Report on the
Conceptual Seismic Retrofit Study
of the
MWDOC Administrative Building
18700 Ward Street, Fountain Valley, California

Prepared for:

WATER EMERGENCY RESPONSE ORGANIZATION OF ORANGE COUNTY
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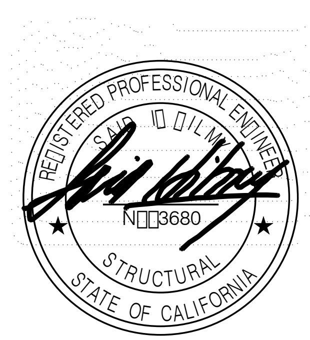

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CONCEPTUAL SEISMIC RETROFIT STUDY
MWDOC ADMINISTRATIVE BUILDING
FOUNTAIN VALLEY, CA

1. EXECUTIVE SUMMARY

IDS has prepared a conceptual/preliminary design of a seismic retrofit for the Municipal Water District of Orange County (MWDOC) Administration Building located at 18700 Ward Street in Fountain Valley, California. For this study, we reviewed a variety of seismic hazards and performance levels. The purpose of this study is primarily to assist the Water Emergency Response Organization of Orange County (WEROC) in determining what level of seismic retrofit to achieve, as well as to develop initial opinions of cost for that work.

We found that the building has numerous beneficial features that will contribute to its seismic performance such as its single-story masonry shear wall lateral system and previous seismic retrofit. However, it also has many features that detract from its ability to serve at higher performance levels necessary for essential facilities.

Based on our study, we found no substantial issues that would prevent the building from performing at the Life-Safety performance level for an administrative office use at lower level seismic events. ASCE-41 defines Life-Safety performance as that in which the overall structural damage is moderate, and continued occupancy may not be likely before repair and may not be economical. Additionally, it includes in the definition that falling hazards may be mitigated, but many architectural, mechanical, and electrical systems are damaged, and that there may be slightly more damage and slightly higher life-safety risk than intended for typical new buildings design. We note that the building was originally designed, constructed and even retrofitted as a non-essential facility. The building is currently serving as an administrative building, however, WEROC desires to utilize the facility for supporting and managing emergency preparedness, planning, response, and recovery efforts among Orange County water and wastewater utilities.

Based on our study, significant improvements to the seismic performance for a range of seismic hazards can be attained; however, achieving higher levels of performance at greater seismic hazards may not be cost effective in relation to the replacement cost of the building. A matrix of cost was developed for each performance level. This matrix is included at the end of this report. In addition to the design strategies presented here, business and event response strategies may also be helpful in managing the seismic risk.

2. INTRODUCTION

Background

The Administration Building was built circa 1972 as a one-story masonry building with a wood-framed roof structure on shallow concrete foundations [Ref 1]. It was designed for office/administrative use and had no critical or essential services designation at that time. A previous seismic study was completed in 1995 by Dames and Moore [Ref. 2]. Recommendations from that study were implemented in 1999, to bring the building's structural system up to the 1997 Uniform Building Code for office/ non-essential facility performance. A minor tenant improvement was performed in 2003 [Ref. 3] to adjust some of the interior partitions. The building's fire suppression systems were upgraded in 2015 to meet the building code in force at that time. In 2017, doorways were added at the reception area as part of a minor tenant improvement [Ref. 4].

We understand that this building currently serves as MWDOC's primary administrative building and is also designated as their backup Emergency Operations Center (EOC). The EOC's principal function is to provide an office space to host emergency water resources personnel during critical events. This space is intended to be used as a communications and resource coordination hub.

IDS prepared an assessment report "Seismic Assessment of the MWDOC Administrative Building," in 2017 [Ref. 5]. That report included a review of the structure's anticipated performance in relation to its use as an essential services facility. Seismic retrofits were recommended in order to achieve the desired performance. A project to brace and anchor non-structural items such as partitions, equipment, and furniture is on-going.

Seismic Risk Management

FEMA 389 [Ref. 6] is a document that provides some helpful descriptions and background on Seismic Risk Management that are summarized in this section. The term "risk" is used to identify possible loss or harm. In the same way, the term "seismic risk" is used to identify losses or harm that may result from an earthquake. Seismic Risk is typically described in terms of three factors, (1) Seismic Hazard or the likelihood of an earthquake occurring and the resulting shaking intensity and duration at a particular site, (2) Seismic Vulnerability or the expected damage or negative outcomes at a particular site or on a particular building as a result of an earthquake occurrence, and (3) the Expected Consequences or losses resulting from the predicted damage. Often these consequences are categorized into injuries, damage, and downtime or interruption of service or operation.

Seismic Risk Management is then the method of controlling or limiting the effects of seismic risk. This control can be accomplished by reducing the damage, reducing the impacts of the damage, or both. Strategies for managing seismic risk include Design Strategies, Business Strategies and Event Response Strategies.

Design Strategies typically involve reducing the site hazards or reducing the vulnerability. Reductions of site hazards can be accomplished by relocating the building to a lower hazard site or improving the site to lessen its hazards. Reductions in vulnerability can include reducing the building response to the site hazard and increasing the building's capacity to withstand the hazard.

Business Strategies typically involve methods such as diversifying or creating redundancies in the business operations. Other methods such as obtaining insurance or other securitization are likely not as applicable to WEROC since its purpose is in supporting and managing countywide emergency preparedness, planning, response, and recovery efforts among Orange County water and wastewater utilities.

Event Response Strategies typically involve developing emergency response procedures, training staff for response following an emergency, arranging for rapid post-event inspections and repairs, providing supplies, food and water to temporarily sustain operations, and developing means of rapidly restoring communications and data following an event.

This report includes a discussion of the seismic hazards at the site and the potential design strategies to manage that hazard.

Scope

Our scope of services involved the following:

1. Perform an engineering analysis and evaluation of up to three seismic performance levels using ASCE 41-13 "Seismic Evaluation and Retrofit of Existing Buildings" (a National Standard document referenced in the 2016 California Building Code).
2. Develop conceptual details related to potential seismic upgrades to assist in preparing initial opinions of cost for retrofit options.
3. Meet with WEROC to explain the seismic performance options, conclusions and recommendations.

Limitations

This letter report is intended for the sole use of Water Emergency Response Organization of Orange County in its evaluation of the subject property. It is not intended for use by other parties, and may not contain sufficient information for purposes of other parties or other uses. This letter report is based on a review of available drawings, our seismic assessment of the building's lateral force resisting system and our engineering judgment and experience. Our assessment is limited to the building's primary structural systems in relation to seismic performance. Evaluation of site related seismic hazards such as liquefaction and slope stability is limited to a review of available regional hazard documentation. Evaluation of nonstructural items such as architectural elements, furnishings and interior equipment, and electrical, mechanical, and plumbing systems are considered only for opinions of retrofit cost. Evaluation of site utilities serving the building is excluded. Evaluation of other hazards affecting essential services performance such as fire, flood and wind are excluded. Evaluation of other adjacent structures including structures that may provide access to this building are excluded. Testing, destructive or otherwise, was not performed. Our limited investigation should not be considered a review of the design, nor an inspection of latent conditions that have not manifested damage to date. Other conditions affecting the structure that were not inspected, anticipated, or accessible including all public safety issues, are beyond the scope of this report. Our professional services have been performed with the degree of care and skill ordinarily exercised, under similar circumstances, by reputable consultants practicing in this field at this time.

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3. SEISMIC HAZARDS

Earthquake Faulting and Ground Shaking

Similar to most of southern California, the MWDOC site is located in a region of high seismicity. The following is an overview of the key seismic hazards for the MWDOC site.

Based on the City of Fountain Valley General Plan [Ref. 7], ground shaking and liquefaction are the most significant hazards anticipated to affect the site. Ground shaking has historically been attributed to two primary faults, the Newport-Inglewood Fault Zone and the Elsinore Fault Zone. Below is a brief summary of characteristics for these two faults:

<u>Newport-Inglewood Fault Zone</u> [Ref. 8]
TYPE OF FAULTING: right-lateral; local reverse slip associated with fault steps
LENGTH: 66 km [Ref. 9]
MOST RECENT MAJOR RUPTURE: March 10, 1933, M_W6.4 (no surface rupture)
SLIP RATE: 1.0 mm/yr [Ref. 9]
INTERVAL BETWEEN MAJOR RUPTURES: unknown
PROBABLE MAGNITUDES: M_W6.0 - 7.4
OTHER NOTES: Surface trace is discontinuous in the Los Angeles Basin, but the fault zone can easily be noted there by the existence of a chain of low hills extending from Culver City to Signal Hill. South of Signal Hill, it roughly parallels the coastline until just south of Newport Bay, where it heads offshore, and becomes the Newport-Inglewood - Rose Canyon fault zone.

<u>Elsinore Fault Zone (Central Avenue Branch)</u> [Ref. 8]
TYPE OF FAULTING: right-lateral strike-slip
LENGTH: about 180 km
MOST RECENT SURFACE RUPTURE: estimated 1700s
LAST MAJOR RUPTURE: May 15, 1910, M6
SLIP RATE: roughly 4 mm/yr
INTERVAL BETWEEN MAJOR RUPTURES: roughly 250 years
PROBABLE MAGNITUDES: M_L6.5 – 7.5
OTHER NOTES: Recurrence interval given above suggests slip of 1.25 to 1.5 meters per surface rupturing event.

The Elsinore fault zone is one of the largest in southern California, and in historical times, has been one of the quietest. The southeastern extension of the Elsinore fault zone, the Laguna Salada fault, ruptured in 1892 in a magnitude 7 quake, but the main trace of the Elsinore fault zone has only seen one historical event greater than magnitude 5.2 -- the earthquake of 1910, a magnitude 6 shock near Temescal Valley, which produced no known surface rupture and did little damage.

At its northern end, the Elsinore fault zone splays into two segments, the Chino fault and the Whittier fault. At its southern end, the Elsinore fault is cut by the Yuha Wells fault from what amounts to its southern continuation: the Laguna Salada fault. Several of the fault strands which make up the Elsinore fault zone possess their own names. Northwest of Lake Elsinore are the Glen Ivy North and Glen Ivy South faults. Heading southeast from

Lake Elsinore, the two parallel fault strands are the Wildomar fault (the more easterly) and the Willard fault.

Another fault that contributes significantly to the seismic hazard at the site is the San Joaquin Hills Blind Thrust Fault. Below is a brief summary of characteristics of this fault:

San Joaquin Hills Thrust [Ref. 10, 11]
TYPE OF FAULTING: Thrust, Dip 23-30° SW.
LENGTH: 33 km
MOST RECENT MAJOR RUPTURE: latest Quaternary (<15 ka)
SLIP RATE: Between 0.2 and 1.0 mm/yr
INTERVAL BETWEEN MAJOR RUPTURES: Approximately 1,650 – 3,100 year, average
PROBABLE MAGNITUDES: M_W 7.3
OTHER NOTES: Movement on this blind thrust fault is thought to have uplifted the San Joaquin Hills, mid-to-late Holocene marine terraces along the coast and a marsh bench in Newport Bay.

However, other regional faults could cause significant damage at the site also. Other faults considered potentially hazardous to the site (within a 50 mile radius) include:

- San Andreas
- San Jacinto
- Norwalk
- Malibu-Coast-Raymond
- Palos Verdes
- San Gabriel
- Sierra Madre-Santa-Susanna-Cucamonga

Figure 3 below shows the site in relation to regional faults and several historical earthquakes.

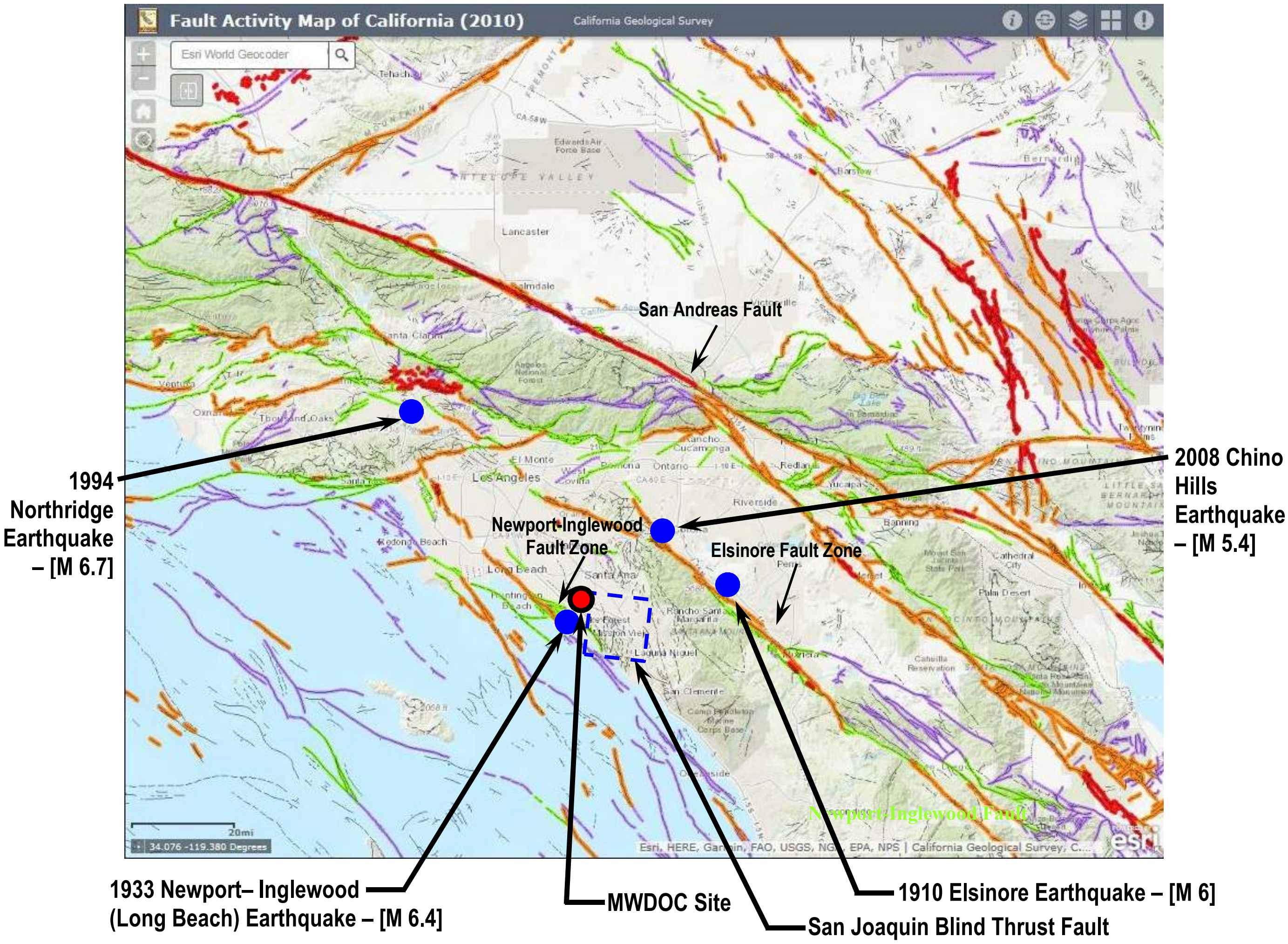
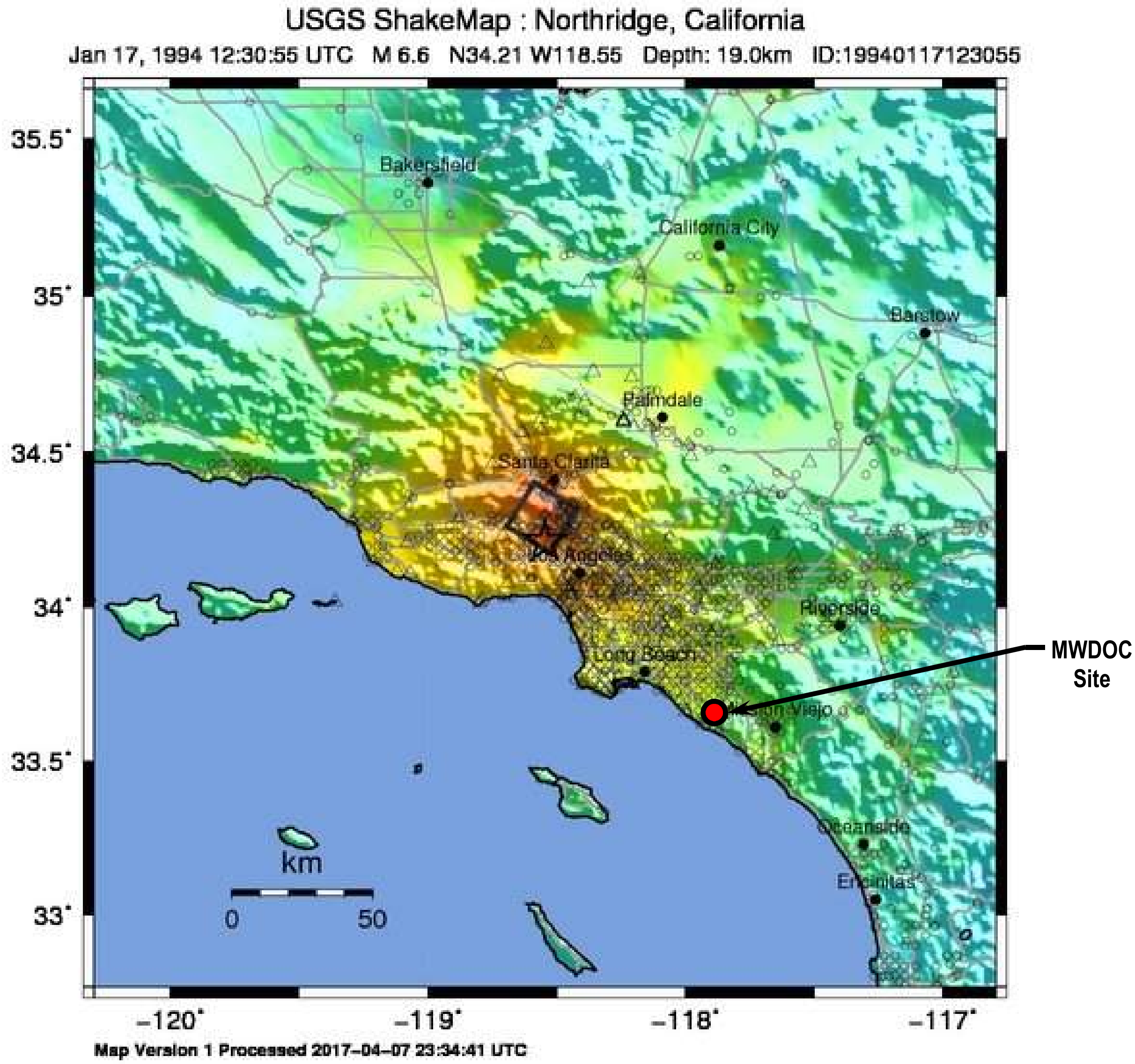


Figure 3: Vicinity Map of Faults [Ref. 8]

Seismic Activity Near the Site:

Seismic intensity is a measure of the ground motion felt during a seismic event. Intensity depends on proximity to the source, soil conditions and other factors. Accelerographs, which measure ground shaking, have been installed by the California Geological Survey throughout the state, from which vital information such as seismic intensity is obtained during seismic events. Shakemaps illustrate these recorded ground motions. Figures 4 and 5 below show the perceived ground shaking and estimated peak ground acceleration for two relatively recent earthquakes, the 1994 Northridge earthquake and the 2005 Chino Hills Earthquake. It is also noted that based on perceived shaking intensity (as measured by the Mercalli scale), Figures 4 and 5 both show that the site likely experienced moderate to light shaking during these earthquakes.



PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Mod./Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	<0.05	0.3	2.8	6.2	12	22	40	75	>139
PEAK VEL.(cm/s)	<0.02	0.1	1.4	4.7	9.6	20	41	86	>178
INSTRUMENTAL INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+

Scale based upon Worden et al. (2012)

Figure 4: Seismic Intensity Map for the Northridge Earthquake, January 1994 [Ref. 14]

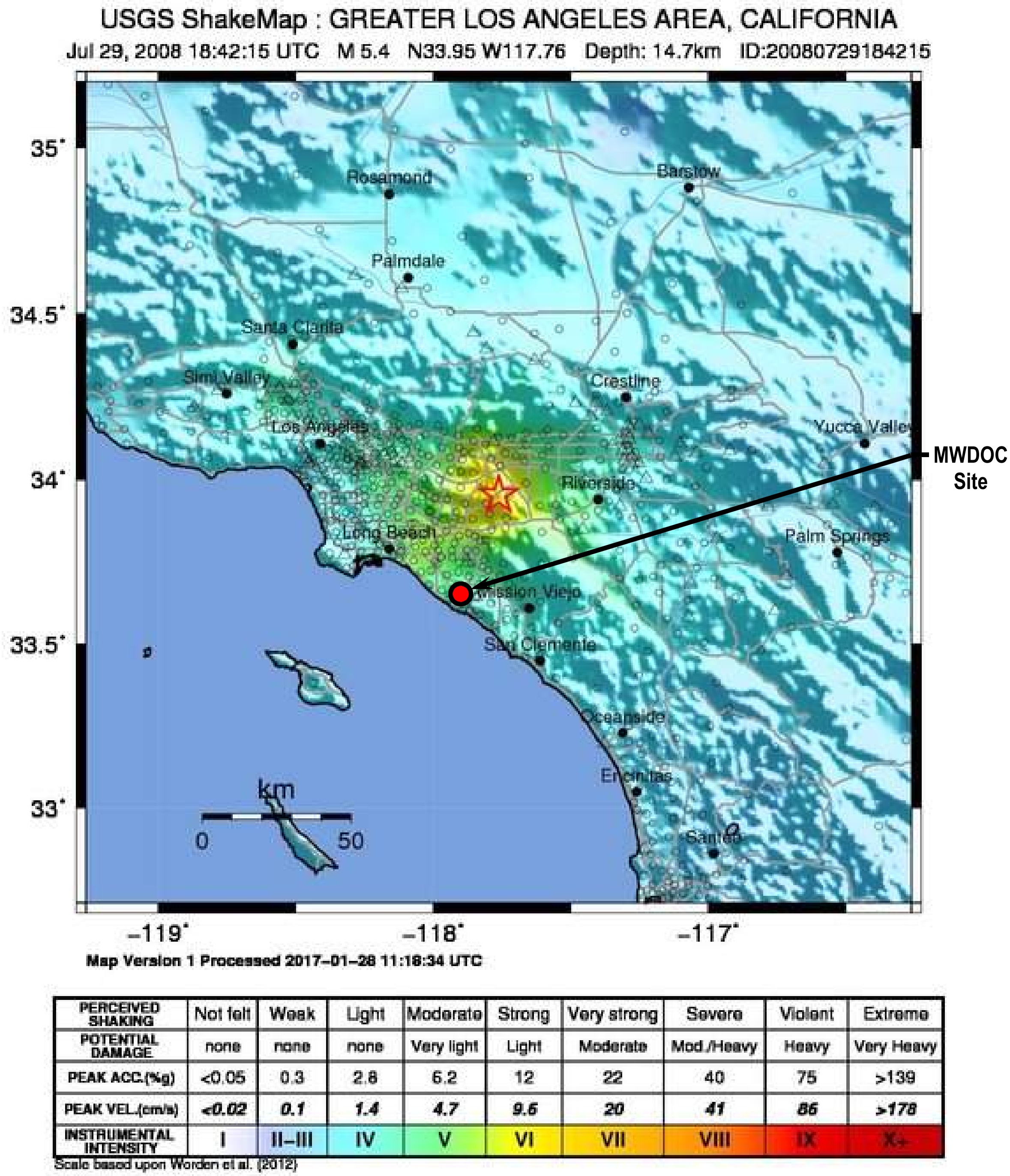


Figure 5: Seismic Intensity Map for the Chino Hills Earthquake, July 2008 [Ref. 15]

Liquefaction and Differential Settlement

Both regional liquefaction data [Ref. 12] and an available Diaz Yourman soils report for the adjacent Water Laboratory Building [Ref. 13] indicate that subsurface soils are susceptible to liquefaction. The Diaz Yourman report estimates liquefaction-induced settlement to be approximately 2 to 4 inches for the adjacent Water Laboratory Building site. The liquefaction and site soil settlement predicted was estimated in relation to an earthquake hazard level with a return period of 475 years. Without other more specific information, we would assume that similar levels and extent of liquefaction would occur at larger events and possibly for somewhat smaller events such as a 225-year event. Additionally, without other more specific information, we would assume that the site generally will behave similar to the area studied for the placement of the Water Laboratory Building.

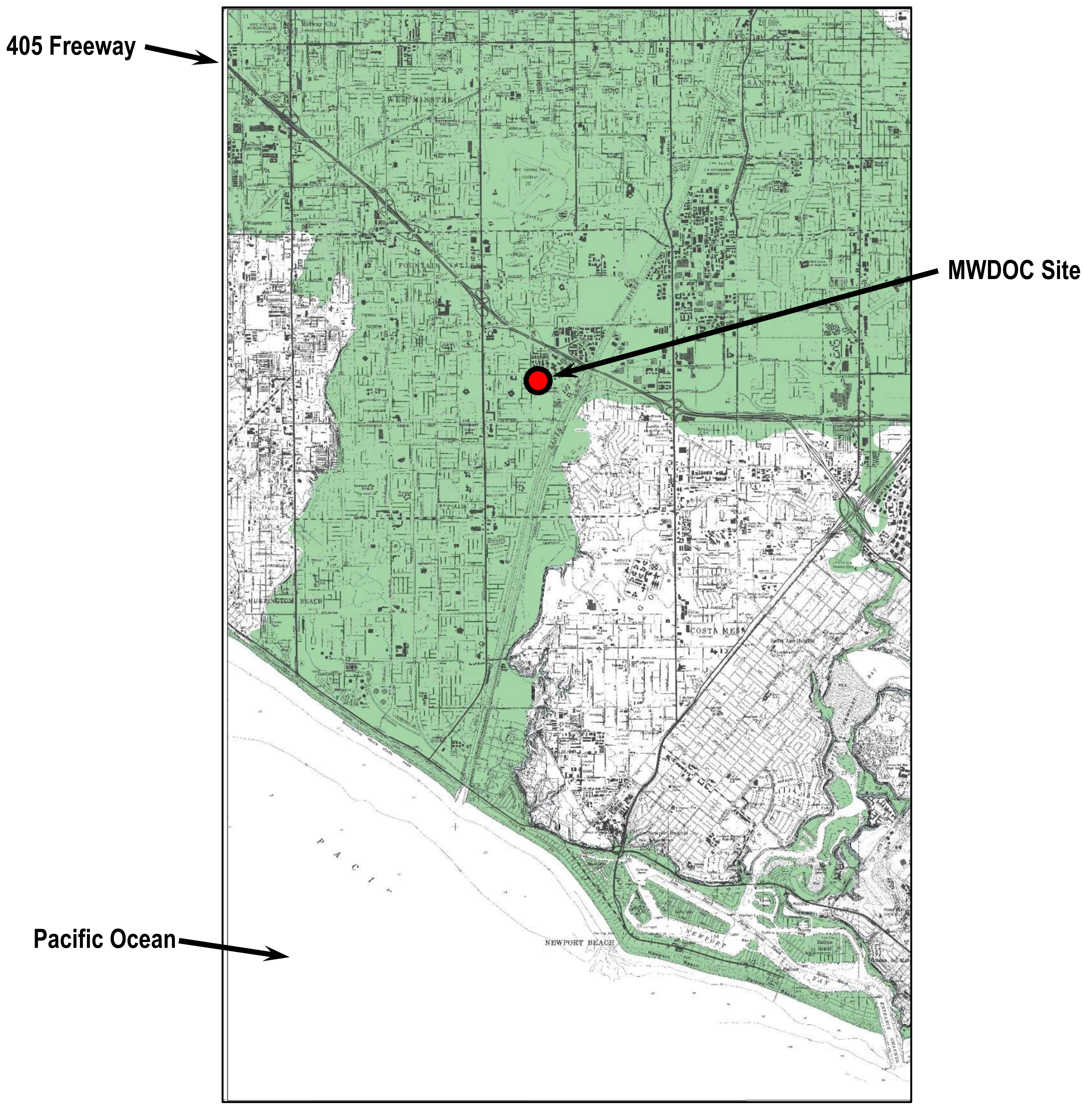


Figure 6: Seismic Hazard Zones Map, Newport Beach Quadrangle [Ref. 12]

Other Seismic Hazards

Other hazards, such as surface fault rupture, landslides or slope instability do not pose a significant threat to the site. Lateral spreading could present some hazard since the Administration building is sited on a soil pad that is elevated from the general site by several feet; however, this is not anticipated to present a significant hazard since the soil borings appear to indicate compacted soil in the upper layer of the site.

4. DESCRIPTION OF BUILDING AND SITE

Structural drawings for the MWDOC Administration Building's original construction were not available in the documents provided. The description provided below was primarily obtained from the available architectural drawings for the Administration Building remodel and construction of the OCWD building [Ref. 1], site observations and the Dames & Moore report [Ref. 2].

The building is a one-story masonry building with a wood framed roof that was constructed circa 1972. It is rectangular in plan having overall dimensions of 144'-8" by 120'-11" and has a rectangular shaped open courtyard at its center that measures approximately 35 feet by 55 feet in plan. The building has an overall height of approximately 19 feet at the top of its mansard roof while the perimeter masonry walls are approximately 11 feet tall where they meet the roof framing.

The building is founded on a level pad elevated several feet above the surrounding grade with the utilities such as gas located below grade to the west. There is an OCWD Administrative building connected via the lobby structure that extends to the south of the MWDOC building. Other buildings and asphalt paved parking areas are located nearby as shown in Figure 1 below.

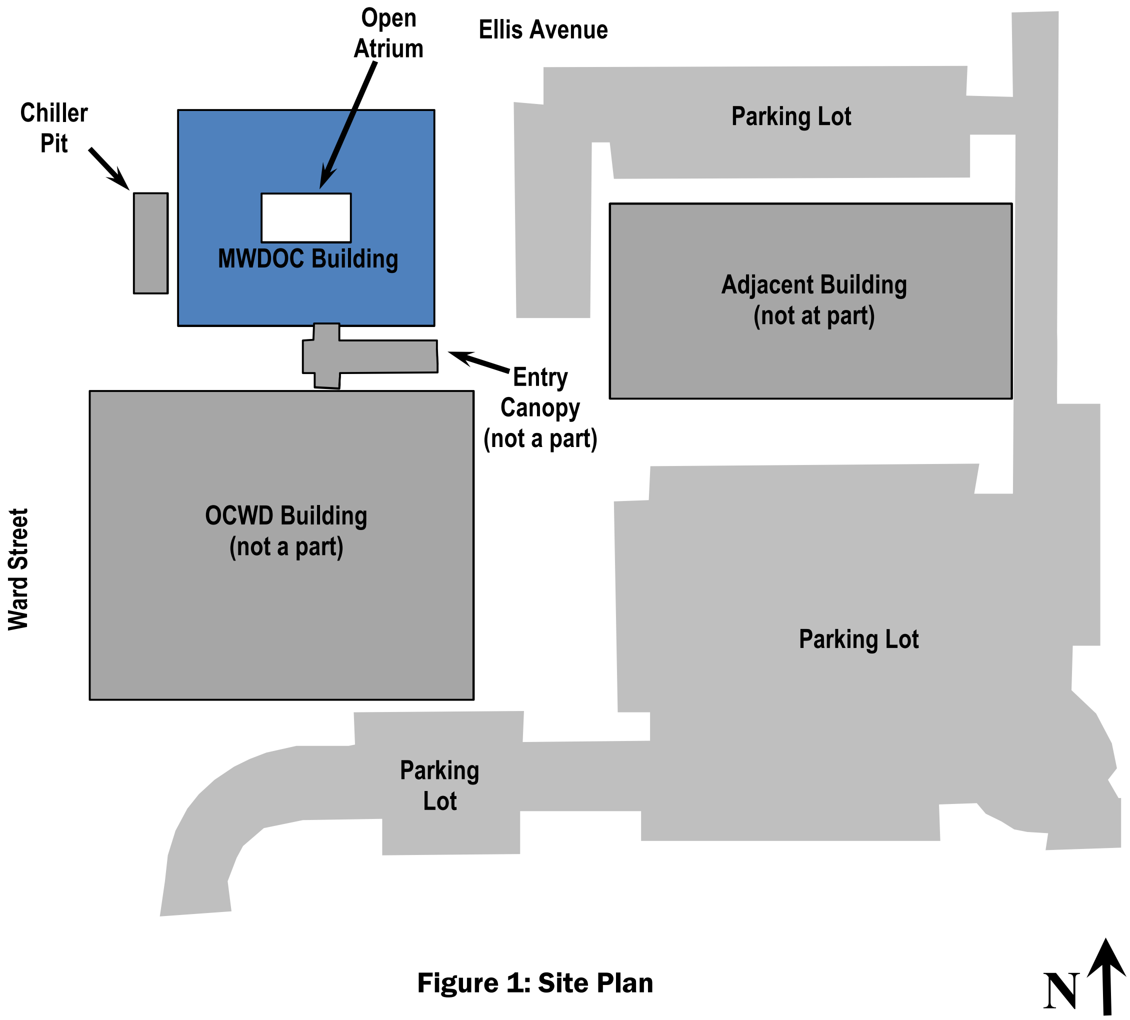


Figure 1: Site Plan

The building is partitioned into offices, conference rooms, kitchen, storage and mechanical equipment areas; a separate lobby structure extends from the south side of the building [Figure 1]. A concrete masonry vault structure exists in the northwest corner of the building [Figure 2].

The vertical load resisting system of the building relies on plywood roof sheathing typically supported by sawn 2x wood rafters spaced at 24 inches on center and steel trusses oriented diagonally across the building corners. The roof framing typically bears on the perimeter masonry walls and a series of 6x wood beams supported by steel tube columns along the perimeter of the atrium. The walls and the interior columns are supported on continuous and spread concrete footings.

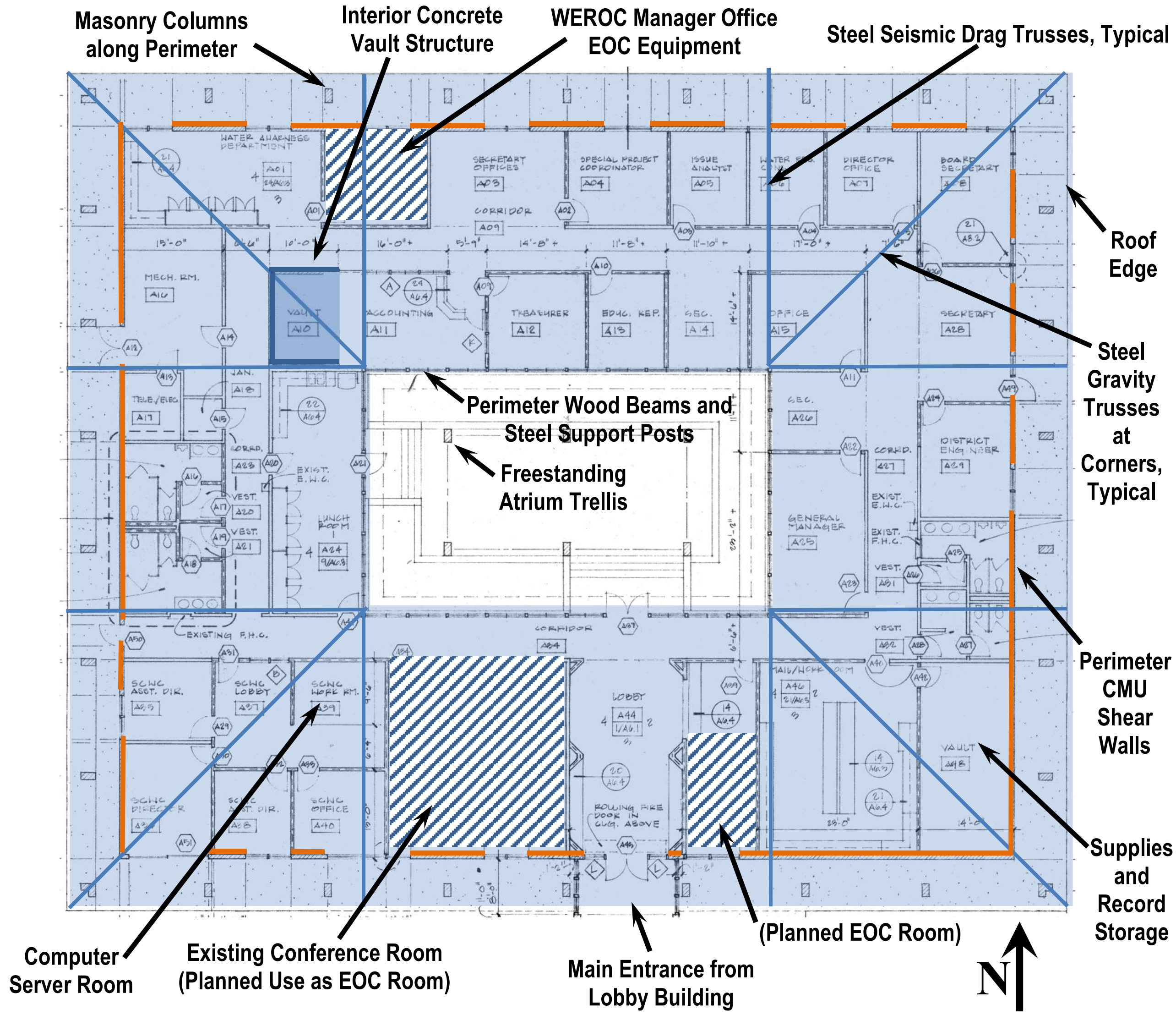


Figure 2: Building Plan Showing Lateral Force Resisting System

The building's lateral force resisting system [shown in Figure 2] relies on the plywood roof diaphragm that transfers the seismic forces out to the perimeter concrete masonry walls. These walls transfer their forces to continuous concrete footings and into the site soils.

