Prioritization

By: LKF Checked: \_\_\_\_\_

## ASCE 31\* BASIC CHECKLIST C2: CONCRETE SHEAR WALL BUILDINGS WITH RIGID OR STIFF DIAPHRAGMS

C   NC   N/A

Comments

### CONNECTIONS

4.6.3.5 FOUNDATION DOWELS: Wall reinforcement shall be doweled into the foundation for Life Safety and the dowels shall be able to develop the lesser of the strength of the walls or the uplift capacity of the foundation for Immediate Occupancy.

Wall dowels are continuous into footing in side retaining walls and in walls at center of building (at earth filled room). Most walls (24", 14") bear directly on soil and do not have separate footings to which to dowel, but these walls are unlikely to slide or tip over.

\* – Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.

Building Name: Building 810A

 Date: July 25, 2003

 Building Address: Lawrence Livermore National Laboratory

 Page: 1 of 2

 Job Number: A20047.08 Job Name: LLNL Prioritization

 By: LKF Checked: \_\_\_\_\_

## ASCE 31\* SUPPLEMENTAL CHECKLIST C2: CONCRETE SHEAR WALL BUILDINGS WITH RIGID OR STIFF DIAPHRAGMS

C NC N/A

Comments

### LATERAL-FORCE-RESISTING SYSTEM

- |                                     |                                     |                                     |  |  |
|-------------------------------------|-------------------------------------|-------------------------------------|--|--|
| <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | 4.4.1.6.2 DEFLECTION COMPATIBILITY: Secondary components shall have the shear capacity to develop the flexural strength of the components for Life Safety and shall meet the requirements of 4.4.1.4.9, 4.4.1.4.10, 4.4.1.4.11, 4.4.1.4.12 and 4.4.1.4.15 for Immediate Occupancy.   | The concrete beam at the east exits is not properly detailed (no 135 degree hooks; #3 stirrups at 18" o.c.).   |
| <input type="checkbox"/>            | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | 4.4.1.6.3 FLAT SLABS: Flat slabs/plates not part of lateral-force-resisting system shall have continuous bottom steel through the column joints for Life Safety.   | No flat slabs/plates that are no a part of the lateral-force-resisting system.   |
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/>            | 4.4.2.2.3 COUPLING BEAMS: The stirrups in coupling beams over means of egress shall be spaced at or less than $d/2$ and shall be anchored into the confined core of the beam with hooks of 135° or more for Life Safety. All coupling beams shall comply with the requirements above and shall have the capacity in shear to develop the uplift capacity of the adjacent wall for Immediate Occupancy. | At the north face, the section of wall (~7 ft tall) over the exits should be sufficient to transfer shear between the wall sections. Wall segments should be able to act independently, and not induce large deformations and spalling of concrete in the connecting segments of wall at openings. |
| <input type="checkbox"/>            | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | 4.4.2.2.4 OVERTURNING: All shear walls shall have aspect ratios less than 4 to 1. Wall piers need not be considered. This statement shall apply to the Immediate Occupancy Performance Level only.   | Statement applies to Immediate Occupancy Performance Level only.   |
| <input type="checkbox"/>            | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | 4.4.2.2.5 CONFINEMENT REINFORCING: For shear walls with aspect ratios greater than 2 to 1, the boundary elements shall be confined with spirals or ties with spacing less than $8d_b$ . This statement shall apply to the Immediate Occupancy Performance Level only.  | Statement applies to Immediate Occupancy Performance Level only.   |
| <input type="checkbox"/>            | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | 4.4.2.2.6 REINFORCING AT OPENINGS: There shall be added trim reinforcement around all wall openings greater than three times the thickness of the wall. This statement shall apply to the Immediate Occupancy Performance Level only.  | Statement applies to Immediate Occupancy Performance Level only.   |
| <input type="checkbox"/>            | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | 4.4.2.2.7 WALL THICKNESS: Thickness of bearing walls shall not be less than 1/25 the unsupported height or length, whichever is shorter, nor less than 4". This statement shall apply to the Immediate Occupancy Performance Level only.   | Statement applies to Immediate Occupancy Performance Level only.   |

### DIAPHRAGMS

- |                                     |                                     |                          |   |  |
|-------------------------------------|-------------------------------------|--------------------------|---|--|
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/> | 4.5.1.1 DIAPHRAGM CONTINUITY: The diaphragms shall not be composed of split-level floors and shall not have expansion joints.   | There are no expansion joints. The high cement asbestos roof deck is 9 feet higher than the low concrete roof. However, these two roofs can be treated as separate levels rather than a split-level diaphragm. |
| <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input type="checkbox"/> | 4.5.1.4 OPENINGS AT SHEAR WALLS: Diaphragm openings immediately adjacent to the shear walls shall be less than 25% of the wall length for Life Safety and 15% of the wall length for Immediate Occupancy. | At the high roof, there are only insulated cement asbestos panels over steel framing; these panels cannot be assumed to act as a diaphragm, and their connection to the walls is not shown.                    |



Building Name: Building 810A

Date: July 25, 2003

Building Address: Lawrence Livermore National Laboratory

Page: 2 of 2

Job Number: A20047.08 Job Name: LLNL Prioritization

By: LKF Checked: \_\_\_\_\_

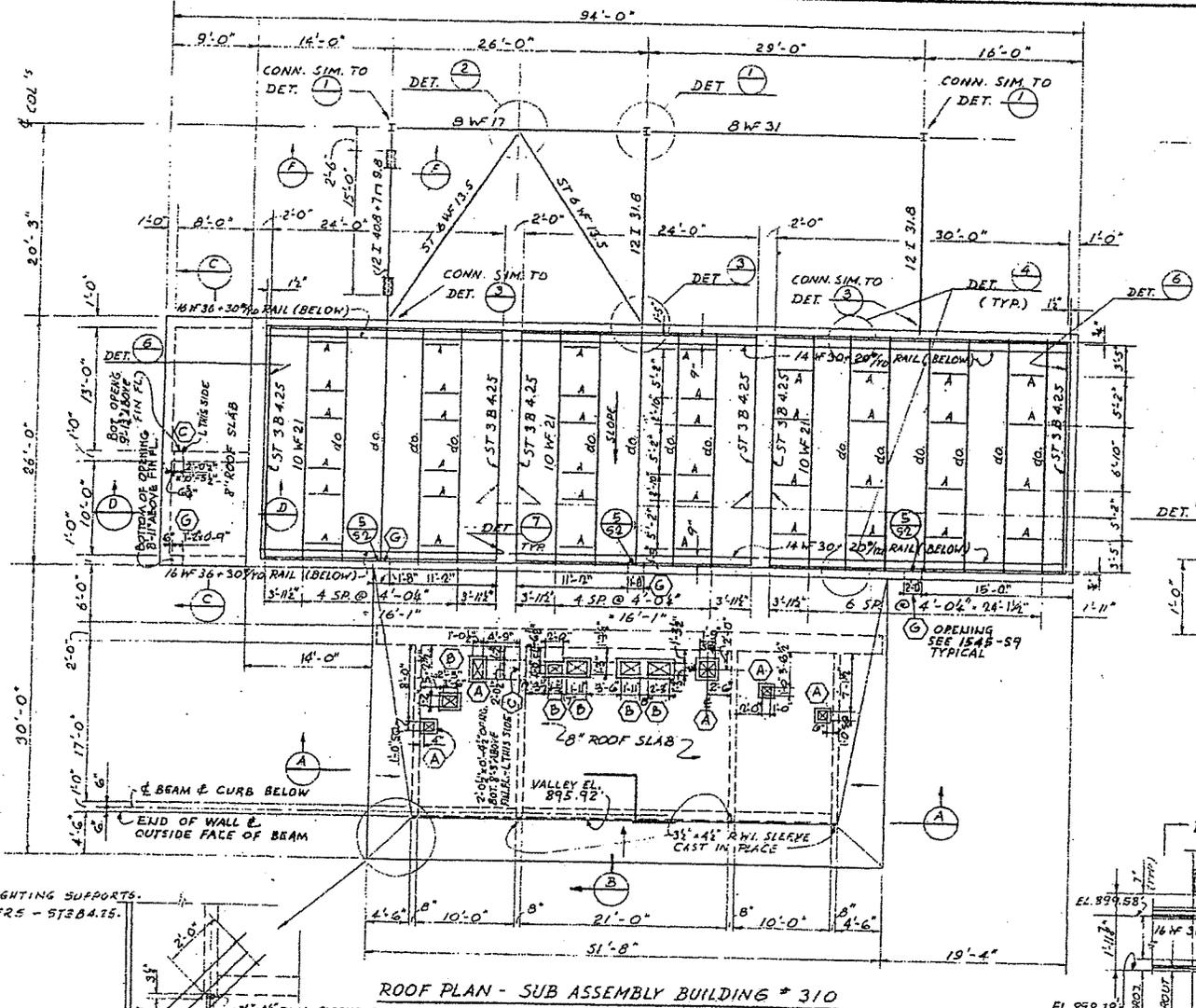
## ASCE 31\* SUPPLEMENTAL CHECKLIST C2: CONCRETE SHEAR WALL BUILDINGS WITH RIGID OR STIFF DIAPHRAGMS

C	NC	N/A		Comments	
<b>DIAPHRAGMS</b>					
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.5.1.7	PLAN IRREGULARITIES: There shall be tensile capacity to develop the strength of the diaphragm at re-entrant corners or other locations of plan irregularities. This statement shall apply to the Immediate Occupancy Performance Level only.	Statement applies to Immediate Occupancy Performance Level only.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.5.1.8	DIAPHRAGM REINFORCEMENT AT OPENINGS: There shall be reinforcing around all diaphragm openings larger than 50% of the building width in either major plan dimension. This statement shall apply to the Immediate Occupancy Performance Level only.	Statement applies to Immediate Occupancy Performance Level only.
<b>CONNECTIONS</b>					
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.6.3.10	UPLIFT AT PILE CAPS: Pile caps shall have top reinforcement and piles shall be anchored to the pile caps for Life Safety, and the pile cap reinforcement and pile anchorage shall be able to develop the tensile capacity of the piles for Immediate Occupancy.	There are no pile caps.

\* – Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.



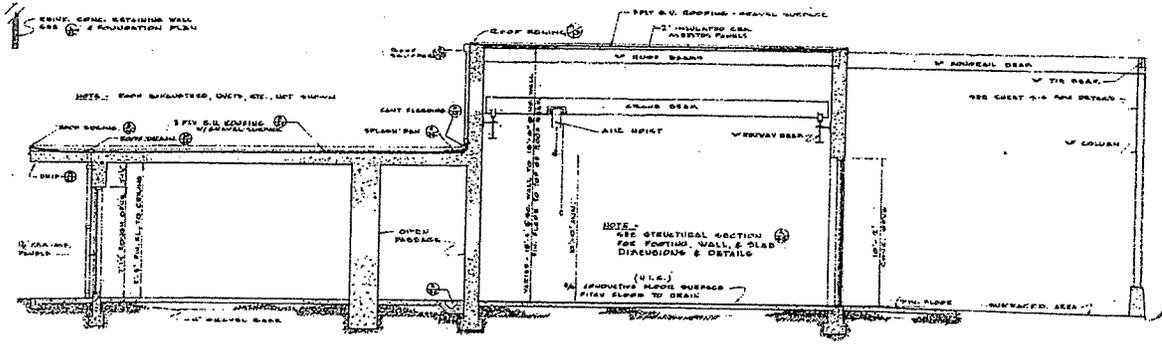
## BUILDING PLAN



NOTE:  
 "A" ARE LIGHTING SUPPORTS.  
 ALL MEMBERS - STEEL.

ROOF PLAN - SUB ASSEMBLY BUILDING # 310

### Roof Plan



Building Section Looking West

### ***Building 810C***

Building 810C is a tall one-story reinforced masonry bearing wall building. The structure consists of prestressed precast hollow core concrete roof planks with concrete topping spanning to reinforced concrete block walls, with concrete grade beams and belled caissons. The primary structural deficiency noted for Building 810C is that the precast roof panels do not have any connection to the walls or to the topping slab. The only method of support is in bearing at the top of the walls. For the building to meet life-safety standards, we recommend replacing the precast panels and topping with a new diaphragm such as a bare metal deck or rod bracing, or providing positive connection between the precast planes and the walls.

Building Name: Building 810C Date: August 6, 2003  
 Building Address: Lawrence Livermore National Laboratory Page: 1 of 1  
 Job Number: A20047.08 Job Name: LLNL Prioritization By: LKF Checked: \_\_\_\_\_

## PRIORITIZATION BUILDING DATA SHEET

### BUILDING DATA

Year Built:	1982	Year(s) Remodeled:	None known	UBC Zone:	4 – Type B Near Field
Area (sf):	900	Length (ft):	34'	Width (ft):	26'
No. Stories:	1	Story Height:	13'	Total Height:	13'

### CONSTRUCTION DATA

Gravity Load Structural System: Prestressed precast hollow core concrete roof planks with concrete topping spanning to reinforced concrete block walls, with concrete grade beams under walls and belled caissons under wall corners.

Exterior Transverse Walls: 8" thick reinforced concrete block walls      Openings?: Yes- doors  
 Exterior Longitudinal Walls: 8" thick reinforced concrete block walls      Openings?: Yes- door and ducts  
 Roof Framing: 6" thick x 40" wide prestressed precast hollow core concrete roof planks with 2 1/2" thick concrete topping and 8" x 8" W1.4xW1.4 mesh  
 Intermediate Floor Framing: N/A  
 Ground Floor: Reinforced concrete slab on grade  
 Columns: N/A  
 Foundation: Strip footings under walls, caissons at wall corners.

### LATERAL-FORCE-RESISTING SYSTEM

	Longitudinal	Transverse
System Classification:	RM2: Reinforced Masonry Bearing Wall Building with Rigid or Stiff Diaphragm	RM2: Reinforced Masonry Bearing Wall Building with Rigid or Stiff Diaphragm
Vertical Elements:	8" thick reinforced concrete block walls	8" thick reinforced concrete block walls
Diaphragms:	6" thick x 40" wide prestressed precast hollow core concrete roof planks with 2 1/2" thick concrete topping and 8" x 8" W1.4xW1.4 mesh	6" thick x 40" wide prestressed precast hollow core concrete roof planks with 2 1/2" thick concrete topping and 8" x 8" W1.4xW1.4 mesh

SEISMIC EVALUATION PERFORMED? Yes EVALUATION: Rapid Evaluation YEAR: 2003

SEISMIC EVALUATION CRITERIA: Life Safety/ ASCE 31-02

VULNERABILITY RATING: 6  
 (1=low to 10=high)

PRIORITIZATION CLASSIFICATION: CLASS C

### POTENTIAL LIFE SAFETY DEFICIENCIES:

THIS BUILDING WAS EVALUATED FOR THE 10% IN 50 YR. EARTHQUAKE.

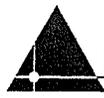
#### LOAD PATH/ WALL ANCHORAGE/ TRANSFER TO SHEAR WALLS

*The precast panels do not appear to have any connection to the walls or to the topping slab. The only method of support is in bearing at the top of the walls. There is no method for transferring seismic forces in shear or out-of-plane between the walls and roof. Separation of the roof and walls under seismic forces could result in collapse.*

### PRELIMINARY STRENGTHENING SCHEMES OR MITIGATION MEASURES:

#### LOAD PATH/ WALL ANCHORAGE/ TRANSFER TO SHEAR WALLS

*Replace existing roof with new diaphragm, using rod bracing or bare metal deck.*



Building Name: **Building 810C**

Date: **August 6, 2003**

Building Address: **Lawrence Livermore National Laboratory**

Page: **1** of **3**

Job Number: **A20047.08**

Job Name: **LLNL Prioritization**

By: **LKF** Checked:

## ASCE 31\* BASIC CHECKLIST RM2: REINFORCED MASONRY BEARING WALL BUILDINGS WITH RIGID OR STIFF DIAPHRAGMS

**C NC N/A**

**Comments**

### BUILDING SYSTEM

- |                                     |                                     |                                     |         |  |
|-------------------------------------|-------------------------------------|-------------------------------------|---------|--|
| <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | 4.3.1.1 | LOAD PATH: The structure shall contain a minimum of one complete load path for Life Safety and Immediate Occupancy for seismic force effects from any horizontal direction that serves to transfer the inertial forces from the mass to the foundation.  |
| <input type="checkbox"/>            | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | 4.3.1.3 | MEZZANINES: Interior mezzanine levels shall be braced independently from the main structure, or shall be anchored to the lateral-force-resisting elements of the main structure.   |
| <input type="checkbox"/>            | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | 4.3.2.1 | WEAK STORY: The strength of the lateral-force-resisting system in any story shall not be less than 80% of the strength in an adjacent story above or below for Life-Safety and Immediate Occupancy.  |
| <input type="checkbox"/>            | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | 4.3.2.2 | SOFT STORY: The stiffness of the lateral-force-resisting-system in any story shall not be less than 70% of the lateral-force-resisting system stiffness in an adjacent story above or below, or less than 80% of the average lateral-force-resisting system stiffness of the three stories above or below for Life Safety and Immediate Occupancy. |
| <input type="checkbox"/>            | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | 4.3.2.3 | GEOMETRY: There shall be no changes in horizontal dimension of the lateral-force-resisting system of more than 30% in a story relative to adjacent stories for Life Safety and Immediate Occupancy, excluding one-story penthouses and mezzanines.   |
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/>            | 4.3.2.4 | VERTICAL DISCONTINUITIES: All vertical elements in the lateral-force-resisting system shall be continuous to the foundation.   |
| <input type="checkbox"/>            | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | 4.3.2.5 | MASS: There shall be no change in effective mass of more than 50% from one story to the next for Life Safety and Immediate Occupancy. Light roofs, penthouses and mezzanines need not be considered.   |
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/>            | 4.3.2.6 | TORSION: The estimated distance between the story center of mass and the story center of rigidity shall be less than 20% of the building width in either plan dimension for Life Safety and Immediate Occupancy.   |
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/>            | 4.3.3.4 | DETERIORATION OF CONCRETE: There shall be no visible deterioration of concrete or reinforcing steel in any of the vertical- or lateral-force-resisting elements.   |
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/>            | 4.3.3.7 | MASONRY UNITS: There shall be no visible deterioration of masonry units.   |
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/>            | 4.3.3.8 | MASONRY JOINTS: The mortar shall not be easily scraped away from the joints by hand with a metal tool, and there shall be no areas of eroded mortar.   |

**The precast panels do not appear to have any connection to the walls or to the topping slab. The only method of support is in bearing at the top of the walls. There is no method for transferring seismic forces in shear or out-of-plane between the walls and roof. Separation of the roof and walls under seismic forces could result in collapse.**

Building Name: **Building 810C**

Date: **August 6, 2003**

Building Address: **Lawrence Livermore National Laboratory**

Page: **2** of **3**

Job Number: **A20047.08**

Job Name: **LLNL Prioritization**

By: **LKF** Checked:

## ASCE 31\* BASIC CHECKLIST RM2: REINFORCED MASONRY BEARING WALL BUILDINGS WITH RIGID OR STIFF DIAPHRAGMS

**C NC N/A**

**Comments**

### BUILDING SYSTEM

- 4.3.3.10 REINFORCED MASONRY WALL CRACKS: All existing diagonal cracks in wall elements shall be less than 1/8" for Life Safety and 1/16" for Immediate Occupancy, shall not be concentrated in one location, and shall not form an X pattern.

### LATERAL-FORCE-RESISTING SYSTEM

- 4.4.2.1.1 REDUNDANCY: The number of lines of shear walls in each principal direction shall be greater than or equal to 2 for Life Safety and Immediate Occupancy.

- 4.4.2.4.1 SHEAR STRESS CHECK: The shear stress in the reinforced masonry shear walls, calculated using the Quick Check Procedure of Section 3.5.3.3, shall be less than 70 psi for Life Safety and Immediate Occupancy.

$V_j^{avg} = 14 \text{ psi} < 70 \text{ psi}$  **OK**

- 4.4.2.4.2 REINFORCING STEEL: The total vertical and horizontal reinforcing steel ratio in reinforced masonry walls shall be greater than 0.002 for Life Safety and Immediate Occupancy of the wall with the minimum of 0.0007 for Life Safety and Immediate Occupancy in either of the two directions; the spacing of reinforcing steel shall be less than 48" for Life Safety and Immediate Occupancy; and all vertical bars shall extend to the top of the walls.

**Spacing is not more than 48" o.c.**  
**Vertical bars extent to top block in wall.**  
**Typical wall is 8", with #4@16" e.w. →**  
**0.0015 each direction OK**

### DIAPHRAGMS

- 4.5.5.1 TOPPING SLAB: Precast concrete diaphragm elements shall be interconnected by a continuous reinforced concrete topping slab.

### CONNECTIONS

- 4.6.1.1 WALL ANCHORAGE: Exterior concrete or masonry walls, that are dependent on the diaphragm for lateral support, shall be anchored for out-of-plane forces at each diaphragm level with steel anchors, reinforcing dowels, or straps that are developed into the diaphragm. Connections shall have adequate strength to resist the connection force calculated in the Quick Check Procedure of Section 3.5.3.7.

**The precast panels do not appear to have any connection to the walls or to the topping slab. The only method of support is in bearing at the top of the walls. There is no method for transferring seismic forces out-of-plane between the walls and roof. Separation of the roof and walls under seismic forces could result in collapse.**

- 4.6.2.1 TRANSFER TO SHEAR WALLS: Diaphragms shall be connected for transfer of loads to the shear walls for Life Safety and the connections shall be able to develop the lesser of the shear strength of the walls or diaphragms for Immediate Occupancy.

**The precast panels do not appear to have any connection to the walls or to the topping slab. The only method of support is in bearing at the top of the walls. There is no method for transferring seismic forces in shear or out-of-plane between the walls and roof. Separation of the roof and walls under seismic forces could result in collapse.**

Building Name: **Building 810C**

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Job Number: **A20047.08**

Job Name: **LLNL Prioritization**

By: **LKF** Checked: \_\_\_\_\_

## ASCE 31\* BASIC CHECKLIST RM2: REINFORCED MASONRY BEARING WALL BUILDINGS WITH RIGID OR STIFF DIAPHRAGMS

**C NC N/A**

**Comments**

### CONNECTIONS

- |                                     |                          |                                     |   |  |
|-------------------------------------|--------------------------|-------------------------------------|---|--|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.6.2.3 TOPPING SLAB TO WALLS OR FRAMES: Reinforced concrete topping slabs that interconnect the precast concrete diaphragm elements shall be doweled for transfer of forces into the shear wall or frame elements for Life Safety and the dowels shall be able to develop the lesser of the shear strength of the walls, frames, or slabs for Immediate Occupancy. | Topping slab is doweled to concrete block walls. |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.6.3.5 FOUNDATION DOWELS: Wall reinforcement shall be doweled into the foundation for Life Safety and the dowels shall be able to develop the lesser of the strength of the walls or the uplift capacity of the foundation for Immediate Occupancy.  |  |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.6.4.1 GIRDER/COLUMN CONNECTION: There shall be a positive connection utilizing plates, connection hardware, or straps between the girder and the column support.  | No girders/columns                               |

\* – Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.

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 Job Number: **A20047.08**

 Job Name: **LLNL Prioritization**

 By: **LKF** Checked:

**ASCE 31\* SUPPLEMENTAL CHECKLIST RM2: REINFORCED MASONRY BEARING WALL BUILDINGS WITH RIGID OR STIFF DIAPHRAGMS**

<b>C</b>	<b>NC</b>	<b>N/A</b>		<b>Comments</b>
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**LATERAL-FORCE-RESISTING SYSTEM**

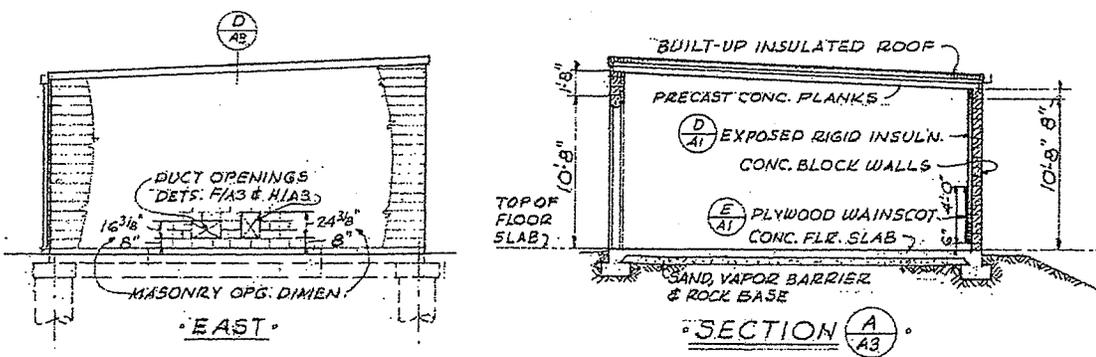
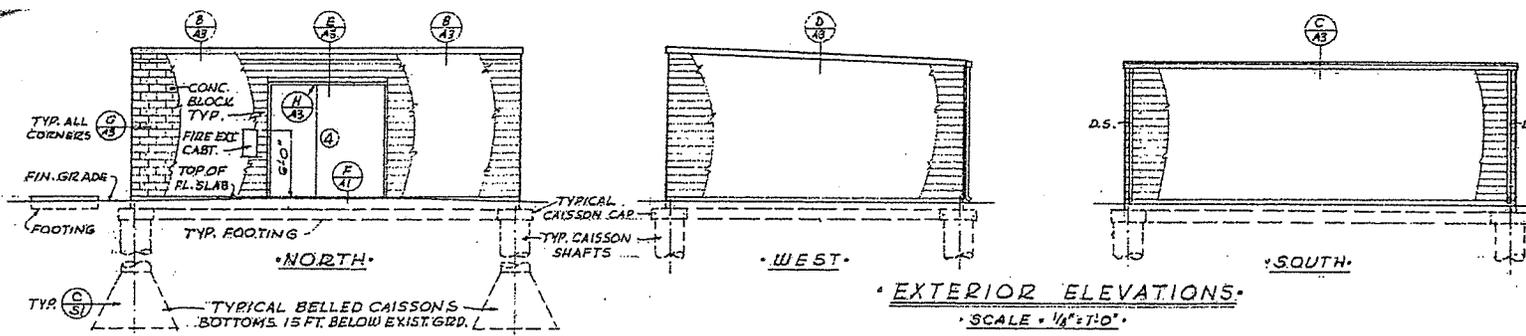
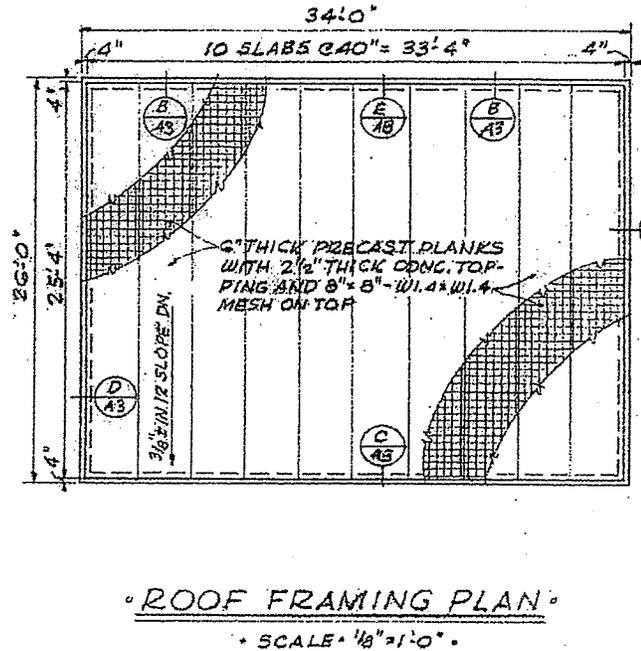
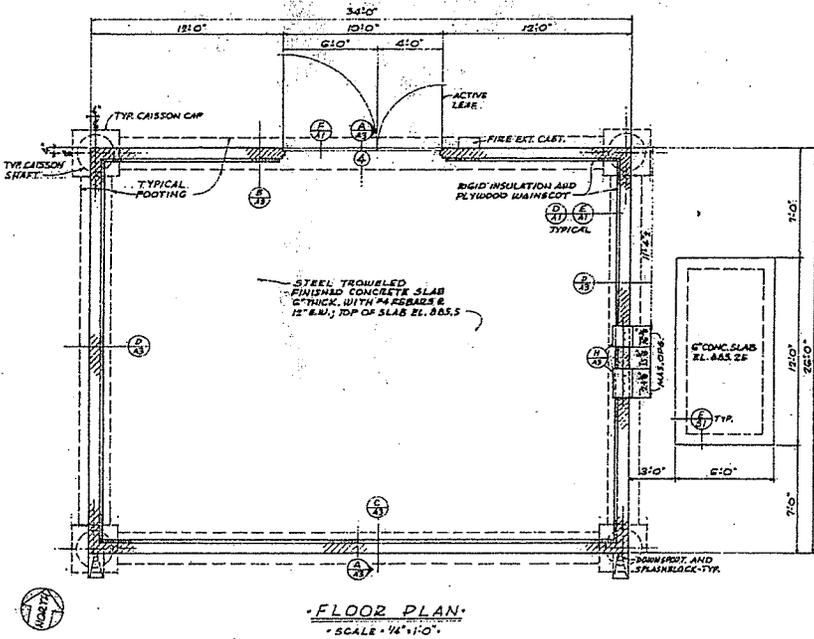
- |                          |                          |                                     |   |   |
|--------------------------|--------------------------|-------------------------------------|---|---|
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.2.2.6 REINFORCING AT OPENINGS: There shall be added trim reinforcement around all wall openings greater than three times the thickness of the wall. This statement shall apply to the Immediate Occupancy Performance Level only. | <b>Statement applies to Immediate Occupancy Performance Level only.</b> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.2.4.4 PROPORTIONS: The height-to-thickness ratio of the shear walls at each story shall be less than 30. This statement shall apply to the Immediate Occupancy Performance Level only.  | <b>Statement applies to Immediate Occupancy Performance Level only.</b> |

**DIAPHRAGMS**

- |                                     |                          |                                     |   |   |
|-------------------------------------|--------------------------|-------------------------------------|---|---|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.5.1.4 OPENINGS AT SHEAR WALLS: Diaphragm openings immediately adjacent to the shear walls shall be less than 25% of the wall length for Life Safety and 15% of the wall length for Immediate Occupancy.   | <b>No diaphragm openings.</b>   |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.5.1.6 OPENINGS AT EXTERIOR MASONRY SHEAR WALLS: Diaphragm openings immediately adjacent to exterior masonry shear walls shall not be greater than 8 ft long for Life Safety and 4 ft long for Immediate Occupancy.                                      | <b>No diaphragm openings.</b>   |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.5.1.7 PLAN IRREGULARITIES: There shall be tensile capacity to develop the strength of the diaphragm at re-entrant corners or other locations of plan irregularities. This statement shall apply to the Immediate Occupancy Performance Level only.      | <b>Statement applies to Immediate Occupancy Performance Level only.</b> |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.5.1.8 DIAPHRAGM REINFORCEMENT AT OPENINGS: There shall be reinforcing around all diaphragm openings larger than 50% of the building width in either major plan dimension. This statement shall apply to the Immediate Occupancy Performance Level only. | <b>Statement applies to Immediate Occupancy Performance Level only.</b> |

\* – Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.

# BUILDING PLANS, ELEVATIONS, SECTIONS



### ***Building 818A***

Building 818A is a one-story reinforced concrete bearing wall building. The structure consists of 2" asbestos panels. The deck is supported by steel beams. The steel beams span to interior and exterior concrete shear walls. Potential structural deficiencies noted for Building 818A are 1) The asbestos roof cannot adequately serve as a diaphragm; 2) Out of plane wall anchorage was found to be inadequate; and 3) There are no cross ties. For the building to meet life-safety requirements, we recommend that the roof be replaced or strengthened with horizontal rod bracing or metal deck. In addition, we recommend that the out of plane wall anchorage is strengthened and cross ties are added.

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 Job Number: **A20047.08**

 Job Name: **LLNL Prioritization**

 By: **JYF** Checked: **JEH**

## PRIORITIZATION BUILDING DATA SHEET

### BUILDING DATA

Year Built:	1964	Year(s) Remodeled:	None	UBC Zone:	4 – Type B Near Field
Area (sf):	1,240	Length (ft):	62	Width (ft):	20
No. Stories:	1	Story Height:	11'	Total Height:	11'

### CONSTRUCTION DATA

Gravity Load Structural System: 1 9/16" thick asbestos panels supported on 8I18.4 steel beams or L2x2x3/16 ledgers. The beams are supported by interior and exterior 8" to 12" thick concrete shear walls. The canopy consists of metal deck supported by 6B12 steel beams and 3 1/2" diameter standard pipes.

Exterior Transverse Walls: 8" to 12" thick reinforced concrete shear walls      Openings?: Door and window openings

Exterior Longitudinal Walls: 8" to 12" thick reinforced concrete shear walls      Openings?: Door and window openings

Roof Framing: 1 9/16" thick asbestos panels supported on 8I18.4 steel beams or L2x2x3/16 ledgers. The canopy consists of metal deck supported by 6B12 steel beams.

Intermediate Floor Framing: None

Ground Floor: 6" concrete slab on grade w/ #4 @ 16" o.c. E.W.

Columns: None

Foundation: Concrete strip footing

### LATERAL-FORCE-RESISTING SYSTEM

	Longitudinal	Transverse
System Classification:	Type 9 (Concrete Shear Wall Building w/ Flexible Diaphragm)	Type 9 (Concrete Shear Wall Building w/ Flexible Diaphragm)
Vertical Elements:	8I18.4 steel beams or L2x2x3/16 ledgers; The canopy consists of 6B12 steel beams. Steel pipe columns, concrete shear walls	8I18.4 steel beams or L2x2x3/16 ledgers; The canopy consists of 6B12 steel beams. Steel pipe columns, concrete shear walls
Diaphragms:	1 9/16" thick asbestos panels	1 9/16" thick asbestos panels

SEISMIC EVALUATION PERFORMED? Yes      EVALUATION: Rapid Evaluation      YEAR: 2003

SEISMIC EVALUATION CRITERIA: Life Safety/ ASCE 31-02

VULNERABILITY RATING: 5  
(1=low to 10=high)

PRIORITIZATION CLASSIFICATION: CLASS C



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By: **JYF** Checked: **JEH**

## PRIORITIZATION BUILDING DATA SHEET

### POTENTIAL LIFE SAFETY DEFICIENCIES:

THIS BUILDING WAS EVALUATED FOR THE 10% IN 50 YR. EARTHQUAKE.

#### OTHER DIAPHRAGMS

*The roof consists of 1 9/16" panels. Per our site visit, the panels are asbestos cement panels.*

#### WALL ANCHORAGE

*Out of plane anchorage is not adequate. D/C = 1.33.*

#### CROSS TIES

*There are no cross ties in the NS direction.*

### PRELIMINARY STRENGTHENING SCHEMES OR MITIGATION MEASURES:

Replace asbestos panels or add rod bracing or metal deck.  
Add out of plane anchorage and cross ties.

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Job Name: **LLNL Prioritization**

By: **JYF** Checked: **JEH**

## ASCE 31\* BASIC CHECKLIST C2A: CONCRETE SHEAR WALL BUILDINGS WITH FLEXIBLE DIAPHRAGMS

**C NC N/A**

**Comments**

### BUILDING SYSTEM

<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.1.1 LOAD PATH: The structure shall contain a minimum of one complete load path for Life Safety and Immediate Occupancy for seismic force effects from any horizontal direction that serves to transfer the inertial forces from the mass to the foundation.	Load is transferred from the 1 9 /16" asbestos cement panel to I beams. The beams deliver the load to the exterior and interior concrete shear walls. The concrete shear walls are doweled into the foundation system. At the canopy, the metal deck delivers load to I beams. The I beams are connected to channels which are anchored to the concrete shear walls.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.1.2 ADJACENT BUILDINGS: The clear distance between the building being evaluated and any adjacent building shall be greater than 4% of the height of the shorter building for Life Safety and Immediate Occupancy.	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.1.3 MEZZANINES: Interior mezzanine levels shall be braced independently from the main structure, or shall be anchored to the lateral-force-resisting elements of the main structure.	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.1 WEAK STORY: The strength of the lateral-force-resisting system in any story shall not be less than 80% of the strength in an adjacent story above or below for Life-Safety and Immediate Occupancy.	One story building.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.2 SOFT STORY: The stiffness of the lateral-force-resisting-system in any story shall not be less than 70% of the lateral-force-resisting system stiffness in an adjacent story above or below, or less than 80% of the average lateral-force-resisting system stiffness of the three stories above or below for Life Safety and Immediate Occupancy.	One story building.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.3 GEOMETRY: There shall be no changes in horizontal dimension of the lateral-force-resisting system of more than 30% in a story relative to adjacent stories for Life Safety and Immediate Occupancy, excluding one-story penthouses and mezzanines.	One story building.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.2.4 VERTICAL DISCONTINUITIES: All vertical elements in the lateral-force-resisting system shall be continuous to the foundation.	The concrete shear walls are doweled into the foundation system.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.5 MASS: There shall be no change in effective mass of more than 50% from one story to the next for Life Safety and Immediate Occupancy. Light roofs, penthouses and mezzanines need not be considered.	One story building.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.3.1 DETERIORATION OF WOOD: There shall be no signs of decay, shrinkage, splitting, fire damage, or sagging in any of the wood members and none of the metal connection hardware shall be deteriorated, broken, or loose.	Site visit made on 8/19/03. No signs of deterioration were observed.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.3.4 DETERIORATION OF CONCRETE: There shall be no visible deterioration of concrete or reinforcing steel in any of the vertical- or lateral-force-resisting elements.	Site visit made on 8/19/03. No signs of deterioration were observed.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.3.5 POST-TENSIONING ANCHORS: There shall be no evidence of corrosion or spalling in the vicinity of post-tensioning or end fittings. Coil anchors shall not have been used.	



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Job Name: **LLNL Prioritization**

By: **JYF** Checked: **JEH**

## ASCE 31\* BASIC CHECKLIST C2A: CONCRETE SHEAR WALL BUILDINGS WITH FLEXIBLE DIAPHRAGMS

C NC N/A

Comments

### BUILDING SYSTEM

- 4.3.3.9 CONCRETE WALL CRACKS: All existing diagonal cracks in wall elements shall be less than 1/8" for Life Safety and 1/16" for Immediate Occupancy, shall not be concentrated in one location, and shall not form an X pattern. Site visit made on 8/19/03. There are no cracks >1/8".

### LATERAL-FORCE-RESISTING SYSTEM

- 4.4.2.1.1 REDUNDANCY: The number of lines of shear walls in each principal direction shall be greater than or equal to 2 for Life Safety and Immediate Occupancy. There are at least 2 lines of shear walls in each direction of loading.
- 4.4.2.2.1 SHEAR STRESS CHECK: The shear stress in the concrete shear walls, calculated using the Quick Check procedure of Section 3.5.3.3, shall be less than 100 psi or  $2\sqrt{f'c}$  for Life Safety and Immediate Occupancy. Maximum average shear stress is 7 psi < 89 psi. Note:  $2\sqrt{f'c} = 89$  psi for  $f'c = 2,000$  psi
- 4.4.2.2.2 REINFORCING STEEL: The ratio of reinforcing steel area to gross concrete area shall be not less than 0.0015 in the vertical direction and 0.0025 in the horizontal direction for Life Safety and Immediate Occupancy. The spacing of reinforcing steel shall be equal to or less than 18" for Life Safety and Immediate Occupancy. Typ. reinforcement in reinforced concrete walls:  
12" wall: Reinforcing = 2#4@12" o.c.: reinforcing ratio = 0.0028 > 0.0025  
8" wall:  
Reinforcing = #4@08" o.c. E.W., reinforcing ratio = 0.0025 = 0.0025.  
Spacing of rebar at 12" o.c. < 18".

### CONNECTIONS

- 4.6.1.1 WALL ANCHORAGE: Exterior concrete or masonry walls, that are dependent on the diaphragm for lateral support, shall be anchored for out-of-plane forces at each diaphragm level with steel anchors, reinforcing dowels, or straps that are developed into the diaphragm. Connections shall have adequate strength to resist the connection force calculated in the Quick Check Procedure of Section 3.5.3.7. Out of plane anchorage: (2) 1/2" diameter x 8" M.B. @ 4' o.c. at the EW walls. 3/8" diameter x 6" @ 3" o.c. + 1/2" diameter x 8" @ 6' o.c. at NS walls  
D/C = 1.33.
- 4.6.2.1 TRANSFER TO SHEAR WALLS: Diaphragms shall be connected for transfer of loads to the shear walls for Life Safety and the connections shall be able to develop the lesser of the shear strength of the walls or diaphragms for Immediate Occupancy. The panels are nailed to 2x4 wood members, which are bolted to the concrete shear walls w/ 1/2" diameter x 8" bolts @ 6'-0" o.c.
- 4.6.3.5 FOUNDATION DOWELS: Wall reinforcement shall be doweled into the foundation for Life Safety and the dowels shall be able to develop the lesser of the strength of the walls or the uplift capacity of the foundation for Immediate Occupancy. Vertical rebar in the shear walls is doweled into the foundation.

\* - Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.

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 Job Name: **LLNL Prioritization**

 By: **JYF** Checked: **JEH**
**ASCE 31\* SUPPLEMENTAL CHECKLIST C2A: CONCRETE SHEAR WALL BUILDINGS WITH FLEXIBLE DIAPHRAGMS**
**C NC N/A**
**Comments**
**LATERAL-FORCE-RESISTING SYSTEM**

- |                          |                          |                                     |   |                                |
|--------------------------|--------------------------|-------------------------------------|---|--------------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.2.2.3 COUPLING BEAMS: The stirrups in coupling beams over means of egress shall be spaced at or less than $d/2$ and shall be anchored into the confined core of the beam with hooks of $135^\circ$ or more for Life Safety. All coupling beams shall comply with the requirements above and shall have the capacity in shear to develop the uplift capacity of the adjacent wall for Immediate Occupancy. |                                |
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.2.2.4 OVERTURNING: All shear walls shall have aspect ratios less than 4 to 1. Wall piers need not be considered. This statement shall apply to the Immediate Occupancy Performance Level only.  | Life Safety Performance Level. |
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.2.2.5 CONFINEMENT REINFORCING: For shear walls with aspect ratios greater than 2 to 1, the boundary elements shall be confined with spirals or ties with spacing less than $8d_b$ . This statement shall apply to the Immediate Occupancy Performance Level only.   | Life Safety Performance Level. |
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.2.2.6 REINFORCING AT OPENINGS: There shall be added trim reinforcement around all wall openings greater than three times the thickness of the wall. This statement shall apply to the Immediate Occupancy Performance Level only.   | Life Safety Performance Level. |
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.2.2.7 WALL THICKNESS: Thickness of bearing walls shall not be less than $1/25$ the unsupported height or length, whichever is shorter, nor less than 4". This statement shall apply to the Immediate Occupancy Performance Level only.  | Life Safety Performance Level. |

**DIAPHRAGMS**

- |                                     |                                     |                                     |   |   |
|-------------------------------------|-------------------------------------|-------------------------------------|---|---|
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/>            | 4.5.1.1 DIAPHRAGM CONTINUITY: The diaphragms shall not be composed of split-level floors and shall not have expansion joints.   |   |
| <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | 4.5.1.2 CROSS TIES: There shall be continuous cross ties between diaphragm chords.  | I-beams serve as cross ties in the EW direction. There are no cross ties in the NS direction. |
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/>            | 4.5.1.4 OPENINGS AT SHEAR WALLS: Diaphragm openings immediately adjacent to the shear walls shall be less than 25% of the wall length for Life Safety and 15% of the wall length for Immediate Occupancy.   |   |
| <input type="checkbox"/>            | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | 4.5.1.7 PLAN IRREGULARITIES: There shall be tensile capacity to develop the strength of the diaphragm at re-entrant corners or other locations of plan irregularities. This statement shall apply to the Immediate Occupancy Performance Level only.      | Life Safety Performance Level.  |
| <input type="checkbox"/>            | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | 4.5.1.8 DIAPHRAGM REINFORCEMENT AT OPENINGS: There shall be reinforcing around all diaphragm openings larger than 50% of the building width in either major plan dimension. This statement shall apply to the Immediate Occupancy Performance Level only. | Life Safety Performance Level.  |
| <input type="checkbox"/>            | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | 4.5.2.1 STRAIGHT SHEATHING: All straight sheathed diaphragms shall have aspect ratios less than 2 to 1 for Life Safety and 1 to 1 for Immediate Occupancy in the direction being considered.  |   |

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By: JYF Checked: JEH

## ASCE 31\* SUPPLEMENTAL CHECKLIST C2A: CONCRETE SHEAR WALL BUILDINGS WITH FLEXIBLE DIAPHRAGMS

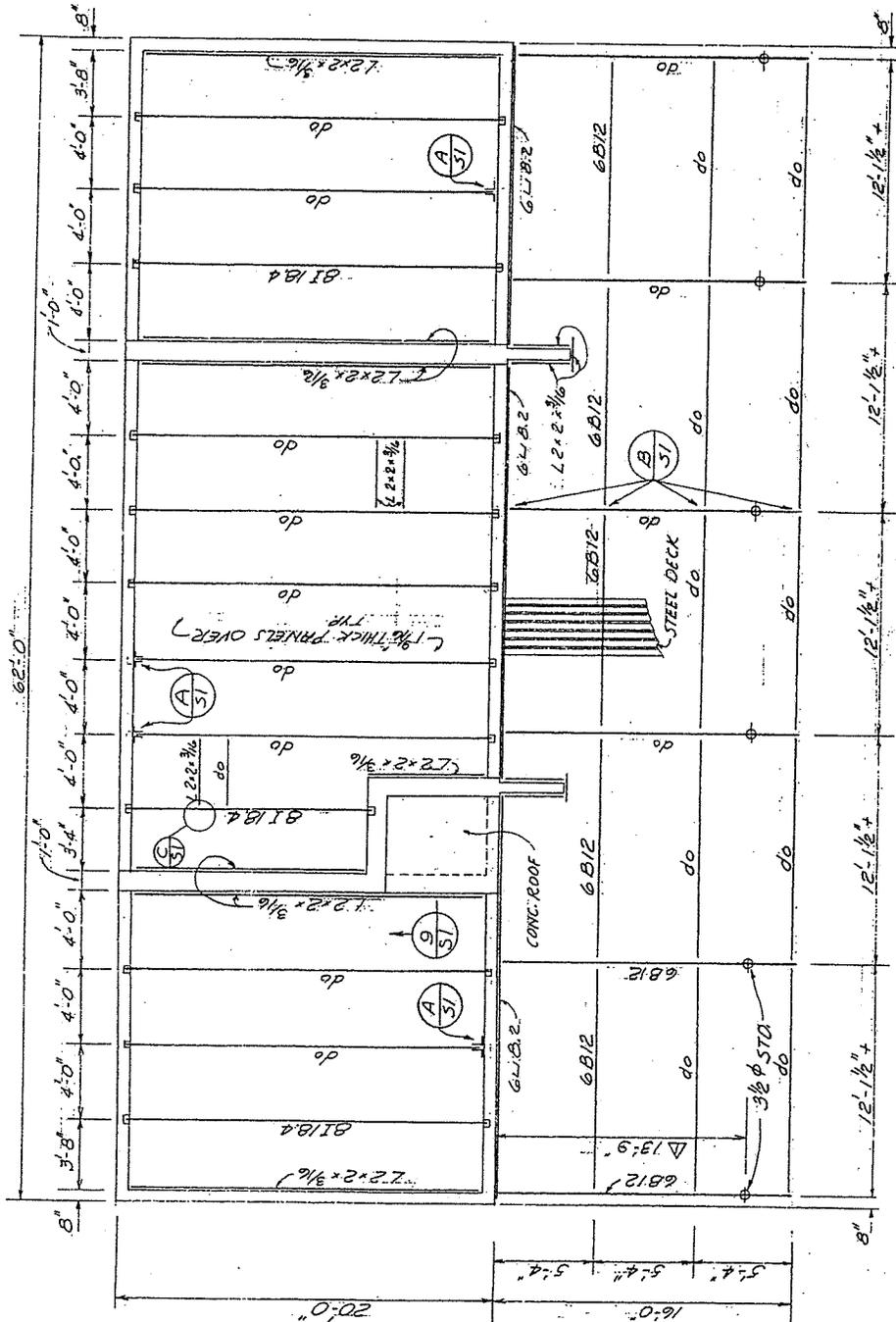
C	NC	N/A		Comments
<b>DIAPHRAGMS</b>				
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.5.2.2 SPANS: All wood diaphragms with spans greater than 24 ft for Life Safety and 12 ft for Immediate Occupancy shall consist of wood structural panels or diagonal sheathing.	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.5.2.3 UNBLOCKED DIAPHRAGMS: All diagonally sheathed and unblocked wood structural panel diaphragms shall have horizontal spans less than 40 ft for Life Safety and 30 ft for Immediate Occupancy and shall have aspect ratios less than or equal to 4 to 1 for Life Safety and 3 to 1 for Immediate Occupancy.	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.5.3.1 NON-CONCRETE FILLED DIAPHRAGMS: Untopped metal deck diaphragms or metal deck diaphragms with fill other than concrete shall consist of horizontal spans of less than 40 ft and shall have aspect ratios less than 4 to 1. This statement shall apply to the Immediate Occupancy Performance Level only.	
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	4.5.7.1 OTHER DIAPHRAGMS: The diaphragm shall not consist of a system other than wood, metal deck, concrete or horizontal bracing.	The roof consists of 1 9/16" panels. There are no information on which type of material are the panels. Site visit made on 8/19/03 indicate these panels are asbestos cement panels.
<b>CONNECTIONS</b>				
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.6.3.10 UPLIFT AT PILE CAPS: Pile caps shall have top reinforcement and piles shall be anchored to the pile caps for Life Safety, and the pile cap reinforcement and pile anchorage shall be able to develop the tensile capacity of the piles for Immediate Occupancy.	

\* – Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.





## ROOF PLAN



ROOF FRAMING PLAN  
4-1-03

### ***Building 827A***

Building 827A is a reinforced concrete bearing wall building, with one level above grade and a full basement below grade. The structure consists of reinforced concrete slabs and beams spanning to concrete bearing walls.

The primary structural deficiencies noted for Building 827A are as follows: 1) Two concrete walls on the upper level are not continuous to the bottom level; there are only beams below, with no supporting walls or columns; and 2) The columns at the center of the building do not have ductile detailing to withstand large deformations.

For the building to meet life-safety standards, we recommend that a column be added at the first level to resist overturning of the discontinuous shear walls. We recommend a more detailed analysis of the concrete columns to examine whether they can withstand seismic deformations.

Building Name: Building 827A Date: July 29, 2003  
 Building Address: Lawrence Livermore National Laboratory Page: 1 of 2  
 Job Number: A20047.08 Job Name: LLNL Prioritization By: LKF Checked: \_\_\_\_\_

## PRIORITIZATION BUILDING DATA SHEET

### BUILDING DATA

Year Built: 1965 (per LLNL records; not evident on dwgs)	Year(s) Remodeled: None known	UBC Zone: 4 – Type B Near Field
Area (sf): 2100 + basement	Length (ft): 52'	Width (ft): 41'
No. Stories: 2	Story Height: ~ 12'	Total Height: 23'-6", but only one story above grade (floor level is at grade at rear of bldg)

### CONSTRUCTION DATA

Gravity Load Structural System: Reinforced concrete slabs over concrete beams spanning to concrete bearing walls with strip footings and to concrete columns with spread footings.

Exterior Transverse Walls: Reinforced concrete, typ 8" thick      Openings?: Yes

Exterior Longitudinal Walls: Reinforced concrete, typ 8" thick      Openings?: Yes

Roof Framing: 4" concrete slab with #3@12 and #4@12 over reinforced concrete beams, typ. 20"x12"

Intermediate Floor Framing: 4" concrete slab with #3@12 over reinforced concrete beams, typ. 20"x12"

Ground Floor: 6" concrete slab-on-grade with #3@12 e.w.

Columns: 12" sq. concrete columns

Foundation: Strip footings

### LATERAL-FORCE-RESISTING SYSTEM

	Longitudinal	Transverse
System Classification:	C2: Concrete Shear Wall Building with Rigid or Stiff Diaphragm	C2: Concrete Shear Wall Building with Rigid or Stiff Diaphragm
Vertical Elements:	Reinforced concrete shear walls	Reinforced concrete shear walls
Diaphragms:	Reinforced concrete slab	Reinforced concrete slab

SEISMIC EVALUATION PERFORMED? Yes EVALUATION: Rapid Evaluation YEAR: 2003

SEISMIC EVALUATION CRITERIA: Life Safety/ ASCE 31-02

6

VULNERABILITY RATING: \_\_\_\_\_  
(1=low to 10=high)

PRIORITIZATION CLASSIFICATION: CLASS C

Building Name: **Building 827A**

Date: **July 29, 2003**

Building Address: **Lawrence Livermore National Laboratory**

Page: **2** of **2**

Job Number: **A20047.08**

Job Name: **LLNL Prioritization**

By: **LKF** Checked:

## PRIORITIZATION BUILDING DATA SHEET

### POTENTIAL LIFE SAFETY DEFICIENCIES:

THIS BUILDING WAS EVALUATED FOR THE 10% IN 50 YR. EARTHQUAKE.

#### VERTICAL DISCONTINUITIES

*Some concrete walls on the second level do not align with any walls on the first level. This is a concern because overturning of the discontinuous walls may damage the supporting gravity beams. Structure is a concrete box in elastic seismic demands on the beams will be united since demands on perimeter concrete walls are low.*

#### DEFLECTION COMPATIBILITY

*Columns at center of building (supporting long girders) are not properly detailed, without 135-degree hooks and with #3 ties at 12". Further evaluation is required to determine whether columns can undergo the deformations associated with seismic drift. However, this is a low priority deficiency because the walls are lowly stressed and the roof diaphragm is relatively stiff, so neither the walls nor the diaphragm is expected to experience large deformations.*

### PRELIMINARY STRENGTHENING SCHEMES OR MITIGATION MEASURES:

#### VERTICAL DISCONTINUITIES

*Add a column at the first level at the end of the discontinuous shear walls, to resist overturning of upper wall.*

#### DEFLECTION COMPATIBILITY

*Further evaluation would probably show that columns could undergo the deformations associated with seismic demands.*

Building Name: Building 827A

Date: July 29, 2003

Building Address: Lawrence Livermore National Laboratory

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Job Number: A20047.08

Job Name: LLNL Prioritization

By: LKF Checked: \_\_\_\_\_

## ASCE 31\* BASIC CHECKLIST C2: CONCRETE SHEAR WALL BUILDINGS WITH RIGID OR STIFF DIAPHRAGMS

C	NC	N/A		Comments
<b>BUILDING SYSTEM</b>				
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.1.1 LOAD PATH: The structure shall contain a minimum of one complete load path for Life Safety and Immediate Occupancy for seismic force effects from any horizontal direction that serves to transfer the inertial forces from the mass to the foundation.	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.1.3 MEZZANINES: Interior mezzanine levels shall be braced independently from the main structure, or shall be anchored to the lateral-force-resisting elements of the main structure.	No interior mezzanine levels.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.2.1 WEAK STORY: The strength of the lateral-force-resisting system in any story shall not be less than 80% of the strength in an adjacent story above or below for Life-Safety and Immediate Occupancy.	The two stories are similar.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.2.2 SOFT STORY: The stiffness of the lateral-force-resisting-system in any story shall not be less than 70% of the lateral-force-resisting system stiffness in an adjacent story above or below, or less than 80% of the average lateral-force-resisting system stiffness of the three stories above or below for Life Safety and Immediate Occupancy.	The two stories are similar.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.2.3 GEOMETRY: There shall be no changes in horizontal dimension of the lateral-force-resisting system of more than 30% in a story relative to adjacent stories for Life Safety and Immediate Occupancy, excluding one-story penthouses and mezzanines.	The two stories are similar.
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	4.3.2.4 VERTICAL DISCONTINUITIES: All vertical elements in the lateral-force-resisting system shall be continuous to the foundation.	Some concrete walls on the second level do not align with any walls on the first level. This is a concern because overturning of the discontinuous walls may overwhelm the supporting beams below. Based on preliminary calculations (D/C beam=4), this is a high priority deficiency.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.2.5 MASS: There shall be no change in effective mass of more than 50% from one story to the next for Life Safety and Immediate Occupancy. Light roofs, penthouses and mezzanines need not be considered.	The two stories are similar.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.2.6 TORSION: The estimated distance between the story center of mass and the story center of rigidity shall be less than 20% of the building width in either plan dimension for Life Safety and Immediate Occupancy.	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.3.4 DETERIORATION OF CONCRETE: There shall be no visible deterioration of concrete or reinforcing steel in any of the vertical- or lateral-force-resisting elements.	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.3.5 POST-TENSIONING ANCHORS: There shall be no evidence of corrosion or spalling in the vicinity of post-tensioning or end fittings. Coil anchors shall not have been used.	No post-tensioning anchors.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.3.9 CONCRETE WALL CRACKS: All existing diagonal cracks in wall elements shall be less than 1/8" for Life Safety and 1/16" for Immediate Occupancy, shall not be concentrated in one location, and shall not form an X pattern.	

Building Name: Building 827A

Date: July 29, 2003

Building Address: Lawrence Livermore National Laboratory

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Job Number: A20047.08

Job Name: LLNL Prioritization

By: LKF Checked: \_\_\_\_\_

## ASCE 31\* BASIC CHECKLIST C2: CONCRETE SHEAR WALL BUILDINGS WITH RIGID OR STIFF DIAPHRAGMS

C NC N/A

Comments

### LATERAL-FORCE-RESISTING SYSTEM

- |                                     |                          |                          |   |  |
|-------------------------------------|--------------------------|--------------------------|---|--|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <p>4.4.1.6.1 COMPLETE FRAMES: Steel or concrete frames classified as secondary components shall form a complete vertical load carrying system.</p>  | <p>The gravity-load-carrying frame is complete because, rather than framing directly to the wall, beams frame into concrete columns (some independent, some embedded in the wall).</p> |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <p>4.4.2.1.1 REDUNDANCY: The number of lines of shear walls in each principal direction shall be greater than or equal to 2 for Life Safety and Immediate Occupancy.</p>  | <p>There are two primary shear walls in each direction.</p>  |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <p>4.4.2.2.1 SHEAR STRESS CHECK: The shear stress in the concrete shear walls, calculated using the Quick Check procedure of Section 3.5.3.3, shall be less than 100 psi or <math>2\sqrt{f'_c}</math> for Life Safety and Immediate Occupancy.</p>  | <p><math>V_j^{avg} = 32</math> psi max &lt; 100 psi<br/>(<math>f'_c</math> unknown)</p>  |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <p>4.4.2.2.2 REINFORCING STEEL: The ratio of reinforcing steel area to gross concrete area shall be not less than 0.0015 in the vertical direction and 0.0025 in the horizontal direction for Life Safety and Immediate Occupancy. The spacing of reinforcing steel shall be equal to or less than 18" for Life Safety and Immediate Occupancy.</p> | <p>Max spacing is 18".<br/>8" wall: #6@12" vert e.f. → 0.0092 <u>OK</u><br/>8" wall: #4@18" horiz e.f. → 0.0027 <u>OK</u><br/>8" wall: #4@9" e.w. → 0.0027 <u>OK</u></p>               |

### CONNECTIONS

- |                                     |                          |                          |  |   |
|-------------------------------------|--------------------------|--------------------------|--|---|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <p>4.6.2.1 TRANSFER TO SHEAR WALLS: Diaphragms shall be connected for transfer of loads to the shear walls for Life Safety and the connections shall be able to develop the lesser of the shear strength of the walls or diaphragms for Immediate Occupancy.</p> | <p>The concrete diaphragm is attached for shear transfer with continuous reinforcement.</p> |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <p>4.6.3.5 FOUNDATION DOWELS: Wall reinforcement shall be doweled into the foundation for Life Safety and the dowels shall be able to develop the lesser of the strength of the walls or the uplift capacity of the foundation for Immediate Occupancy.</p>      | <p>Walls are doweled into strip footings and columns to spread footings.</p>                |

\* – Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.

