ZFA STRUCTURAL ENGINEERS

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Kensington Public Safety Building: Risk Assessment Report

The Kensington Public Safety Building is undergoing a retrofit in accordance with the 2019 California Existing Building Code in order to address potentially life-threatening seismic deficiencies. While this retrofit will conform to code due to the extensive nature of the planned upgrades to the building, the Board of Directors desires to better quantify the increase in performance the structure experiences due to the retrofit. ZFA has performed an Advanced SP3 Risk Analysis following the FEMA P-58 methodology, a national standard for performing seismic risk assessments. The methodology focuses on three key metrics – Financial Losses, Loss of Life, and Recovery Time – in the wake of a seismic event.

Summary of Risk Assessment Approach

To properly capture the performance of the building, ZFA produced (4) analytical building models in the SP3 software – (2) existing and (2) retrofitted – and then averaged the results of the models based on the proportion of building area included in each. The models included structural and non-structural components which are assigned acceleration and drift capacities. In an earthquake, the whole building and its contents move. SP3 provides values for standard building components and evaluates the probability of damage across 2500 iterations at each prescribed intensity. For the Kensington Public Safety Building, ZFA evaluated the following **Return Periods**: 50% in 50 year, 10% in 50 year, Code Design Earthquake, 5% in 50 year, Code Maximum Considered Earthquake, and the 2% in 50 Year. These **Return Periods** coincide with a particular **Seismic Event Intensity**, as defined below, of shaking and peak ground acceleration. The ground acceleration values are based on the United States Geological Survey (USGS) database. The damage consequences are defined as cost, risk to human life, and time to repair or regain function.

In this report, ZFA has focused on the 10% in 50 year event as the return period is independent of the site. Typically, the 10% in 50 year event is equivalent in intensity to the Code Design Earthquake. However, the Code Design Earthquake return period and intensity varies by site which leads to difficulty in comparing and understanding risk assessment results. Thus, to provide a clear statement of performance for the Public Safety Building, we highlight the 10% in 50 year seismic event.

In addition to this brief report, ZFA has prepared a set of summary sheets featuring graphics and figures related to the analyses performed at each intensity.

Risk Assessment Background – Definitions

- Scenario Expected Loss (SEL): The average losses for a given scenario
- Scenario Upper Loss (SUL): Losses which have a 90% probability of not being exceeded for a given scenario
- Seismic Event Intensity: The probability of exceedance of ground shaking in a given time period; e.g. "10% in 50 years" corresponds to the level of shaking that has a 10% probability of being exceeded over a 50-year period.
- Casualty: Injury or Death due to earthquake shaking and falling hazards.
- **Functional Recovery:** Time to complete repairs such that the damaged building can support its pre-earthquake function.

- **Red Tag:** Unsafe placard posting from a post-earthquake building evaluation. Redtagged buildings
- **Code Design Earthquake***: The earthquake effects that are two-thirds of the corresponding risk-targeted maximum considered earthquake (MCE_R) effects.
- Code Maximum Considered Earthquake (MCE_R)*: The most severe earthquake effects considered by ASCE 7 determined for the orientation that results in the largest maximum response to horizontal ground motions and with adjustment for targeted risk.

*Definitions taken directly from ASCE 7-16, *Minimum Design Loads and Associated Criteria for Buildings and Other Structures*

Results Summary – 10% in 50-year Event

Financial Losses: In the existing building, the expected (mean) losses were 42% of the total building replacement value. In the retrofitted structure, the losses were reduced to 14%, for a net gain of 28%. This 28% gain is equivalent to approximately \$3 million saved in postearthquake construction costs for the design-level event – the relative intensity of shaking which the retrofit is deemed to meet.

Casualties: For the existing building, the anticipated number of persons injured in a design level event is ~0.40 and the probability that any one person will be injured anywhere in the building is 11%. For the retrofitted condition, the number of persons drops to ~0.05 and the probability of a single injury is 1.62%. <u>The relative improvement in safety based on probability of injury is a near 10x reduction due to the retrofit.</u>

Recovery: In its current condition, the structure is expected to require 4.4 months to meet the Functional Recovery requirements of ATC-138, the latest draft standard in functional recovery. After the retrofit, the expected functional recovery time is approximately 3.0 months.

Red Tag Probability: It is anticipated that in the 10% in 50 year event, the existing building would have a 27% probability of receiving a red tag. <u>The retrofitted building would not likely</u> receive a red tag for the design event, as the theoretical probability is 0%.

Limitations

The seismic performance assessment summarized in the above was completed using industry standards of practice and care. The findings are in accordance with our best prediction of the building performance during a seismic event and consider the variation in results for a range of seismic intensities.

It is important to note that it is unrealistic to precisely predict any of the probabilistic assessment information or data. Each factor affecting the seismic performance of a building has a degree of uncertainty that affects our ability to predict exact frequency values. For example, the fault that will produce the next earthquake and the magnitude of shaking that will occur are not known with any certainty. Nor is there a perfect understanding of the structural seismic behavior, including factors such as damping, stiffness and strength degradation, soil-structure interaction effects, and elements designed to resist only gravity loads. The smaller city of Christchurch, New Zealand (population <400,000 people) is still, over a decade later, struggling to rebuild the central business district following a M6.2 earthquake in 2011. Therefore, the recovery times provided in this study are limited to a stand-alone building because the impeding factors remain largely unknown at this time.

Regards,

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It Patter

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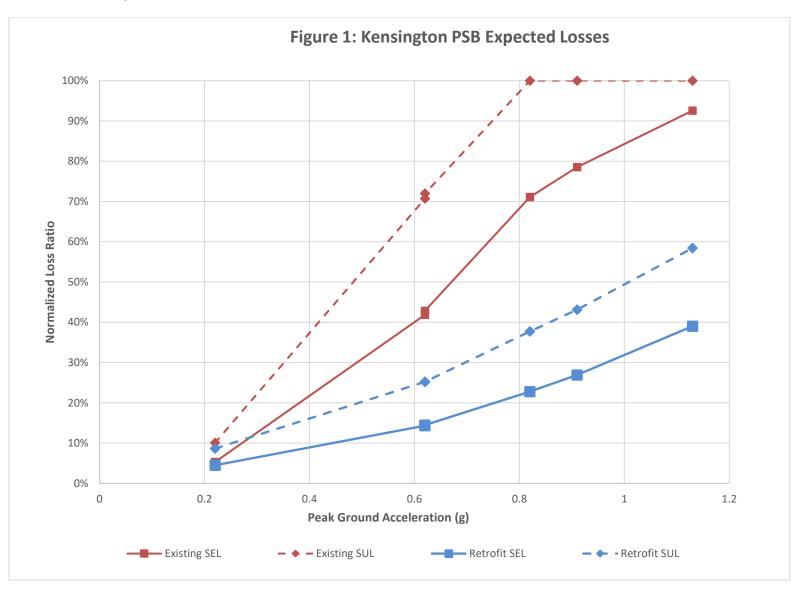
Kensington Public Safety Building 217 Arlington Avenue Kensington, CA 94707



Site Coordinates	Lat 37.75868; Long -121.95975
Retrofit Building Code	2019 California Existing Building Code
Year Constructed	1969
# of Stories	
Occupancy / Use	Fire Station
Structural Seismic Systems	Wood Light Frame w/ Concrete shear wall and steel moment frame
(ASCE 41-17 Building Type)	in longitudinal direction at ground floor (W2, C2, S1a)
Total Area	6133 SF
Building Aspect Ratio	
Replacement Cost per SF	\$1794 / SF
Story Heights	13'-6" at First Floor
	9'-0" at Second Floor
Building Irregularities	None
Risk Category	IV
Soil Site Class	C – Stiff Soil
Type of Construction	Wood frame structure with gypsum board on wood partitions.
Existing Foundation System	,
	retaining wall along East face of building.

1. Financial Losses:

Based on an expected building replacement value of approximately \$11 million, for the 10% in 50-year event (PGA = 0.62), the retrofit provides a mean cost savings of \$3 M.



2. Casualties:

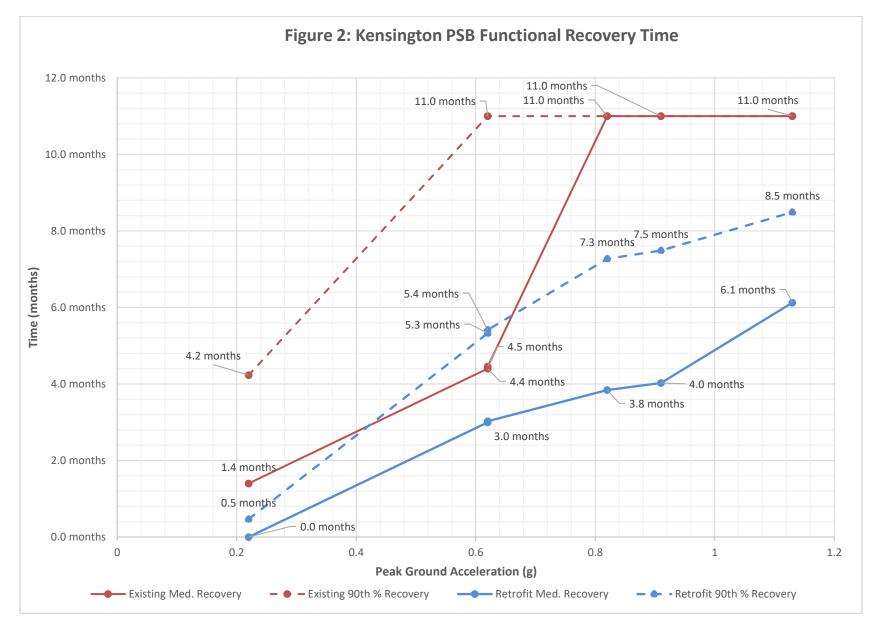
Table 1: Existing Building

Total Casualties	50%/50	10%/50	DE	5%/50	MCER	2%/50
	year	year		year		year
Injury (number people)	0.0780	0.3880	0.3913	0.5904	0.6616	0.8230
% single person is injured anywhere	(2.370)	(11.055)	(11.098)	(16.249)	(18.094)	(22.398)
Death (number of people)	0.0007	0.0037	0.0037	0.0058	0.0065	0.0082
% single person is killed anywhere	(0.021)	(0.099)	(0.100)	(0.153)	(0.174)	(0.220)

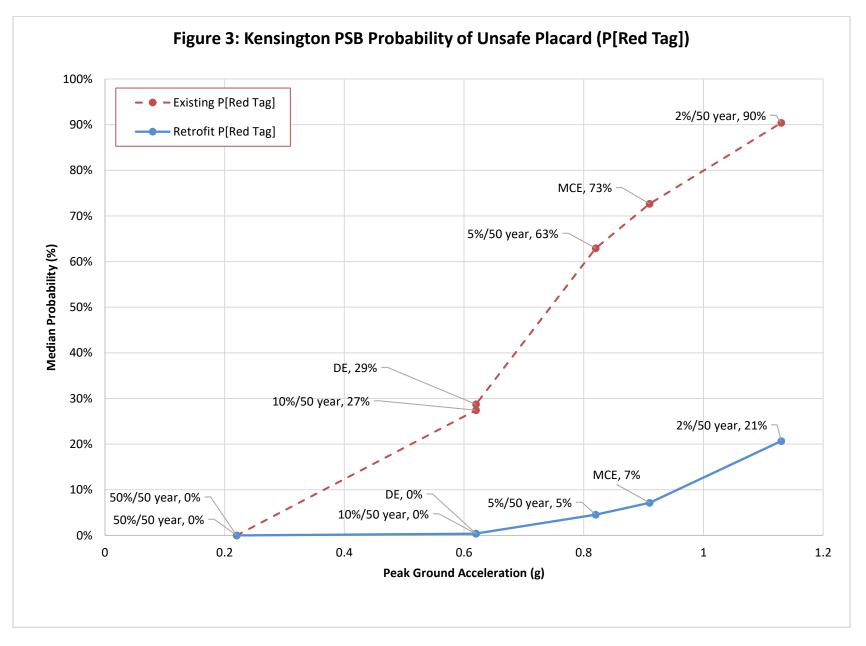
Table 2: Retrofit Building

Total Casualties	50%/50 year	10%/50 year	DE	5%/50 year	MCER	2%/50 year
Injury (number people)	0.0006	0.0512	0.0579	0.0834	0.1043	0.1450
% single person is injured anywhere	(0.033)	(1.615)	(1.776)	(2.755)	(3.444)	(4.902)
Death (number of people)	0.0000	0.0000	0.0000	0.0001	0.0002	0.0006
% single person is killed anywhere	0.000	(0.001)	(0.001)	(0.005)	(0.010)	(0.024)