We understand that a seismic retrofit was performed in 1999 to bring the facility up to the 1997 Uniform Building Code. Drawings from that retrofit were not available for review, however some elements of a retrofit were observed during our site survey. Those elements primarily included out-of-plane wall anchors spaced at approximately 8 feet on center along the perimeter masonry wall. These anchors appeared to consist of vertical steel angles bolted to the perimeter walls and existing wood framing. Where the roof framing was parallel to the perimeter wall, anchors included a horizontal steel strap extending approximately 4 feet into the wood diaphragm and fastened with screws into 2x blocking.

For design to current CBC [Ref. 16], the building on this site would fall into Seismic Design Category E if the use was for administrative office type of use. The Seismic Design Category would be F if the building was intended to be used for essential services type of use.

5. SUMMARY OF SEISMIC EVALUATION

Summary of Hazard Levels Considered

A variety of seismic hazards were considered for this study. Those range from smaller, more frequent events to much larger but less frequent events. The bullets below provide some description and definition of the events included [Refs. 16 to 18]:

- 2%-50yrs (BSE-2N) – This is a hazard consistent with the Maximum Considered Earthquake ground motions and can be thought of a having a 2% probability of exceedance in 50 years. This is an extreme, infrequent event. In the design of new buildings, this hazard is intended to provide a probability of collapse of approximately 1% in 50 years.
- 5%-50yrs (BSE-2E) – For buildings in California, this hazard generally represents ground motions that are approximately 75% as large as those of the BSE-2N. In California, this 25% reduction is a traditional extreme hazard level used for evaluation of existing buildings.
- 10%-50yrs (BSE-1N) – This hazard is set at 2/3 the values for the BSE-2N hazard and is intended to match the typical design hazard for new buildings. In many locations in California, this hazard is similar to a hazard having a 10% probably of exceedance in 50 years. The 10% in 50-year hazard was used in building design provisions prior to the 1997 NEHRP provisions; although that probabilistic level is no longer explicitly referenced in new building design standards.
- 20%-50yrs (BSE-1E) – This hazard level is a reduced design level hazard traditionally used in the evaluation of existing buildings similar to the reduced BSE-2E hazard.
- 50%-50yrs – This hazard was selected for comparison purposes. It is a more frequent event that has a much higher likelihood of occurring within the building's useful life.

Table 1 below provides a summary of the primary seismic hazard levels considered in this seismic study along with some example earthquakes that could generate the hazards at the site.

Table 1: Seismic Hazard Levels and Example of Earthquake Scenarios

Probabilistic Seismic Hazard Level	Mean Return Period (yrs)	Peak Ground Acceleration (g)	Design Short Period Spectral Response Acceleration Parameter S_{XS} (g)	Example of Earthquake Scenario	
				Fault and Distance (miles)	Magnitude
2%-50yrs (BSE-2N)	2475	0.79	1.56	San Joaquin Hills – 3.71	7.2
				Newport-Inglewood – 5.03	7.4
5%-50yrs (BSE-2E)	975	0.56	1.16	Compton – 11.0	7.3
				Palos Verde – 22.43	7.3
10%-50yrs (BSE-1N)	475	0.42	1.04	Elsinore – 36.0	6.6
				San Andreas – 78.2	8.0
20%-50yrs (BSE-1E)	225	0.30	0.74		
50%-50yrs	72		0.45		

Summary of Anticipated Structural Performance

IDS performed a basic assessment of the building's seismic force resisting system in our previous study [Ref. 5]. The following issues were identified through our review:

- Liquefaction – The site has been identified to have a potential for liquefaction where permanent ground displacements are anticipated to occur. This liquefaction and settlement is anticipated to affect the building and its foundations as well as site utilities and the site generally.
- Insufficient Wall Anchorage – Wall anchorage connections having straps to wood blocking are insufficient.
- Adjacent Structures – There is insufficient gap between the Administration Building and the Lobby Building to the South.
- Fire Suppression Piping – Fire suppression piping appears to be generally compliant regarding seismic restraint detailing, but locations were observed throughout the structure where vertical restraints at support locations are not compliant and impact with adjacent items could damage the sprinkler lines.
- Contents and Furnishings – Contents and furnishings are generally unanchored and unbraced.

- Lights, Ceilings and Partitions – Support and bracing of lights, ceilings and partitions was found to be deficient.

A summary of the results of that study are provided in Table 2 below.

Table 2: Opinion of Probable Cost to Achieve Anticipated Performance Level

Seismic Hazard Level	**ASCE 41-13 Target Building Performance Level**					
Probability of Exceed./ Return Period	**Operational (1-A)**	**Immediate Occupancy (1-B)**	**Damage Control (2-B)**	**Life Safety (3-C)**	**Reduced Safety (4-D)**	**Collapse Prevention (5-D)**
2%/50 yrs (BSE-2N) 2,475 yr	*, **	$ 1,900,000** a – f	$ 1,900,000** a – f	$ 300,000 a, b, c, f	$ 200,000 a, b, c	$ 100,000 a, b
5%/50 yrs (BSE-2E) 975 yr	*, **	$ 1,900,000** a – f	$ 1,900,000** a – f	$ 200,000 a, b, f	$ 100,000 a, b	$ 100,000 a, b
10%/50 yrs (BSE-1N) 475 yr	*, **	$ 1,900,000** a – f	$ 500,000 a – d, f	$ 200,000 a, b, f	$ 100,000 a, b	$ 40,000 a
20%/50 yrs (BSE-1E) 225 yr	$ 1,900,000 a - f	$ 1,900,000 a – f	$ 200,000 a, b, f	$ 140,000 a, f	No Cost/ Retrofit	No Cost/ Retrofit
50%/50 yrs 72 yr	$ 300,000 a, b, c, f	$ 200,000 a, b, c	$ 140,000 a, f	No Cost/ Retrofit	No Cost/ Retrofit	No Cost/ Retrofit

Table 2 Notes:

* - Due to anticipated liquefaction effects of the site generally, damage is expected to utilities and other services that could diminish or prevent operations. Additionally, the site around the building and the utilities serving the site may be damaged and inoperable. The extent and nature of remediating these site hazards is not estimated for this level of study. The costs indicated above are only related to the site improvements necessary to provide additional protection of the building.

** - Approaching building replacement cost.

1. For definitions of the performance levels and other terms indicated in this table, refer to the information from ASCE-41 provided in Attachment A.

2. Scope of work items identified as items “a” to “f” are listed below the costs in the table. Costs and reference details for these items are provided in Table 3 below.

3. Basic summary of building improvement items related to the costs shown in the table above are preliminary and rough and are only intended to convey differences in the various levels shown above. Actual costs could vary at least +50% and -25% from the values shown and are based on our judgement only. Conceptual details for these improvements are enclosed at the back of this letter.

Table 3: Scope of Work Items and Cost

	Scope of Work Items	**Opinion of Cost (ROM)**	**Conceptual Details**
a.	Improve Drags at Atrium Corners	$ 40,000	SSK-1 to 4
b.	Strengthen Existing Out-of-Plane Wall Connections	$ 60,000	–
c.	Strengthen Roof Diaphragm at East and West Ends	$ 100,000	SSK-1 & 6
d.	Add Out-of-Plane Wall Connections to Roof	$ 200,000	SSK-1 & 5
e.	Improving Soils Beneath the Building for Liquefaction	$ 1,400,000	–
f.	Bracing/ Improvements to Non-Structural Items	$ 100,000	–

6. CONCLUSIONS AND RECOMMENDATIONS

IDS has prepared a conceptual/preliminary design of a seismic retrofit for the Municipal Water District of Orange County (MWDOC) Administration Building located at 18700 Ward Street in Fountain Valley, California. For this study, we reviewed a variety of seismic hazards and performance levels. IDS then prepared conceptual details of the retrofits necessary to address particular deficiencies at each performance level so that an opinion of cost could be prepared. The purpose of this study is primarily to assist the Water Emergency Response Organization of Orange County (WEROC) in determining what level of seismic retrofit to achieve, as well as to develop initial opinions of cost for that work. This report is intended to present the results of that study including the potential design strategies to manage that hazard.

The building is a one-story masonry building with a wood framed roof that was constructed circa 1972. It is rectangular in plan and has a rectangular shaped open courtyard at its center. The building has an overall height of approximately 19 feet at the top of its mansard roof while the perimeter masonry walls are approximately 11 feet tall where they meet the roof framing. It is founded on a level pad elevated several feet above the surrounding grade with the utilities such as gas located below grade to the west. There is an OCWD Administrative building connected via the lobby structure that extends to the south of the MWDOC building. The building is partitioned into offices, conference rooms, kitchen, storage and mechanical equipment areas; a separate lobby structure extends from the south side of the building.

The vertical load resisting system of the building relies on a wood framed roof with steel trusses oriented diagonally across the building corners. The roof framing is supported by perimeter masonry walls and a series of wood beams supported by steel tube columns along the perimeter of the atrium. The walls and the interior columns are supported on continuous and spread concrete footings. The building's lateral force resisting system relies on the plywood roof diaphragm to transfer the seismic forces out to the perimeter concrete masonry walls and then to the site soils. A seismic retrofit was performed in 1999 to bring the facility up to the 1997 Uniform Building Code.

In general, the building was found to be in relatively good condition for its age and structural system and seismic restraint and bracing systems were generally found to be present. We found that the building has numerous beneficial features that will contribute to its seismic performance such as its single-story masonry shear wall lateral system and previous seismic retrofit. However, it also has many features that detract from its ability to serve at higher performance levels necessary for essential facilities. We note that the building was originally designed, constructed and even retrofitted as a non-essential facility.

Based on our study, we found no substantial issues that would prevent the building from performing at the Life-Safety performance level for an administrative office use at lower level seismic events. ASCE-41 defines Life-Safety performance as that in which the overall structural damage is moderate, and continued occupancy may not be likely before repair and may not be economical. Additionally, it includes in the definition that falling hazards may be mitigated, but many architectural, mechanical, and electrical systems are damaged, and that there may be slightly more damage and slightly higher life-safety risk than intended for typical new buildings design. We note that the building was originally designed, constructed and even retrofitted as a non-essential facility. The building is currently serving as an administrative building (this would correspond to Seismic Design Category E in the current CBC), however, WEROC desires to utilize the facility for supporting and managing emergency preparedness, planning, response, and recovery efforts among Orange County water and wastewater utilities (this would correspond to Seismic Design Category F in the current CBC).

Based on our study, significant improvements to the seismic performance for a range of seismic hazards can be attained; however, achieving higher levels of performance at greater seismic hazards may not be cost effective in relation to the replacement cost of the building. A matrix of cost was developed for each performance level and is presented in Table 2, above. In addition to the design strategies presented here, business and event response strategies may also be helpful in managing the seismic risk.

The current Building Code does not require upgrade of the existing seismic force resisting system unless alterations are considered such as change of occupancy, increase of building mass or size, and modifications of the existing lateral force resisting system.

ATTACHMENT A

Descriptions of Performance from ASCE 41

Information from ASCE 41-13

These are "earthquake severities" that are used in design to current Building Code force levels.

Lower "earthquake severities" or seismic hazards are also often considered for existing buildings.

We believe that the existing building was designed and retrofitted using this Risk Category

Essential Services Buildings are generally designed and retrofitted using this Risk Category

Table 2-2. Basic Performance Objective Equivalent to New Building Standards (BPON)

Risk Category	Seismic Hazard Level: BSE-1N	Seismic Hazard Level: BSE-2N
I & II	Life Safety Structural Performance Position Retention Nonstructural Performance (3-B)	Collapse Prevention Structural Performance Nonstructural Performance Not Considered (5-D)
III	Damage Control Structural Performance Position Retention Nonstructural Performance (2-B)	Limited Safety Structural Performance Nonstructural Performance Not Considered (4-D)
IV	Immediate Occupancy Structural Performance Operational Nonstructural Performance (1-A)	Life Safety Structural Performance Nonstructural Performance Not Considered (3-D)

This figure can also provide additional explanation of performance.

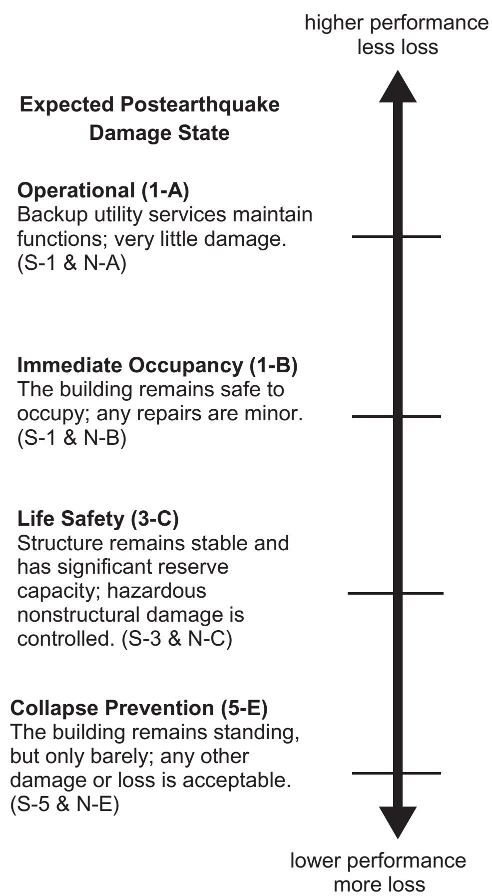


FIG. C2-1. Target Building Performance Levels and Ranges

American Society of Civil Engineers, "ASCE 41-13 Seismic Evaluation and Retrofit of Existing Buildings"

Table C2-3. Damage Control and Building Performance Levels

	Target Building Performance Levels			
	Collapse Prevention Level (5-D)	Life Safety Level (3-C)	Immediate Occupancy Level (1-B)	Operational Level (1-A)
Overall damage	Severe	Moderate	Light	Very light
Structural components	Little residual stiffness and strength to resist lateral loads, but gravity load-bearing columns and walls function. Large permanent drifts. Some exits blocked. Building is near collapse in aftershocks and should not continue to be occupied.	Some residual strength and stiffness left in all stories. Gravity-load-bearing elements function. No out-of-plane failure of walls. Some permanent drift. Damage to partitions. Continued occupancy might not be likely before repair. Building might not be economical to repair.	No permanent drift. Structure substantially retains original strength and stiffness. Continued occupancy likely.	No permanent drift. Structure substantially retains original strength and stiffness. Minor cracking of facades, partitions, and ceilings as well as structural elements. All systems important to normal operation are functional. Continued occupancy and use highly likely.
Nonstructural components	Extensive damage. Infills and unbraced parapets failed or at incipient failure.	Falling hazards, such as parapets, mitigated, but many architectural, mechanical, and electrical systems are damaged.	Equipment and contents are generally secure but might not operate due to mechanical failure or lack of utilities. Some cracking of facades, partitions, and ceilings as well as structural elements. Elevators can be restarted. Fire protection operable.	Negligible damage occurs. Power and other utilities are available, possibly from standby sources.
Comparison with performance intended for typical buildings designed to codes or standards for new buildings, for the design earthquake	Significantly more damage and greater life safety risk.	Somewhat more damage and slightly higher life safety risk.	Less damage and low life safety risk.	Much less damage and very low life safety risk.

Table C2-4. Structural Performance Levels and Illustrative Damage

Seismic-Force-Resisting System	Type	Structural Performance Levels		
		Collapse Prevention (S-5)	Life Safety (S-3)	Immediate Occupancy (S-1)
Reinforced masonry walls	Primary elements	Crushing; extensive cracking. Damage around openings and at corners. Some fallen units.	Major cracking distributed throughout wall. Some isolated crushing.	Minor cracking. No out-of-plane offsets.
	Secondary elements	Panels shattered and virtually disintegrated.	Crushing; extensive cracking; damage around openings and at corners; some fallen units.	Same as for primary elements.
	Drift	Transient drift sufficient to cause extensive nonstructural damage. Extensive permanent drift.	Transient drift sufficient to cause nonstructural damage. Noticeable permanent drift.	Transient drift that causes minor or no nonstructural damage. Negligible permanent drift.