Building Name: Building 827A

Date: July 29, 2003

Building Address: Lawrence Livermore National Laboratory

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Job Number: A20047.08 Job Name: LLNL Prioritization

By: LKF Checked: \_\_\_\_\_

## ASCE 31\* SUPPLEMENTAL CHECKLIST C2: CONCRETE SHEAR WALL BUILDINGS WITH RIGID OR STIFF DIAPHRAGMS

**C NC N/A**

**Comments**

### LATERAL-FORCE-RESISTING SYSTEM

- |                          |                                     |                                     |  |   |
|--------------------------|-------------------------------------|-------------------------------------|--|---|
| <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <p>4.4.1.6.2 DEFLECTION COMPATIBILITY: Secondary components shall have the shear capacity to develop the flexural strength of the components for Life Safety and shall meet the requirements of 4.4.1.4.9, 4.4.1.4.10, 4.4.1.4.11, 4.4.1.4.12 and 4.4.1.4.15 for Immediate Occupancy.</p>  | <p>Columns at center of building (supporting long girders) are not properly detailed, without 135-degree hooks and with #3 ties at 12". Further evaluation is required to determine whether columns can undergo the deformations associated with seismic drift. However, this is a low priority deficiency because the walls are lowly stressed and the roof diaphragm is relatively stiff, so neither the walls nor the diaphragm is expected to experience large deformation.</p> |
| <input type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <p>4.4.1.6.3 FLAT SLABS: Flat slabs/plates not part of lateral-force-resisting system shall have continuous bottom steel through the column joints for Life Safety.</p>  | <p>No such flat slabs/ plates.</p>  |
| <input type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <p>4.4.2.2.3 COUPLING BEAMS: The stirrups in coupling beams over means of egress shall be spaced at or less than <math>d/2</math> and shall be anchored into the confined core of the beam with hooks of 135° or more for Life Safety. All coupling beams shall comply with the requirements above and shall have the capacity in shear to develop the uplift capacity of the adjacent wall for Immediate Occupancy.</p> | <p>No coupling beams.</p>   |
| <input type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <p>4.4.2.2.4 OVERTURNING: All shear walls shall have aspect ratios less than 4 to 1. Wall piers need not be considered. This statement shall apply to the Immediate Occupancy Performance Level only.</p>  | <p>Statement applies to Immediate Occupancy Performance Level only.</p>   |
| <input type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <p>4.4.2.2.5 CONFINEMENT REINFORCING: For shear walls with aspect ratios greater than 2 to 1, the boundary elements shall be confined with spirals or ties with spacing less than <math>8d_b</math>. This statement shall apply to the Immediate Occupancy Performance Level only.</p>   | <p>Statement applies to Immediate Occupancy Performance Level only.</p>   |
| <input type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <p>4.4.2.2.6 REINFORCING AT OPENINGS: There shall be added trim reinforcement around all wall openings greater than three times the thickness of the wall. This statement shall apply to the Immediate Occupancy Performance Level only.</p>   | <p>Statement applies to Immediate Occupancy Performance Level only.</p>   |
| <input type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <p>4.4.2.2.7 WALL THICKNESS: Thickness of bearing walls shall not be less than <math>1/25</math> the unsupported height or length, whichever is shorter, nor less than 4". This statement shall apply to the Immediate Occupancy Performance Level only.</p>   | <p>Statement applies to Immediate Occupancy Performance Level only.</p>   |

### DIAPHRAGMS

- |                                     |                          |                          |  |   |
|-------------------------------------|--------------------------|--------------------------|--|---|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <p>4.5.1.1 DIAPHRAGM CONTINUITY: The diaphragms shall not be composed of split-level floors and shall not have expansion joints.</p>   | <p>Continuous diaphragms.</p>                                 |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <p>4.5.1.4 OPENINGS AT SHEAR WALLS: Diaphragm openings immediately adjacent to the shear walls shall be less than 25% of the wall length for Life Safety and 15% of the wall length for Immediate Occupancy.</p> | <p>No large openings immediately adjacent to shear walls.</p> |

Building Name: Building 827A

Date: July 29, 2003

Building Address: Lawrence Livermore National Laboratory

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Job Number: A20047.08 Job Name: LLNL Prioritization

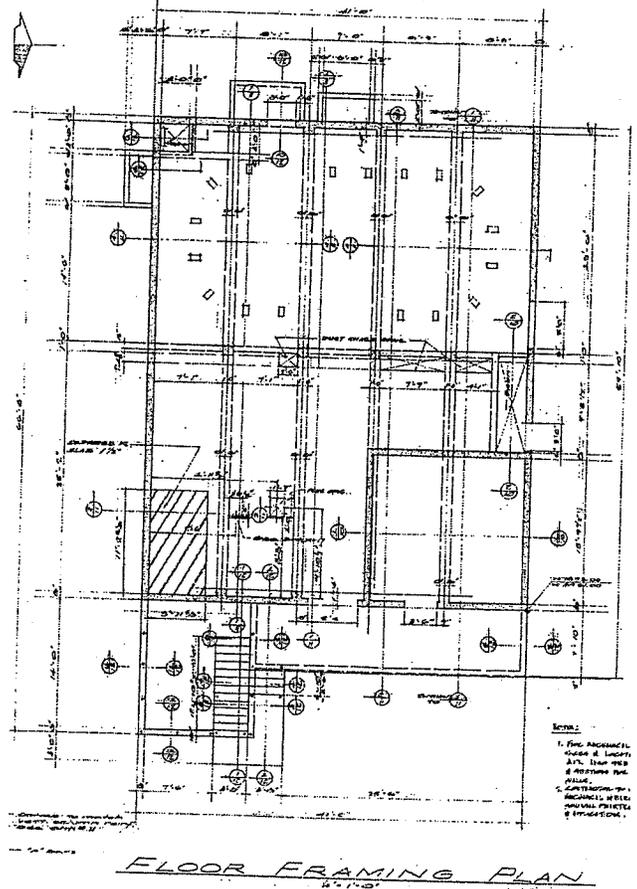
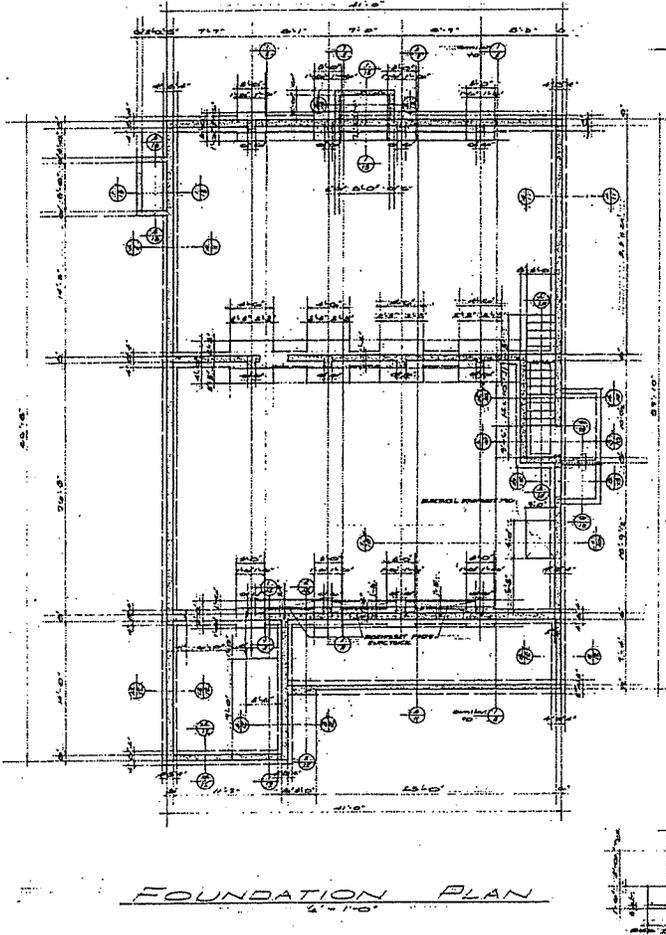
By: LKF Checked: \_\_\_\_\_

**ASCE 31\* SUPPLEMENTAL CHECKLIST C2: CONCRETE SHEAR WALL BUILDINGS WITH RIGID OR STIFF DIAPHRAGMS**

C	NC	N/A		Comments
<b>DIAPHRAGMS</b>				
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.5.1.7 PLAN IRREGULARITIES: There shall be tensile capacity to develop the strength of the diaphragm at re-entrant corners or other locations of plan irregularities. This statement shall apply to the Immediate Occupancy Performance Level only.	Statement applies to Immediate Occupancy Performance Level only.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.5.1.8 DIAPHRAGM REINFORCEMENT AT OPENINGS: There shall be reinforcing around all diaphragm openings larger than 50% of the building width in either major plan dimension. This statement shall apply to the Immediate Occupancy Performance Level only.	Statement applies to Immediate Occupancy Performance Level only.
<b>CONNECTIONS</b>				
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.6.3.10 UPLIFT AT PILE CAPS: Pile caps shall have top reinforcement and piles shall be anchored to the pile caps for Life Safety, and the pile cap reinforcement and pile anchorage shall be able to develop the tensile capacity of the piles for Immediate Occupancy.	There are no pile caps.

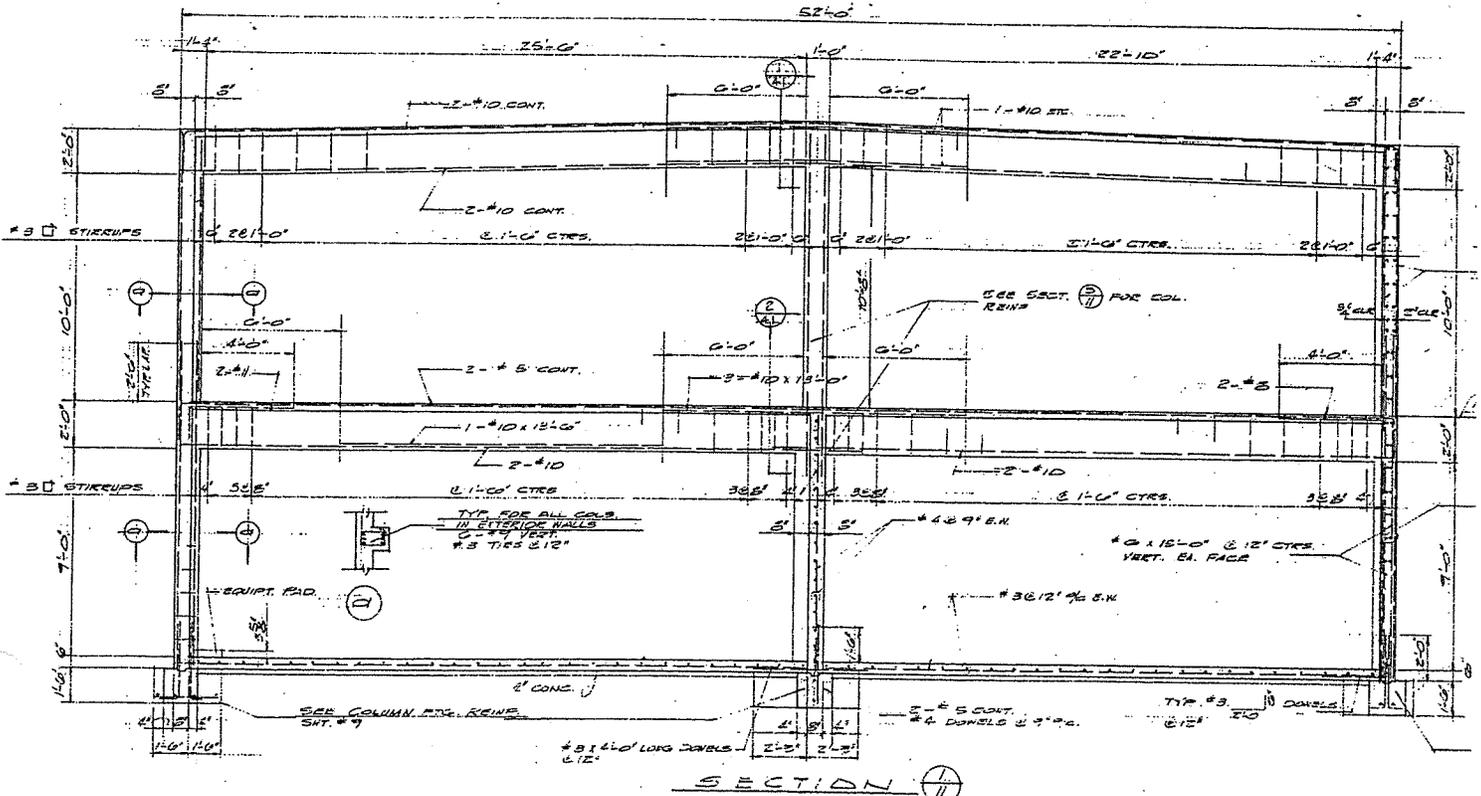
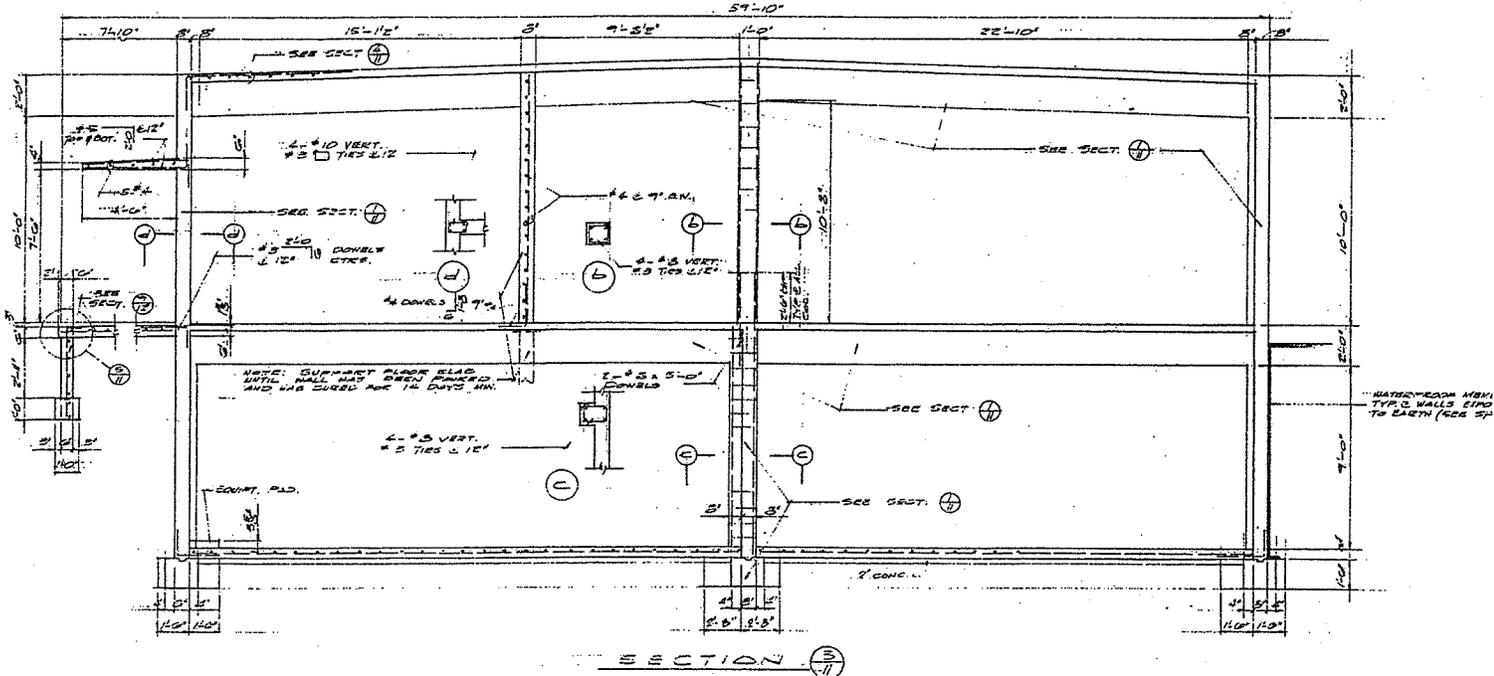
\* – Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.

# BUILDING PLAN





**BUILDING PLAN**



***Buildings 827C, 827D, and 827E***

Buildings 827C, 827D and 827E are one-story reinforced concrete bearing wall buildings. The structures consist of 12" thick concrete flat slabs supported by concrete beams and shear walls. The primary structural deficiency noted for these buildings is that the mezzanine steel grating, which support mechanical equipment, is not well-connected to the steel support framing. Only clips are present, so the grating may slip off the beam supports and the equipment may become falling hazards. For the building to meet life-safety requirements, we recommend that the connections at the mezzanine gratings are strengthened.

Building Name: **Building 827C** (also valid for 827D and 827E; buildings are almost identical) Date: **July 31, 2003**

Building Address: **Lawrence Livermore National Laboratory** Page: **1** of **1**

Job Number: **A20047.08** Job Name: **LLNL Prioritization** By: **LKF** Checked: \_\_\_\_\_

## PRIORITIZATION BUILDING DATA SHEET

### BUILDING DATA

Year Built: 1965 (per LLNL records; not evident on dwgs)	Year(s) Remodeled: None known	UBC Zone: 4 – Type B Near Field
Area (sf): 3200	Length (ft): 87'	Width (ft): 28'
No. Stories: 1 tall story with mezzanine	Story Height: 22'-9"	Total Height: 26'-3" including parapet

### CONSTRUCTION DATA

Gravity Load Structural System: Concrete slabs and beams spanning to concrete retaining walls and bearing walls with strip footings

Exterior Transverse Walls: Reinforced concrete, typically 12" thick	Openings?: No; soil surrounding
Exterior Longitudinal Walls: Reinforced concrete, typically 12" thick	Openings?: Yes, at front (South)
Roof Framing: 12" concrete slab with #4@12 e.w. top, and #6@6 e.w. bot.	
Intermediate Floor Framing: @ mezzanine: 8" concrete slab with #4@12 each way, or 1 1/4" steel grating over steel WF beams	
Ground Floor: 6" concrete slab-on-grade with #4@18 e.w.	
Columns: 42" x 24" piers at perimeter	
Foundation: Strip footings/ retaining walls	

### LATERAL-FORCE-RESISTING SYSTEM

	Longitudinal	Transverse
System Classification:	C2: Concrete Shear Wall Building with Rigid or Stiff Diaphragm	C2: Concrete Shear Wall Building with Rigid or Stiff Diaphragm
Vertical Elements:	Reinforced concrete shear walls	Reinforced concrete shear walls
Diaphragms:	Reinforced concrete slab	Reinforced concrete slab

SEISMIC EVALUATION PERFORMED? Yes EVALUATION: Rapid Evaluation YEAR: 2003

SEISMIC EVALUATION CRITERIA: Life Safety/ ASCE 31-02

VULNERABILITY RATING: 4  
(1=low to 10=high)

PRIORITIZATION CLASSIFICATION: CLASS C

### POTENTIAL LIFE SAFETY DEFICIENCIES:

THIS BUILDING WAS EVALUATED FOR THE 10% IN 50 YR. EARTHQUAKE.

#### MEZZANINES / FALLING HAZARD

*The small intermediate slab at the interior "mezzanine" level at the center of the building is connected to the main structural system; the reinforcement is continuous with the wall reinforcement. The supporting steel beams at the equipment area are well connected to the concrete walls, but the grating over the beams is not well connected to the beams. Only clips are present, so the grating may slip off the beam supports and the equipment supported on the mezzanine level may become falling hazards.*

### PRELIMINARY STRENGTHENING SCHEMES OR MITIGATION MEASURES:

#### MEZZANINES / FALLING HAZARD

*Further evaluation may show that the building deformations will be small enough such that the mezzanine grating will not move off the beam supports. Alternatively, strengthening of the connections of the grating to the structure would eliminate this deficiency.*

Building Name: Building 827C (also valid for 827D and 827E; buildings are almost identical) Date: July 31, 2003  
 Building Address: Lawrence Livermore National Laboratory Page: 1 of 2  
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## ASCE 31\* BASIC CHECKLIST C2: CONCRETE SHEAR WALL BUILDINGS WITH RIGID OR STIFF DIAPHRAGMS

C	NC	N/A		Comments
<b>BUILDING SYSTEM</b>				
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.1.1 LOAD PATH: The structure shall contain a minimum of one complete load path for Life Safety and Immediate Occupancy for seismic force effects from any horizontal direction that serves to transfer the inertial forces from the mass to the foundation.	
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	4.3.1.3 MEZZANINES: Interior mezzanine levels shall be braced independently from the main structure, or shall be anchored to the lateral-force-resisting elements of the main structure.	The small intermediate slab at the interior "mezzanine" level at the center of the building is connected to the main structural system; the reinforcement is continuous with the wall reinforcement. The supporting steel beams at the equipment area are well connected to the concrete walls, but the grating over the beams is not well connected to the beams. Only clips are present, so the grating may slip off the beam supports and the equipment supported on the mezzanine level may become falling hazards.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.1 WEAK STORY: The strength of the lateral-force-resisting system in any story shall not be less than 80% of the strength in an adjacent story above or below for Life-Safety and Immediate Occupancy.	One story building.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.2 SOFT STORY: The stiffness of the lateral-force-resisting-system in any story shall not be less than 70% of the lateral-force-resisting system stiffness in an adjacent story above or below, or less than 80% of the average lateral-force-resisting system stiffness of the three stories above or below for Life Safety and Immediate Occupancy.	One story building.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.3 GEOMETRY: There shall be no changes in horizontal dimension of the lateral-force-resisting system of more than 30% in a story relative to adjacent stories for Life Safety and Immediate Occupancy, excluding one-story penthouses and mezzanines.	One story building.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.2.4 VERTICAL DISCONTINUITIES: All vertical elements in the lateral-force-resisting system shall be continuous to the foundation.	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.5 MASS: There shall be no change in effective mass of more than 50% from one story to the next for Life Safety and Immediate Occupancy. Light roofs, penthouses and mezzanines need not be considered.	One story building.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.2.6 TORSION: The estimated distance between the story center of mass and the story center of rigidity shall be less than 20% of the building width in either plan dimension for Life Safety and Immediate Occupancy.	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.3.4 DETERIORATION OF CONCRETE: There shall be no visible deterioration of concrete or reinforcing steel in any of the vertical- or lateral-force-resisting elements.	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.3.5 POST-TENSIONING ANCHORS: There shall be no evidence of corrosion or spalling in the vicinity of post-tensioning or end fittings. Coil anchors shall not have been used.	No post-tensioning anchors.

Building Name: **Building 827C** (also valid for 827D and 827E; buildings are almost identical) Date: **July 31, 2003**  
 Building Address: **Lawrence Livermore National Laboratory** Page: **2** of **2**  
 Job Number: **A20047.08** Job Name: **LLNL Prioritization** By: **LKF** Checked: \_\_\_\_\_

## ASCE 31\* BASIC CHECKLIST C2: CONCRETE SHEAR WALL BUILDINGS WITH RIGID OR STIFF DIAPHRAGMS

C	NC	N/A		Comments
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### BUILDING SYSTEM

- |                                     |                          |                          |  |  |
|-------------------------------------|--------------------------|--------------------------|--|--|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 4.3.3.9 CONCRETE WALL CRACKS: All existing diagonal cracks in wall elements shall be less than 1/8" for Life Safety and 1/16" for Immediate Occupancy, shall not be concentrated in one location, and shall not form an X pattern. |  |
|-------------------------------------|--------------------------|--------------------------|--|--|

### LATERAL-FORCE-RESISTING SYSTEM

- |                                     |                          |                                     |  |  |
|-------------------------------------|--------------------------|-------------------------------------|--|--|
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.1.6.1 COMPLETE FRAMES: Steel or concrete frames classified as secondary components shall form a complete vertical load carrying system.  | System consists only of a thick slab spanning to thick concrete walls.   |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.4.2.1.1 REDUNDANCY: The number of lines of shear walls in each principal direction shall be greater than or equal to 2 for Life Safety and Immediate Occupancy.  | There are two primary shear walls in each direction.   |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.4.2.2.1 SHEAR STRESS CHECK: The shear stress in the concrete shear walls, calculated using the Quick Check procedure of Section 3.5.3.3, shall be less than 100 psi or $2\sqrt{f'_c}$ for Life Safety and Immediate Occupancy.   | For transverse direction:<br>$V_j^{avg} = 52 \text{ psi max} < 100 \text{ psi (} f'_c \text{ unknown)}$<br><br>Longitudinal direction not checked; retaining walls with soil up to roof level will prevent significant deformation or high stresses in longitudinal direction. |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.4.2.2.2 REINFORCING STEEL: The ratio of reinforcing steel area to gross concrete area shall be not less than 0.0015 in the vertical direction and 0.0025 in the horizontal direction for Life Safety and Immediate Occupancy. The spacing of reinforcing steel shall be equal to or less than 18" for Life Safety and Immediate Occupancy. | Per sections on sheet 21:<br>⇒ Max spacing is 18".<br>⇒ Reinforcing is as follows:<br>12" wall: #6@6" vert inside,<br>#4@12 vert outside → 0.0075 OK<br>12" wall: #7@6" horiz inside,<br>#4@12 horiz outside → 0.0097 OK<br>12" wall: #4@12" e.w.e.f. → 0.0028 OK              |

### CONNECTIONS

- |                                     |                          |                          |   |  |
|-------------------------------------|--------------------------|--------------------------|---|--|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 4.6.2.1 TRANSFER TO SHEAR WALLS: Diaphragms shall be connected for transfer of loads to the shear walls for Life Safety and the connections shall be able to develop the lesser of the shear strength of the walls or diaphragms for Immediate Occupancy. | The concrete diaphragm is attached for shear transfer with continuous reinforcement. |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 4.6.3.5 FOUNDATION DOWELS: Wall reinforcement shall be doweled into the foundation for Life Safety and the dowels shall be able to develop the lesser of the strength of the walls or the uplift capacity of the foundation for Immediate Occupancy.      | Walls are doweled into strip footings.   |

\* - Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.

Building Name: **Building 827C** (also valid for 827D and 827E; buildings are almost identical)

 Date: **July 31, 2003**

 Building Address: **Lawrence Livermore National Laboratory**

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 Job Number: **A20047.08**

 Job Name: **LLNL Prioritization**

 By: **LKF** Checked: \_\_\_\_\_

## ASCE 31\* SUPPLEMENTAL CHECKLIST C2: CONCRETE SHEAR WALL BUILDINGS WITH RIGID OR STIFF DIAPHRAGMS

C NC N/A

Comments

### LATERAL-FORCE-RESISTING SYSTEM

- |                          |                          |                                     |  |   |
|--------------------------|--------------------------|-------------------------------------|--|---|
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.1.6.2 DEFLECTION COMPATIBILITY: Secondary components shall have the shear capacity to develop the flexural strength of the components for Life Safety and shall meet the requirements of 4.4.1.4.9, 4.4.1.4.10, 4.4.1.4.11, 4.4.1.4.12 and 4.4.1.4.15 for Immediate Occupancy.   | No secondary components.  |
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.1.6.3 FLAT SLABS: Flat slabs/plates not part of lateral-force-resisting system shall have continuous bottom steel through the column joints for Life Safety.   | Flat slabs are part of the lateral-force-resisting-system, and are well detailed with continuous steel through the joints at walls. |
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.2.2.3 COUPLING BEAMS: The stirrups in coupling beams over means of egress shall be spaced at or less than $d/2$ and shall be anchored into the confined core of the beam with hooks of 135° or more for Life Safety. All coupling beams shall comply with the requirements above and shall have the capacity in shear to develop the uplift capacity of the adjacent wall for Immediate Occupancy. | No coupling beams.  |
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.2.2.4 OVERTURNING: All shear walls shall have aspect ratios less than 4 to 1. Wall piers need not be considered. This statement shall apply to the Immediate Occupancy Performance Level only.   | Statement applies to Immediate Occupancy Performance Level only.  |
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.2.2.5 CONFINEMENT REINFORCING: For shear walls with aspect ratios greater than 2 to 1, the boundary elements shall be confined with spirals or ties with spacing less than $8d_b$ . This statement shall apply to the Immediate Occupancy Performance Level only.  | Statement applies to Immediate Occupancy Performance Level only.  |
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.2.2.6 REINFORCING AT OPENINGS: There shall be added trim reinforcement around all wall openings greater than three times the thickness of the wall. This statement shall apply to the Immediate Occupancy Performance Level only.  | Statement applies to Immediate Occupancy Performance Level only.  |
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.2.2.7 WALL THICKNESS: Thickness of bearing walls shall not be less than 1/25 the unsupported height or length, whichever is shorter, nor less than 4". This statement shall apply to the Immediate Occupancy Performance Level only.   | Statement applies to Immediate Occupancy Performance Level only.  |

### DIAPHRAGMS

- |                                     |                          |                                     |  |  |
|-------------------------------------|--------------------------|-------------------------------------|--|--|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.5.1.1 DIAPHRAGM CONTINUITY: The diaphragms shall not be composed of split-level floors and shall not have expansion joints.  | Continuous diaphragm at roof level.                              |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.5.1.4 OPENINGS AT SHEAR WALLS: Diaphragm openings immediately adjacent to the shear walls shall be less than 25% of the wall length for Life Safety and 15% of the wall length for Immediate Occupancy.  | Per available drawings, the roof diaphragm has no openings.      |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.5.1.7 PLAN IRREGULARITIES: There shall be tensile capacity to develop the strength of the diaphragm at re-entrant corners or other locations of plan irregularities. This statement shall apply to the Immediate Occupancy Performance Level only. | Statement applies to Immediate Occupancy Performance Level only. |

Building Name: Building 827C (also valid for 827D and 827E; buildings are almost identical) Date: July 31, 2003

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**ASCE 31\* SUPPLEMENTAL CHECKLIST C2: CONCRETE SHEAR WALL  
BUILDINGS WITH RIGID OR STIFF DIAPHRAGMS**

**C NC N/A** **Comments**

**DIAPHRAGMS**

- |   |                |  |  |
|---|----------------|--|--|
| <input type="checkbox"/> <input type="checkbox"/> <input checked="" type="checkbox"/> | <p>4.5.1.8</p> | <p>DIAPHRAGM REINFORCEMENT AT OPENINGS: There shall be reinforcing around all diaphragm openings larger than 50% of the building width in either major plan dimension. This statement shall apply to the Immediate Occupancy Performance Level only.</p> | <p><b>Statement applies to Immediate Occupancy Performance Level only.</b></p> |
|---|----------------|--|--|

**CONNECTIONS**

- |   |                 |  |                                       |
|---|-----------------|--|---------------------------------------|
| <input type="checkbox"/> <input type="checkbox"/> <input checked="" type="checkbox"/> | <p>4.6.3.10</p> | <p>UPLIFT AT PILE CAPS: Pile caps shall have top reinforcement and piles shall be anchored to the pile caps for Life Safety, and the pile cap reinforcement and pile anchorage shall be able to develop the tensile capacity of the piles for Immediate Occupancy.</p> | <p><b>There are no pile caps.</b></p> |
|---|-----------------|--|---------------------------------------|

\* – Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.





### ***Building 833***

Building 833 is a one-story reinforced concrete bearing wall building. The structure consists of a 12" thick concrete flat slab supported by concrete shear walls. There has been two additions at Building 833. The East Addition is similar to the main structure. The West Addition consists of an asbestos cement slab supported on interior WF beams and columns and exterior asbestos cement panels. The potential structural deficiencies noted for Building 833 are 1) The asbestos roof cannot adequately deliver seismic load to the lateral-force-resisting elements at the West Addition; and 2) Out of plane wall anchorage could not be identified on the West Addition. For the building to meet life-safety requirements, we recommend that the roof be replaced or strengthened with horizontal rod bracing or metal deck at the West Addition. In addition, we recommend that the out of plane wall anchorage at the West Addition be further investigated or strengthened.

Building Name: **Building 833**

Date: **August 21, 2003**

Building Address: **Lawrence Livermore National Laboratory**

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Job Number: **A20047.08**

Job Name: **LLNL Prioritization**

By: **JYF** Checked: **JEH**

## PRIORITIZATION BUILDING DATA SHEET

### BUILDING DATA

Year Built:	1959	Year(s) Remodeled:	No Available Info	UBC Zone:	4 – Type B Near Field
Area (sf):	2,050	Length (ft):	51	Width (ft):	38
No. Stories:	1	Story Height:	11'	Total Height:	11'

### CONSTRUCTION DATA

Gravity Load Structural System: 12" thick flat slab supported on interior and exterior 8" to 1'-0" thick reinforced concrete shear walls. At the West Addition: Asbestos cement slab supported on interior WF beams and columns and exterior asbestos cement panels.

Exterior Transverse Walls: 8" to 1'-0" thick reinforced concrete shear walls or asbestos cement panels      Openings?: Door and window openings

Exterior Longitudinal Walls: 8" to 1'-0" thick reinforced concrete shear walls or asbestos cement panels      Openings?: Door and window openings

Roof Framing: 12" thick flat slab, at the West Addition: asbestos cement slab

Intermediate Floor Framing: None

Ground Floor: 4" thick concrete slab on grade w/ 4x4x6/6 WWF

Columns: None

Foundation: Concrete strip footing

### LATERAL-FORCE-RESISTING SYSTEM

	Longitudinal	Transverse
System Classification:	Type 9 (Concrete Shear Wall Building w/ Stiff Diaphragm)	Type 9 (Concrete Shear Wall Building w/ Stiff Diaphragm)
Vertical Elements:	Concrete flat slab, concrete shear walls Asbestos cement slab, asbestos cement walls	Concrete flat slab, concrete shear walls Asbestos cement slab, asbestos cement walls
Diaphragms:	12" thick concrete flat slab, Asbestos cement slab	12" thick concrete flat slab, Asbestos cement slab

SEISMIC EVALUATION PERFORMED? Yes      EVALUATION: Rapid Evaluation      YEAR: 2003

SEISMIC EVALUATION CRITERIA: Life Safety/ ASCE 31-02

VULNERABILITY RATING: 5  
(1=low to 10=high)

PRIORITIZATION CLASSIFICATION: CLASS C

Building Name: **Building 833**

Date: **August 21, 2003**

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Job Name: **LLNL Prioritization**

By: **JYF** Checked: **JEH**

## PRIORITIZATION BUILDING DATA SHEET

### POTENTIAL LIFE SAFETY DEFICIENCIES:

THIS BUILDING WAS EVALUATED FOR THE 10% IN 50 YR. EARTHQUAKE.

#### OTHER DIAPHRAGMS

*The roof at the addition on the West Side of the building consists of asbestos cement panels.*

#### WALL ANCHORAGE

*Out of plane anchorage could not be verified on the site visit for the West Side addition. No drawings are available for review.*

### PRELIMINARY STRENGTHENING SCHEMES OR MITIGATION MEASURES:

Further investigation of the West Side addition is recommended. Add out of plane anchorage at the West Side Addition as required.

Strengthen the diaphragm at the West Side Addition with rod bracing or metal deck.

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Job Name: **LLNL Prioritization**

By: **JYF** Checked: **JEH**

## ASCE 31\* BASIC CHECKLIST C2: CONCRETE SHEAR WALL BUILDINGS WITH RIGID OR STIFF DIAPHRAGMS

**C NC N/A**

**Comments**

### BUILDING SYSTEM

<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.1.1	LOAD PATH: The structure shall contain a minimum of one complete load path for Life Safety and Immediate Occupancy for seismic force effects from any horizontal direction that serves to transfer the inertial forces from the mass to the foundation.	12" thick LWC flat slab supported by 8" to 1'-0" thick reinforced concrete shear walls. The shear walls are doveled into the foundation system. Similar for the Addition on the East side of the building. At the Addition on the West side of the building, the slab consists of asbestos cement. The load is transferred from the slab to the interior WF beams and columns or exterior asbestos cement panels.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.1.3	MEZZANINES: Interior mezzanine levels shall be braced independently from the main structure, or shall be anchored to the lateral-force-resisting elements of the main structure.	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.1	WEAK STORY: The strength of the lateral-force-resisting system in any story shall not be less than 80% of the strength in an adjacent story above or below for Life-Safety and Immediate Occupancy.	One story building.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.2	SOFT STORY: The stiffness of the lateral-force-resisting-system in any story shall not be less than 70% of the lateral-force-resisting system stiffness in an adjacent story above or below, or less than 80% of the average lateral-force-resisting system stiffness of the three stories above or below for Life Safety and Immediate Occupancy.	One story building.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.3	GEOMETRY: There shall be no changes in horizontal dimension of the lateral-force-resisting system of more than 30% in a story relative to adjacent stories for Life Safety and Immediate Occupancy, excluding one-story penthouses and mezzanines.	One story building.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.2.4	VERTICAL DISCONTINUITIES: All vertical elements in the lateral-force-resisting system shall be continuous to the foundation.	The shear walls are doveled into the foundation system. Verification of the connection of the asbestos panels to the foundation could not be made. The shear capacities of the asbestos panels were not taken into account.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.5	MASS: There shall be no change in effective mass of more than 50% from one story to the next for Life Safety and Immediate Occupancy. Light roofs, penthouses and mezzanines need not be considered.	One story building.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.2.6	TORSION: The estimated distance between the story center of mass and the story center of rigidity shall be less than 20% of the building width in either plan dimension for Life Safety and Immediate Occupancy.	Concrete shear walls around the perimeter of the building.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.3.4	DETERIORATION OF CONCRETE: There shall be no visible deterioration of concrete or reinforcing steel in any of the vertical- or lateral-force-resisting elements.	Site visit made on 8/19/03. No signs of deterioration were observed.

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By: **JYF** Checked: **JEH**

## ASCE 31\* BASIC CHECKLIST C2: CONCRETE SHEAR WALL BUILDINGS WITH RIGID OR STIFF DIAPHRAGMS

C	NC	N/A		Comments
<b>BUILDING SYSTEM</b>				
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.3.5 POST-TENSIONING ANCHORS: There shall be no evidence of corrosion or spalling in the vicinity of post-tensioning or end fittings. Coil anchors shall not have been used.	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.3.9 CONCRETE WALL CRACKS: All existing diagonal cracks in wall elements shall be less than 1/8" for Life Safety and 1/16" for Immediate Occupancy, shall not be concentrated in one location, and shall not form an X pattern.	Site visit made on 8/19/03. There are no cracks >1/8".
<b>LATERAL-FORCE-RESISTING SYSTEM</b>				
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.4.1.6.1 COMPLETE FRAMES: Steel or concrete frames classified as secondary components shall form a complete vertical load carrying system.	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.4.2.1.1 REDUNDANCY: The number of lines of shear walls in each principal direction shall be greater than or equal to 2 for Life Safety and Immediate Occupancy.	There are at least 2 lines of resistance in each direction of loading.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.4.2.2.1 SHEAR STRESS CHECK: The shear stress in the concrete shear walls, calculated using the Quick Check procedure of Section 3.5.3.3, shall be less than 100 psi or $2\sqrt{f'_c}$ for Life Safety and Immediate Occupancy.	The maximum shear stress is 41 psi < 100 psi. Note: $2\sqrt{f'_c} = 110$ psi for $f'_c = 3,000$ psi.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.4.2.2.2 REINFORCING STEEL: The ratio of reinforcing steel area to gross concrete area shall be not less than 0.0015 in the vertical direction and 0.0025 in the horizontal direction for Life Safety and Immediate Occupancy. The spacing of reinforcing steel shall be equal to or less than 18" for Life Safety and Immediate Occupancy.	Typ. reinforcement in reinforced concrete walls: 8" thick wall: vertical: #5 @12" o.c.; $\rho = 0.0032 > 0.0015$ horizontal: #4 @10" o.c.; $\rho = 0.0025 = 0.0025$ 12" thick wall: 2#4 @12" o.c. E.W.; $\rho = 0.0028 > 0.0025$  The spacing <= 18".
<b>CONNECTIONS</b>				
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.6.2.1 TRANSFER TO SHEAR WALLS: Diaphragms shall be connected for transfer of loads to the shear walls for Life Safety and the connections shall be able to develop the lesser of the shear strength of the walls or diaphragms for Immediate Occupancy.	Rebar from slab dowels into concrete shear walls.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.6.3.5 FOUNDATION DOWELS: Wall reinforcement shall be doweled into the foundation for Life Safety and the dowels shall be able to develop the lesser of the strength of the walls or the uplift capacity of the foundation for Immediate Occupancy.	Rebar dowels into foundation match vertical rebar in shear walls.

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**ASCE 31\* BASIC CHECKLIST C2: CONCRETE SHEAR WALL BUILDINGS WITH RIGID OR STIFF DIAPHRAGMS**

**C NC N/A** **Comments**

**CONNECTIONS**

**FOR WEST SIDE ADDITION W/ FLEXIBLE DIAPHRAGM**

<input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/>	<b>4.6.1.1</b>	<b>WALL ANCHORAGE:</b> Exterior concrete or masonry walls, that are dependent on the diaphragm for lateral support, shall be anchored for out-of-plane forces at each diaphragm level with steel anchors, reinforcing dowels, or straps that are developed into the diaphragm. Connections shall have adequate strength to resist the connection force calculated in the Quick Check Procedure of Section 3.5.3.7.	<b>Out of plane wall anchorage could not be verified for the West Side Addition at the site visit on August 19,2003. Drawings are not available for the West Side Addition.</b>
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\* – Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.

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Job Name: **LLNL Prioritization**

By: **JYF** Checked: **JEH**

## ASCE 31\* SUPPLEMENTAL CHECKLIST C2: CONCRETE SHEAR WALL BUILDINGS WITH RIGID OR STIFF DIAPHRAGMS

C	NC	N/A		Comments
<b>LATERAL-FORCE-RESISTING SYSTEM</b>				
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.4.1.6.2 DEFLECTION COMPATIBILITY: Secondary components shall have the shear capacity to develop the flexural strength of the components for Life Safety and shall meet the requirements of 4.4.1.4.9, 4.4.1.4.10, 4.4.1.4.11, 4.4.1.4.12 and 4.4.1.4.15 for Immediate Occupancy.	No secondary elements in the original building or the addition on the East side of the building. At the West side of the building, there are WF steel columns.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.4.1.6.3 FLAT SLABS: Flat slabs/plates not part of lateral-force-resisting system shall have continuous bottom steel through the column joints for Life Safety.	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.4.2.2.3 COUPLING BEAMS: The stirrups in coupling beams over means of egress shall be spaced at or less than $d/2$ and shall be anchored into the confined core of the beam with hooks of 135° or more for Life Safety. All coupling beams shall comply with the requirements above and shall have the capacity in shear to develop the uplift capacity of the adjacent wall for Immediate Occupancy.	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.4.2.2.4 OVERTURNING: All shear walls shall have aspect ratios less than 4 to 1. Wall piers need not be considered. This statement shall apply to the Immediate Occupancy Performance Level only.	Life Safety Performance Level.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.4.2.2.5 CONFINEMENT REINFORCING: For shear walls with aspect ratios greater than 2 to 1, the boundary elements shall be confined with spirals or ties with spacing less than $8d_s$ . This statement shall apply to the Immediate Occupancy Performance Level only.	Life Safety Performance Level.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.4.2.2.6 REINFORCING AT OPENINGS: There shall be added trim reinforcement around all wall openings greater than three times the thickness of the wall. This statement shall apply to the Immediate Occupancy Performance Level only.	Life Safety Performance Level.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.4.2.2.7 WALL THICKNESS: Thickness of bearing walls shall not be less than $1/25$ the unsupported height or length, whichever is shorter, nor less than 4". This statement shall apply to the Immediate Occupancy Performance Level only.	Life Safety Performance Level.
<b>DIAPHRAGMS</b>				
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.5.1.1 DIAPHRAGM CONTINUITY: The diaphragms shall not be composed of split-level floors and shall not have expansion joints.	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.5.1.4 OPENINGS AT SHEAR WALLS: Diaphragm openings immediately adjacent to the shear walls shall be less than 25% of the wall length for Life Safety and 15% of the wall length for Immediate Occupancy.	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.5.1.7 PLAN IRREGULARITIES: There shall be tensile capacity to develop the strength of the diaphragm at re-entrant corners or other locations of plan irregularities. This statement shall apply to the Immediate Occupancy Performance Level only.	Life Safety Performance Level.

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By: JYF Checked: JEH

## ASCE 31\* SUPPLEMENTAL CHECKLIST C2: CONCRETE SHEAR WALL BUILDINGS WITH RIGID OR STIFF DIAPHRAGMS

C	NC	N/A		Comments
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### DIAPHRAGMS

- |                          |                          |                                     |   |                                |
|--------------------------|--------------------------|-------------------------------------|---|--------------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.5.1.8 DIAPHRAGM REINFORCEMENT AT OPENINGS: There shall be reinforcing around all diaphragm openings larger than 50% of the building width in either major plan dimension. This statement shall apply to the Immediate Occupancy Performance Level only. | Life Safety Performance Level. |
|--------------------------|--------------------------|-------------------------------------|---|--------------------------------|

### CONNECTIONS

- |                          |                          |                                     |  |  |
|--------------------------|--------------------------|-------------------------------------|--|--|
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.6.3.10 UPLIFT AT PILE CAPS: Pile caps shall have top reinforcement and piles shall be anchored to the pile caps for Life Safety, and the pile cap reinforcement and pile anchorage shall be able to develop the tensile capacity of the piles for Immediate Occupancy. |  |
|--------------------------|--------------------------|-------------------------------------|--|--|

\* – Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.

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Job Name: **LLNL Prioritization**

By: **JYF** Checked: **JEH**

## ASCE 31\* SUPPLEMENTAL CHECKLIST C2A: CONCRETE SHEAR WALL BUILDINGS WITH FLEXIBLE DIAPHRAGMS

**C NC N/A**

**Comments**

### LATERAL-FORCE-RESISTING SYSTEM

- |                          |                          |                                     |           |   |                                       |
|--------------------------|--------------------------|-------------------------------------|-----------|---|---------------------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.2.2.3 | COUPLING BEAMS: The stirrups in coupling beams over means of egress shall be spaced at or less than $d/2$ and shall be anchored into the confined core of the beam with hooks of $135^\circ$ or more for Life Safety. All coupling beams shall comply with the requirements above and shall have the capacity in shear to develop the uplift capacity of the adjacent wall for Immediate Occupancy. |                                       |
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.2.2.4 | OVERTURNING: All shear walls shall have aspect ratios less than 4 to 1. Wall piers need not be considered. This statement shall apply to the Immediate Occupancy Performance Level only.  | <b>Life Safety Performance Level.</b> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.2.2.5 | CONFINEMENT REINFORCING: For shear walls with aspect ratios greater than 2 to 1, the boundary elements shall be confined with spirals or ties with spacing less than $8d_b$ . This statement shall apply to the Immediate Occupancy Performance Level only.   | <b>Life Safety Performance Level.</b> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.2.2.6 | REINFORCING AT OPENINGS: There shall be added trim reinforcement around all wall openings greater than three times the thickness of the wall. This statement shall apply to the Immediate Occupancy Performance Level only.   | <b>Life Safety Performance Level.</b> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.2.2.7 | WALL THICKNESS: Thickness of bearing walls shall not be less than $1/25$ the unsupported height or length, whichever is shorter, nor less than 4". This statement shall apply to the Immediate Occupancy Performance Level only.  | <b>Life Safety Performance Level.</b> |

### DIAPHRAGMS

- |                                     |                          |                                     |         |   |  |
|-------------------------------------|--------------------------|-------------------------------------|---------|---|--|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.5.1.1 | DIAPHRAGM CONTINUITY: The diaphragms shall not be composed of split-level floors and shall not have expansion joints.   |  |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.5.1.2 | CROSS TIES: There shall be continuous cross ties between diaphragm chords.  | <b>Steel beams serve as the cross ties in both directions.</b> |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.5.1.4 | OPENINGS AT SHEAR WALLS: Diaphragm openings immediately adjacent to the shear walls shall be less than 25% of the wall length for Life Safety and 15% of the wall length for Immediate Occupancy.   |  |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.5.1.7 | PLAN IRREGULARITIES: There shall be tensile capacity to develop the strength of the diaphragm at re-entrant corners or other locations of plan irregularities. This statement shall apply to the Immediate Occupancy Performance Level only.      | <b>Life Safety Performance Level.</b>                          |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.5.1.8 | DIAPHRAGM REINFORCEMENT AT OPENINGS: There shall be reinforcing around all diaphragm openings larger than 50% of the building width in either major plan dimension. This statement shall apply to the Immediate Occupancy Performance Level only. | <b>Life Safety Performance Level.</b>                          |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.5.2.1 | STRAIGHT SHEATHING: All straight sheathed diaphragms shall have aspect ratios less than 2 to 1 for Life Safety and 1 to 1 for Immediate Occupancy in the direction being considered.  |  |

Building Name: **Building 833**

Date: **August 21, 2003**

Building Address: **Lawrence Livermore National Laboratory**

Page: **2** of **2**

Job Number: **A20047.08** Job Name: **LLNL Prioritization**

By: **JYF** Checked: **JEH**

## ASCE 31\* SUPPLEMENTAL CHECKLIST C2A: CONCRETE SHEAR WALL BUILDINGS WITH FLEXIBLE DIAPHRAGMS

C	NC	N/A		Comments
---	----	-----	--	----------

### DIAPHRAGMS

- |                          |                                     |                                     |  |  |
|--------------------------|-------------------------------------|-------------------------------------|--|--|
| <input type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | 4.5.2.2 SPANS: All wood diaphragms with spans greater than 24 ft for Life Safety and 12 ft for Immediate Occupancy shall consist of wood structural panels or diagonal sheathing.  |  |
| <input type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | 4.5.2.3 UNBLOCKED DIAPHRAGMS: All diagonally sheathed and unblocked wood structural panel diaphragms shall have horizontal spans less than 40 ft for Life Safety and 30 ft for Immediate Occupancy and shall have aspect ratios less than or equal to 4 to 1 for Life Safety and 3 to 1 for Immediate Occupancy. |  |
| <input type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | 4.5.3.1 NON-CONCRETE FILLED DIAPHRAGMS: Untopped metal deck diaphragms or metal deck diaphragms with fill other than concrete shall consist of horizontal spans of less than 40 ft and shall have aspect ratios less than 4 to 1. This statement shall apply to the Immediate Occupancy Performance Level only.  |  |
| <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | 4.5.7.1 OTHER DIAPHRAGMS: The diaphragm shall not consist of a system other than wood, metal deck, concrete or horizontal bracing.   | The roof consists of asbestos cement panels at the West side addition. |

### CONNECTIONS

- |                          |                          |                                     |  |  |
|--------------------------|--------------------------|-------------------------------------|--|--|
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.6.3.10 UPLIFT AT PILE CAPS: Pile caps shall have top reinforcement and piles shall be anchored to the pile caps for Life Safety, and the pile cap reinforcement and pile anchorage shall be able to develop the tensile capacity of the piles for Immediate Occupancy. |  |
|--------------------------|--------------------------|-------------------------------------|--|--|

\* - Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.

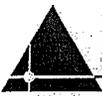




### ***Building 836B***

Building 836B is a one-story building. At the East Elevation, there is a reinforced concrete block wall. In the EW direction, there are 2 bays of rod bracing. In the NS direction, there are steel moment resisting frames. The roof consists of blow out panels with rod bracing supported by steel web joists at 4 feet o.c. The out of plane anchorage at the concrete block wall consists of ledger angles supporting the deck or joists and bolted to the wall w/ 3/4" diameter bolts at 32 inches o. c. A structural evaluation of Building 836B was not completed because no structural drawings for the roof level were available for review. A detailed on-site evaluation is required to conclusively determine the structural deficiencies in the building. However, based on our site visit observations, experience and judgement, we cannot deem Building 836B to be life-safe. We identified the following as potential deficiencies for the building: 1) The diaphragm may not adequately transfer seismic loads to the lateral-force-resisting elements; 2) The out-of-plane anchorage connections may not adequate.

For the building to meet life-safety requirements, we recommend a detailed on-site evaluation to conclusively identify the deficiencies in the building and strengthened elements of the structure as required.



Building Name: **Building 836**

Date: **July 30, 2003**

Building Address: **Lawrence Livermore National Laboratory**

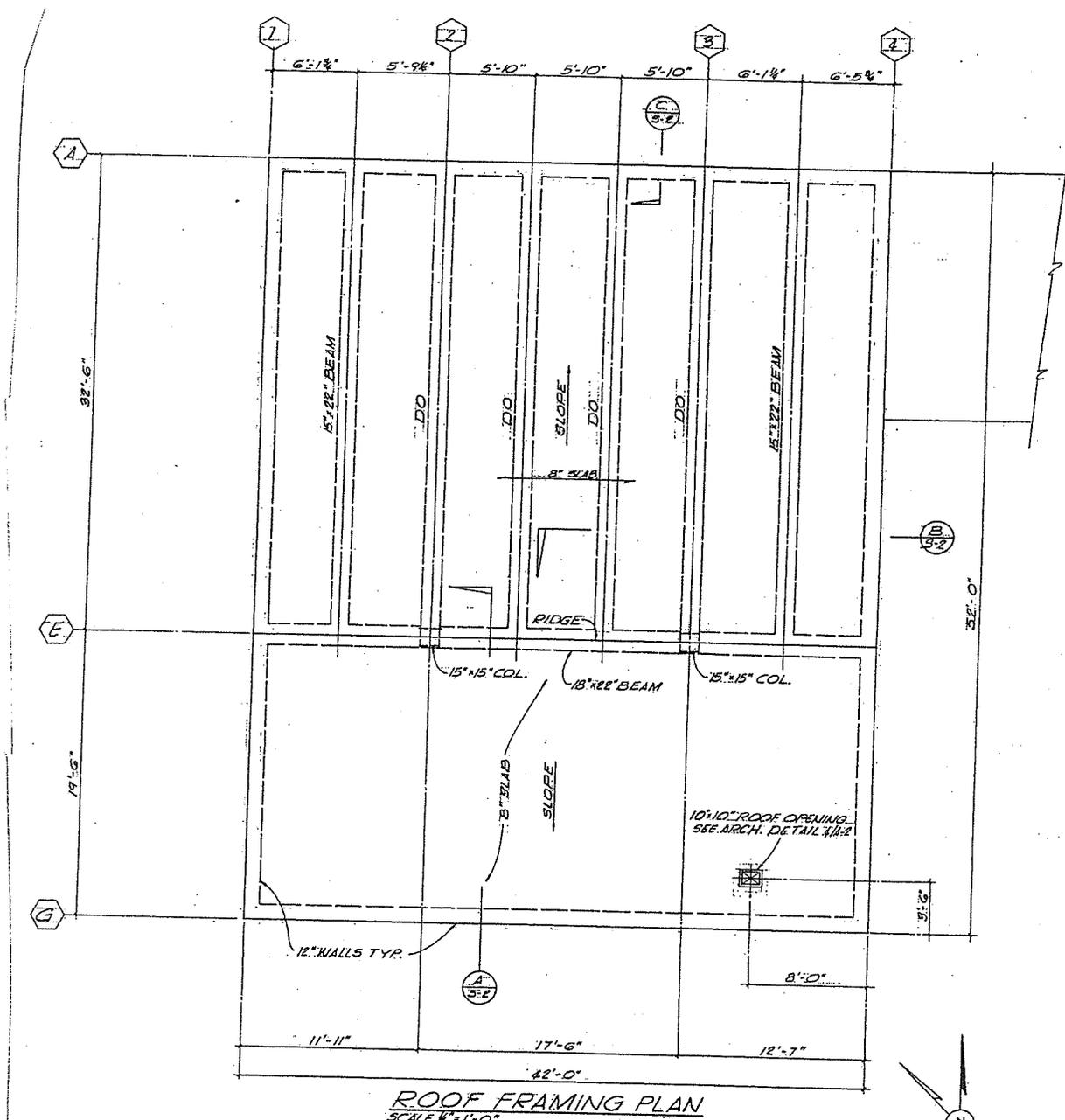
Page: **1** of **1**

Job Number: **A20047.08**

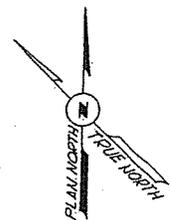
Job Name: **LLNL Prioritization**

By: **JYF** Checked: **JEH**

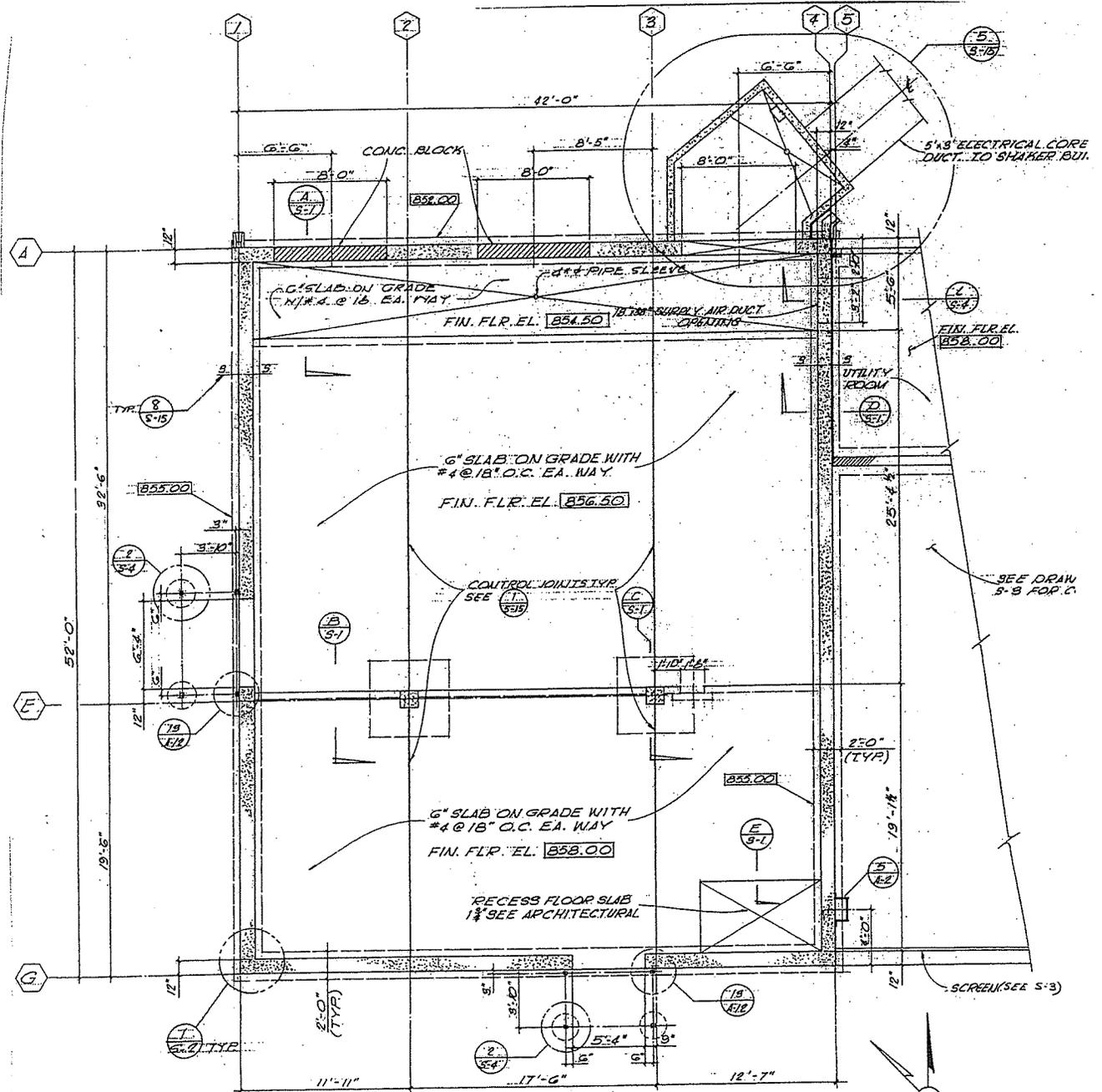
## ROOF PLAN



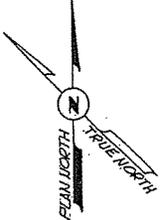
**ROOF FRAMING PLAN**  
SCALE 1/4" = 1'-0"



# ROOF PLAN



**FOUNDATION PLAN**  
SCALE 1/4" = 1'-0"



### ***Building 836D***

Building 836D is approximately 2,500-sq. ft. and is a one-story reinforced concrete bearing wall building. There are concrete shear walls on three sides of the building. At the front, there are no concrete shear walls and only blow out panels. The roof consists of also blow out panels. A structural evaluation of Building 836D was not completed because no structural drawings were available for review. A detailed on-site evaluation is required to conclusively determine the structural deficiencies in the building. However, based on our site visit observations, experience and judgement, we identified the following deficiencies for the building: 1) The diaphragm cannot adequately transfer seismic loads to the shear walls; 2) There is no redundancy in the lateral-force-resisting system in one direction of loading; and 3) The out-of-plane anchorage connections are not adequate.

For the building to meet life-safety requirements, we recommend adding a brace frame or moment frame at the front of the building.

### ***Building 870***

Building 870 is a one-story wood frame building. The structure consists of 2x6 tongue and groove supported by wood purlins and steel girders, which are supported by wood posts or steel pipes. The lateral-force-resisting system consists of 3/8" plywood shear walls. Potential structural deficiencies noted for Building 870 are 1) The shear walls are not adequate for resisting the seismic demands; and 2) The diaphragm span is greater than 24' allowable for straight sheathing. We recommend that new plywood shear walls are added and that the roof be strengthened with plywood sheathing.

Building Name: Building 870 Date: July 15, 2003  
 Building Address: Lawrence Livermore National Laboratory Page: 1 of 1  
 Job Number: A20047.08 Job Name: LLNL Prioritization By: JYF Checked: JEH

**PRIORITIZATION BUILDING DATA SHEET**

**BUILDING DATA**

Year Built: 1958 Year(s) Remodeled: 1983 UBC Zone: 4 – Type B Near Field  
 Area (sf): 3,890 Length (ft): 97 Width (ft): 41  
 No. Stories: 1 Story Height: 9 Total Height: 9

**CONSTRUCTION DATA**

Gravity Load Structural System: 2x6 T&G, Wood purlins on steel/wood girders supported by perimeter posts and steel pipes at the interior  
 Exterior Transverse Walls: 3/8" plywood shear walls (1" diagonal sheathing at interior) Openings?: Door and window openings  
 Exterior Longitudinal Walls: 3/8" plywood shear walls Openings?: Door and window openings  
 Roof Framing: 2x6 T&G supported on 4x12 D.F. beams and 12B16.5/12WF27 girders  
 Intermediate Floor Framing: None  
 Ground Floor: 6" concrete slab on grade w/ 4x4-6/6 WWF  
 Columns: 4x8 posts (exterior) and 3" diameter steel pipes (interior)  
 Foundation: Spread footing under columns, strip footing under walls and at perimeter

**LATERAL-FORCE-RESISTING SYSTEM**

	Longitudinal	Transverse
System Classification:	Type 1 (Wood light frame)	Type 1 Wood light frame)
Vertical Elements:	Wood purlins, steel/wood girders, wood posts & steel columns	Wood purlins, steel/wood girders, wood posts & steel columns
Diaphragms:	2x6 T&G	2x6 T&G

**SEISMIC EVALUATION PERFORMED?** Yes **EVALUATION:** Rapid Evaluation **YEAR:** 2003

**SEISMIC EVALUATION CRITERIA:** Life Safety/ ASCE 31-02

**VULNERABILITY RATING:** 6  
 (1=low to 10=high)

**PRIORITIZATION CLASSIFICATION:** CLASS B

**POTENTIAL LIFE SAFETY DEFICIENCIES:**

THIS BUILDING WAS EVALUATED FOR THE 10% IN 50 YR. EARTHQUAKE.