3. Recovery:



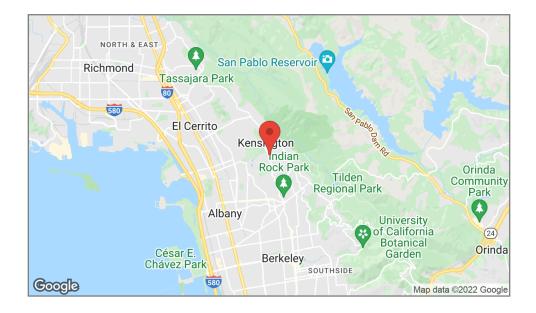
4. Red Tag Probability:





SEISMIC RISK ASSESSMENT REPORT Created with the SP3-RiskModel

Full Detailed Report



Report Generated for:

217 Arlington Avenue, Kensington, CA, 94707 Latitude: 37.90622° Longitude: -122.27875°

Report Generated by:

The SP3-RiskModel Software v1.2.0 of the Seismic Performance Prediction Program (SP3)

March 16, 2022





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1 SUMMARY OF INPUTS AND RISK RESULTS

Risk Model Inputs

Prim	ary	Building Design	n Info	
Model Name:HBuilding Type:NDesign Code Year:H	Kensington Fire Station Existing WLF w/ Frame WLF: General 1967 2	Level of Detailing (Dir. 1, 2): Drift Limit (Dir. 1, 2): Risk Category: Seismic Importance Factor, <i>I</i> _e :	Orc	linary, linary %, 1.5%
Occupancy:	Commercial Office	Component Importance Factor,	I_p : –	
		Structural Prop Allow Components to Affect		Yes
		- Structural Properties? Mode Shapes Specified?	1	No
Analysis	Options	Directional Properties	Dir. 1	Dir. 2
Include Collapse in Analys Consider Residual Drift:	is: Yes Yes	Base Shear Strength (g): Yield Drift (%):	0.419	0.283
Region Cost Multiplier: Date Cost Multiplier: Occupancy Cost Multiplier	- - : -	1^{st} Mode Period (T_1) (s):	0.45	0.6
		Component Infor	mation	
Building Layou	t Information	Selection Method	Cus	stom
Cost per Square Foot: Scale component repair cos building value?	sts with No	Building Stab	ility	
Total Square Feet: Aspect Ratio: First Story Height (ft):	4,395 1.95 13.5	Median Collapse Capacity: Beta (Dispersion):	_	
Upper Story Heights (ft): Vertical Irregularity: Plan Irregularity:	9 Moderate Extreme	Responses No responses provided	5	
Frac. of Full Height Ext. Dir. 1 Story 1 Dir. 1 Upper Stories Dir. 2 Story 1 Dir. 2 Upper Stories	Wood Walls _ _ _ _ _			

Ground Motion and Soil Information

Site Class:	С
Site Hazard:	SP3 Default

_



Repair Time Options

Repair Time Method	ATC-138 (Beta)			
Factors Delaying Start of Repairs				
Inspection	Yes			
Financing	Yes			
Permitting	Yes			
Engineering Mobilization	Yes			
Contractor Mobilization	Yes			
Mitigation Factors				
Inspector on Retainer	No			
Engineer on Retainer	No			
Contractor on Retainer	No			
Funding Source	Private Loans			
Cash on Hand	-			

ATC-138 Functional Recovery (Beta) Options

Need HVAC for Function	-
Need Elevator for Function	_
Include Surge Demand	-

Component Checklist

Stairs and Elevators

- Does the building have stairs?
 - > Yes
 - What type of stairs are in the building?
 - > Light Frame

Interior Finishes

- Does the building have suspended ceilings?
 - > Yes
 - Are the ceilings laterally supported?

> Yes

- Does the building contain pendant (non-recessed) lighting?
 - > Yes
 - Are the pendant lights seismically rated? > *No*

Piping

• Is the building's water piping OSHPD certified or equivalent? > *No*

HVAC

• Is the HVAC cooling/heating equipment seismically anchored? > *No*

Electrical

- Does the building have a backup battery/generator system? > *No*
 - /hich best describ
- Which best describes the building's electrical system?
- > No significant electrical equipment (rugged)



Expected Loss

	pected loss in percen	t of total building va	lue
Shaking Intensity	Return Period	SEL (%)	SUL (%)
50% in 50 years	72 Years	4.6	8.1
10% in 50 years	475 Years	39	67
DE	481 Years	40	68
5% in 50 years	975 Years	64	100
MCE_R	1277 Years	72	100
2% in 50 years	2475 Years	90	100

Expected loss in percent of total building value

Repair Time

Median repair time summary					
	FEMA	A P-58 [†]	ATC-138 H	Functional Recov	ery (Beta) [‡]
Intensity	Parallel	Series	Re- Occupancy	Functional	Full
50% in 50 years	14 days	2.1 weeks	0 days	1.9 months	2.3 months
10% in 50 years	2.4 months	2.5 months	4.1 months	4.4 months	4.7 months
DE	2.4 months	2.5 months	4.1 months	4.4 months	4.7 months
5% in 50 years	11 months	11 months	11 months	11 months	11 months
MCE_R	11 months	11 months	11 months	11 months	11 months
2% in 50 years	11 months	11 months	11 months	11 months	11 months

[†] Does *not* include impedance factors

[‡] Does include impedance factors





2 BASIS OF ANALYSIS

This analysis is based on the SP3-RiskModel of the Seismic Performance Prediction Program (SP3) software platform. The underlying analysis methods are based on the FEMA P-58 analytical method, which is a transparent and well documented method developed through a 15 year project (Applied Technology Council, 2018). This project leveraged the previous decades of academic research, funded by a \$16 million investment by the Federal Emergency Management Agency (FEMA). In contrast to many risk assessment methods based on judgment and past earthquake experience, the FEMA P-58 and SP3 analysis are based on engineering-oriented risk evaluation methods.

3 DOCUMENTATION OF SITE AND BUILDING INPUT DATA

Project Name:	Kensington Fire Station
Model Name:	Existing WLF w/ Frame

3.1 Site Information

Address:217 Arlington Avenue, Kensington, CA, 94707Latitude:37.90622°Longitude:-122.27875°

3.2 Building Information

Material Type:	WLF
Number of Stories:	2
Total Building Square Footage:	4,395
Occupancy Type:	Commercial Office
Total Expected Building Replacement Value:	\$1,328,911

4 SITE HAZARD INFORMATION

This section presents the site's seismic hazard information. The V_{S30} value is the shear wave velocity in the soil at a depth of 30 meters. This value and the associated site class are presented in Table 4.1.

Table 4.1. Site soil information	
V _{S30} (m/s):	537.0
Site Class:	С
Closest V_{S30} for USGS Hazard Lookup (m/s):	530

Table 4.2 and Figure 4.1 present the spectral acceleration information for this site. The spectral acceleration is a measure of how much force the building will attract in an earthquake. This amount of force is dependent on the intensity of the ground shaking (e.g. 10% in 50 years), as well as a dynamic property of the building known as the "fundamental period". Shorter buildings tend to have smaller fundamental periods and taller buildings tend to have larger fundamental periods. As indicated by Figure 4.1, smaller fundamental periods (with the exception of very short fundamental periods) will attract more force in an earthquake.

The Design Earthquake (DE) and Maximum Considered Earthquake (MCE) are based on the modern code maximum direction spectra and are converted to geometric mean for comparison.

Intensity	Return Period (yrs)	PGA	$S_a(0.2s)$	$S_a(1.0s)$	$S_a(0.45s)$	$S_a(0.6s)$	$S_a(T_1)$ Dir 1	$)/v_{ult}$ [†] Dir 2
50% in 50 years	72	0.22	0.52	0.17	0.36	0.29	0.86	1.02
10% in 50 years	475	0.62	1.50	0.56	1.11	0.92	2.66	3.23
DE	481	0.62	1.50	0.57	1.12	0.92	2.67	3.25
5% in 50 years	975	0.82	2.03	0.80	1.55	1.29	3.70	4.55
MCE_R	1277	0.91	2.26	0.91	1.73	1.44	4.12	5.07
2% in 50 years	2475	1.13	2.84	1.19	2.22	1.86	5.29	6.58

Table 4.2. Geometric mean spectral acceleration values (in g)

[†] $S_a(T_1)/v_{ult}$ is the ratio of shaking intensity to building strength where in direction 1 $v_{ult} = 0.419$ and $T_1 = 0.450$ s and in direction 2 $v_{ult} = 0.283$ and $T_1 = 0.600$ s (see Table 5.3 for more detailed structural properties)





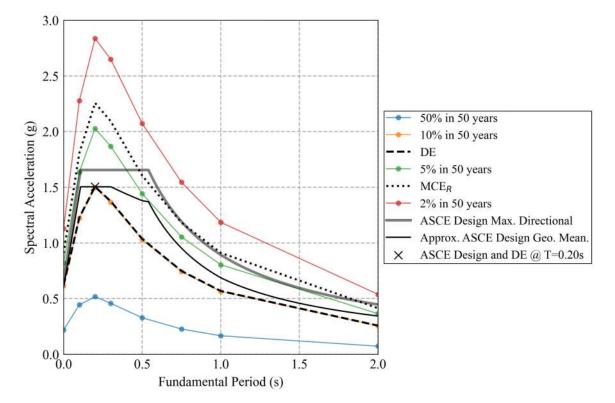


Figure 4.1. Hazard curves for this site. All curves are geometric mean unless otherwise stated.

5 BUILDING DESIGN SUMMARY FROM THE SP3 BUILDING CODE DESIGN DATABASE

5.1 Building Code Design Parameters

The seismic design parameters used to compute the seismic base shear coefficients for this building are presented in Table 5.1. These parameters are specific to the 1967 edition of the Uniform Building Code (International Conference of Building Officials, 1967).

Table 5.1. Code design parameters	s
-----------------------------------	---

(a) UBC 1967 structural system parameters		(b) U	JBC 1967 site spec	ific parameter		
	Parameter	Dir. 1	Dir. 2		Parameter	Value
	C_d	1	1		Z	1
	k	1	1		Seismic Zone	3
	-					

5.2 Modern Building Code Design Parameters (for comparison purposes)

For comparison to modern code, the modern code parameters are presented in Table 5.2.

(a) ASCE/SEI 7-2010 structural system parameters

(b) ASCE/SEI 7-2010 site specific parameters

Parameter	Dir. 1	Dir. 2	Parameter
C_t	0.02	0.02	S_s
C_d	4	4	S_1
x	0.75	0.75	S_{ds}
R	6.5	6.5	S_{d1}
Ω_0	3	3	SDC
			C_u

(c) ASCE/SEI 7-2010 site specific parameters based on the period of the building

Parameter	Value
$MCE_{R,max}(g)$	2.482
$MCE_{R,geomean}(g)$	2.06
$DE_{max}(g)$	1.655
$DE_{geomean}(g)$	1.373

5.3 Structural Properties

This section summarizes the main structural properties of the building in each direction. These structural properties are used as inputs to the SP3 Structural Response Prediction Engine.