Table C2-5. Nonstructural Performance Levels and Illustrative Damage—Architectural Components

Component Group	Nonstructural Performance Levels: Life Safety (N-C)	Position Retention (N-B)	Operational (N-A)
Cladding	Extensive distortion in connections and damage to cladding components, including loss of weather-tightness and security. Overhead panels do not fall.	Connections yield; minor cracks or bending in cladding. Limited loss of weather-tightness.	Connections yield; negligible damage to panels. No loss of function or weather-tightness.
Glazing	Extensively cracked glass with potential loss of weather-tightness and security. Overhead panes do not shatter or fall.	Some cracked panes; none broken. Limited loss of weather-tightness.	No cracked or broken panes.
Partitions (masonry and hollow clay tile)	Distributed damage; some severe cracking, crushing, and dislodging in some areas.	Minor cracking at openings. Minor crushing and cracking at corners. Some minor dislodging, but no wall failure.	Minor cracking at openings. Minor crushing and cracking at corners.
Partitions (plaster and gypsum)	Distributed damage; some severe cracking and racking in some areas.	Cracking at openings. Minor cracking and racking throughout.	Minor cracking.
Ceilings	Extensive damage. Plaster ceilings cracked and spalled but did not drop as a unit. Tiles in grid ceilings dislodged and falling; grids distorted and pulled apart. Potential impact on immediate egress. Potential damage to adjacent partitions and suspended equipment.	Limited damage. Plaster ceilings cracked and spalled but did not drop as a unit. Suspended ceiling grids largely undamaged, though individual tiles falling.	Generally negligible damage with no impact on reoccupancy or functionality.
Parapets and ornamentation	Extensive damage; some falling in unoccupied areas.	Minor damage.	Minor damage.
Canopies and marquees	Extensively damaged but elements have not fallen.	Some damage to the elements, but essentially in place.	Minor damage to the elements, but essentially in place.
Chimneys and stacks	Extensive damage. No collapse.	Minor cracking.	Negligible damage.
Stairs and fire escapes	Some racking and cracking of slabs. Usable.	Minor damage.	Negligible damage.
Doors	Distributed damage. Some racked and jammed doors.	Minor damage. Doors operable.	Some minor damage. Doors operable.

NOTES: This table describes damage patterns commonly associated with nonstructural components for Nonstructural Performance Levels. The damage states described in the table might occur in some elements at the Nonstructural Performance Level, but it is unlikely that all of the damage states described will occur in all components at that Nonstructural Performance Level. The descriptions of damage states do not replace or supplement the quantitative definitions of performance provided elsewhere in this standard and are not intended for use in postearthquake evaluation of damage or for judging the safety of, or required level of repair to, a structure after an earthquake. They are presented to assist engineers using this standard to understand the relative degrees of damage at each defined performance level.
Damage patterns in nonstructural elements depend on the modes of behavior of those elements. More complete descriptions of damage patterns and levels of damage associated with damage levels can be found in other documents, such as FEMA E-74 (2011).

Table C2-6. Nonstructural Performance Levels and Illustrative Damage—Mechanical, Electrical, and Plumbing Systems and Components

System or Component Group	Nonstructural Performance Levels: Life Safety (N-C)	Position Retention (N-B)	Operational (N-A)
Elevators	Elevators out of service; counterweights do not dislodge.	Elevators operable; can be started when power available.	Elevators operate.
HVAC equipment	Units shifted on supports, rupturing attached ducting, piping, and conduit, but did not fall. Units might not operate.	Units are secure and possibly operate if power and other required utilities are available.	Units are secure and operate if emergency power and other utilities provided.
Manufacturing equipment	Units slid and overturned; utilities disconnected. Heavy units require reconnection and realignment. Sensitive equipment might not be functional.	Units secure but potentially not operable.	Units secure and operable if power and utilities available.
Ducts	Ducts broke loose from equipment and louvers; some supports failed; some ducts fell.	Minor damage at joints but ducts remain serviceable.	Negligible damage.
Piping	Some lines rupturea. Some supports failing. Some piping falling.	Minor leaks develop at a few joints. Some supports damaged, but systems remain suspended.	Negligible damage.
Fire suppression piping	Some sprinkler heads damaged by swaying ceilings. Leaks develop at some couplings.	Minor leakage at a few heads or pipe joints. System remains operable.	Negligible damage.
Fire alarm systems	Ceiling-mounted sensors damaged. Might not function.	System is functional.	System is functional.
Emergency lighting	Some lights fall. Power might be available from emergency generator.	System is functional.	System is functional.
Electrical distribution equipment	Units shift on supports and might not operate. Generators provided for emergency power start; utility service lost.	Units are secure and generally operable. Emergency generators start but might not be adequate to service all power requirements.	Units are functional. Emergency power is provided, as needed.
Light fixtures	Many broken light fixtures. Falling hazards generally avoided in heavier fixtures.	Minor damage. Some pendant lights broken.	Negligible damage.
Plumbing	Some fixtures broken, lines broken; mains disrupted at source.	Fixtures and lines serviceable; however, utility service might not be available.	System is functional. On-site water supply provided, if required.

NOTES: This table describes damage patterns commonly associated with nonstructural components for Nonstructural Performance Levels. The damage states described in the table might occur in some elements at the Nonstructural Performance Level, but it is unlikely that all of the damage states described will occur in a component at that Nonstructural Performance Level. The descriptions of damage states do not replace or supplement the quantitative definitions of performance provided elsewhere in this standard and are not intended for use in postearthquake evaluation of damage or for judging the safety of, or required level of repair to, a structure after an earthquake. They are presented to assist engineers using this standard to understand the relative degrees of damage at each defined performance level.

Damage patterns in nonstructural elements depend on the modes of behavior of those elements. More complete descriptions of damage patterns and levels of damage associated with damage levels can be found in other documents, such as FEMA E-74 (2011).

Table C2-7. Nonstructural Performance Levels and Illustrative Damage—Contents

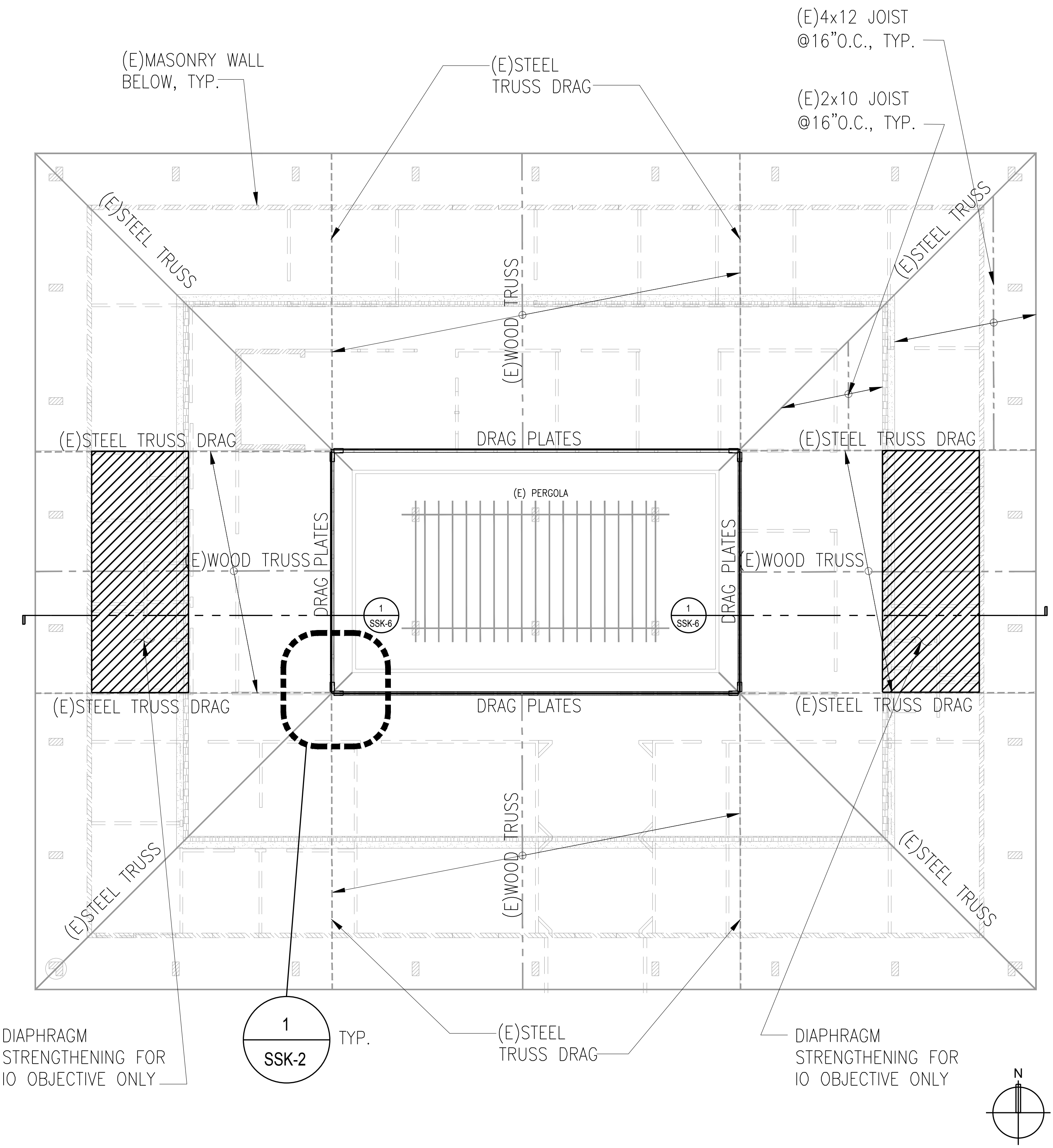
Contents	Nonstructural Performance Levels: Life Safety (N-C)	Position Retention (N-B)	Operational (N-A)
Computer systems	Units rolled and overturned, disconnecting cables. Raised-access floors collapse. Power not available.	Units secure and remain connected. Power might not be available to operate, and internal damage might occur.	Units undamaged and operable; power available.
Desktop equipment	Some equipment slid off desks.	Some equipment slid off desks.	Equipment secured to desks and operable.
File cabinets	Cabinets overturned and spilled contents.	Drawers slid open, but cabinets did not tip.	Drawers slid open, but cabinets did not tip.
Bookshelves	Shelves overturned and spilled contents.	Books slid on shelves and some toppled from shelves.	Books remained on shelves.
Hazardous materials	Minor damage; occasional materials spilled; gaseous materials contained.	Negligible damage; materials contained.	Negligible damage; materials contained.

NOTES: This table describes damage patterns commonly associated with nonstructural components for Nonstructural Performance Levels. The damage states described in the table might occur in some elements at the Nonstructural Performance Level, but it is unlikely that all of the damage states described will occur in a component at that Nonstructural Performance Level. The descriptions of damage states do not replace or supplement the quantitative definitions of performance provided elsewhere in this standard and are not intended for use in postearthquake evaluation of damage or for judging the safety of, or required level of repair to, a structure after an earthquake. They are presented to assist engineers using this standard to understand the relative degrees of damage at each defined performance level.

Damage patterns in nonstructural elements depend on the modes of behavior of those elements. More complete descriptions of damage patterns and levels of damage associated with damage levels can be found in other documents, such as FEMA E-74 (2011).

ATTACHMENT B

Conceptual Retrofit Details



ROOF FRAMING PLAN

N.T.S.

1

IDS GROUP

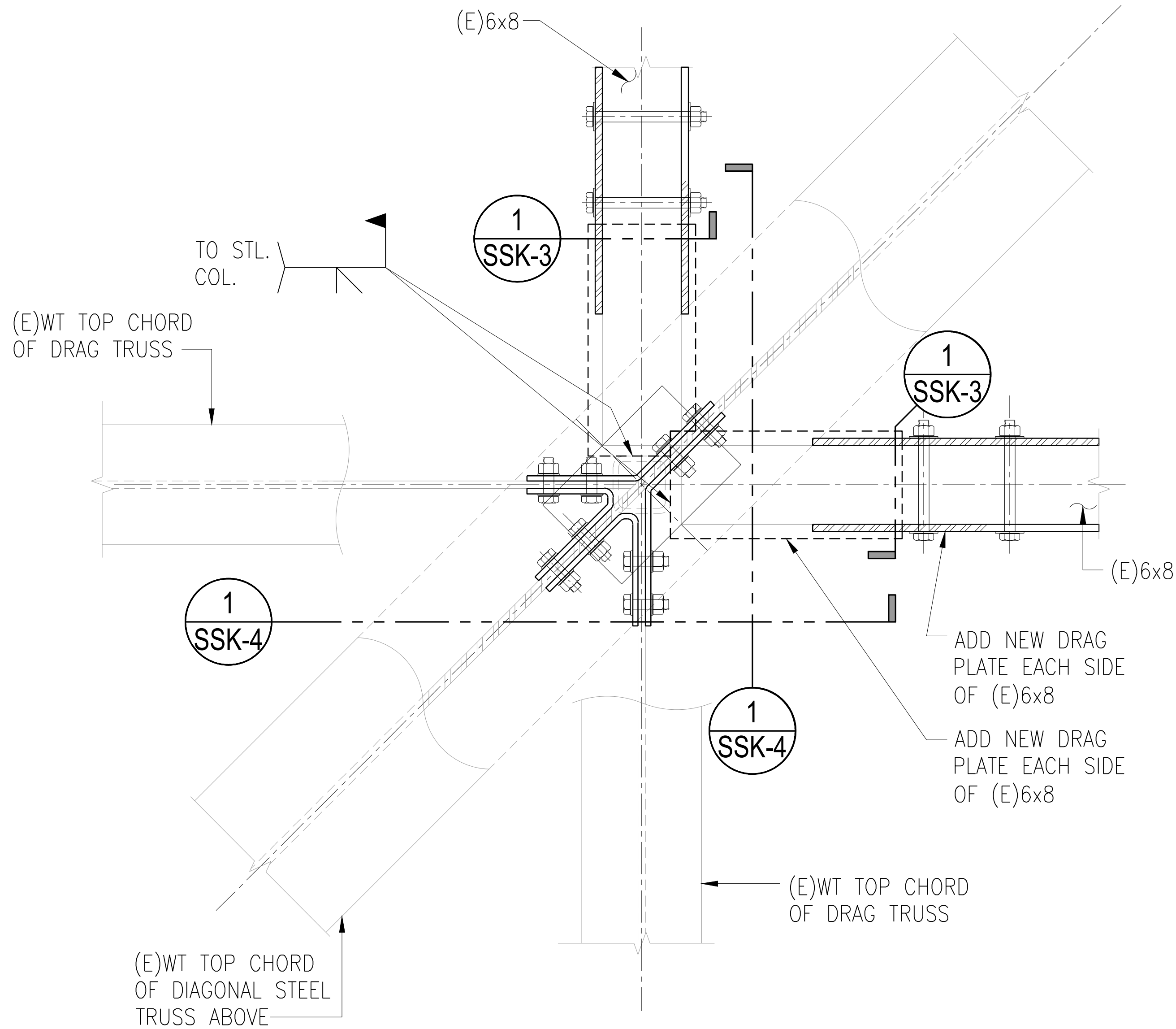
1 PETERS CANYON ROAD, SUITE 130
IRVINE, CA 92606
TEL: 949-387-8500, FAX: 949-387-0800

MWDOC Fountain Valley

Administration Building
Seismic Retrofit Concepts

18700 WARD STREET
FOUNTAIN VALLEY, CA 92708

DATE	SHT. NO.
02/09/2018	SSK-1



PLAN

CONCEPTUAL RETROFIT DETAIL AT ATRIUM CORNER	1"=1'-0"	1

IDS
IDS GROUP
1 PETERS CANYON ROAD, SUITE 130
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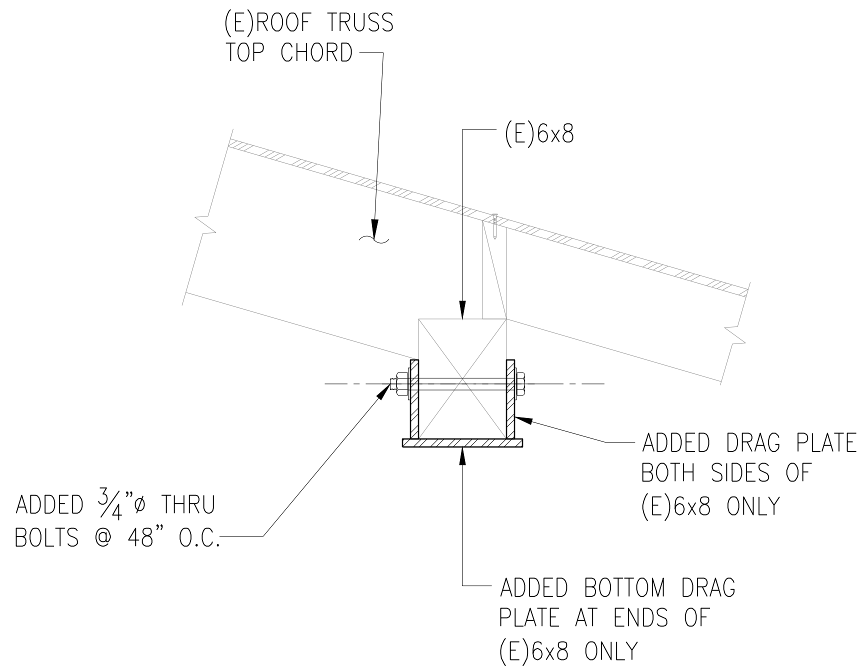
TEL: 949-387-8500, FAX: 949-387-0800

MWDOC Fountain Valley
Administration Building
Seismic Retrofit Concepts
18700 WARD STREET
FOUNTAIN VALLEY, CA 92708

DATE	SHT. NO.
02/09/2018	SSK-2



REINFORCEMENT OF (E) 6x8 CHORD / DRAG MEMBER

1"=1'-0"