**STRESS CHECK**

*Shear stresses in the shear walls exceed the allowable values. Maximum D/C = 1.16.*

**DIAPHRAGM SPAN**

*Max span = 40' > 24'. Diaphragm is 2x6 T&G, not wood structural panels or diagonal sheathing.*

**PRELIMINARY STRENGTHENING SCHEMES OR MITIGATION MEASURES:**

Add plywood sheathing at the roof.  
 Add plywood shear walls.

Building Name: **Building 870**

Date: **July 15, 2003**

Building Address: **Lawrence Livermore National Laboratory**

Page: **1** of **2**

Job Number: **A20047.08**

Job Name: **LLNL Prioritization**

By: **JYF** Checked: **JEH**

## ASCE 31\* BASIC CHECKLIST W1: WOOD LIGHT FRAMES

C	NC	N/A		Comments
<b>BUILDING SYSTEM</b>				
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.1.1 LOAD PATH: The structure shall contain a minimum of one complete load path for Life Safety and Immediate Occupancy for seismic force effects from any horizontal direction that serves to transfer the inertial forces from the mass to the foundation.	There are 3 interior diagonal sheathed shear walls in the transverse direction. At the perimeter of the building, there are 3/8" plywood shear walls.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.2.4 VERTICAL DISCONTINUITIES: All vertical elements in the lateral-force-resisting system shall be continuous to the foundation.	Shear walls are continuous to the foundation (Detail 4/ S9).
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.3.1 DETERIORATION OF WOOD: There shall be no signs of decay, shrinkage, splitting, fire damage, or sagging in any of the wood members and none of the metal connection hardware shall be deteriorated, broken, or loose.	Site visit made on 8/19/03. No signs of deterioration were observed. We noticed that the 2x6 T&G straight sheathing at the roof has shrunk. There are noticeable gaps between the 2x6 pieces.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.3.2 WOOD STRUCTURAL PANEL SHEAR WALL FASTENERS: There shall be no more than 15% of inadequate fastening such as overdriven fasteners, omitted blocking, excessive fastening spacing, or inadequate edge distance. This statement shall apply to the Immediate Occupancy Performance Level only.	Life Safety Performance Level.
<b>LATERAL-FORCE-RESISTING SYSTEM</b>				
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.4.2.1.1 REDUNDANCY: The number of lines of shear walls in each principal direction shall be greater than or equal to 2 for Life Safety and Immediate Occupancy.	There are 5 lines of resistance in the transverse direction. There are 2 lines of resistance in the longitudinal direction.
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	4.4.2.7.1 SHEAR STRESS CHECK: The shear stress in the shear walls, calculated using the Quick Check procedure of Section 3.5.3.3, shall be less than the following values for Life Safety and Immediate Occupancy:  <div style="margin-left: 40px;">                     Structural panel sheathing: 1000 plf                      Diagonal sheathing: 700 plf                      Straight sheathing: 100 plf                      All other conditions: 100 plf                 </div>	Transverse direction: Max shear stress at Line 10 = 724 plf > 700 plf for diagonal sheathing. D/C = 1.03.  Longitudinal direction: Max stress = 1,162 plf > 1,000 plf for 3/8" plywood sheathing. D/C = 1.16.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.4.2.7.2 STUCCO (EXTERIOR PLASTER) SHEAR WALLS: Multistory buildings shall not rely on exterior stucco walls as the primary lateral-force-resisting system.	One story building.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.4.2.7.3 GYPSUM WALLBOARD OR PLASTER SHEAR WALLS: Interior plaster or gypsum wallboard shall not be used as shear walls on buildings over one story in height with the exception of the uppermost level of a multistory building.	One story building.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.4.2.7.4 NARROW WOOD SHEAR WALLS: Narrow wood shear walls with an aspect ratio greater than 2 to 1 for Life Safety and 1.5 to 1 for Immediate Occupancy shall not be used to resist lateral forces developed in the building in levels of moderate and high seismicity. Narrow wood shear walls with an aspect ratio greater than 2 to 1 for Immediate Occupancy shall not be used to resist lateral forces developed in the building in levels of low seismicity.	The narrowest shear wall is at Line A. The maximum height = 10'-7 1/2" and the width = 6'-0". The aspect ratio < 2 to 1.

Building Name: **Building 870**

Date: **July 15, 2003**

Building Address: **Lawrence Livermore National Laboratory**

Page: **2** of **2**

Job Number: **A20047.08**

Job Name: **LLNL Prioritization**

By: **JYF** Checked: **JEH**

## ASCE 31\* BASIC CHECKLIST W1: WOOD LIGHT FRAMES

C	NC	N/A	Comments
---	----	-----	----------

### LATERAL-FORCE-RESISTING SYSTEM

- |                          |                          |                                     |   |   |
|--------------------------|--------------------------|-------------------------------------|---|---|
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.2.7.5 WALLS CONNECTED THROUGH FLOORS: Shear walls shall have interconnection between stories to transfer overturning and shear forces through the floor.  | One story building.                           |
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.2.7.6 HILLSIDE SITE: For structures that are taller on at least one side by more than half of a story due to a sloping site, all shear walls on the downhill slope shall have an aspect ratio less than 1 to 1 for Life Safety and 1 to 2 for Immediate Occupancy.                      | Building is on level lot.                     |
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.2.7.7 CRIPPLE WALLS: Cripple walls below first floor level shear walls shall be braced to the foundation with wood structural panels.   | There are no cripple walls.                   |
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.2.7.8 OPENINGS: Walls with openings greater than 80% of the length shall be braced with wood structural panel shear walls with aspect ratios of not more than 1.5 to 1 or shall be supported by adjacent construction through positive ties capable of transferring the lateral forces. | There are no shear walls with large openings. |

### CONNECTIONS

- |                                     |                          |                          |  |  |
|-------------------------------------|--------------------------|--------------------------|--|--|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 4.6.3.3 WOOD POSTS: There shall be a positive connection of wood posts to the foundation.  | Wood posts are connected to 1/4"x3" steel U-shaped plates by (2) 1/2" diameter bolts. The U-shaped plates are 6" embedded into the concrete footing. (Detail 3/S9) |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 4.6.3.4 WOOD SILLS: All wood sills shall be bolted to the foundation.  | 2x4 sill plates are anchored into the foundation by 5/8" diameter bolts at 4'-0" or center. (Detail 4/S9)  |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 4.6.4.1 GIRDER/COLUMN CONNECTION: There shall be a positive connection utilizing plates, connection hardware, or straps between the girder and the column support. | Girders are bolted to plates which are welded to the steel columns. (Details 1 and 3/ S10). Girders are bolted to wood posts (Detail 4/S10).                       |

\* – Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.

Building Name: **Building 870**

 Date: **July 15, 2003**

 Building Address: **Lawrence Livermore National Laboratory**

 Page: **1** of **1**

 Job Number: **A20047.08**

 Job Name: **LLNL Prioritization**

 By: **JYF** Checked: **JEH**

## ASCE 31\* SUPPLEMENTAL CHECKLIST W1: WOOD LIGHT FRAMES

C NC N/A

Comments

### LATERAL-FORCE-RESISTING SYSTEM

- |                          |                          |                                     |   |                                       |
|--------------------------|--------------------------|-------------------------------------|---|---------------------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.2.7.9 HOLD-DOWN ANCHORS: All shear walls shall have hold-down anchors constructed per acceptable construction practices, attached to the end studs. This statement shall apply to the Immediate Occupancy Performance Level only. | <b>Life Safety Performance Level.</b> |
|--------------------------|--------------------------|-------------------------------------|---|---------------------------------------|

### DIAPHRAGMS

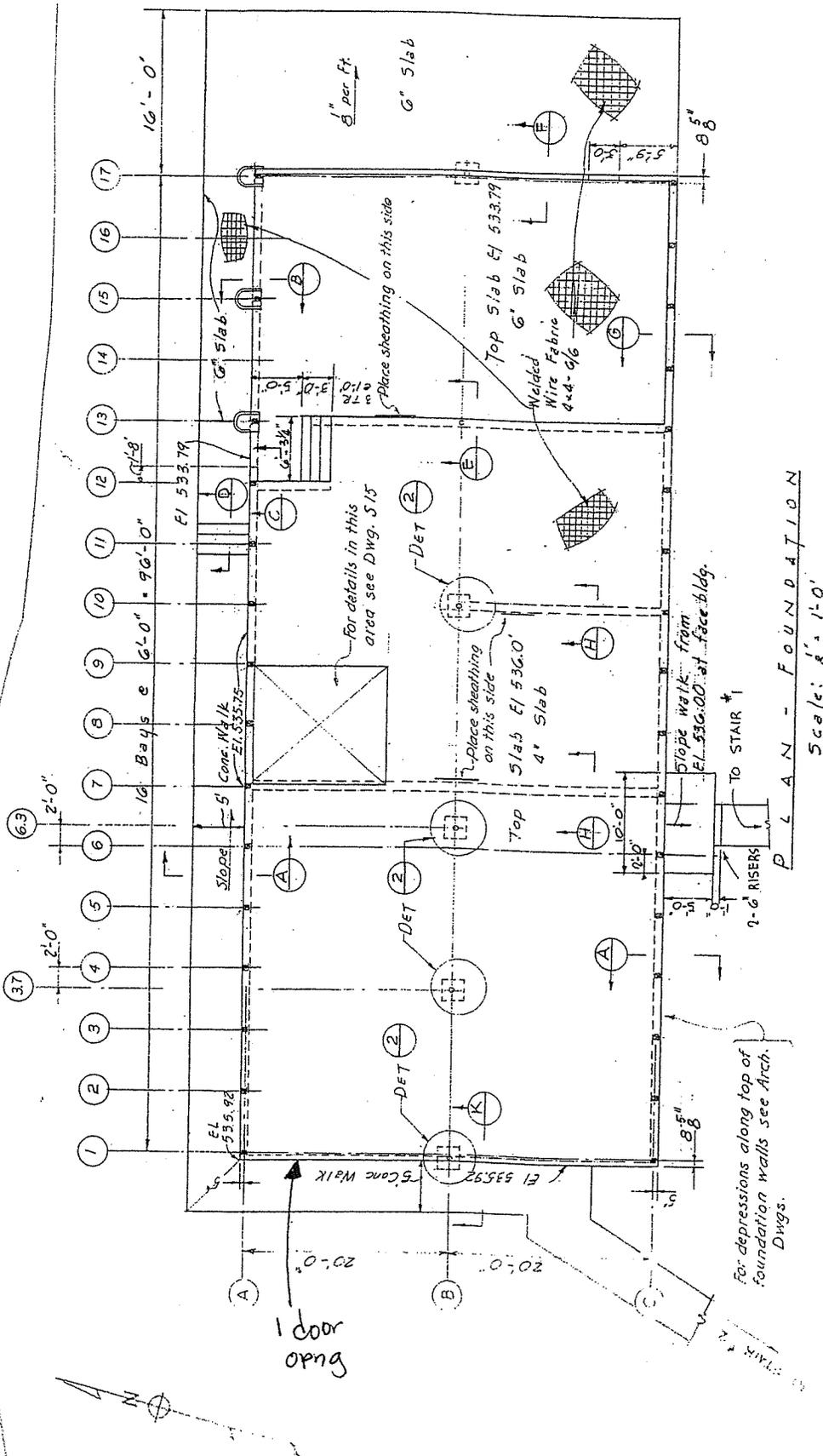
- |                                     |                                     |                                     |  |  |
|-------------------------------------|-------------------------------------|-------------------------------------|--|--|
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/>            | 4.5.1.1 DIAPHRAGM CONTINUITY: The diaphragms shall not be composed of split-level floors and shall not have expansion joints.  | <b>There are no split level floors or expansion joints.</b>            |
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/>            | 4.5.1.3 ROOF CHORD CONTINUITY: All chord elements shall be continuous, regardless of changes in roof elevation.  |  |
| <input type="checkbox"/>            | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | 4.5.1.7 PLAN IRREGULARITIES: There shall be tensile capacity to develop the strength of the diaphragm at re-entrant corners or other locations of plan irregularities. This statement shall apply to the Immediate Occupancy Performance Level only.   | <b>Life Safety Performance Level.</b>                                  |
| <input type="checkbox"/>            | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | 4.5.1.8 DIAPHRAGM REINFORCEMENT AT OPENINGS: There shall be reinforcing around all diaphragm openings larger than 50% of the building width in either major plan dimension. This statement shall apply to the Immediate Occupancy Performance Level only.  | <b>Life Safety Performance Level.</b>                                  |
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/>            | 4.5.2.1 STRAIGHT SHEATHING: All straight sheathed diaphragms shall have aspect ratios less than 2 to 1 for Life Safety and 1 to 1 for Immediate Occupancy in the direction being considered.   | <b>Diaphragm is 2x6 T&amp;G. Max aspect ratio = 40/24 &lt; 2 to 1.</b> |
| <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | 4.5.2.2 SPANS: All wood diaphragms with spans greater than 24 ft for Life Safety and 12 ft for Immediate Occupancy shall consist of wood structural panels or diagonal sheathing.  | <b>Max span = 40'. Diaphragm is 2x6 T&amp;G.</b>                       |
| <input type="checkbox"/>            | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | 4.5.2.3 UNBLOCKED DIAPHRAGMS: All diagonally sheathed and unblocked wood structural panel diaphragms shall have horizontal spans less than 40 ft for Life Safety and 30 ft for Immediate Occupancy and shall have aspect ratios less than or equal to 4 to 1 for Life Safety and 3 to 1 for Immediate Occupancy. | <b>Diaphragm is 2x6 T&amp;G.</b>                                       |
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/>            | 4.5.7.1 OTHER DIAPHRAGMS: The diaphragm shall not consist of a system other than wood, metal deck, concrete or horizontal bracing.   | <b>Diaphragm is 2x6 T&amp;G.</b>                                       |

### CONNECTIONS

- |                                     |                          |                          |   |  |
|-------------------------------------|--------------------------|--------------------------|---|--|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 4.6.3.9 WOOD SILL BOLTS: Sill bolts shall be spaced at 6 ft or less for Life Safety and 4 ft or less for Immediate Occupancy, with proper edge and end distance provided for wood and concrete. | <b>2x4 sill plates are anchored into the foundation by 5/8" diameter bolts at 4'-0" or center. (Detail 4/S9)</b> |
|-------------------------------------|--------------------------|--------------------------|---|--|

\* – Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.

**BUILDING PLAN**



**Appendix C      Building Data Sheets**  
**Class D – Lowest Priority Buildings**

### **Building 166A & D**

Building 166A & D are similar one-story steel light framed structures. The roof systems consists of bare metal deck with insulation and roofing. The lateral system in the transverse direction consists of steel moment frames. In the longitudinal direction, the lateral system consists of 4 bays of ½” diameter rods. The total square footage for 166A is 3,200 square feet and building 166D is 4,000 square feet.

Structural drawings were not available. The only potential deficiency is the ability of the moment connections to develop the strength of the adjoining connections. A detailed evaluation will likely show that moment frame connection meets the life-safety performance level. These buildings are rated Class D – Low Priority pending detailed evaluation.

Building Name: **Building 166A**

Date: **September 19, 2003**

Building Address: **Lawrence Livermore National Laboratory**

Page: **1** of **2**

Job Number: **A20047.08** Job Name: **LLNL Prioritization**

By: **AK** Checked: **AK**

## PRIORITIZATION BUILDING DATA SHEET

### BUILDING DATA

Year Built:	-	Year(s) Remodeled:	-	UBC Zone:	4 – Type B Near Field
Area (sf):	3,200 sf	Length (ft):	80'	Width (ft):	40'
No. Stories:	1	Story Height:	Sloped Roof	Total Height:	-

### CONSTRUCTION DATA

Gravity Load Structural System: Single story steel-light-frame structure. Bare metal deck supported on steel roof beams. Beams span 40 feet to perimeter columns.

Exterior Transverse Walls: metal wall panels Openings?: Roll up doors

Exterior Longitudinal Walls: metal wall panels Openings?: Roll up doors

Roof Framing: Bare metal deck supported on steel roof beams

Intermediate Floor Framing: -

Ground Floor: Concrete slab on grade

Columns: Wide flange columns located on the perimeter.

Foundation: No structural drawings available.

### LATERAL-FORCE-RESISTING SYSTEM

	Longitudinal (W-E)	Transverse (N-S)
System Classification:	S3 – Steel Light Frames	S3 – Steel Light Frames
Vertical Elements:	Steel wide flange columns	Steel wide flange columns
Diaphragms:	Bare metal deck with roofing	Bare metal deck with roofing

SEISMIC EVALUATION PERFORMED? Yes EVALUATION: Rapid Evaluation YEAR: 2003

SEISMIC EVALUATION CRITERIA: Life Safety/ ASCE 31-02

VULNERABILITY RATING: 3  
(1=low to 10=high)

PRIORITIZATION CLASSIFICATION: CLASS D  
*\*Pending detailed evaluations of moment connection*



**Degenkolb**

DEGENKOLB ENGINEERS

Building Name: Building 166A

Date: September 19, 2003

Building Address: Lawrence Livermore National Laboratory

Page: 2 of 2

Job Number: A20047.08

Job Name: LLNL Prioritization

By: AK Checked: \_\_\_\_\_

## PRIORITIZATION BUILDING DATA SHEET

### POTENTIAL LIFE SAFETY DEFICIENCIES (STRUCTURAL):

THIS BUILDING WAS EVALUATED FOR THE 10% IN 50 YR. EARTHQUAKE.

*All moment connections shall be able to develop strength of adjoining members.*

### PRELIMINARY STRENGTHENING SCHEMES OR MITIGATION MEASURES:

*Detailed evaluation of steel moment connection to confirm compliance with life safety performance level.*

Building Name: Building 166A

 Date: September 19, 2003

 Building Address: Lawrence Livermore National Laboratory

 Page: 1 of 2

 Job Number: A20047.08 Job Name: LLNL Prioritization

 By: AK Checked: \_\_\_\_\_

## ASCE 31\* BASIC CHECKLIST S3: STEEL LIGHT FRAMES

C	NC	N/A		Comments
<b>BUILDING SYSTEM</b>				
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	4.3.1.1 LOAD PATH: The structure shall contain a minimum of one complete load path for Life Safety and Immediate Occupancy for seismic force effects from any horizontal direction that serves to transfer the inertial forces from the mass to the foundation.	Rod bracing in the longitudinal frames. Moment frames in the transverse frames.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.1.3 MEZZANINES: Interior mezzanine levels shall be braced independently from the main structure, or shall be anchored to the lateral-force-resisting elements of the main structure.	No mezzanines.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.2.4 VERTICAL DISCONTINUITIES: All vertical elements in the lateral-force-resisting system shall be continuous to the foundation.	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.2.6 TORSION: The estimated distance between the story center of mass and the story center of rigidity shall be less than 20% of the building width in either plan dimension for Life Safety and Immediate Occupancy.	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.3.3 DETERIORATION OF STEEL: There shall be no visible rusting, corrosion, cracking, or other deterioration in any of the steel elements or connections in the vertical- or lateral-force-resisting systems.	
<b>LATERAL-FORCE-RESISTING SYSTEM</b>				
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.4.3.1.2 AXIAL STRESS CHECK: The axial stress in the diagonals, calculated using the Quick Check Procedure of Section 3.5.3.4, shall be less than $0.50F_y$ for Life Safety and for Immediate Occupancy.	Calculated axial stress in rods is 37 ksi. For 36 ksi steel, DCR = 1.03. OK
<b>CONNECTIONS</b>				
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.6.2.2 TRANSFER TO STEEL FRAMES: Diaphragms shall be connected for transfer of loads to the steel frames for Life Safety and the connections shall be able to develop the lesser of the strength of the frames or the diaphragms for Immediate Occupancy.	Metal deck welded to roof beams.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.6.3.1 STEEL COLUMNS: The columns in lateral-force-resisting frames shall be anchored to the building foundation for Life Safety and the anchorage shall be able to develop the lesser of the tensile capacity of the column, the tensile capacity of the lowest level column splice (if any), or the uplift capacity of the foundation, for Immediate Occupancy.	No structural drawings. From site visit, columns were observed to have anchor bolts into the slab on grade.
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.6.3.8 WALL PANELS: Metal, fiberglass or cementitious wall panels shall be positively attached to the foundation for Life Safety and Immediate Occupancy.	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.6.5.1 ROOF PANELS: Metal, plastic, or cementitious roof panels shall be positively attached to the roof framing to resist seismic forces for Life Safety and Immediate Occupancy.	Roof consists of bare metal deck on steel roof beams.



Building Name: Building 166A

Date: September 19, 2003

Building Address: Lawrence Livermore National Laboratory

Page: 2 of 2

Job Number: A20047.08

Job Name: LLNL Prioritization

By: AK Checked: \_\_\_\_\_

## ASCE 31\* BASIC CHECKLIST S3: STEEL LIGHT FRAMES

C NC N/A

Comments

### CONNECTIONS

4.6.5.2 WALL PANELS: Metal, fiberglass or cementitious wall panels shall be positively attached to the framing to resist seismic forces for Life Safety and Immediate Occupancy.

\* – Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31

Building Name: Building 166A

 Date: September 19, 2003

 Building Address: Lawrence Livermore National Laboratory

 Page: 1 of 1

 Job Number: A20047.08

 Job Name: LLNL Prioritization

 By: AK Checked: \_\_\_\_\_

## ASCE 31\* SUPPLEMENTAL CHECKLIST S3: STEEL LIGHT FRAMES

C	NC	N/A		Comments
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### LATERAL-FORCE-RESISTING SYSTEM

- |                          |                                     |                                     |   |                                   |
|--------------------------|-------------------------------------|-------------------------------------|---|-----------------------------------|
| <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | 4.4.1.3.3 MOMENT-RESISTING CONNECTIONS: All moment connections shall be able to develop the strength of the adjoining members or panel zones.   |                                   |
| <input type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/>            | 4.4.1.3.7 COMPACT MEMBERS: All frame elements shall meet section requirements set forth by Table I-9-1 of <i>Seismic Provisions for Structural Steel Buildings</i> (AISC, 1997).  | No structural drawings available. |
| <input type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | 4.4.1.3.8 BEAM PENETRATIONS: All openings in frame-beam webs shall be less than 1/4 of the beam depth and shall be located in the center half of the beams. This statement shall apply to the Immediate Occupancy Performance Level only. | Life Safety Evaluation.           |
| <input type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | 4.4.1.3.10 OUT-OF-PLANE BRACING: Beam-column joints shall be braced out-of-plane. This statement shall apply to the Immediate Occupancy Performance Level only.   | Life Safety Evaluation.           |
| <input type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | 4.4.1.3.11 BOTTOM FLANGE BRACING: The bottom flanges of beams shall be braced out-of-plane. This statement shall apply to the Immediate Occupancy Performance Level only.   | Life Safety Evaluation.           |

### DIAPHRAGMS

- |                                     |                          |                                     |   |                         |
|-------------------------------------|--------------------------|-------------------------------------|---|-------------------------|
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.5.1.7 PLAN IRREGULARITIES: There shall be tensile capacity to develop the strength of the diaphragm at re-entrant corners or other locations of plan irregularities. This statement shall apply to the Immediate Occupancy Performance Level only.      | Life Safety Evaluation. |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.5.1.8 DIAPHRAGM REINFORCEMENT AT OPENINGS: There shall be reinforcing around all diaphragm openings larger than 50% of the building width in either major plan dimension. This statement shall apply to the Immediate Occupancy Performance Level only. | Life Safety Evaluation. |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.5.7.1 OTHER DIAPHRAGMS: The diaphragm shall not consist of a system other than wood, metal deck, concrete or horizontal bracing.  |                         |

### CONNECTIONS

- |                          |                          |                                     |  |   |
|--------------------------|--------------------------|-------------------------------------|--|---|
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.6.3.10 UPLIFT AT PILE CAPS: Pile caps shall have top reinforcement and piles shall be anchored to the pile caps for Life Safety, and the pile cap reinforcement and pile anchorage shall be able to develop the tensile capacity of the piles for Immediate Occupancy. | No structural drawings. But pile foundations not typical at site. |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.6.5.3 ROOF PANEL CONNECTIONS: Roof panel connections shall be spaced at or less than 12" for Life Safety and 8" for Immediate Occupancy.   | No structural drawings available.                                 |

\* - Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.

Building Name: Building 166D

Date: August 8, 2003

Building Address: Lawrence Livermore National Laboratory

Page: 1 of 2

Job Number: A20047.08

Job Name: LLNL Prioritization

By: AK Checked: \_\_\_\_\_

## PRIORITIZATION BUILDING DATA SHEET

### BUILDING DATA

Year Built:	-	Year(s) Remodeled:	-	UBC Zone:	4 – Type B Near Field
Area (sf):	4,000 sf	Length (ft):	100'	Width (ft):	40'
No. Stories:	1	Story Height:	Sloped Roof	Total Height:	26'

### CONSTRUCTION DATA

Gravity Load Structural System: Single story steel-light-frame structure. Bare metal deck supported on steel roof beams. Beams span 40 feet to perimeter columns.

Exterior Transverse Walls: metal wall panels Openings?: None

Exterior Longitudinal Walls: metal wall panels Openings?: None

Roof Framing: Bare metal deck supported on steel roof beams

Intermediate Floor Framing: -

Ground Floor: Concrete slab on grade

Columns: Wide flange columns located on the perimeter.

Foundation: No structural drawings available.

### LATERAL-FORCE-RESISTING SYSTEM

	Longitudinal (W-E)	Transverse (N-S)
System Classification:	S3 – Steel Light Frames	S3 – Steel Light Frames
Vertical Elements:	Steel wide flange columns	Steel wide flange columns
Diaphragms:	Bare metal deck with roofing	Bare metal deck with roofing

SEISMIC EVALUATION PERFORMED? Yes EVALUATION: Rapid Evaluation YEAR: 2003

SEISMIC EVALUATION CRITERIA: Life Safety/ ASCE 31-02

VULNERABILITY RATING: 3  
(1=low to 10=high)

PRIORITIZATION CLASSIFICATION: CLASS D  
*\*Pending detailed evaluations of moment connections*

Building Name: **Building 166D**

Date: **August 8, 2003**

Building Address: **Lawrence Livermore National Laboratory**

Page: **2** of **2**

Job Number: **A20047.08**

Job Name: **LLNL Prioritization**

By: **AK** Checked: \_\_\_\_\_

## **PRIORITIZATION BUILDING DATA SHEET**

### **POTENTIAL LIFE SAFETY DEFICIENCIES:**

THIS BUILDING WAS EVALUATED FOR THE 10% IN 50 YR. EARTHQUAKE.

*All moment connections shall be able to develop strength of adjoining members.*

### **PRELIMINARY STRENGTHENING SCHEMES OR MITIGATION MEASURES:**

*Detailed evaluation of moment connection.*

Building Name: Building 166D

Date: August 8, 2003

Building Address: Lawrence Livermore National Laboratory

Page: 1 of 2

Job Number: A20047.08

Job Name: LLNL Prioritization

By: AK Checked: \_\_\_\_\_

## ASCE 31\* BASIC CHECKLIST S3: STEEL LIGHT FRAMES

**C NC N/A**

**Comments**

### BUILDING SYSTEM

- |                                     |                          |                                     |  |   |
|-------------------------------------|--------------------------|-------------------------------------|--|---|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | <p>4.3.1.1 LOAD PATH: The structure shall contain a minimum of one complete load path for Life Safety and Immediate Occupancy for seismic force effects from any horizontal direction that serves to transfer the inertial forces from the mass to the foundation.</p> | <p>There are steel moment frames in the transverse direction and rod braced frames in the longitudinal direction.</p> |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <p>4.3.1.3 MEZZANINES: Interior mezzanine levels shall be braced independently from the main structure, or shall be anchored to the lateral-force-resisting elements of the main structure.</p>  |   |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | <p>4.3.2.4 VERTICAL DISCONTINUITIES: All vertical elements in the lateral-force-resisting system shall be continuous to the foundation.</p>  |   |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | <p>4.3.2.6 TORSION: The estimated distance between the story center of mass and the story center of rigidity shall be less than 20% of the building width in either plan dimension for Life Safety and Immediate Occupancy.</p>  |   |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | <p>4.3.3.3 DETERIORATION OF STEEL: There shall be no visible rusting, corrosion, cracking, or other deterioration in any of the steel elements or connections in the vertical- or lateral-force-resisting systems.</p>   |   |

### LATERAL-FORCE-RESISTING SYSTEM

- |                                     |                          |                          |   |  |
|-------------------------------------|--------------------------|--------------------------|---|--|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <p>4.4.3.1.2 AXIAL STRESS CHECK: The axial stress in the diagonals, calculated using the Quick Check Procedure of Section 3.5.3.4, shall be less than <math>0.50F_y</math> for Life Safety and for Immediate Occupancy.</p> | <p>Calculated axial stress in rods is approximately 36.5 ksi. For 36 ksi steel, DCR = 1.01, OK</p> |
|-------------------------------------|--------------------------|--------------------------|---|--|

### CONNECTIONS

- |                                     |                          |                          |   |  |
|-------------------------------------|--------------------------|--------------------------|---|--|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <p>4.6.2.2 TRANSFER TO STEEL FRAMES: Diaphragms shall be connected for transfer of loads to the steel frames for Life Safety and the connections shall be able to develop the lesser of the strength of the frames or the diaphragms for Immediate Occupancy.</p>   | <p>Metal deck welded to roof beams.</p>  |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <p>4.6.3.1 STEEL COLUMNS: The columns in lateral-force-resisting frames shall be anchored to the building foundation for Life Safety and the anchorage shall be able to develop the lesser of the tensile capacity of the column, the tensile capacity of the lowest level column splice (if any), or the uplift capacity of the foundation, for Immediate Occupancy.</p> | <p>No structural drawings. From site visit, columns were observed to have anchor bolts into the slab on grade.</p> |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <p>4.6.3.8 WALL PANELS: Metal, fiberglass or cementitious wall panels shall be positively attached to the foundation for Life Safety and Immediate Occupancy.</p>   |  |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <p>4.6.5.1 ROOF PANELS: Metal, plastic, or cementitious roof panels shall be positively attached to the roof framing to resist seismic forces for Life Safety and Immediate Occupancy.</p>  | <p>Roof consists of bare metal deck on steel roof beams.</p>   |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <p>4.6.5.2 WALL PANELS: Metal, fiberglass or cementitious wall panels shall be positively attached to the framing to resist seismic forces for Life Safety and Immediate Occupancy.</p>   |  |



Building Name: Building 166D

Date: August 8, 2003

Building Address: Lawrence Livermore National Laboratory

Page: 2 of 2

Job Number: A20047.08

Job Name: LLNL Prioritization

By: AK Checked: \_\_\_\_\_

**ASCE 31\* BASIC CHECKLIST S3: STEEL LIGHT FRAMES**

C NC N/A

Comments

**CONNECTIONS**

- 4.6.5.2 WALL PANELS: Metal, fiberglass or cementitious wall panels shall be positively attached to the framing to resist seismic forces for Life Safety and Immediate Occupancy.

\* – Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.

Building Name: Building 166D

Date: August 8, 2003

Building Address: Lawrence Livermore National Laboratory

Page: 1 of 1

Job Number: A20047.08 Job Name: LLNL Prioritization

By: AK Checked: \_\_\_\_\_

## ASCE 31\* SUPPLEMENTAL CHECKLIST S3: STEEL LIGHT FRAMES

C NC N/A

Comments

### LATERAL-FORCE-RESISTING SYSTEM

- |                          |                                     |                                     |   |                                   |
|--------------------------|-------------------------------------|-------------------------------------|---|-----------------------------------|
| <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | 4.4.1.3.3 MOMENT-RESISTING CONNECTIONS: All moment connections shall be able to develop the strength of the adjoining members or panel zones.   |                                   |
| <input type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | 4.4.1.3.7 COMPACT MEMBERS: All frame elements shall meet section requirements set forth by Table I-9-1 of <i>Seismic Provisions for Structural Steel Buildings</i> (AISC, 1997).  | No structural drawings available. |
| <input type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | 4.4.1.3.8 BEAM PENETRATIONS: All openings in frame-beam webs shall be less than 1/4 of the beam depth and shall be located in the center half of the beams. This statement shall apply to the Immediate Occupancy Performance Level only. | Life Safety Evaluation.           |
| <input type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | 4.4.1.3.10 OUT-OF-PLANE BRACING: Beam-column joints shall be braced out-of-plane. This statement shall apply to the Immediate Occupancy Performance Level only.   | Life Safety Evaluation.           |
| <input type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | 4.4.1.3.11 BOTTOM FLANGE BRACING: The bottom flanges of beams shall be braced out-of-plane. This statement shall apply to the Immediate Occupancy Performance Level only.   | Life Safety Evaluation.           |

### DIAPHRAGMS

- |                                     |                          |                                     |   |                         |
|-------------------------------------|--------------------------|-------------------------------------|---|-------------------------|
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.5.1.7 PLAN IRREGULARITIES: There shall be tensile capacity to develop the strength of the diaphragm at re-entrant corners or other locations of plan irregularities. This statement shall apply to the Immediate Occupancy Performance Level only.      | Life Safety Evaluation. |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.5.1.8 DIAPHRAGM REINFORCEMENT AT OPENINGS: There shall be reinforcing around all diaphragm openings larger than 50% of the building width in either major plan dimension. This statement shall apply to the Immediate Occupancy Performance Level only. | Life Safety Evaluation. |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.5.7.1 OTHER DIAPHRAGMS: The diaphragm shall not consist of a system other than wood, metal deck, concrete or horizontal bracing.  |                         |

### CONNECTIONS

- |                                     |                          |                                     |  |   |
|-------------------------------------|--------------------------|-------------------------------------|--|---|
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.6.3.10 UPLIFT AT PILE CAPS: Pile caps shall have top reinforcement and piles shall be anchored to the pile caps for Life Safety, and the pile cap reinforcement and pile anchorage shall be able to develop the tensile capacity of the piles for Immediate Occupancy. | No structural drawings. But pile foundations not typical at site. |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.6.5.3 ROOF PANEL CONNECTIONS: Roof panel connections shall be spaced at or less than 12" for Life Safety and 8" for Immediate Occupancy.   |   |

\* - Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.



Building Name: Building 253, Original

Date: July 17, 2003

Building Address: Lawrence Livermore National Laboratory

Page: 1 of 1

Job Number: A20047.08

Job Name: LLNL Prioritization

By: JYF

Checked: JEH

**PRIORITIZATION BUILDING DATA SHEET**

**BUILDING DATA**

Year Built:	1959	Year(s) Remodeled:	None	UBC Zone:	4 – Type B Near Field
Area (sf):	4,800	Length (ft):	80	Width (ft):	60
No. Stories:	1	Story Height:	14.5 ft	Total Height:	14.5 ft

**CONSTRUCTION DATA**

Gravity Load Structural System: Bare metal deck supported by WF beams and tapered steel beams, which are supported by perimeter reinforced concrete block walls

Exterior Transverse Walls: 8" concrete block walls

Openings?: Door and window openings

Exterior Longitudinal Walls: 8" concrete block walls

Openings?: Door and window openings

Roof Framing: 1 1/2" Bare metal deck supported by 10B11.5 beams tapered steel girders

Intermediate Floor Framing: None

Ground Floor: 5" concrete slab on grade w/ 6x6-6/6 WWM

Columns: None

Foundation: Strip footing @ concrete block walls

**LATERAL-FORCE-RESISTING SYSTEM**

	<u>Longitudinal</u>	<u>Transverse</u>
System Classification:	Type 13 (Reinforced concrete block walls w/ flexible diaphragm)	Type 13 (Reinforced concrete block walls w/ flexible diaphragm)
Vertical Elements:	Steel beams and girders, reinforced concrete block walls @ perimeter	Steel beams and girders, reinforced concrete block walls @ perimeter
Diaphragms:	Bare metal deck	Bare metal deck

SEISMIC EVALUATION PERFORMED? Yes EVALUATION: Rapid Evaluation YEAR: 2003

SEISMIC EVALUATION CRITERIA: Life Safety/ ASCE 31-02

VULNERABILITY RATING: 1  
(1=low to 10=high)

PRIORITIZATION CLASSIFICATION: CLASS D

**POTENTIAL LIFE SAFETY DEFICIENCIES:**

THIS BUILDING WAS EVALUATED FOR THE 10% IN 50 YR. EARTHQUAKE.

*There are no potential life safety deficiencies identified.*

**PRELIMINARY STRENGTHENING SCHEMES OR MITIGATION MEASURES:**

*None recommended.*



Building Name: Building 253, Original

Date: July 18, 2003

Building Address: Lawrence Livermore National Laboratory

Page: 1 of 3

Job Number: A20047.08

Job Name: LLNL Prioritization

By: JYF Checked: JEH

**ASCE 31\* BASIC CHECKLIST RM1: REINFORCED MASONRY BEARING WALL BUILDINGS WITH FLEXIBLE DIAPHRAGMS**

C NC N/A

Comments

**BUILDING SYSTEM**

<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.1.1	LOAD PATH: The structure shall contain a minimum of one complete load path for Life Safety and Immediate Occupancy for seismic force effects from any horizontal direction that serves to transfer the inertial forces from the mass to the foundation.	The bare metal deck delivers load to the W beams and tapered steel girders, which transfer load to the perimeter reinforced concrete block walls. The concrete block walls are doweled into the concrete strip foundation system.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.1.2	ADJACENT BUILDINGS: The clear distance between the building being evaluated and any adjacent building shall be greater than 4% of the height of the shorter building for Life Safety and Immediate Occupancy.	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.1.3	MEZZANINES: Interior mezzanine levels shall be braced independently from the main structure, or shall be anchored to the lateral-force-resisting elements of the main structure.	There are no mezzanines.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.1	WEAK STORY: The strength of the lateral-force-resisting system in any story shall not be less than 80% of the strength in an adjacent story above or below for Life-Safety and Immediate Occupancy.	One story building
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.2	SOFT STORY: The stiffness of the lateral-force-resisting-system in any story shall not be less than 70% of the lateral-force-resisting system stiffness in an adjacent story above or below, or less than 80% of the average lateral-force-resisting system stiffness of the three stories above or below for Life Safety and Immediate Occupancy.	One story building
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.3	GEOMETRY: There shall be no changes in horizontal dimension of the lateral-force-resisting system of more than 30% in a story relative to adjacent stories for Life Safety and Immediate Occupancy, excluding one-story penthouses and mezzanines.	One story building
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.2.4	VERTICAL DISCONTINUITIES: All vertical elements in the lateral-force-resisting system shall be continuous to the foundation.	The concrete block walls are doweled into the concrete strip foundation system.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.5	MASS: There shall be no change in effective mass of more than 50% from one story to the next for Life Safety and Immediate Occupancy. Light roofs, penthouses and mezzanines need not be considered.	One story building
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.3.1	DETERIORATION OF WOOD: There shall be no signs of decay, shrinkage, splitting, fire damage, or sagging in any of the wood members and none of the metal connection hardware shall be deteriorated, broken, or loose.	Site visit made on 7/30/03. No signs of deterioration were observed.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.3.7	MASONRY UNITS: There shall be no visible deterioration of masonry units.	Site visit made on 7/30/03. No signs of deterioration were observed.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.3.8	MASONRY JOINTS: The mortar shall not be easily scraped away from the joints by hand with a metal tool, and there shall be no areas of eroded mortar.	Site visit made on 7/30/03. No eroded mortar was observed

Building Name: **Building 253, Original**

Date: **July 18, 2003**

Building Address: **Lawrence Livermore National Laboratory**

Page: **2** of **3**

Job Number: **A20047.08**

Job Name: **LLNL Prioritization**

By: **JYF** Checked: **JEH**

## ASCE 31\* BASIC CHECKLIST RM1: REINFORCED MASONRY BEARING WALL BUILDINGS WITH FLEXIBLE DIAPHRAGMS

**C NC N/A**

**Comments**

### BUILDING SYSTEM

- |                                     |                          |                          |  |  |
|-------------------------------------|--------------------------|--------------------------|--|--|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <p>4.3.3.10 REINFORCED MASONRY WALL CRACKS: All existing diagonal cracks in wall elements shall be less than 1/8" for Life Safety and 1/16" for Immediate Occupancy, shall not be concentrated in one location, and shall not form an X pattern.</p> | <p>Site visit made on 7/30/03. There are no cracks &gt;1/8".</p> |
|-------------------------------------|--------------------------|--------------------------|--|--|

### LATERAL-FORCE-RESISTING SYSTEM

- |                                     |                          |                          |  |  |
|-------------------------------------|--------------------------|--------------------------|--|--|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <p>4.4.2.1.1 REDUNDANCY: The number of lines of shear walls in each principal direction shall be greater than or equal to 2 for Life Safety and Immediate Occupancy.</p>   | <p>There are two lines of shear walls in both the longitudinal and transverse directions.</p>  |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <p>4.4.2.4.1 SHEAR STRESS CHECK: The shear stress in the reinforced masonry shear walls, calculated using the Quick Check Procedure of Section 3.5.3.3, shall be less than 70 psi for Life Safety and Immediate Occupancy.</p>   | <p>The maximum shear stress in the concrete block wall is 10 psi &lt; 70 psi at Line 5.</p>  |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <p>4.4.2.4.2 REINFORCING STEEL: The total vertical and horizontal reinforcing steel ratio in reinforced masonry walls shall be greater than 0.002 for Life Safety and Immediate Occupancy of the wall with the minimum of 0.0007 for Life Safety and Immediate Occupancy in either of the two directions; the spacing of reinforcing steel shall be less than 48" for Life Safety and Immediate Occupancy; and all vertical bars shall extend to the top of the walls.</p> | <p>Typ. reinforcement in reinforced concrete block walls:<br/>           Vertical Reinforcing = #5@32" o.c.:<br/>           reinforcing ratio = 0.0012 &gt; 0.0007<br/>           Horizontal Reinforcing = #5@24" o.c.<br/>           horizontal: reinforcing ratio = 0.0016 &gt; 0.0007.</p> <p>Total reinforcing steel ratio =<br/> <math>(0.31 \times 32 / 24 + 0.31) \text{ in}^2 / (32 \times 8 \text{ in}) = 0.0028 = 0.002</math></p> |

### CONNECTIONS

- |                                     |                          |                                     |  |  |
|-------------------------------------|--------------------------|-------------------------------------|--|--|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | <p>4.6.1.1 WALL ANCHORAGE: Exterior concrete or masonry walls, that are dependent on the diaphragm for lateral support, shall be anchored for out-of-plane forces at each diaphragm level with steel anchors, reinforcing dowels, or straps that are developed into the diaphragm. Connections shall have adequate strength to resist the connection force calculated in the Quick Check Procedure of Section 3.5.3.7.</p> | <p>Out of plane anchorage: EW walls: (2) 3/4" diameter bolts at 20 ft o.c. and 1/2" diameter bolts @ 2 ft o.c.. NS walls: (2) 5/8" diameter bolts at 10 ft o.c. and 1/2" diameter bolts @ 2 ft o.c.</p> <p>D/C = 0.96.</p> |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <p>4.6.1.2 WOOD LEDGERS: The connection between the wall panels and the diaphragm shall not induce cross-grain bending or tension in the wood ledgers.</p>   | <p>There are no wood ledgers.</p>  |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | <p>4.6.2.1 TRANSFER TO SHEAR WALLS: Diaphragms shall be connected for transfer of loads to the shear walls for Life Safety and the connections shall be able to develop the lesser of the shear strength of the walls or diaphragms for Immediate Occupancy.</p>   | <p>Details shows the metal deck to be welded to 3"x1/4" embed plates w/ #4 anchors embedded into concrete block wall @ 2' o.c</p>  |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | <p>4.6.3.5 FOUNDATION DOWELS: Wall reinforcement shall be doweled into the foundation for Life Safety and the dowels shall be able to develop the lesser of the strength of the walls or the uplift capacity of the foundation for Immediate Occupancy.</p>  | <p>#5x 3'-6" dowels @ 32" o.c. into foundation to match vertical reinforcing in the concrete block walls.</p>  |

Building Name: Building 253, Original Date: July 18, 2003  
 Building Address: Lawrence Livermore National Laboratory Page: 3 of 3  
 Job Number: A20047.08 Job Name: LLNL Prioritization By: JYF Checked: JEH

**ASCE 31\* BASIC CHECKLIST RM1: REINFORCED MASONRY BEARING WALL BUILDINGS WITH FLEXIBLE DIAPHRAGMS**

C	NC	N/A		Comments
---	----	-----	--	----------

**CONNECTIONS**

- |                          |                          |                                     |  |                       |
|--------------------------|--------------------------|-------------------------------------|--|-----------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.6.4.1 GIRDER/COLUMN CONNECTION: There shall be a positive connection utilizing plates, connection hardware, or straps between the girder and the column support. | There are no columns. |
|--------------------------|--------------------------|-------------------------------------|--|-----------------------|

\* – Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.

Building Name: **Building 253, Original**

Date: **July 18, 2003**

Building Address: **Lawrence Livermore National Laboratory**

Page: **1** of **2**

Job Number: **A20047.08**

Job Name: **LLNL Prioritization**

By: **JYF** Checked: **JEH**

## ASCE 31\* SUPPLEMENTAL CHECKLIST RM1: REINFORCED MASONRY BEARING WALL BUILDINGS WITH FLEXIBLE DIAPHRAGMS

**C NC N/A**

**Comments**

### LATERAL-FORCE-RESISTING SYSTEM

- |                          |                          |                                     |   |                                |
|--------------------------|--------------------------|-------------------------------------|---|--------------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.2.4.3 REINFORCING AT OPENINGS: All wall openings that interrupt rebar shall have trim reinforcing on all sides. This statement shall apply to the Immediate Occupancy Performance Level only. | Life Safety Performance Level. |
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.2.4.4 PROPORTIONS: The height-to-thickness ratio of the shear walls at each story shall be less than 30. This statement shall apply to the Immediate Occupancy Performance Level only.        | Life Safety Performance Level. |

### DIAPHRAGMS

- |                                     |                          |                                     |  |  |
|-------------------------------------|--------------------------|-------------------------------------|--|--|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.5.1.2 CROSS TIES: There shall be continuous cross ties between diaphragm chords.   | Steel beams serve as the cross ties.                     |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.5.1.4 OPENINGS AT SHEAR WALLS: Diaphragm openings immediately adjacent to the shear walls shall be less than 25% of the wall length for Life Safety and 15% of the wall length for Immediate Occupancy.  | There are no diaphragm openings adjacent to shear walls. |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.5.1.6 OPENINGS AT EXTERIOR MASONRY SHEAR WALLS: Diaphragm openings immediately adjacent to exterior masonry shear walls shall not be greater than 8 ft long for Life Safety and 4 ft long for Immediate Occupancy.   | There are no diaphragm openings adjacent to shear walls. |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.5.1.7 PLAN IRREGULARITIES: There shall be tensile capacity to develop the strength of the diaphragm at re-entrant corners or other locations of plan irregularities. This statement shall apply to the Immediate Occupancy Performance Level only.   | Life Safety Performance Level.                           |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.5.1.8 DIAPHRAGM REINFORCEMENT AT OPENINGS: There shall be reinforcing around all diaphragm openings larger than 50% of the building width in either major plan dimension. This statement shall apply to the Immediate Occupancy Performance Level only.  | Life Safety Performance Level.                           |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.5.2.1 STRAIGHT SHEATHING: All straight sheathed diaphragms shall have aspect ratios less than 2 to 1 for Life Safety and 1 to 1 for Immediate Occupancy in the direction being considered.   | Bare metal deck.   |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.5.2.2 SPANS: All wood diaphragms with spans greater than 24 ft for Life Safety and 12 ft for Immediate Occupancy shall consist of wood structural panels or diagonal sheathing.  | Bare metal deck.   |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.5.2.3 UNBLOCKED DIAPHRAGMS: All diagonally sheathed and unblocked wood structural panel diaphragms shall have horizontal spans less than 40 ft for Life Safety and 30 ft for Immediate Occupancy and shall have aspect ratios less than or equal to 4 to 1 for Life Safety and 3 to 1 for Immediate Occupancy. | Bare metal deck.   |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.5.3.1 NON-CONCRETE FILLED DIAPHRAGMS: Untopped metal deck diaphragms or metal deck diaphragms with fill other than concrete shall consist of horizontal spans of less than 40 ft and shall have aspect ratios less than 4 to 1. This statement shall apply to the Immediate Occupancy Performance Level only.  | Life Safety Performance Level.                           |



Building Name: **Building 253, Original**

Date: **July 18, 2003**

Building Address: **Lawrence Livermore National Laboratory**

Page: **2** of **2**

Job Number: **A20047.08**

Job Name: **LLNL Prioritization**

By: **JYF** Checked: **JEH**

## ASCE 31\* SUPPLEMENTAL CHECKLIST RM1: REINFORCED MASONRY BEARING WALL BUILDINGS WITH FLEXIBLE DIAPHRAGMS

C NC N/A

Comments

### DIAPHRAGMS

- 4.5.7.1 OTHER DIAPHRAGMS: The diaphragm shall not consist of a system other than wood, metal deck, concrete or horizontal bracing.

### CONNECTIONS

- 4.6.1.4 STIFFNESS OF WALL ANCHORS: Anchors of concrete or masonry walls to wood structural elements shall be installed taut and shall be stiff enough to limit the relative movement between the wall and the diaphragm to no greater than 1/8".

\* - Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.



Building Name: **Building 253, Original**

Date: **July 17, 2003**

Building Address: **Lawrence Livermore National Laboratory**

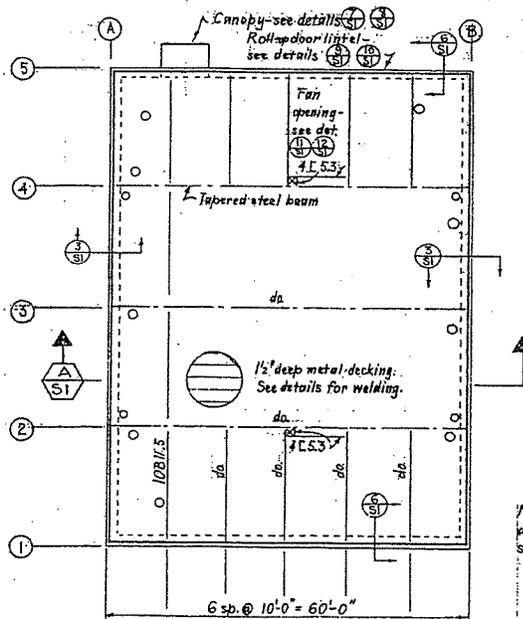
Page: **1** of **1**

Job Number: **A20047.08**

Job Name: **LLNL Prioritization**

By: **JYF** Checked: **JEH**

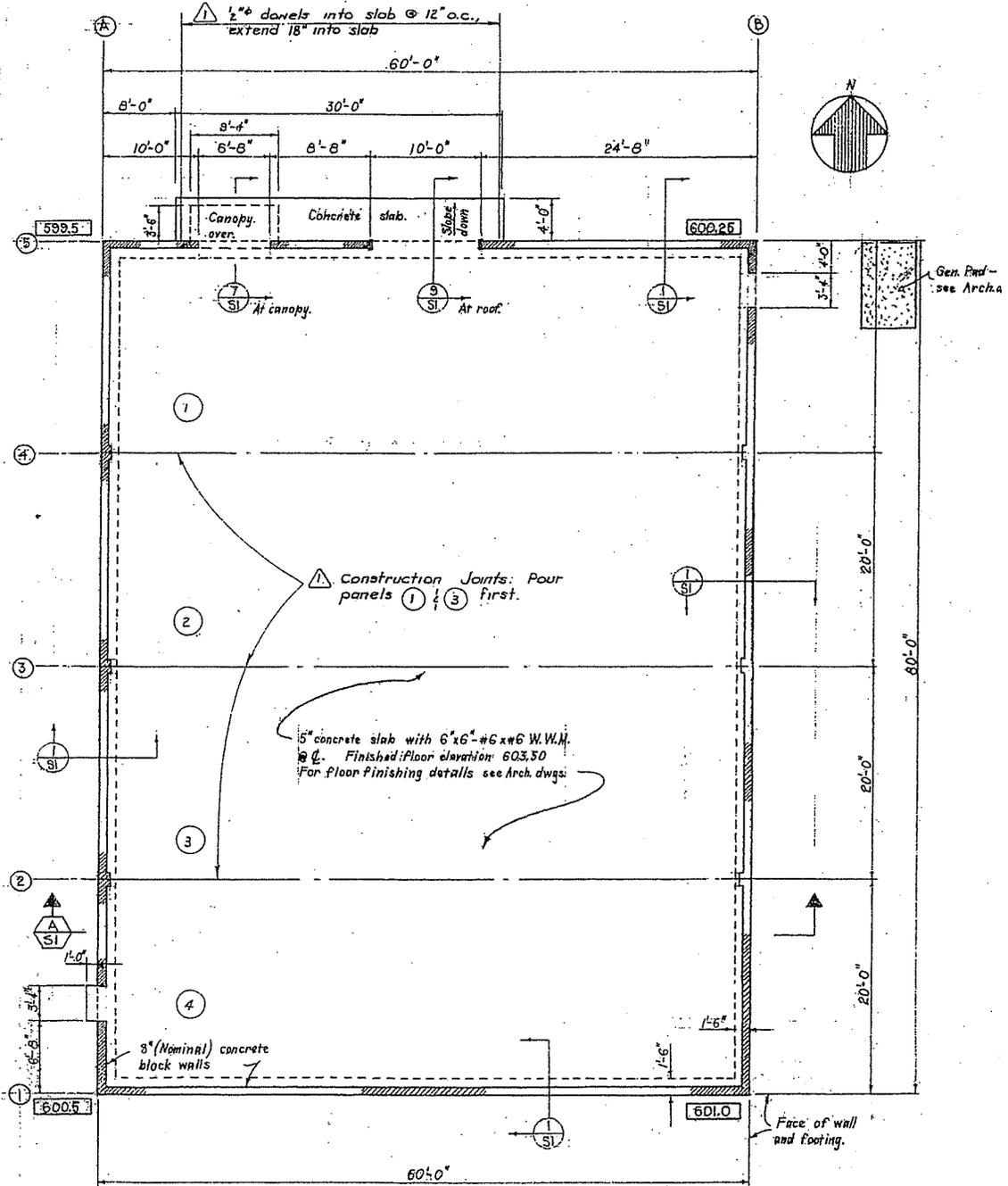
## ROOF PLAN



### ROOF PLAN

Scale: 1/8" = 1'-0"

**BUILDING PLAN**



**FOUNDATION PLAN**

Scale: 1/8" = 1'-0"



Building Name: **Building 281, Increment 2**

Date: **July 23, 2003**

Building Address: **Lawrence Livermore National Laboratory**

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Job Number: **A20047.08**

Job Name: **LLNL Prioritization**

By: **JYF** Checked: **JEH**

## ASCE 31\* BASIC CHECKLIST RM1: REINFORCED MASONRY BEARING WALL BUILDINGS WITH FLEXIBLE DIAPHRAGMS

C NC N/A

Comments

### BUILDING SYSTEM

<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.1.1	LOAD PATH: The structure shall contain a minimum of one complete load path for Life Safety and Immediate Occupancy for seismic force effects from any horizontal direction that serves to transfer the inertial forces from the mass to the foundation.	The bare metal deck delivers load to the WF beams and girders, which transfer load to the interior and perimeter reinforced concrete block walls. The concrete block walls are doweled into the concrete strip foundation system.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.1.2	ADJACENT BUILDINGS: The clear distance between the building being evaluated and any adjacent building shall be greater than 4% of the height of the shorter building for Life Safety and Immediate Occupancy.	Building 281 (South, Building 281 Addition), constructed in 1991 is adjacent to Building 281 (North, Increment 2). The seismic joint is ~4" measured on site visit on 7/22/03. The original Bldg 281, constructed in the early 1950's is seismically separated by a 3' seismic joint. All buildings are at the same elevation.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.1.3	MEZZANINES: Interior mezzanine levels shall be braced independently from the main structure, or shall be anchored to the lateral-force-resisting elements of the main structure.	There are no mezzanines.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.1	WEAK STORY: The strength of the lateral-force-resisting system in any story shall not be less than 80% of the strength in an adjacent story above or below for Life-Safety and Immediate Occupancy.	One story building
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.2	SOFT STORY: The stiffness of the lateral-force-resisting-system in any story shall not be less than 70% of the lateral-force-resisting system stiffness in an adjacent story above or below, or less than 80% of the average lateral-force-resisting system stiffness of the three stories above or below for Life Safety and Immediate Occupancy.	One story building
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.3	GEOMETRY: There shall be no changes in horizontal dimension of the lateral-force-resisting system of more than 30% in a story relative to adjacent stories for Life Safety and Immediate Occupancy, excluding one-story penthouses and mezzanines.	One story building
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.2.4	VERTICAL DISCONTINUITIES: All vertical elements in the lateral-force-resisting system shall be continuous to the foundation.	The concrete block walls are doweled into the concrete strip foundation system.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.5	MASS: There shall be no change in effective mass of more than 50% from one story to the next for Life Safety and Immediate Occupancy. Light roofs, penthouses and mezzanines need not be considered.	One story building
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.3.1	DETERIORATION OF WOOD: There shall be no signs of decay, shrinkage, splitting, fire damage, or sagging in any of the wood members and none of the metal connection hardware shall be deteriorated, broken, or loose.	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.3.7	MASONRY UNITS: There shall be no visible deterioration of masonry units.	Site visit made on 7/22/03. No signs of deterioration were observed.

Building Name: **Building 281, Increment 2**

Date: **July 23, 2003**

Building Address: **Lawrence Livermore National Laboratory**

Page: **2** of **3**

Job Number: **A20047.08**

Job Name: **LLNL Prioritization**

By: **JYF** Checked: **JEH**

## ASCE 31\* BASIC CHECKLIST RM1: REINFORCED MASONRY BEARING WALL BUILDINGS WITH FLEXIBLE DIAPHRAGMS

C	NC	N/A		Comments
<b>BUILDING SYSTEM</b>				
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.3.8 MASONRY JOINTS: The mortar shall not be easily scraped away from the joints by hand with a metal tool, and there shall be no areas of eroded mortar.	Site visit made on 7/22/03. No eroded mortar was observed.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.3.10 REINFORCED MASONRY WALL CRACKS: All existing diagonal cracks in wall elements shall be less than 1/8" for Life Safety and 1/16" for Immediate Occupancy, shall not be concentrated in one location, and shall not form an X pattern.	Site visit made on 7/22/03. There are no cracks >1/8".
<b>LATERAL-FORCE-RESISTING SYSTEM</b>				
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.4.2.1.1 REDUNDANCY: The number of lines of shear walls in each principal direction shall be greater than or equal to 2 for Life Safety and Immediate Occupancy.	There are at least two lines of shear walls in both the longitudinal and transverse directions.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.4.2.4.1 SHEAR STRESS CHECK: The shear stress in the reinforced masonry shear walls, calculated using the Quick Check Procedure of Section 3.5.3.3, shall be less than 70 psi for Life Safety and Immediate Occupancy.	The maximum shear stress in the concrete block wall is 64 psi < 70 psi at the Line E.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.4.2.4.2 REINFORCING STEEL: The total vertical and horizontal reinforcing steel ratio in reinforced masonry walls shall be greater than 0.002 for Life Safety and Immediate Occupancy of the wall with the minimum of 0.0007 for Life Safety and Immediate Occupancy in either of the two directions; the spacing of reinforcing steel shall be less than 48" for Life Safety and Immediate Occupancy; and all vertical bars shall extend to the top of the walls.	Typ. reinforcement in reinforced concrete block walls: Vertical Reinforcing = #5@32" o.c.: reinforcing ratio = 0.0012 > 0.0007 Horizontal Reinforcing = #5@32" o.c. horizontal: reinforcing ratio = 0.0012 > 0.0007.  Total reinforcing steel ratio = $(0.31+0.31)in^2/(32"*8") = 0.0024 = 0.002$
<b>CONNECTIONS</b>				
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.6.1.1 WALL ANCHORAGE: Exterior concrete or masonry walls, that are dependent on the diaphragm for lateral support, shall be anchored for out-of-plane forces at each diaphragm level with steel anchors, reinforcing dowels, or straps that are developed into the diaphragm. Connections shall have adequate strength to resist the connection force calculated in the Quick Check Procedure of Section 3.5.3.7.	Out of plane anchorage: Critical case-Girder to wall connection: (2) 3/4" diameter x 12" bolts. Maximum spacing of anchorage @ 18". Metal deck to wall connection: #4 L-anchors @ 2' o.c.  D/C = 0.79.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.6.1.2 WOOD LEDGERS: The connection between the wall panels and the diaphragm shall not induce cross-grain bending or tension in the wood ledgers.	There are no wood ledgers.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.6.2.1 TRANSFER TO SHEAR WALLS: Diaphragms shall be connected for transfer of loads to the shear walls for Life Safety and the connections shall be able to develop the lesser of the shear strength of the walls or diaphragms for Immediate Occupancy.	Details shows the metal deck to be screwed to 3x1/4 plate which are connected to the concrete block walls by #4 L anchors @ 24" o.c.