Parameter	Direction 1	Direction 2
General		
Structural System	WLF: General	WLF: General
Building Edge Length (ft)	33	65
Detailing Level	Ordinary	Ordinary
Seismic Strength		
Seismic Design Base Shear Ratio, C_s [†]	0.100	0.100
Wind Strength		
Wind Design Base Shear Ratio, v_{wind} [†]	0.157	0.072
Total Strength		
Ultimate Base Shear Ratio, v_{ult}	0.419^{\ddagger}	0.283 [‡]
Stiffness		
$T_{1,design}$ (s)	0.27	0.19
T_1 Final (s)	0.45^{\ddagger}	0.60^{\ddagger}

Table 5.3.	Structural	properties table
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[†] Design base shear values reported as LRFD

[‡] User defined, not SP3 default





5.4 Mode Shapes

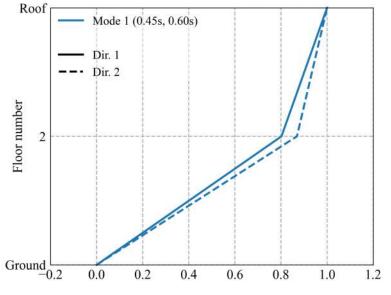


Figure 5.1. Mode shapes

	Dir. 1 Mode 1	Dir. 2 Mode 1
Roof	1.00	1.00
2	0.802	0.869
Ground	0.00	0.00

6 SP3 PERFORMANCE FACTORS

Table 6.1 compares the seismic design base shear, C_s , to the 475-year shaking (reduced by the modern response modification coefficient, R). Generally speaking, the modern building code design requirements are based on the 475-year event with the exception of extremely high seismic (near-fault) areas that are designed for a lesser deterministic ground motion or the transition region between deterministic and probabilistic portions of the ground motion maps.

The shaking intensity is then reduced by the response modification coefficient, R, based on the ductility level of the system (in anticipation of controlled damage of specially designed elements).

When the ratio of design base shear to the reduced spectra $(C_s / [S_a(T_1)_{475}/R])$ is 1.0, then the building was designed consistent with 10% in 50 year hazard. When the ratio is above 1.0, it was designed higher, so expect better performance (all other things equal), and for ratios below 1.0, expect worse performance.

	Dir. 1	Dir. 2
Seismic Design Base Shear, C_s	0.100	0.100
475-year Shaking Intensity, $S_a(T_1)_{475}$ [†]	1.11g	0.915g
Reduced Spectral Acceleration, $S_a(T_1)_{475}/R^{\ddagger}$	0.171g	0.141g
Ratio of Design Base Shear to 475-year Shaking Demand, $C_s/\left[S_a(T_1)_{475}/R ight]$ §	0.58	0.71
$^{\dagger}T_1$ includes all sources of overstiffness ($T_{1,dir1} = 0.450$ s and $T_{1,dir2} = 0.600$ s, see Tabl	e 5.3).	

Table 6.1. Design base shear vs. 475-year shaking intensity

¹ Response Modification Coefficient, R, is from the modern code ($R_{dir1} = 6.5$ and $R_{dir2} = 6.5$).

Table 6.2 shows a comparison of the properties of the building to the properties of the building if it were constructed using the modern code guidelines. This table only compares the difference in building strength and period, and does not present differences in component damageability. The full SP3-RiskModel analysis does include effects of component damageability differences, so while the metrics in this table are informative, they are not all-encompassing of differences between new and old code design.

	Dir. 1	Dir. 2
Seismic Design Base Shear, C_s		
UBC 1967	0.100	0.100
ASCE/SEI 7-2010 †	0.382	0.382
Ratio $\frac{C_{s,UBC1967}}{C_{s,ASCE/SEI7-2010}}$	0.262	0.262
Ultimate Base Shear (C_s with Overstrength), v_{ult}		
UBC 1967	0.419	0.283
ASCE/SEI 7-2010	0.433	0.605
Ratio $\frac{v_{ult,UBC1967}}{v_{ult,ASCE/SEI7-2010}}$	0.967	0.468
Period Considering All Sources of Stiffness, T_1 (s)		
UBC 1967	0.450	0.600
ASCE/SEI 7-2010	0.833	0.455

Table 6.2. Comparison of structural properties from UBC 1967 and ASCE/SEI 7-2010

[†] $R_{dir1} = 6.5$ and $R_{dir2} = 6.5$



7 BUILDING STABILITY

The FEMA P-154 collapse capacity score was calculated as follows using the "very high" seismicity level. The terminology used in this section is consistent with the FEMA P-154 methodology (Applied Technology Council, 2015a):

- $P[COL|MCE_R]_{P-154}$: the probability that the building will be in the HAZUS complete structural damage state when subjected to MCER shaking, times the collapse factor
- $P[COL|MCE_R]_{P-58}$: the probability that the building will be in the HAZUS complete structural damage state when subjected to MCER shaking
- Collapse Factor: expected ratio of collapsed area to total area given that the building is in the HAZUS Complete structural damage state

For a more in-depth explanation of "collapse," refer to Section 4.4.1.5 of FEMA P-155 Third Edition available <u>here</u> (Applied Technology Council, 2015b).

FEMA ID:	W2
Basic Score	1.8
Soil	0
Year	0
Plan Irregularity	-0.6
Vertical Irregularity	-0.5
Risk Category [†] (Cat IV)	0
Sum:	0.7
Minimum Allowed:	0.7
Score:	0.7
Dispersion (β):	0.58

Table 7.1. Breakdown of FEMA P-154 score assignment

[†] Non-standard property implemented by SP3

The FEMA P-154 probability of collapse at the MCE_R level event is then calculated as:

$$P[COL|MCE_R]_{P-154} = 10^{-\text{score}}$$

= 10^{-0.7} (FEMA P-155 eqn. 4-1)
= 20.0%

Taking into account the fraction of floor area collapsed (0.33 in this case), the probability of collapse is:

$$P[COL|MCE_R]_{P-58} = P[COL|MCE_R]_{P-154} / \text{Collapse Factor}$$
$$= 20.0\% / 0.33$$
$$= 60.5\%$$

The median collapse capacity (before any direct modifications to the median) is calculated as:

$$S_{a, collapse median, P-58} = \exp\left(\ln(S_{a,MCE_R}) - \operatorname{norminv}\left(P[COL|MCE_R]_{P-58}\right) \cdot \beta\right)$$
$$= \exp\left(\ln(1.58g) - \operatorname{norminv}\left(60.5\%\right) \cdot 0.58\right)$$
$$= 1.36q$$

where norminv is the inverse of the standard normal cumulative distribution function (CDF).



To further refine the collapse capacity, the factors from Table 7.2 were applied to the median collapse S_a .

Table 7.2. Scale factor applied to the median collapse S_a value.

Reason	Factor
Wood Light Frame	1.05

The WLF modification reflects a weighted average of the FEMA P-154 median and the median collapse capacity observed in extensive non-linear dynamic modeling.

The final median for the collapse curve is therefore:

$$S_{a, collapse median, P-58 (adjusted)} = S_{a, collapse median, P-58} \cdot \text{Factors}$$

= $1.36g \cdot 1.05$ (Using additional SP3 factors)
= $1.43g$

Which corresponds to a probability of collapse at MCE of:

$$P[COL|MCE_R]_{P-58 \ (adjusted)} = 56.9\%$$
 (Using additional SP3 factors)

Figure 7.1 shows the collapse capacity cumulative distribution function used in the analysis.

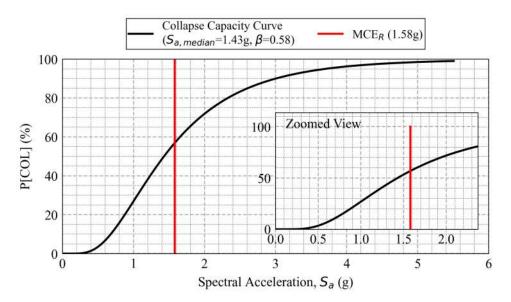


Figure 7.1. Cumulative distribution function for collapse capacity



8 STRUCTURAL RESPONSE PREDICTIONS FROM THE SP3 STRUCTURAL RESPONSE PREDICTION ENGINE

The SP3 Response Prediction Engine predicts the structural responses (typically providing 100 ground motions per intensity level); this is done by using a combination of three-mode elastic modal analysis, coupled with both elastic and inelastic response modifiers mined from the large SP3 Structural Responses Database (with over 4,000,000 response simulations, and growing). These response predictions track all of the important statistical information in the responses (mean, variability, and correlations); this enables a statistically robust vulnerability curve at the end of the risk assessment process.

8.1 Peak Interstory Drift

Peak interstory drift ratio is an important metric for both structural and non-structural components in the building. It measures how much the ceiling of a given story moves relative to the floor, normalized to the height of the story. The greater the interstory drift ratio, the greater the damage to the components on that level. Typical components that are damaged from interstory drift ratio are structural components (beams and columns), gypsum partition walls, and exterior cladding and glazing.

Story	50% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 years
2 1	0.03 0.31	0.13 1.87	0.13 1.88	0.17 2.85	0.20 3.29	0.31 4.68
$\frac{S_a(T_1)}{v_{ult}} =$	= 0.86	2.66	2.67	3.70	4.12	5.29

Table 8.1. Median Peak Interstory Drift dema	nds in direction 1
--	--------------------

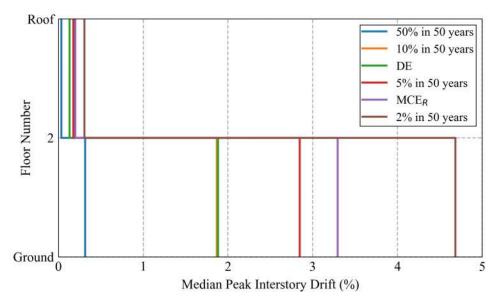


Figure 8.1. Median Peak Interstory Drift demands in direction 1





Story	50% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 years
2 1	0.04 0.71	0.12 3.19	0.12 3.21	0.17 4.80	0.20 5.50	0.31 7.78
$\frac{S_a(T_1)}{v_{ult}} =$	= 1.02	3.23	3.25	4.55	5.07	6.58

Table 8.2. Median Peak Interstory Drift demands in direction 2

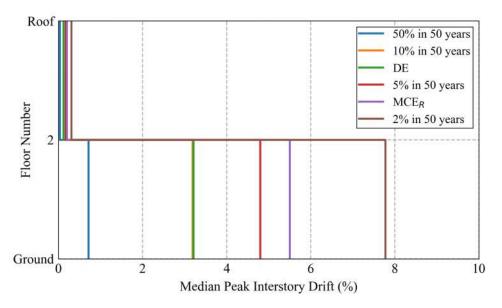


Figure 8.2. Median Peak Interstory Drift demands in direction 2



8.2 Residual Interstory Drift

Residual drift is a metric that informs the need for structural repairs or building demolition (where excessive drifts are present). Residual drift ratio is a measure of how much the building is "leaning over" after the seismic event has ceased. A residual drift of 2% would indicate that the story is laterally displaced 2% of it's height, which equates to about 3.6 inches for a 15 foot tall story.