1

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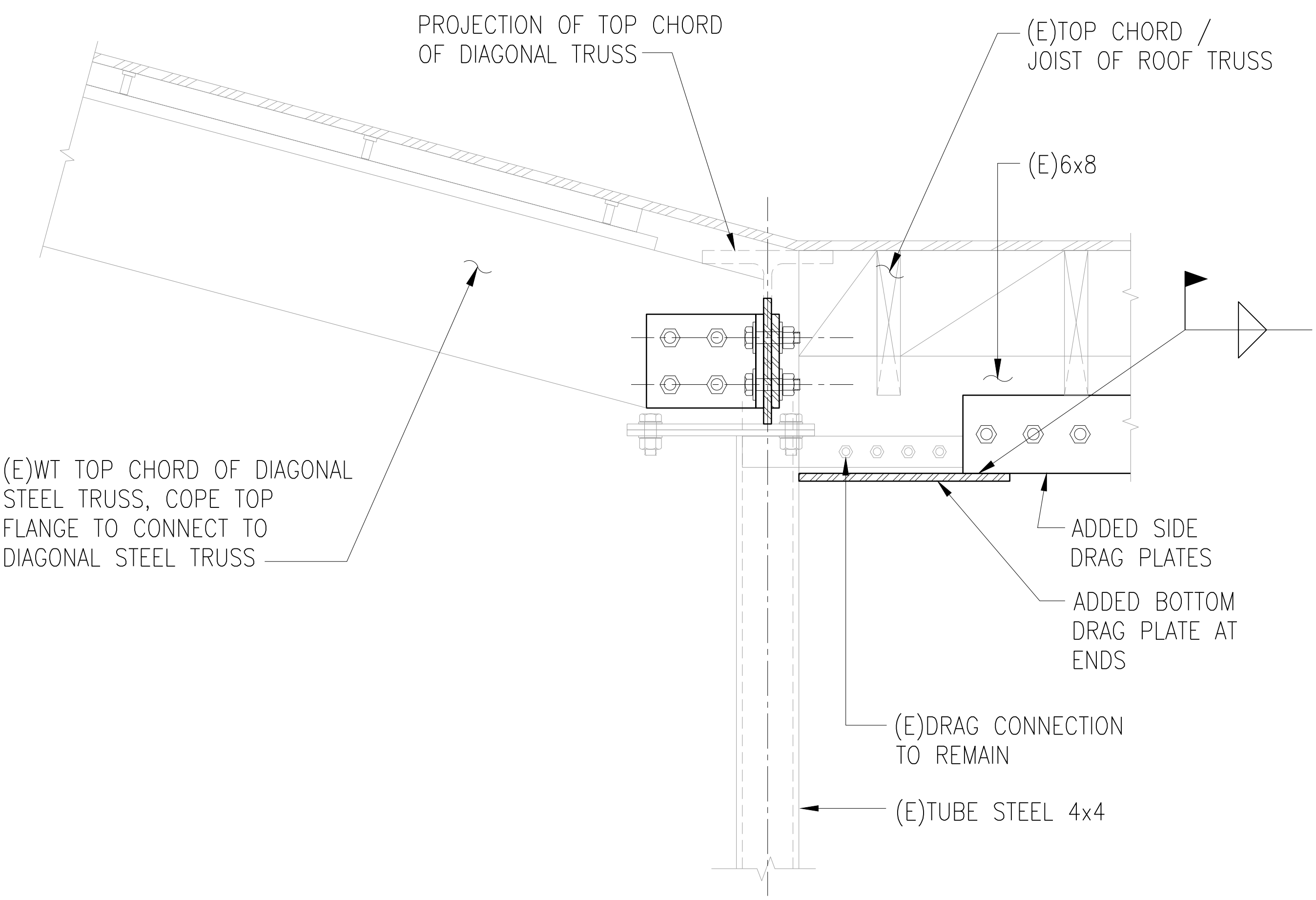
MWDOC Fountain Valley
Administration Building
Seismic Retrofit Concepts

18700 WARD STREET
FOUNTAIN VALLEY, CA 92708

DATE	SHT. NO.
02/09/2018	SSK-3



DIAGONAL CONNECTION TO DIAPHRAGM THRU (E) COLUMN	1"=1'-0"	1

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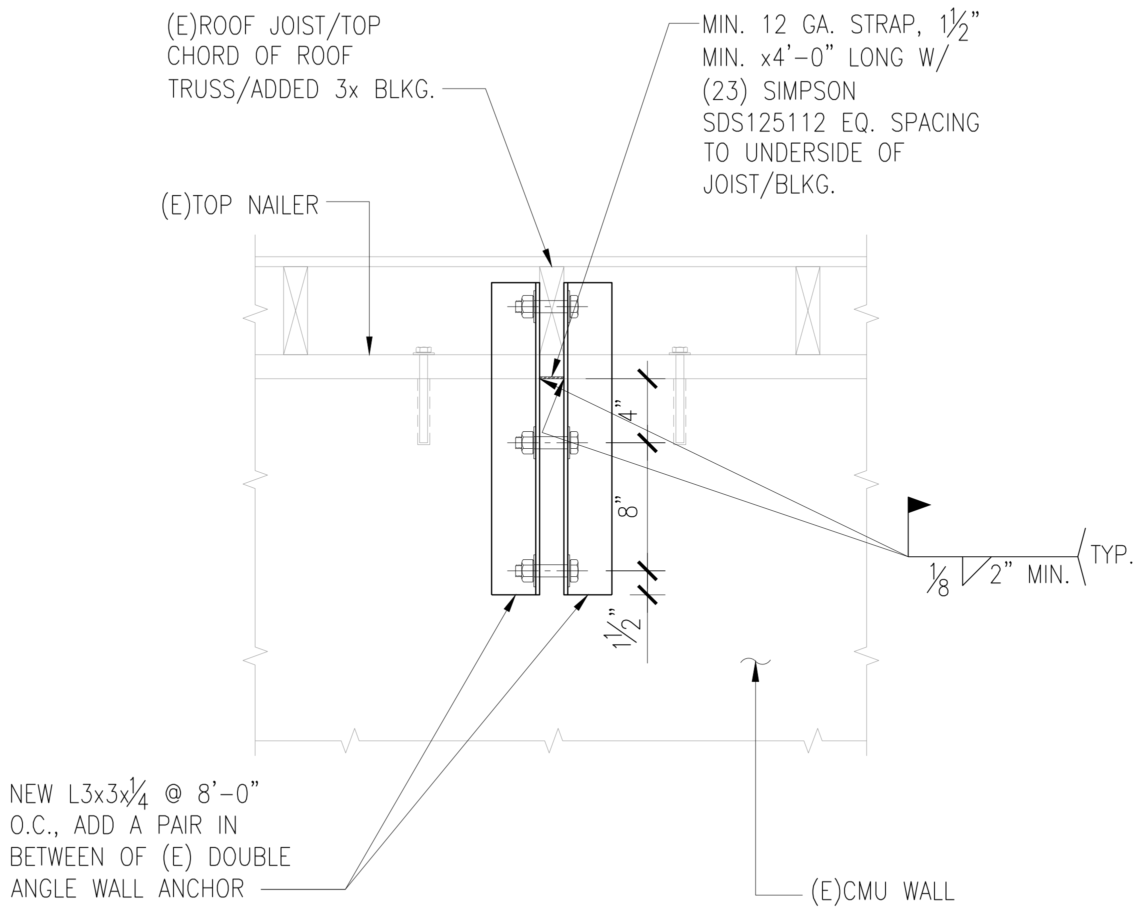
MWDOC Fountain Valley
Administration Building
Seismic Retrofit Concepts

18700 WARD STREET
FOUNTAIN VALLEY, CA 92708

DATE	SHT. NO.
02/09/2018	SSK-4



(FOR IO OBJECTIVE ONLY)

ADDITIONAL WALL ANCHOR DETAIL	1"=1'-0"	1

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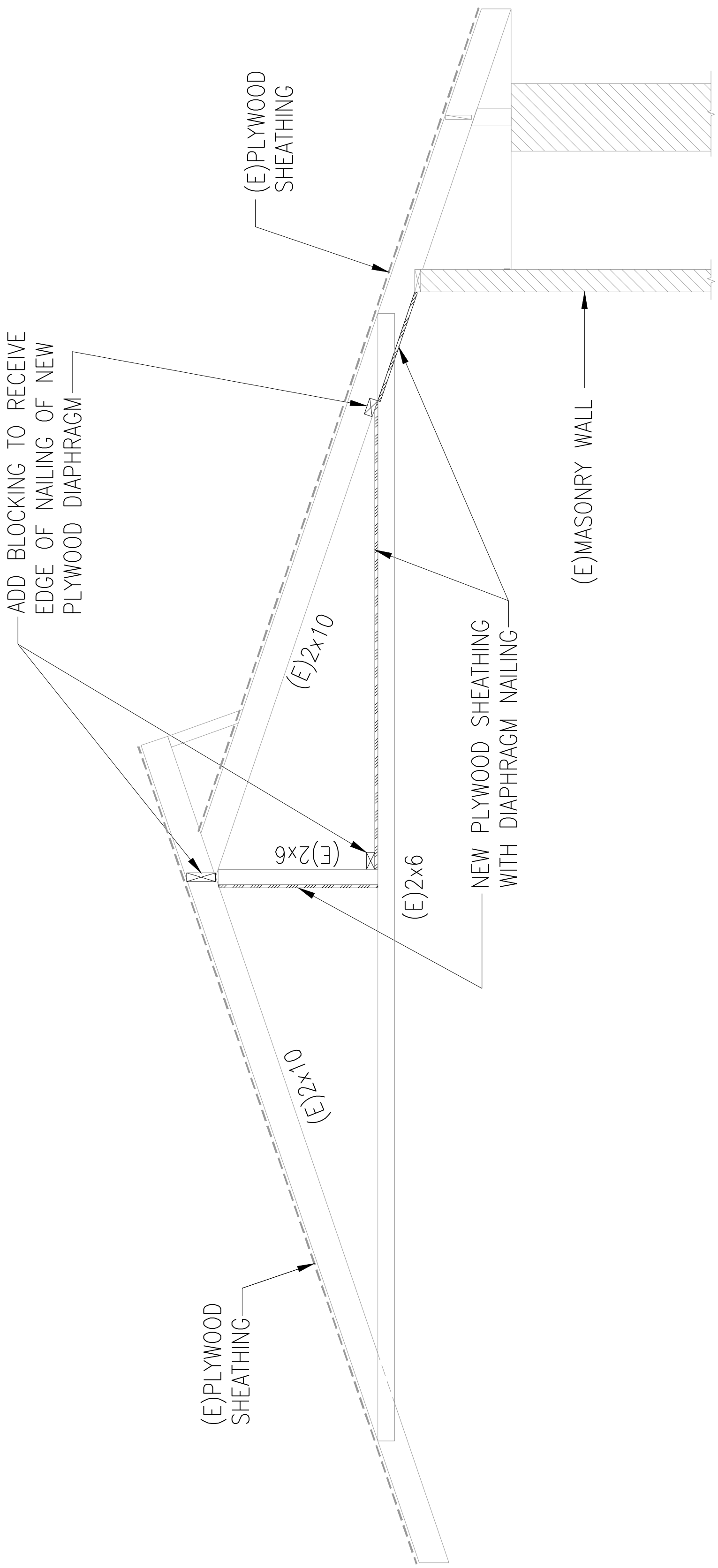
FOUNTAIN VALLEY, CA 92708

DATE	SHT. NO.
02/09/2018	SSK-5



TYPICAL SECTION
(FOR IO OBJECTIVE ONLY)

DIAPHRAGM STENGTHENING	N.T.S.	1

IDS
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1 PETERS CANYON ROAD, SUITE 130
IRVINE, CA 92606
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BE WATER PREPARED
Water Emergency Response Organization of Orange County
PROTECTING WATER THROUGH PREPAREDNESS & RESPONSE COORDINATION

MWDOC Fountain Valley
Administration Building
Seismic Retrofit Concepts
18700 WARD STREET
FOUNTAIN VALLEY, CA 92708

DATE	SHT. NO.
02/09/2018	SSK-6

ATTACHMENT C

IDS Report dated 9/11/2017

“Seismic Assessment of the MWDOC Administrative Building”

September 11, 2017

Ms. Kelly Hubbard
Emergency Services Manager
WATER EMERGENCY RESPONSE ORGANIZATION OF ORANGE COUNTY
18700 Ward Street
Fountain Valley, CA 92708

Subject: ***Seismic Assessment of the MWDOC Administrative Building***
18700 Ward Street, Fountain Valley, CA 92708
IDS Job Number: 17S020.01

Dear Ms. Hubbard:

Per your request, IDS Group, Inc. (IDS) has performed a seismic assessment of the Municipal Water District (MWDOC) Administrative Building located at 18700 Ward Street in Fountain Valley, California for the Water Emergency Response Organization of Orange County (WEROC). This letter presents our opinions, observations, conclusions and recommendations based upon our assessment.

Background

WEROC has been preparing a thorough assessment of their Emergency Operations Center (EOC) facilities and this requested seismic assessment is part of that program.

We understand that the Administration Building was built circa 1972 as a one-story masonry building with a wood-framed roof structure on shallow concrete foundations. A previous seismic study was completed in 1995 by Dames and Moore. Recommendations from that study were implemented in 1999, to bring the building's structural system up to the 1997 Uniform Building Code for non-essential facility performance. The building's fire suppression systems were upgraded in 2015 to meet current building codes.

We understand that this building serves as MWDOC's primary administrative building and is also designated as their backup Emergency Operations Center (EOC). The EOC's principal function is to provide an office space to host emergency water resources personnel during critical events. This space is intended to be used as a communications and resource coordination hub. For this study, the building is considered as a Risk Category IV (essential services) facility.

Purpose

The purpose of this project is to provide a seismic assessment of the WEROC MWDOC Administration Building for consideration as an EOC, and make recommendations, as needed. We understand that their primary concerns are the:

1) Life-safety protection of employees or volunteers working at the facility.

2) Ability of the facility to continue serving as an EOC following anticipated shaking.

Scope

Our scope of services involved the following:

1. Visit the site to verify building framing conformance with available record drawings, and document the condition of the building including identifying areas of obvious damage, corrosion, cracking or settlement.

2. Perform a seismic assessment of the building using the available building information and field information in accordance with the seismic requirements of the 2016 California Building Code and ASCE 7-10, providing the necessary calculations as needed for the various parts of the structure.

3. Prepare this building assessment letter report recommending seismic modifications/ retrofits, as required per the 2016 California Building Code and prepare simple structural drawings as needed for the recommended seismic retrofit (if any). Recommendations related to life safety performance are be identified separate from recommendations related to essential facility performance.

Building Description

Structural drawings for the MWDOC Administration Building were not available in the documents provided. The description provided below was primarily obtained from the available architectural drawings for the Administration Building remodel and construction of the OCWD building [Ref. 1], site observations and the Dames & Moore report [Ref. 3].

The building is a one-story masonry building with a wood framed roof that was constructed circa 1972 [Photos 1 to 6]. It is rectangular in plan having overall dimensions of 144'-8" by 120'-11" and has a rectangular shaped open courtyard at its center that measures approximately 35 feet by 55 feet in plan [Photos 7 & 8]. The building has an overall height of approximately 19 feet at the top of its mansard roof while the perimeter masonry walls are approximately 11 feet tall where they meet the roof framing [Photo 4].

The building is partitioned into offices, conference rooms, kitchen, storage and mechanical equipment areas; a separate lobby structure extends from the south side of the building [Figure 1]. A concrete masonry vault structure exists in the northwest corner of the building [Figure 2].

The building is founded on a level pad elevated several feet above the surrounding grade with the utilities such as gas located below grade to the west. There is an OCWD Administrative building connected via the lobby structure that extends to the south of the MWDOC building. Other buildings and asphalt paved parking areas are located nearby as shown in Figure 1 below.

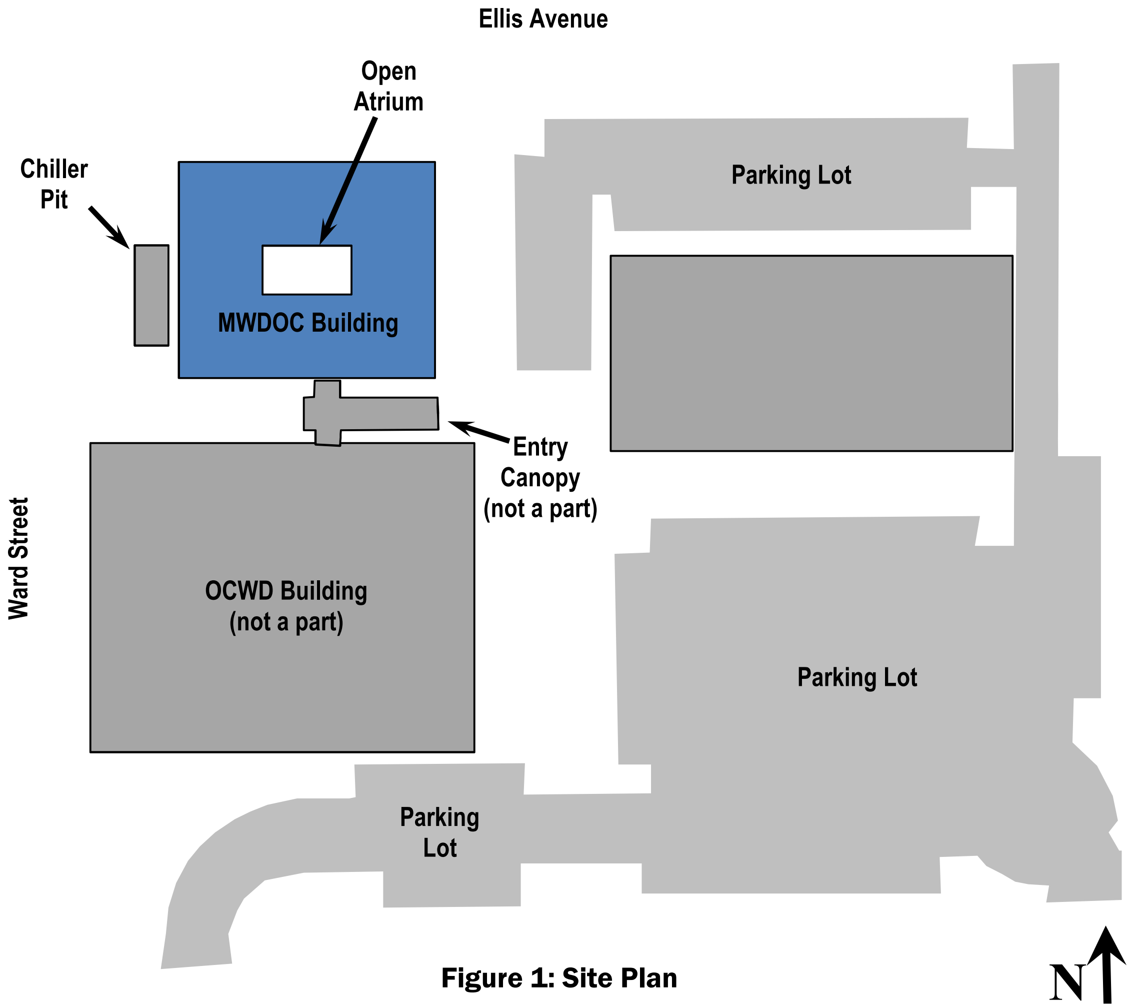


Figure 1: Site Plan

The vertical load resisting system of the building relies on plywood roof sheathing typically supported by sawn 2x wood rafters spaced at 24 inches on center and steel trusses oriented diagonally across the building corners. The roof framing typically bears on the perimeter masonry walls and a series of 6x wood beams supported by steel tube columns along the perimeter of the atrium. The walls and the interior columns are supported on continuous and spread concrete footings.