Building Name: Building 281, Increment 2

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Building Address: Lawrence Livermore National Laboratory

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Job Number: A20047.08

Job Name: LLNL Prioritization

By: JYF Checked: JEH

## ASCE 31\* BASIC CHECKLIST RM1: REINFORCED MASONRY BEARING WALL BUILDINGS WITH FLEXIBLE DIAPHRAGMS

C	NC	N/A		Comments
<b>CONNECTIONS</b>				
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.6.3.5 FOUNDATION DOWELS: Wall reinforcement shall be doweled into the foundation for Life Safety and the dowels shall be able to develop the lesser of the strength of the walls or the uplift capacity of the foundation for Immediate Occupancy.	#5x 3'-6" dowels @ 32" o.c. into concrete foundation to match vertical reinforcing in the concrete block walls.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.6.4.1 GIRDER/COLUMN CONNECTION: There shall be a positive connection utilizing plates, connection hardware, or straps between the girder and the column support.	Girders are connected to the columns w/ bolts and welds.

\* – Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31



Building Name: Building 281, Increment 2

Date: July 23, 2003

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Job Number: A20047.08

Job Name: LLNL Prioritization

By: JYF Checked: JEH

## ASCE 31\* SUPPLEMENTAL CHECKLIST RM1: REINFORCED MASONRY BEARING WALL BUILDINGS WITH FLEXIBLE DIAPHRAGMS

C NC N/A

Comments

### LATERAL-FORCE-RESISTING SYSTEM

- |                          |                          |                                     |   |                                |
|--------------------------|--------------------------|-------------------------------------|---|--------------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.2.4.3 REINFORCING AT OPENINGS: All wall openings that interrupt rebar shall have trim reinforcing on all sides. This statement shall apply to the Immediate Occupancy Performance Level only. | Life Safety Performance Level. |
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.2.4.4 PROPORTIONS: The height-to-thickness ratio of the shear walls at each story shall be less than 30. This statement shall apply to the Immediate Occupancy Performance Level only.        | Life Safety Performance Level. |

### DIAPHRAGMS

- |                                     |                          |                                     |  |  |
|-------------------------------------|--------------------------|-------------------------------------|--|--|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.5.1.2 CROSS TIES: There shall be continuous cross ties between diaphragm chords.   | Steel beams serve as the cross ties.   |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.5.1.4 OPENINGS AT SHEAR WALLS: Diaphragm openings immediately adjacent to the shear walls shall be less than 25% of the wall length for Life Safety and 15% of the wall length for Immediate Occupancy.  | Diaphragm openings adjacent to shear walls are less than 25% of the wall length. Max opening size = 40" x 40". |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.5.1.6 OPENINGS AT EXTERIOR MASONRY SHEAR WALLS: Diaphragm openings immediately adjacent to exterior masonry shear walls shall not be greater than 8 ft long for Life Safety and 4 ft long for Immediate Occupancy.   | Openings adjacent to shear walls =27" for mechanical units.  |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.5.1.7 PLAN IRREGULARITIES: There shall be tensile capacity to develop the strength of the diaphragm at re-entrant corners or other locations of plan irregularities. This statement shall apply to the Immediate Occupancy Performance Level only.   | Life Safety Performance Level.   |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.5.1.8 DIAPHRAGM REINFORCEMENT AT OPENINGS: There shall be reinforcing around all diaphragm openings larger than 50% of the building width in either major plan dimension. This statement shall apply to the Immediate Occupancy Performance Level only.  | Life Safety Performance Level.   |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.5.2.1 STRAIGHT SHEATHING: All straight sheathed diaphragms shall have aspect ratios less than 2 to 1 for Life Safety and 1 to 1 for Immediate Occupancy in the direction being considered.   | Bare metal deck.   |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.5.2.2 SPANS: All wood diaphragms with spans greater than 24 ft for Life Safety and 12 ft for Immediate Occupancy shall consist of wood structural panels or diagonal sheathing.  | Bare metal deck.   |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.5.2.3 UNBLOCKED DIAPHRAGMS: All diagonally sheathed and unblocked wood structural panel diaphragms shall have horizontal spans less than 40 ft for Life Safety and 30 ft for Immediate Occupancy and shall have aspect ratios less than or equal to 4 to 1 for Life Safety and 3 to 1 for Immediate Occupancy. | Bare metal deck.   |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.5.3.1 NON-CONCRETE FILLED DIAPHRAGMS: Untopped metal deck diaphragms or metal deck diaphragms with fill other than concrete shall consist of horizontal spans of less than 40 ft and shall have aspect ratios less than 4 to 1. This statement shall apply to the Immediate Occupancy Performance Level only.  | Life Safety Performance Level.   |



Building Name: Building 281, Increment 2

Date: July 23, 2003

Building Address: Lawrence Livermore National Laboratory

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Job Number: A20047.08

Job Name: LLNL Prioritization

By: JYF Checked: JEH

**ASCE 31\* SUPPLEMENTAL CHECKLIST RM1: REINFORCED MASONRY BEARING WALL BUILDINGS WITH FLEXIBLE DIAPHRAGMS**

C NC N/A Comments

**DIAPHRAGMS**

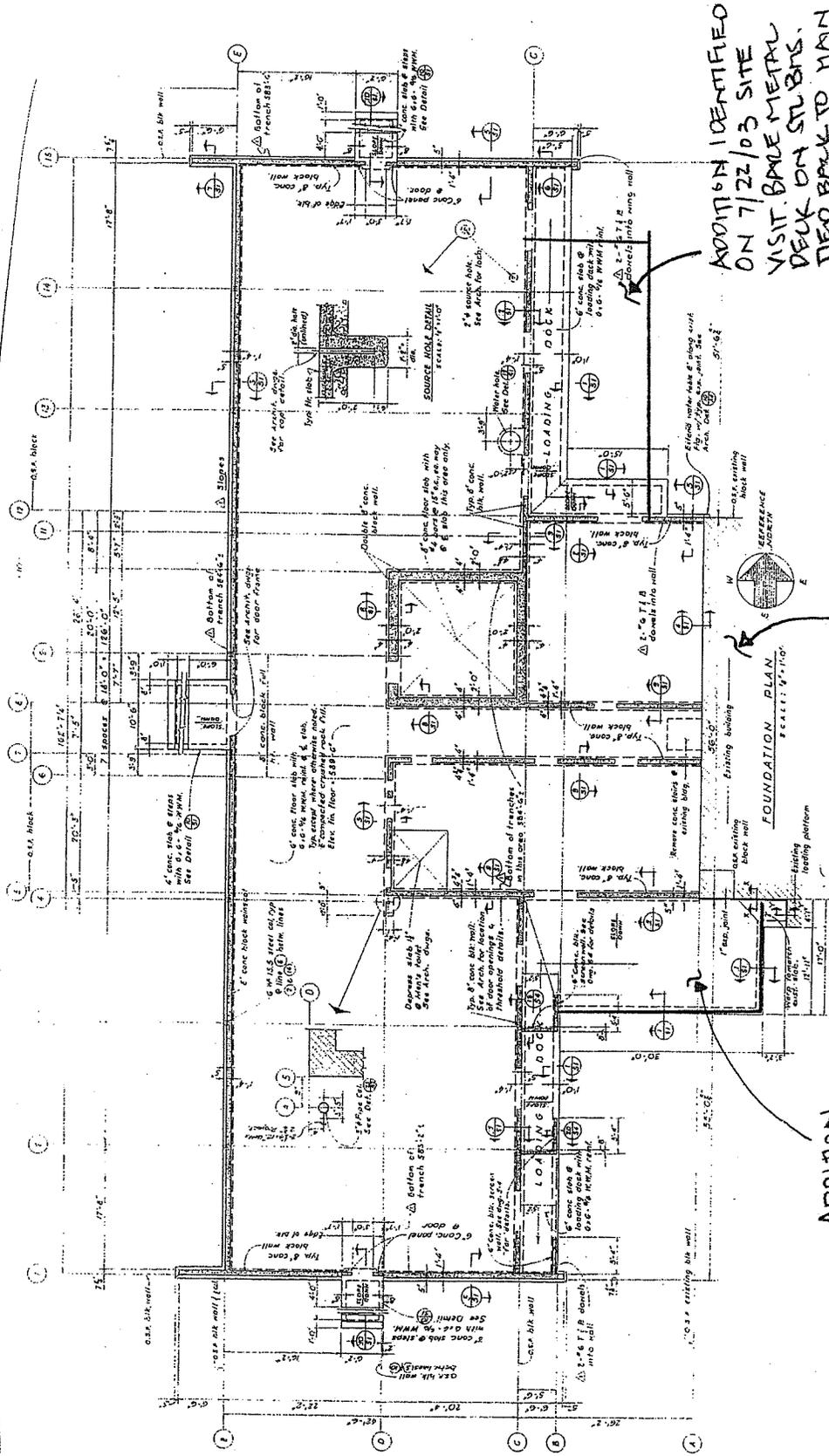
4.5.7.1 OTHER DIAPHRAGMS: The diaphragm shall not consist of a system other than wood, metal deck, concrete or horizontal bracing.

**CONNECTIONS**

4.6.1.4 STIFFNESS OF WALL ANCHORS: Anchors of concrete or masonry walls to wood structural elements shall be installed taut and shall be stiff enough to limit the relative movement between the wall and the diaphragm to no greater than 1/8".

\* – Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31

**BUILDING PLAN**



ADDITION IDENTIFIED ON 7/22/03 SITE VISIT. BARE METAL DECK ON STUBS. TIED BACK TO MAIN STRUCTURE.

DWG'S NOT AVAILABLE FOR (E) BLDG. SEISMICCAUT SEPARATED BY 3' JOINT. INCREMENT 1

ADDITION IN 1969. BARE METAL DECK ON STEEL BEAMS SUPPORTED BY PERIMETER CONCR. BLOCK WALLS.

1991 ADDITION 4" SEISMIC JOINT

FOUNDATION PLAN SCALE: 1/4"=1'-0"

Building Name: Building 281 (South), Addition

Date: July 17, 2003

Building Address: Lawrence Livermore National Laboratory

Page: 1 of 1

Job Number: A20047.08

Job Name: LLNL Prioritization

By: JYF

Checked: JEH

## PRIORITIZATION BUILDING DATA SHEET

### BUILDING DATA

Year Built:	1991	Year(s) Remodeled:	None	UBC Zone:	4 – Type B Near Field
Area (sf):	4,300	Length (ft):	76	Width (ft):	56
No. Stories:	1	Story Height:	16.7 ft	Total Height:	16.7 ft

### CONSTRUCTION DATA

Gravity Load Structural System: 1/2" plywood supported by 3x12 wood joists spaced at ~2'-0" o.c. and 5 1/8 glulams. TS4x4 columns, and perimeter concrete block walls

Exterior Transverse Walls: 8" concrete block walls

Openings?: Door and window openings

Exterior Longitudinal Walls: 8" concrete block walls

Openings?: Door and window openings

Roof Framing: 1/2" plywood supported by wood joists and glulams

Intermediate Floor Framing: None

Ground Floor: 6" concrete slab on grade w/ #5@12" o.c. E.W.

Columns: TS 4x4 columns

Foundation: Strip footing @ concrete block walls, spread footings at columns

### LATERAL-FORCE-RESISTING SYSTEM

	Longitudinal	Transverse
System Classification:	Type 13 (Reinforced concrete block walls w/ wood diaphragm)	Type 13 (Reinforced concrete block walls w/ wood diaphragm)
Vertical Elements:	Wood joists and glulams, TS columns, concrete block walls at perimeter	Wood joists and glulams, TS columns, concrete block walls at perimeter
Diaphragms:	1/2" plywood sheathing	1/2" plywood sheathing

SEISMIC EVALUATION PERFORMED? Yes EVALUATION: Rapid Evaluation YEAR: 2003

SEISMIC EVALUATION CRITERIA: Life Safety/ ASCE 31-02

VULNERABILITY RATING: 1  
(1=low to 10=high)

PRIORITIZATION CLASSIFICATION: CLASS D

### POTENTIAL LIFE SAFETY DEFICIENCIES:

THIS BUILDING WAS EVALUATED FOR THE 10% IN 50 YR. EARTHQUAKE.

*There are no potential life safety deficiencies identified.*

### PRELIMINARY STRENGTHENING SCHEMES OR MITIGATION MEASURES:

*None recommended.*

Building Name: **Building 281 (South), Addition**

Date: **July 17, 2003**

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Page: **1** of **3**

Job Number: **A20047.08**

Job Name: **LLNL Prioritization**

By: **JYF** Checked: **JEH**

## ASCE 31\* BASIC CHECKLIST RM1: REINFORCED MASONRY BEARING WALL BUILDINGS WITH FLEXIBLE DIAPHRAGMS

**C NC N/A**

**Comments**

### BUILDING SYSTEM

<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.1.1	LOAD PATH: The structure shall contain a minimum of one complete load path for Life Safety and Immediate Occupancy for seismic force effects from any horizontal direction that serves to transfer the inertial forces from the mass to the foundation.	The 1/2" plywood diaphragm delivers load to the wood beams and girders, which transfer load to the interior and perimeter reinforced concrete block walls. The concrete block walls are doweled into the concrete strip foundation system.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.1.2	ADJACENT BUILDINGS: The clear distance between the building being evaluated and any adjacent building shall be greater than 4% of the height of the shorter building for Life Safety and Immediate Occupancy.	Building 281 (South, Building 281 Addition, constructed in 1991 is adjacent to Building 281 (North, Increment 2). The seismic joint is ~4" measured on site visit on 7/22/03. All buildings are at the same elevation.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.1.3	MEZZANINES: Interior mezzanine levels shall be braced independently from the main structure, or shall be anchored to the lateral-force-resisting elements of the main structure.	There are no mezzanines.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.1	WEAK STORY: The strength of the lateral-force-resisting system in any story shall not be less than 80% of the strength in an adjacent story above or below for Life-Safety and Immediate Occupancy.	One story building
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.2	SOFT STORY: The stiffness of the lateral-force-resisting-system in any story shall not be less than 70% of the lateral-force-resisting system stiffness in an adjacent story above or below, or less than 80% of the average lateral-force-resisting system stiffness of the three stories above or below for Life Safety and Immediate Occupancy.	One story building
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.3	GEOMETRY: There shall be no changes in horizontal dimension of the lateral-force-resisting system of more than 30% in a story relative to adjacent stories for Life Safety and Immediate Occupancy, excluding one-story penthouses and mezzanines.	One story building
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.2.4	VERTICAL DISCONTINUITIES: All vertical elements in the lateral-force-resisting system shall be continuous to the foundation.	The concrete block walls are doweled into the concrete strip foundation system.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.5	MASS: There shall be no change in effective mass of more than 50% from one story to the next for Life Safety and Immediate Occupancy. Light roofs, penthouses and mezzanines need not be considered.	One story building
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.3.1	DETERIORATION OF WOOD: There shall be no signs of decay, shrinkage, splitting, fire damage, or sagging in any of the wood members and none of the metal connection hardware shall be deteriorated, broken, or loose.	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.3.7	MASONRY UNITS: There shall be no visible deterioration of masonry units.	Site visit made on 7/22/03. No signs of deterioration were observed.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.3.8	MASONRY JOINTS: The mortar shall not be easily scraped away from the joints by hand with a metal tool, and there shall be no areas of eroded mortar.	Site visit made on 7/22/03. No eroded mortar was observed.

Building Name: Building 281 (South), Addition

Date: July 17, 2003

Building Address: Lawrence Livermore National Laboratory

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Job Number: A20047.08

Job Name: LLNL Prioritization

By: JYF Checked: JEH

## ASCE 31\* BASIC CHECKLIST RM1: REINFORCED MASONRY BEARING WALL BUILDINGS WITH FLEXIBLE DIAPHRAGMS

C NC N/A

Comments

### BUILDING SYSTEM

- |                                     |                          |                          |  |  |
|-------------------------------------|--------------------------|--------------------------|--|--|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <p>4.3.3.10 REINFORCED MASONRY WALL CRACKS: All existing diagonal cracks in wall elements shall be less than 1/8" for Life Safety and 1/16" for Immediate Occupancy, shall not be concentrated in one location, and shall not form an X pattern.</p> | <p>Site visit made on 7/22/03. There are no cracks &gt;1/8".</p> |
|-------------------------------------|--------------------------|--------------------------|--|--|

### LATERAL-FORCE-RESISTING SYSTEM

- |                                     |                          |                          |  |   |
|-------------------------------------|--------------------------|--------------------------|--|---|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <p>4.4.2.1.1 REDUNDANCY: The number of lines of shear walls in each principal direction shall be greater than or equal to 2 for Life Safety and Immediate Occupancy.</p>   | <p>There are at least two lines of shear walls in both the longitudinal and transverse directions.</p>  |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <p>4.4.2.4.1 SHEAR STRESS CHECK: The shear stress in the reinforced masonry shear walls, calculated using the Quick Check Procedure of Section 3.5.3.3, shall be less than 70 psi for Life Safety and Immediate Occupancy.</p>   | <p>The maximum shear stress in the concrete block wall is 31 psi &lt; 70 psi at the Line E.</p>   |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <p>4.4.2.4.2 REINFORCING STEEL: The total vertical and horizontal reinforcing steel ratio in reinforced masonry walls shall be greater than 0.002 for Life Safety and Immediate Occupancy of the wall with the minimum of 0.0007 for Life Safety and Immediate Occupancy in either of the two directions; the spacing of reinforcing steel shall be less than 48" for Life Safety and Immediate Occupancy; and all vertical bars shall extend to the top of the walls.</p> | <p>Typ. reinforcement in reinforced concrete block walls:<br/>           Vertical Reinforcing = #5@16" o.c.:<br/>           reinforcing ratio = 0.0024 &gt; 0.0007<br/>           Horizontal Reinforcing = #5@24" o.c.<br/>           horizontal: reinforcing ratio = 0.0016 &gt; 0.0007.</p> <p>Total reinforcing steel ratio =<br/> <math>(0.31 \times 24 / 16 + 0.31) \text{ in}^2 / (24 \times 8 \text{ in}) = 0.004 = 0.002</math></p> |

### CONNECTIONS

- |                                     |                          |                          |  |  |
|-------------------------------------|--------------------------|--------------------------|--|--|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <p>4.6.1.1 WALL ANCHORAGE: Exterior concrete or masonry walls, that are dependent on the diaphragm for lateral support, shall be anchored for out-of-plane forces at each diaphragm level with steel anchors, reinforcing dowels, or straps that are developed into the diaphragm. Connections shall have adequate strength to resist the connection force calculated in the Quick Check Procedure of Section 3.5.3.7.</p> | <p>Out of plane anchorage: Simpson PATM25 w/ 13-16d.<br/><br/>D/C = 0.90.</p>  |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <p>4.6.1.2 WOOD LEDGERS: The connection between the wall panels and the diaphragm shall not induce cross-grain bending or tension in the wood ledgers.</p>   |  |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <p>4.6.2.1 TRANSFER TO SHEAR WALLS: Diaphragms shall be connected for transfer of loads to the shear walls for Life Safety and the connections shall be able to develop the lesser of the shear strength of the walls or diaphragms for Immediate Occupancy.</p>   | <p>1/2" plywood is connected to joists and ledger w/ Simpson PATM25's. Ledgers are bolted to concrete block walls w/ (2)-5/8" diameter x9" A307 bolts @ 24" o.c.</p> |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <p>4.6.3.5 FOUNDATION DOWELS: Wall reinforcement shall be doweled into the foundation for Life Safety and the dowels shall be able to develop the lesser of the strength of the walls or the uplift capacity of the foundation for Immediate Occupancy.</p>  | <p>#5 L-dowels @ 16" o.c. into concrete foundation to match vertical reinforcing in the concrete block walls.</p>  |



Building Name: Building 281 (South), Addition

Date: July 17, 2003

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Job Number: A20047.08

Job Name: LLNL Prioritization

By: JYF Checked: JEH

## ASCE 31\* BASIC CHECKLIST RM1: REINFORCED MASONRY BEARING WALL BUILDINGS WITH FLEXIBLE DIAPHRAGMS

C	NC	N/A	Comments
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### CONNECTIONS

4.6.4.1 GIRDER/COLUMN CONNECTION: There shall be a positive connection utilizing plates, connection hardware, or straps between the girder and the column support.

Glulams are connected to TS columns w/ Simpson CCO5 1/4.

\* – Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.

Building Name: Building 281 (South), Addition

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 Building Address: Lawrence Livermore National Laboratory

 Page: 1 of 2

 Job Number: A20047.08

 Job Name: LLNL Prioritization

 By: JYF Checked: JEH

## ASCE 31\* SUPPLEMENTAL CHECKLIST RM1: REINFORCED MASONRY BEARING WALL BUILDINGS WITH FLEXIBLE DIAPHRAGMS

**C NC N/A**
**Comments**

### LATERAL-FORCE-RESISTING SYSTEM

- |                          |                          |                                     |   |                                |
|--------------------------|--------------------------|-------------------------------------|---|--------------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.2.4.3 REINFORCING AT OPENINGS: All wall openings that interrupt rebar shall have trim reinforcing on all sides. This statement shall apply to the Immediate Occupancy Performance Level only. | Life Safety Performance Level. |
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.2.4.4 PROPORTIONS: The height-to-thickness ratio of the shear walls at each story shall be less than 30. This statement shall apply to the Immediate Occupancy Performance Level only.        | Life Safety Performance Level. |

### DIAPHRAGMS

- |                                     |                          |                                     |  |   |
|-------------------------------------|--------------------------|-------------------------------------|--|---|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.5.1.2 CROSS TIES: There shall be continuous cross ties between diaphragm chords.   | Glulams act as cross ties in the NS direction. Wood joists act as cross ties in the EW direction. |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.5.1.4 OPENINGS AT SHEAR WALLS: Diaphragm openings immediately adjacent to the shear walls shall be less than 25% of the wall length for Life Safety and 15% of the wall length for Immediate Occupancy.  |   |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.5.1.6 OPENINGS AT EXTERIOR MASONRY SHEAR WALLS: Diaphragm openings immediately adjacent to exterior masonry shear walls shall not be greater than 8 ft long for Life Safety and 4 ft long for Immediate Occupancy.   |   |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.5.1.7 PLAN IRREGULARITIES: There shall be tensile capacity to develop the strength of the diaphragm at re-entrant corners or other locations of plan irregularities. This statement shall apply to the Immediate Occupancy Performance Level only.   | Life Safety Performance Level.  |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.5.1.8 DIAPHRAGM REINFORCEMENT AT OPENINGS: There shall be reinforcing around all diaphragm openings larger than 50% of the building width in either major plan dimension. This statement shall apply to the Immediate Occupancy Performance Level only.  | Life Safety Performance Level.  |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.5.2.1 STRAIGHT SHEATHING: All straight sheathed diaphragms shall have aspect ratios less than 2 to 1 for Life Safety and 1 to 1 for Immediate Occupancy in the direction being considered.   | 1/2" plywood sheathing.   |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.5.2.2 SPANS: All wood diaphragms with spans greater than 24 ft for Life Safety and 12 ft for Immediate Occupancy shall consist of wood structural panels or diagonal sheathing.  | 1/2" plywood sheathing.   |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.5.2.3 UNBLOCKED DIAPHRAGMS: All diagonally sheathed and unblocked wood structural panel diaphragms shall have horizontal spans less than 40 ft for Life Safety and 30 ft for Immediate Occupancy and shall have aspect ratios less than or equal to 4 to 1 for Life Safety and 3 to 1 for Immediate Occupancy. | Blocked diaphragm.  |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.5.3.1 NON-CONCRETE FILLED DIAPHRAGMS: Untopped metal deck diaphragms or metal deck diaphragms with fill other than concrete shall consist of horizontal spans of less than 40 ft and shall have aspect ratios less than 4 to 1. This statement shall apply to the Immediate Occupancy Performance Level only.  | Life Safety Performance Level.  |



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Job Number: A20047.08

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## ASCE 31\* SUPPLEMENTAL CHECKLIST RM1: REINFORCED MASONRY BEARING WALL BUILDINGS WITH FLEXIBLE DIAPHRAGMS

C NC N/A

Comments

### DIAPHRAGMS

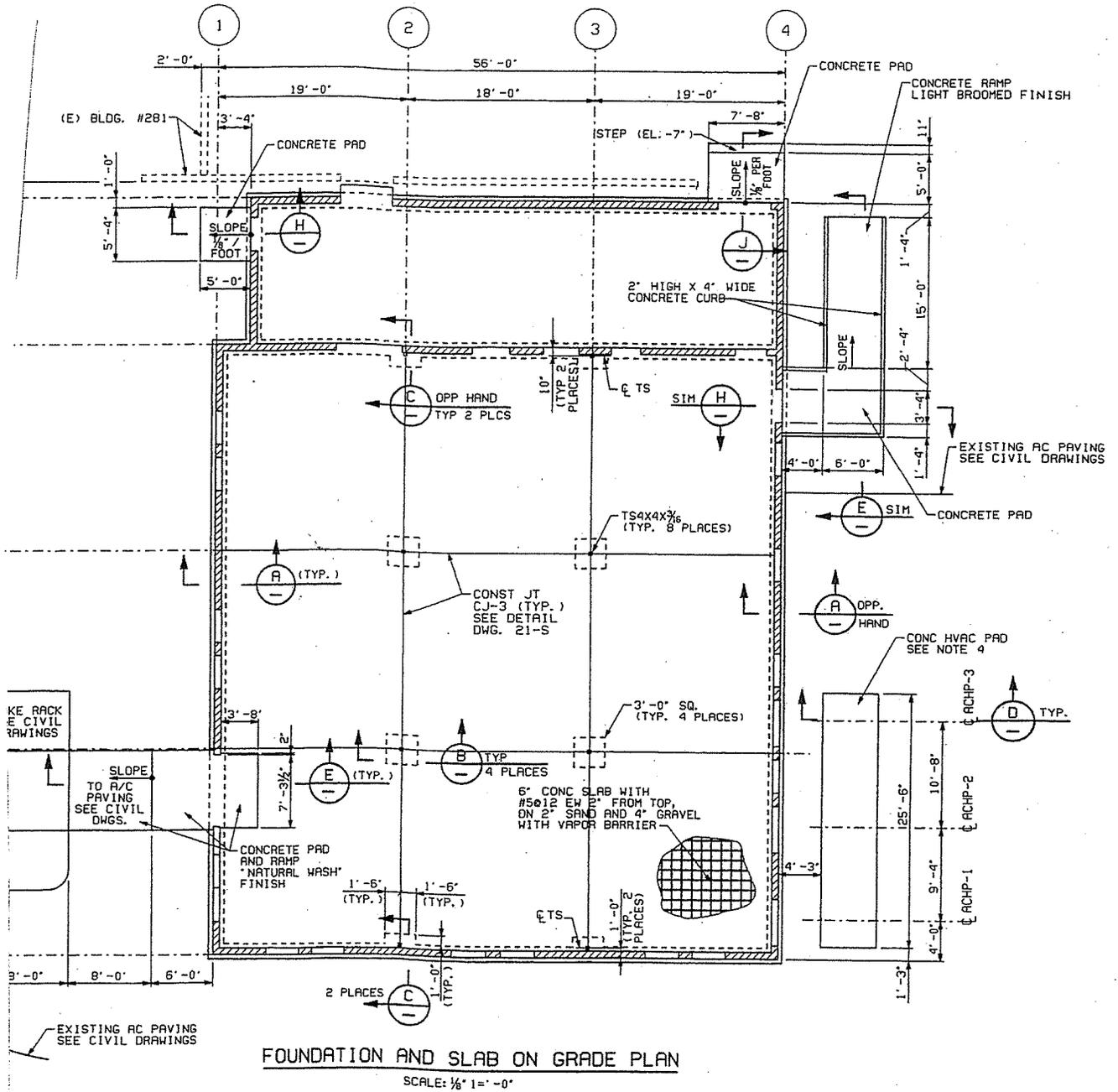
- 4.5.7.1 OTHER DIAPHRAGMS: The diaphragm shall not consist of a system other than wood, metal deck, concrete or horizontal bracing.

### CONNECTIONS

- 4.6.1.4 STIFFNESS OF WALL ANCHORS: Anchors of concrete or masonry walls to wood structural elements shall be installed taut and shall be stiff enough to limit the relative movement between the wall and the diaphragm to no greater than 1/8".

\* – Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31

# BUILDING PLAN



### **Building 292**

Building 292 is a one-story building. It consists of two types of construction: 1) 1/2" plywood sheathing supported by joists and glulams, which are supported by wood shear walls; 2) 4' to 7' thick concrete flat slab supported by interior and exterior concrete shear walls. The only deficiency noted for Building 292 is the lateral-force-resisting system of the mezzanine. The structural drawing showing the mezzanine details was not available for review. During our site visit, we did not have access to this part of the building. Madhu Kamath (Structural Engineer at LLNL) has verified that the mezzanine has a separate lateral force resisting system than the main structure. The mezzanine consists of hollow steel tube sections with angle knee braces.

Therefore this building is placed in Class D – Low Priority.

Building Name: Building 292 Date: July 28, 2003  
 Building Address: Lawrence Livermore National Laboratory Page: 1 of 2  
 Job Number: A20047.08 Job Name: LLNL Prioritization By: JYF Checked: JEH

## PRIORITIZATION BUILDING DATA SHEET

### BUILDING DATA

Year Built:	1979	Year(s) Remodeled:	1997, 1999	UBC Zone:	4 – Type B Near Field
Area (sf):	19,200	Length (ft):	142	Width (ft):	187
No. Stories:	1	Story Height:	18' to 26'	Total Height:	26' max

### CONSTRUCTION DATA

Gravity Load Structural System: Two types of construction: For the machine and target rooms, the structure consists of 4' to 7' thick concrete slabs supported by interior and exterior shear walls. The shear walls are doweled into the foundation below. The rest of the structure consists of 1/2" plywood sheathing supported by joists and glulams, which are supported by exterior plywood shear walls and interior stud walls. The shear walls are anchored to the concrete foundation below.

Exterior Transverse Walls: 3/8" plywood shear walls or reinforced concrete walls      Openings?: Door and window openings

Exterior Longitudinal Walls: 3/8" plywood shear walls or reinforced concrete walls      Openings?: Door and window openings

Roof Framing: Two types of construction: For the machine and target rooms, the structure consists of 4' to 7' thick concrete slabs. The rest of the structure consists of 1/2" plywood sheathing supported by joists and glulams. In the evaluation, the wood glulams were assumed to drag load from the wood diaphragms to the concrete walls. The connections were looked at and are adequate for transferring this load.

Intermediate Floor Framing: None

Ground Floor: 4" to 12" concrete slab on grade. 4" slab: #3@ 18" o.c., E.W. 6" slab: #4@ 18" o.c., E.W. 8" slab: #4@ 12" o.c., E.W. 12" slab: #8@ 12" o.c., E.W., E.F.

Columns: 4" diameter standard pipe columns

Foundation: Concrete strip footing and spread footings

### LATERAL-FORCE-RESISTING SYSTEM

	Longitudinal	Transverse
System Classification:	Type 9 (Concrete shear wall building w/ stiff diaphragm) and Type 2 (Wood frames, commercial and industrial)	Type 9 (Concrete shear wall building w/ stiff diaphragm) and Type 2 (Wood frames, commercial and industrial)
Vertical Elements:	Wood joists, glulams, steel pipe columns, wood stud and shear walls, concrete shear walls	Wood joists, glulams, steel pipe columns, wood stud and shear walls, concrete shear walls
Diaphragms:	1/2" plywood or 4' to 7' concrete slab	1/2" plywood or 4' to 7' concrete slab

SEISMIC EVALUATION PERFORMED? Yes EVALUATION: Rapid Evaluation YEAR: 2003

SEISMIC EVALUATION CRITERIA: Life Safety/ ASCE 31-02

VULNERABILITY RATING: 1  
(1=low to 10=high)

PRIORITIZATION CLASSIFICATION: CLASS D

Building Name: **Building 292**

Date: **July 28, 2003**

Building Address: **Lawrence Livermore National Laboratory**

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Job Number: **A20047.08**

Job Name: **LLNL Prioritization**

By: **JYF** Checked: **JEH**

## **PRIORITIZATION BUILDING DATA SHEET**

### **POTENTIAL LIFE SAFETY DEFICIENCIES:**

THIS BUILDING WAS EVALUATED FOR THE 10% IN 50 YR. EARTHQUAKE.

*There are no potential life safety deficiencies identified.*

### **PRELIMINARY STRENGTHENING SCHEMES OR MITIGATION MEASURES:**

*None recommended.*



Building Name: Building 292

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Job Number: A20047.08

Job Name: LLNL Prioritization

By: JYF Checked: JEH

**ASCE 31\* GENERAL BASIC STRUCTURAL CHECKLIST**

C NC N/A

Comments

**BUILDING SYSTEM**

**General**

- 4.3.1.1 LOAD PATH: The structure shall contain a minimum of one complete load path for Life Safety and Immediate Occupancy for seismic force effects from any horizontal direction that serves to transfer the inertial forces from the mass to the foundation. There are two types of construction: For the machine and target rooms, the structure consists of 4' to 7' thick concrete slabs supported by interior and exterior shear walls. The shear walls are doweled into the foundation below. The rest of the structure consists of 1/2" plywood sheathing supported by joists and glulams, which are supported by exterior plywood shear walls and interior stud walls. The shear walls are anchored to the concrete foundation below.
- 4.3.1.2 ADJACENT BUILDINGS: The clear distance between the building being evaluated and any adjacent building shall be greater than 4% of the height of the shorter building for Life Safety and Immediate Occupancy.
- 4.3.1.3 MEZZANINES: Interior mezzanine levels shall be braced independently from the main structure, or shall be anchored to the lateral-force-resisting elements of the main structure. Architectural drawings show a platform. The structural drawings do not show any anchorage of the mezzanine. On our site visit on 8/6/03, we could not enter this portion of the building. Madhu Kamath (LLNL personnel) has verified that the mezzanine has a separate lateral force resisting system than the main structure. The mezzanine consists of hollow steel tube sections with angle knee braces.

**Configuration**

- 4.3.2.1 WEAK STORY: The strength of the lateral-force-resisting system in any story shall not be less than 80% of the strength in an adjacent story above or below for Life-Safety and Immediate Occupancy. One story building.
- 4.3.2.2 SOFT STORY: The stiffness of the lateral-force-resisting-system in any story shall not be less than 70% of the lateral-force-resisting system stiffness in an adjacent story above or below, or less than 80% of the average lateral-force-resisting system stiffness of the three stories above or below for Life Safety and Immediate Occupancy. One story building.
- 4.3.2.3 GEOMETRY: There shall be no changes in horizontal dimension of the lateral-force-resisting system of more than 30% in a story relative to adjacent stories for Life Safety and Immediate Occupancy, excluding one-story penthouses and mezzanines. One story building.
- 4.3.2.4 VERTICAL DISCONTINUITIES: All vertical elements in the lateral-force-resisting system shall be continuous to the foundation. One story building.

Building Name: Building 292

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Job Number: A20047.08

Job Name: LLNL Prioritization

By: JYF Checked: JEH

## ASCE 31\* GENERAL BASIC STRUCTURAL CHECKLIST

C	NC	N/A		Comments
<b>BUILDING SYSTEM</b>				
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.5 MASS: There shall be no change in effective mass of more than 50% from one story to the next for Life Safety and Immediate Occupancy. Light roofs, penthouses and mezzanines need not be considered.	One story building.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.2.6 TORSION: The estimated distance between the story center of mass and the story center of rigidity shall be less than 20% of the building width in either plan dimension for Life Safety and Immediate Occupancy.	The rigid diaphragm is only at the machine and target rooms, which have thick concrete walls at the perimeter and interior
<b>Condition of Materials</b>				
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.3.1 DETERIORATION OF WOOD: There shall be no signs of decay, shrinkage, splitting, fire damage, or sagging in any of the wood members and none of the metal connection hardware shall be deteriorated, broken, or loose.	Site visit made on 8/6/03. No signs of deterioration were observed.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.3.2 WOOD STRUCTURAL PANEL SHEAR WALL FASTENERS: There shall be no more than 15% of inadequate fastening such as overdriven fasteners, omitted blocking, excessive fastening spacing, or inadequate edge distance. This statement shall apply to the Immediate Occupancy Performance Level only.	Life Safety Performance Level.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.3.3 DETERIORATION OF STEEL: There shall be no visible rusting, corrosion, cracking, or other deterioration in any of the steel elements or connections in the vertical- or lateral-force-resisting systems.	Site visit made on 8/6/03. No signs of deterioration were observed.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.3.4 DETERIORATION OF CONCRETE: There shall be no visible deterioration of concrete or reinforcing steel in any of the vertical- or lateral-force-resisting elements.	Site visit made on 8/6/03. No signs of deterioration were observed.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.3.5 POST-TENSIONING ANCHORS: There shall be no evidence of corrosion or spalling in the vicinity of post-tensioning or end fittings. Coil anchors shall not have been used.	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.3.6 PRECAST CONCRETE WALLS: There shall be no visible deterioration of concrete or reinforcing steel or evidence of distress, especially at the connections.	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.3.7 MASONRY UNITS: There shall be no visible deterioration of masonry units.	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.3.8 MASONRY JOINTS: The mortar shall not be easily scraped away from the joints by hand with a metal tool, and there shall be no areas of eroded mortar.	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.3.9 CONCRETE WALL CRACKS: All existing diagonal cracks in wall elements shall be less than 1/8" for Life Safety and 1/16" for Immediate Occupancy, shall not be concentrated in one location, and shall not form an X pattern.	Site visit made on on 8/6/03. There are no cracks >1/8".
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.3.10 REINFORCED MASONRY WALL CRACKS: All existing diagonal cracks in wall elements shall be less than 1/8" for Life Safety and 1/16" for Immediate Occupancy, shall not be concentrated in one location, and shall not form an X pattern.	



Building Name: Building 292

Date: July 28, 2003

Building Address: Lawrence Livermore National Laboratory

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Job Number: A20047.08

Job Name: LLNL Prioritization

By: JYF Checked: JEH

## ASCE 31\* GENERAL BASIC STRUCTURAL CHECKLIST

C	NC	N/A	Comments
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### BUILDING SYSTEM

- |                          |                          |                                     |  |
|--------------------------|--------------------------|-------------------------------------|--|
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.3.3.11 UNREINFORCED MASONRY WALL CRACKS: There shall be no existing diagonal cracks in the wall elements greater than 1/8" for Life Safety and 1/16" for Immediate Occupancy, or out-of-plane offsets in the bed joint greater than 1/8" for Life Safety and 1/16" for Immediate Occupancy, and shall not form an X pattern. |
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.3.3.12 CRACKS IN INFILL WALLS: There shall be no existing diagonal cracks in the infilled walls that extend throughout a panel, greater than 1/8" for Life Safety and 1/16" for Immediate Occupancy, or out-of-plane offsets in the bed joint greater than 1/8" for Life Safety and 1/16" for Immediate Occupancy.           |
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.3.3.13 CRACKS IN BOUNDARY COLUMNS: There shall be no existing diagonal cracks wider than 1/8" for Life Safety and 1/16" for Immediate Occupancy in concrete columns that encase masonry infills.   |

### LATERAL-FORCE-RESISTING SYSTEM

#### Shear Walls – General

- |                                     |                          |                          |   |   |
|-------------------------------------|--------------------------|--------------------------|---|---|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 4.4.2.1.1 REDUNDANCY: The number of lines of shear walls in each principal direction shall be greater than or equal to 2 for Life Safety and Immediate Occupancy. | There are at least two lines of shear walls in each direction of loading. |
|-------------------------------------|--------------------------|--------------------------|---|---|

#### Concrete Shear Walls

- |                                     |                          |                                     |  |  |
|-------------------------------------|--------------------------|-------------------------------------|--|--|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.4.2.2.1 SHEAR STRESS CHECK: The shear stress in the concrete shear walls, calculated using the Quick Check procedure of Section 3.5.3.3, shall be less than 100 psi or $2\sqrt{f'_c}$ for Life Safety and Immediate Occupancy.   | The maximum shear stress is 22 psi < 100 psi at Line 2. See Building Plan. Note: $2\sqrt{f'_c} = 110$ psi for $f'_c = 3,000$ psi.  |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.4.2.2.2 REINFORCING STEEL: The ratio of reinforcing steel area to gross concrete area shall be not less than 0.0015 in the vertical direction and 0.0025 in the horizontal direction for Life Safety and Immediate Occupancy. The spacing of reinforcing steel shall be equal to or less than 18" for Life Safety and Immediate Occupancy. | Typ. reinforcement in reinforced concrete walls:<br>4'-8" thick wall: #6 @9" o.c.; $\rho = 0.44/(9 \times 9) = 0.0054 > 0.0025$<br>7' thick wall: #7 @9" o.c.; $\rho = 0.6/(9 \times 9) = 0.0074 > 0.0025$<br>8' thick wall: #8 @9" o.c.; $\rho = 0.79/(9 \times 9) = 0.0098 > 0.0025$<br><br>The spacing = 12" < 18". |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.2.2.9 COLUMN SPLICES: Steel columns encased in shear wall boundary elements shall have splices that develop the tensile strength of the column. This statement shall apply to the Immediate Occupancy Performance Level only.  | Life Safety Performance Level.   |

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Job Number: **A20047.08**

Job Name: **LLNL Prioritization**

By: **JYF** Checked: **JEH**

## ASCE 31\* GENERAL BASIC STRUCTURAL CHECKLIST

**C NC N/A**

**Comments**

### Walls in Wood-Frame Buildings

- |                                     |                          |                                     |   |  |          |                     |         |                     |         |                       |         |   |
|-------------------------------------|--------------------------|-------------------------------------|---|--|----------|---------------------|---------|---------------------|---------|-----------------------|---------|---|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | <p>4.4.2.7.1 SHEAR STRESS CHECK: The shear stress in the shear walls, calculated using the Quick Check procedure of Section 3.5.3.3, shall be less than the following values for Life Safety and Immediate Occupancy:</p> <table border="0" style="margin-left: 40px;"> <tr> <td>Structural panel sheathing:</td> <td>1000 plf</td> </tr> <tr> <td>Diagonal sheathing:</td> <td>700 plf</td> </tr> <tr> <td>Straight sheathing:</td> <td>100 plf</td> </tr> <tr> <td>All other conditions:</td> <td>100 plf</td> </tr> </table> | Structural panel sheathing:  | 1000 plf | Diagonal sheathing: | 700 plf | Straight sheathing: | 100 plf | All other conditions: | 100 plf | <p><b>EW direction of loading: Max shear stress = 908 plf &lt; 1,000 plf for 3/8" plywood sheathing.</b></p> <p><b>NS direction of loading: Max stress = 324 plf &lt; 1,000 plf for 3/8" plywood sheathing.</b></p> |
| Structural panel sheathing:         | 1000 plf                 |                                     |   |  |          |                     |         |                     |         |                       |         |   |
| Diagonal sheathing:                 | 700 plf                  |                                     |   |  |          |                     |         |                     |         |                       |         |   |
| Straight sheathing:                 | 100 plf                  |                                     |   |  |          |                     |         |                     |         |                       |         |   |
| All other conditions:               | 100 plf                  |                                     |   |  |          |                     |         |                     |         |                       |         |   |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <p>4.4.2.7.2 STUCCO (EXTERIOR PLASTER) SHEAR WALLS: Multistory buildings shall not rely on exterior stucco walls as the primary lateral-force-resisting system.</p>   | <p><b>One story building.</b></p>  |          |                     |         |                     |         |                       |         |   |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <p>4.4.2.7.3 GYPSUM WALLBOARD OR PLASTER SHEAR WALLS: Interior plaster or gypsum wallboard shall not be used as shear walls on buildings over one story in height with the exception of the uppermost level of a multistory building.</p>   | <p><b>One story building.</b></p>  |          |                     |         |                     |         |                       |         |   |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | <p>4.4.2.7.4 NARROW WOOD SHEAR WALLS: Narrow wood shear walls with an aspect ratio greater than 2 to 1 for Life Safety and 1.5 to 1 for Immediate Occupancy shall not be used to resist lateral forces developed in the building in levels of moderate and high seismicity. Narrow wood shear walls with an aspect ratio greater than 2 to 1 for Immediate Occupancy shall not be used to resist lateral forces developed in the building in levels of low seismicity.</p>  | <p><b>The narrowest shear wall is in Area A. The height = 18' and the width = 12'. The aspect ratio &lt; 2 to 1.</b></p> |          |                     |         |                     |         |                       |         |   |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <p>4.4.2.7.5 WALLS CONNECTED THROUGH FLOORS: Shear walls shall have interconnection between stories to transfer overturning and shear forces through the floor.</p>   | <p><b>One story building.</b></p>  |          |                     |         |                     |         |                       |         |   |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <p>4.4.2.7.6 HILLSIDE SITE: For structures that are taller on at least one side by more than half of a story due to a sloping site, all shear walls on the downhill slope shall have an aspect ratio less than 1 to 1 for Life Safety and 1 to 2 for Immediate Occupancy.</p>   | <p><b>One story building.</b></p>  |          |                     |         |                     |         |                       |         |   |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <p>4.4.2.7.7 CRIPPLE WALLS: Cripple walls below first floor level shear walls shall be braced to the foundation with wood structural panels.</p>  | <p><b>One story building.</b></p>  |          |                     |         |                     |         |                       |         |   |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <p>4.4.2.7.8 OPENINGS: Walls with openings greater than 80% of the length shall be braced with wood structural panel shear walls with aspect ratios of not more than 1.5 to 1 or shall be supported by adjacent construction through positive ties capable of transferring the lateral forces.</p>  | <p><b>One story building.</b></p>  |          |                     |         |                     |         |                       |         |   |

### DIAPHRAGMS

#### Precast Concrete Diaphragms

- |                          |                          |                                     |  |  |
|--------------------------|--------------------------|-------------------------------------|--|--|
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <p>4.5.5.1 TOPPING SLAB: Precast concrete diaphragm elements shall be interconnected by a continuous reinforced concrete topping slab.</p> |  |
|--------------------------|--------------------------|-------------------------------------|--|--|

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 Job Name: **LLNL Prioritization**

 By: **JYF** Checked: **JEH**

## ASCE 31\* GENERAL BASIC STRUCTURAL CHECKLIST

C   NC   N/A

Comments

### CONNECTIONS

#### Anchorage for Normal Forces

- |                                     |                          |                                     |   |   |
|-------------------------------------|--------------------------|-------------------------------------|---|---|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.6.1.1 WALL ANCHORAGE: Exterior concrete or masonry walls, that are dependent on the diaphragm for lateral support, shall be anchored for out-of-plane forces at each diaphragm level with steel anchors, reinforcing dowels, or straps that are developed into the diaphragm. Connections shall have adequate strength to resist the connection force calculated in the Quick Check Procedure of Section 3.5.3.7. | Min. wall anchorage for out of plane @ 4' thick slab: #8 @ 18" o.c. top and #6 @ 9" o.c. bottom dowel into the walls from the concrete slab, E.W.<br><br>D/C = 0.5. |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.6.1.2 WOOD LEDGERS: The connection between the wall panels and the diaphragm shall not induce cross-grain bending or tension in the wood ledgers.   | There are no wood ledgers in the concrete portion of the building.  |

#### Shear Transfer

- |                                     |                          |                                     |   |  |
|-------------------------------------|--------------------------|-------------------------------------|---|--|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.6.2.1 TRANSFER TO SHEAR WALLS: Diaphragms shall be connected for transfer of loads to the shear walls for Life Safety and the connections shall be able to develop the lesser of the shear strength of the walls or diaphragms for Immediate Occupancy.   | @ Concrete shear wall: Rebar from the slab is doweled into the concrete wall. Min. wall anchorage for shear transfer @ 4' thick slab #8 @ 18" o.c. top and #6 @ 9" o.c. bottom dowel into the walls from the concrete slab E.W.<br><br>@ Wood shear wall: the plywood sheathing is panel nailed to joists and blocking, which are nailed to the plywood shear walls. |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.6.2.2 TRANSFER TO STEEL FRAMES: Diaphragms shall be connected for transfer of loads to the steel frames for Life Safety and the connections shall be able to develop the lesser of the strength of the frames or the diaphragms for Immediate Occupancy.  |  |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.6.2.3 TOPPING SLAB TO WALLS OR FRAMES: Reinforced concrete topping slabs that interconnect the precast concrete diaphragm elements shall be doweled for transfer of forces into the shear wall or frame elements for Life Safety and the dowels shall be able to develop the lesser of the shear strength of the walls, frames, or slabs for Immediate Occupancy. |  |

#### Vertical Components

- |                          |                          |                                     |  |  |
|--------------------------|--------------------------|-------------------------------------|--|--|
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.6.3.1 STEEL COLUMNS: The columns in lateral-force-resisting frames shall be anchored to the building foundation for Life Safety and the anchorage shall be able to develop the lesser of the tensile capacity of the column, the tensile capacity of the lowest level column splice (if any), or the uplift capacity of the foundation, for Immediate Occupancy. |  |
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.6.3.2 CONCRETE COLUMNS: All concrete columns shall be doweled into the foundation for Life Safety and the dowels shall be able to develop the tensile capacity of reinforcement in columns of lateral-force-resisting system for Immediate Occupancy.  |  |

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By: **JYF** Checked: **JEH**

## ASCE 31\* GENERAL BASIC STRUCTURAL CHECKLIST

C	NC	N/A		Comments
<b>CONNECTIONS</b>				
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.6.3.3 WOOD POSTS: There shall be a positive connection of wood posts to the foundation.	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.6.3.4 WOOD SILLS: All wood sills shall be bolted to the foundation.	3x sills are bolted to the foundation w/ 5/8" diameter bolts @ 4'-0" o.c.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.6.3.5 FOUNDATION DOWELS: Wall reinforcement shall be doweled into the foundation for Life Safety and the dowels shall be able to develop the lesser of the strength of the walls or the uplift capacity of the foundation for Immediate Occupancy.	Dowels into the foundation match vertical rebar in the walls.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.6.3.6 SHEAR-WALL-BOUNDARY COLUMNS: The shear wall boundary columns shall be anchored to the building for Life Safety and the anchorage shall be able to develop the tensile capacity of the column for Immediate Occupancy.	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.6.3.7 PRECAST WALL PANELS: Precast wall panels shall be connected to the foundation for Life Safety and the connections shall be able to develop the strength of the walls for Immediate Occupancy.	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.6.3.8 WALL PANELS: Metal, fiberglass or cementitious wall panels shall be positively attached to the foundation for Life Safety and Immediate Occupancy.	
<b>Interconnection of Elements</b>				
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.6.4.1 GIRDER/COLUMN CONNECTION: There shall be a positive connection utilizing plates, connection hardware, or straps between the girder and the column support.	Glulams are connected to the steel pipes with welded plate column caps.
<b>Panel Connections</b>				
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.6.5.1 ROOF PANELS: Metal, plastic, or cementitious roof panels shall be positively attached to the roof framing to resist seismic forces for Life Safety and Immediate Occupancy.	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.6.5.2 WALL PANELS: Metal, fiberglass or cementitious wall panels shall be positively attached to the framing to resist seismic forces for Life Safety and Immediate Occupancy.	

\* – Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.

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By: JYF Checked: JEH

**ASCE 31\* GENERAL SUPPLEMENTAL STRUCTURAL CHECKLIST**

**C NC N/A** **Comments**

**LATERAL-FORCE-RESISTING SYSTEM**

**Concrete Shear Walls**

- 4.4.2.2.3 COUPLING BEAMS: The stirrups in coupling beams over means of egress shall be spaced at or less than  $d/2$  and shall be anchored into the confined core of the beam with hooks of  $135^\circ$  or more for Life Safety. All coupling beams shall comply with the requirements above and shall have the capacity in shear to develop the uplift capacity of the adjacent wall for Immediate Occupancy.
- 4.4.2.2.4 OVERTURNING: All shear walls shall have aspect ratios less than 4 to 1. Wall piers need not be considered. This statement shall apply to the Immediate Occupancy Performance Level only. Life Safety Performance Level.
- 4.4.2.2.5 CONFINEMENT REINFORCING: For shear walls with aspect ratios greater than 2 to 1, the boundary elements shall be confined with spirals or ties with spacing less than  $8d_b$ . This statement shall apply to the Immediate Occupancy Performance Level only.
- 4.4.2.2.6 REINFORCING AT OPENINGS: There shall be added trim reinforcement around all wall openings greater than three times the thickness of the wall. This statement shall apply to the Immediate Occupancy Performance Level only. Life Safety Performance Level.
- 4.4.2.2.7 WALL THICKNESS: Thickness of bearing walls shall not be less than  $1/25$  the unsupported height or length, whichever is shorter, nor less than 4". This statement shall apply to the Immediate Occupancy Performance Level only. Life Safety Performance Level.
- 4.4.2.2.8 WALL CONNECTIONS: There shall be a positive connection between the shear walls and the steel beams and columns for Life Safety and the connection shall be able to develop the strength of the walls for Immediate Occupancy. There are no steel beams.

**Walls in Wood-Frame Buildings**

- 4.4.2.7.9 HOLD-DOWN ANCHORS: All shear walls shall have hold-down anchors constructed per acceptable construction practices, attached to the end studs. This statement shall apply to the Immediate Occupancy Performance Level only. Life Safety Performance Level.

**DIAPHRAGMS**

**General**

- 4.5.1.1 DIAPHRAGM CONTINUITY: The diaphragms shall not be composed of split-level floors and shall not have expansion joints. There are no split level roofs or expansion joints.
- 4.5.1.2 CROSS TIES: There shall be continuous cross ties between diaphragm chords. Glulams and joists serve as the cross ties. In Area 3, there are no glulams in the EW direction. However, the area is small and a full height stud wall is located in the middle of the building. This statement is considered mitigated.

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By: **JYF** Checked: **JEH**

## ASCE 31\* GENERAL SUPPLEMENTAL STRUCTURAL CHECKLIST

**C NC N/A**

**Comments**

### LATERAL-FORCE-RESISTING SYSTEM

- |                                     |                          |                                     |   |                                |
|-------------------------------------|--------------------------|-------------------------------------|---|--------------------------------|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.5.1.3 ROOF CHORD CONTINUITY: All chord elements shall be continuous, regardless of changes in roof elevation.   |                                |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.5.1.4 OPENINGS AT SHEAR WALLS: Diaphragm openings immediately adjacent to the shear walls shall be less than 25% of the wall length for Life Safety and 15% of the wall length for Immediate Occupancy.   |                                |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.5.1.5 OPENINGS AT BRACED FRAMES: Diaphragm openings immediately adjacent to the braced frames shall extend less than 25% of the frame length for Life Safety and 15% of the frame length for Immediate Occupancy.                                       |                                |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.5.1.6 OPENINGS AT EXTERIOR MASONRY SHEAR WALLS: Diaphragm openings immediately adjacent to exterior masonry shear walls shall not be greater than 8 ft long for Life Safety and 4 ft long for Immediate Occupancy.                                      |                                |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.5.1.7 PLAN IRREGULARITIES: There shall be tensile capacity to develop the strength of the diaphragm at re-entrant corners or other locations of plan irregularities. This statement shall apply to the Immediate Occupancy Performance Level only.      | Life Safety Performance Level. |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.5.1.8 DIAPHRAGM REINFORCEMENT AT OPENINGS: There shall be reinforcing around all diaphragm openings larger than 50% of the building width in either major plan dimension. This statement shall apply to the Immediate Occupancy Performance Level only. | Life Safety Performance Level. |

### Wood Diaphragms

- |                                     |                          |                                     |  |                         |
|-------------------------------------|--------------------------|-------------------------------------|--|-------------------------|
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.5.2.1 STRAIGHT SHEATHING: All straight sheathed diaphragms shall have aspect ratios less than 2 to 1 for Life Safety and 1 to 1 for Immediate Occupancy in the direction being considered.   | 1/2" plywood sheathing. |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.5.2.2 SPANS: All wood diaphragms with spans greater than 24 ft for Life Safety and 12 ft for Immediate Occupancy shall consist of wood structural panels or diagonal sheathing.  | 1/2" plywood sheathing. |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.5.2.3 UNBLOCKED DIAPHRAGMS: All diagonally sheathed and unblocked wood structural panel diaphragms shall have horizontal spans less than 40 ft for Life Safety and 30 ft for Immediate Occupancy and shall have aspect ratios less than or equal to 4 to 1 for Life Safety and 3 to 1 for Immediate Occupancy. |                         |

### Metal Deck Diaphragms

- |                          |                          |                                     |   |  |
|--------------------------|--------------------------|-------------------------------------|---|--|
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.5.3.1 NON-CONCRETE FILLED DIAPHRAGMS: Untopped metal deck diaphragms or metal deck diaphragms with fill other than concrete shall consist of horizontal spans of less than 40 ft and shall have aspect ratios less than 4 to 1. This statement shall apply to the Immediate Occupancy Performance Level only. |  |
|--------------------------|--------------------------|-------------------------------------|---|--|

### Other Diaphragms

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By: **JYF** Checked: **JEH**

## ASCE 31\* GENERAL SUPPLEMENTAL STRUCTURAL CHECKLIST

**C NC N/A**

**Comments**

### LATERAL-FORCE-RESISTING SYSTEM

- 4.5.7.1 OTHER DIAPHRAGMS: The diaphragm shall not consist of a system other than wood, metal deck, concrete or horizontal bracing.

### CONNECTIONS

#### Anchorage for Normal Forces

- 4.6.1.3 PRECAST PANEL CONNECTIONS: There shall be at least two anchors from each precast wall panel into the diaphragm elements for Life Safety and the anchors shall be able to develop the strength of the panels for Immediate Occupancy.
- 4.6.1.4 STIFFNESS OF WALL ANCHORS: Anchors of concrete or masonry walls to wood structural elements shall be installed taut and shall be stiff enough to limit the relative movement between the wall and the diaphragm to no greater than 1/8".

#### Vertical Components

- 4.6.3.9 WOOD SILL BOLTS: Sill bolts shall be spaced at 6 ft or less for Life Safety and 4 ft or less for Immediate Occupancy, with proper edge and end distance provided for wood and concrete. **5/8" diameter bolts @ 4' o.c.**
- 4.6.3.10 UPLIFT AT PILE CAPS: Pile caps shall have top reinforcement and piles shall be anchored to the pile caps for Life Safety, and the pile cap reinforcement and pile anchorage shall be able to develop the tensile capacity of the piles for Immediate Occupancy.

#### Interconnection of Elements

- 4.6.4.2 GIRDERS: Girders supported by walls or pilasters shall have at least two ties securing the anchor bolts for Life Safety and Immediate Occupancy.
- 4.6.4.3 CORBEL BEARING: If the frame girders bear on column corbels, the length of bearing shall be greater than 3" for Life Safety and Immediate Occupancy.
- 4.6.4.4 CORBEL CONNECTIONS: The frame girders shall not be connected to corbels with welded elements.
- 4.6.4.5 BEAM, GIRDER AND TRUSS SUPPORTS: Beams, girders and trusses supported by unreinforced masonry walls or pilasters shall have independent secondary columns for support of vertical loads.

#### Panel Connections

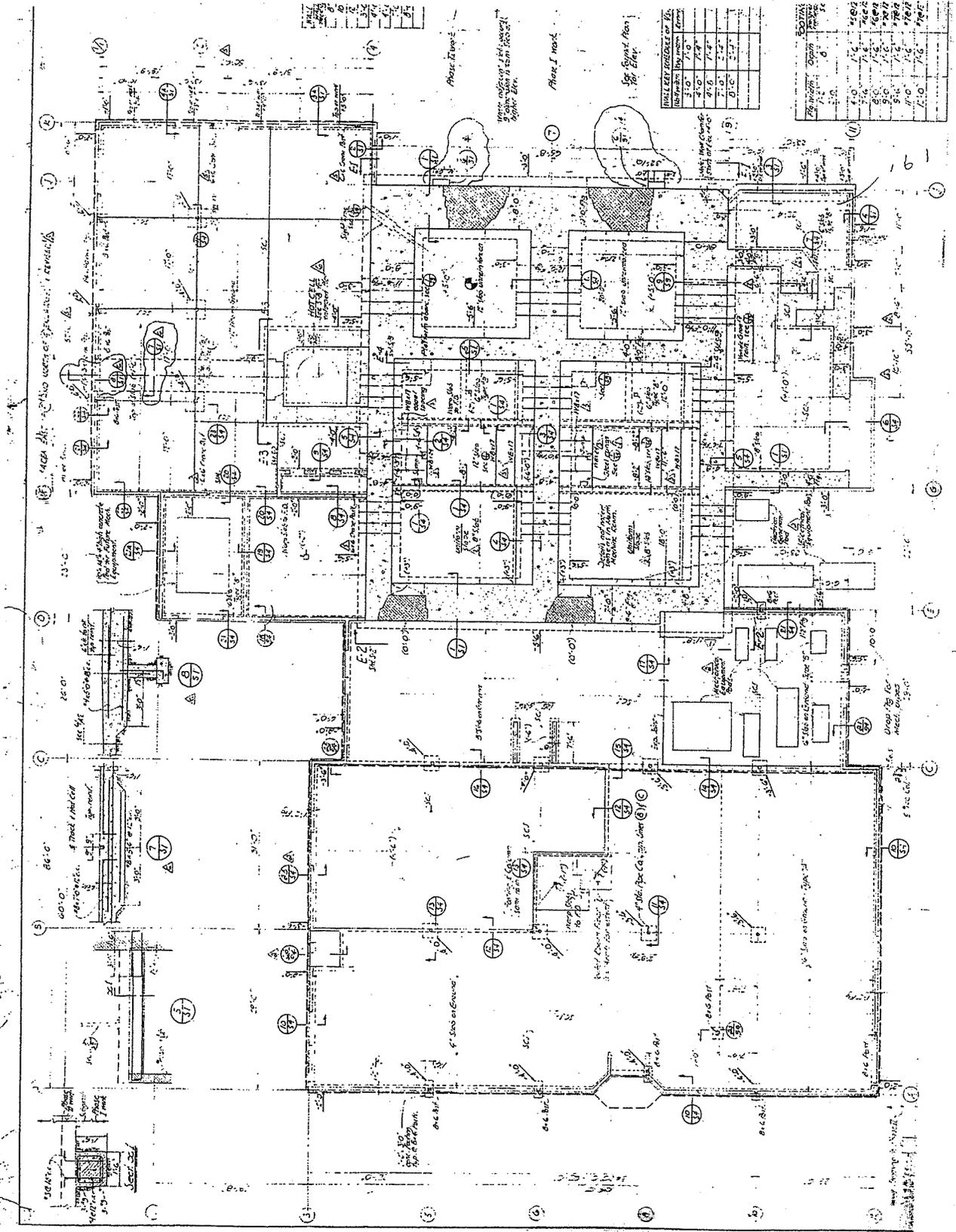
- 4.6.5.3 ROOF PANEL CONNECTIONS: Roof panel connections shall be spaced at or less than 12" for Life Safety and 8" for Immediate Occupancy.

\* – Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.





## BUILDING PLAN





Building Name: Building 298

Date: July 25, 2003

Building Address: Lawrence Livermore National Laboratory

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Job Number: A20047.08

Job Name: LLNL Prioritization

By: JYF Checked: JEH

**PRIORITIZATION BUILDING DATA SHEET**

**BUILDING DATA**

Year Built:	1980	Year(s) Remodeled:	2003 (seismic upgrade)	UBC Zone:	4 – Type B Near Field
Area (sf):	47,200 SF	Length (ft):	160	Width (ft):	220
No. Stories:	1	Story Height:	21'	Total Height:	21'

**CONSTRUCTION DATA**

Gravity Load Structural System: 5/8" or 3/8" plywood sheathing supported by 2x6 wood joists @ 24" o.c. in the EW direction and 48" deep trusses in the NS direction. The joists are supported by interior TS 6x6 columns and perimeter precast concrete shear walls.

Exterior Transverse Walls: 6.25" precast concrete shear walls      Openings?: Door and window openings

Exterior Longitudinal Walls: 6.25" precast concrete shear walls      Openings?: Door and window openings

Roof Framing: 5/8" or 3/8" plywood sheathing supported by 2x6 wood joists @ 24" o.c. in the EW direction and 48" deep trusses in the NS direction.

Intermediate Floor Framing: None

Ground Floor: 6" slab on grade w/ 6x6 W1.4/W1.4 WWF on 6" aggregate base

Columns: TS6x6

Foundation: Concrete strip footing and spread footings

**LATERAL-FORCE-RESISTING SYSTEM**

	<u>Longitudinal</u>	<u>Transverse</u>
System Classification:	Type 11 (Precast concrete shear wall building w/ flexible diaphragm)	Type 11 (Precast concrete shear wall building w/ flexible diaphragm)
Vertical Elements:	Wood joists and trusses, TS columns, perimeter precast concrete shear walls	Wood joists and trusses, TS columns, perimeter precast concrete shear walls
Diaphragms:	5/8" or 3/8" plywood sheathing	5/8" or 3/8" plywood sheathing

SEISMIC EVALUATION PERFORMED? Yes      EVALUATION: Rapid Evaluation      YEAR: 2003

SEISMIC EVALUATION CRITERIA: Life Safety/ ASCE 31-02

VULNERABILITY RATING: 1  
(1=low to 10=high)

PRIORITIZATION CLASSIFICATION: CLASS D

**POTENTIAL LIFE SAFETY DEFICIENCIES:**

THIS BUILDING WAS EVALUATED FOR THE 10% IN 50 YR. EARTHQUAKE.

*There are no potential life safety deficiencies identified.*

**PRELIMINARY STRENGTHENING SCHEMES OR MITIGATION MEASURES:**

*None recommended.*



**Degenkolb**

DEGENKOLB ENGINEERS

Building Name: **Building 298**

Date: **July 25, 2003**

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Job Number: **A20047.08**

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By: **JYF** Checked: **JEH**

## **PRIORITIZATION BUILDING DATA SHEET**

NOTE: This evaluation has been completed base on the drawings by Peoples Associates Structural Engineers, "Building 298 Roof Replacement", 2003, A1 To A5, S1 To S7. According to LLNL, the construction of the retrofit project has just been started. The results in this evaluation assume that the construction will be completed per the 2003 retrofit drawings

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Job Name: **LLNL Prioritization**

By: **JYF** Checked: **JEH**

## ASCE 31\* BASIC CHECKLIST PC1: PRECAST/TILT-UP CONCRETE SHEAR WALL BUILDINGS WITH FLEXIBLE DIAPHRAGMS

C	NC	N/A		Comments
<b>BUILDING SYSTEM</b>				
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.1.1 LOAD PATH: The structure shall contain a minimum of one complete load path for Life Safety and Immediate Occupancy for seismic force effects from any horizontal direction that serves to transfer the inertial forces from the mass to the foundation.	Load is transferred from the 3/8" or 5/8" plywood sheathing to the wood joists and wood trusses, which are then transferred to perimeter precast concrete panels. The panels are doweled in the concrete slab on grade. The S.O.G. is doweled in to the concrete strip footing below the precast walls.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.1.2 ADJACENT BUILDINGS: The clear distance between the building being evaluated and any adjacent building shall be greater than 4% of the height of the shorter building for Life Safety and Immediate Occupancy.	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.1.3 MEZZANINES: Interior mezzanine levels shall be braced independently from the main structure, or shall be anchored to the lateral-force-resisting elements of the main structure.	The 3/4" plywood diaphragm and joists in the mezzanine frames into the interior partition walls of the main building. From mezzanine level down, there are 1/2" plywood sheathing on both sides of the partition walls.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.1 WEAK STORY: The strength of the lateral-force-resisting system in any story shall not be less than 80% of the strength in an adjacent story above or below for Life-Safety and Immediate Occupancy.	One story building.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.2 SOFT STORY: The stiffness of the lateral-force-resisting-system in any story shall not be less than 70% of the lateral-force-resisting system stiffness in an adjacent story above or below, or less than 80% of the average lateral-force-resisting system stiffness of the three stories above or below for Life Safety and Immediate Occupancy.	One story building.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.3 GEOMETRY: There shall be no changes in horizontal dimension of the lateral-force-resisting system of more than 30% in a story relative to adjacent stories for Life Safety and Immediate Occupancy, excluding one-story penthouses and mezzanines.	One story building.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.2.4 VERTICAL DISCONTINUITIES: All vertical elements in the lateral-force-resisting system shall be continuous to the foundation.	The panels are doweled in the concrete slab on grade. The S.O.G. is doweled in to the concrete strip footing below the precast walls.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.5 MASS: There shall be no change in effective mass of more than 50% from one story to the next for Life Safety and Immediate Occupancy. Light roofs, penthouses and mezzanines need not be considered.	One story building.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.3.1 DETERIORATION OF WOOD: There shall be no signs of decay, shrinkage, splitting, fire damage, or sagging in any of the wood members and none of the metal connection hardware shall be deteriorated, broken, or loose.	No site visit will be performed. Retrofit project under construction.

Building Name: **Building 298**

Date: **July 25, 2003**

Building Address: **Lawrence Livermore National Laboratory**

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Job Number: **A20047.08** Job Name: **LLNL Prioritization**

By: **JYF** Checked: **JEH**

## ASCE 31\* BASIC CHECKLIST PC1: PRECAST/TILT-UP CONCRETE SHEAR WALL BUILDINGS WITH FLEXIBLE DIAPHRAGMS

C	NC	N/A		Comments
<b>BUILDING SYSTEM</b>				
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.3.6 PRECAST CONCRETE WALLS: There shall be no visible deterioration of concrete or reinforcing steel or evidence of distress, especially at the connections.	No site visit will be performed. Retrofit project under construction.
<b>LATERAL-FORCE-RESISTING SYSTEM</b>				
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.4.2.1.1 REDUNDANCY: The number of lines of shear walls in each principal direction shall be greater than or equal to 2 for Life Safety and Immediate Occupancy.	There are at least two lines of shear walls in each direction of loading.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.4.2.3.1 SHEAR STRESS CHECK: The shear stress in the precast panels, calculated using the Quick Check procedure of Section 3.5.3.3, shall be less than 100 psi or $2\sqrt{f'_c}$ for Life Safety and Immediate Occupancy.	The max. shear stress is 30 psi at the east and west elevations < 100 psi. Note: $2\sqrt{f'_c} = 110$ psi for $f'_c = 3,000$ psi.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.4.2.3.2 REINFORCING STEEL: The ratio of reinforcing steel area to gross concrete area shall be not less than 0.0015 in the vertical direction and 0.0025 in the horizontal direction for Life Safety and Immediate Occupancy. The spacing of reinforcing steel shall be equal to or less than 18" for Life Safety and Immediate Occupancy.	<p>Typ. reinforcement in reinforced concrete walls: At min. cross section of thickness = 6.25".</p> <p>Vertical Reinforcing = #4@12" o.c.: reinforcing ratio = 0.0027 &gt; 0.0007</p> <p>Horizontal Reinforcing = #4@12" o.c. horizontal: reinforcing ratio = 0.0027 &gt; 0.0007.</p> <p>Spacing = 12" o.c. &lt; 18" o.c.</p>
<b>CONNECTIONS</b>				
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.6.1.1 WALL ANCHORAGE: Exterior concrete or masonry walls, that are dependent on the diaphragm for lateral support, shall be anchored for out-of-plane forces at each diaphragm level with steel anchors, reinforcing dowels, or straps that are developed into the diaphragm. Connections shall have adequate strength to resist the connection force calculated in the Quick Check Procedure of Section 3.5.3.7.	In 2003, the roof seismic upgrade added HSS 4x3 members, bolted to the precast panels w/ (2) 5/8" M.B. Spacing of the HSS members is ~ 8' o.c.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.6.1.2 WOOD LEDGERS: The connection between the wall panels and the diaphragm shall not induce cross-grain bending or tension in the wood ledgers.	Typical diaphragm to precast wall anchorage: Simpson HD2 @ 8'-0" o.c.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.6.2.1 TRANSFER TO SHEAR WALLS: Diaphragms shall be connected for transfer of loads to the shear walls for Life Safety and the connections shall be able to develop the lesser of the shear strength of the walls or diaphragms for Immediate Occupancy.	Typical diaphragm to precast wall anchorage for shear transfer: Wood trusses are nailed to 4x10 ledgers, which are connected to C9 channels @ 8' o.c.. The C9's are bolted to the precast walls w/ (3) 1" diameter anchors.

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Job Number: **A20047.08**

Job Name: **LLNL Prioritization**

By: **JYF** Checked: **JEH**

## ASCE 31\* BASIC CHECKLIST PC1: PRECAST/TILT-UP CONCRETE SHEAR WALL BUILDINGS WITH FLEXIBLE DIAPHRAGMS

C	NC	N/A		Comments
<b>CONNECTIONS</b>				
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<b>4.6.3.7 PRECAST WALL PANELS:</b> Precast wall panels shall be connected to the foundation for Life Safety and the connections shall be able to develop the strength of the walls for Immediate Occupancy.	The panels are doweled in the concrete slab on grade w/ #4 @ 12" o.c. The S.O.G. is doweled in to the concrete spread footing below the precast walls w/ 1#4 dowels, each footing.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<b>4.6.4.1 GIRDER/COLUMN CONNECTION:</b> There shall be a positive connection utilizing plates, connection hardware, or straps between the girder and the column support.	Glulams are connected to the TS columns w/ column caps w/ (2) 3/4" diameter bolts.

\* – Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.

Building Name: Building 298

 Date: July 25, 2003

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 Job Number: A20047.08

 Job Name: LLNL Prioritization

 By: JYF Checked: JEH

## ASCE 31\* BASIC CHECKLIST PC1: PRECAST/TILT-UP CONCRETE SHEAR WALL BUILDINGS WITH FLEXIBLE DIAPHRAGMS

C	NC	N/A		Comments
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### LATERAL-FORCE-RESISTING SYSTEM

- |                                     |                          |                                     |   |   |
|-------------------------------------|--------------------------|-------------------------------------|---|---|
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.2.2.3 COUPLING BEAMS: The stirrups in coupling beams over means of egress shall be spaced at or less than $d/2$ and shall be anchored into the confined core of the beam with hooks of $135^\circ$ or more for Life Safety. All coupling beams shall comply with the requirements above and shall have the capacity in shear to develop the uplift capacity of the adjacent wall for Immediate Occupancy. |   |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.4.2.3.3 WALL OPENINGS: The total width of openings along any perimeter wall line shall constitute less than 75% of the length of any perimeter wall for Life Safety and 50% for Immediate Occupancy with the wall piers having aspect ratios of less than 2 to 1 for Life Safety and Immediate Occupancy.   | Openings are < 75% of the length of any perimeter wall. |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.2.3.4 CORNER OPENINGS: Walls with openings at a building corner larger than the width of a typical panel shall be connected to the remainder of the wall with collector reinforcing.  |   |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.2.3.5 PANEL-TO-PANEL CONNECTIONS: Adjacent wall panels shall be interconnected to transfer overturning forces between panels by methods other than welded steel inserts. This statement shall apply to the Immediate Occupancy Performance Level only.  | Life Safety Performance Level.                          |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.2.3.6 WALL THICKNESS: Thickness of bearing walls shall not be less than $1/25$ the unsupported height or length, whichever is shorter, nor less than 4". This statement shall apply to the Immediate Occupancy Performance Level only.  | Life Safety Performance Level.                          |

### DIAPHRAGMS

- |                                     |                          |                                     |   |   |
|-------------------------------------|--------------------------|-------------------------------------|---|---|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.5.1.2 CROSS TIES: There shall be continuous cross ties between diaphragm chords.  | Truss joists serve as the cross ties in the NS direction. 2x6 joists serve as the cross ties in the EW direction. |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.5.1.7 PLAN IRREGULARITIES: There shall be tensile capacity to develop the strength of the diaphragm at re-entrant corners or other locations of plan irregularities. This statement shall apply to the Immediate Occupancy Performance Level only.      | Life Safety Performance Level.  |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.5.1.8 DIAPHRAGM REINFORCEMENT AT OPENINGS: There shall be reinforcing around all diaphragm openings larger than 50% of the building width in either major plan dimension. This statement shall apply to the Immediate Occupancy Performance Level only. | Life Safety Performance Level.  |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.5.2.1 STRAIGHT SHEATHING: All straight sheathed diaphragms shall have aspect ratios less than 2 to 1 for Life Safety and 1 to 1 for Immediate Occupancy in the direction being considered.  | Diaphragm consists of plywood sheathing.  |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.5.2.2 SPANS: All wood diaphragms with spans greater than 24 ft for Life Safety and 12 ft for Immediate Occupancy shall consist of wood structural panels or diagonal sheathing.   | Spans = 8' < 24'. Diaphragm consists of plywood sheathing.  |

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By: JYF Checked: JEH

## ASCE 31\* BASIC CHECKLIST PC1: PRECAST/TILT-UP CONCRETE SHEAR WALL BUILDINGS WITH FLEXIBLE DIAPHRAGMS

C	NC	N/A		Comments
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### DIAPHRAGMS

- |                          |                          |                                     |   |  |
|--------------------------|--------------------------|-------------------------------------|---|--|
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <p>4.5.2.3 UNBLOCKED DIAPHRAGMS: All diagonally sheathed and unblocked wood structural panel diaphragms shall have horizontal spans less than 40 ft for Life Safety and 30 ft for Immediate Occupancy and shall have aspect ratios less than or equal to 4 to 1 for Life Safety and 3 to 1 for Immediate Occupancy.</p> |  |
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <p>4.5.7.1 OTHER DIAPHRAGMS: The diaphragm shall not consist of a system other than wood, metal deck, concrete or horizontal bracing.</p>   |  |

### CONNECTIONS

- |                                     |                          |                                     |   |   |
|-------------------------------------|--------------------------|-------------------------------------|---|---|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | <p>4.6.1.3 PRECAST PANEL CONNECTIONS: There shall be at least two anchors from each precast wall panel into the diaphragm elements for Life Safety and the anchors shall be able to develop the strength of the panels for Immediate Occupancy.</p>                             | <p>Typical diaphragm to precast wall anchorage for out of plane: Simpson HD2 @ 8'-0" o.c. Typical diaphragm to precast wall anchorage for shear transfer: Wood trusses are nailed to 4x10 ledgers, which are connected to C9 channels @ 8' o.c.. The C9's are bolted to the precast walls w/ (3) 1" diameter anchors.</p> |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <p>4.6.3.10 UPLIFT AT PILE CAPS: Pile caps shall have top reinforcement and piles shall be anchored to the pile caps for Life Safety, and the pile cap reinforcement and pile anchorage shall be able to develop the tensile capacity of the piles for Immediate Occupancy.</p> |   |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | <p>4.6.4.2 GIRDERS: Girders supported by walls or pilasters shall have at least two ties securing the anchor bolts for Life Safety and Immediate Occupancy.</p>   | <p>3#5 continuous at bolts.</p>   |

\* - Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.





Building Name: **Building 519B**

Date: **August 8, 2003**

Building Address: **Lawrence Livermore National Laboratory**

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Job Number: **A20047.08**

Job Name: **LLNL Prioritization**

By: **AK** Checked: \_\_\_\_\_

## PRIORITIZATION BUILDING DATA SHEET

### POTENTIAL LIFE SAFETY DEFICIENCIES:

THIS BUILDING WAS EVALUATED FOR THE 10% IN 50 YR. EARTHQUAKE.

#### MEZZANINE

*Mezzanine is attached to the structure on 3 sides only.*

### PRELIMINARY STRENGTHENING SCHEMES OR MITIGATION MEASURES:

Provide angle braces at mezzanine.

Building Name: Building 519B

Date: August 8, 2003

Building Address: Lawrence Livermore National Laboratory

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Job Number: A20047.08

Job Name: LLNL Prioritization

By: AK Checked: \_\_\_\_\_

## ASCE 31\* SUPPLEMENTAL CHECKLIST S3: STEEL LIGHT FRAMES

**C NC N/A**

**Comments**

### LATERAL-FORCE-RESISTING SYSTEM

- |                          |                                     |                                     |   |                                   |
|--------------------------|-------------------------------------|-------------------------------------|---|-----------------------------------|
| <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | 4.4.1.3.3 MOMENT-RESISTING CONNECTIONS: All moment connections shall be able to develop the strength of the adjoining members or panel zones.   |                                   |
| <input type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/>            | 4.4.1.3.7 COMPACT MEMBERS: All frame elements shall meet section requirements set forth by Table I-9-1 of <i>Seismic Provisions for Structural Steel Buildings</i> (AISC, 1997).  | No structural drawings available. |
| <input type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | 4.4.1.3.8 BEAM PENETRATIONS: All openings in frame-beam webs shall be less than 1/4 of the beam depth and shall be located in the center half of the beams. This statement shall apply to the Immediate Occupancy Performance Level only. | Life Safety Evaluation.           |
| <input type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | 4.4.1.3.10 OUT-OF-PLANE BRACING: Beam-column joints shall be braced out-of-plane. This statement shall apply to the Immediate Occupancy Performance Level only.   | Life Safety Evaluation.           |
| <input type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | 4.4.1.3.11 BOTTOM FLANGE BRACING: The bottom flanges of beams shall be braced out-of-plane. This statement shall apply to the Immediate Occupancy Performance Level only.   | Life Safety Evaluation.           |

### DIAPHRAGMS

- |                                     |                          |                                     |   |                         |
|-------------------------------------|--------------------------|-------------------------------------|---|-------------------------|
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.5.1.7 PLAN IRREGULARITIES: There shall be tensile capacity to develop the strength of the diaphragm at re-entrant corners or other locations of plan irregularities. This statement shall apply to the Immediate Occupancy Performance Level only.      | Life Safety Evaluation. |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.5.1.8 DIAPHRAGM REINFORCEMENT AT OPENINGS: There shall be reinforcing around all diaphragm openings larger than 50% of the building width in either major plan dimension. This statement shall apply to the Immediate Occupancy Performance Level only. | Life Safety Evaluation. |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.5.7.1 OTHER DIAPHRAGMS: The diaphragm shall not consist of a system other than wood, metal deck, concrete or horizontal bracing.  |                         |

### CONNECTIONS

- |                          |                          |                                     |  |   |
|--------------------------|--------------------------|-------------------------------------|--|---|
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.6.3.10 UPLIFT AT PILE CAPS: Pile caps shall have top reinforcement and piles shall be anchored to the pile caps for Life Safety, and the pile cap reinforcement and pile anchorage shall be able to develop the tensile capacity of the piles for Immediate Occupancy. | No structural drawings. But pile foundations not typical at site. |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.6.5.3 ROOF PANEL CONNECTIONS: Roof panel connections shall be spaced at or less than 12" for Life Safety and 8" for Immediate Occupancy.   | No structural drawings available.                                 |

\* - Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.

Building Name: **Building 802A**

Date: **July 29, 2003**

Building Address: **Lawrence Livermore National Laboratory**

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Job Number: **A20047.08**

Job Name: **LLNL Prioritization**

By: **JYF** Checked: **JEH**

## PRIORITIZATION BUILDING DATA SHEET

### BUILDING DATA

Year Built:	1958	Year(s) Remodeled:	None	UBC Zone:	4 – Type B Near Field
Area (sf):	2,300	Length (ft):	51'-6"	Width (ft):	40
No. Stories:	1	Story Height:	12'	Total Height:	12'

### CONSTRUCTION DATA

Gravity Load Structural System: 12" thick LWC flat slab supported by 8" to 1'-10" thick reinforced concrete shear walls.

Exterior Transverse Walls: 8" to 1'-10" thick reinforced concrete shear walls

Openings?: Door and window openings

Exterior Longitudinal Walls: 8" to 1'-10" thick reinforced concrete shear walls

Openings?: Door and window openings

Roof Framing: 12" thick LWC flat slab

Intermediate Floor Framing: None

Ground Floor: 8" concrete slab on grade w/ #4 @ 9" o.c.

Columns: None

Foundation: Concrete strip footing or thickened slab

### LATERAL-FORCE-RESISTING SYSTEM

	Longitudinal	Transverse
System Classification:	Type 9 (Concrete Shear Wall Building w/ Stiff Diaphragm)	Type 9 (Concrete Shear Wall Building w/ Stiff Diaphragm)
Vertical Elements:	Concrete flat slab, concrete shear walls	Concrete flat slab, concrete shear walls
Diaphragms:	12" thick concrete flat slab	12" thick concrete flat slab

SEISMIC EVALUATION PERFORMED? Yes EVALUATION: Rapid Evaluation YEAR: 2003

SEISMIC EVALUATION CRITERIA: Life Safety/ ASCE 31-02

VULNERABILITY RATING: 1  
(1=low to 10=high)

PRIORITIZATION CLASSIFICATION: CLASS D

### POTENTIAL LIFE SAFETY DEFICIENCIES:

THIS BUILDING WAS EVALUATED FOR THE 10% IN 50 YR. EARTHQUAKE.

*There are no potential life safety deficiencies identified.*

### PRELIMINARY STRENGTHENING SCHEMES OR MITIGATION MEASURES:

*None recommended.*

Building Name: **Building 802A**

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Job Number: **A20047.08**

Job Name: **LLNL Prioritization**

By: **JYF** Checked: **JEH**

## ASCE 31\* BASIC CHECKLIST C2: CONCRETE SHEAR WALL BUILDINGS WITH RIGID OR STIFF DIAPHRAGMS

C	NC	N/A		Comments
<b>BUILDING SYSTEM</b>				
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.1.1 LOAD PATH: The structure shall contain a minimum of one complete load path for Life Safety and Immediate Occupancy for seismic force effects from any horizontal direction that serves to transfer the inertial forces from the mass to the foundation.	12" thick concrete slab transfers load to the perimeter and interior concrete shear walls. The shear walls are doweled into the foundation system.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.1.3 MEZZANINES: Interior mezzanine levels shall be braced independently from the main structure, or shall be anchored to the lateral-force-resisting elements of the main structure.	The mezzanine level is bolted to concrete shear walls on all sides.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.1 WEAK STORY: The strength of the lateral-force-resisting system in any story shall not be less than 80% of the strength in an adjacent story above or below for Life-Safety and Immediate Occupancy.	One story building.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.2 SOFT STORY: The stiffness of the lateral-force-resisting-system in any story shall not be less than 70% of the lateral-force-resisting system stiffness in an adjacent story above or below, or less than 80% of the average lateral-force-resisting system stiffness of the three stories above or below for Life Safety and Immediate Occupancy.	One story building.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.3 GEOMETRY: There shall be no changes in horizontal dimension of the lateral-force-resisting system of more than 30% in a story relative to adjacent stories for Life Safety and Immediate Occupancy, excluding one-story penthouses and mezzanines.	One story building.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.2.4 VERTICAL DISCONTINUITIES: All vertical elements in the lateral-force-resisting system shall be continuous to the foundation.	The shear walls are doweled into the foundation system.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.5 MASS: There shall be no change in effective mass of more than 50% from one story to the next for Life Safety and Immediate Occupancy. Light roofs, penthouses and mezzanines need not be considered.	One story building.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.2.6 TORSION: The estimated distance between the story center of mass and the story center of rigidity shall be less than 20% of the building width in either plan dimension for Life Safety and Immediate Occupancy.	Concrete shear walls around the perimeter of the building.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.3.4 DETERIORATION OF CONCRETE: There shall be no visible deterioration of concrete or reinforcing steel in any of the vertical- or lateral-force-resisting elements.	Site visit made on 8/18/03. No signs of deterioration were observed except minor corrosion at one corner of a shear wall on the west side of the building.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.3.5 POST-TENSIONING ANCHORS: There shall be no evidence of corrosion or spalling in the vicinity of post-tensioning or end fittings. Coil anchors shall not have been used.	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.3.9 CONCRETE WALL CRACKS: All existing diagonal cracks in wall elements shall be less than 1/8" for Life Safety and 1/16" for Immediate Occupancy, shall not be concentrated in one location, and shall not form an X pattern.	Site visit made on 8/18/03. There are no cracks >1/8".

Building Name: **Building 802A**

 Date: **July 29, 2003**

 Building Address: **Lawrence Livermore National Laboratory**

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 Job Number: **A20047.08**

 Job Name: **LLNL Prioritization**

 By: **JYF** Checked: **JEH**
**ASCE 31\* BASIC CHECKLIST C2: CONCRETE SHEAR WALL BUILDINGS WITH RIGID OR STIFF DIAPHRAGMS**

C	NC	N/A		Comments
<b>LATERAL-FORCE-RESISTING SYSTEM</b>				
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.4.1.6.1 COMPLETE FRAMES: Steel or concrete frames classified as secondary components shall form a complete vertical load carrying system.	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.4.2.1.1 REDUNDANCY: The number of lines of shear walls in each principal direction shall be greater than or equal to 2 for Life Safety and Immediate Occupancy.	There are at least 2 lines of resistance in each direction of loading.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.4.2.2.1 SHEAR STRESS CHECK: The shear stress in the concrete shear walls, calculated using the Quick Check procedure of Section 3.5.3.3, shall be less than 100 psi or $2\sqrt{f'_c}$ for Life Safety and Immediate Occupancy.	The maximum shear stress is 39 psi < 100 psi. Note: $2\sqrt{f'_c} = 100$ psi for $f'_c = 2,500$ psi.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.4.2.2.2 REINFORCING STEEL: The ratio of reinforcing steel area to gross concrete area shall be not less than 0.0015 in the vertical direction and 0.0025 in the horizontal direction for Life Safety and Immediate Occupancy. The spacing of reinforcing steel shall be equal to or less than 18" for Life Safety and Immediate Occupancy.	Typ. reinforcement in reinforced concrete walls: 8" thick wall: min. #4 @18" o.c. E.F.; $\rho = 0.0028 > 0.0025$ 12" thick wall: #4 @15" o.c. E.F.; $\rho = 0.0022 > 0.0015$ horiz. #4 @ 9" o.c. inside face, #6 @ 9" o.c. outside face; $\rho = 0.0059 > 0.0025$ 24" thick wall: vertical: #5@12" o.c. E.F.; $\rho = 0.0022 > 0.0015$ horiz.: #6 @ 6" o.c. E.F.; $\rho = 0.0061 > 0.0025$  The spacing <= 18".
<b>CONNECTIONS</b>				
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.6.2.1 TRANSFER TO SHEAR WALLS: Diaphragms shall be connected for transfer of loads to the shear walls for Life Safety and the connections shall be able to develop the lesser of the shear strength of the walls or diaphragms for Immediate Occupancy.	Rebar from slab dowels into concrete shear walls.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.6.3.5 FOUNDATION DOWELS: Wall reinforcement shall be doweled into the foundation for Life Safety and the dowels shall be able to develop the lesser of the strength of the walls or the uplift capacity of the foundation for Immediate Occupancy.	#4 dowels from wall to foundation

\* - Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.

Building Name: **Building 802A**

Date: **July 29, 2003**

Building Address: **Lawrence Livermore National Laboratory**

Page: **1** of **2**

Job Number: **A20047.08**

Job Name: **LLNL Prioritization**

By: **JYF** Checked: **JEH**

## ASCE 31\* SUPPLEMENTAL CHECKLIST C2: CONCRETE SHEAR WALL BUILDINGS WITH RIGID OR STIFF DIAPHRAGMS

**C NC N/A** **Comments**

### LATERAL-FORCE-RESISTING SYSTEM

- |                          |                          |                                     |  |   |
|--------------------------|--------------------------|-------------------------------------|--|---|
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <p>4.4.1.6.2 DEFLECTION COMPATIBILITY: Secondary components shall have the shear capacity to develop the flexural strength of the components for Life Safety and shall meet the requirements of 4.4.1.4.9, 4.4.1.4.10, 4.4.1.4.11, 4.4.1.4.12 and 4.4.1.4.15 for Immediate Occupancy.</p>  | <p><b>There are no secondary components</b></p> |
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <p>4.4.1.6.3 FLAT SLABS: Flat slabs/plates not part of lateral-force-resisting system shall have continuous bottom steel through the column joints for Life Safety.</p>  | <p><b>No columns.</b></p>                       |
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <p>4.4.2.2.3 COUPLING BEAMS: The stirrups in coupling beams over means of egress shall be spaced at or less than <math>d/2</math> and shall be anchored into the confined core of the beam with hooks of 135° or more for Life Safety. All coupling beams shall comply with the requirements above and shall have the capacity in shear to develop the uplift capacity of the adjacent wall for Immediate Occupancy.</p> |   |
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <p>4.4.2.2.4 OVERTURNING: All shear walls shall have aspect ratios less than 4 to 1. Wall piers need not be considered. This statement shall apply to the Immediate Occupancy Performance Level only.</p>  | <p><b>Life Safety Performance Level.</b></p>    |
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <p>4.4.2.2.5 CONFINEMENT REINFORCING: For shear walls with aspect ratios greater than 2 to 1, the boundary elements shall be confined with spirals or ties with spacing less than <math>8d_b</math>. This statement shall apply to the Immediate Occupancy Performance Level only.</p>   | <p><b>Life Safety Performance Level.</b></p>    |
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <p>4.4.2.2.6 REINFORCING AT OPENINGS: There shall be added trim reinforcement around all wall openings greater than three times the thickness of the wall. This statement shall apply to the Immediate Occupancy Performance Level only.</p>   | <p><b>Life Safety Performance Level.</b></p>    |
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <p>4.4.2.2.7 WALL THICKNESS: Thickness of bearing walls shall not be less than <math>1/25</math> the unsupported height or length, whichever is shorter, nor less than 4". This statement shall apply to the Immediate Occupancy Performance Level only.</p>   | <p><b>Life Safety Performance Level.</b></p>    |

### DIAPHRAGMS

- |                                     |                          |                                     |   |  |
|-------------------------------------|--------------------------|-------------------------------------|---|--|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | <p>4.5.1.1 DIAPHRAGM CONTINUITY: The diaphragms shall not be composed of split-level floors and shall not have expansion joints.</p>  |  |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | <p>4.5.1.4 OPENINGS AT SHEAR WALLS: Diaphragm openings immediately adjacent to the shear walls shall be less than 25% of the wall length for Life Safety and 15% of the wall length for Immediate Occupancy.</p>  |  |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <p>4.5.1.7 PLAN IRREGULARITIES: There shall be tensile capacity to develop the strength of the diaphragm at re-entrant corners or other locations of plan irregularities. This statement shall apply to the Immediate Occupancy Performance Level only.</p> | <p><b>Life Safety Performance Level.</b></p> |



Building Name: **Building 802A**

Date: **July 29, 2003**

Building Address: **Lawrence Livermore National Laboratory**

Page: **2** of **2**

Job Number: **A20047.08**

Job Name: **LLNL Prioritization**

By: **JYF** Checked: **JEH**

## ASCE 31\* SUPPLEMENTAL CHECKLIST C2: CONCRETE SHEAR WALL BUILDINGS WITH RIGID OR STIFF DIAPHRAGMS

C	NC	N/A	Comments
---	----	-----	----------

### DIAPHRAGMS

- |                          |                          |                                     |   |                                |
|--------------------------|--------------------------|-------------------------------------|---|--------------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.5.1.8 DIAPHRAGM REINFORCEMENT AT OPENINGS: There shall be reinforcing around all diaphragm openings larger than 50% of the building width in either major plan dimension. This statement shall apply to the Immediate Occupancy Performance Level only. | Life Safety Performance Level. |
|--------------------------|--------------------------|-------------------------------------|---|--------------------------------|

### CONNECTIONS

- |                          |                          |                                     |  |  |
|--------------------------|--------------------------|-------------------------------------|--|--|
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.6.3.10 UPLIFT AT PILE CAPS: Pile caps shall have top reinforcement and piles shall be anchored to the pile caps for Life Safety, and the pile cap reinforcement and pile anchorage shall be able to develop the tensile capacity of the piles for Immediate Occupancy. |  |
|--------------------------|--------------------------|-------------------------------------|--|--|

\* - Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.





Building Name: Building 810B Date: August 6, 2003  
 Building Address: Lawrence Livermore National Laboratory Page: 1 of 1  
 Job Number: A20047.08 Job Name: LLNL Prioritization By: LKF Checked: \_\_\_\_\_

**PRIORITIZATION BUILDING DATA SHEET**

**BUILDING DATA**

Year Built:	1982	Year(s) Remodeled:	None known	UBC Zone:	4 – Type B Near Field
Area (sf):	900	Length (ft):	32'-7"	Width (ft):	28'-0"
No. Stories:	1	Story Height:	27'-2"	Total Height:	27'-2"

**CONSTRUCTION DATA**

Gravity Load Structural System: 8" thick concrete roof slab over concrete beams spanning to concrete columns adjacent to concrete bearing walls

Exterior Transverse Walls: Reinforced concrete      Openings?: Yes- doors  
 Exterior Longitudinal Walls: Reinforced concrete      Openings?: Yes- door and ducts

Roof Framing: Reinforced concrete beams and slab

Intermediate Floor Framing: N/A

Ground Floor: Reinforced concrete slab on grade, with lower pit area in center.

Columns: 16" sq. reinforced concrete

Foundation: Strip footings under walls, spread footings or concrete caissons under columns, retaining walls at pit.

**LATERAL-FORCE-RESISTING SYSTEM**

	<u>Longitudinal</u>	<u>Transverse</u>
System Classification:	C2: Concrete Shear Wall Building with Rigid or Stiff Diaphragm	C2: Concrete Shear Wall Building with Rigid or Stiff Diaphragm
Vertical Elements:	Reinforced concrete shear walls	Reinforced concrete shear walls
Diaphragms:	Reinforced concrete roof slab	Reinforced concrete roof slab

**SEISMIC EVALUATION PERFORMED?** Yes **EVALUATION:** Rapid Evaluation **YEAR:** 2003

**SEISMIC EVALUATION CRITERIA:** Life Safety/ ASCE 31-02

**VULNERABILITY RATING:** 3  
 (1=low to 10=high)

**PRIORITIZATION CLASSIFICATION:** CLASS D

**POTENTIAL LIFE SAFETY DEFICIENCIES:**

THIS BUILDING WAS EVALUATED FOR THE 10% IN 50 YR. EARTHQUAKE.

**UPLIFT AT PILE CAPS**

*There is no top reinforcement in the caissons, so that they may not be capable of resisting tension due to overturning.*

**PRELIMINARY STRENGTHENING SCHEMES OR MITIGATION MEASURES:**

**UPLIFT AT PILE CAPS**

*Further evaluation may show that tension demands are low enough that the caisson cap is adequate.*

Building Name: **Building 810B**

Date: **August 6, 2003**

Building Address: **Lawrence Livermore National Laboratory**

Page: **1** of **2**

Job Number: **A20047.08**

Job Name: **LLNL Prioritization**

By: **LKF** Checked: \_\_\_\_\_

## ASCE 31\* BASIC CHECKLIST C2: CONCRETE SHEAR WALL BUILDINGS WITH RIGID OR STIFF DIAPHRAGMS

C	NC	N/A		Comments
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### BUILDING SYSTEM

- |                                     |                          |                                     |         |  |                                   |
|-------------------------------------|--------------------------|-------------------------------------|---------|--|-----------------------------------|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.3.1.1 | LOAD PATH: The structure shall contain a minimum of one complete load path for Life Safety and Immediate Occupancy for seismic force effects from any horizontal direction that serves to transfer the inertial forces from the mass to the foundation.  |                                   |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.3.1.3 | MEZZANINES: Interior mezzanine levels shall be braced independently from the main structure, or shall be anchored to the lateral-force-resisting elements of the main structure.   |                                   |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.3.2.1 | WEAK STORY: The strength of the lateral-force-resisting system in any story shall not be less than 80% of the strength in an adjacent story above or below for Life-Safety and Immediate Occupancy.  |                                   |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.3.2.2 | SOFT STORY: The stiffness of the lateral-force-resisting-system in any story shall not be less than 70% of the lateral-force-resisting system stiffness in an adjacent story above or below, or less than 80% of the average lateral-force-resisting system stiffness of the three stories above or below for Life Safety and Immediate Occupancy. |                                   |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.3.2.3 | GEOMETRY: There shall be no changes in horizontal dimension of the lateral-force-resisting system of more than 30% in a story relative to adjacent stories for Life Safety and Immediate Occupancy, excluding one-story penthouses and mezzanines.   |                                   |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.3.2.4 | VERTICAL DISCONTINUITIES: All vertical elements in the lateral-force-resisting system shall be continuous to the foundation.   |                                   |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.3.2.5 | MASS: There shall be no change in effective mass of more than 50% from one story to the next for Life Safety and Immediate Occupancy. Light roofs, penthouses and mezzanines need not be considered.   |                                   |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.3.2.6 | TORSION: The estimated distance between the story center of mass and the story center of rigidity shall be less than 20% of the building width in either plan dimension for Life Safety and Immediate Occupancy.   |                                   |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.3.3.4 | DETERIORATION OF CONCRETE: There shall be no visible deterioration of concrete or reinforcing steel in any of the vertical- or lateral-force-resisting elements.   |                                   |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.3.3.5 | POST-TENSIONING ANCHORS: There shall be no evidence of corrosion or spalling in the vicinity of post-tensioning or end fittings. Coil anchors shall not have been used.  | <b>No post-tensioning anchors</b> |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.3.3.9 | CONCRETE WALL CRACKS: All existing diagonal cracks in wall elements shall be less than 1/8" for Life Safety and 1/16" for Immediate Occupancy, shall not be concentrated in one location, and shall not form an X pattern.   |                                   |



Building Name: **Building 810B**

Date: **August 6, 2003**

Building Address: **Lawrence Livermore National Laboratory**

Page: **2** of **2**

Job Number: **A20047.08**

Job Name: **LLNL Prioritization**

By: **LKF** Checked: \_\_\_\_\_

**ASCE 31\* BASIC CHECKLIST C2: CONCRETE SHEAR WALL BUILDINGS WITH RIGID OR STIFF DIAPHRAGMS**

C	NC	N/A		Comments
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**LATERAL-FORCE-RESISTING SYSTEM**

- 4.4.1.6.1 COMPLETE FRAMES: Steel or concrete frames classified as secondary components shall form a complete vertical load carrying system. **Concrete beams span to columns embedded in walls.**
- 4.4.2.1.1 REDUNDANCY: The number of lines of shear walls in each principal direction shall be greater than or equal to 2 for Life Safety and Immediate Occupancy.
- 4.4.2.2.1 SHEAR STRESS CHECK: The shear stress in the concrete shear walls, calculated using the Quick Check procedure of Section 3.5.3.3, shall be less than 100 psi or  $2\sqrt{f'_c}$  for Life Safety and Immediate Occupancy.  **$V_j^{avg} = 35 \text{ psi} < 100 \text{ psi}$  OK**
- 4.4.2.2.2 REINFORCING STEEL: The ratio of reinforcing steel area to gross concrete area shall be not less than 0.0015 in the vertical direction and 0.0025 in the horizontal direction for Life Safety and Immediate Occupancy. The spacing of reinforcing steel shall be equal to or less than 18" for Life Safety and Immediate Occupancy. **Spacing is not more than 18" o.c. Typical wall is 10", with #4@8" e.w.e.f. → 0.0049 OK**

**CONNECTIONS**

- 4.6.2.1 TRANSFER TO SHEAR WALLS: Diaphragms shall be connected for transfer of loads to the shear walls for Life Safety and the connections shall be able to develop the lesser of the shear strength of the walls or diaphragms for Immediate Occupancy.
- 4.6.3.5 FOUNDATION DOWELS: Wall reinforcement shall be doweled into the foundation for Life Safety and the dowels shall be able to develop the lesser of the strength of the walls or the uplift capacity of the foundation for Immediate Occupancy.

\* – Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.

Building Name: **Building 810B**

Date: **August 6, 2003**

Building Address: **Lawrence Livermore National Laboratory**

Page: **1** of **2**

Job Number: **A20047.08**

Job Name: **LLNL Prioritization**

By: **LKF** Checked: \_\_\_\_\_

## ASCE 31\* SUPPLEMENTAL CHECKLIST C2: CONCRETE SHEAR WALL BUILDINGS WITH RIGID OR STIFF DIAPHRAGMS

C	NC	N/A		Comments
<b>LATERAL-FORCE-RESISTING SYSTEM</b>				
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.4.1.6.2 DEFLECTION COMPATIBILITY: Secondary components shall have the shear capacity to develop the flexural strength of the components for Life Safety and shall meet the requirements of 4.4.1.4.9, 4.4.1.4.10, 4.4.1.4.11, 4.4.1.4.12 and 4.4.1.4.15 for Immediate Occupancy.	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.4.1.6.3 FLAT SLABS: Flat slabs/plates not part of lateral-force-resisting system shall have continuous bottom steel through the column joints for Life Safety.	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.4.2.2.3 COUPLING BEAMS: The stirrups in coupling beams over means of egress shall be spaced at or less than $d/2$ and shall be anchored into the confined core of the beam with hooks of 135° or more for Life Safety. All coupling beams shall comply with the requirements above and shall have the capacity in shear to develop the uplift capacity of the adjacent wall for Immediate Occupancy.	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.4.2.2.4 OVERTURNING: All shear walls shall have aspect ratios less than 4 to 1. Wall piers need not be considered. This statement shall apply to the Immediate Occupancy Performance Level only.	Statement applies to Immediate Occupancy Performance Level only.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.4.2.2.5 CONFINEMENT REINFORCING: For shear walls with aspect ratios greater than 2 to 1, the boundary elements shall be confined with spirals or ties with spacing less than $8d_b$ . This statement shall apply to the Immediate Occupancy Performance Level only.	Statement applies to Immediate Occupancy Performance Level only.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.4.2.2.6 REINFORCING AT OPENINGS: There shall be added trim reinforcement around all wall openings greater than three times the thickness of the wall. This statement shall apply to the Immediate Occupancy Performance Level only.	Statement applies to Immediate Occupancy Performance Level only.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.4.2.2.7 WALL THICKNESS: Thickness of bearing walls shall not be less than 1/25 the unsupported height or length, whichever is shorter, nor less than 4". This statement shall apply to the Immediate Occupancy Performance Level only.	Statement applies to Immediate Occupancy Performance Level only.
<b>DIAPHRAGMS</b>				
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.5.1.1 DIAPHRAGM CONTINUITY: The diaphragms shall not be composed of split-level floors and shall not have expansion joints.	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.5.1.4 OPENINGS AT SHEAR WALLS: Diaphragm openings immediately adjacent to the shear walls shall be less than 25% of the wall length for Life Safety and 15% of the wall length for Immediate Occupancy.	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.5.1.7 PLAN IRREGULARITIES: There shall be tensile capacity to develop the strength of the diaphragm at re-entrant corners or other locations of plan irregularities. This statement shall apply to the Immediate Occupancy Performance Level only.	Statement applies to Immediate Occupancy Performance Level only.



Building Name: **Building 810B**

Date: **August 6, 2003**

Building Address: **Lawrence Livermore National Laboratory**

Page: **2** of **2**

Job Number: **A20047.08**

Job Name: **LLNL Prioritization**

By: **LKF** Checked: \_\_\_\_\_

## ASCE 31\* SUPPLEMENTAL CHECKLIST C2: CONCRETE SHEAR WALL BUILDINGS WITH RIGID OR STIFF DIAPHRAGMS

C	NC	N/A		Comments
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### DIAPHRAGMS

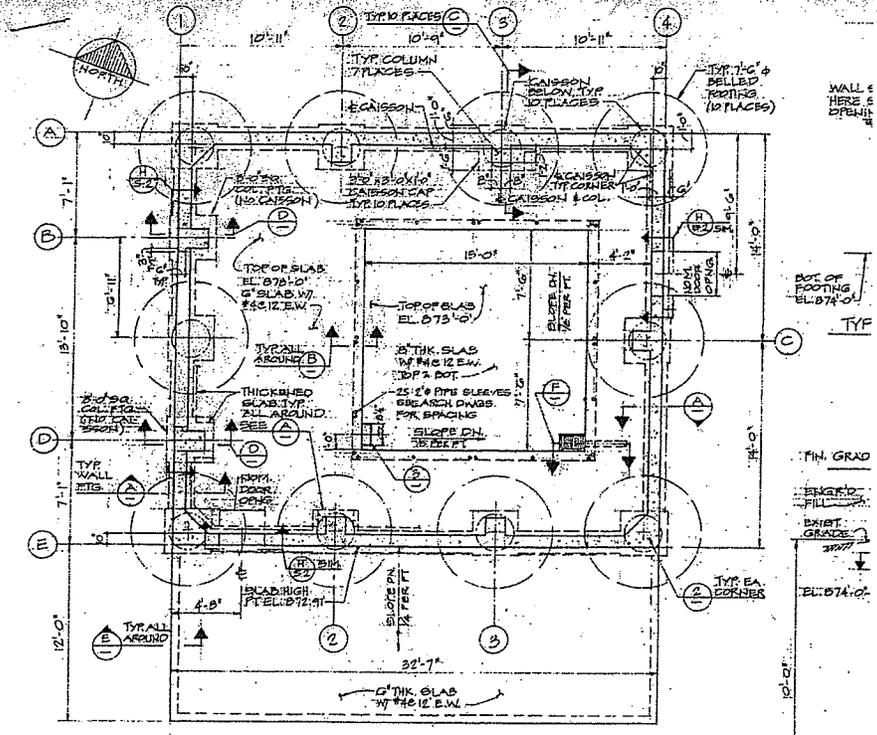
- |                          |                          |                                     |   |  |
|--------------------------|--------------------------|-------------------------------------|---|--|
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <p><b>4.5.1.8 DIAPHRAGM REINFORCEMENT AT OPENINGS:</b> There shall be reinforcing around all diaphragm openings larger than 50% of the building width in either major plan dimension. This statement shall apply to the Immediate Occupancy Performance Level only.</p> | <p><b>Statement applies to Immediate Occupancy Performance Level only.</b></p> |
|--------------------------|--------------------------|-------------------------------------|---|--|

### CONNECTIONS

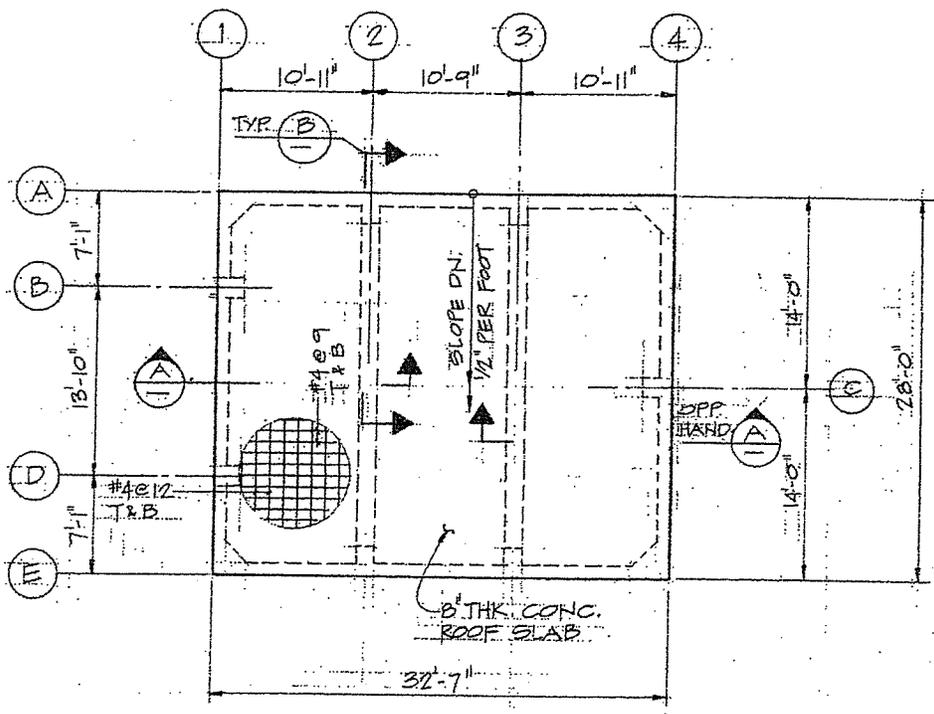
- |                          |                                     |                          |  |   |
|--------------------------|-------------------------------------|--------------------------|--|---|
| <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <p><b>4.6.3.10 UPLIFT AT PILE CAPS:</b> Pile caps shall have top reinforcement and piles shall be anchored to the pile caps for Life Safety, and the pile cap reinforcement and pile anchorage shall be able to develop the tensile capacity of the piles for Immediate Occupancy.</p> | <p><b>There is no top reinforcement in the caissons, so that they may not be capable of resisting tension due to overturning. Further evaluation may show that tension demands are low enough that caisson cap is adequate.</b></p> |
|--------------------------|-------------------------------------|--------------------------|--|---|

\* – Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.

**BUILDING PLAN**



FOUNDATION PLAN



ROOF FRAMING PLAN



Building Name: **Building 812E**

 Date: **August 7, 2003**

 Building Address: **Lawrence Livermore National Laboratory**

 Page: **1** of **2**

 Job Number: **A20047.08**

 Job Name: **LLNL Prioritization**

 By: **LKF** Checked:

## ASCE 31\* BASIC CHECKLIST C2: CONCRETE SHEAR WALL BUILDINGS WITH RIGID OR STIFF DIAPHRAGMS

C	NC	N/A		Comments
<b>BUILDING SYSTEM</b>				
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.1.1 LOAD PATH: The structure shall contain a minimum of one complete load path for Life Safety and Immediate Occupancy for seismic force effects from any horizontal direction that serves to transfer the inertial forces from the mass to the foundation.	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.1.3 MEZZANINES: Interior mezzanine levels shall be braced independently from the main structure, or shall be anchored to the lateral-force-resisting elements of the main structure.	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.1 WEAK STORY: The strength of the lateral-force-resisting system in any story shall not be less than 80% of the strength in an adjacent story above or below for Life-Safety and Immediate Occupancy.	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.2 SOFT STORY: The stiffness of the lateral-force-resisting-system in any story shall not be less than 70% of the lateral-force-resisting system stiffness in an adjacent story above or below, or less than 80% of the average lateral-force-resisting system stiffness of the three stories above or below for Life Safety and Immediate Occupancy.	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.3 GEOMETRY: There shall be no changes in horizontal dimension of the lateral-force-resisting system of more than 30% in a story relative to adjacent stories for Life Safety and Immediate Occupancy, excluding one-story penthouses and mezzanines.	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.2.4 VERTICAL DISCONTINUITIES: All vertical elements in the lateral-force-resisting system shall be continuous to the foundation.	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.5 MASS: There shall be no change in effective mass of more than 50% from one story to the next for Life Safety and Immediate Occupancy. Light roofs, penthouses and mezzanines need not be considered.	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.2.6 TORSION: The estimated distance between the story center of mass and the story center of rigidity shall be less than 20% of the building width in either plan dimension for Life Safety and Immediate Occupancy.	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.3.4 DETERIORATION OF CONCRETE: There shall be no visible deterioration of concrete or reinforcing steel in any of the vertical- or lateral-force-resisting elements.	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.3.5 POST-TENSIONING ANCHORS: There shall be no evidence of corrosion or spalling in the vicinity of post-tensioning or end fittings. Coil anchors shall not have been used.	No post-tensioning anchors
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.3.9 CONCRETE WALL CRACKS: All existing diagonal cracks in wall elements shall be less than 1/8" for Life Safety and 1/16" for Immediate Occupancy, shall not be concentrated in one location, and shall not form an X pattern.	

Building Name: Building 812E

Date: August 7, 2003

Building Address: Lawrence Livermore National Laboratory

Page: 2 of 2

Job Number: A20047.08

Job Name: LLNL Prioritization

By: LKF Checked: \_\_\_\_\_

## ASCE 31\* BASIC CHECKLIST C2: CONCRETE SHEAR WALL BUILDINGS WITH RIGID OR STIFF DIAPHRAGMS

C	NC	N/A		Comments
---	----	-----	--	----------

### LATERAL-FORCE-RESISTING SYSTEM

- |                                     |                          |                          |  |  |
|-------------------------------------|--------------------------|--------------------------|--|--|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 4.4.1.6.1 COMPLETE FRAMES: Steel or concrete frames classified as secondary components shall form a complete vertical load carrying system.  |  |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 4.4.2.1.1 REDUNDANCY: The number of lines of shear walls in each principal direction shall be greater than or equal to 2 for Life Safety and Immediate Occupancy.  |  |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 4.4.2.2.1 SHEAR STRESS CHECK: The shear stress in the concrete shear walls, calculated using the Quick Check procedure of Section 3.5.3.3, shall be less than 100 psi or $2\sqrt{f'_c}$ for Life Safety and Immediate Occupancy.   | $V_j^{avg} = 71 \text{ psi} < 100 \text{ psi}$ <u>OK</u>   |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 4.4.2.2.2 REINFORCING STEEL: The ratio of reinforcing steel area to gross concrete area shall be not less than 0.0015 in the vertical direction and 0.0025 in the horizontal direction for Life Safety and Immediate Occupancy. The spacing of reinforcing steel shall be equal to or less than 18" for Life Safety and Immediate Occupancy. | Max spacing is 18".<br>Typical wall is 8", with a minimum of #4@12" e.w.e.f. → 0.0041. <u>OK</u> |

### CONNECTIONS

- |                                     |                          |                          |   |  |
|-------------------------------------|--------------------------|--------------------------|---|--|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 4.6.2.1 TRANSFER TO SHEAR WALLS: Diaphragms shall be connected for transfer of loads to the shear walls for Life Safety and the connections shall be able to develop the lesser of the shear strength of the walls or diaphragms for Immediate Occupancy. |  |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 4.6.3.5 FOUNDATION DOWELS: Wall reinforcement shall be doweled into the foundation for Life Safety and the dowels shall be able to develop the lesser of the strength of the walls or the uplift capacity of the foundation for Immediate Occupancy.      |  |

\* – Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.

Building Name: **Building 812E**

Date: **August 6, 2003**

Building Address: **Lawrence Livermore National Laboratory**

Page: **1** of **2**

Job Number: **A20047.08**

Job Name: **LLNL Prioritization**

By: **LKF** Checked:

## ASCE 31\* SUPPLEMENTAL CHECKLIST C2: CONCRETE SHEAR WALL BUILDINGS WITH RIGID OR STIFF DIAPHRAGMS

C	NC	N/A		Comments
<b>LATERAL-FORCE-RESISTING SYSTEM</b>				
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.4.1.6.2 DEFLECTION COMPATIBILITY: Secondary components shall have the shear capacity to develop the flexural strength of the components for Life Safety and shall meet the requirements of 4.4.1.4.9, 4.4.1.4.10, 4.4.1.4.11, 4.4.1.4.12 and 4.4.1.4.15 for Immediate Occupancy.	No such secondary components.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.4.1.6.3 FLAT SLABS: Flat slabs/plates not part of lateral-force-resisting system shall have continuous bottom steel through the column joints for Life Safety.	No flat slabs that are not a part of the lateral-force-resisting system.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.4.2.2.3 COUPLING BEAMS: The stirrups in coupling beams over means of egress shall be spaced at or less than $d/2$ and shall be anchored into the confined core of the beam with hooks of $135^\circ$ or more for Life Safety. All coupling beams shall comply with the requirements above and shall have the capacity in shear to develop the uplift capacity of the adjacent wall for Immediate Occupancy.	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.4.2.2.4 OVERTURNING: All shear walls shall have aspect ratios less than 4 to 1. Wall piers need not be considered. This statement shall apply to the Immediate Occupancy Performance Level only.	Statement applies to Immediate Occupancy Performance Level only.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.4.2.2.5 CONFINEMENT REINFORCING: For shear walls with aspect ratios greater than 2 to 1, the boundary elements shall be confined with spirals or ties with spacing less than $8d_b$ . This statement shall apply to the Immediate Occupancy Performance Level only.	Statement applies to Immediate Occupancy Performance Level only.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.4.2.2.6 REINFORCING AT OPENINGS: There shall be added trim reinforcement around all wall openings greater than three times the thickness of the wall. This statement shall apply to the Immediate Occupancy Performance Level only.	Statement applies to Immediate Occupancy Performance Level only.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.4.2.2.7 WALL THICKNESS: Thickness of bearing walls shall not be less than $1/25$ the unsupported height or length, whichever is shorter, nor less than 4". This statement shall apply to the Immediate Occupancy Performance Level only.	Statement applies to Immediate Occupancy Performance Level only.
<b>DIAPHRAGMS</b>				
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.5.1.1 DIAPHRAGM CONTINUITY: The diaphragms shall not be composed of split-level floors and shall not have expansion joints.	Continuous diaphragm.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.5.1.4 OPENINGS AT SHEAR WALLS: Diaphragm openings immediately adjacent to the shear walls shall be less than 25% of the wall length for Life Safety and 15% of the wall length for Immediate Occupancy.	No significant openings at shear walls.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.5.1.7 PLAN IRREGULARITIES: There shall be tensile capacity to develop the strength of the diaphragm at re-entrant corners or other locations of plan irregularities. This statement shall apply to the Immediate Occupancy Performance Level only.	Statement applies to Immediate Occupancy Performance Level only.

Building Name: **Building 812E**

Date: **August 6, 2003**

Building Address: **Lawrence Livermore National Laboratory**

Page: **2** of **2**

Job Number: **A20047.08**

Job Name: **LLNL Prioritization**

By: **LKF** Checked:

## ASCE 31\* SUPPLEMENTAL CHECKLIST C2: CONCRETE SHEAR WALL BUILDINGS WITH RIGID OR STIFF DIAPHRAGMS

C	NC	N/A		Comments
<b>DIAPHRAGMS</b>				
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<b>4.5.1.8 DIAPHRAGM REINFORCEMENT AT OPENINGS:</b> There shall be reinforcing around all diaphragm openings larger than 50% of the building width in either major plan dimension. This statement shall apply to the Immediate Occupancy Performance Level only.	<b>Statement applies to Immediate Occupancy Performance Level only.</b>
<b>CONNECTIONS</b>				
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<b>4.6.3.10 UPLIFT AT PILE CAPS:</b> Pile caps shall have top reinforcement and piles shall be anchored to the pile caps for Life Safety, and the pile cap reinforcement and pile anchorage shall be able to develop the tensile capacity of the piles for Immediate Occupancy.	<b>No piles.</b>

\* – Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.





Building Name: **Building 817A**

Date: **August 7, 2003**

Building Address: **Lawrence Livermore National Laboratory**

Page: **1** of **1**

Job Number: **A20047.08**

Job Name: **LLNL Prioritization**

By: **LKF** Checked:

## PRIORITIZATION BUILDING DATA SHEET

### BUILDING DATA

Year Built:	1959	Year(s) Remodeled:	None known	UBC Zone:	4 – Type B Near Field
Area (sf):	400	Length (ft):	26'	Width (ft):	16'
No. Stories:	1	Story Height:	10'	Total Height:	10'

### CONSTRUCTION DATA

Gravity Load Structural System: 12" reinforced concrete roof slab to concrete bearing walls, with strip footings.