Story	50% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 years
2 1	0.00 0.00	0.00 0.20	0.00 0.21	0.00 0.42	0.00 0.52	0.00 0.84
$\frac{S_a(T_1)}{v_{ult}} =$	= 0.86	2.66	2.67	3.70	4.12	5.29

Table 8.3. Median Residual Interstory Drift demands in direction 1

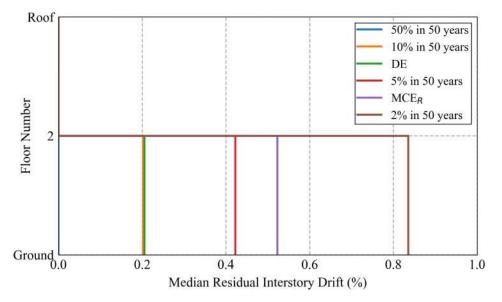


Figure 8.3. Median Residual Interstory Drift demands in direction 1



Story	50% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 years
2 1	0.00 0.00	0.00 0.34	0.00 0.34	0.00 0.65	0.00 0.78	0.00 1.54
$\frac{S_a(T_1)}{v_{ult}} =$	= 1.02	3.23	3.25	4.55	5.07	6.58

Table 8.4. Median Residual Interstory Drift demands in direction 2

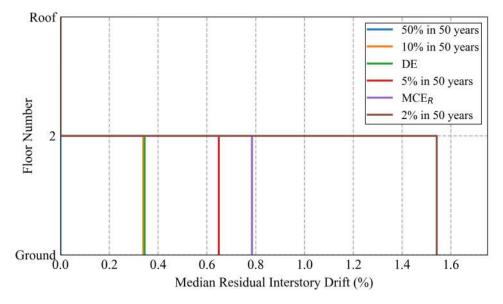


Figure 8.4. Median Residual Interstory Drift demands in direction 2

8.3 Peak Floor Acceleration

Peak floor acceleration is an an important metric for non-structural components in the building. Components such as piping, HVAC, and electrical switchgear are sensitive to the floor accelerations. High accelerations will typically damage a component itself or cause the component's anchorage to fail, both of which may require repair or replacement of the component.

Floor	50% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 years
Roof	0.35	0.69	0.69	0.82	0.91	1.13
2	0.34	0.67	0.67	0.82	0.91	1.13
Ground	0.22	0.62	0.62	0.82	0.91	1.13
$\frac{S_a(T_1)}{v_{ult}} =$	= 0.86	2.66	2.67	3.70	4.12	5.29

Table 8.5. Median Peak Floor Acceleration demands in direction 1

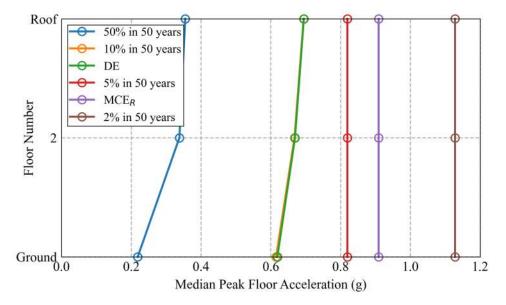


Figure 8.5. Median Peak Floor Acceleration demands in direction 1





Floor	50% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 years
Roof	0.36	0.62	0.62	0.82	0.91	1.13
2	0.37	0.62	0.62	0.82	0.91	1.13
Ground	0.22	0.62	0.62	0.82	0.91	1.13
$\frac{S_a(T_1)}{v_{ult}} =$	= 1.02	3.23	3.25	4.55	5.07	6.58

Table 8.6. Median Peak Floor Acceleration demands in direction 2

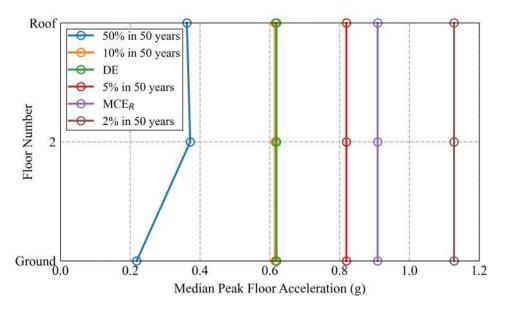


Figure 8.6. Median Peak Floor Acceleration demands in direction 2

8.4 Max. Residual Interstory Drift

	50% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 years
_	0.00	0.20	0.21	0.42	0.52	0.84
$\frac{S_a(T_1)}{v_{ult}} =$	= 0.86	2.66	2.67	3.70	4.12	5.29

Table 8.7. Median Max. Residual Interstory Drift demands in direction 1

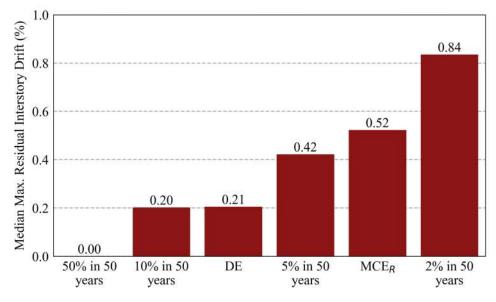


Figure 8.7. Median Max. Residual Interstory Drift demands in direction 1





	50% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 years
_	0.00	0.34	0.34	0.65	0.78	1.54
$\frac{S_a(T_1)}{v_{ult}} =$	= 1.02	3.23	3.25	4.55	5.07	6.58

Table 8.8. Median Max. Residual Interstory Drift demands in direction 2

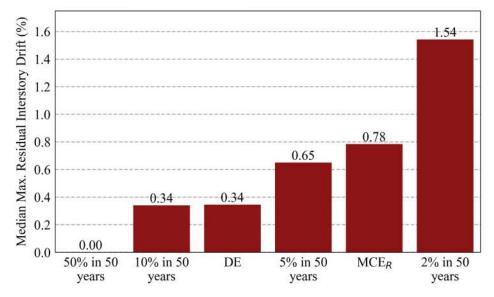


Figure 8.8. Median Max. Residual Interstory Drift demands in direction 2

9 REPAIR COSTS - BY LEVEL OF GROUND MOTION

9.1 Mean and 90th Percentile Repair Costs (SEL and SUL)

The different metrics for repair cost are as follows:

- Mean (SEL): ("Scenario Expected Loss") the average repair cost of the building repair/replacement.
- Median: there is a 50% probability that the repair cost will not exceed this value.
- Fitted SUL: Fitted value of "Scenario Upper Loss".
- Counted 90th Percentile: there is a 90% probability that the repair cost will not exceed this value.

Intensity	PGA (g)	Mean (SEL) (%)	Fitted SUL (%)	Median (%)	Counted 90 th Percentile (%)	$S_a(T_1)$ Dir 1	$)/v_{ult}$ † Dir 2
50% in 50 years	0.22	4.6	8.1	4.1	8.1	0.86	1.02
10% in 50 years	0.62	39	67	17	100	2.66	3.23
DE	0.62	40	68	18	100	2.67	3.25
5% in 50 years	0.82	64	100	100	100	3.70	4.55
MCE_R	0.91	72	100	100	100	4.12	5.07
2% in 50 years	1.13	90	100	100	100	5.29	6.58

Table 9.1. Loss metrics normalized by building cost

[†] $S_a(T_1)/v_{ult}$ is the ratio of shaking intensity to building strength where in direction 1 $v_{ult} = 0.419$ and $T_1 = 0.450$ s and in direction 2 $v_{ult} = 0.283$ and $T_1 = 0.600$ s (see Table 5.3 for more detailed structural properties)

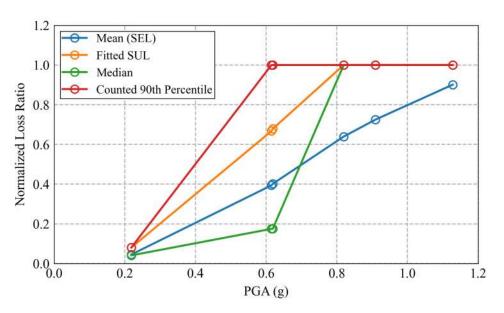


Figure 9.1. Loss metrics across all intensity levels analyzed



10 REPAIR COST BREAKDOWN BY BUILDING COMPONENTS

10.1 Categories for Repair Cost Breakdowns

Repair costs are binned into eight categories as follows:

- Collapse: building demolition and replacement following a collapse.
- Residual: building demolition and replacement following unacceptable residual drifts.
- **Structural**: components of the lateral force resisting system or gravity system (e.g. beam column connections, link beams, shear wall, shear tabs, etc.).
- Partitions: partition wall components (e.g. wood or metal stud gypsum full height partitions).
- Exterior: components placed on the exterior of the building (e.g. cladding, glazing, etc.).
- **Interior**: non-structural components on the interior of the building (e.g. raised access floors, ceilings, lighting).
- **HVAC**: HVAC and plumbing components (e.g. water piping and bracing, sanitary piping, ducting, boilers etc.).
- **Other**: components not included in the categories above (e.g. elevators, user defined components, fire protection components).

10.2 Repair Cost Breakdown for Various Ground Motion Levels

Intensity	Total	Collapse	Residual	Structural	Partitions	Other	Exterior	HVAC	Interior
50% in 50 years	4.6	0.0	0.0	0.2	2.1	1.2	0.1	0.6	0.3
10% in 50 years	39	27	1.1	2.9	4.7	2.0	0.8	0.7	0.3
DE	40	27	1.6	2.9	4.6	2.0	0.8	0.7	0.3
5% in 50 years	64	49	6.2	3.0	3.1	1.4	0.6	0.5	0.2
MCE_R	72	56	8.9	2.5	2.5	1.1	0.5	0.4	0.1
2% in 50 years	90	73	14	1.2	0.9	0.4	0.2	0.2	0.0

Table 10.1. Expected mean loss per component group (in percent)

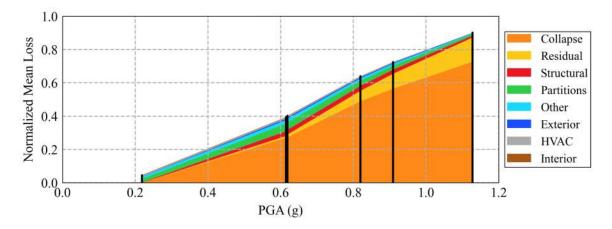


Figure 10.1. Contribution of building components to mean loss ratio





10.3 Repair Cost Breakdown for Expected Annual Loss

The expected annual loss for this building is \$5,411.

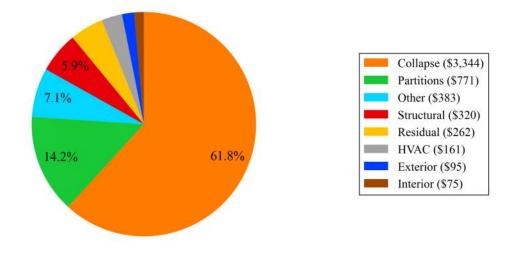


Figure 10.2. Annualized loss breakdown

11 REPAIR TIME AND BUILDING CLOSURE TIME

These downtimes were calculated using the ATC-138 Functional Recovery (Beta) Methodology. This includes all sources of impedance specified by the user; possible sources of impedance considered are listed below.

- Post-earthquake Inspection
- Engineering Mobilization and Review/Re-design
- Financing
- Contractor Mobilization and Bid Process
- Permitting

These capture the time required to start the repairs, since beginning repairs immediately after an earthquake may not be realistic.

	FEMA	A P-58 [†]	ATC-138 Functional Recovery (Beta) [‡]			
Intensity	Parallel	Series	Re- Occupancy	Functional	Full	
50% in 50 years	14 days	2.1 weeks	0 days	1.9 months	2.3 months	
10% in 50 years	2.4 months	2.5 months	4.1 months	4.4 months	4.7 months	
DE	2.4 months	2.5 months	4.1 months	4.4 months	4.7 months	
5% in 50 years	11 months	11 months	11 months	11 months	11 months	
MCE_R	11 months	11 months	11 months	11 months	11 months	
2% in 50 years	11 months	11 months	11 months	11 months	11 months	

Table 11.1. Median repair time summary

[†] Does *not* include impedance factors

[‡] Does include impedance factors

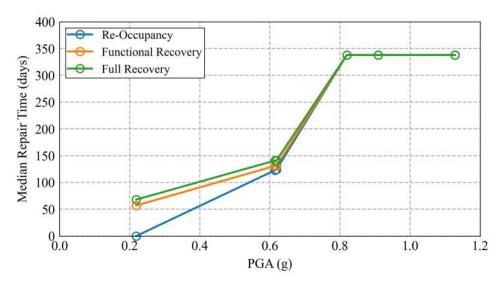


Figure 11.1. Median repair time from the ATC-138 Functional Recovery (Beta) Methodology, includes specified impeding factors





12 DISCLAIMER

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- Applied Technology Council. 2015b. FEMA P-155: Rapid Visual Screening of Buildings for Potential Seismic Hazards: Supporting Documentation.