The building's lateral force resisting system [shown in Figure 2] relies on the plywood roof diaphragm that transfers the seismic forces out to the perimeter concrete masonry walls. These walls transfer their forces to continuous concrete footings and into the site soils.

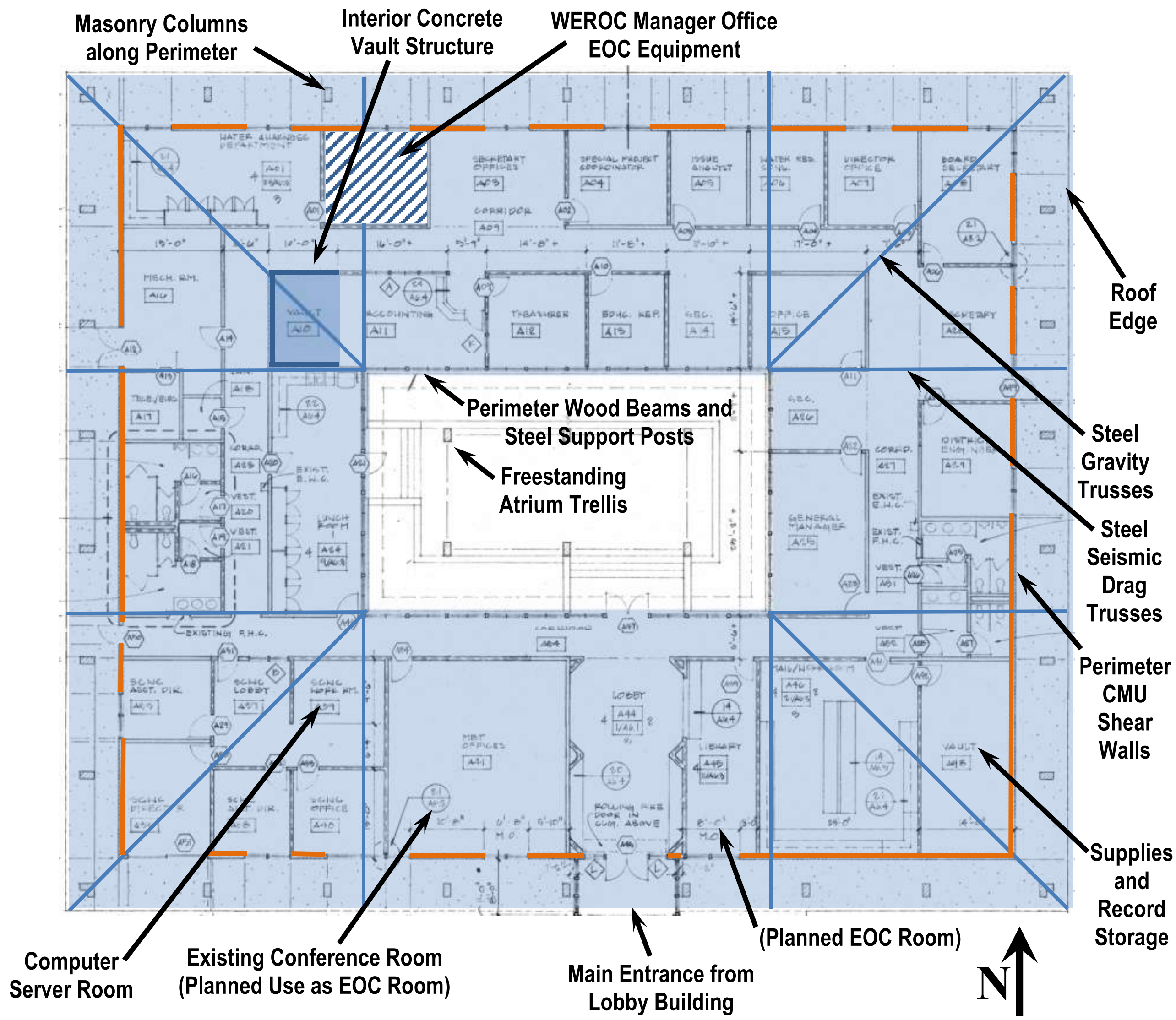


Figure 2: Building Plan Showing Lateral Force Resisting System

We understand that a seismic retrofit was performed in 1999 to bring the facility up to the 1997 Uniform Building Code. Drawings from that retrofit were not available for review, however some elements of a retrofit were observed during our site survey. Those elements primarily included out-of-plane wall anchors spaced at approximately 8 feet on center along the perimeter masonry wall. These anchors appeared to consist of vertical steel angles bolted to the perimeter walls and existing wood framing. Where the roof framing was parallel to the perimeter wall, anchors included a horizontal steel strap extending approximately 4 feet into the wood diaphragm and fastened with screws into 2x blocking.

Summary of Site Observations

David Pomerleau, structural engineer and Maja Milosevic design engineer with IDS visited the site on August 9, 2017 to observe readily accessible areas of the building. No testing or destructive investigation was conducted during this visit. In general, the building's construction appears to be consistent with the available plans. While the primary lateral force resisting system relies primarily on the perimeter masonry shear walls which are generally visible, the other elements of the system and connections between the elements were not generally visible due to the finishes or other obstructions. Overall, the building appears to be in good condition. The following items were noted during our site visit:

- Seismic Retrofit Connections – Out-of-plane connections of the perimeter masonry walls to the roof diaphragm are typically spaced at approximately 8 feet on center. Two primary versions of this connection were observed. One connection had the angles and strap connections on the inside face of the wall with blocking between the roof framing members [Photo 9]. These connections were typically observed at the building corners. Some locations revealed apparent installation deficiencies [Photo 10]. Another connection appeared to have most of the seismic connection on the exterior face of the wall. This connection was not visible, but its presence was inferred from the pattern of bolts observed protruding through the perimeter masonry wall at a spacing similar to the other seismic connections [Photo 11]. Seismic retrofit connections are also apparent at the corners of the atrium area. In these locations, bolted plates with welded connections to the steel drag trusses were observed [Photo 12].

- Interior Partition Bracing – Interior partitions have incomplete, steep, widely spaced or insufficiently attached bracing to roof framing members [Photos 13 to 16]. Some of these braces were fastened at framing locations without blocking or stability bracing. [Photo 15].

- Computer Equipment Not Anchored – Computer equipment, including the main servers for the building, that are presumed critical to the emergency operations generally have no seismic restraint or seismic straps and anchors were not engaged [Photos 17 to 20].

- Contents Not Anchored – Tall and narrow book cases located in offices as well as the building corridors are not anchored [Photos 21 and 24]. Several maps in the front conference room have support clips without sufficient seismic restraint.

- Piping Not Sufficiently Anchored – Piping is insufficiently supported and braced, especially in the ceiling above the computer server room where line breakage could flood the computer equipment [Photos 25 and 26]. Photo 26 shows some small diameter lines that have the potential to impact the structural framing due to the swaying or movement of the mechanical unit above the ceiling of the computer room. This type of impact could cause a leak. Fire sprinkler lines exist both protruding through the suspended ceiling of the computer room and in the attic space above the computer room. If the system were to discharge or open, the computer system would be flooded.

- Mechanical Equipment Not Sufficiently Anchored – Mechanical equipment located within the building's mechanical room does not have sufficient seismic restraint [Photo 27]. Additionally, mechanical units suspended within the ceiling space have no lateral bracing [Photo 28].
- Suspended Ceilings – The ceilings generally have suspension and bracing including compression posts at brace locations [Photo 29]. However, improper bracing conditions were still observed [Photos 30 to 32]. Ceiling grids are generally not anchored along their perimeter. Additionally, the perimeter ceiling support angles are generally too narrow and irregularly anchored to properly support the ceiling grid. The grid near the concrete vault in the northwest corner have perimeter support angles insufficiently fastened to the concrete vault.
- Light Fixture Supplemental Support Wires Generally Present – The light fixtures in the ceiling system generally have supplemental support wires on all four corners of each fixture [Photos 29, 31 and 32]. Limited locations have improperly installed wires [Photos 33 and 34].
- Concrete Vault – The concrete vault located in the northwest corner of the building has been modified from the configuration shown on the available record drawings. It appears that a wall has been removed from this vault leaving only three walls as shown in Figure 2 above. Additionally, horizontal steel tube reinforcement elements appear to have been added to the top of the vault [Photos 35]. The ceiling system surrounding this vault is rigidly connected to the vault with some of the fasteners improperly or incompletely installed [Photo 36].
- Loose Tiles – Roof tiles were observed to be loose and could become detached and pose a falling hazard.

Summary of Structural Review

IDS reviewed the available record drawings in reference to the building's seismic force resisting system and performed preliminary calculations based on the seismic force requirements of the 2016 CBC.

IDS also used the Tier 1 Checklists from the ASCE Standard 41-13 [Ref. 7] to provide a basic screening for seismic deficiencies. ASCE 41 is a national standard widely used for the seismic evaluation of structures. Its Tier 1 procedure is a screening type of methodology intended to quickly identify potential seismic deficiencies of various structural systems and non-structural elements.

The following issues were identified through our review:

- Liquefaction – We reviewed the Seismic Hazard Zones map for this area [Ref. 7], and determined that the site is located within a regional area identified as a liquefaction zone. The USGS defines this as an area "where historic occurrence of liquefaction, or local geological, geotechnical and groundwater conditions indicate a potential for permanent ground displacements such that mitigation" would be required. Since the building is understood to be supported by shallow foundations, we would anticipate structural damage even though the building is relatively light. This damage could also include breaking of glass around the interior atrium area as the building displaces. Along the front/south side of building, the atrium glazing occurs along the main building corridor which could create issues for immediate occupancy and use. Additionally, soil instabilities may also result from the spreading of the raised pad that the building rests on. These instabilities would add to building displacements which could affect glazing and the operation of doors. More broadly, depending on the amount of liquefaction that occurs, the site's utilities, its overall function, the city and the surrounding area are expected to have increased damage and loss of functionality due to liquefaction.

- Insufficient Wall Anchorage – Wall anchorage connections having straps to wood blocking are insufficient to resist the anticipated lateral forces required by the current Code based on the observed connections at each corner of the building. Other connections along the sides of the building away from the corner were not visible and their capacity is unknown.

- Adjacent Structures – There is insufficient gap between the Administration Building and the Lobby Building to the South. However, damage resulting from impact of these two buildings is not anticipated to be significant since the structural and non-structural systems at the interface essentially mirror each other.

- Fire Suppression Piping – Fire suppression piping appears to be generally compliant regarding seismic restraint detailing, but locations were observed throughout the structure where vertical restraints at support locations are not compliant and impact with adjacent items which could damage the sprinkler lines could occur.

- Contents and Furnishings – Contents and furnishings are generally unanchored and unbraced.

- Lights, Ceilings and Partitions – Support and bracing of lights, ceilings and partitions was found to be deficient.

Conclusions and Recommendations

In general, the building was found to be in relatively good condition for its age and structural system and seismic restraint and bracing systems were generally found to be present. We note that the building was originally designed, constructed and even retrofitted as a non-essential facility.

However, the Immediate Occupancy performance level desired for Emergency Operations use is a high level of performance that is often difficult to consistently and completely achieve. Based on our site visit and observations of the building, as well as preliminary calculations, the MWDOC Administration building is insufficient to provide immediate occupancy performance following a major earthquake.

While some occupant injuries might occur during the earthquake, the overall risk of life-threatening injury because of structural damage is expected to be low. While the Administration building has numerous beneficial features that will contribute to better performance such as a masonry shear wall lateral system, modern single-story construction, and previous seismic retrofit; it also has many features that detract from its ability to serve as an essential facility.

The current Building Code does not require upgrade of the existing seismic force resisting system unless alterations are considered such as change of occupancy, increase of building mass or size, and modifications of the existing lateral force resisting system. However, in its current configuration, we do not believe that the Administration building will meet the structural and non-structural performance objectives desired by WEROC.

We do not believe that there are any substantial issues that would prevent the building from performing at the Life-Safety performance level similar to other office occupancy buildings of this type and vintage.

For this building to serve as an essential facility serving critical functions following a major earthquake, the following items, at a minimum, would be necessary:

1. <u>Upgrade of the Seismic Force Resisting System</u> – The previous seismic retrofit was not performed to the force levels and detailing requirements of the current codes for essential services performance. Additionally, that retrofit focused on building structural issues and did not include review of non-structural performance or contents. More specific information would be required of the existing seismic retrofit and a complete assessment of as-built conditions would be required to provide more specific recommendations. Several key deficiencies of the building include adequacy of the out of plane wall anchors. Consideration of liquefaction effects is also necessary to achieve the desired performance. However, regarding liquefaction, the consideration of the performance of the overall facility and utilities is also recommended.

2. <u>Glazing</u> – Performance of the building glazing, especially along the front hallway at the building entrance and outside the conference room intended to serve EOC functions, should be considered. Damage to this glazing may present safety hazards in these areas.

3. <u>Ceiling and Light Support and Bracing Improvements</u> – Ceiling edge angles and restraints do not comply with current code. Bracing and light supports should be reviewed and improved

throughout the building to reduce the likelihood of ceiling damage and falling panels that could inhibit the operation of the building following a major earthquake.

4. Anchor Non-Structural Elements and Equipment – Anchorage and bracing of non-structural elements and equipment is necessary to prevent or reduce falling objects and potential damage to equipment necessary for emergency operations. Additionally, we recommend consideration of moving the computer server room to an area free from overhead piping and possibly providing a room with a dry fire suppression system that would not impair the server if it were to be implemented.

5. Secure Loose Roof Tiles – Securing of loose roof tiles is recommended to prevent or reduce the potential for falling objects.

References

1. Grillas, Pirc, Rosier, Alves; "MWDOC/OCWD Office Complex, 10500 Ellis Avenue, Fountain Valley, California;" Sheets T1.1, T1.2, C1.1, C1.2, C3.1, C3.2, C4.1, C5.1, C5.2, A2.1 to A2.4, A3.1 to A3.8, A4.1 to A4.3, A5.1, A5.2, A6.1 to A6.5, A7.1, A7.2, A8.1 to A8.6, *{OCWD structural drawings only}* S1.1, S2.1, S3.1 to S3.3, S4.1, S4.2, S5.1 to S5.4, M1.1, M1.2, M2.1, M3.1 to M3.6, M4.1, M5.1, M6.1, P1.1, P2.1, P3.1 to P3.5, E1.1, E2.1 to E2.5, E3.1 E3.2, E4.1, E4.2, E5.1, E5.2, E6.1, E7.1, E8.1, L2.1 to L2.4, L3.1, F3.1, I3.1, I3.2; Not for Construction Set; Dated 6/9/89.

2. Thornton Tomasetti/Coil & Welsh; "Tenant Improvements for Orange County Water District Administration Building (MWDOC), 10500 Ellis Ave., Fountain Valley, CA 92708; Sheets S-0, to S-2, Dated 1/17/03.

3. Dames & Moore; 1996 EqRiskReductionStudy MWDOC Bldg.

4. PDC Interiors; "MWDOC Entry/Conference Room, MWDOC Reception Floor Plan;" Proposed Sheet A1.0, Dated 3/4/2016.

5. California Building Standards Commission; "2016 California Building Code, California Code of Regulations Title 24."

6. American Society of Civil Engineers (ASCE); "Minimum Design Loads for Buildings and Other Structures (ASCE/SEI 7-10)."

7. American Society of Civil Engineers (ASCE); "Seismic Evaluation and Retrofit of Existing Buildings (ASCE/SEI 41-13)."

8. State of California Division of Mines and Geology; "State of California, Seismic Hazard Zones – Newport Quadrangle;" released April 15, 1998.

Limitations

This letter report is intended for the sole use of Water Emergency Response Organization of Orange County in its evaluation of the subject property. It is not intended for use by other parties, and may not contain sufficient information for purposes of other parties or other uses. This letter report is based on our observations of readily accessible areas, review of available drawings, rough engineering calculations related to the building's lateral force resisting system and our engineering judgment and experience. Our assessment is limited to the building's primary structural systems in relation to seismic performance. Evaluation of site related seismic hazards such as liquefaction and slope stability is limited to a review of available regional hazard documentation. Evaluation of nonstructural items such as architectural elements, furnishings and interior equipment, and electrical, mechanical, and plumbing systems are not considered in this evaluation. Evaluation of site utilities serving the building is excluded. Evaluation of other hazards affecting essential services performance such as fire, flood and wind are excluded. Testing, destructive or otherwise, was not performed. Our limited investigation should not be considered a review of the design, nor an inspection of latent conditions that have not manifested damage to date. Other conditions affecting the structure that were not inspected, anticipated, or accessible including all public safety issues, are beyond the scope of this report. Our professional services have been performed with the degree of care and skill ordinarily exercised, under similar circumstances, by reputable consultants practicing in this field at this time.

♦◆♦

Thank you for allowing us this opportunity to be of service on this project. If you have any questions regarding this letter report, please do not hesitate to contact us.

Sincerely,

IDS Group, Inc.