Exterior Transverse Walls: Reinforced concrete	Openings?: No; soil
Exterior Longitudinal Walls: Reinforced concrete	Openings?: Doors on east; soil on west
Roof Framing: 12" reinforced concrete roof slab	
Intermediate Floor Framing: N/A	
Ground Floor: Concrete slab-on-grade	
Columns: N/A	

Foundation: Strip footings, thickened footings, retaining walls around back and sides

### LATERAL-FORCE-RESISTING SYSTEM

	Longitudinal	Transverse
System Classification:	C2: Concrete Shear Wall Building with Rigid or Stiff Diaphragm	C2: Concrete Shear Wall Building with Rigid or Stiff Diaphragm
Vertical Elements:	Reinforced concrete shear walls	Reinforced concrete shear walls
Diaphragms:	Reinforced concrete slab	Reinforced concrete slab

SEISMIC EVALUATION PERFORMED? Yes EVALUATION: Rapid Evaluation YEAR: 2003

SEISMIC EVALUATION CRITERIA: Life Safety/ ASCE 31-02

VULNERABILITY RATING: 2  
(1=low to 10=high)

PRIORITIZATION CLASSIFICATION: CLASS D

### POTENTIAL LIFE SAFETY DEFICIENCIES:

THIS BUILDING WAS EVALUATED FOR THE 10% IN 50 YR. EARTHQUAKE.

#### COUPLING BEAMS:

*3' deep portion of wall above doors on east face is not detailed as a coupling beam (no 135° hooks).*

### PRELIMINARY STRENGTHENING SCHEMES OR MITIGATION MEASURES:

THIS IS A LOW OCCUPANCY STRUCTURE WITH LOW SEISMIC DEMANDS. THEREFORE JUDGED TO MEET INTENT OF LIFE SAFETY REQUIREMENTS

*No further analysis required.*

Building Name: **Building 817A**

Date: **August 7, 2003**

Building Address: **Lawrence Livermore National Laboratory**

Page: **1** of **2**

Job Number: **A20047.08** Job Name: **LLNL Prioritization**

By: **LKF** Checked: \_\_\_\_\_

## ASCE 31\* BASIC CHECKLIST C2: CONCRETE SHEAR WALL BUILDINGS WITH RIGID OR STIFF DIAPHRAGMS

**C NC N/A**

**Comments**

### BUILDING SYSTEM

- |                                     |                          |                                     |         |  |                                    |
|-------------------------------------|--------------------------|-------------------------------------|---------|--|------------------------------------|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.3.1.1 | LOAD PATH: The structure shall contain a minimum of one complete load path for Life Safety and Immediate Occupancy for seismic force effects from any horizontal direction that serves to transfer the inertial forces from the mass to the foundation.  |                                    |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.3.1.3 | MEZZANINES: Interior mezzanine levels shall be braced independently from the main structure, or shall be anchored to the lateral-force-resisting elements of the main structure.   |                                    |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.3.2.1 | WEAK STORY: The strength of the lateral-force-resisting system in any story shall not be less than 80% of the strength in an adjacent story above or below for Life-Safety and Immediate Occupancy.  |                                    |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.3.2.2 | SOFT STORY: The stiffness of the lateral-force-resisting-system in any story shall not be less than 70% of the lateral-force-resisting system stiffness in an adjacent story above or below, or less than 80% of the average lateral-force-resisting system stiffness of the three stories above or below for Life Safety and Immediate Occupancy. |                                    |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.3.2.3 | GEOMETRY: There shall be no changes in horizontal dimension of the lateral-force-resisting system of more than 30% in a story relative to adjacent stories for Life Safety and Immediate Occupancy, excluding one-story penthouses and mezzanines.   |                                    |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.3.2.4 | VERTICAL DISCONTINUITIES: All vertical elements in the lateral-force-resisting system shall be continuous to the foundation.   |                                    |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.3.2.5 | MASS: There shall be no change in effective mass of more than 50% from one story to the next for Life Safety and Immediate Occupancy. Light roofs, penthouses and mezzanines need not be considered.   |                                    |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.3.2.6 | TORSION: The estimated distance between the story center of mass and the story center of rigidity shall be less than 20% of the building width in either plan dimension for Life Safety and Immediate Occupancy.   |                                    |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.3.3.4 | DETERIORATION OF CONCRETE: There shall be no visible deterioration of concrete or reinforcing steel in any of the vertical- or lateral-force-resisting elements.   |                                    |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.3.3.5 | POST-TENSIONING ANCHORS: There shall be no evidence of corrosion or spalling in the vicinity of post-tensioning or end fittings. Coil anchors shall not have been used.  | <b>No post-tensioning anchors.</b> |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.3.3.9 | CONCRETE WALL CRACKS: All existing diagonal cracks in wall elements shall be less than 1/8" for Life Safety and 1/16" for Immediate Occupancy, shall not be concentrated in one location, and shall not form an X pattern.   |                                    |

Building Name: Building 817A

Date: August 7, 2003

Building Address: Lawrence Livermore National Laboratory

Page: 2 of 2

Job Number: A20047.08

Job Name: LLNL Prioritization

By: LKF Checked: \_\_\_\_\_

## ASCE 31\* BASIC CHECKLIST C2: CONCRETE SHEAR WALL BUILDINGS WITH RIGID OR STIFF DIAPHRAGMS

**C NC N/A**

**Comments**

### LATERAL-FORCE-RESISTING SYSTEM

- |                                     |                          |                                     |   |   |
|-------------------------------------|--------------------------|-------------------------------------|---|---|
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <p>4.4.1.6.1 COMPLETE FRAMES: Steel or concrete frames classified as secondary components shall form a complete vertical load carrying system.</p>  | <p>There are no beams or columns. The concrete slab is well connected to the walls.</p>                       |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | <p>4.4.2.1.1 REDUNDANCY: The number of lines of shear walls in each principal direction shall be greater than or equal to 2 for Life Safety and Immediate Occupancy.</p>  |   |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | <p>4.4.2.2.1 SHEAR STRESS CHECK: The shear stress in the concrete shear walls, calculated using the Quick Check procedure of Section 3.5.3.3, shall be less than 100 psi or <math>2\sqrt{f'_c}</math> for Life Safety and Immediate Occupancy.</p>  | <p><math>v_j^{avg} = 13 \text{ psi} &lt; 100 \text{ psi}</math>     <u>OK</u></p>                             |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | <p>4.4.2.2.2 REINFORCING STEEL: The ratio of reinforcing steel area to gross concrete area shall be not less than 0.0015 in the vertical direction and 0.0025 in the horizontal direction for Life Safety and Immediate Occupancy. The spacing of reinforcing steel shall be equal to or less than 18" for Life Safety and Immediate Occupancy.</p> | <p>Max spacing is 18".<br/>Typical wall is 12", with a minimum of #4@12" e.w.e.f. → 0.0027.     <u>OK</u></p> |

### CONNECTIONS

- |                                     |                          |                          |  |  |
|-------------------------------------|--------------------------|--------------------------|--|--|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <p>4.6.2.1 TRANSFER TO SHEAR WALLS: Diaphragms shall be connected for transfer of loads to the shear walls for Life Safety and the connections shall be able to develop the lesser of the shear strength of the walls or diaphragms for Immediate Occupancy.</p> |  |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <p>4.6.3.5 FOUNDATION DOWELS: Wall reinforcement shall be doweled into the foundation for Life Safety and the dowels shall be able to develop the lesser of the strength of the walls or the uplift capacity of the foundation for Immediate Occupancy.</p>      |  |

\* – Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.

Building Name: **Building 817A**

Date: **August 7, 2003**

Building Address: **Lawrence Livermore National Laboratory**

Page: **1** of **2**

Job Number: **A20047.08** Job Name: **LLNL Prioritization**

By: **LKF** Checked:

## ASCE 31\* SUPPLEMENTAL CHECKLIST C2: CONCRETE SHEAR WALL BUILDINGS WITH RIGID OR STIFF DIAPHRAGMS

C NC N/A

Comments

### LATERAL-FORCE-RESISTING SYSTEM

- |                          |                                     |                                     |  |  |
|--------------------------|-------------------------------------|-------------------------------------|--|--|
| <input type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <p>4.4.1.6.2 DEFLECTION COMPATIBILITY: Secondary components shall have the shear capacity to develop the flexural strength of the components for Life Safety and shall meet the requirements of 4.4.1.4.9, 4.4.1.4.10, 4.4.1.4.11, 4.4.1.4.12 and 4.4.1.4.15 for Immediate Occupancy.</p>  | <p>No such secondary components.</p>   |
| <input type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <p>4.4.1.6.3 FLAT SLABS: Flat slabs/plates not part of lateral-force-resisting system shall have continuous bottom steel through the column joints for Life Safety.</p>  | <p>No such flat slabs.</p>   |
| <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <p>4.4.2.2.3 COUPLING BEAMS: The stirrups in coupling beams over means of egress shall be spaced at or less than <math>d/2</math> and shall be anchored into the confined core of the beam with hooks of 135° or more for Life Safety. All coupling beams shall comply with the requirements above and shall have the capacity in shear to develop the uplift capacity of the adjacent wall for Immediate Occupancy.</p> | <p>3' deep portion of wall above doors on east face is not detailed as a coupling beam (no 135° hooks). Further evaluation might show that this is not a life-safety issue. This is a low-priority potential deficiency because the shear stress in the walls is very low.</p> |
| <input type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <p>4.4.2.2.4 OVERTURNING: All shear walls shall have aspect ratios less than 4 to 1. Wall piers need not be considered. This statement shall apply to the Immediate Occupancy Performance Level only.</p>  | <p>Statement applies to Immediate Occupancy Performance Level only.</p>  |
| <input type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <p>4.4.2.2.5 CONFINEMENT REINFORCING: For shear walls with aspect ratios greater than 2 to 1, the boundary elements shall be confined with spirals or ties with spacing less than <math>8d_b</math>. This statement shall apply to the Immediate Occupancy Performance Level only.</p>   | <p>Statement applies to Immediate Occupancy Performance Level only.</p>  |
| <input type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <p>4.4.2.2.6 REINFORCING AT OPENINGS: There shall be added trim reinforcement around all wall openings greater than three times the thickness of the wall. This statement shall apply to the Immediate Occupancy Performance Level only.</p>   | <p>Statement applies to Immediate Occupancy Performance Level only.</p>  |
| <input type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <p>4.4.2.2.7 WALL THICKNESS: Thickness of bearing walls shall not be less than <math>1/25</math> the unsupported height or length, whichever is shorter, nor less than 4". This statement shall apply to the Immediate Occupancy Performance Level only.</p>   | <p>Statement applies to Immediate Occupancy Performance Level only.</p>  |

### DIAPHRAGMS

- |                                     |                          |                                     |   |   |
|-------------------------------------|--------------------------|-------------------------------------|---|---|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | <p>4.5.1.1 DIAPHRAGM CONTINUITY: The diaphragms shall not be composed of split-level floors and shall not have expansion joints.</p>  |   |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | <p>4.5.1.4 OPENINGS AT SHEAR WALLS: Diaphragm openings immediately adjacent to the shear walls shall be less than 25% of the wall length for Life Safety and 15% of the wall length for Immediate Occupancy.</p>  |   |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <p>4.5.1.7 PLAN IRREGULARITIES: There shall be tensile capacity to develop the strength of the diaphragm at re-entrant corners or other locations of plan irregularities. This statement shall apply to the Immediate Occupancy Performance Level only.</p> | <p>Statement applies to Immediate Occupancy Performance Level only.</p> |



Building Name: **Building 817A**

Date: **August 7, 2003**

Building Address: **Lawrence Livermore National Laboratory**

Page: **2** of **2**

Job Number: **A20047.08**

Job Name: **LLNL Prioritization**

By: **LKF** Checked: \_\_\_\_\_

**ASCE 31\* SUPPLEMENTAL CHECKLIST C2: CONCRETE SHEAR WALL BUILDINGS WITH RIGID OR STIFF DIAPHRAGMS**

**C NC N/A**

**Comments**

**DIAPHRAGMS**

- 4.5.1.8 DIAPHRAGM REINFORCEMENT AT OPENINGS: There shall be reinforcing around all diaphragm openings larger than 50% of the building width in either major plan dimension. This statement shall apply to the Immediate Occupancy Performance Level only.

**Statement applies to Immediate Occupancy Performance Level only.**

**CONNECTIONS**

- 4.6.3.10 UPLIFT AT PILE CAPS: Pile caps shall have top reinforcement and piles shall be anchored to the pile caps for Life Safety, and the pile cap reinforcement and pile anchorage shall be able to develop the tensile capacity of the piles for Immediate Occupancy.

**No piles.**

\* - Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.



Building Name: **Building 817A**

Date: **August 7, 2003**

Building Address: **Lawrence Livermore National Laboratory**

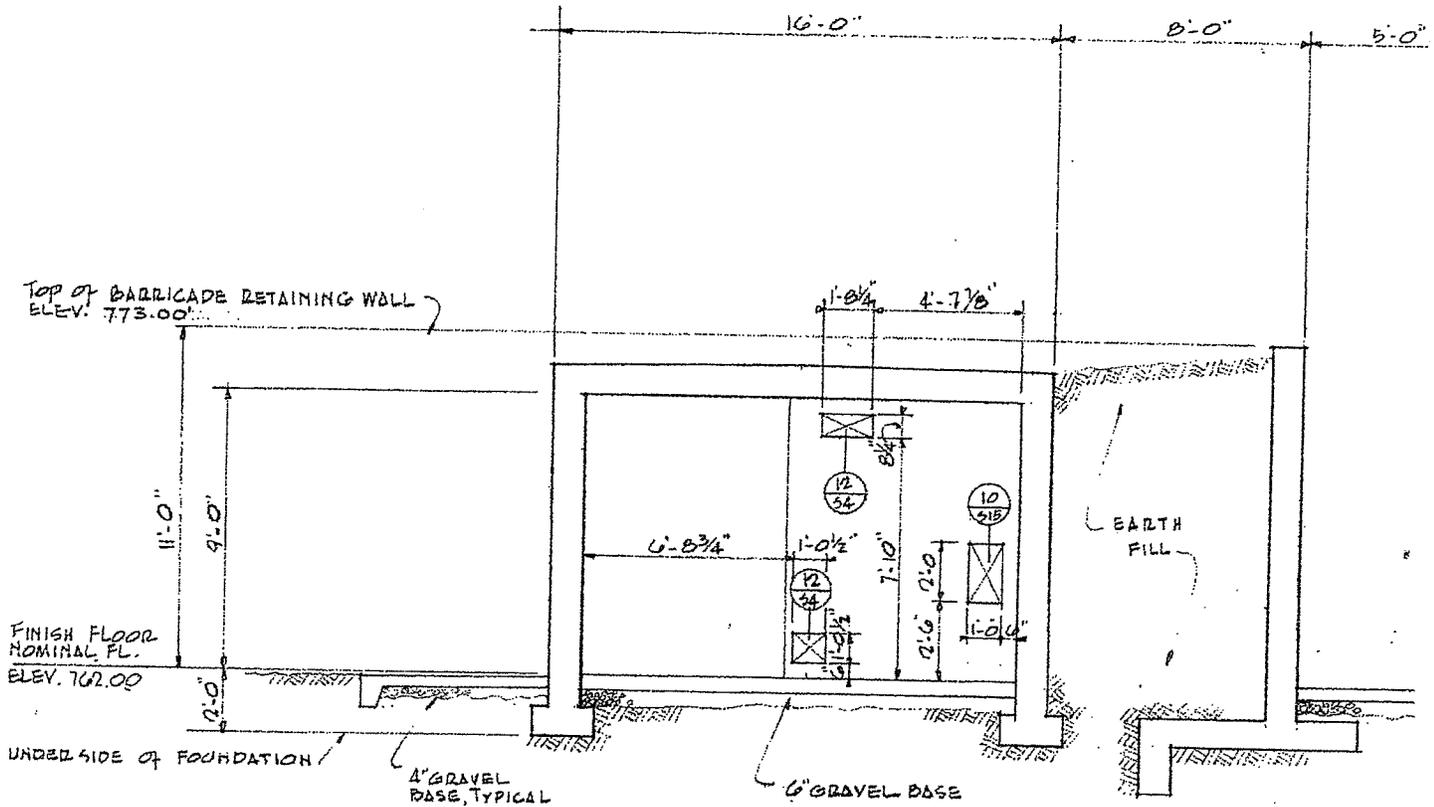
Page: **2** of **2**

Job Number: **A20047.08**

Job Name: **LLNL Prioritization**

By: **LKF** Checked:

**BUILDING PLANS AND SECTIONS**



Section

Building Name: **Building 817C Oven Building**

Date: **August 7, 2003**

Building Address: **Lawrence Livermore National Laboratory**

Page: **1** of **1**

Job Number: **A20047.08** Job Name: **LLNL Prioritization**

By: **LKF** Checked: \_\_\_\_\_

## PRIORITIZATION BUILDING DATA SHEET

### BUILDING DATA

Year Built: 1959	Year(s) Remodeled: 1971	UBC Zone: 4 – Type B Near Field
Area (sf): 300	Length (ft): 36'	Width (ft): 16'
No. Stories: 1	Story Height: 10'	Total Height: 13.5'

### CONSTRUCTION DATA

Gravity Load Structural System: Reinforced concrete roof slab, spanning to concrete bearing/retaining walls, with strip footings.

Exterior Transverse Walls: 12" Reinforced concrete	Openings?: No; soil
Exterior Longitudinal Walls: 12" Reinforced concrete	Openings?: Door on west; soil on east
Roof Framing: 12" concrete slab	
Intermediate Floor Framing: N/A	
Ground Floor: 6" Concrete slab-on-grade	
Columns: N/A	

Foundation: Strip footings, retaining walls around back and sides

### LATERAL-FORCE-RESISTING SYSTEM

	Longitudinal	Transverse
System Classification:	C2: Concrete Shear Wall Building with Rigid or Stiff Diaphragm	C2: Concrete Shear Wall Building with Rigid or Stiff Diaphragm
Vertical Elements:	Reinforced concrete shear walls	Reinforced concrete shear walls
Diaphragms:	Concrete slab	Concrete slab

SEISMIC EVALUATION PERFORMED? Yes EVALUATION: Rapid Evaluation YEAR: 2003

SEISMIC EVALUATION CRITERIA: Life Safety/ ASCE 31-02

VULNERABILITY RATING: 2  
(1=low to 10=high)

PRIORITIZATION CLASSIFICATION: CLASS D

### POTENTIAL LIFE SAFETY DEFICIENCIES:

THIS BUILDING WAS EVALUATED FOR THE 10% IN 50 YR. EARTHQUAKE.

#### COUPLING BEAMS:

*Portion of wall above front doors is not detailed as a coupling beam (no 135° hooks).*

### PRELIMINARY STRENGTHENING SCHEMES OR MITIGATION MEASURES:

THIS IS A LOW OCCUPANCY STRUCTURE WITH LOW SEISMIC DEMANDS. THEREFORE JUDGED TO MEET INTENT OF LIFE SAFETY REQUIREMENTS:

*No further analysis required.*

Building Name: Building 817C Oven Building

Date: August 7, 2003

Building Address: Lawrence Livermore National Laboratory

Page: 1 of 2

Job Number: A20047.08

Job Name: LLNL Prioritization

By: LKF Checked: \_\_\_\_\_

## ASCE 31\* BASIC CHECKLIST C2: CONCRETE SHEAR WALL BUILDINGS WITH RIGID OR STIFF DIAPHRAGMS

C	NC	N/A		Comments
<b>BUILDING SYSTEM</b>				
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.1.1 LOAD PATH: The structure shall contain a minimum of one complete load path for Life Safety and Immediate Occupancy for seismic force effects from any horizontal direction that serves to transfer the inertial forces from the mass to the foundation.	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.1.3 MEZZANINES: Interior mezzanine levels shall be braced independently from the main structure, or shall be anchored to the lateral-force-resisting elements of the main structure.	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.1 WEAK STORY: The strength of the lateral-force-resisting system in any story shall not be less than 80% of the strength in an adjacent story above or below for Life-Safety and Immediate Occupancy.	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.2 SOFT STORY: The stiffness of the lateral-force-resisting-system in any story shall not be less than 70% of the lateral-force-resisting system stiffness in an adjacent story above or below, or less than 80% of the average lateral-force-resisting system stiffness of the three stories above or below for Life Safety and Immediate Occupancy.	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.3 GEOMETRY: There shall be no changes in horizontal dimension of the lateral-force-resisting system of more than 30% in a story relative to adjacent stories for Life Safety and Immediate Occupancy, excluding one-story penthouses and mezzanines.	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.2.4 VERTICAL DISCONTINUITIES: All vertical elements in the lateral-force-resisting system shall be continuous to the foundation.	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.5 MASS: There shall be no change in effective mass of more than 50% from one story to the next for Life Safety and Immediate Occupancy. Light roofs, penthouses and mezzanines need not be considered.	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.2.6 TORSION: The estimated distance between the story center of mass and the story center of rigidity shall be less than 20% of the building width in either plan dimension for Life Safety and Immediate Occupancy.	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.3.4 DETERIORATION OF CONCRETE: There shall be no visible deterioration of concrete or reinforcing steel in any of the vertical- or lateral-force-resisting elements.	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.3.5 POST-TENSIONING ANCHORS: There shall be no evidence of corrosion or spalling in the vicinity of post-tensioning or end fittings. Coil anchors shall not have been used.	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.3.9 CONCRETE WALL CRACKS: All existing diagonal cracks in wall elements shall be less than 1/8" for Life Safety and 1/16" for Immediate Occupancy, shall not be concentrated in one location, and shall not form an X pattern.	

Building Name: Building 817C Oven Building

Date: August 7, 2003

Building Address: Lawrence Livermore National Laboratory

Page: 2 of 2

Job Number: A20047.08

Job Name: LLNL Prioritization

By: LKF Checked: \_\_\_\_\_

## ASCE 31\* BASIC CHECKLIST C2: CONCRETE SHEAR WALL BUILDINGS WITH RIGID OR STIFF DIAPHRAGMS

C	NC	N/A		Comments
---	----	-----	--	----------

### LATERAL-FORCE-RESISTING SYSTEM

- |                                     |                          |                                     |  |   |
|-------------------------------------|--------------------------|-------------------------------------|--|---|
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.1.6.1 COMPLETE FRAMES: Steel or concrete frames classified as secondary components shall form a complete vertical load carrying system.  | There are no beams or columns. The concrete slab is well connected to the walls.                  |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.4.2.1.1 REDUNDANCY: The number of lines of shear walls in each principal direction shall be greater than or equal to 2 for Life Safety and Immediate Occupancy.  |   |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.4.2.2.1 SHEAR STRESS CHECK: The shear stress in the concrete shear walls, calculated using the Quick Check procedure of Section 3.5.3.3, shall be less than 100 psi or $2\sqrt{f'_c}$ for Life Safety and Immediate Occupancy.   | $V_j^{avg} = 25 \text{ psi} < 100 \text{ psi}$ <u>OK</u>  |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.4.2.2.2 REINFORCING STEEL: The ratio of reinforcing steel area to gross concrete area shall be not less than 0.0015 in the vertical direction and 0.0025 in the horizontal direction for Life Safety and Immediate Occupancy. The spacing of reinforcing steel shall be equal to or less than 18" for Life Safety and Immediate Occupancy. | Max spacing is 18".<br>Typical wall is 12", with a minimum of #4@12" e.w.e.f. → 0.0027. <u>OK</u> |

### CONNECTIONS

- |                                     |                          |                          |   |  |
|-------------------------------------|--------------------------|--------------------------|---|--|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 4.6.2.1 TRANSFER TO SHEAR WALLS: Diaphragms shall be connected for transfer of loads to the shear walls for Life Safety and the connections shall be able to develop the lesser of the shear strength of the walls or diaphragms for Immediate Occupancy. |  |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 4.6.3.5 FOUNDATION DOWELS: Wall reinforcement shall be doweled into the foundation for Life Safety and the dowels shall be able to develop the lesser of the strength of the walls or the uplift capacity of the foundation for Immediate Occupancy.      |  |

\* - Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.

Building Name: Building 817C Oven Building

Date: August 7, 2003

Building Address: Lawrence Livermore National Laboratory

Page: 1 of 2

Job Number: A20047.08

Job Name: LLNL Prioritization

By: LKF Checked: \_\_\_\_\_

## ASCE 31\* SUPPLEMENTAL CHECKLIST C2: CONCRETE SHEAR WALL BUILDINGS WITH RIGID OR STIFF DIAPHRAGMS

**C NC N/A**

**Comments**

### LATERAL-FORCE-RESISTING SYSTEM

- |                          |                                     |                                     |   |  |
|--------------------------|-------------------------------------|-------------------------------------|---|--|
| <input type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | 4.4.1.6.2 DEFLECTION COMPATIBILITY: Secondary components shall have the shear capacity to develop the flexural strength of the components for Life Safety and shall meet the requirements of 4.4.1.4.9, 4.4.1.4.10, 4.4.1.4.11, 4.4.1.4.12 and 4.4.1.4.15 for Immediate Occupancy.  | No such secondary components.  |
| <input type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | 4.4.1.6.3 FLAT SLABS: Flat slabs/plates not part of lateral-force-resisting system shall have continuous bottom steel through the column joints for Life Safety.  | No such flat slabs.  |
| <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | 4.4.2.2.3 COUPLING BEAMS: The stirrups in coupling beams over means of egress shall be spaced at or less than $d/2$ and shall be anchored into the confined core of the beam with hooks of $135^\circ$ or more for Life Safety. All coupling beams shall comply with the requirements above and shall have the capacity in shear to develop the uplift capacity of the adjacent wall for Immediate Occupancy. | Portion of wall above doors at front face is not detailed as a coupling beam (no $135^\circ$ hooks). Further evaluation might show that this is not a life-safety issue. This is a low-priority potential deficiency because the shear stress in the walls is low. |
| <input type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | 4.4.2.2.4 OVERTURNING: All shear walls shall have aspect ratios less than 4 to 1. Wall piers need not be considered. This statement shall apply to the Immediate Occupancy Performance Level only.  | Statement applies to Immediate Occupancy Performance Level only.   |
| <input type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | 4.4.2.2.5 CONFINEMENT REINFORCING: For shear walls with aspect ratios greater than 2 to 1, the boundary elements shall be confined with spirals or ties with spacing less than $8d_b$ . This statement shall apply to the Immediate Occupancy Performance Level only.   | Statement applies to Immediate Occupancy Performance Level only.   |
| <input type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | 4.4.2.2.6 REINFORCING AT OPENINGS: There shall be added trim reinforcement around all wall openings greater than three times the thickness of the wall. This statement shall apply to the Immediate Occupancy Performance Level only.   | Statement applies to Immediate Occupancy Performance Level only.   |
| <input type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | 4.4.2.2.7 WALL THICKNESS: Thickness of bearing walls shall not be less than $1/25$ the unsupported height or length, whichever is shorter, nor less than 4". This statement shall apply to the Immediate Occupancy Performance Level only.  | Statement applies to Immediate Occupancy Performance Level only.   |

### DIAPHRAGMS

- |                                     |                          |                                     |  |  |
|-------------------------------------|--------------------------|-------------------------------------|--|--|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.5.1.1 DIAPHRAGM CONTINUITY: The diaphragms shall not be composed of split-level floors and shall not have expansion joints.  |  |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.5.1.4 OPENINGS AT SHEAR WALLS: Diaphragm openings immediately adjacent to the shear walls shall be less than 25% of the wall length for Life Safety and 15% of the wall length for Immediate Occupancy.  |  |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.5.1.7 PLAN IRREGULARITIES: There shall be tensile capacity to develop the strength of the diaphragm at re-entrant corners or other locations of plan irregularities. This statement shall apply to the Immediate Occupancy Performance Level only. | Statement applies to Immediate Occupancy Performance Level only. |



Building Name: Building 817C Oven Building

Date: August 7, 2003

Building Address: Lawrence Livermore National Laboratory

Page: 2 of 2

Job Number: A20047.08

Job Name: LLNL Prioritization

By: LKF Checked: \_\_\_\_\_

**ASCE 31\* SUPPLEMENTAL CHECKLIST C2: CONCRETE SHEAR WALL BUILDINGS WITH RIGID OR STIFF DIAPHRAGMS**

C NC N/A Comments

**DIAPHRAGMS**

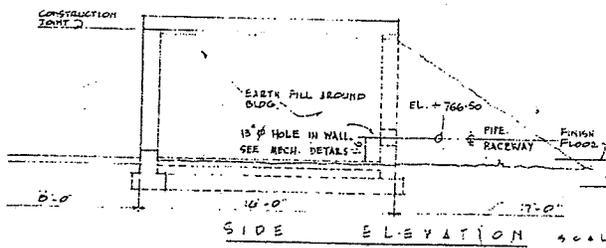
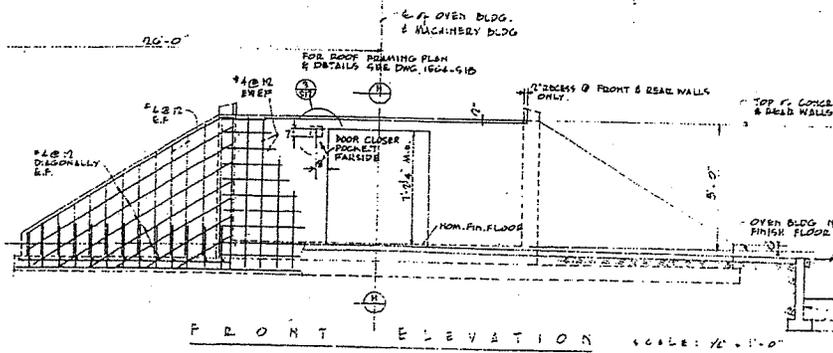
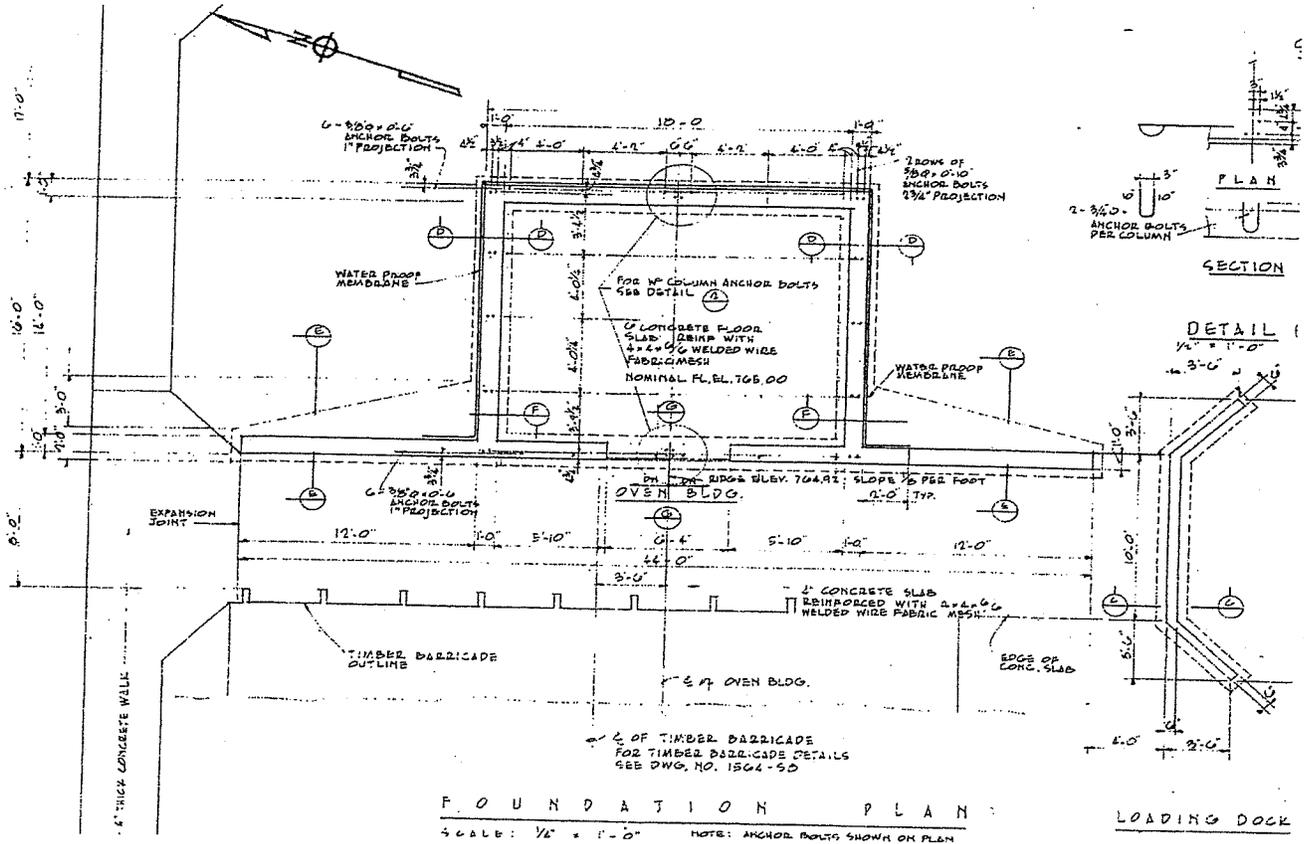
- 4.5.1.8 DIAPHRAGM REINFORCEMENT AT OPENINGS: There shall be reinforcing around all diaphragm openings larger than 50% of the building width in either major plan dimension. This statement shall apply to the Immediate Occupancy Performance Level only.

**CONNECTIONS**

- 4.6.3.10 UPLIFT AT PILE CAPS: Pile caps shall have top reinforcement and piles shall be anchored to the pile caps for Life Safety, and the pile cap reinforcement and pile anchorage shall be able to develop the tensile capacity of the piles for Immediate Occupancy.

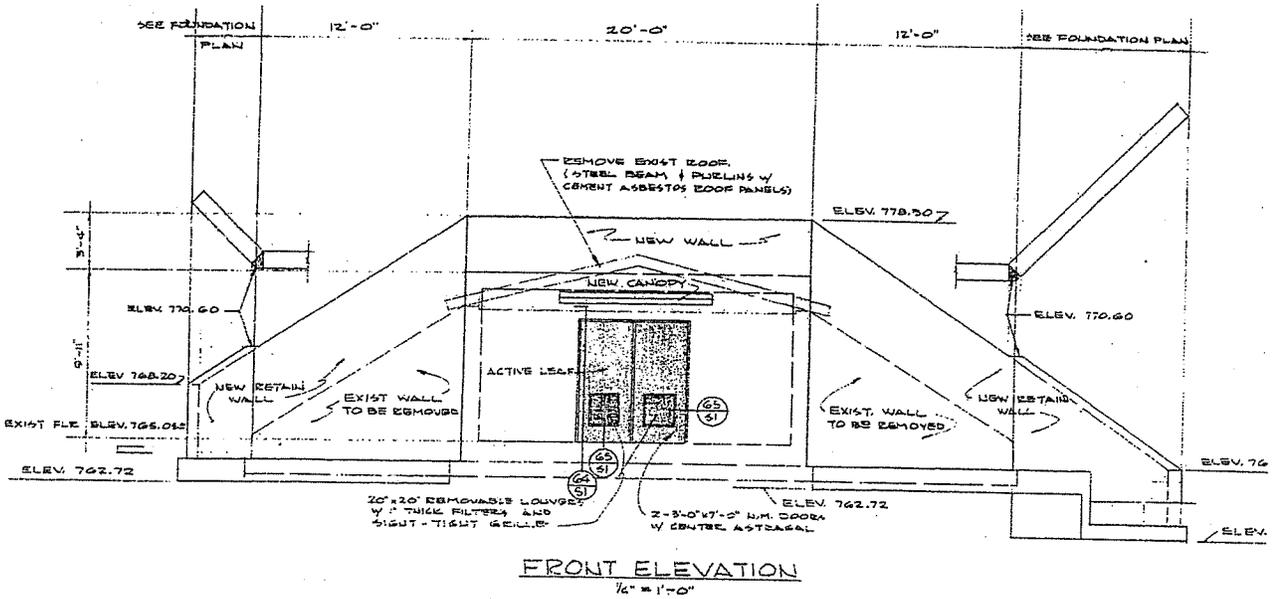
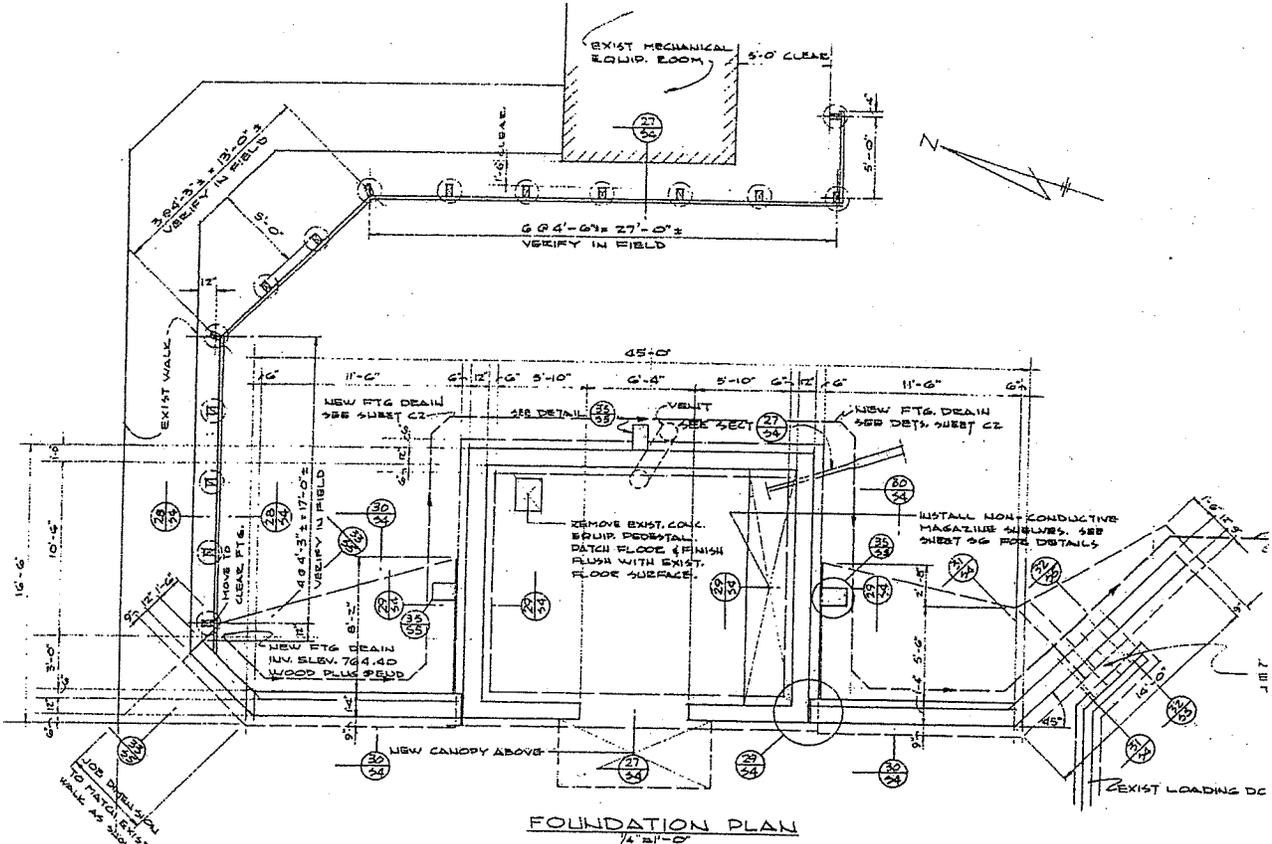
\* - Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.

**BUILDING PLANS, ELEVATIONS, AND SECTIONS**



**PLAN, ELEVATION, AND SECTION FROM ORIGINAL (1959) DRAWINGS**

**BUILDING PLANS, ELEVATIONS, AND SECTIONS**



GENERAL CONTRACTOR TO INSTALL AND FINISH HARDWARE FOR ALL HOLLOW METAL DOORS

**PLAN AND ELEVATION FROM RETROFIT (1971) DRAWINGS**



Building Name: Building 817F Date: August 7, 2003  
 Building Address: Lawrence Livermore National Laboratory Page: 1 of 1  
 Job Number: A20047.08 Job Name: LLNL Prioritization By: LKF Checked: \_\_\_\_\_

**PRIORITIZATION BUILDING DATA SHEET**

**BUILDING DATA**

Year Built:	1959	Year(s) Remodeled:	None known	UBC Zone:	4 – Type B Near Field
Area (sf):	300	Length (ft):	62' incl front retaining walls	Width (ft):	23'
No. Stories:	1	Story Height:	12'-9" to roof slab	Total Height:	16'

**CONSTRUCTION DATA**

Gravity Load Structural System: Concrete slab spanning to concrete bearing/retaining walls, with strip footings.

Exterior Transverse Walls:	Reinforced concrete	Openings?:	No; soil
Exterior Longitudinal Walls:	Reinforced concrete	Openings?:	Door on east; soil on east
Roof Framing:	12" reinforced concrete slab		
Intermediate Floor Framing:	N/A		
Ground Floor:	6" Concrete slab-on-grade		
Columns:	N/A		
Foundation:	Strip footings, retaining walls around back and sides		

**LATERAL-FORCE-RESISTING SYSTEM**

	<u>Longitudinal</u>	<u>Transverse</u>
System Classification:	C2: Concrete Shear Wall Building with Rigid or Stiff Diaphragm	C2: Concrete Shear Wall Building with Rigid or Stiff Diaphragm
Vertical Elements:	Reinforced concrete shear walls	Reinforced concrete shear walls
Diaphragms:	Reinforced concrete slab	Reinforced concrete slab

SEISMIC EVALUATION PERFORMED? Yes EVALUATION: Rapid Evaluation YEAR: 2003

SEISMIC EVALUATION CRITERIA: Life Safety/ ASCE 31-02

VULNERABILITY RATING: 2  
(1=low to 10=high)

PRIORITIZATION CLASSIFICATION: CLASS D

POTENTIAL LIFE SAFETY DEFICIENCIES:  
THIS BUILDING WAS EVALUATED FOR THE 10% IN 50 YR. EARTHQUAKE.

COUPLING BEAMS:  
*Portion of wall above front doors is not detailed as a coupling beam (no 135° hooks).*

**PRELIMINARY STRENGTHENING SCHEMES OR MITIGATION MEASURES:**  
THIS IS A LOW OCCUPANCY STRUCTURE WITH LOW SEISMIC DEMANDS. THEREFORE JUDGED TO MEET INTENT OF LIFE SAFETY REQUIREMENTS:  
No further analysis required.



Building Name: Building 817F

Date: August 7, 2003

Building Address: Lawrence Livermore National Laboratory

Page: 1 of 2

Job Number: A20047.08

Job Name: LLNL Prioritization

By: LKF Checked: \_\_\_\_\_

# ASCE 31\* BASIC CHECKLIST C2: CONCRETE SHEAR WALL BUILDINGS WITH RIGID OR STIFF DIAPHRAGMS

C	NC	N/A	Comments
---	----	-----	----------

## BUILDING SYSTEM

- |                                     |                          |                                     |  |                             |
|-------------------------------------|--------------------------|-------------------------------------|--|-----------------------------|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.3.1.1 LOAD PATH: The structure shall contain a minimum of one complete load path for Life Safety and Immediate Occupancy for seismic force effects from any horizontal direction that serves to transfer the inertial forces from the mass to the foundation.  |                             |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.3.1.3 MEZZANINES: Interior mezzanine levels shall be braced independently from the main structure, or shall be anchored to the lateral-force-resisting elements of the main structure.   |                             |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.3.2.1 WEAK STORY: The strength of the lateral-force-resisting system in any story shall not be less than 80% of the strength in an adjacent story above or below for Life-Safety and Immediate Occupancy.  |                             |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.3.2.2 SOFT STORY: The stiffness of the lateral-force-resisting-system in any story shall not be less than 70% of the lateral-force-resisting system stiffness in an adjacent story above or below, or less than 80% of the average lateral-force-resisting system stiffness of the three stories above or below for Life Safety and Immediate Occupancy. |                             |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.3.2.3 GEOMETRY: There shall be no changes in horizontal dimension of the lateral-force-resisting system of more than 30% in a story relative to adjacent stories for Life Safety and Immediate Occupancy, excluding one-story penthouses and mezzanines.   |                             |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.3.2.4 VERTICAL DISCONTINUITIES: All vertical elements in the lateral-force-resisting system shall be continuous to the foundation.   |                             |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.3.2.5 MASS: There shall be no change in effective mass of more than 50% from one story to the next for Life Safety and Immediate Occupancy. Light roofs, penthouses and mezzanines need not be considered.   |                             |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.3.2.6 TORSION: The estimated distance between the story center of mass and the story center of rigidity shall be less than 20% of the building width in either plan dimension for Life Safety and Immediate Occupancy.   |                             |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.3.3.4 DETERIORATION OF CONCRETE: There shall be no visible deterioration of concrete or reinforcing steel in any of the vertical- or lateral-force-resisting elements.   |                             |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.3.3.5 POST-TENSIONING ANCHORS: There shall be no evidence of corrosion or spalling in the vicinity of post-tensioning or end fittings. Coil anchors shall not have been used.  | No post-tensioning anchors. |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.3.3.9 CONCRETE WALL CRACKS: All existing diagonal cracks in wall elements shall be less than 1/8" for Life Safety and 1/16" for Immediate Occupancy, shall not be concentrated in one location, and shall not form an X pattern.   |                             |

Building Name: **Building 817F**

Date: **August 7, 2003**

Building Address: **Lawrence Livermore National Laboratory**

Page: **2** of **2**

Job Number: **A20047.08** Job Name: **LLNL Prioritization**

By: **LKF** Checked: \_\_\_\_\_

## ASCE 31\* BASIC CHECKLIST C2: CONCRETE SHEAR WALL BUILDINGS WITH RIGID OR STIFF DIAPHRAGMS

C	NC	N/A		Comments
---	----	-----	--	----------

### LATERAL-FORCE-RESISTING SYSTEM

- |                                     |                          |                                     |  |   |
|-------------------------------------|--------------------------|-------------------------------------|--|---|
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.1.6.1 COMPLETE FRAMES: Steel or concrete frames classified as secondary components shall form a complete vertical load carrying system.  | There are no beams or columns. The concrete slab is well connected to the walls.                  |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.4.2.1.1 REDUNDANCY: The number of lines of shear walls in each principal direction shall be greater than or equal to 2 for Life Safety and Immediate Occupancy.  |   |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.4.2.2.1 SHEAR STRESS CHECK: The shear stress in the concrete shear walls, calculated using the Quick Check procedure of Section 3.5.3.3, shall be less than 100 psi or $2\sqrt{f'_c}$ for Life Safety and Immediate Occupancy.   | $v_j^{avg} = 25 \text{ psi} < 100 \text{ psi}$ <b>OK</b>  |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.4.2.2.2 REINFORCING STEEL: The ratio of reinforcing steel area to gross concrete area shall be not less than 0.0015 in the vertical direction and 0.0025 in the horizontal direction for Life Safety and Immediate Occupancy. The spacing of reinforcing steel shall be equal to or less than 18" for Life Safety and Immediate Occupancy. | Max spacing is 18".<br>Typical wall is 12", with a minimum of #4@12" e.w.e.f. → 0.0027. <b>OK</b> |

### CONNECTIONS

- |                                     |                          |                          |   |  |
|-------------------------------------|--------------------------|--------------------------|---|--|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 4.6.2.1 TRANSFER TO SHEAR WALLS: Diaphragms shall be connected for transfer of loads to the shear walls for Life Safety and the connections shall be able to develop the lesser of the shear strength of the walls or diaphragms for Immediate Occupancy. |  |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 4.6.3.5 FOUNDATION DOWELS: Wall reinforcement shall be doweled into the foundation for Life Safety and the dowels shall be able to develop the lesser of the strength of the walls or the uplift capacity of the foundation for Immediate Occupancy.      |  |

\* – Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.

Building Name: **Building 817F**

 Date: **August 8, 2003**

 Building Address: **Lawrence Livermore National Laboratory**

 Page: **1** of **2**

 Job Number: **A20047.08**

 Job Name: **LLNL Prioritization**

 By: **LKF** Checked:

## ASCE 31\* SUPPLEMENTAL CHECKLIST C2: CONCRETE SHEAR WALL BUILDINGS WITH RIGID OR STIFF DIAPHRAGMS

C NC N/A

Comments

### LATERAL-FORCE-RESISTING SYSTEM

- |                          |                                     |                                     |  |   |
|--------------------------|-------------------------------------|-------------------------------------|--|---|
| <input type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | 4.4.1.6.2 DEFLECTION COMPATIBILITY: Secondary components shall have the shear capacity to develop the flexural strength of the components for Life Safety and shall meet the requirements of 4.4.1.4.9, 4.4.1.4.10, 4.4.1.4.11, 4.4.1.4.12 and 4.4.1.4.15 for Immediate Occupancy.   | No secondary components   |
| <input type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | 4.4.1.6.3 FLAT SLABS: Flat slabs/plates not part of lateral-force-resisting system shall have continuous bottom steel through the column joints for Life Safety.   | No such flat slabs  |
| <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | 4.4.2.2.3 COUPLING BEAMS: The stirrups in coupling beams over means of egress shall be spaced at or less than $d/2$ and shall be anchored into the confined core of the beam with hooks of 135° or more for Life Safety. All coupling beams shall comply with the requirements above and shall have the capacity in shear to develop the uplift capacity of the adjacent wall for Immediate Occupancy. | Portion of wall above doors at front face is not detailed as a coupling beam (no 135° hooks). Further evaluation might show that this is not a life-safety issue. This is a low-priority potential deficiency because the shear stress in the walls is low. |
| <input type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | 4.4.2.2.4 OVERTURNING: All shear walls shall have aspect ratios less than 4 to 1. Wall piers need not be considered. This statement shall apply to the Immediate Occupancy Performance Level only.   | Statement applies to Immediate Occupancy Performance Level only.  |
| <input type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | 4.4.2.2.5 CONFINEMENT REINFORCING: For shear walls with aspect ratios greater than 2 to 1, the boundary elements shall be confined with spirals or ties with spacing less than $8d_b$ . This statement shall apply to the Immediate Occupancy Performance Level only.  | Statement applies to Immediate Occupancy Performance Level only.  |
| <input type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | 4.4.2.2.6 REINFORCING AT OPENINGS: There shall be added trim reinforcement around all wall openings greater than three times the thickness of the wall. This statement shall apply to the Immediate Occupancy Performance Level only.  | Statement applies to Immediate Occupancy Performance Level only.  |
| <input type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | 4.4.2.2.7 WALL THICKNESS: Thickness of bearing walls shall not be less than 1/25 the unsupported height or length, whichever is shorter, nor less than 4". This statement shall apply to the Immediate Occupancy Performance Level only.   | Statement applies to Immediate Occupancy Performance Level only.  |

### DIAPHRAGMS

- |                                     |                          |                                     |  |  |
|-------------------------------------|--------------------------|-------------------------------------|--|--|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.5.1.1 DIAPHRAGM CONTINUITY: The diaphragms shall not be composed of split-level floors and shall not have expansion joints.  |  |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.5.1.4 OPENINGS AT SHEAR WALLS: Diaphragm openings immediately adjacent to the shear walls shall be less than 25% of the wall length for Life Safety and 15% of the wall length for Immediate Occupancy.  |  |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.5.1.7 PLAN IRREGULARITIES: There shall be tensile capacity to develop the strength of the diaphragm at re-entrant corners or other locations of plan irregularities. This statement shall apply to the Immediate Occupancy Performance Level only. | Statement applies to Immediate Occupancy Performance Level only. |

Building Name: **Building 817F**

Date: **August 8, 2003**

Building Address: **Lawrence Livermore National Laboratory**

Page: **2** of **2**

Job Number: **A20047.08**

Job Name: **LLNL Prioritization**

By: **LKF** Checked:

**ASCE 31\* SUPPLEMENTAL CHECKLIST C2: CONCRETE SHEAR WALL BUILDINGS WITH RIGID OR STIFF DIAPHRAGMS**

C	NC	N/A		Comments
---	----	-----	--	----------

**DIAPHRAGMS**

<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<p>4.5.1.8 DIAPHRAGM REINFORCEMENT AT OPENINGS: There shall be reinforcing around all diaphragm openings larger than 50% of the building width in either major plan dimension. This statement shall apply to the Immediate Occupancy Performance Level only.</p>	<p><b>Statement applies to Immediate Occupancy Performance Level only.</b></p>
--------------------------	--------------------------	-------------------------------------	--	--

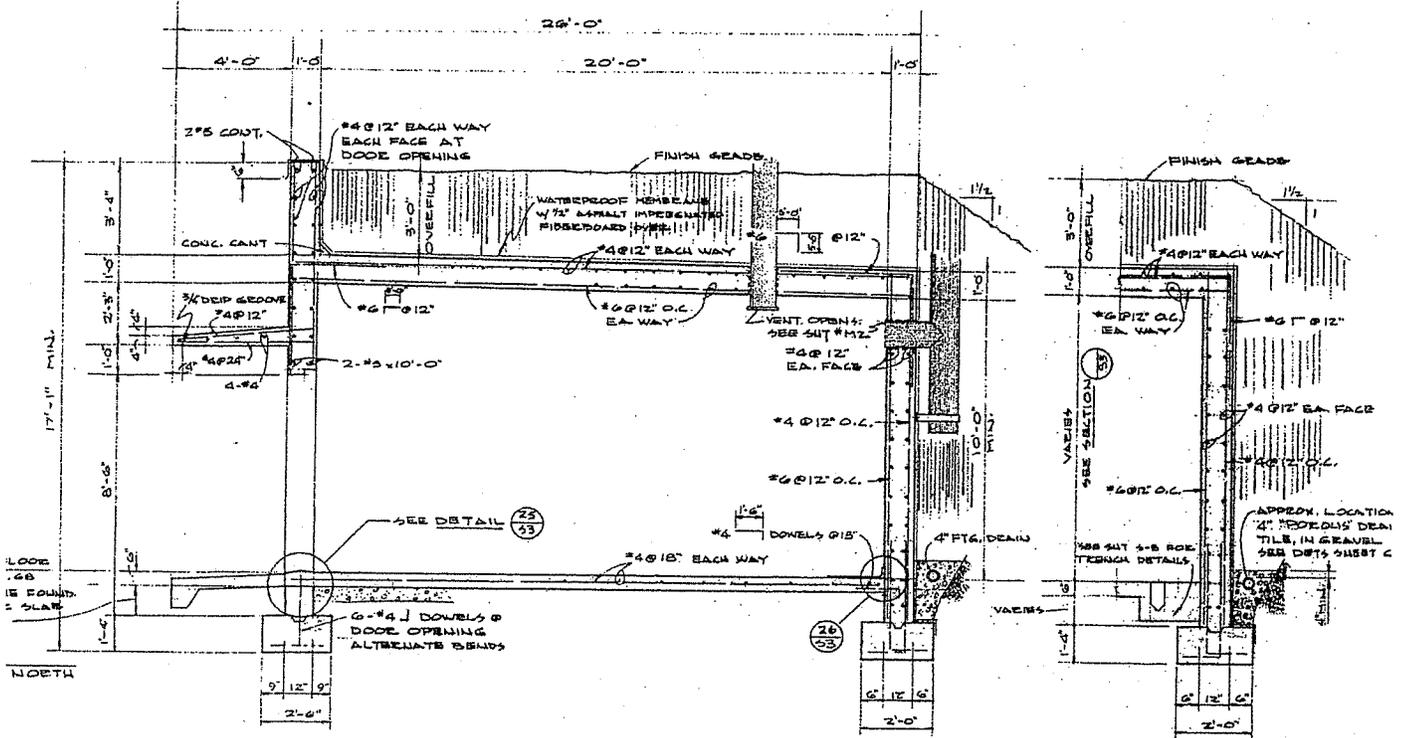
**CONNECTIONS**

<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<p>4.6.3.10 UPLIFT AT PILE CAPS: Pile caps shall have top reinforcement and piles shall be anchored to the pile caps for Life Safety, and the pile cap reinforcement and pile anchorage shall be able to develop the tensile capacity of the piles for Immediate Occupancy.</p>	<p><b>No pile caps</b></p>
--------------------------	--------------------------	-------------------------------------	---	----------------------------

\* – Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31



**BUILDING PLANS AND ELEVATIONS**



SECTION 19  
SCALE 3/8"=1'-0" 53

SECTION 21  
SCALE 3/8"=1'-0" 53



Building Name: **Building 825**

Date: **July 29, 2003**

Building Address: **Lawrence Livermore National Laboratory**

Page: **1** of **1**

Job Number: **A20047.08**

Job Name: **LLNL Prioritization**

By: **JYF**

Checked: **JEH**

## PRIORITIZATION BUILDING DATA SHEET

### BUILDING DATA

Year Built:	1959	Year(s) Remodeled:	None	UBC Zone:	4 – Type B Near Field
Area (sf):	1,300	Length (ft):	51	Width (ft):	38
No. Stories:	1	Story Height:	11'	Total Height:	11'

### CONSTRUCTION DATA

Gravity Load Structural System: 12" thick flat slab supported on interior and exterior 8" to 1'-0" thick reinforced concrete shear walls.

Exterior Transverse Walls: 8" to 1'-0" thick reinforced concrete shear walls	Openings?: Door and window openings
Exterior Longitudinal Walls: 8" to 1'-0" thick reinforced concrete shear walls	Openings?: Door and window openings

Roof Framing: 12" thick flat slab

Intermediate Floor Framing: None

Ground Floor: 4" thick concrete slab on grade w/ 4x4x6/6 WWF

Columns: None

Foundation: Concrete strip footing

### LATERAL-FORCE-RESISTING SYSTEM

	Longitudinal	Transverse
System Classification:	Type 9 (Concrete Shear Wall Building w/ Stiff Diaphragm)	Type 9 (Concrete Shear Wall Building w/ Stiff Diaphragm)
Vertical Elements:	Concrete flat slab, concrete shear walls	Concrete flat slab, concrete shear walls
Diaphragms:	12" thick concrete flat slab	12" thick concrete flat slab

**SEISMIC EVALUATION PERFORMED?** Yes **EVALUATION:** Rapid Evaluation **YEAR:** 2003

**SEISMIC EVALUATION CRITERIA:** Life Safety/ ASCE 31-02

**VULNERABILITY RATING:** 1  
(1=low to 10=high)

**PRIORITIZATION CLASSIFICATION:** CLASS D

**POTENTIAL LIFE SAFETY DEFICIENCIES:**  
THIS BUILDING WAS EVALUATED FOR THE 10% IN 50 YR. EARTHQUAKE.

*There are no potential life safety deficiencies identified.*

**PRELIMINARY STRENGTHENING SCHEMES OR MITIGATION MEASURES:**  
*None recommended.*



Building Name: **Building 825**

Date: **July 29, 2003**

Building Address: **Lawrence Livermore National Laboratory**

Page: **1** of **2**

Job Number: **A20047.08**

Job Name: **LLNL Prioritization**

By: **JYF** Checked: **JEH**

# ASCE 31\* BASIC CHECKLIST C2: CONCRETE SHEAR WALL BUILDINGS WITH RIGID OR STIFF DIAPHRAGMS

C	NC	N/A		Comments
---	----	-----	--	----------

## BUILDING SYSTEM

<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.1.1	LOAD PATH: The structure shall contain a minimum of one complete load path for Life Safety and Immediate Occupancy for seismic force effects from any horizontal direction that serves to transfer the inertial forces from the mass to the foundation.	12" thick LWC flat slab supported by 8" to 1'-0" thick reinforced concrete shear walls. The shear walls are doweled into the foundation system.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.1.3	MEZZANINES: Interior mezzanine levels shall be braced independently from the main structure, or shall be anchored to the lateral-force-resisting elements of the main structure.	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.1	WEAK STORY: The strength of the lateral-force-resisting system in any story shall not be less than 80% of the strength in an adjacent story above or below for Life-Safety and Immediate Occupancy.	One story building.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.2	SOFT STORY: The stiffness of the lateral-force-resisting-system in any story shall not be less than 70% of the lateral-force-resisting system stiffness in an adjacent story above or below, or less than 80% of the average lateral-force-resisting system stiffness of the three stories above or below for Life Safety and Immediate Occupancy.	One story building.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.3	GEOMETRY: There shall be no changes in horizontal dimension of the lateral-force-resisting system of more than 30% in a story relative to adjacent stories for Life Safety and Immediate Occupancy, excluding one-story penthouses and mezzanines.	One story building.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.2.4	VERTICAL DISCONTINUITIES: All vertical elements in the lateral-force-resisting system shall be continuous to the foundation.	The shear walls are doweled into the foundation system.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.5	MASS: There shall be no change in effective mass of more than 50% from one story to the next for Life Safety and Immediate Occupancy. Light roofs, penthouses and mezzanines need not be considered.	One story building.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.2.6	TORSION: The estimated distance between the story center of mass and the story center of rigidity shall be less than 20% of the building width in either plan dimension for Life Safety and Immediate Occupancy.	Concrete shear walls around the perimeter of the building.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.3.4	DETERIORATION OF CONCRETE: There shall be no visible deterioration of concrete or reinforcing steel in any of the vertical- or lateral-force-resisting elements.	Site visit made on 8/18/03. No signs of deterioration were observed.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.3.5	POST-TENSIONING ANCHORS: There shall be no evidence of corrosion or spalling in the vicinity of post-tensioning or end fittings. Coil anchors shall not have been used.	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.3.9	CONCRETE WALL CRACKS: All existing diagonal cracks in wall elements shall be less than 1/8" for Life Safety and 1/16" for Immediate Occupancy, shall not be concentrated in one location, and shall not form an X pattern.	Site visit made on 8/18/03. There are no cracks >1/8".