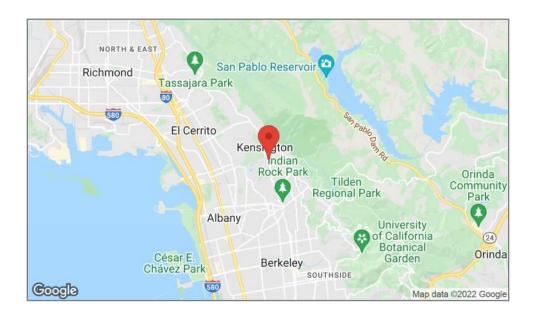
Applied Technology Council. 2018. FEMA P-58: Seismic Perfromance Assessment of Buildings.

International Conference of Building Officials. 1967. *Uniform Building Code 1967 Edition*. International Conference of Building Officials.



SEISMIC RISK ASSESSMENT REPORT Created with the SP3-RiskModel

Functional Recovery Time Report using the ATC-138 Functional Recovery (Beta) Methodology



Report Generated for:

217 Arlington Avenue, Kensington, CA, 94707 Latitude: 37.90622° Longitude: -122.27875°

Report Generated by:

The SP3-RiskModel Software v1.2.0 of the Seismic Performance Prediction Program (SP3)

March 16, 2022



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SP3

1 SUMMARY OF INPUTS AND RISK RESULTS

Risk Model Inputs

Prir	nary		Building Desig	gn Info		
Project Name:KensingtoModel Name:Existing WBuilding Type:WLF: GerDesign Code Year:1967Number of Stories:2Occupancy:CommerceAddress:217 Arlington Avenue Kensington, CA, 94707		7 w/ Frame 1	Level of Detailing (Dir. 1, 2):Ordinar OrdinarDrift Limit (Dir. 1, 2): 1.5% , 1Risk Category:IVSeismic Importance Factor, I_e : $-$ Component Importance Factor, I_p : $-$ Structural Properties			
Latitude: 37.90622° Longitude: -122.27875°		Allow Components to Affect Ye Structural Properties?				
			Mode Shapes Specified?]	No	
Analysis	s Options		Directional Properties	Dir. 1	Dir. 2	
Include Collapse in Analy Consider Residual Drift:	ysis: Ye Ye	~	Base Shear Strength (g): Yield Drift (%):	0.419	0.283	
Region Cost Multiplier: Date Cost Multiplier: Occupancy Cost Multiplie	- - er: –		1^{st} Mode Period (T_1) (s):	0.45	0.6	
Building Layo	ut Informatio	n	Component Info		stom	
Cost per Square Foot: Scale component repair co building value?	_		Building Sta	bility		
Total Square Feet: Aspect Ratio: First Story Height (ft): Upper Story Heights (ft):	4,3 1.9 13. 9	-	Median Collapse Capacity: Beta (Dispersion):	_		
Vertical Irregularity:	Mo	oderate	Response	es		
Plan Irregularity:	Ex	treme	No responses provided			
Frac. of Full Height Ext Dir. 1 Story 1 Dir. 1 Upper Stories Dir. 2 Story 1 Dir. 2 Upper Stories	. Wood Walls - - - -					

Ground Motion and Soil Information

Site Class:	С
Site Hazard:	SP3 Default

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Structural Properties						
Allow Components to Affect Structural Properties?	ffect Yes					
Mode Shapes Specified?	No					
Directional Properties	Dir. 1	Dir. 2				
Base Shear Strength (g): Yield Drift (%):	0.419 -	0.283				
1^{st} Mode Period (T_1) (s):	0.45	0.6				

Repair Time Options

Repair Time Method	ATC-138 (Beta)					
Factors Delaying Start of Repairs						
Inspection	Yes					
Financing	Yes					
Permitting	Yes					
Engineering Mobilization	Yes					
Contractor Mobilization	Yes					
Mitigation Factors						
Inspector on Retainer	No					
Engineer on Retainer	No					
Contractor on Retainer	No					
Funding Source	Private Loans					
Cash on Hand	-					

ATC-138 Functional Recovery (Beta) Options

Need HVAC for Function	-
Need Elevator for Function	-
Include Surge Demand	-

Component Checklist

Stairs and Elevators

- Does the building have stairs?
 - > Yes
 - What type of stairs are in the building?
 - > Light Frame

Interior Finishes

- Does the building have suspended ceilings?
 - > Yes
 - Are the ceilings laterally supported?

> Yes

- Does the building contain pendant (non-recessed) lighting?
 - > Yes
 - Are the pendant lights seismically rated? > *No*

Piping

• Is the building's water piping OSHPD certified or equivalent? > *No*

HVAC

• Is the HVAC cooling/heating equipment seismically anchored? > *No*

Electrical

- Does the building have a backup battery/generator system? > *No*
- Which best describes the building's electrical system?
- > No significant electrical equipment (rugged)



Expected Loss

Expected loss in percent of total building value							
Shaking Intensity	Return Period	SEL (%)	SUL (%)				
50% in 50 years	72 Years	4.6	8.1				
10% in 50 years	475 Years	39	67				
DE	481 Years	40	68				
5% in 50 years	975 Years	64	100				
MCE_R	1277 Years	72	100				
2% in 50 years	2475 Years	90	100				

Expected loss in percent of total building value

Repair Time

Median repair time summary								
	FEMA	A P-58 [†]	ATC-138 H	ATC-138 Functional Recovery (Beta) [‡]				
Intensity	ensity Parallel Series		Re- Occupancy	Functional	Full			
50% in 50 years	14 days	2.1 weeks	0 days	1.9 months	2.3 months			
10% in 50 years	2.4 months	2.5 months	4.1 months	4.4 months	4.7 months			
DE	2.4 months	2.5 months	4.1 months	4.4 months	4.7 months			
5% in 50 years	11 months	11 months	11 months	11 months	11 months			
MCE_R	11 months	11 months	11 months	11 months	11 months			
2% in 50 years	11 months	11 months	11 months	11 months	11 months			

[†] Does *not* include impedance factors

[‡] Does include impedance factors



2 FUNCTIONAL RECOVERY OVERVIEW

					Median		90	th Percer	ntile
Intensity	Return Period	PGA (g)	$\operatorname{Sa}(T_1)^*$	Re- Occ.	Func.	Full	Re- Occ.	Func.	Full
50% in 50 years	72 years	0.22	0.32	0d	1.9m	2.3m	3.5m	4.4m	4.7m
10% in 50 years	475 years	0.62	1.01	4.1m	4.4m	4.7m	11m	11m	11m
DE	481 years	0.62	1.02	4.1m	4.4m	4.7m	11m	11m	11m
5% in 50 years	975 years	0.82	1.42	11m	11m	11m	11m	11m	11m
MCE_R	1277 years	0.91	1.58	11m	11m	11m	11m	11m	11m
2% in 50 years	2475 years	1.13	2.04	11m	11m	11m	11m	11m	11m

Table 2.1. Recovery Times from the ATC-138 Functional Recovery (Beta) Methodology

* Sa (T_1) is the spectral acceleration at T_1 where is the mean of T_1 in both directions

Table 2.2. Global Consequences

Intensity	Return Period	PGA (g)	$\operatorname{Sa}(T_1)^*$	P[red tag]	P[collapse]	P[excessive residual]
50% in 50 years	72 years	0.22	0.32	0.0%	0.0%	0.0%
10% in 50 years	475 years	0.62	1.01	28%	27%	1.1%
DE	481 years	0.62	1.02	29%	27%	1.6%
5% in 50 years	975 years	0.82	1.42	55%	49%	6.2%
MCE_R	1277 years	0.91	1.58	65%	56%	8.9%
2% in 50 years	2475 years	1.13	2.04	87%	73%	14%

* Sa (T_1) is the spectral acceleration at T_1 where is the mean of T_1 in both directions

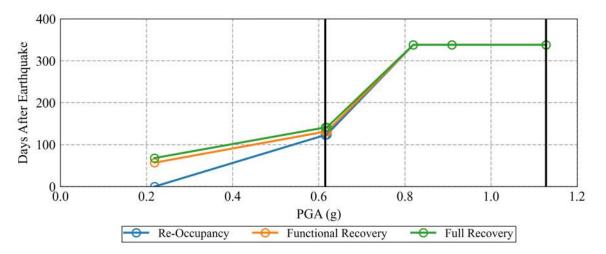


Figure 2.1. ATC-138 Functional Recovery (Beta) Methodology median recovery times





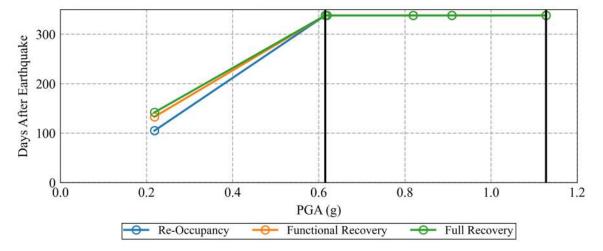


Figure 2.2. ATC-138 Functional Recovery (Beta) Methodology 90^{th} percentile recovery times

3 COMPONENT DAMAGE OVERVIEW

3.1 Most Damaged Components

This section outlines the most damaged component at each intensity. "Most damaged" is determined by cost and does not necessarily mean that it's the main component impeding building function.

Intensity	Component	Damage State	Expected Repair Cost
50% in 50 years	B1071.302	1	\$1,507
10% in 50 years	B1031.011a	1	\$16,523
DE	B1031.011a	1	\$16,821
5% in 50 years	B1031.011a	1	\$21,343
MCE_R	B1031.011a	1	\$18,853
2% in 50 years	B1031.011a	1	\$8,919

Table 3.1. Most damaged Structural components at each intensity level.

Table 3.2. Most damaged Non-Structural components at each intensity level.

Intensity	Component	Damage State	Expected Repair Cost
50% in 50 years	D1014.022	1	\$14,645
10% in 50 years	C1011.211a	3	\$31,390
DE	C1011.211a	3	\$31,104
5% in 50 years	C1011.211a	3	\$21,129
MCE_R	C1011.211a	3	\$16,921
2% in 50 years	C1011.211a	3	\$6,506

Details of the most damaged components and their damage states:

- B1031.011a: Steel Column Base Plates, Column W < 150 plf
 - DS1a: Initiation of crack at the fusion line between the column flange and the base plate weld. Damage in field is either obscured or deemed to not warrant repair. No repair conducted.
 - DS1b: Initiation of crack at the fusion line between the column flange and the base plate weld.
- **B1071.302**: Interior Structural Wall Light framed wood walls with structural panel sheathing, gypsum wallboard on both sides, with hold-downs
 - DS1: Cracking of paint over fasteners or joints.
- **C1011.211a**: Wall Partition Type: Gypsum with wood studs (both sides), Full Height, Fixed Below, Fixed Above
 - DS3: Local and global buckling out-of-plane and crushing of gypsum wallboards. Studs are typically not damaged by failure of the gypsum wallboard, but framing adjustments possible for this damage state.
- **D1014.022**: Hydraulic Elevator Applies to most California Installations prior to 1976, most western states installations prior to 1982 and most U.S installations prior to 1998.
 - DS1a: Damaged controls.
 - DS1b: Damaged vane and hoist-way switches, and or bent cab stabilizers, and or damaged car guide shoes.