David Pomerleau, SE
Project Manager

Said Hilmy, Ph.D., SE, LEED AP
Principal

REGISTERED PROFESSIONAL ENGINEER
SAID I. HILMY
No. 3680
STRUCTURAL
STATE OF CALIFORNIA

Canopy to Building Entrance

Building Pad Several Feet Higher than the Surrounding Site

Photo 1: Building Overview from Southeast Corner

Adjacent Chiller Pit

Photo 2: Building Overview from Southwest Corner

Photo 3: East Side of Building

Photo 4: North Side of Building

Photo 5: South Side of Building at Entry Lobby

Photo 6: North Side of Building

Photo 7: Free Standing Trellis in Atrium

Photo 8: Free Standing Trellis in Atrium

Photo 9: Typical Out of Plane Wall Anchorage Connection

Photo 10: Close-up Showing Gap at Seismic Blocking

Photo 11: Wall Anchorage Connection Presumed to Exist on Far Side of Wall

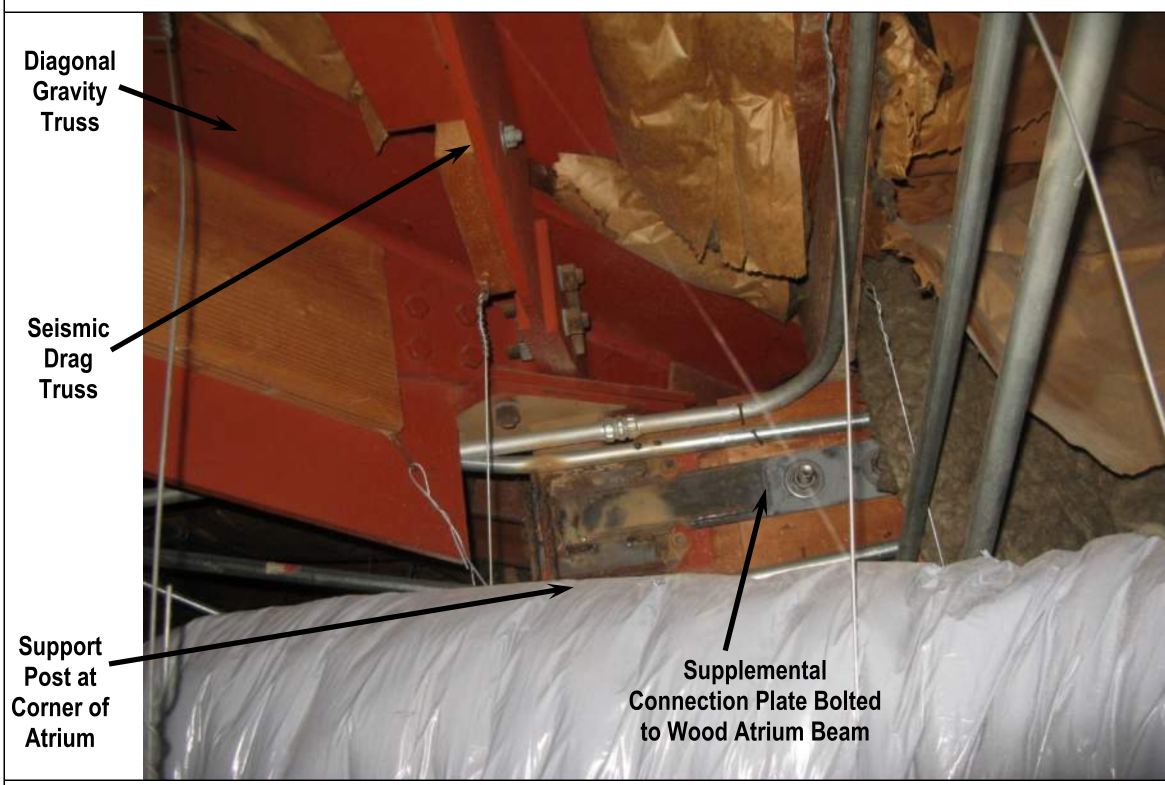


Photo 12: Roof Seismic Connection at Atrium Corner

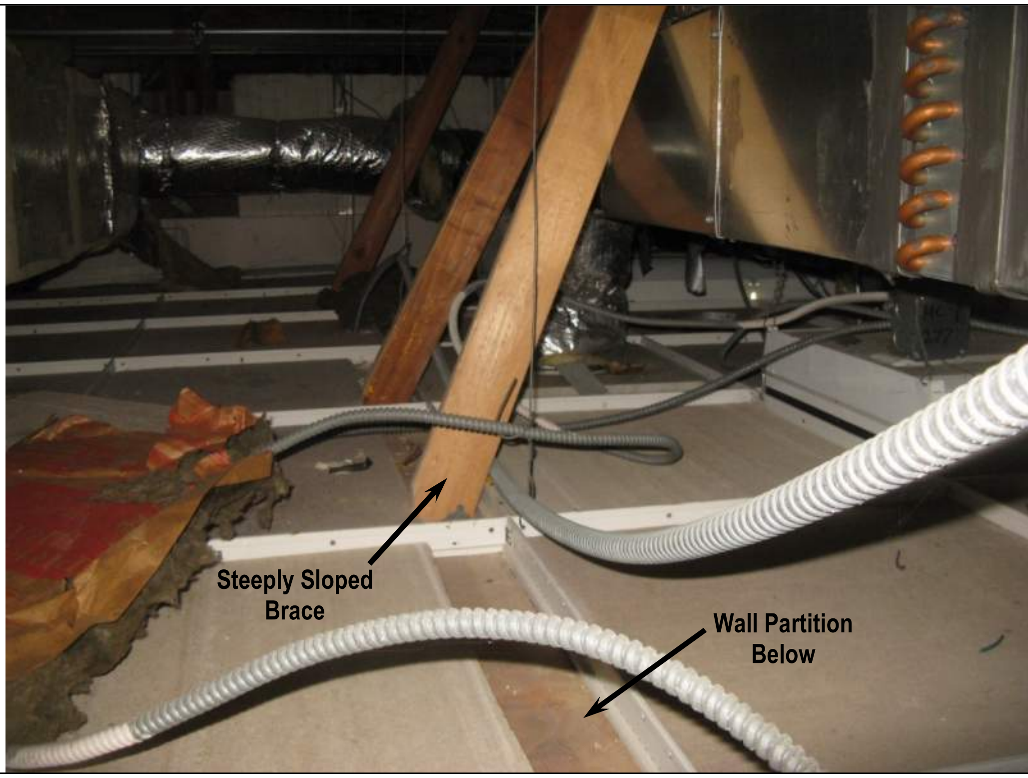


Photo 13: Steeply Sloped Partition Bracing

Photo 14: Interior Partition Bracing Connection

Photo 15: Partition Brace to Unbraced Roof Framing

Wall
Partition
Below

Photo 16: Widely Spaced, Steeply Sloped and Inadequate Brace Connection

Photo 17: Computer Server Cabinet Not Anchored

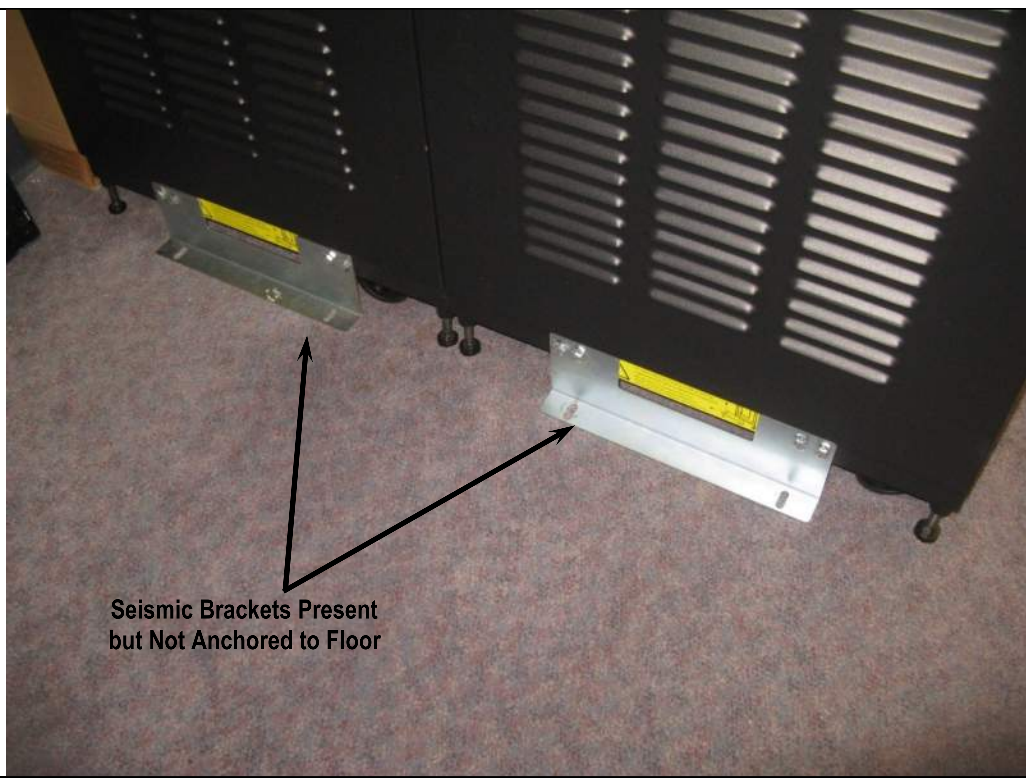


Photo 18: Computer Server Cabinet Not Anchored

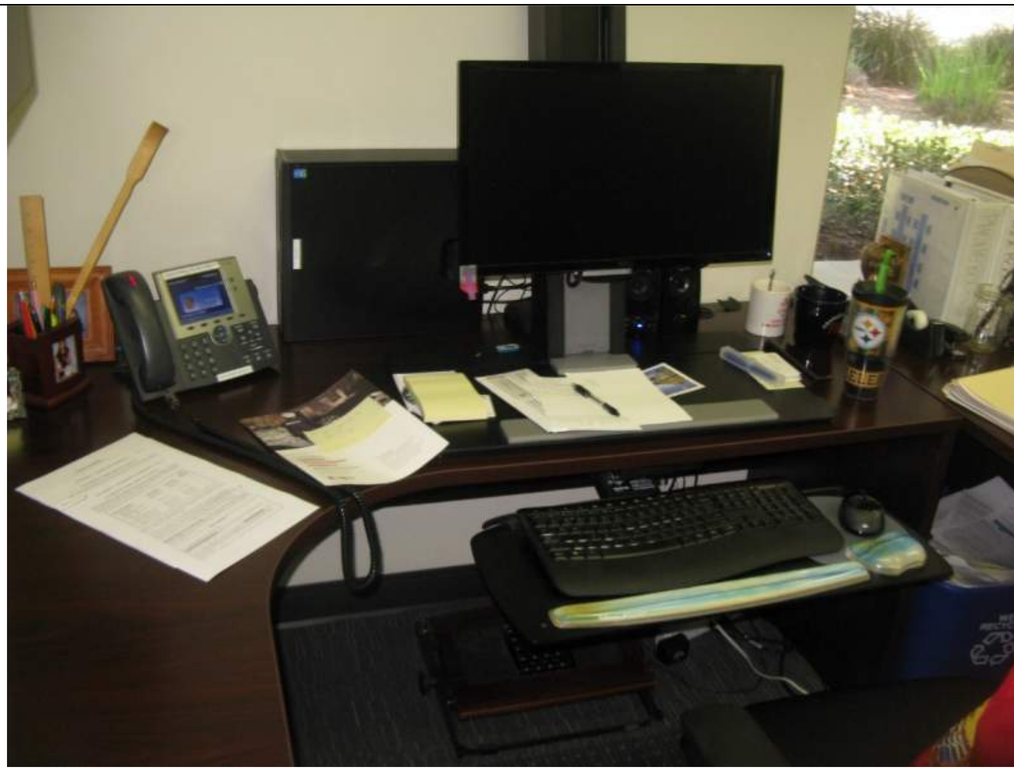


Photo 19: Typical Unanchored Office Computer Equipment

Photo 20: Unrestrained Communications Equipment

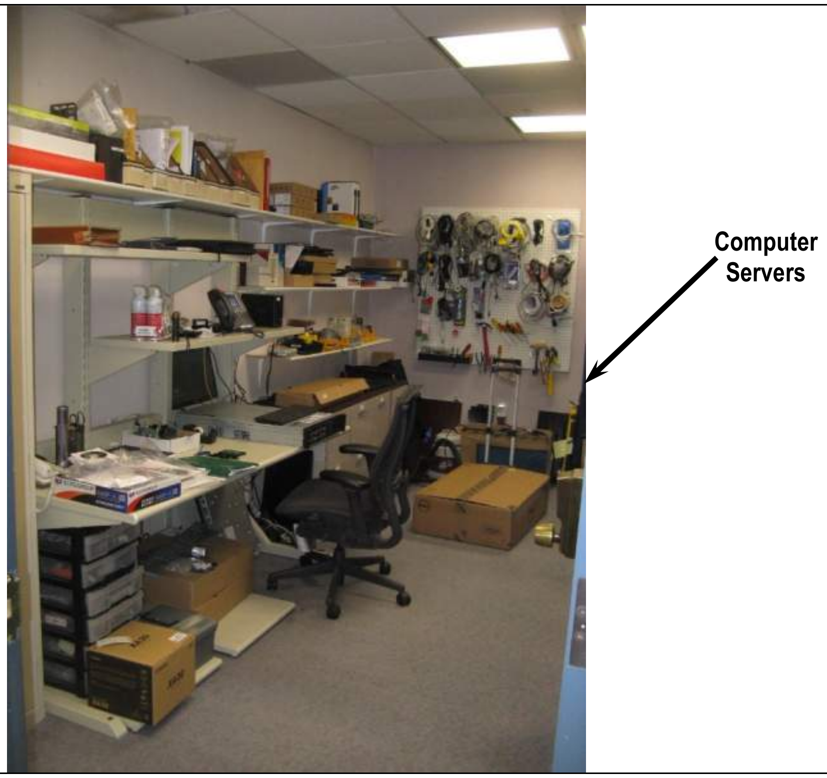


Photo 21: Unrestrained Contents in Computer Server Room

Photo 22: Unanchored Tall Narrow Contents in Hallway

Tall Narrow Contents Not Restrained

Photo 23: Storage Room at Southeast Corner

Fire Sprinkler Riser

Tall Narrow Contents Not Restrained

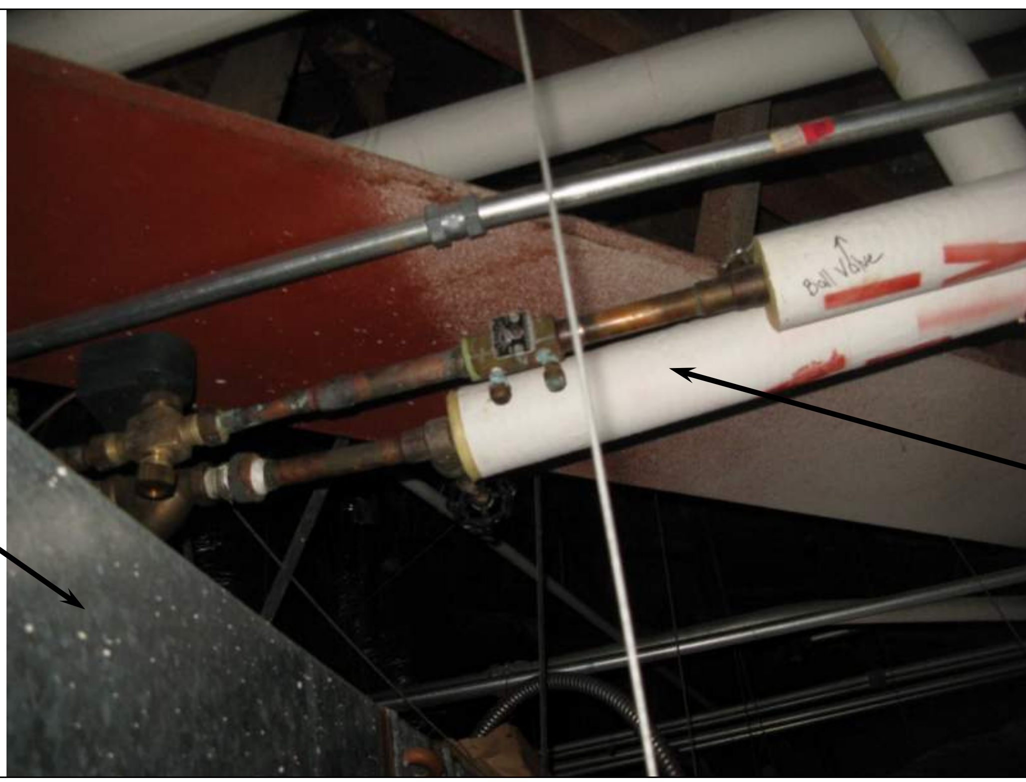
Photo 24: Storage Room at Southeast Corner