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Date: **July 29, 2003**

Building Address: **Lawrence Livermore National Laboratory**

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Job Number: **A20047.08**

Job Name: **LLNL Prioritization**

By: **JYF** Checked: **JEH**

## ASCE 31\* BASIC CHECKLIST C2: CONCRETE SHEAR WALL BUILDINGS WITH RIGID OR STIFF DIAPHRAGMS

C	NC	N/A		Comments
<b>LATERAL-FORCE-RESISTING SYSTEM</b>				
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.4.1.6.1 COMPLETE FRAMES: Steel or concrete frames classified as secondary components shall form a complete vertical load carrying system.	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.4.2.1.1 REDUNDANCY: The number of lines of shear walls in each principal direction shall be greater than or equal to 2 for Life Safety and Immediate Occupancy.	There are at least 2 lines of resistance in each direction of loading.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.4.2.2.1 SHEAR STRESS CHECK: The shear stress in the concrete shear walls, calculated using the Quick Check procedure of Section 3.5.3.3, shall be less than 100 psi or $2\sqrt{f'c}$ for Life Safety and Immediate Occupancy.	The maximum shear stress is 18 psi < 100 psi. Note: $2\sqrt{f'c} = 110$ psi for $f'c = 3,000$ psi.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.4.2.2.2 REINFORCING STEEL: The ratio of reinforcing steel area to gross concrete area shall be not less than 0.0015 in the vertical direction and 0.0025 in the horizontal direction for Life Safety and Immediate Occupancy. The spacing of reinforcing steel shall be equal to or less than 18" for Life Safety and Immediate Occupancy.	Typ. reinforcement in reinforced concrete walls: 8" thick wall: vertical: #5 @12" o.c.; $\rho = 0.0032 > 0.0015$ horizontal: #4 @10" o.c.; $\rho = 0.0025 = 0.002$ 12" thick wall: 2#4 @12" o.c. E.W.; $\rho = 0.0028 > 0.0025$  The spacing $\leq 18"$ .
<b>CONNECTIONS</b>				
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.6.2.1 TRANSFER TO SHEAR WALLS: Diaphragms shall be connected for transfer of loads to the shear walls for Life Safety and the connections shall be able to develop the lesser of the shear strength of the walls or diaphragms for Immediate Occupancy.	Rebar from slab dowels into concrete shear walls.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.6.3.5 FOUNDATION DOWELS: Wall reinforcement shall be doweled into the foundation for Life Safety and the dowels shall be able to develop the lesser of the strength of the walls or the uplift capacity of the foundation for Immediate Occupancy.	Rebar dowels into foundation match vertical rebar in shear walls.

\* - Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.

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 Job Number: **A20047.08**

 Job Name: **LLNL Prioritization**

 By: **JYF** Checked: **JEH**

## ASCE 31\* SUPPLEMENTAL CHECKLIST C2: CONCRETE SHEAR WALL BUILDINGS WITH RIGID OR STIFF DIAPHRAGMS

C	NC	N/A		Comments
---	----	-----	--	----------

### LATERAL-FORCE-RESISTING SYSTEM

- |                                     |                          |                                     |   |                                |
|-------------------------------------|--------------------------|-------------------------------------|---|--------------------------------|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.4.1.6.2 DEFLECTION COMPATIBILITY: Secondary components shall have the shear capacity to develop the flexural strength of the components for Life Safety and shall meet the requirements of 4.4.1.4.9, 4.4.1.4.10, 4.4.1.4.11, 4.4.1.4.12 and 4.4.1.4.15 for Immediate Occupancy.  | No secondary elements.         |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.1.6.3 FLAT SLABS: Flat slabs/plates not part of lateral-force-resisting system shall have continuous bottom steel through the column joints for Life Safety.  |                                |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.2.2.3 COUPLING BEAMS: The stirrups in coupling beams over means of egress shall be spaced at or less than $d/2$ and shall be anchored into the confined core of the beam with hooks of $135^\circ$ or more for Life Safety. All coupling beams shall comply with the requirements above and shall have the capacity in shear to develop the uplift capacity of the adjacent wall for Immediate Occupancy. |                                |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.2.2.4 OVERTURNING: All shear walls shall have aspect ratios less than 4 to 1. Wall piers need not be considered. This statement shall apply to the Immediate Occupancy Performance Level only.  | Life Safety Performance Level. |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.2.2.5 CONFINEMENT REINFORCING: For shear walls with aspect ratios greater than 2 to 1, the boundary elements shall be confined with spirals or ties with spacing less than $8d_b$ . This statement shall apply to the Immediate Occupancy Performance Level only.   | Life Safety Performance Level. |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.2.2.6 REINFORCING AT OPENINGS: There shall be added trim reinforcement around all wall openings greater than three times the thickness of the wall. This statement shall apply to the Immediate Occupancy Performance Level only.   | Life Safety Performance Level. |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.4.2.2.7 WALL THICKNESS: Thickness of bearing walls shall not be less than $1/25$ the unsupported height or length, whichever is shorter, nor less than 4". This statement shall apply to the Immediate Occupancy Performance Level only.  | Life Safety Performance Level. |

### DIAPHRAGMS

- |                                     |                          |                                     |  |                                |
|-------------------------------------|--------------------------|-------------------------------------|--|--------------------------------|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.5.1.1 DIAPHRAGM CONTINUITY: The diaphragms shall not be composed of split-level floors and shall not have expansion joints.  |                                |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | 4.5.1.4 OPENINGS AT SHEAR WALLS: Diaphragm openings immediately adjacent to the shear walls shall be less than 25% of the wall length for Life Safety and 15% of the wall length for Immediate Occupancy.  |                                |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.5.1.7 PLAN IRREGULARITIES: There shall be tensile capacity to develop the strength of the diaphragm at re-entrant corners or other locations of plan irregularities. This statement shall apply to the Immediate Occupancy Performance Level only. | Life Safety Performance Level. |

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## ASCE 31\* SUPPLEMENTAL CHECKLIST C2: CONCRETE SHEAR WALL BUILDINGS WITH RIGID OR STIFF DIAPHRAGMS

C	NC	N/A		Comments
<b>DIAPHRAGMS</b>				
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<b>4.5.1.8</b> DIAPHRAGM REINFORCEMENT AT OPENINGS: There shall be reinforcing around all diaphragm openings larger than 50% of the building width in either major plan dimension. This statement shall apply to the Immediate Occupancy Performance Level only.	Life Safety Performance Level.
<b>CONNECTIONS</b>				
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<b>4.6.3.10</b> UPLIFT AT PILE CAPS: Pile caps shall have top reinforcement and piles shall be anchored to the pile caps for Life Safety, and the pile cap reinforcement and pile anchorage shall be able to develop the tensile capacity of the piles for Immediate Occupancy.	

\* – Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31





### ***Building 818A***

Building 818A is a one-story reinforced concrete bearing wall building. The structure consists of 2" asbestos panels. The deck is supported by steel beams. The steel beams span to interior and exterior concrete shear walls. Potential structural deficiencies noted for Building 818A are 1) The asbestos roof cannot adequately serve as a diaphragm; 2) Out of plane wall anchorage was found to be inadequate; and 3) There are no cross ties. For the building to meet life-safety requirements, we recommend that the roof be replaced or strengthened with horizontal rod bracing or metal deck. In addition, we recommend that the out of plane wall anchorage is strengthened and cross ties are added.

### ***Building 826***

Building 826 is a one-story reinforced concrete bearing building. The structure consists of a 6" thick concrete flat slab supported by concrete beams and columns or concrete shear walls. The primary structural deficiency noted for Building 826 is the canopy's attachment to the main structure which induces cross grain bending on the wood ledger supporting the canopy. For the building to meet life-safety requirements, we recommend that the connection at the canopy be strengthened with steel straps.

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Job Name: **LLNL Prioritization**

By: **JYF** Checked: **JEH**

## PRIORITIZATION BUILDING DATA SHEET

### BUILDING DATA

Year Built:	1961	Year(s) Remodeled:	None	UBC Zone:	4 – Type B Near Field
Area (sf):	2,200	Length (ft):	50	Width (ft):	43'-6"
No. Stories:	1	Story Height:	10'-10"	Total Height:	10'-10"

### CONSTRUCTION DATA

Gravity Load Structural System: 6" thick flat slab supported by concrete beams and columns or 8" to 1'-2" thick reinforced concrete shear walls.

Exterior Transverse Walls: 8" to 1'-2" thick reinforced concrete shear walls	Openings?: Door and window openings
Exterior Longitudinal Walls: 8" to 1'-2" thick reinforced concrete shear walls	Openings?: Door and window openings
Roof Framing: 6" thick flat slab supported by concrete beams	
Intermediate Floor Framing: None	
Ground Floor: 4" concrete slab on grade w/ #4 @ 16" o.c. E.W.	
Columns: 10" x 12" concrete columns	
Foundation: Concrete strip footing or thickened slab	

### LATERAL-FORCE-RESISTING SYSTEM

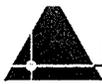
	Longitudinal	Transverse
System Classification:	Type 9 (Concrete Shear Wall Building w/ Stiff Diaphragm)	Type 9 (Concrete Shear Wall Building w/ Stiff Diaphragm)
Vertical Elements:	Concrete flat slab, concrete beams and columns, concrete shear walls	Concrete flat slab, concrete beams and columns, concrete shear walls
Diaphragms:	6" thick flat slab	6" thick flat slab

SEISMIC EVALUATION PERFORMED? Yes EVALUATION: Rapid Evaluation YEAR: 2003

SEISMIC EVALUATION CRITERIA: Life Safety/ ASCE 31-02

VULNERABILITY RATING: 5  
(1=low to 10=high)

PRIORITIZATION CLASSIFICATION: CLASS C



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By: **JYF**

Checked: **JEH**

## PRIORITIZATION BUILDING DATA SHEET

### POTENTIAL LIFE SAFETY DEFICIENCIES:

THIS BUILDING WAS EVALUATED FOR THE 10% IN 50 YR. EARTHQUAKE.

#### CANOPY SUPPORT

*The canopy is attached to the main building but induces cross grain bending on the wood ledger supporting the canopy.*

### PRELIMINARY STRENGTHENING SCHEMES OR MITIGATION MEASURES:

Demand on the building is low. There are two columns in the building. The potential deficiency identified for deflection compatibility can be mitigated through detailed analysis.

Retrofit canopy to main building connection. Replace connection at wood ledger to eliminate cross grain bending.

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By: **JYF** Checked: **JEH**

## ASCE 31\* BASIC CHECKLIST C2: CONCRETE SHEAR WALL BUILDINGS WITH RIGID OR STIFF DIAPHRAGMS

C	NC	N/A		Comments
---	----	-----	--	----------

### BUILDING SYSTEM

<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.1.1 LOAD PATH: The structure shall contain a minimum of one complete load path for Life Safety and Immediate Occupancy for seismic force effects from any horizontal direction that serves to transfer the inertial forces from the mass to the foundation.	6" thick flat slab supported on concrete beams. The concrete beams span to concrete columns in the interior or are supported by 8" to 1'-2" thick reinforced concrete shear walls. The shear walls are doweled into the foundation system.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.1.3 MEZZANINES: Interior mezzanine levels shall be braced independently from the main structure, or shall be anchored to the lateral-force-resisting elements of the main structure.	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.1 WEAK STORY: The strength of the lateral-force-resisting system in any story shall not be less than 80% of the strength in an adjacent story above or below for Life-Safety and Immediate Occupancy.	One story building.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.2 SOFT STORY: The stiffness of the lateral-force-resisting-system in any story shall not be less than 70% of the lateral-force-resisting system stiffness in an adjacent story above or below, or less than 80% of the average lateral-force-resisting system stiffness of the three stories above or below for Life Safety and Immediate Occupancy.	One story building.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.3 GEOMETRY: There shall be no changes in horizontal dimension of the lateral-force-resisting system of more than 30% in a story relative to adjacent stories for Life Safety and Immediate Occupancy, excluding one-story penthouses and mezzanines.	One story building.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.2.4 VERTICAL DISCONTINUITIES: All vertical elements in the lateral-force-resisting system shall be continuous to the foundation.	The shear walls are doweled into the foundation system.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.5 MASS: There shall be no change in effective mass of more than 50% from one story to the next for Life Safety and Immediate Occupancy. Light roofs, penthouses and mezzanines need not be considered.	One story building.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.2.6 TORSION: The estimated distance between the story center of mass and the story center of rigidity shall be less than 20% of the building width in either plan dimension for Life Safety and Immediate Occupancy.	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.3.4 DETERIORATION OF CONCRETE: There shall be no visible deterioration of concrete or reinforcing steel in any of the vertical- or lateral-force-resisting elements.	Site visit made on 8/18/03. No signs of deterioration were observed.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.3.5 POST-TENSIONING ANCHORS: There shall be no evidence of corrosion or spalling in the vicinity of post-tensioning or end fittings. Coil anchors shall not have been used.	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.3.9 CONCRETE WALL CRACKS: All existing diagonal cracks in wall elements shall be less than 1/8" for Life Safety and 1/16" for Immediate Occupancy, shall not be concentrated in one location, and shall not form an X pattern.	Site visit made on 8/18/03. There are no cracks >1/8".

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By: **JYF**

Checked: **JEH**

## ASCE 31\* BASIC CHECKLIST C2: CONCRETE SHEAR WALL BUILDINGS WITH RIGID OR STIFF DIAPHRAGMS

**C NC N/A**

**Comments**

### LATERAL-FORCE-RESISTING SYSTEM

- |                                     |                                     |                          |   |  |
|-------------------------------------|-------------------------------------|--------------------------|---|--|
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/> | <p>4.4.1.6.1 COMPLETE FRAMES: Steel or concrete frames classified as secondary components shall form a complete vertical load carrying system.</p>  |  |
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/> | <p>4.4.2.1.1 REDUNDANCY: The number of lines of shear walls in each principal direction shall be greater than or equal to 2 for Life Safety and Immediate Occupancy.</p>  | <p><b>There are at least 2 lines of resistance in each direction of loading.</b></p>   |
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/> | <p>4.4.2.2.1 SHEAR STRESS CHECK: The shear stress in the concrete shear walls, calculated using the Quick Check procedure of Section 3.5.3.3, shall be less than 100 psi or <math>2\sqrt{f'_c}</math> for Life Safety and Immediate Occupancy.</p>  | <p><b>The maximum shear stress in the concrete block wall is 30 psi &lt; 100 psi. Note: <math>2\sqrt{f'_c} = 100</math> psi for <math>f'_c = 2,500</math> psi.</b></p>   |
| <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <p>4.4.2.2.2 REINFORCING STEEL: The ratio of reinforcing steel area to gross concrete area shall be not less than 0.0015 in the vertical direction and 0.0025 in the horizontal direction for Life Safety and Immediate Occupancy. The spacing of reinforcing steel shall be equal to or less than 18" for Life Safety and Immediate Occupancy.</p> | <p><b>Typ. reinforcement in reinforced concrete walls:<br/>8" thick wall:<br/>vertical: #4 @12" o.c.; <math>\rho = 0.0021 &gt; 0.0015</math><br/>horizontal: #4 @9" o.c.; <math>\rho = 0.0028 &gt; 0.0025</math><br/>12" thick wall: 2#4 @12" o.c. E.W.; <math>\rho = 0.0028 &gt; 0.0025</math><br/>24" thick wall: 2#5@6" o.c. vertical and 2#5 @ 12" o.c. horizontal; <math>\rho = 0.00215 &lt; 0.0025</math></b></p> <p><b>The spacing &lt; = 18".</b></p> <p><b>Judged okay with respect to Life Safety for these large wall with Low Seismic demands.</b></p> |

### CONNECTIONS

- |                                     |                          |                          |  |   |
|-------------------------------------|--------------------------|--------------------------|--|---|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <p>4.6.2.1 TRANSFER TO SHEAR WALLS: Diaphragms shall be connected for transfer of loads to the shear walls for Life Safety and the connections shall be able to develop the lesser of the shear strength of the walls or diaphragms for Immediate Occupancy.</p> | <p><b>Rebar from slab dowels into concrete shear walls.</b></p>                 |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <p>4.6.3.5 FOUNDATION DOWELS: Wall reinforcement shall be doweled into the foundation for Life Safety and the dowels shall be able to develop the lesser of the strength of the walls or the uplift capacity of the foundation for Immediate Occupancy.</p>      | <p><b>Rebar dowels into foundation match vertical rebar in shear walls.</b></p> |

\* -- Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.

Building Name: **Building 826**

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Job Number: **A20047.08**

Job Name: **LLNL Prioritization**

By: **JYF** Checked: **JEH**

## ASCE 31\* SUPPLEMENTAL CHECKLIST C2: CONCRETE SHEAR WALL BUILDINGS WITH RIGID OR STIFF DIAPHRAGMS

C	NC	N/A		Comments
<b>LATERAL-FORCE-RESISTING SYSTEM</b>				
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	4.4.1.6.2 DEFLECTION COMPATIBILITY: Secondary components shall have the shear capacity to develop the flexural strength of the components for Life Safety and shall meet the requirements of 4.4.1.4.9, 4.4.1.4.10, 4.4.1.4.11, 4.4.1.4.12 and 4.4.1.4.15 for Immediate Occupancy.	0'-10" x 1'-0" columns have (8)#5 vertical rebar and 2#2 ties @ 10" o.c. The shear capacity is not adequate to develop the flexural strength of the column.  Deformations expected to be low in this small concrete shear wall building. Judged okay for Life-Safety.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.4.1.6.3 FLAT SLABS: Flat slabs/plates not part of lateral-force-resisting system shall have continuous bottom steel through the column joints for Life Safety.	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.4.2.2.3 COUPLING BEAMS: The stirrups in coupling beams over means of egress shall be spaced at or less than d/2 and shall be anchored into the confined core of the beam with hooks of 135° or more for Life Safety. All coupling beams shall comply with the requirements above and shall have the capacity in shear to develop the uplift capacity of the adjacent wall for Immediate Occupancy.	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.4.2.2.4 OVERTURNING: All shear walls shall have aspect ratios less than 4 to 1. Wall piers need not be considered. This statement shall apply to the Immediate Occupancy Performance Level only.	Life Safety Performance Level.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.4.2.2.5 CONFINEMENT REINFORCING: For shear walls with aspect ratios greater than 2 to 1, the boundary elements shall be confined with spirals or ties with spacing less than 8d <sub>b</sub> . This statement shall apply to the Immediate Occupancy Performance Level only.	Life Safety Performance Level.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.4.2.2.6 REINFORCING AT OPENINGS: There shall be added trim reinforcement around all wall openings greater than three times the thickness of the wall. This statement shall apply to the Immediate Occupancy Performance Level only.	Life Safety Performance Level.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.4.2.2.7 WALL THICKNESS: Thickness of bearing walls shall not be less than 1/25 the unsupported height or length, whichever is shorter, nor less than 4". This statement shall apply to the Immediate Occupancy Performance Level only.	Life Safety Performance Level.
<b>DIAPHRAGMS</b>				
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.5.1.1 DIAPHRAGM CONTINUITY: The diaphragms shall not be composed of split-level floors and shall not have expansion joints.	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.5.1.4 OPENINGS AT SHEAR WALLS: Diaphragm openings immediately adjacent to the shear walls shall be less than 25% of the wall length for Life Safety and 15% of the wall length for Immediate Occupancy.	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.5.1.7 PLAN IRREGULARITIES: There shall be tensile capacity to develop the strength of the diaphragm at re-entrant corners or other locations of plan irregularities. This statement shall apply to the Immediate Occupancy Performance Level only.	Life Safety Performance Level.



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## ASCE 31\* SUPPLEMENTAL CHECKLIST C2: CONCRETE SHEAR WALL BUILDINGS WITH RIGID OR STIFF DIAPHRAGMS

C	NC	N/A	Comments
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### DIAPHRAGMS

- |                          |                          |                                     |   |                                |
|--------------------------|--------------------------|-------------------------------------|---|--------------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.5.1.8 DIAPHRAGM REINFORCEMENT AT OPENINGS: There shall be reinforcing around all diaphragm openings larger than 50% of the building width in either major plan dimension. This statement shall apply to the Immediate Occupancy Performance Level only. | Life Safety Performance Level. |
|--------------------------|--------------------------|-------------------------------------|---|--------------------------------|

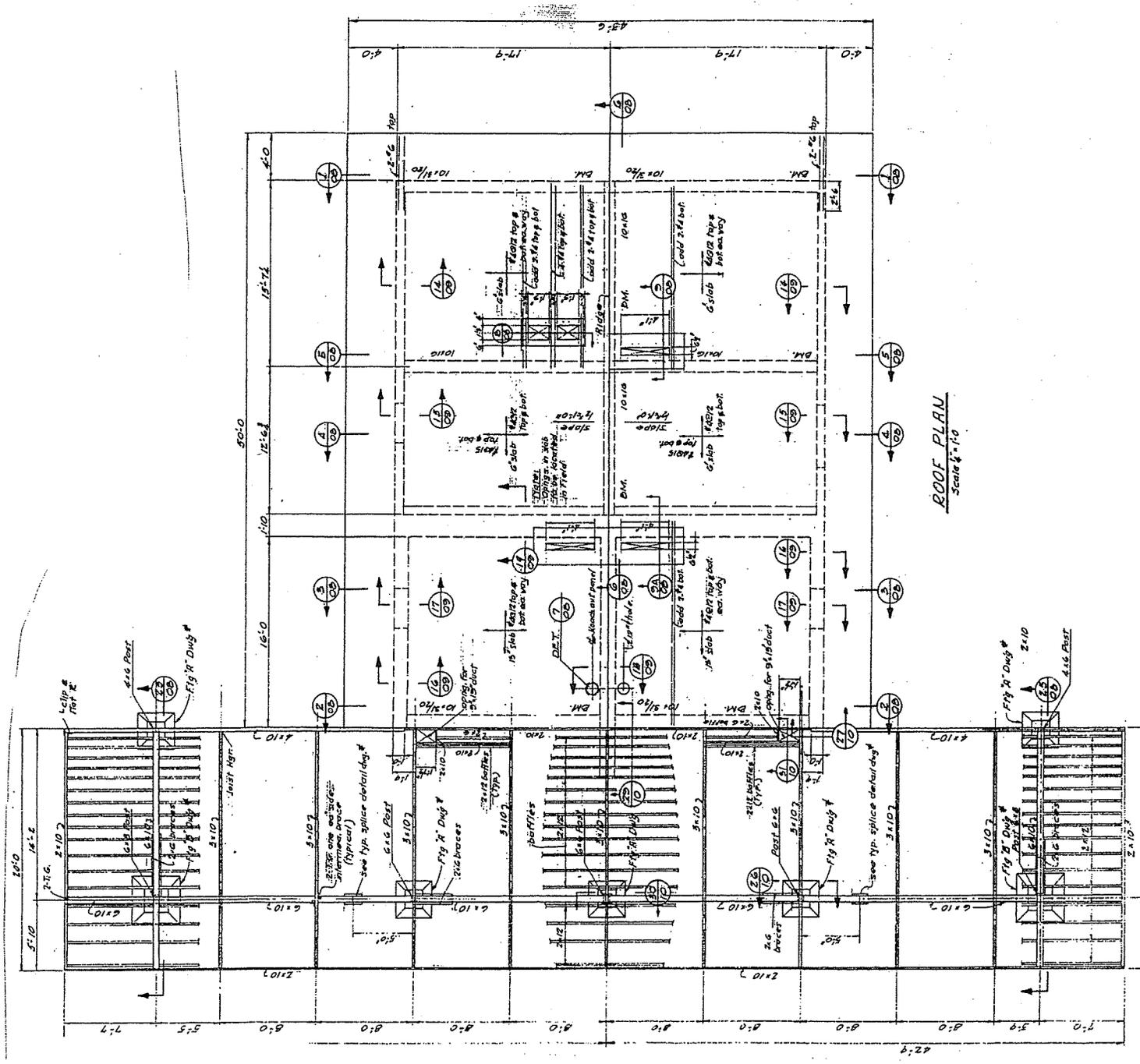
### CONNECTIONS

- |                          |                          |                                     |  |  |
|--------------------------|--------------------------|-------------------------------------|--|--|
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.6.3.10 UPLIFT AT PILE CAPS: Pile caps shall have top reinforcement and piles shall be anchored to the pile caps for Life Safety, and the pile cap reinforcement and pile anchorage shall be able to develop the tensile capacity of the piles for Immediate Occupancy. |  |
|--------------------------|--------------------------|-------------------------------------|--|--|

\* – Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.



**ROOF PLAN**



Building Name: **Building 836A**

Date: **July 30, 2003**

Building Address: **Lawrence Livermore National Laboratory**

Page: **1** of **1**

Job Number: **A20047.08**

Job Name: **LLNL Prioritization**

By: **JYF** Checked: **JEH**

## PRIORITIZATION BUILDING DATA SHEET

### BUILDING DATA

Year Built:	1957	Year(s) Remodeled:	None	UBC Zone:	4 – Type B Near Field
Area (sf):	1,300	Length (ft):	51	Width (ft):	38
No. Stories:	1	Story Height:	11'	Total Height:	11'

### CONSTRUCTION DATA

Gravity Load Structural System: 12" thick flat slab supported by concrete columns or interior and exterior 8" to 1'-0" thick reinforced concrete shear walls.

Exterior Transverse Walls: 8" to 1'-0" thick reinforced concrete shear walls      Openings?: Door and window openings  
 Exterior Longitudinal Walls: 8" to 1'-0" thick reinforced concrete shear walls      Openings?: Door and window openings

Roof Framing: 12" thick flat slab

Intermediate Floor Framing: None

Ground Floor: 4" thick concrete slab on grade w/ 4x4x6/6 WWF

Columns: 1'-3" x 1'-3" concrete columns

Foundation: Concrete strip footing

### LATERAL-FORCE-RESISTING SYSTEM

	Longitudinal	Transverse
System Classification:	Type 9 (Concrete Shear Wall Building w/ Stiff Diaphragm)	Type 9 (Concrete Shear Wall Building w/ Stiff Diaphragm)
Vertical Elements:	Concrete flat slab, concrete columns and concrete shear walls	Concrete flat slab, concrete columns and concrete shear walls
Diaphragms:	12" thick concrete flat slab	12" thick concrete flat slab

SEISMIC EVALUATION PERFORMED? Yes      EVALUATION: Rapid Evaluation      YEAR: 2003

SEISMIC EVALUATION CRITERIA: Life Safety/ ASCE 31-02

VULNERABILITY RATING: 3  
(1=low to 10=high)

PRIORITIZATION CLASSIFICATION: CLASS D

### POTENTIAL LIFE SAFETY DEFICIENCIES:

THIS BUILDING WAS EVALUATED FOR THE 10% IN 50 YR. EARTHQUAKE.

None

### PRELIMINARY STRENGTHENING SCHEMES OR MITIGATION MEASURES:

None.

Building Name: **Building 836A**

Date: **July 31, 2003**

Building Address: **Lawrence Livermore National Laboratory**

Page: **1** of **2**

Job Number: **A20047.08**

Job Name: **LLNL Prioritization**

By: **JYF** Checked: **JEH**

## ASCE 31\* BASIC CHECKLIST C2: CONCRETE SHEAR WALL BUILDINGS WITH RIGID OR STIFF DIAPHRAGMS

C	NC	N/A		Comments
<b>BUILDING SYSTEM</b>				
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.1.1 LOAD PATH: The structure shall contain a minimum of one complete load path for Life Safety and Immediate Occupancy for seismic force effects from any horizontal direction that serves to transfer the inertial forces from the mass to the foundation.	<b>8" concrete flat slab supported concrete beams, which span to concrete columns or perimeter 12" thick reinforced concrete shear walls. The shear walls are doweled into the foundation system.</b>
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.1.3 MEZZANINES: Interior mezzanine levels shall be braced independently from the main structure, or shall be anchored to the lateral-force-resisting elements of the main structure.	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.1 WEAK STORY: The strength of the lateral-force-resisting system in any story shall not be less than 80% of the strength in an adjacent story above or below for Life-Safety and Immediate Occupancy.	<b>One story building.</b>
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.2 SOFT STORY: The stiffness of the lateral-force-resisting-system in any story shall not be less than 70% of the lateral-force-resisting system stiffness in an adjacent story above or below, or less than 80% of the average lateral-force-resisting system stiffness of the three stories above or below for Life Safety and Immediate Occupancy.	<b>One story building.</b>
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.3 GEOMETRY: There shall be no changes in horizontal dimension of the lateral-force-resisting system of more than 30% in a story relative to adjacent stories for Life Safety and Immediate Occupancy, excluding one-story penthouses and mezzanines.	<b>One story building.</b>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.2.4 VERTICAL DISCONTINUITIES: All vertical elements in the lateral-force-resisting system shall be continuous to the foundation.	<b>The shear walls are doweled into the foundation system.</b>
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.5 MASS: There shall be no change in effective mass of more than 50% from one story to the next for Life Safety and Immediate Occupancy. Light roofs, penthouses and mezzanines need not be considered.	<b>One story building.</b>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.2.6 TORSION: The estimated distance between the story center of mass and the story center of rigidity shall be less than 20% of the building width in either plan dimension for Life Safety and Immediate Occupancy.	<b>Concrete shear walls around the perimeter of the building.</b>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.3.4 DETERIORATION OF CONCRETE: There shall be no visible deterioration of concrete or reinforcing steel in any of the vertical- or lateral-force-resisting elements.	<b>Site visit made on 8/18/03. No signs of deterioration were observed.</b>
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.3.5 POST-TENSIONING ANCHORS: There shall be no evidence of corrosion or spalling in the vicinity of post-tensioning or end fittings. Coil anchors shall not have been used.	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.3.9 CONCRETE WALL CRACKS: All existing diagonal cracks in wall elements shall be less than 1/8" for Life Safety and 1/16" for Immediate Occupancy, shall not be concentrated in one location, and shall not form an X pattern.	<b>Site visit made on 8/18/03. There are no cracks &gt;1/8".</b>

Building Name: **Building 836A**

Date: **July 31, 2003**

Building Address: **Lawrence Livermore National Laboratory**

Page: **2** of **2**

Job Number: **A20047.08**

Job Name: **LLNL Prioritization**

By: **JYF**

Checked: **JEH**

## ASCE 31\* BASIC CHECKLIST C2: CONCRETE SHEAR WALL BUILDINGS WITH RIGID OR STIFF DIAPHRAGMS

C	NC	N/A		Comments
<b>LATERAL-FORCE-RESISTING SYSTEM</b>				
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.4.1.6.1 COMPLETE FRAMES: Steel or concrete frames classified as secondary components shall form a complete vertical load carrying system.	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.4.2.1.1 REDUNDANCY: The number of lines of shear walls in each principal direction shall be greater than or equal to 2 for Life Safety and Immediate Occupancy.	There are at least 2 lines of resistance in each direction of loading.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.4.2.2.1 SHEAR STRESS CHECK: The shear stress in the concrete shear walls, calculated using the Quick Check procedure of Section 3.5.3.3, shall be less than 100 psi or $2\sqrt{f'_c}$ for Life Safety and Immediate Occupancy.	The maximum shear stress is 31 psi < 100 psi. Note: $2\sqrt{f'_c} = 110$ psi for $f'_c = 3,000$ psi.
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	4.4.2.2.2 REINFORCING STEEL: The ratio of reinforcing steel area to gross concrete area shall be not less than 0.0015 in the vertical direction and 0.0025 in the horizontal direction for Life Safety and Immediate Occupancy. The spacing of reinforcing steel shall be equal to or less than 18" for Life Safety and Immediate Occupancy.	Typ. reinforcement in reinforced concrete walls: 12" thick wall: 2#4 @16" o.c. E.W.; $\rho = 0.0021 < 0.0025$  The spacing <= 18".
<b>CONNECTIONS</b>				
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.6.2.1 TRANSFER TO SHEAR WALLS: Diaphragms shall be connected for transfer of loads to the shear walls for Life Safety and the connections shall be able to develop the lesser of the shear strength of the walls or diaphragms for Immediate Occupancy.	Rebar from slab dowels into concrete shear walls.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.6.3.5 FOUNDATION DOWELS: Wall reinforcement shall be doweled into the foundation for Life Safety and the dowels shall be able to develop the lesser of the strength of the walls or the uplift capacity of the foundation for Immediate Occupancy.	Rebar dowels into foundation match vertical rebar in shear walls.

\* – Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.

Building Name: Building 836A

Date: July 31, 2003

Building Address: Lawrence Livermore National Laboratory

Page: 2 of 2

Job Number: A20047.08 Job Name: LLNL Prioritization

By: JYF Checked: JEH

## ASCE 31\* BASIC CHECKLIST C2: CONCRETE SHEAR WALL BUILDINGS WITH RIGID OR STIFF DIAPHRAGMS

C	NC	N/A		Comments
<b>LATERAL-FORCE-RESISTING SYSTEM</b>				
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.4.1.6.1 COMPLETE FRAMES: Steel or concrete frames classified as secondary components shall form a complete vertical load carrying system.	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.4.2.1.1 REDUNDANCY: The number of lines of shear walls in each principal direction shall be greater than or equal to 2 for Life Safety and Immediate Occupancy.	There are at least 2 lines of resistance in each direction of loading.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.4.2.2.1 SHEAR STRESS CHECK: The shear stress in the concrete shear walls, calculated using the Quick Check procedure of Section 3.5.3.3, shall be less than 100 psi or $2\sqrt{f'_c}$ for Life Safety and Immediate Occupancy.	The maximum shear stress is 31 psi < 100 psi. Note: $2\sqrt{f'_c} = 110$ psi for $f'_c = 3,000$ psi.
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	4.4.2.2.2 REINFORCING STEEL: The ratio of reinforcing steel area to gross concrete area shall be not less than 0.0015 in the vertical direction and 0.0025 in the horizontal direction for Life Safety and Immediate Occupancy. The spacing of reinforcing steel shall be equal to or less than 18" for Life Safety and Immediate Occupancy.	Typ. reinforcement in reinforced concrete walls: 12" thick wall: 2#4 @16" o.c. E.W.; $\rho = 0.0021 < 0.0025$  The spacing <= 18".  Building has low seismic demands. Judged okay for Life-Safety.
<b>CONNECTIONS</b>				
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.6.2.1 TRANSFER TO SHEAR WALLS: Diaphragms shall be connected for transfer of loads to the shear walls for Life Safety and the connections shall be able to develop the lesser of the shear strength of the walls or diaphragms for Immediate Occupancy.	Rebar from slab dowels into concrete shear walls.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.6.3.5 FOUNDATION DOWELS: Wall reinforcement shall be doweled into the foundation for Life Safety and the dowels shall be able to develop the lesser of the strength of the walls or the uplift capacity of the foundation for Immediate Occupancy.	Rebar dowels into foundation match vertical rebar in shear walls.

\* – Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.

Building Name: **Building 836A**

Date: **July 30, 2003**

Building Address: **Lawrence Livermore National Laboratory**

Page: **1** of **2**

Job Number: **A20047.08**

Job Name: **LLNL Prioritization**

By: **JYF** Checked: **JEH**

## ASCE 31\* SUPPLEMENTAL CHECKLIST C2: CONCRETE SHEAR WALL BUILDINGS WITH RIGID OR STIFF DIAPHRAGMS

C	NC	N/A		Comments
<b>LATERAL-FORCE-RESISTING SYSTEM</b>				
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	4.4.1.6.2 DEFLECTION COMPATIBILITY: Secondary components shall have the shear capacity to develop the flexural strength of the components for Life Safety and shall meet the requirements of 4.4.1.4.9, 4.4.1.4.10, 4.4.1.4.11, 4.4.1.4.12 and 4.4.1.4.15 for Immediate Occupancy.	1'-3" x 1'-3" columns have (4)#7 vertical rebar and 2#2 ties @ 12" o.c. The shear capacity is not adequate to develop the flexural strength of the column.  Building has low seismic demands. Judge okay for Life-Safety.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.4.1.6.3 FLAT SLABS: Flat slabs/plates not part of lateral-force-resisting system shall have continuous bottom steel through the column joints for Life Safety.	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.4.2.2.3 COUPLING BEAMS: The stirrups in coupling beams over means of egress shall be spaced at or less than $d/2$ and shall be anchored into the confined core of the beam with hooks of 135° or more for Life Safety. All coupling beams shall comply with the requirements above and shall have the capacity in shear to develop the uplift capacity of the adjacent wall for Immediate Occupancy.	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.4.2.2.4 OVERTURNING: All shear walls shall have aspect ratios less than 4 to 1. Wall piers need not be considered. This statement shall apply to the Immediate Occupancy Performance Level only.	Life Safety Performance Level.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.4.2.2.5 CONFINEMENT REINFORCING: For shear walls with aspect ratios greater than 2 to 1, the boundary elements shall be confined with spirals or ties with spacing less than $8d_b$ . This statement shall apply to the Immediate Occupancy Performance Level only.	Life Safety Performance Level.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.4.2.2.6 REINFORCING AT OPENINGS: There shall be added trim reinforcement around all wall openings greater than three times the thickness of the wall. This statement shall apply to the Immediate Occupancy Performance Level only.	Life Safety Performance Level.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.4.2.2.7 WALL THICKNESS: Thickness of bearing walls shall not be less than 1/25 the unsupported height or length, whichever is shorter, nor less than 4". This statement shall apply to the Immediate Occupancy Performance Level only.	Life Safety Performance Level.
<b>DIAPHRAGMS</b>				
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.5.1.1 DIAPHRAGM CONTINUITY: The diaphragms shall not be composed of split-level floors and shall not have expansion joints.	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.5.1.4 OPENINGS AT SHEAR WALLS: Diaphragm openings immediately adjacent to the shear walls shall be less than 25% of the wall length for Life Safety and 15% of the wall length for Immediate Occupancy.	
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.5.1.7 PLAN IRREGULARITIES: There shall be tensile capacity to develop the strength of the diaphragm at re-entrant corners or other locations of plan irregularities. This statement shall apply to the Immediate Occupancy Performance Level only.	Life Safety Performance Level.

Building Name: **Building 850**

 Date: **July 29, 2003**

 Building Address: **Lawrence Livermore National Laboratory**

 Page: **1** of **1**

 Job Number: **A20047.08**

 Job Name: **LLNL Prioritization**

 By: **JYF** Checked: **JEH**

## PRIORITIZATION BUILDING DATA SHEET

### BUILDING DATA

Year Built:	1960	Year(s) Remodeled:	None	UBC Zone:	4 – Type B Near Field
Area (sf):	6,200	Length (ft):	90	Width (ft):	61
No. Stories:	1	Story Height:	15'	Total Height:	15'

### CONSTRUCTION DATA

Gravity Load Structural System: 12" thick LWC flat slab supported on concrete beams. The concrete beams span to concrete columns in the interior or are supported by 8" to 2'-0" thick reinforced concrete shear walls.

Exterior Transverse Walls: 8" to 2'-0" thick reinforced concrete shear walls      Openings?: Door and window openings

Exterior Longitudinal Walls: 8" to 2'-0" thick reinforced concrete shear walls      Openings?: Door and window openings

Roof Framing: 12" thick LWC flat slab

Intermediate Floor Framing: None

Ground Floor: 8" to 10" concrete slab on grade w/ #4 @ 10" o.c. min. E.W.

Columns: 1'-6" x 1'-6" concrete columns

Foundation: Concrete strip footing or thickened slab

### LATERAL-FORCE-RESISTING SYSTEM

	Longitudinal	Transverse
System Classification:	Type 9 (Concrete Shear Wall Building w/ Stiff Diaphragm)	Type 9 (Concrete Shear Wall Building w/ Stiff Diaphragm)
Vertical Elements:	Concrete flat slab, concrete beams and columns, concrete shear walls	Concrete flat slab, concrete beams and columns, concrete shear walls
Diaphragms:	12" thick concrete flat slab	12" thick concrete flat slab

SEISMIC EVALUATION PERFORMED? Yes      EVALUATION: Rapid Evaluation      YEAR: 2003

SEISMIC EVALUATION CRITERIA: Life Safety/ ASCE 31-02

VULNERABILITY RATING: 3  
 (1=low to 10=high)

PRIORITIZATION CLASSIFICATION: CLASS D

### POTENTIAL LIFE SAFETY DEFICIENCIES:

THIS BUILDING WAS EVALUATED FOR THE 10% IN 50 YR. EARTHQUAKE.

None.

### PRELIMINARY STRENGTHENING SCHEMES OR MITIGATION MEASURES:

None.

Building Name: Building 850

Date: July 29, 2003

Building Address: Lawrence Livermore National Laboratory

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Job Number: A20047.08

Job Name: LLNL Prioritization

By: JYF Checked: JEH

## ASCE 31\* BASIC CHECKLIST C2: CONCRETE SHEAR WALL BUILDINGS WITH RIGID OR STIFF DIAPHRAGMS

C	NC	N/A		Comments
<b>BUILDING SYSTEM</b>				
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.1.1 LOAD PATH: The structure shall contain a minimum of one complete load path for Life Safety and Immediate Occupancy for seismic force effects from any horizontal direction that serves to transfer the inertial forces from the mass to the foundation.	12" thick LWC flat slab supported on concrete beams. The concrete beams spa to concrete columns in the interior or are supported by 8" to 2'-0" thick reinforced concrete shear walls. The shear walls are doweled into the foundation system.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.1.3 MEZZANINES: Interior mezzanine levels shall be braced independently from the main structure, or shall be anchored to the lateral-force-resisting elements of the main structure.	The mezzanine level is bolted to concrete shear walls on all sides.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.1 WEAK STORY: The strength of the lateral-force-resisting system in any story shall not be less than 80% of the strength in an adjacent story above or below for Life-Safety and Immediate Occupancy.	One story building.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.2 SOFT STORY: The stiffness of the lateral-force-resisting-system in any story shall not be less than 70% of the lateral-force-resisting system stiffness in an adjacent story above or below, or less than 80% of the average lateral-force-resisting system stiffness of the three stories above or below for Life Safety and Immediate Occupancy.	One story building.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.3 GEOMETRY: There shall be no changes in horizontal dimension of the lateral-force-resisting system of more than 30% in a story relative to adjacent stories for Life Safety and Immediate Occupancy, excluding one-story penthouses and mezzanines.	One story building.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.2.4 VERTICAL DISCONTINUITIES: All vertical elements in the lateral-force-resisting system shall be continuous to the foundation.	The shear walls are doweled into the foundation system.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.2.5 MASS: There shall be no change in effective mass of more than 50% from one story to the next for Life Safety and Immediate Occupancy. Light roofs, penthouses and mezzanines need not be considered.	One story building.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.2.6 TORSION: The estimated distance between the story center of mass and the story center of rigidity shall be less than 20% of the building width in either plan dimension for Life Safety and Immediate Occupancy.	Concrete shear walls around the perimeter of the building.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.3.4 DETERIORATION OF CONCRETE: There shall be no visible deterioration of concrete or reinforcing steel in any of the vertical- or lateral-force-resisting elements.	Site visit made on 8/19/03. No signs of deterioration were observed.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.3.5 POST-TENSIONING ANCHORS: There shall be no evidence of corrosion or spalling in the vicinity of post-tensioning or end fittings. Coil anchors shall not have been used.	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.3.9 CONCRETE WALL CRACKS: All existing diagonal cracks in wall elements shall be less than 1/8" for Life Safety and 1/16" for Immediate Occupancy, shall not be concentrated in one location, and shall not form an X pattern.	Site visit made on 8/19/03. There are no cracks >1/8".

Building Name: **Building 850**

 Date: **July 29, 2003**

 Building Address: **Lawrence Livermore National Laboratory**

 Page: **2** of **2**

 Job Number: **A20047.08** Job Name: **LLNL Prioritization**

 By: **JYF** Checked: **JEH**

## ASCE 31\* BASIC CHECKLIST C2: CONCRETE SHEAR WALL BUILDINGS WITH RIGID OR STIFF DIAPHRAGMS

C	NC	N/A		Comments
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### LATERAL-FORCE-RESISTING SYSTEM

- |                                     |                                     |                          |  |  |
|-------------------------------------|-------------------------------------|--------------------------|--|--|
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/> | 4.4.1.6.1 COMPLETE FRAMES: Steel or concrete frames classified as secondary components shall form a complete vertical load carrying system.  |  |
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/> | 4.4.2.1.1 REDUNDANCY: The number of lines of shear walls in each principal direction shall be greater than or equal to 2 for Life Safety and Immediate Occupancy.  | There are at least 2 lines of resistance in each direction of loading.   |
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/> | 4.4.2.2.1 SHEAR STRESS CHECK: The shear stress in the concrete shear walls, calculated using the Quick Check procedure of Section 3.5.3.3, shall be less than 100 psi or $2\sqrt{f'_c}$ for Life Safety and Immediate Occupancy.   | The maximum shear stress is 65 psi < 100 psi. Note: $2\sqrt{f'_c} = 100$ psi for $f'_c = 2,500$ psi.   |
| <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input type="checkbox"/> | 4.4.2.2.2 REINFORCING STEEL: The ratio of reinforcing steel area to gross concrete area shall be not less than 0.0015 in the vertical direction and 0.0025 in the horizontal direction for Life Safety and Immediate Occupancy. The spacing of reinforcing steel shall be equal to or less than 18" for Life Safety and Immediate Occupancy. | Typ. reinforcement in reinforced concrete walls:<br>8" thick wall:<br>vertical: #4 @12" o.c.; $\rho = 0.0021 > 0.0015$<br>horizontal: #4 @9" o.c.; $\rho = 0.0028 > 0.0025$<br>12" thick wall: 2#4 @12" o.c. E.W.; $\rho = 0.0028 > 0.0025$<br>24" thick wall: 2#5@6" o.c. vertical and 2#5 @ 12" o.c. horizontal; $\rho = 0.00215 < 0.0025$<br><br>The spacing <= 18".<br><br>Seismic demands are low. Judged okay for Life-Safety. |

### CONNECTIONS

- |                                     |                          |                          |   |   |
|-------------------------------------|--------------------------|--------------------------|---|---|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 4.6.2.1 TRANSFER TO SHEAR WALLS: Diaphragms shall be connected for transfer of loads to the shear walls for Life Safety and the connections shall be able to develop the lesser of the shear strength of the walls or diaphragms for Immediate Occupancy. | Rebar from slab dowels into concrete shear walls.                 |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 4.6.3.5 FOUNDATION DOWELS: Wall reinforcement shall be doweled into the foundation for Life Safety and the dowels shall be able to develop the lesser of the strength of the walls or the uplift capacity of the foundation for Immediate Occupancy.      | Rebar dowels into foundation match vertical rebar in shear walls. |

\* - Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.

Building Name: Building 850

Date: July 29, 2003

Building Address: Lawrence Livermore National Laboratory

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Job Number: A20047.08

Job Name: LLNL Prioritization

By: JYF Checked: JEH

## ASCE 31\* BASIC CHECKLIST C2: CONCRETE SHEAR WALL BUILDINGS WITH RIGID OR STIFF DIAPHRAGMS

C	NC	N/A		Comments
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### LATERAL-FORCE-RESISTING SYSTEM

- |                                     |                                     |                          |  |  |
|-------------------------------------|-------------------------------------|--------------------------|--|--|
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/> | 4.4.1.6.1 COMPLETE FRAMES: Steel or concrete frames classified as secondary components shall form a complete vertical load carrying system.  |  |
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/> | 4.4.2.1.1 REDUNDANCY: The number of lines of shear walls in each principal direction shall be greater than or equal to 2 for Life Safety and Immediate Occupancy.  | There are at least 2 lines of resistance in each direction of loading.   |
| <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/> | 4.4.2.2.1 SHEAR STRESS CHECK: The shear stress in the concrete shear walls, calculated using the Quick Check procedure of Section 3.5.3.3, shall be less than 100 psi or $2\sqrt{f'_c}$ for Life Safety and Immediate Occupancy.   | The maximum shear stress is 65 psi < 100 psi. Note: $2\sqrt{f'_c} = 100$ psi for $f'_c = 2,500$ psi.   |
| <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input type="checkbox"/> | 4.4.2.2.2 REINFORCING STEEL: The ratio of reinforcing steel area to gross concrete area shall be not less than 0.0015 in the vertical direction and 0.0025 in the horizontal direction for Life Safety and Immediate Occupancy. The spacing of reinforcing steel shall be equal to or less than 18" for Life Safety and Immediate Occupancy. | Typ. reinforcement in reinforced concrete walls:<br>8" thick wall:<br>vertical: #4 @12" o.c.; $\rho = 0.0021 > 0.0015$<br>horizontal: #4 @9" o.c.; $\rho = 0.0028 > 0.0025$<br>12" thick wall: 2#4 @12" o.c. E.W.; $\rho = 0.0028 > 0.0025$<br>24" thick wall: 2#5@6" o.c. vertical and 2#5 @ 12" o.c. horizontal; $\rho = 0.00215 < 0.0025$<br><br>The spacing <= 18".<br><i>SEISMIC DEMANDS ARE LOW, JUDGED OK FOR LIFE-S,</i> |

### CONNECTIONS

- |                                     |                          |                          |   |   |
|-------------------------------------|--------------------------|--------------------------|---|---|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 4.6.2.1 TRANSFER TO SHEAR WALLS: Diaphragms shall be connected for transfer of loads to the shear walls for Life Safety and the connections shall be able to develop the lesser of the shear strength of the walls or diaphragms for Immediate Occupancy. | Rebar from slab dowels into concrete shear walls.                 |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 4.6.3.5 FOUNDATION DOWELS: Wall reinforcement shall be doweled into the foundation for Life Safety and the dowels shall be able to develop the lesser of the strength of the walls or the uplift capacity of the foundation for Immediate Occupancy.      | Rebar dowels into foundation match vertical rebar in shear walls. |

\* - Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.

Building Name: **Building 850**

Date: **July 29, 2003**

Building Address: **Lawrence Livermore National Laboratory**

Page: **1** of **2**

Job Number: **A20047.08**

Job Name: **LLNL Prioritization**

By: **JYF**

Checked: **JEH**

## ASCE 31\* SUPPLEMENTAL CHECKLIST C2: CONCRETE SHEAR WALL BUILDINGS WITH RIGID OR STIFF DIAPHRAGMS

**C NC N/A**

**Comments**

### LATERAL-FORCE-RESISTING SYSTEM

- |                          |                                     |                                     |  |  |
|--------------------------|-------------------------------------|-------------------------------------|--|--|
| <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <p>4.4.1.6.2 DEFLECTION COMPATIBILITY: Secondary components shall have the shear capacity to develop the flexural strength of the components for Life Safety and shall meet the requirements of 4.4.1.4.9, 4.4.1.4.10, 4.4.1.4.11, 4.4.1.4.12 and 4.4.1.4.15 for Immediate Occupancy.</p>  | <p>1'-6" x 1'-6" columns have (8)#7 vertical rebar and 2#2 ties @ 12" o.c. The shear capacity is not adequate to develop the flexural strength of the column.</p> <p>Seismic demands are low. Judged okay for Life-Safety.</p> |
| <input type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <p>4.4.1.6.3 FLAT SLABS: Flat slabs/plates not part of lateral-force-resisting system shall have continuous bottom steel through the column joints for Life Safety.</p>  |  |
| <input type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <p>4.4.2.2.3 COUPLING BEAMS: The stirrups in coupling beams over means of egress shall be spaced at or less than <math>d/2</math> and shall be anchored into the confined core of the beam with hooks of <math>135^\circ</math> or more for Life Safety. All coupling beams shall comply with the requirements above and shall have the capacity in shear to develop the uplift capacity of the adjacent wall for Immediate Occupancy.</p> |  |
| <input type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <p>4.4.2.2.4 OVERTURNING: All shear walls shall have aspect ratios less than 4 to 1. Wall piers need not be considered. This statement shall apply to the Immediate Occupancy Performance Level only.</p>  | <p>Life Safety Performance Level.</p>  |
| <input type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <p>4.4.2.2.5 CONFINEMENT REINFORCING: For shear walls with aspect ratios greater than 2 to 1, the boundary elements shall be confined with spirals or ties with spacing less than <math>8d_b</math>. This statement shall apply to the Immediate Occupancy Performance Level only.</p>   | <p>Life Safety Performance Level.</p>  |
| <input type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <p>4.4.2.2.6 REINFORCING AT OPENINGS: There shall be added trim reinforcement around all wall openings greater than three times the thickness of the wall. This statement shall apply to the Immediate Occupancy Performance Level only.</p>   | <p>Life Safety Performance Level.</p>  |
| <input type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <p>4.4.2.2.7 WALL THICKNESS: Thickness of bearing walls shall not be less than <math>1/25</math> the unsupported height or length, whichever is shorter, nor less than 4". This statement shall apply to the Immediate Occupancy Performance Level only.</p>   | <p>Life Safety Performance Level.</p>  |

### DIAPHRAGMS

- |                                     |                          |                                     |   |                                       |
|-------------------------------------|--------------------------|-------------------------------------|---|---------------------------------------|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | <p>4.5.1.1 DIAPHRAGM CONTINUITY: The diaphragms shall not be composed of split-level floors and shall not have expansion joints.</p>  |                                       |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | <p>4.5.1.4 OPENINGS AT SHEAR WALLS: Diaphragm openings immediately adjacent to the shear walls shall be less than 25% of the wall length for Life Safety and 15% of the wall length for Immediate Occupancy.</p>  |                                       |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <p>4.5.1.7 PLAN IRREGULARITIES: There shall be tensile capacity to develop the strength of the diaphragm at re-entrant corners or other locations of plan irregularities. This statement shall apply to the Immediate Occupancy Performance Level only.</p> | <p>Life Safety Performance Level.</p> |



Building Name: Building 850

Date: July 29, 2003

Building Address: Lawrence Livermore National Laboratory

Page: 2 of 2

Job Number: A20047.08

Job Name: LLNL Prioritization

By: JYF Checked: JEH

**ASCE 31\* SUPPLEMENTAL CHECKLIST C2: CONCRETE SHEAR WALL BUILDINGS WITH RIGID OR STIFF DIAPHRAGMS**

C NC N/A Comments

**DIAPHRAGMS**

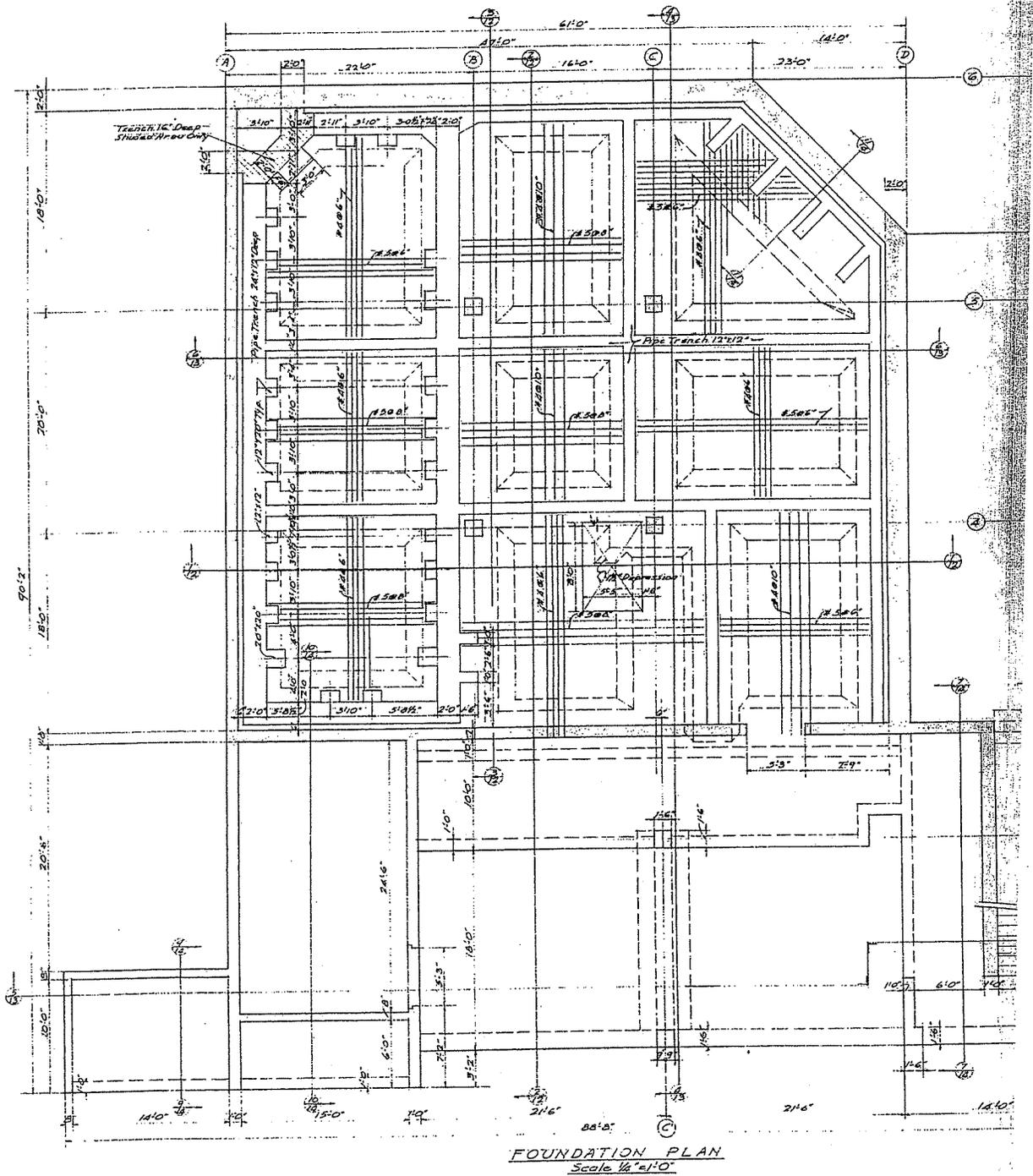
- 4.5.1.8 DIAPHRAGM REINFORCEMENT AT OPENINGS: There shall be reinforcing around all diaphragm openings larger than 50% of the building width in either major plan dimension. This statement shall apply to the Immediate Occupancy Performance Level only. Life Safety Performance Level.

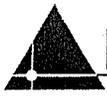
**CONNECTIONS**

- 4.6.3.10 UPLIFT AT PILE CAPS: Pile caps shall have top reinforcement and piles shall be anchored to the pile caps for Life Safety, and the pile cap reinforcement and pile anchorage shall be able to develop the tensile capacity of the piles for Immediate Occupancy.

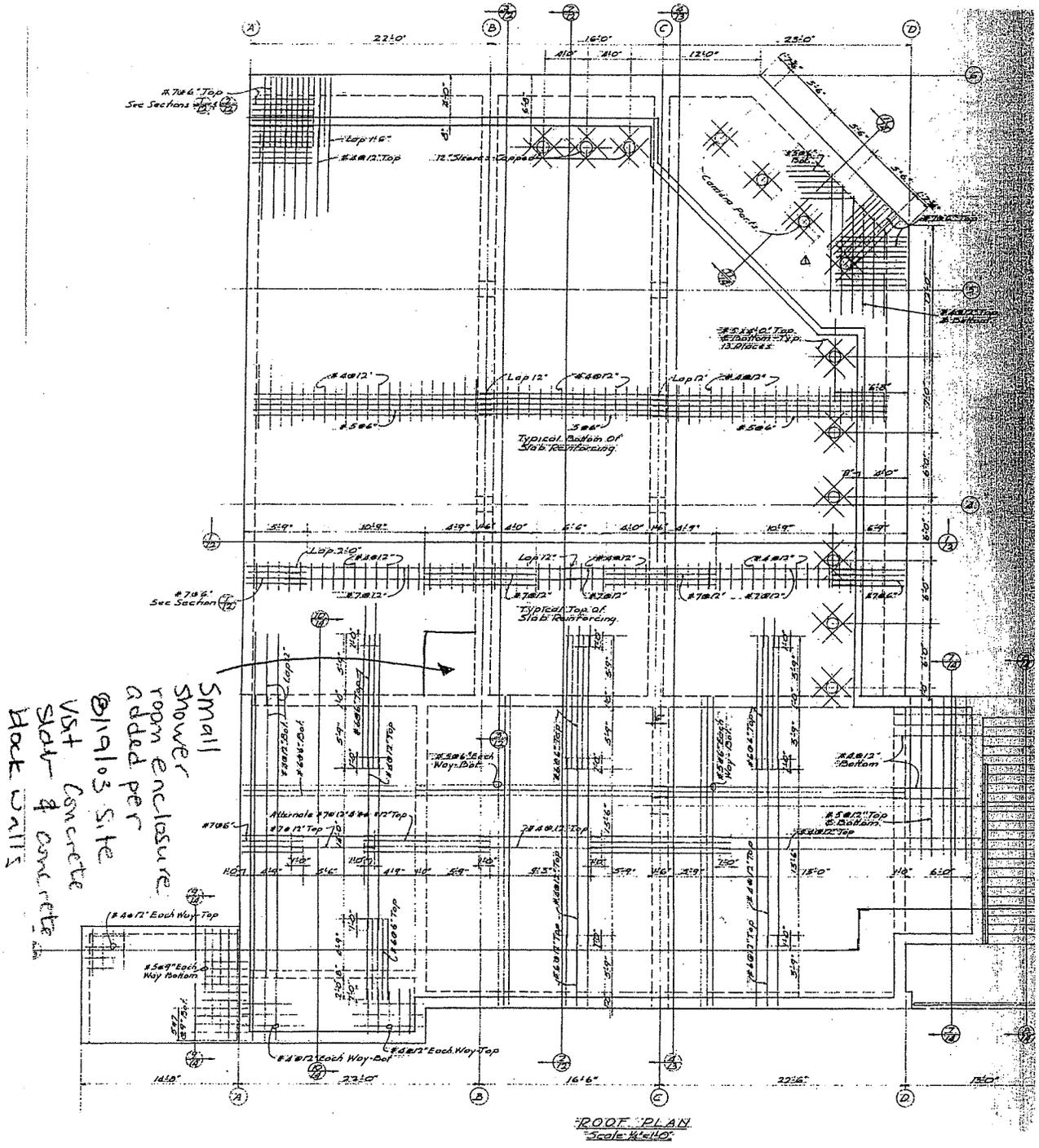
\* – Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.