DS1c: Damaged entrance and car door, and or flooring damage.

DS1d: Oil leak in hydraulic line, and or hydraulic tank failure.

3.2 Worker Days Summary

This table shows the expected worker days on a per-damage state basis. The header shows the probability of global failures (collapse and residual drift demolition) for reference.

The color scale is meant to indicate **relative** performance of components, not absolute performance. A "green" value does not indicate that the value falls in a pre-determined "good" range, just that it performs well compared to other components. Likewise, a "red" value does does not indicate that the value falls in a pre-determined "bad" range, just that it performs worse compared to other components.

50	0% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 years
P[Col](%)	0.0	27	27	49	56	73
P[Res](%)	0.0	1.1	1.6	6.2	8.9	14
B1031.011a	#1 (B1031.011a	a: Steel Column Base I	Plates, Colum	n W < 150 plf)		
DS1a	0.0	0.0	0.0	0.0	0.0	0.0
DS1b	0.0	0.8	0.9	0.8	0.7	0.2
DS2	0.0	6.1	6.7	7.7	5.7	2.9
DS3	0.0	4.3	3.7	6.2	6.9	3.2
Total	0.0	11	11	15	13	6.3
B1035.041 #	1 (B1035.041:]	Pre-Northridge WUF-	B beam-colu	nn joint, beam one sid	le of column,	beam depth)
DS1a	0.0	0.0	0.0	0.0	0.0	0.0
DS1b	0.0	0.0	0.0	0.0	0.0	0.0
DS2a	0.0	0.0	0.0	0.0	0.0	0.0
DS2b	0.0	0.0	0.0	0.0	0.0	0.0
DS3	0.0	0.0	0.0	0.0	0.0	0.0
Total	0.0	0.0	0.0	0.0	0.0	0.0
B1035.051 #	1 (B1035.051:]	Pre-Northridge WUF-	B beam-colu	nn joint, beam both si	des of colum	n, beam)
DS1a	0.0	0.0	0.0	0.0	0.0	0.0
DS1b	0.0	0.0	0.0	0.0	0.0	0.0
DS2a	0.0	0.0	0.0	0.0	0.0	0.0
DS2b	0.0	0.0	0.0	0.0	0.0	0.0
DS3	0.0	0.0	0.0	0.0	0.0	0.0
Total	0.0	0.0	0.0	0.0	0.0	0.0
B1071.002 #	1 (B1071.002:]	Light framed wood wa	lls with struc	tural panel sheathing	. gypsum wall	board)
DS1	0.7	2.8	2.8	1.4	0.9	0.2
DS2	0.1	2.0	1.9	1.4	1.1	0.4
DS3	0.0	5.6	5.5	6.2	5.3	2.8
Total	0.8	10	10	8.9	7.3	3.4
B1071.302 #	1 (B1071.302:	Interior Structural Wa	ıll - Lioht fra	med wood walls with s	structural nar	nel)
D10/1002 #	0.5	0.2	0.2	0.1	0.1	0.0
DS2	0.2	0.2	0.2	0.1	0.0	0.0
DS3	0.2	1.5	1.5	0.7	0.5	0.1
DS4	0.0	1.2	1.1	0.9	0.7	0.3
DS5	0.0	1.5	1.4	2.0	1.7	1.0
Total	0.8	4.5	4.4	3.8	3.1	1.4
R2011 401 #	1 (B2011 401)	Exterior Wall - Light f	ramed wood	walls with exterior na	nelized sheat	ning)
DS1	1.9	1.8	1.8	0.7	0.5	0.1
DS1 DS2	0.6	2.2	2.2	1.1	0.5	0.1
DS2 DS3	0.0	13	13	1.1	0.8 9.0	3.8
000	3.2	17	17	13	10	4.2

Table 3.3	Expected	worker	dave ner	damage	ctate (Worker Days)
	Expected	WOLKEL	uays per	uamage	state (worker Days)

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	Table	3.3 (Continued). Expect	ed worker da	ys per damage state (We	orker Days)	
5	0% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 years
P[Col](%)	0.0	27	27	49	56	73
P[Res](%)	0.0	1.1	1.6	6.2	8.9	14
C1011.211a	#1 (C1011.211a	a: Wall Partition - Typ	e: Gypsum v	vith wood studs (both	sides), Full He	eight,)
DS1	1.9	1.2	1.2	1.0	0.9	0.4
DS2	1.7	0.8	0.7	0.3	0.2	0.1
DS3	3.9	16	16	11	8.6	3.1
Total	7.6	18	18	12	10	3.6
C1011.311a	#1 (C1011.311a	a: Interior of Exterior	Wall - Type:	Gypsum with wood s	tuds (single-si	ded)
DS1	1.7	0.6	0.6	0.5	0.5	0.2
DS2	1.7	0.7	0.6	0.2	0.2	0.1
DS3	4.6	16	16	11	8.5	3.1
Total	8.1	17	17	11	9.1	3.4
C2011.041b	#1 (C2011.041	b: Light frame stair fr	agility. Appr	oximation as a placeh	older until the	ere is)
DS1	0.3	0.1	0.1	0.1	0.0	0.0
DS2	0.4	0.9	0.9	0.4	0.3	0.1
DS3	0.4	4.5	4.6	3.9	3.2	1.3
Total	1.1	5.6	5.6	4.4	3.6	1.4
C3034.001 #	#1 (C3034.001:	Independent Pendant	Lighting - no	on seismic)		
DS1	3.0	2.8	2.8	1.7	1.2	0.4
D1014.022 #	#1 (D1014.022:	Hydraulic Elevator - A	applies to mo	st California Installat	ions prior to	.)
DS1a	0.3	0.3	0.3	0.2	0.2	0.1
DS1b	4.3	5.5	5.6	3.6	2.8	1.1
DS1c	5.3	7.2	7.3	4.7	3.5	1.2
DS1d	0.8	1.2	1.1	0.8	0.6	0.2
Total	11	14	14	9.3	7.1	2.6
D2021.012a	#1 (D2021.012	a: Cold or Hot Potable	- Small Diar	neter Threaded Steel	- (2.5 inches ir)
DS1	0.0	0.0	0.0	0.0	0.0	0.0
DS2	0.0	0.0	0.0	0.0	0.0	0.0
Total	0.0	0.0	0.0	0.0	0.0	0.0
D2021.012b	#1 (D2021.012	b: Cold or Hot Potable	e - Small Dia	meter Threaded Steel	- (2.5 inches in	n)
DS1	0.0	0.0	0.0	0.0	0.0	0.0
DS2	0.0	0.0	0.0	0.0	0.0	0.0
Total	0.0	0.0	0.0	0.0	0.0	0.0
D2021.022a	#1 (D2021.022;	a: Cold or Hot Potable	Water Pipin	g (dia > 2.5 inches), S	DC C, PIPINO	G)
DS1	0.0	0.0	0.0	0.0	0.0	0.0
DS2	0.0	0.1	0.0	0.1	0.1	0.0
Total	0.0	0.1	0.1	0.1	0.1	0.0
D2031.022a	#1 (D2031.022	a: Sanitary Waste Pipi	ng - Cast Iro	n w/bell and spigot co	uplings, SDC	
DS1	0.1	0.2	0.2	0.2	0.2	0.1
D2031.022b	#1 (D2031.022	b: Sanitary Waste Pipi	ing - Cast Iro	on w/bell and spigot co	uplings, SDC	C,)
DS1	0.0	0.0	0.0	0.0	0.0	0.0
DS2	0.0	0.1	0.1	0.1	0.1	0.0
Total	0.0	0.1	0.1	0.1	0.1	0.0
D3032.011a	#1 (D3032.011a	a: Compressor - Capao	city: Small n	on medical air supply	- Unanchored	equipment)
DS1a	0.6	0.6	0.6	0.4	0.3	0.1
DS1b	0.3	0.4	0.4	0.2	0.2	0.1
Total	1.0	1.0	1.0	0.6	0.5	0.2

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	Table	3.3 (Continued). Expe	cted worker day	s per damage state (We	orker Days)	
	50% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 years
P[Col](%)	0.0	27	27	49	56	73
P[Res](%)	0.0	1.1	1.6	6.2	8.9	14
D3032.01	la #2 (D3032.011a	a: Compressor - Cap	acity: Small no	on medical air supply	- Unanchored	equipment)
DS1a	0.8	0.7	0.6	0.4	0.3	0.1
DS1b	0.5	0.4	0.4	0.2	0.2	0.1
Total	1.3	1.0	1.0	0.6	0.5	0.2
D3041.01	lc #1 (D3041.011c	: HVAC Galvanized	Sheet Metal D	ucting less than 6 sq.	ft in cross sect	tional)
DS1	0.0	0.0	0.0	0.0	0.0	0.0
DS2	0.0	0.0	0.0	0.0	0.0	0.0
Total	0.0	0.0	0.1	0.1	0.1	0.0
D3041.03	2c #1 (D3041.032c	: HVAC Drops / Diff	users without o	eilings - supported by	y ducting only	- No)
DS1	0.2	1.1	1.1	1.1	1.0	0.5

3.3 Component Name Reference

This list is provided for reference where only the fragility ID is available.

- B1031.011a: Steel Column Base Plates, Column W < 150 plf
- B1035.041: Pre-Northridge WUF-B beam-column joint, beam one side of column, beam depth <= W27
- B1035.051: Pre-Northridge WUF-B beam-column joint, beam both sides of column, beam depth <= W27
- **B1071.002**: Light framed wood walls with structural panel sheathing, gypsum wallboard and hold-downs
- **B1071.302**: Interior Structural Wall Light framed wood walls with structural panel sheathing, gypsum wallboard on both sides, with hold-downs
- **B2011.401**: Exterior Wall Light framed wood walls with exterior panelized sheathing (OSB) and horizontal wood siding, no hold-downs
- C1011.211a: Wall Partition Type: Gypsum with wood studs (both sides), Full Height, Fixed Below, Fixed Above
- **C1011.311a**: Interior of Exterior Wall Type: Gypsum with wood studs (single-sided gypsum), Full Height, Fixed Below, Fixed Above
- C2011.041b: Light frame stair fragility. Approximation as a placeholder until there is more research on the topic. Damage states from P-58 Light frame stair example. Costing approximated from various online sources for stair replacement.
- C3034.001: Independent Pendant Lighting non seismic
- **D1014.022**: Hydraulic Elevator Applies to most California Installations prior to 1976, most western states installations prior to 1982 and most U.S installations prior to 1998.
- **D2021.012a**: Cold or Hot Potable Small Diameter Threaded Steel (2.5 inches in diameter or less), SDC C, PIPING FRAGILITY
- **D2021.012b**: Cold or Hot Potable Small Diameter Threaded Steel (2.5 inches in diameter or less), SDC C, BRACING FRAGILITY
- D2021.022a: Cold or Hot Potable Water Piping (dia > 2.5 inches), SDC C, PIPING FRAGILITY
- **D2031.022a**: Sanitary Waste Piping Cast Iron w/bell and spigot couplings, SDC C, PIPING FRAGILITY
- D2031.022b: Sanitary Waste Piping Cast Iron w/bell and spigot couplings, SDC C, BRACING FRAGILITY
- D3032.011a: Compressor Capacity: Small non medical air supply Unanchored equipment that is not vibration isolated Equipment fragility only
- D3041.011c: HVAC Galvanized Sheet Metal Ducting less than 6 sq. ft in cross sectional area, SDC D, E, or F
- D3041.032c: HVAC Drops / Diffusers without ceilings supported by ducting only No independent safety wires, SDC D, E, or F



4 DETAILED REOCCUPANCY AND FUNCTIONALITY RESULTS BY GROUND MOTION INTENSITY

4.1 50% in 50 years Intensity

4.1.1 Selected Realizations for 50th percentile

Note that this is a single realization and may not be representative of a general trend. This selected realization is intended to give a sense of what the repair schedule may look like, it is not intended to generalize what the "typical" repair schedule looks like.