See Photo 26 for View Above

Pipe Hanger Detached

Photo 25: Piping in Ceiling Above Computer Room

Mechanical Unit



Piping & Valves Could Impact the Structural Framing

Photo 26: Water Piping in Ceiling Above Computer Room

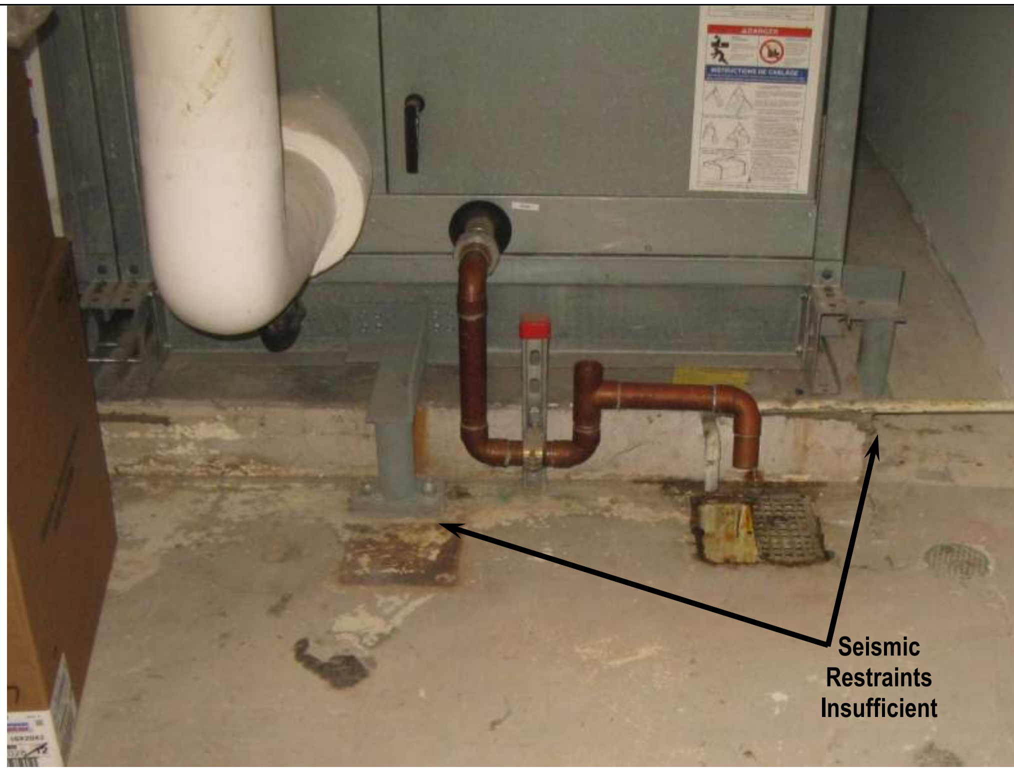


Photo 27: Mechanical Unit in Mechanical Room

Photo 28: Typical In-Line Mechanical Unit without Seismic Bracing

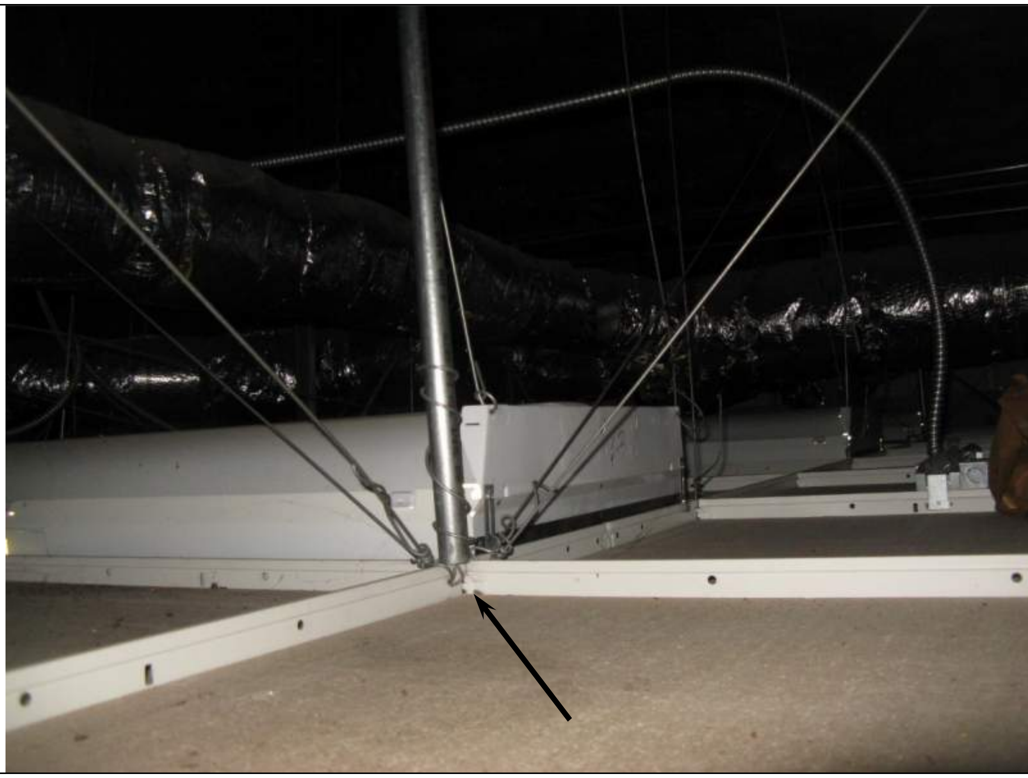


Photo 29: Typical Ceiling Bracing with Compression Post

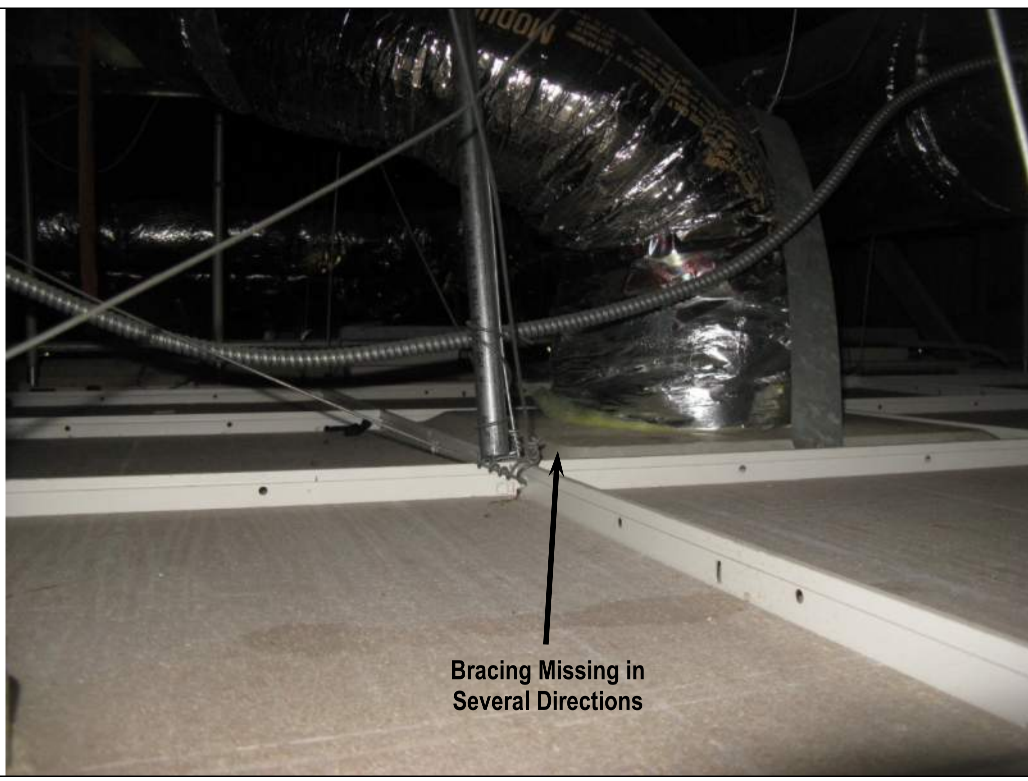


Photo 30: View of Incomplete Lateral Bracing

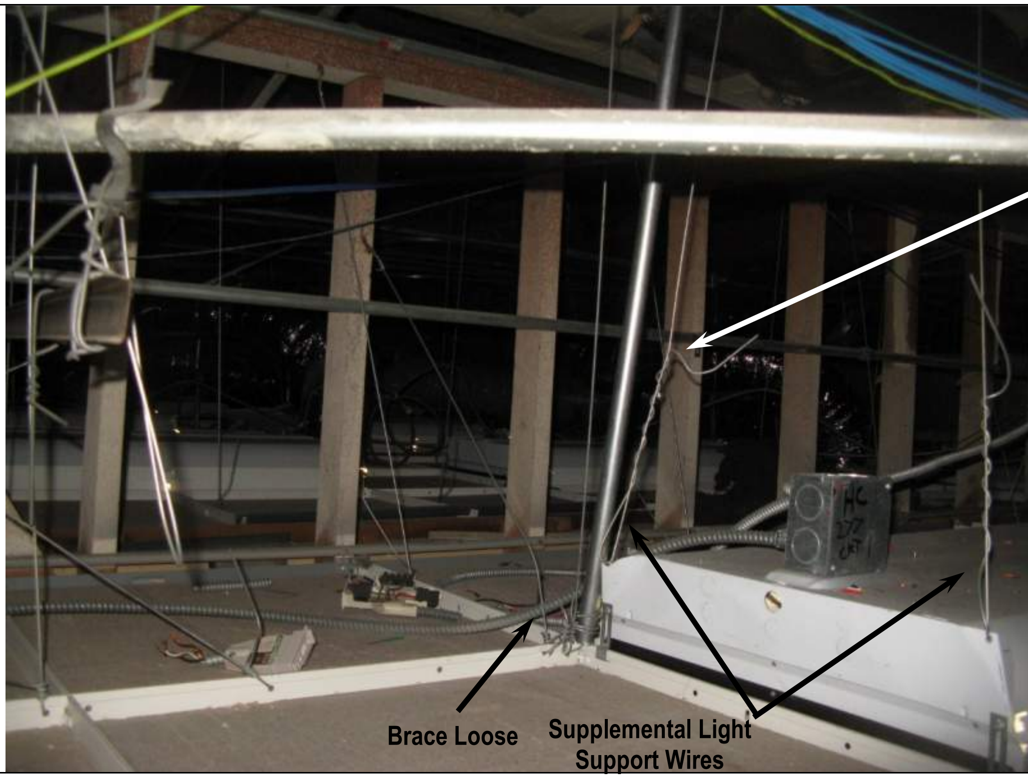


Photo 31: Incomplete/ Improper Ceiling Bracing

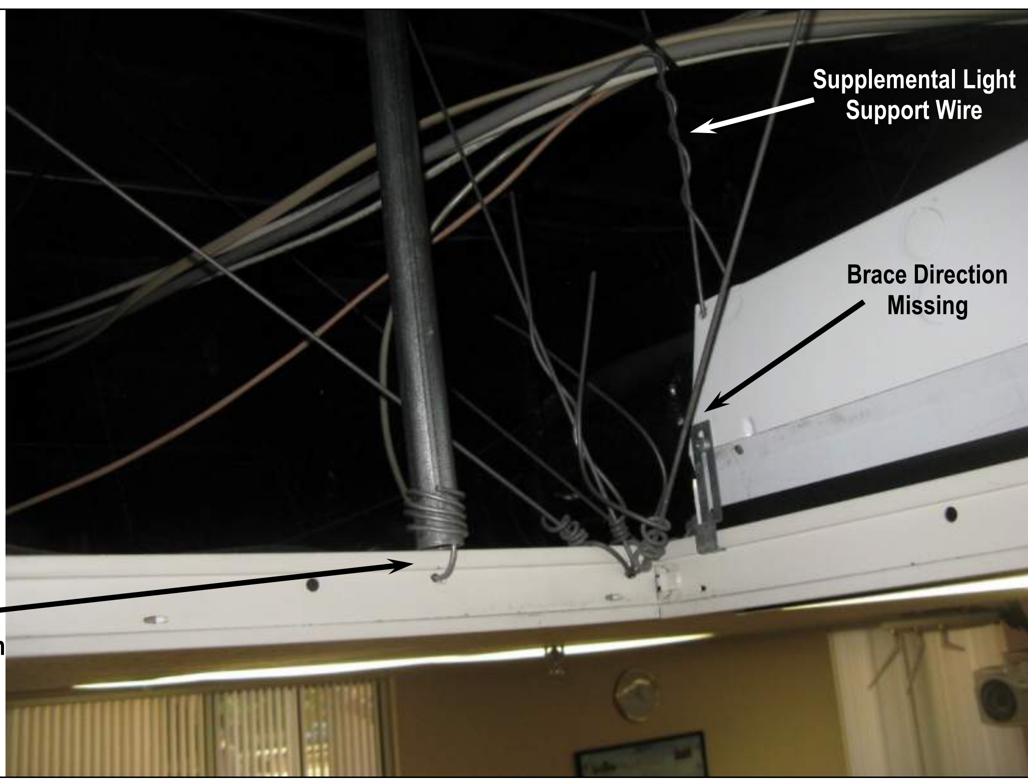


Photo 32: Improper Ceiling Bracing Above Front/Main Conference Room

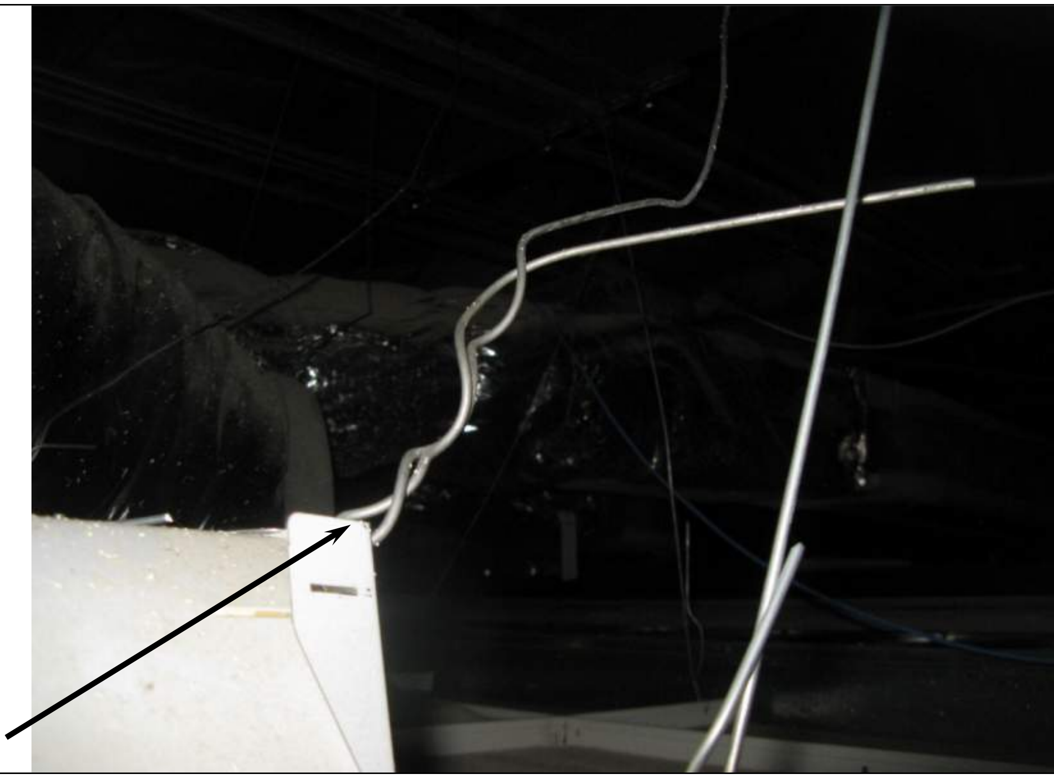


Photo 33: Improper Light Support Wire

Photo 34: Improper Light Support Wire

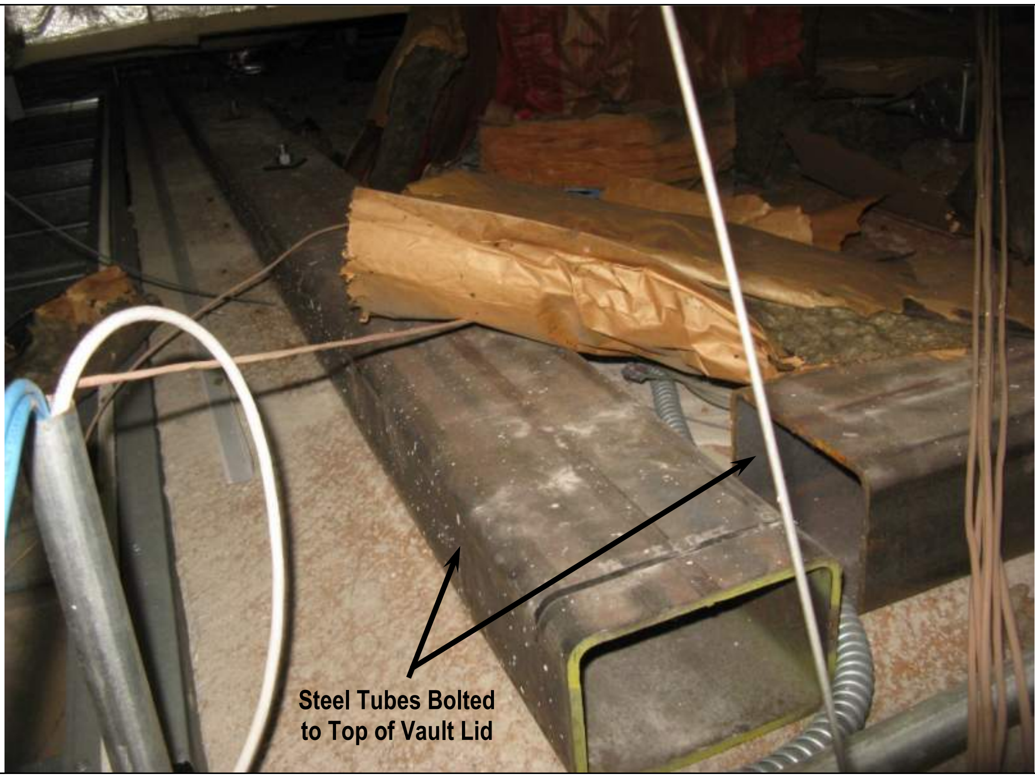


Photo 35: Reinforcement of Vault Lid

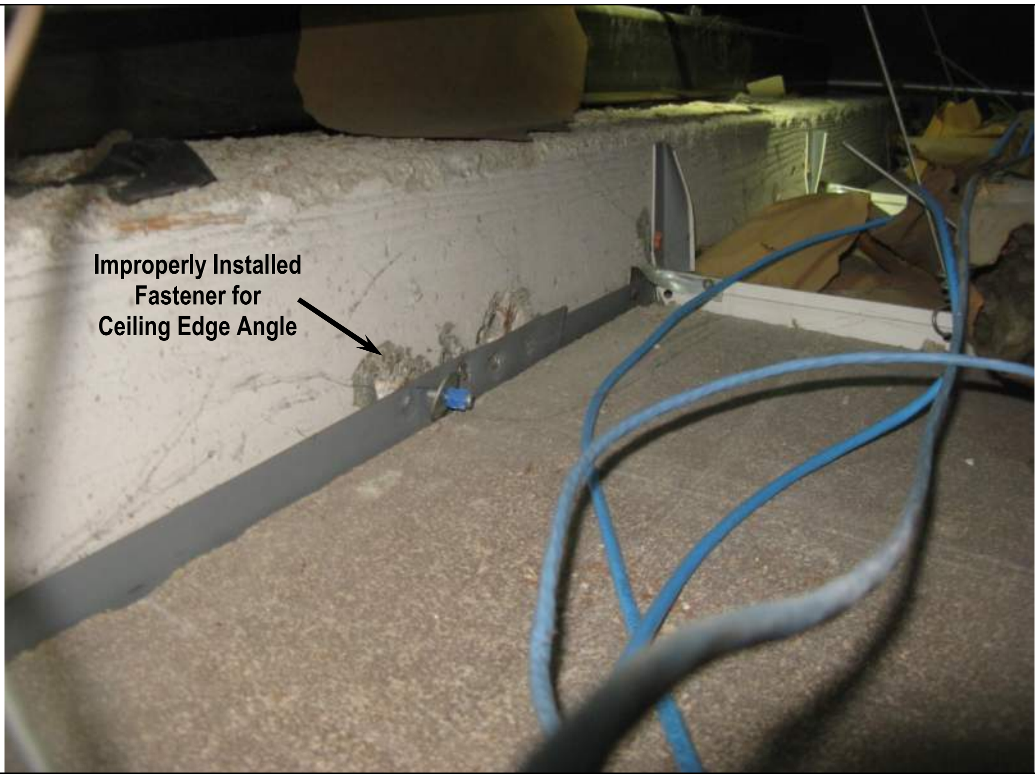


Photo 36: Ceiling at Northwest Vault Lid