# BUILDING PLAN





**ROOF PLAN**



Building Name: Building 851 Date: August 20, 2003  
 Building Address: Lawrence Livermore National Laboratory Page: 1 of 1  
 Job Number: A20047.08 Job Name: LLNL Prioritization By: JYF Checked: JEH

## PRIORITIZATION BUILDING DATA SHEET

### BUILDING DATA

Year Built:	1960	Year(s) Remodeled:	None	UBC Zone:	4 – Type B Near Field
Area (sf):	10,800	Length (ft):	87	Width (ft):	124
No. Stories:	2	Story Height:	~13'	Total Height:	27'

### CONSTRUCTION DATA

Gravity Load Structural System: 9" to 12" concrete flat slab supported by concrete beams, which span to interior concrete columns or interior and exterior 12" to 3'-0" concrete shear walls

Exterior Transverse Walls: 12" to 3'-0" thick reinforced concrete shear walls	Openings?: Door and window openings
Exterior Longitudinal Walls: 12" to 3'-0" thick reinforced concrete shear walls	Openings?: Door and window openings

Roof Framing: 9" thick flat slab supported by concrete beams typical, 12" thick flat slab at high roof

Intermediate Floor Framing: @ mezzanines: 1/4" checked plate supported by WF beams. The WF beams are embedded and bolted to the concrete shear walls on 4 side.

Ground Floor: 8" concrete slab on grade w/ #4 @ 10" o.c. E.W. typical

Columns: 14" x 16" concrete columns  
 Foundation: Concrete strip footing or thickened slab

### LATERAL-FORCE-RESISTING SYSTEM

	Longitudinal	Transverse
System Classification:	Type 9 (Concrete Shear Wall Building w/ Stiff Diaphragm)	Type 9 (Concrete Shear Wall Building w/ Stiff Diaphragm)
Vertical Elements:	Concrete flat slab, concrete beams and columns, concrete shear walls	Concrete flat slab, concrete beams and columns, concrete shear walls
Diaphragms:	9" to 12" thick flat slab	9" to 12" thick flat slab

**SEISMIC EVALUATION PERFORMED?** Yes **EVALUATION:** Rapid Evaluation **YEAR:** 2003

**SEISMIC EVALUATION CRITERIA:** Life Safety/ ASCE 31-02

**VULNERABILITY RATING:** 3  
 (1=low to 10=high)

**PRIORITIZATION CLASSIFICATION:** CLASS D

#### POTENTIAL LIFE SAFETY DEFICIENCIES:

THIS BUILDING WAS EVALUATED FOR THE 10% IN 50 YR. EARTHQUAKE.

None.

#### PRELIMINARY STRENGTHENING SCHEMES OR MITIGATION MEASURES:

None.

Building Name: **Building 851**

Date: **August 20, 2003**

Building Address: **Lawrence Livermore National Laboratory**

Page: **1** of **2**

Job Number: **A20047.08**

Job Name: **LLNL Prioritization**

By: **JYF** Checked: **JEH**

## ASCE 31\* BASIC CHECKLIST C2: CONCRETE SHEAR WALL BUILDINGS WITH RIGID OR STIFF DIAPHRAGMS

C	NC	N/A		Comments
<b>BUILDING SYSTEM</b>				
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.1.1 LOAD PATH: The structure shall contain a minimum of one complete load path for Life Safety and Immediate Occupancy for seismic force effects from any horizontal direction that serves to transfer the inertial forces from the mass to the foundation.	9" or 12" thick flat slab supported on concrete beams. The concrete beams span to concrete columns in the interior or are supported by 12" to 3'-0 thick reinforced concrete shear walls. The shear walls are doweled into the foundation system.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.1.3 MEZZANINES: Interior mezzanine levels shall be braced independently from the main structure, or shall be anchored to the lateral-force-resisting elements of the main structure.	The two mezzanines are supported by steel beams, which are embedded into the main buildings concrete shear walls. Note: At mechanical equipment room 4, the mezzanine floor consists of metal grating. The grating is connected to the WF beams below with clips only.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.2.1 WEAK STORY: The strength of the lateral-force-resisting system in any story shall not be less than 80% of the strength in an adjacent story above or below for Life-Safety and Immediate Occupancy.	Shear walls continue to the foundation.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.2.2 SOFT STORY: The stiffness of the lateral-force-resisting-system in any story shall not be less than 70% of the lateral-force-resisting system stiffness in an adjacent story above or below, or less than 80% of the average lateral-force-resisting system stiffness of the three stories above or below for Life Safety and Immediate Occupancy.	Shear walls continue to the foundation.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.2.3 GEOMETRY: There shall be no changes in horizontal dimension of the lateral-force-resisting system of more than 30% in a story relative to adjacent stories for Life Safety and Immediate Occupancy, excluding one-story penthouses and mezzanines.	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.2.4 VERTICAL DISCONTINUITIES: All vertical elements in the lateral-force-resisting system shall be continuous to the foundation.	The shear walls are doweled into the foundation system.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.2.5 MASS: There shall be no change in effective mass of more than 50% from one story to the next for Life Safety and Immediate Occupancy. Light roofs, penthouses and mezzanines need not be considered.	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.2.6 TORSION: The estimated distance between the story center of mass and the story center of rigidity shall be less than 20% of the building width in either plan dimension for Life Safety and Immediate Occupancy.	Shear walls all along perimeter of building.
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4.3.3.4 DETERIORATION OF CONCRETE: There shall be no visible deterioration of concrete or reinforcing steel in any of the vertical- or lateral-force-resisting elements.	Site visit made on 8/20/03. No signs of deterioration were observed.
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	4.3.3.5 POST-TENSIONING ANCHORS: There shall be no evidence of corrosion or spalling in the vicinity of post-tensioning or end fittings. Coil anchors shall not have been used.	

Building Name: **Building 851**

Date: **August 20, 2003**

Building Address: **Lawrence Livermore National Laboratory**

Page: **2** of **2**

Job Number: **A20047.08**

Job Name: **LLNL Prioritization**

By: **JYF** Checked: **JEH**

## ASCE 31\* BASIC CHECKLIST C2: CONCRETE SHEAR WALL BUILDINGS WITH RIGID OR STIFF DIAPHRAGMS

C	NC	N/A		Comments
---	----	-----	--	----------

### BUILDING SYSTEM

- |                                     |                          |                          |   |  |
|-------------------------------------|--------------------------|--------------------------|---|--|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <b>4.3.3.9 CONCRETE WALL CRACKS:</b> All existing diagonal cracks in wall elements shall be less than 1/8" for Life Safety and 1/16" for Immediate Occupancy, shall not be concentrated in one location, and shall not form an X pattern. | Site visit made on 8/20/03. There are no cracks >1/8". |
|-------------------------------------|--------------------------|--------------------------|---|--|

### LATERAL-FORCE-RESISTING SYSTEM

- |                                     |                          |                          |   |  |
|-------------------------------------|--------------------------|--------------------------|---|--|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <b>4.4.1.6.1 COMPLETE FRAMES:</b> Steel or concrete frames classified as secondary components shall form a complete vertical load carrying system.  |  |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <b>4.4.2.1.1 REDUNDANCY:</b> The number of lines of shear walls in each principal direction shall be greater than or equal to 2 for Life Safety and Immediate Occupancy.  | There are at least 2 lines of resistance in each direction of loading.   |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <b>4.4.2.2.1 SHEAR STRESS CHECK:</b> The shear stress in the concrete shear walls, calculated using the Quick Check procedure of Section 3.5.3.3, shall be less than 100 psi or $2\sqrt{f'c}$ for Life Safety and Immediate Occupancy.  | The maximum shear stress in the concrete block wall is 59 psi < 100 psi. Note: $2\sqrt{f'c} = 110$ psi for $f'c = 3,000$ psi.  |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <b>4.4.2.2.2 REINFORCING STEEL:</b> The ratio of reinforcing steel area to gross concrete area shall be not less than 0.0015 in the vertical direction and 0.0025 in the horizontal direction for Life Safety and Immediate Occupancy. The spacing of reinforcing steel shall be equal to or less than 18" for Life Safety and Immediate Occupancy. | Typ. reinforcement in reinforced concrete walls:<br>12" thick wall: min. #4 @12" E.F. o.c.; $\rho = 0.0028 > 0.0025$<br>2' thick wall: min. #5 @10" o.c. E.F.; $\rho = 0.0026 > 0.0025$<br>3' thick wall: min. #5@6" o.c. E.F.; $\rho = 0.0029 > 0.0025$<br><br>The spacing < 18". |

### CONNECTIONS

- |                                     |                          |                          |  |   |
|-------------------------------------|--------------------------|--------------------------|--|---|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <b>4.6.2.1 TRANSFER TO SHEAR WALLS:</b> Diaphragms shall be connected for transfer of loads to the shear walls for Life Safety and the connections shall be able to develop the lesser of the shear strength of the walls or diaphragms for Immediate Occupancy. | Rebar from slab dowels into concrete shear walls. |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <b>4.6.3.5 FOUNDATION DOWELS:</b> Wall reinforcement shall be doweled into the foundation for Life Safety and the dowels shall be able to develop the lesser of the strength of the walls or the uplift capacity of the foundation for Immediate Occupancy.      | Rebar dowels into foundation. #4 @ 8" typ.        |

\* - Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.

Building Name: **Building 851**

Date: **August 20, 2003**

Building Address: **Lawrence Livermore National Laboratory**

Page: **1** of **2**

Job Number: **A20047.08** Job Name: **LLNL Prioritization**

By: **JYF** Checked: **JEH**

## ASCE 31\* SUPPLEMENTAL CHECKLIST C2: CONCRETE SHEAR WALL BUILDINGS WITH RIGID OR STIFF DIAPHRAGMS

C	NC	N/A		Comments
---	----	-----	--	----------

### LATERAL-FORCE-RESISTING SYSTEM

- |                          |                                     |                                     |  |   |
|--------------------------|-------------------------------------|-------------------------------------|--|---|
| <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <p>4.4.1.6.2 DEFLECTION COMPATIBILITY: Secondary components shall have the shear capacity to develop the flexural strength of the components for Life Safety and shall meet the requirements of 4.4.1.4.9, 4.4.1.4.10, 4.4.1.4.11, 4.4.1.4.12 and 4.4.1.4.15 for Immediate Occupancy.</p>  | <p><b>1'-2" x 1'-4" columns have (6)#8 vertical rebar and 2#3 ties @ 14" o.c. The shear capacity is not adequate to develop the flexural strength of the column.</b></p> <p>Seismic demands are low. Judged okay for Life-Safety.</p> |
| <input type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <p>4.4.1.6.3 FLAT SLABS: Flat slabs/plates not part of lateral-force-resisting system shall have continuous bottom steel through the column joints for Life Safety.</p>  |   |
| <input type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <p>4.4.2.2.3 COUPLING BEAMS: The stirrups in coupling beams over means of egress shall be spaced at or less than <math>d/2</math> and shall be anchored into the confined core of the beam with hooks of 135° or more for Life Safety. All coupling beams shall comply with the requirements above and shall have the capacity in shear to develop the uplift capacity of the adjacent wall for Immediate Occupancy.</p> |   |
| <input type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <p>4.4.2.2.4 OVERTURNING: All shear walls shall have aspect ratios less than 4 to 1. Wall piers need not be considered. This statement shall apply to the Immediate Occupancy Performance Level only.</p>  | <p><b>Life Safety Performance Level.</b></p>  |
| <input type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <p>4.4.2.2.5 CONFINEMENT REINFORCING: For shear walls with aspect ratios greater than 2 to 1, the boundary elements shall be confined with spirals or ties with spacing less than <math>8d_b</math>. This statement shall apply to the Immediate Occupancy Performance Level only.</p>   | <p><b>Life Safety Performance Level.</b></p>  |
| <input type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <p>4.4.2.2.6 REINFORCING AT OPENINGS: There shall be added trim reinforcement around all wall openings greater than three times the thickness of the wall. This statement shall apply to the Immediate Occupancy Performance Level only.</p>   | <p><b>Life Safety Performance Level.</b></p>  |
| <input type="checkbox"/> | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <p>4.4.2.2.7 WALL THICKNESS: Thickness of bearing walls shall not be less than 1/25 the unsupported height or length, whichever is shorter, nor less than 4". This statement shall apply to the Immediate Occupancy Performance Level only.</p>  | <p><b>Life Safety Performance Level.</b></p>  |

### DIAPHRAGMS

- |                                     |                          |                                     |   |  |
|-------------------------------------|--------------------------|-------------------------------------|---|--|
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | <p>4.5.1.1 DIAPHRAGM CONTINUITY: The diaphragms shall not be composed of split-level floors and shall not have expansion joints.</p>  |  |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/>            | <p>4.5.1.4 OPENINGS AT SHEAR WALLS: Diaphragm openings immediately adjacent to the shear walls shall be less than 25% of the wall length for Life Safety and 15% of the wall length for Immediate Occupancy.</p>  |  |
| <input type="checkbox"/>            | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <p>4.5.1.7 PLAN IRREGULARITIES: There shall be tensile capacity to develop the strength of the diaphragm at re-entrant corners or other locations of plan irregularities. This statement shall apply to the Immediate Occupancy Performance Level only.</p> | <p><b>Life Safety Performance Level.</b></p> |



Building Name: Building 851

Date: August 20, 2003

Building Address: Lawrence Livermore National Laboratory

Page: 2 of 2

Job Number: A20047.08

Job Name: LLNL Prioritization

By: JYF Checked: JEH

## ASCE 31\* SUPPLEMENTAL CHECKLIST C2: CONCRETE SHEAR WALL BUILDINGS WITH RIGID OR STIFF DIAPHRAGMS

C	NC	N/A	Comments
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### DIAPHRAGMS

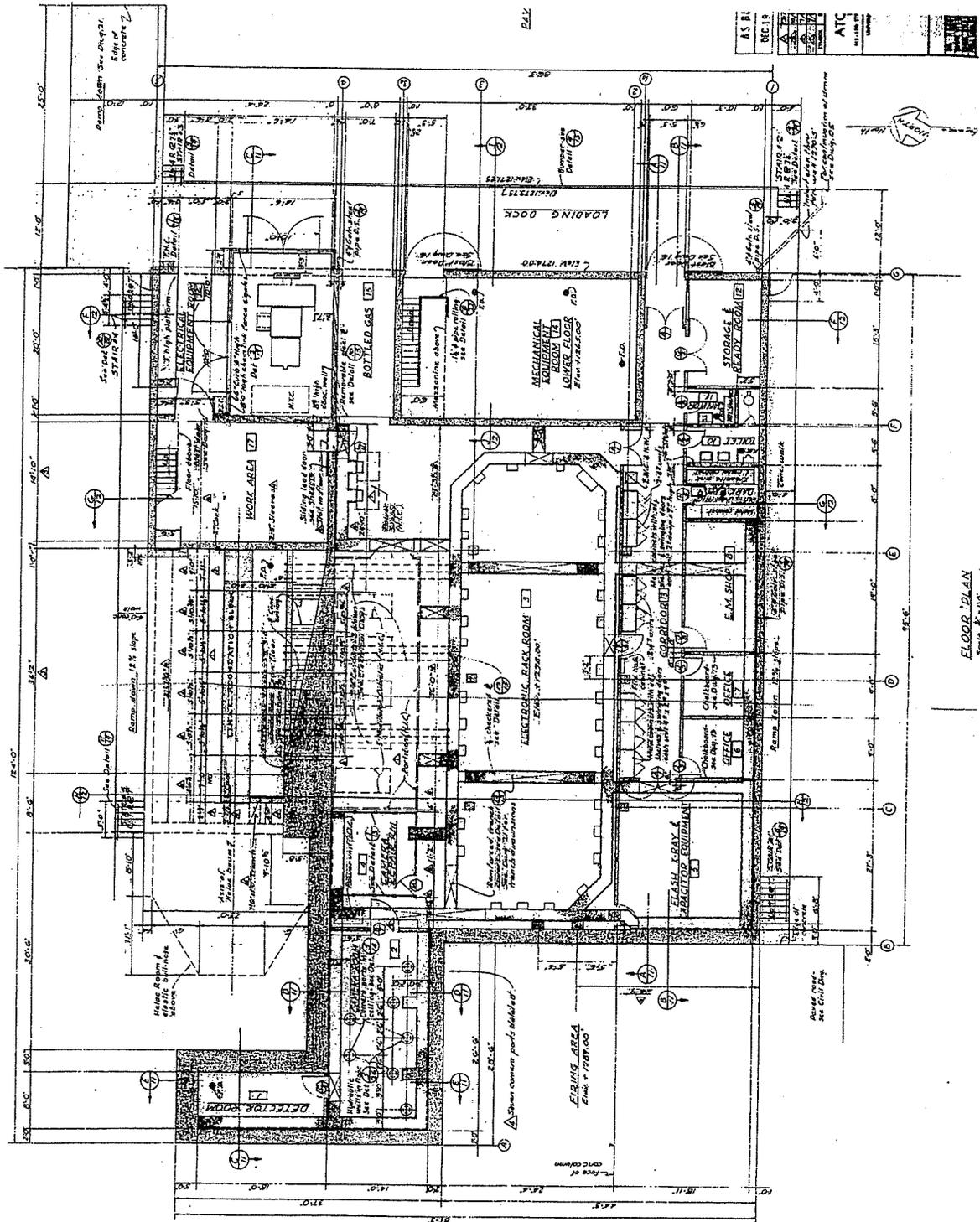
- |                          |                          |                                     |   |                                |
|--------------------------|--------------------------|-------------------------------------|---|--------------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.5.1.8 DIAPHRAGM REINFORCEMENT AT OPENINGS: There shall be reinforcing around all diaphragm openings larger than 50% of the building width in either major plan dimension. This statement shall apply to the Immediate Occupancy Performance Level only. | Life Safety Performance Level. |
|--------------------------|--------------------------|-------------------------------------|---|--------------------------------|

### CONNECTIONS

- |                          |                          |                                     |  |  |
|--------------------------|--------------------------|-------------------------------------|--|--|
| <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | 4.6.3.10 UPLIFT AT PILE CAPS: Pile caps shall have top reinforcement and piles shall be anchored to the pile caps for Life Safety, and the pile cap reinforcement and pile anchorage shall be able to develop the tensile capacity of the piles for Immediate Occupancy. |  |
|--------------------------|--------------------------|-------------------------------------|--|--|

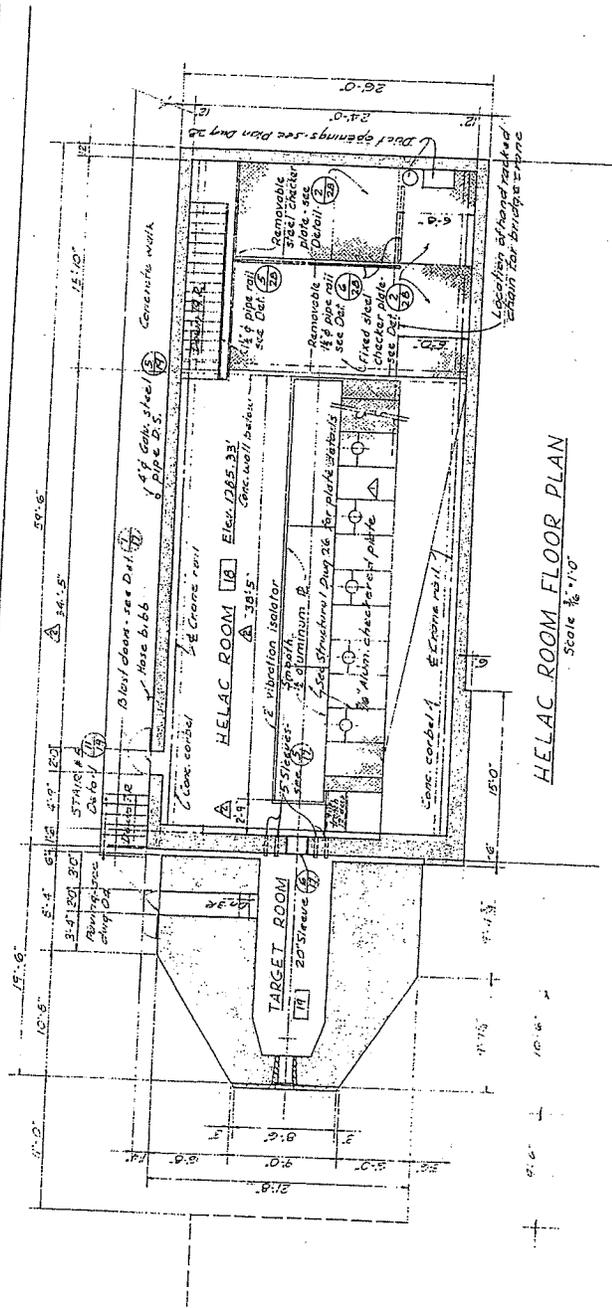
\* - Checklist statements are based on the second public ballot version of ASCE 31. This checklist will be updated as revisions are made to ASCE 31.

# BUILDING PLAN





BUILDING PLAN

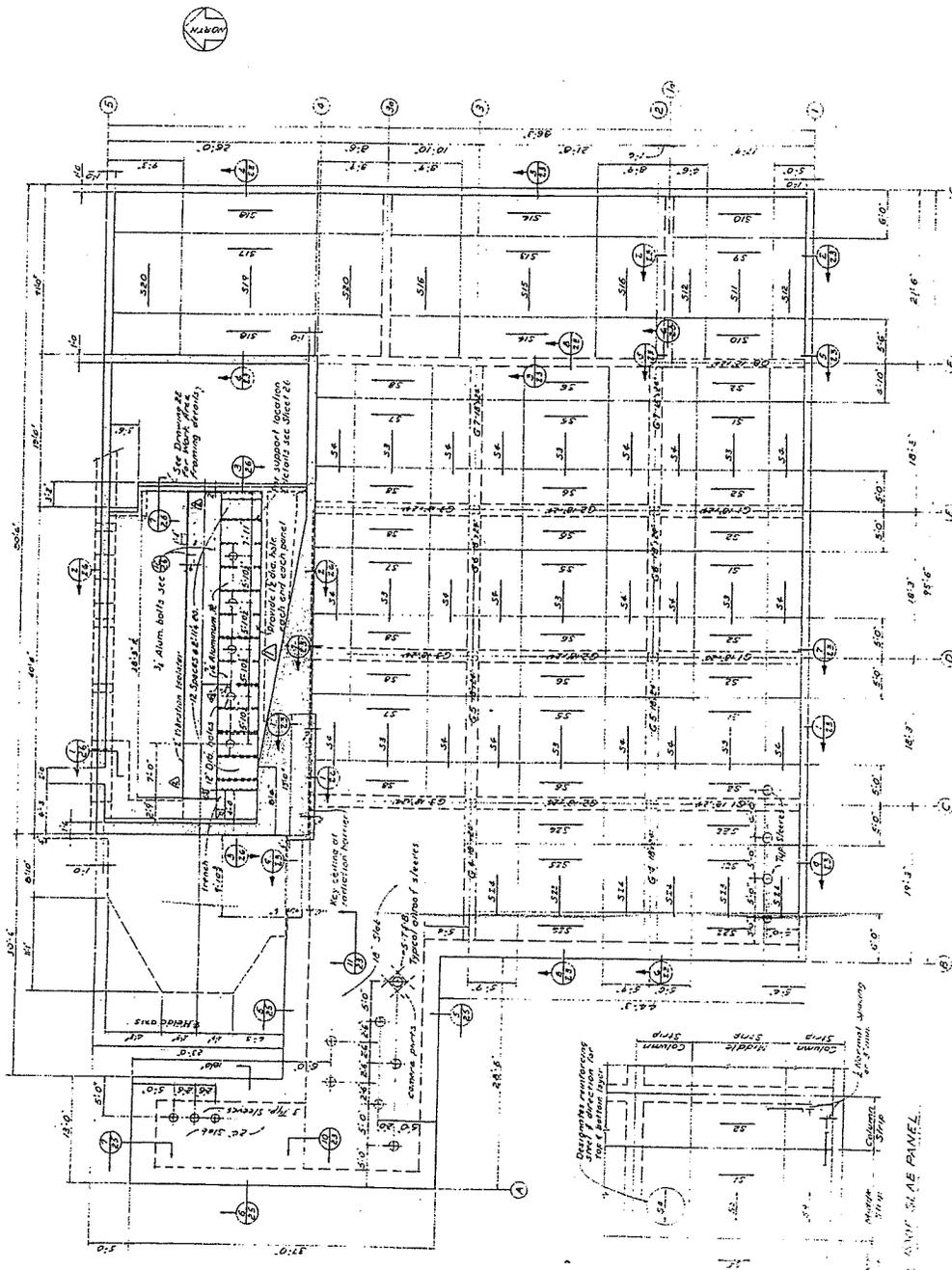


HELAC ROOM FLOOR PLAN

Scale 1/8" = 1'-0"



## ROOF PLAN



## Appendix D      Cost Projections



Subject: Cost Projection Job Number: A20047.08 Date: 09/30/03  
 Job: LLNL By: JEH Section: Appendix D  
 Checked By: Page/of: 1 of 1

Seismic Strengthening Cost Projection for 41 Tier I Evaluated Buildings (90 Building Sectors)  
 Basis for Cost Projection: FEMA 156 & 157  
**Cost Projections for 57 Non-Exempt Building Sectors (33 Building Sectors are Exempt with no Strengthening Required)**

Organized by Seismic Priority Classification	Description	Building Number	Year Built	No. of Stories	ASCE 31 Designation	ASCE 31 Model Building Type	Size (sf)	FEMA-156 Building Group	Building Size	Mean Structural Cost / SF	Mean Nonstructural Cost / SF	Mean Architectural-Finishing Cost / SF	Mean Project PM Cost / SF	Mean Total Project Cost / SF	Total Project Cost	Total Project Cost (75% Confidence Upper Bound) = Mean Tot Proj Cost * 2.88	Percent of Total
A	Highest Priority																
B	High Priority	435	1960	3	S2A	4	32,000	6	MEDIUM	\$13.06	\$4.10	\$5.47	\$6.79	\$29.41	\$941,033	\$2,710,000	9.2%
		115	1954	1	RM1	13	11,600	3	MEDIUM	\$24.19	\$4.10	\$5.47	\$10.13	\$43.88	\$508,985	\$1,466,000	5.0%
		115, Addition	1985	1	RM1	13	2,000	3	SMALL	\$25.54	\$4.10	\$5.47	\$10.53	\$45.64	\$91,282	\$263,000	0.9%
		116	1958	2	C2	9	7,500	8	SMALL	\$30.98	\$4.10	\$5.47	\$12.16	\$52.71	\$395,311	\$1,138,000	3.9%
		166C	1961	1	URM	15	1,345	1	SMALL	\$24.90	\$4.10	\$5.47	\$10.34	\$44.80	\$60,261	\$174,000	0.6%
		253, Increment 2	1964	1	RM2	14	20,900	8	MEDIUM	\$30.14	\$4.10	\$5.47	\$11.91	\$51.62	\$1,078,850	\$3,107,000	10.6%
		326	1953	2	W1	1	3,386	2	SMALL	\$19.22	\$4.10	\$5.47	\$8.64	\$37.42	\$126,711	\$365,000	1.2%
		327	1959	4	S2	4	18,200	6	MEDIUM	\$13.06	\$4.10	\$5.47	\$6.79	\$29.41	\$535,212	\$1,541,000	5.3%
		806	1958	1	C2A	9	2,650	8	SMALL	\$30.98	\$4.10	\$5.47	\$12.16	\$52.71	\$139,676	\$402,000	1.4%
C	Medium Priority	41 Warehouse	1969	1	S3	5	19,346	6	MEDIUM	\$13.06	\$4.10	\$5.47	\$6.79	\$29.41	\$568,913	\$1,638,000	5.6%
		281, Original	1956	1	RM2	14	5,400	8	SMALL	\$30.98	\$4.10	\$5.47	\$12.16	\$52.71	\$284,624	\$820,000	2.8%
		519A	1953	1	S3	5	5,760	6	SMALL	\$13.76	\$4.10	\$5.47	\$7.00	\$30.32	\$174,623	\$503,000	1.7%
		810A	1958	1	C2	9	3,500	8	SMALL	\$30.98	\$4.10	\$5.47	\$12.16	\$52.71	\$184,478	\$531,000	1.8%
		810C	1982	1	RM2	14	900	8	SMALL	\$30.98	\$4.10	\$5.47	\$12.16	\$52.71	\$47,437	\$137,000	0.5%
		826	1961	1	C2	9	2,200	8	SMALL	\$30.98	\$4.10	\$5.47	\$12.16	\$52.71	\$115,958	\$334,000	1.1%
		827E	1965	1	C2	9	3,222	8	SMALL	\$30.98	\$4.10	\$5.47	\$12.16	\$52.71	\$169,825	\$489,000	1.7%
		827D	1965	1	C2	9	3,222	8	SMALL	\$30.98	\$4.10	\$5.47	\$12.16	\$52.71	\$169,825	\$489,000	1.7%
		827C	1965	1	C2	9	3,222	8	SMALL	\$30.98	\$4.10	\$5.47	\$12.16	\$52.71	\$169,825	\$489,000	1.7%
		827A	1965	2	C2	9	4,489	8	SMALL	\$30.98	\$4.10	\$5.47	\$12.16	\$52.71	\$236,607	\$681,000	2.3%
		836D	??	1	C2	9	2,500	8	SMALL	\$30.98	\$4.10	\$5.47	\$12.16	\$52.71	\$131,770	\$379,000	1.3%
		870	1958	1	W1	1	3,890	2	SMALL	\$19.22	\$4.10	\$5.47	\$8.64	\$37.42	\$145,571	\$419,000	1.4%
		115, Magnetic Vault	1985	1	RM1	13	1,025	3	SMALL	\$25.54	\$4.10	\$5.47	\$10.53	\$45.64	\$46,782	\$135,000	0.5%
		117B	1959	1	RM1	13	7,400	3	SMALL	\$25.54	\$4.10	\$5.47	\$10.53	\$45.64	\$337,745	\$973,000	3.3%
		233	1960	1	RM1	13	4,900	3	SMALL	\$25.54	\$4.10	\$5.47	\$10.53	\$45.64	\$223,642	\$644,000	2.2%
		362	1964	1	RM1	13	3,749	3	SMALL	\$25.54	\$4.10	\$5.47	\$10.53	\$45.64	\$171,109	\$493,000	1.7%
		363	1965	1	RM1	13	1,584	3	SMALL	\$25.54	\$4.10	\$5.47	\$10.53	\$45.64	\$72,296	\$208,000	0.7%
		515	1966	1	S3	5	4,372	6	SMALL	\$13.76	\$4.10	\$5.47	\$7.00	\$30.32	\$132,544	\$382,000	1.3%
		809	1958	1	C2	9	2,289	8	SMALL	\$30.98	\$4.10	\$5.47	\$12.16	\$52.71	\$120,649	\$347,000	1.2%
		818A	1964	1	C2A	9	1,300	8	SMALL	\$30.98	\$4.10	\$5.47	\$12.16	\$52.71	\$68,521	\$197,000	0.7%
		833	1959	1	C2A	9	2,050	8	SMALL	\$30.98	\$4.10	\$5.47	\$12.16	\$52.71	\$108,052	\$311,000	1.1%
		836B	1970	1	C2	9	4,900	8	SMALL	\$30.98	\$4.10	\$5.47	\$12.16	\$52.71	\$258,270	\$744,000	2.5%
		41 Office Area	1969	1	W2	2	4,175	2	SMALL	\$19.22	\$4.10	\$5.47	\$8.64	\$37.42	\$156,237	\$450,000	1.5%
165, Annex	??	1	C2	9	1,000	8	SMALL	\$30.98	\$4.10	\$5.47	\$12.16	\$52.71	\$52,708	\$152,000	0.5%		
322	1962	1	RM1	13	5,789	3	SMALL	\$25.54	\$4.10	\$5.47	\$10.53	\$45.64	\$264,217	\$761,000	2.6%		
4675	1979	1	W2	2	8,720	2	SMALL	\$19.22	\$4.10	\$5.47	\$8.64	\$37.42	\$326,320	\$940,000	3.2%		
D	Lowest Priority	166D	??	1	S3	5	4,000	6	SMALL	\$0.00	\$4.10	\$5.47	\$2.87	\$12.43	\$49,737	\$143,000	0.5%
		166A	??	1	S3	5	3,200	6	SMALL	\$0.00	\$4.10	\$5.47	\$2.87	\$12.43	\$39,790	\$115,000	0.4%
		292	1979	1	C2	9	19,200	8	MEDIUM	\$0.00	\$4.10	\$5.47	\$2.87	\$12.43	\$238,737	\$688,000	2.3%
		519B	1982	1	S3	5	3,200	6	SMALL	\$0.00	\$4.10	\$5.47	\$2.87	\$12.43	\$39,790	\$115,000	0.4%
		810B	1982	1	C2	9	900	8	SMALL	\$0.00	\$4.10	\$5.47	\$2.87	\$12.43	\$11,191	\$32,000	0.1%
		836A	1957	1	C2	9	1,300	8	SMALL	\$0.00	\$4.10	\$5.47	\$2.87	\$12.43	\$16,165	\$47,000	0.2%
		850	1960	1	C2	9	6,200	8	SMALL	\$0.00	\$4.10	\$5.47	\$2.87	\$12.43	\$77,092	\$222,000	0.8%
		851	1960	2	C2	9	10,800	8	MEDIUM	\$0.00	\$4.10	\$5.47	\$2.87	\$12.43	\$134,290	\$387,000	1.3%
		817F	1958	1	C2	9	300	8	SMALL	\$0.00	\$4.10	\$5.47	\$2.87	\$12.43	\$3,730	\$11,000	0.0%
		817C	1958	1	C2	9	300	8	SMALL	\$0.00	\$4.10	\$5.47	\$2.87	\$12.43	\$3,730	\$11,000	0.0%
		817A	1958	1	C2	9	400	8	SMALL	\$0.00	\$4.10	\$5.47	\$2.87	\$12.43	\$4,974	\$14,000	0.0%
		253, Original	1959	1	RM1	13	4,800	3	SMALL	\$0.00	\$4.10	\$5.47	\$2.87	\$12.43	\$59,684	\$172,000	0.6%
		253, Addition	??	1	RM1	13	5,000	3	SMALL	\$0.00	\$4.10	\$5.47	\$2.87	\$12.43	\$62,171	\$179,000	0.6%
		281, Increment 2	1958	1	RM1	13	8,400	3	SMALL	\$0.00	\$4.10	\$5.47	\$2.87	\$12.43	\$104,448	\$301,000	1.0%
		281, Addition	1991	1	RM1	13	4,256	3	SMALL	\$0.00	\$4.10	\$5.47	\$2.87	\$12.43	\$52,920	\$152,000	0.5%
		298	1982	1	PC1	11	47,764	3	MEDIUM	\$0.00	\$4.10	\$5.47	\$2.87	\$12.43	\$593,909	\$1,710,000	5.8%
		802A	1958	1	C2	9	2,300	8	SMALL	\$0.00	\$4.10	\$5.47	\$2.87	\$12.43	\$28,599	\$82,000	0.3%
		812E	1961	1	C2	9	1,200	8	SMALL	\$0.00	\$4.10	\$5.47	\$2.87	\$12.43	\$14,921	\$43,000	0.1%
		825	1959	1	C2	9	1,323	8	SMALL	\$0.00	\$4.10	\$5.47	\$2.87	\$12.43	\$16,450	\$47,000	0.2%
		851C	??	1	C2	9	1,000	8	SMALL	\$0.00	\$4.10	\$5.47	\$2.87	\$12.43	\$12,434	\$36,000	0.1%
Group Subtotal:														\$10,200,000	\$11,400,000	100.0%	

## Appendix E      Proposal and Statement of Work



San Francisco  
Los Angeles  
Portland  
**Oakland**  
San Diego  
Seattle

June 30, 2003

Ms. Eileen Nasto  
Contract Administrator Specialist  
University of California  
Lawrence Livermore National Laboratory  
P.O. Box 5012  
Livermore, California 94551

Reference: **Request for Proposal**  
**FEMA 310 Seismic Evaluation of 41 Buildings**  
**Blanket Agreement No. H615700**  
**[Degenkolb Job Number – A20047.08]**

Dear Eileen:

We are pleased to respond to the request for proposal dated June 20, 2003, regarding the FEMA 310 Tier I evaluations of 41 buildings at Lawrence Livermore National Laboratory.

We have in-depth knowledge of buildings at Lawrence Livermore National Laboratory. We assisted LLNL with seismic screening of the building inventory to meet the requirements of Executive Order 12941. We performed detailed seismic evaluations and prepared recommendations for seismic strengthening for many buildings, including B131, B151, B231, B239, B241, B391 and B511.

Most recently, we assisted LLNL in establishing a prioritization system for seismic mitigation of buildings that do not meet the minimum requirements of Executive Order 12941; these buildings are identified as "non-exempt" buildings. At this time, there are 85 non-exempt buildings at LLNL. Forty-four of those buildings have been evaluated in the past and based on the type and extent of seismic deficiencies have been prioritized into one of the following categories: "Highest Priority", "High Priority", "Medium Priority", and "Lowest Priority". See Attachment A. Forty-one of those buildings have not been evaluated in the past, and therefore have not been prioritized.

The purpose of this project is to perform seismic evaluations of the 41 non-evaluated buildings in accordance with the Tier I screening evaluation procedure using FEMA 310 "Handbook for the Seismic Evaluation of Buildings – A Prestandard". The buildings will then be prioritized based on the type and extent of seismic deficiencies, consistent with criteria and methodology used in previous evaluations. Cost projections for seismic mitigation will be prepared based on FEMA 156 and 157, and a summary report of findings will be prepared.

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In addition to our past work at LLNL, we have assisted other building owners in performing seismic evaluations and developing prioritization programs for seismic strengthening, including the Veterans Administration, Kaiser Permanente, Hewlett-Packard, and the University of California at Berkeley. This experience combined with our in depth knowledge of the buildings at LLNL makes us well qualified to assist LLNL with this important project.

### **Scope of Work**

We will perform our work in accordance with the Statement of Work contained in the RFP for the following buildings:

#### LLNL Main Site:

- Buildings 41, 115, 116, 117, 165, 166, 233, 253, 281, 292, 298, 322, 326, 327, 362, 363, 435, 515, 519, 3203, and 4675.

#### LLNL Site 300:

- Buildings 802A, 805, 806, 807, 809, 810, 812, 817, 818, 825, 826, 827A, 827C, 827D, 827E, 833, 836, 850, 851, and 870.

See Attachment B for available information on the size and building system for each of the 41 buildings included in this project.

We propose to perform the following tasks:

1. Attend project kick-off meeting with LLNL project team.
2. Coordinate with LLNL personnel to obtain drawings for each of the 41 buildings identified in the Statement of Work. The drawings will be the basis for the seismic evaluations.
3. Review drawings and collect general building information using the Prioritization Building Data Sheet. This involves gathering general building data (size, number of stories, year of construction etc.), and construction data (gravity system, lateral system, wall system, and foundation system description). This Data Sheet will also be used to prioritize potential seismic deficiencies.

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4. Perform a Tier I screening evaluation in accordance with FEMA 310 procedures. The purpose of this evaluation is to identify potential seismic deficiencies in the building without performing a detailed seismic evaluation. An understanding of the potential seismic deficiencies within each building will be the basis for prioritizing each building as part of the LLNL seismic mitigation program.
5. Perform a walkthrough of each of the 41 buildings. We understand that there may be limited access to certain buildings or areas within the buildings. The intent of the walkthrough is to confirm that the available drawings properly identify the extent of the building, and to observe whether significant building modifications have occurred.
6. Prioritize each of the 41 buildings into one of the following categories:
  - **“Highest Priority Buildings”**: Buildings that are “Exceptionally High Risk” and require evaluation and mitigation of seismic deficiencies in accordance with RP6. In accordance with EO 12941, exceptionally high risk buildings are defined on the basis that a) they have a structural system known to be especially vulnerable to earthquake induced damage, or b) they have a combination of high occupancy and high seismic risk in accordance with Approach A in the DOE Management Plan. *We expect none of the 41 buildings will be placed in this classification.*
  - **“High Priority Buildings”**: Buildings that do not meet Life Safety and have the potential to sustain heavy damage and possibly local collapse in a major earthquake, but some margin against total collapse based on observed behavior of similar buildings in past earthquakes. *We expect a small number of the 41 buildings will be placed in this classification.*
  - **“Medium Priority Buildings”**: Buildings that do not meet Life Safety and may incur life threatening level of damage, with collapse not likely. *We expect approximately 50% of the 41 buildings will be placed in this classification.*
  - **“Lowest Priority Buildings”**: Buildings that do not have structural Life Safety deficiencies, but have potential nonstructural deficiencies. . *We expect approximately 50% of the 41 buildings will be placed in this classification.*

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7. Prepare cost projections for the seismic mitigation of the 41 buildings using FEMA 156 and 157 methodology. Cost projections are based on an accumulation of data regarding actual costs of strengthening buildings collected by FEMA. The FEMA 156/157 methodology presents costs on a dollar per square foot basis depending on level of ground shaking, desired performance level, building size and lateral system type. The cost projections are adjusted based on the level of certainty desired. We will present the average cost of strengthening and the cost of strengthening to obtain a 90% confidence level.
8. Prepare a Draft Report of findings.
9. Meet with LLNL to review draft report.
10. Obtain LLNL comments and prepare final report.

The prioritization of the 41 buildings into the four categories will be consistent with the methodology used for prioritization of the 44 buildings that we have previously evaluated. The prioritization goes beyond the FEMA 310 Tier I evaluations and is based on the expected damage state of each building following a major earthquake.

We assume that each of the 41 buildings contains one building sector to be evaluated. We have not included time to evaluate multiple independent building sectors within each of the 41 buildings. Nonstructural evaluations are not included.

### **Personnel**

Jorn E. Halle will be the Principal and project manager and will be assisted by Darrick Hom, who will be the lead engineer. Joyce Feng, Gina Sandoval and Allen Kwan will be design engineers. Chris D. Poland will serve as project mentor, providing in-house consultation and review. Resumes for each team member is attached.

All employees of Degenkolb Engineers that will be working on this project are United States citizens.

Ms. Feng, Ms. Sandoval, and Mr. Kwan are California licensed Professional Engineers and have considerable experience in the evaluation of existing buildings.

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Mr. Halle, Mr. Hom and Mr. Poland are California licensed Structural Engineers and have extensive experience in the seismic evaluation and mitigation of existing buildings. Mr. Poland, with the assistance of Mr. Hom, led the project to develop FEMA 310 and then to turn it into an American Society of Civil Engineer Standard ASCE 31.

### **Compensation**

We propose to perform our work on a fixed fee basis for \$112,000 in accordance with our Blanket Agreement Number H615700 with LLNL. We estimate that our reimbursable expenses will be in the range of \$500 for creating copies of the report, mail, and mileage to LLNL. Attached is a fee worksheet showing a breakdown of our effort.

We intend to use five labor categories titled Senior Principal, Principal, Project Engineer, Design Engineer, and Engineering Administrator. Hourly billing rates are in accordance with our Blanket Agreement.

We will not submit or deliver to the University any proprietary technical data.

We will complete a draft Report delivered to LLNL by the end of September. We expect that LLNL will take two weeks to review the report so that we can submit the Final Report by October 30, 2003. We assume that work will start on Monday July 7, 2003



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We appreciate the opportunity to be of continued service to LLNL. Please contact us immediately if you need additional information or clarification.

Very truly yours,  
DEGENKOLB ENGINEERS

Jorn E. Halle  
Principal, S. E. 3966

Chris D. Poland  
Senior Principal, S. E. 2336

ACCEPTED:

**Lawrence Livermore National Laboratory**

BY:

---

DATE:

---

PURCHASE ORDER OR  
REFERENCE NUMBER:

---



The following Degenkolb Engineers' personnel are licensed by the  
California Board for Professional Engineers and Land Surveyors  
(Effective February 3, 2003)

Allen, Michael G.	Horne, James P.	Poland, Chris D.
Ayroso, Anna Marie V.	Hsueh, Yu J.	Pugliesi, Raymond S.
Barnard, Matthew P.	Johnston, Kirk A.	Razzano, Holly J.
Bartoletti, Stacy J.	Johnston, Laurie K.	Redlinger, Mark J.
Bischoff, Carrie E.	Knight, Brian T.	Roggenkamp, David A.
Bonneville, David R.	Kwan, Allen	Rost, Kimiko M.
Chang, Shih-Po	LaPlante, Ronald W.	Rubbo, Antonio
Cole, Craig A.	Lewis, Jared	Sandoval, Gina M.
Dal Pino, John A.	Liu, James B.	Scott, Andrew N.
Feng, Joyce Y.	Love, Richard J.	Sinclair, Kenneth M.
Franco, Richard	Low, Wayne A.	Smith, Christopher J.
Gallant, Sharon M.	Madden, Glenn J.	Stept, Noah J.
Gonzalez, David	Maffei, Janiele	Stillwell, Katherine A.
Graff, Robert M.	Maline-Brown, Suzanne	Thompson, Christopher
Graves, Martin R.	Malley, James O.	Tovani, Robert M.
Greco, Adam M.	McDonald, John S.	Walsh, John
Grogan, William	Miller, James A.	Weir, Randall E.
Guyader, Brenda A.	Mitchell, Andrew D.	Williams, Taryn M.
Hall, Gretchen E.	Nacamuli, Adrian M.	Woodgate, Jeremy P.
Halle, Jorn E.	Nilles, David	Wosser, Thomas D.
Heintz, Jon A.	Noel, Shane N.	Wyllie, Loring A.
Hernandez, Ricardo R.	Parra, Rogelio	
Hom, Darrick B.	Pekelnicky, Robert G.	

This information is provided pursuant to section 138 of the  
Business and Professions Code and Title 16, Chapter 5  
California Code of Regulations section 463.5.

**Appendix F      Degenkolb Engineers Letter Dated June 6, 2003**



June 6, 2003

Mr. Dave Coats  
University of California  
Lawrence Livermore National Laboratory  
P.O. Box 5502  
Livermore, California 94551

Reference: **Seismic Mitigation and Prioritization Study**  
**Release KXM0001 under Blanket Agreement H615700**  
**Lawrence Livermore National Laboratory**  
**[Degenkolb Job Number A20047.02]**

Dear Dave:

We enjoyed meeting with you and Mr. Frank Tokarz to discuss the seismic mitigation program for existing buildings at Lawrence Livermore National Laboratory. The purpose of this letter is to summarize our discussion on key issues regarding the seismic mitigation program, including:

- Basis for "Exempt" status of buildings in the 1998 Executive Order 12941 Report,
- Regulatory requirements to mitigate structural deficiencies in "Non-Exempt" buildings,
- Description of expected performance and damage state of buildings that are "Non-exempt" and,
- Recommendations for evaluations to better define cost of seismic strengthening for high priority "Non-Exempt" buildings.

### **Background**

The seismic mitigation program at LLNL was initiated in 1996 to meet the requirements of Executive Order 12941 (EO 12941) dated December 1, 1994. EO 12941, titled *Seismic Safety of Federally Owned or Leased Buildings*, required each federal agency to develop an inventory of its buildings and to estimate costs of mitigating unacceptable seismic risks in those buildings. In September 1998, LLNL submitted to the Department of Energy an electronic database with building inventory information and a report titled "Supporting Documentation on the Implementation of EO 12941". A summary report titled *Seismic Evaluation for Compliance with Executive Order 12941*, was prepared by Degenkolb in October 1998.

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June 6, 2003

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EO 12941 also required the development of standards for the seismic rehabilitation of Federal Buildings. RP4, titled *Standards of Seismic Safety for Existing Federally Owned or Leased Buildings* was developed by the Interagency Committee on Seismic Safety in Construction (ICSSC) as the minimum technical standard for evaluation and mitigation of seismic risks. This Standard was recently updated to incorporate new knowledge in earthquake engineering gained from research and from observed performance of structures in recent earthquakes. RP6, *Standards of Seismic Safety for Federally Owned and Leased Buildings*, dated January 18, 2002 is the revision to RP4.

RP6 is the current Federal regulatory Standard that provides common minimum requirements for the seismic safety of existing Federal buildings. The primary objective of the Standards is to reduce the life-safety risk to occupants and to the public. Therefore, Life-Safety is defined as the minimum performance level appropriate for Federal Buildings. Life-Safety building performance is described as "building performance that includes significant damage to both structural and nonstructural components during the design earthquake, though at least some margin against either partial or total structural collapse remains. Injuries may occur, but the level of risk for life threatening injury and entrapment is low. People will likely be unable to reoccupy the building for continuous use until structural repairs are completed."

RP6 Standards include:

- Criteria for defining buildings as "exempt" from the Standards,
- Definition of situations that trigger the need for seismic evaluation and mitigation of existing Federal buildings,
- Minimum standards for the seismic evaluation of existing buildings,
- Minimum standards for the seismic mitigation of existing buildings, and
- Requirement that each Agency develop standards for performance levels higher than life-safety

The work to comply with the EO12941 requirements and prepare the 1998 report had four components, including the building inventory, building evaluation, cost estimation, and reporting.

1. The inventory phase included collecting building data for all buildings at LLNL. Buildings meeting the requirements of RP4 and the DOE Management Plan were identified as "exempt" from seismic evaluation and mitigation. The remaining buildings were identified as "non-exempt". This exempt status means that they are judged to be adequate from a seismic safety perspective and need no further consideration.

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2. The evaluation phase included the evaluation of a sample of non-exempt building representative of the building stock at LLNL, along with several buildings having the potential of being classified as Exceptionally High Risk. Most of the buildings evaluated were required to meet the Life-Safety performance level (PC1), and a few were evaluated for higher performance levels (PC2/PC3). The majority of PC1 buildings had a rapid Tier 1 or a detailed Tier 2 evaluation performed. The majority of PC2/PC3 buildings were not evaluated, although we expect that many will likely meet Life-Safety requirements if evaluations are performed.
3. The cost estimation phase included development of cost projections for the seismic mitigation of all non-exempt buildings using the methodology of FEMA 156 and 157, *Typical Costs for Seismic Rehabilitation of Existing Buildings*.
4. The report phase included development of an electronic database with building inventory information following the requirements of E012941, and a report titled "Supporting Documentation on the Implementation of EO 12941", dated September 1998.

Subsequent to your 1998 report, the seismic mitigation program at LLNL has evolved as building functions have changed and seismic evaluation and mitigation work has continued. This has resulted in changes in the status of a number of exempt and non-exempt buildings. At the time of the 1998 E012941 report, there were a total of 534 buildings included in the facility database. Of those buildings, 449 are currently identified as exempt and 85 are non-exempt.

### **Exempt Buildings**

The criteria used at LLNL to define buildings as "exempt" from seismic evaluation and mitigation were taken directly from the Federal Standard RP4 and the DOE Management Plan. These exemptions are valid and represent that these buildings meet Life-Safety performance in the judgement of the ICSSC. These exemptions are based on earthquake engineering research and observation of building performance in past earthquakes. Buildings that are "exempt" do not require further evaluation or mitigation to comply with the minimum Federal Standard for seismic safety of existing Federal buildings. RP6 uses similar exemptions.

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The 449 exempt buildings at LLNL have been classified based on the following nine categories:

Exemption E1: There are 21 buildings classified as intended for incidental human occupancy, or occupied by persons for a total of less than two hours a day. The low potential that any one building will collapse, combined with the low occupancy within these structures results in a very low life safety risk.

Exemption E2: There are zero buildings classified as detached family dwellings in an area of low seismicity.

Exemption E3: There are 81 small one story buildings of steel light frame or wood construction with an area less than 3000 square feet. Performance of these types of buildings is very similar to modern residential construction found in the United States. Observed performance of these structures in past earthquakes is very good with respect to the life safety performance level.

Exemption E4: There are 14 buildings that have been previously strengthened to meet RP4 requirements for life safety protection or better and are therefore acceptable.

Exemption E5: There are 306 buildings designed and constructed in accordance with seismic provisions that are considered by Federal Standard RP4 to provide life-safety protection. RP4 defines "benchmark" years for each building code that are considered to result in a building that meets a Life Safety performance level. The benchmark year is dependent on the code and the type of construction. This definition is largely based on observed behavior of buildings in past earthquakes and a knowledge of when modern detailing practices were introduced into codes.

Exemption E6: There are 16 buildings that have been evaluated and meet "life-safety" protection standards. Seven buildings were evaluated by Degenkolb and nine buildings were evaluated by Engle & Engle prior to 1994. We recommend a re-evaluation of the buildings to confirm the Engle & Engle findings, because the evaluations were based on University of California Evaluation criteria, which is different from the E012941 criteria.

Exemption E8: There are 8 buildings as of year 2001 scheduled for abandonment or demolition within the next five years. This timeframe for removal of the deficiency is consistent with the timeframe to seismically strengthen an existing building and is therefore judged to be acceptable.

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See attachment A for identification of specific buildings classified by exemption category.

### **Non-Exempt Buildings**

There are currently eighty-five "non-exempt" buildings on the LLNL campus. These buildings require seismic evaluation to confirm their level of deficiency, and some will require seismic mitigation, in order to meet the Federal Standards seismic safety of existing buildings. These buildings define the extent of the seismic mitigation program at LLNL. See attachment B for a summary of the recommended LLNL seismic mitigation program.

### ***Regulatory Requirements For Seismic Mitigation of Non-Exempt Buildings:***

RP6 currently mandates seismic rehabilitation only if a building is considered to be an "exceptionally high risk" or if certain trigger events occur. Such events include changes in facility use, major building alterations, or when the building experiences earthquake related damage. The extent of mandated seismic mitigation work is therefore low (4 out of 85 buildings) relative to the overall extent of work in the LLNL seismic mitigation program.

RP6 states that as a minimum, a building shall be evaluated and unacceptable risks mitigated when any of the following occur:

1. a change in function results in a significant increase in the building's level of use, importance, or occupancy,
2. a project is planned which significantly extends the building's useful life through alterations or repairs which total more than 30% of the replacement value of the building,
3. the building or part of the building has been damaged by fire, wind, earthquake, or other cause to the extent that significant structural degradation of the vertical or lateral capacity has occurred,
4. the building is deemed to be exceptionally high risk to occupants or the public at large, or
5. the building is added to the Federal inventory through purchase or donation after.

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The majority of the seismic mitigation work at LLNL is left to the discretion LLNL and the DOE (81 out of 85 buildings). The duration of the program will likely depend on the availability of funding, resources, schedule to perform the rehabilitation work, and opportunity planning to coincide with other work. To be most effective, the program should be based on a prioritization system. Based on our past conversations, we understand that at LLNL prioritization will be based on seismic performance and building occupancy level.

***Seismic Mitigation Recommendations for Non-Exempt Buildings:***

In our recent meetings, we identified five classes of buildings at LLNL that require seismic evaluation and mitigation. The 85 non-exempt buildings are placed in one of the five building classes (Class A-E) depending on the severity of the seismic vulnerability and whether the buildings have been evaluated in the past.

**Class A – Highest Priority Buildings (4 Buildings):**

Buildings 377, 231, 241, and 511 are currently rated as “Exceptionally High Risk” in the 1998 E012941 report and require evaluation and mitigation of seismic deficiencies in accordance with RP6. Exceptionally high risk buildings were defined in the 1998 evaluation on the basis that a) they have a structural system known to be especially vulnerable to earthquake induced damage, or b) they have a combination of high occupancy and high seismic risk in accordance with Approach A in the DOE Management Plan. Exceptionally high risk buildings have the potential for collapse. We recommend the following:

- **Building 377:** This building is one story measuring 5,000 square feet with masonry walls and a heavy precast plank roof system with minimal interconnections. This type of structural system may exhibit poor performance in a seismic event. We recommend developing a seismic strengthening schemes to upgrade life safety protection.
- **Building 511:** This building is a large wood framed building constructed in 1942 and previously used as an airplane hanger. The building measures 60,000 square feet and contains a high bay center portion and low bay wings. Our seismic evaluations have identified high demand capacity ratios combined with a high occupancy, therefore placing the building in the exceptionally high risk category. We recommend strengthening building 511 according to recommendations in August 2002 report by Degenkolb. Further evaluation is not required.

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- Building 231: This building, initially constructed in 1969, has 8 seismically independent sectors constructed primarily of steel with perimeter concrete non-bearing walls, measuring a total of 137,000 square feet. Our past seismic evaluations have identified high demand capacity ratios combined with a high occupancy, therefore placing the building in the exceptionally high risk category. This building has had a past detailed evaluation that focused on development of strengthening recommendations to PC2 in the past. A computer analysis was not performed. We recommend that a detailed evaluation be performed and strengthening concepts and cost estimates developed to upgrade the building to life safety.
- Building 241: This building was constructed in 1960 and measures 54,000 square feet. The building is steel framed and has a perimeter precast nonbearing walls. This building has had a past detailed evaluation that focused on development of strengthening recommendations to PC2. A computer analysis was not performed. We recommend that a detailed evaluation be performed and strengthening concepts and cost estimates developed to upgrade the building to life safety.

Class B – High Priority Buildings (5 Buildings):

Buildings 391, 321, 381, 131 and 194 do not meet Life Safety and are classified as having a High Priority. Heavy damage and possibly local collapse conditions are expected in a major earthquake, but some margin against total collapse is expected based on observed behavior of similar buildings in past earthquakes.

We recommend these buildings be evaluated and strengthened to life-safety as an “active” part of the LLNL seismic mitigation program. Determine cost to strengthen, obtain funding and strengthen as funding becomes available. Note that RP6 does not currently trigger action. Past seismic evaluations are available and have focused on development of strengthening schemes to the PC2 level.

Building 391 has been evaluated in the past and construction documents for strengthening to the life-safety performance level are available.

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Class C – Medium Priority Buildings (13 Buildings):

Thirteen buildings do not meet Life Safety and are classified as having medium priority.

- Buildings 141, 151, 251, 255, and 343 have the potential for “life threatening damage”, affecting people in the local vicinity of where the damage will occur, but collapse is not likely.
- Buildings 216, 217, 218, 219, 314, 315, 316, and 319 are two story wood framed barracks buildings. The primary deficiency is the lack of a cripple wall between the foundation and the raised first floor. There is a potential that the buildings will suffer a local collapse condition between the foundation and first floor. The consequence of this collapse is not likely to threaten life safety.

We recommend strengthening of these buildings as they are remodeled or modernized, or as seismic mitigation funding becomes available.

Class D - Evaluated Buildings with Non-Structural Deficiencies Only (22 Buildings):

Twenty-two of the 85 non-exempt buildings have been evaluated and do not have structural deficiencies that require mitigation to meet Life Safety performance. However, these buildings are not exempt because they may have non-structural deficiencies. Nonstructural bracing deficiencies may result in life threatening damage due to falling hazards. However, mitigating these deficiencies is a Low Priority relative to mitigating structural deficiencies. We recommend that nonstructural bracing deficiencies be identified and mitigated as part of an ongoing facility maintenance program for all non-exempt buildings. See attachment B for identification of buildings in this category.

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Class E - Non-Evaluated Buildings (41 Buildings):

Forty-one of the 85 non-exempt buildings have not been seismically evaluated. Most of the non-evaluated buildings are classified by LLNL as having a target PC2 or PC3 performance objective. Since the focus of the initial evaluations was on PC1 buildings, the PC2 and PC3 buildings were not evaluated.

We recommend that a Tier 1 evaluation for Life Safety be performed on the non-evaluated buildings so that buildings can be prioritized with the other non-exempt buildings. Although this evaluation will be inconclusive with regards to the buildings meeting PC2 and PC3 criteria, we expect that approximately 1/3 of the buildings will meet Life Safety and be placed in Class D, thus reducing the overall scope of the seismic mitigation program. We expect the majority of the buildings that do not meet Life Safety will be placed in Class C, Medium Priority with some potentially in Class B, High Priority.

**Recommendations**

As the next step in the seismic mitigation program at LLNL we recommend performing the following evaluations:

*Tier I Evaluations for previously non-evaluated buildings:*

Perform Tier I evaluations of the 42 buildings that have not previously been evaluated. We expect that up to 33% of these buildings will meet the "life safety" performance criteria. The intent of these evaluations is to eliminate some buildings from the seismic mitigation program by showing they meet life safety criteria by evaluation. The buildings that do not meet life safety can then be prioritized with the previously evaluated buildings.

*Tier II Evaluations for High Priority Buildings:*

Perform detailed Tier II evaluations and develop concept level strengthening schemes to the life safety performance level for the buildings currently identified as High Priority and above. These include buildings 377, 231, 241, 381, 131, 194. Buildings 511, 321, and 391 have completed life safety strengthening concepts and require no additional evaluation work. The intent of these evaluations is to prepare conceptual strengthening schemes for costing purposes, and to reclassify building priority if appropriate. Past building evaluations will be used where possible.



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We appreciate the opportunity to be of continued service to LLNL. Please contact us if you would like to schedule a meeting or discuss the information contained in this letter. We will be happy to prepare a more detailed scope of work identifying extent of evaluation work necessary per building as the need arises.

Very truly yours,

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