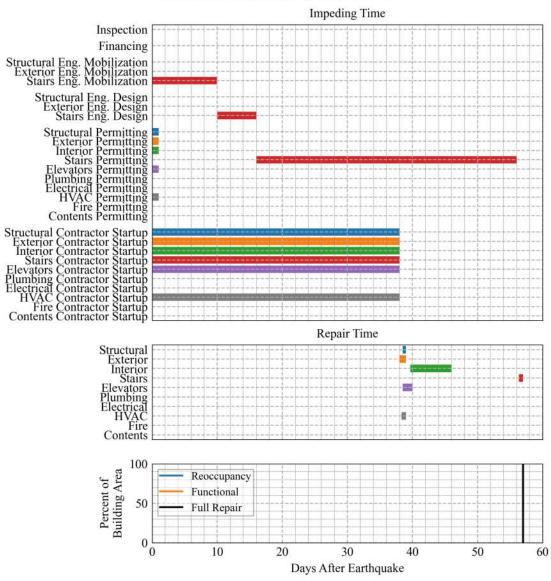


Figure 4.1. 50% in 50 years Percentile = 50





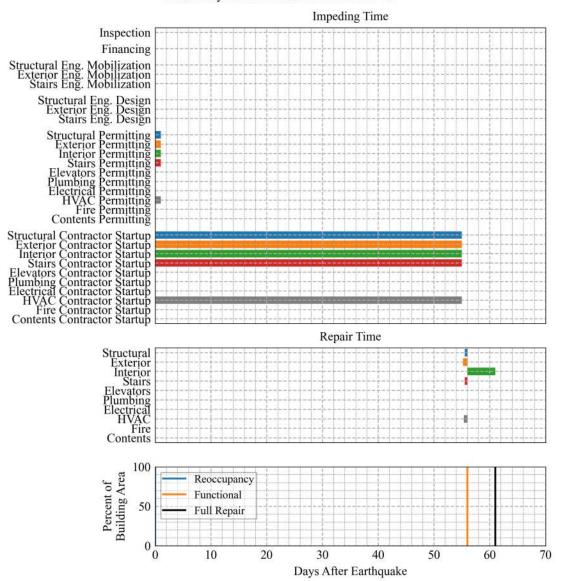


Figure 4.2. 50% in 50 years Percentile = 49



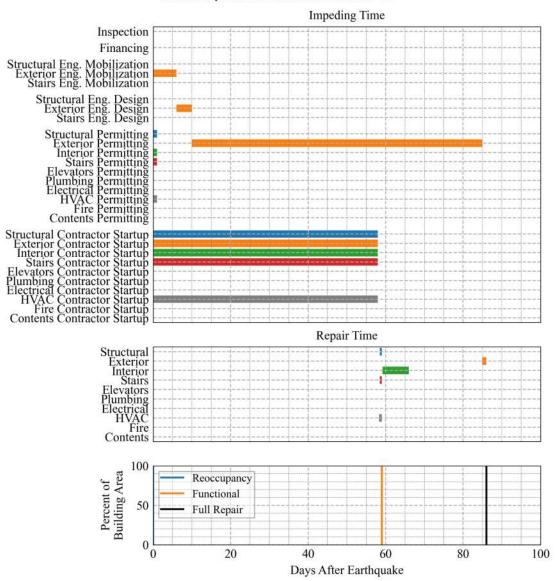


Figure 4.3. 50% in 50 years Percentile = 51

4.1.2 Selected Realizations for 90th percentile

Note that this is a single realization and may not be representative of a general trend. This selected realization is intended to give a sense of what the repair schedule may look like, it is not intended to generalize what the "typical" repair schedule looks like.

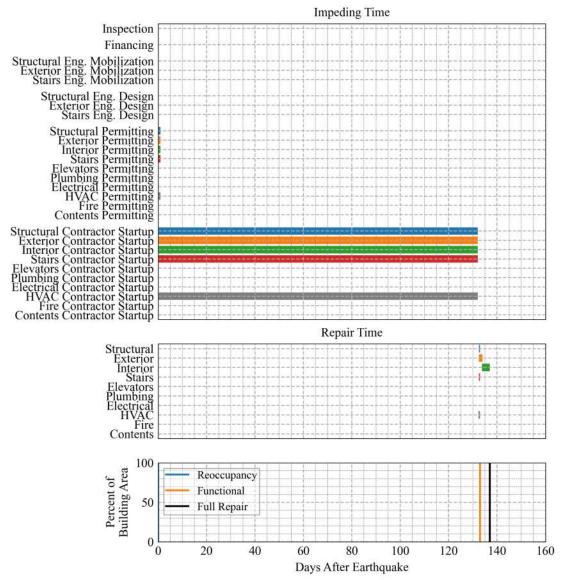


Figure 4.4. 50% in 50 years Percentile = 90



4.1.3 Damage to Building Systems

Table 4.1 shows the percentage of realizations that the named system prevents reoccupancy/function for the 50% in 50 years intensity. Note that if a system prevents reoccupancy, it will also prevent functionality. This means that the functionality checks may all be fine, but if the reoccupancy checks indicate the building is not reoccupiable then the building will not be considered functional.

Each column represents a milestone time after the earthquake and the values in that column indicate the percentage of realizations in which that component is preventing reoccupancy/functionality at that milestone.

	Immediate	>3 days	>7 days	>14 days	>1 month	>6 months	>12 months
Building Reoccupancy	(also affects fu	nction)					
Red Tag (Structural)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hazardous Material	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fire Egress	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Entry Door Access	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Falling hazard	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Entry Door Racking	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Stairs	25	25	25	25	25	1.0	0.0
Stairway Doors	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Exterior	5.1	4.9	2.2	0.4	0.0	0.0	0.0
Interior	0.6	0.6	0.5	0.4	0.3	0.0	0.0
Building Function (affe	cts function on	ly, not reocc	cupancy)				
Elevators	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Exterior	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Interior	24	23	12	2.7	0.0	0.0	0.0
Water	18	18	18	17	12	0.2	0.0
Electrical	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HVAC	98	98	98	94	70	1.5	0.0

Table 4.1. Percent of realizations affecting building reoccupancy/function per system - 50% in 50 years



4.1.4 Damage to Individual Components

Table 4.2 shows the percentage of realizations that a specific component prevents reoccupancy/function for the 50% in 50 years intensity. Note that if a component prevents reoccupancy, it will also prevent functionality.

Each column represents a milestone time after the earthquake and the values in that column indicate the percentage of realizations in which that component is preventing reoccupancy/functionality at that milestone.

	Immediate	>3 days	>7 days	>14 days	>1 month	>6 months	>12 months
B1031.011a	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
B1035.041	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
B1035.051	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
B1071.002	0.5 / 0.4	0.4 / 0.4	0.1 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
B1071.302	0.0 / 1.5	0.0 / 1.1	0.0 / 0.4	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
B2011.401	5.1 / 9.6	4.9 / 8.5	2.2 / 1.9	0.4 / 0.1	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
C1011.211a	0.0 / 13	0.0 / 11	0.0 / 2.8	0.0 / 0.1	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
C1011.311a	0.0 / 24	0.0 / 22	0.0 / 12	0.0 / 2.6	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
C2011.041b	25 / 0.0	25 / 0.0	25 / 0.0	25 / 0.0	25 / 0.0	1.0 / 0.0	0.0 / 0.0
C3034.001	0.6 / 19	0.6 / 17	0.3 / 4.6	0.0 / 0.3	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D1014.022	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D2021.012a	0.3 / 0.3	0.3 / 0.3	0.2 / 0.3	0.2 / 0.3	0.2 / 0.2	0.0 / 0.0	0.0 / 0.0
D2021.012b	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D2021.022a	0.3 / 0.3	0.3 / 0.3	0.3 / 0.3	0.2 / 0.2	0.1 / 0.1	0.0 / 0.0	0.0 / 0.0
D2031.022a	0.0 / 17	0.0 / 17	0.0 / 17	0.0 / 16	0.0 / 11	0.0 / 0.2	0.0 / 0.0
D2031.022b	0.0 / 1.8	0.0 / 1.8	0.0 / 1.8	0.0 / 1.8	0.0 / 1.0	0.0 / 0.0	0.0 / 0.0
D3032.011a	0.0 / <mark>98</mark>	0.0 / <mark>98</mark>	0.0 / <mark>98</mark>	0.0 / <mark>94</mark>	0.0 / <mark>69</mark>	0.0 / 1.4	0.0 / 0.0
D3041.011c	0.1 / 0.8	0.1 / 0.8	0.0 / 0.8	0.0 / 0.8	0.0 / 0.7	0.0 / 0.1	0.0 / 0.0
D3041.032c	0.3 / 5.6	0.3 / 5.6	0.2 / 5.6	0.2 / 5.6	0.1 / 4.6	0.0 / 0.0	0.0 / 0.0

Table 4.2. Percent of realizations affecting building reoccupancy/functionality per component - 50% in 50 years





4.2 10% in 50 years Intensity

4.2.1 Selected Realizations for 50th percentile

Note that this is a single realization and may not be representative of a general trend. This selected realization is intended to give a sense of what the repair schedule may look like, it is not intended to generalize what the "typical" repair schedule looks like.

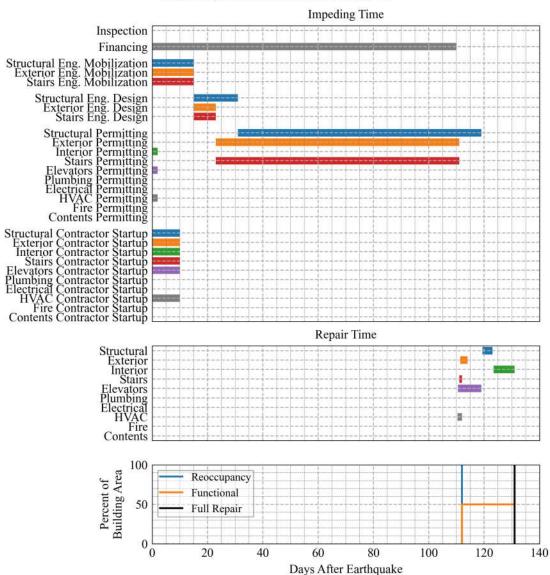


Figure 4.5. 10% in 50 years Percentile = 50



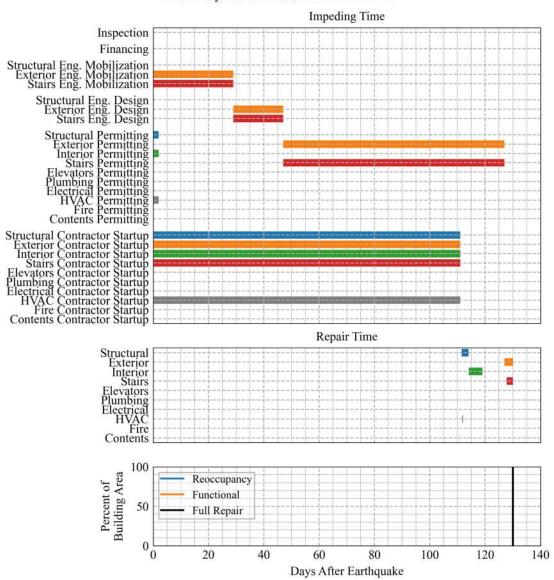


Figure 4.6. 10% in 50 years Percentile = 49



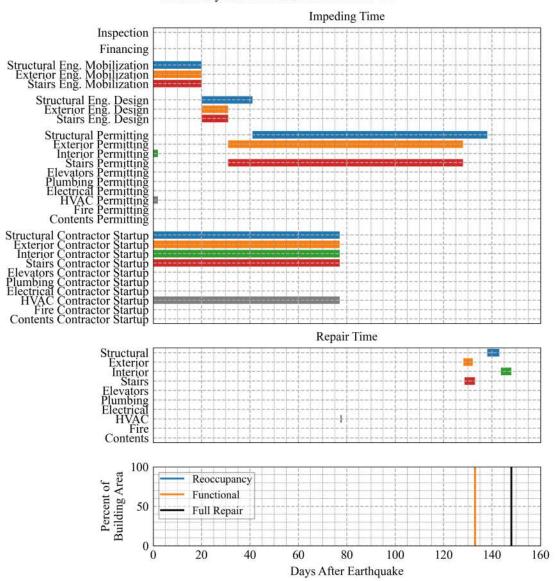


Figure 4.7. 10% in 50 years Percentile = 51

4.2.2 Selected Realizations for 90th percentile

Note that this is a single realization and may not be representative of a general trend. This selected realization is intended to give a sense of what the repair schedule may look like, it is not intended to generalize what the "typical" repair schedule looks like.

This particular realization (10% in 50 years Percentile = 90) resulted in global failure, no scheduling was computed.



4.2.3 Damage to Building Systems

Table 4.3 shows the percentage of realizations that the named system prevents reoccupancy/function for the 10% in 50 years intensity. Note that if a system prevents reoccupancy, it will also prevent functionality. This means that the functionality checks may all be fine, but if the reoccupancy checks indicate the building is not reoccupiable then the building will not be considered functional.

Each column represents a milestone time after the earthquake and the values in that column indicate the percentage of realizations in which that component is preventing reoccupancy/functionality at that milestone.

	Immediate	>3 days	>7 days	>14 days	>1 month	>6 months	>12 months
Building Reoccupancy	(also affects fu	nction)					
Red Tag (Structural)	28	28	0.0	0.0	0.0	0.0	0.0
Hazardous Material	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fire Egress	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Entry Door Access	82	0.0	0.0	0.0	0.0	0.0	0.0
Falling hazard	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Entry Door Racking	82	0.0	0.0	0.0	0.0	0.0	0.0
Stairs	70	70	70	70	70	3.4	0.0
Stairway Doors	65	0.0	0.0	0.0	0.0	0.0	0.0
Exterior	67	64	41	15	4.0	0.0	0.0
Interior	9.1	8.7	8.0	7.2	6.7	0.2	0.0
Building Function (affe	cts function on	ly, not reocc	cupancy)				
Elevators	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Exterior	36	36	36	36	36	2.2	0.0
Interior	70	69	50	21	6.6	0.0	0.0
Water	42	42	42	42	40	0.9	0.0
Electrical	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HVAC	72	72	72	72	69	3.5	0.0

Table 4.3. Percent of realizations affecting building reoccupancy/function per system - 10% in 50 years



4.2.4 Damage to Individual Components

Table 4.4 shows the percentage of realizations that a specific component prevents reoccupancy/function for the 10% in 50 years intensity. Note that if a component prevents reoccupancy, it will also prevent functionality.

Each column represents a milestone time after the earthquake and the values in that column indicate the percentage of realizations in which that component is preventing reoccupancy/functionality at that milestone.

	Immediate	>3 days	>7 days	>14 days	>1 month	>6 months	>12 months
B1031.011a	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
B1035.041	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
B1035.051	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
B1071.002	44 / 44	40 / 41	20 / 22	9.4 / 8.3	3.3 / 3.5	0.0 / 0.0	0.0 / 0.0
B1071.302	0.0 / 65	0.0 / 63	0.0 / 46	0.0 / 38	0.0 / 37	0.0 / 2.2	0.0 / 0.0
B2011.401	67 / 69	63 / 66	38 / 48	14 / 39	4.0 / 37	0.0 / 2.2	0.0 / 0.0
C1011.211a	0.0 / <mark>69</mark>	0.0 / <mark>65</mark>	0.0 / 33	0.0 / 12	0.0 / 3.4	0.0 / 0.0	0.0 / 0.0
C1011.311a	0.0 / <mark>70</mark>	0.0 / 67	0.0 / 38	0.0 / 14	0.0 / 4.0	0.0 / 0.0	0.0 / 0.0
C2011.041b	70 / 0.0	70 / 0.0	70 / 0.0	70 / 0.0	70 / 0.0	3.4 / 0.0	0.0 / 0.0
C3034.001	9.1 / <mark>68</mark>	8.5 / 64	5.3 / <mark>28</mark>	2.2 / 8.8	0.6 / 3.2	0.0 / 0.0	0.0 / 0.0
D1014.022	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D2021.012a	4.6 / 4.8	4.5 / 4.8	4.0 / 4.8	3.2 / 4.8	2.8 / 4.6	0.2 / 0.2	0.0 / 0.0
D2021.012b	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D2021.022a	5.2 / 5.2	5.2 / 5.2	5.2 / 5.2	5.2 / 5.2	5.1 / 5.1	0.1 / 0.1	0.0 / 0.0
D2031.022a	0.0 / <mark>39</mark>	0.0 / <mark>39</mark>	0.0 / <mark>39</mark>	0.0 / <mark>39</mark>	0.0 / 37	0.0 / 0.8	0.0 / 0.0
D2031.022b	0.0 / 9.0	0.0 / <mark>9.0</mark>	0.0 / <mark>9.0</mark>	0.0 / 9.0	0.0 / 8.7	0.0 / 0.2	0.0 / 0.0
D3032.011a	0.0 / 72	0.0 / 72	0.0 / 72	0.0 / 72	0.0 / <mark>68</mark>	0.0 / 1.6	0.0 / 0.0
D3041.011c	3.0 / 7.5	1.7 / 7.5	0.7 / 7.5	0.6 / 7.5	0.2 / 7.5	0.0 / 0.7	0.0 / 0.0
D3041.032c	5.5 / 24	5.2 / <mark>2</mark> 4	4.6 / 24	4.1 / 24	3.8 / <mark>24</mark>	0.1 / 2.5	0.0 / 0.0

Table 4.4. Percent of realizations affecting building reoccupancy/functionality per component - 10% in 50 years

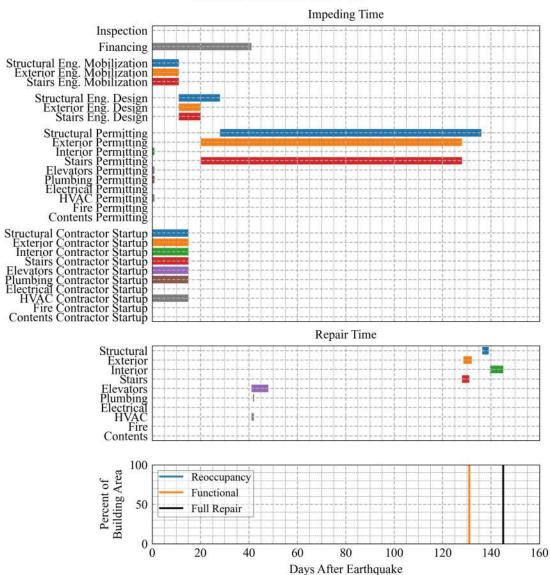




4.3 DE Intensity

4.3.1 Selected Realizations for 50th percentile

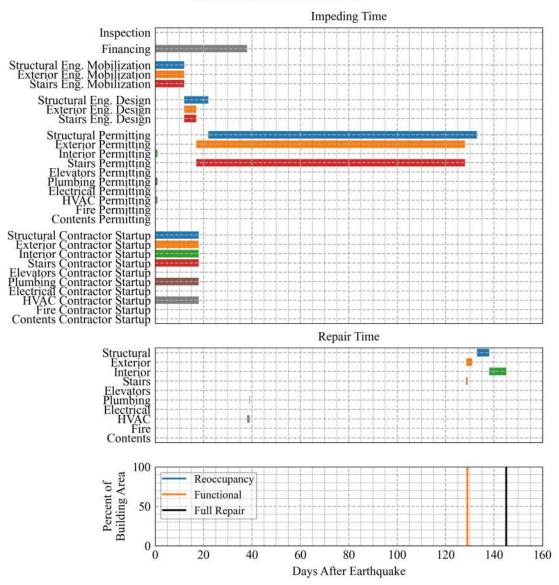
Note that this is a single realization and may not be representative of a general trend. This selected realization is intended to give a sense of what the repair schedule may look like, it is not intended to generalize what the "typical" repair schedule looks like.



DE: Realization for Percentile=50

Figure 4.8. DE Percentile = 50

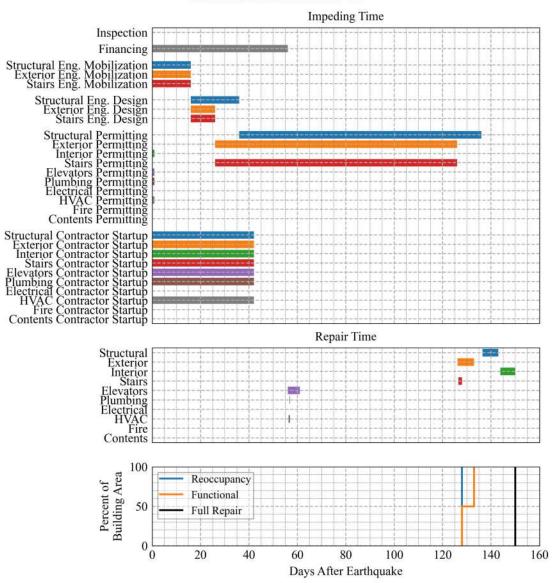




DE: Realization for Percentile=49

Figure 4.9. DE Percentile = 49





DE: Realization for Percentile=51

Figure 4.10. DE Percentile = 51

4.3.2 Selected Realizations for 90th percentile

Note that this is a single realization and may not be representative of a general trend. This selected realization is intended to give a sense of what the repair schedule may look like, it is not intended to generalize what the "typical" repair schedule looks like.

This particular realization (DE Percentile = 90) resulted in global failure, no scheduling was computed.



4.3.3 Damage to Building Systems

Table 4.5 shows the percentage of realizations that the named system prevents reoccupancy/function for the DE intensity. Note that if a system prevents reoccupancy, it will also prevent functionality. This means that the functionality checks may all be fine, but if the reoccupancy checks indicate the building is not reoccupiable then the building will not be considered functional.

Each column represents a milestone time after the earthquake and the values in that column indicate the percentage of realizations in which that component is preventing reoccupancy/functionality at that milestone.

	Immediate	>3 days	>7 days	>14 days	>1 month	>6 months	>12 months
Building Reoccupancy	(also affects fu	nction)					
Red Tag (Structural)	29	29	0.0	0.0	0.0	0.0	0.0
Hazardous Material	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fire Egress	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Entry Door Access	85	0.0	0.0	0.0	0.0	0.0	0.0
Falling hazard	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Entry Door Racking	85	0.0	0.0	0.0	0.0	0.0	0.0
Stairs	69	69	69	69	69	2.9	0.0
Stairway Doors	64	0.0	0.0	0.0	0.0	0.0	0.0
Exterior	67	63	40	14	4.1	0.0	0.0
Interior	9.6	8.9	7.7	6.9	6.2	0.1	0.0
Building Function (affe	ets function on	ly, not reocc	cupancy)				
Elevators	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Exterior	34	34	34	34	34	1.5	0.0
Interior	70	68	50	20	6.6	0.0	0.0
Water	41	41	41	41	39	0.8	0.0
Electrical	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HVAC	71	71	71	71	68	3.0	0.0

Table 4.5. Percent of realizations affecting building reoccupancy/function per system - DE



4.3.4 Damage to Individual Components

Table 4.6 shows the percentage of realizations that a specific component prevents reoccupancy/function for the DE intensity. Note that if a component prevents reoccupancy, it will also prevent functionality.

Each column represents a milestone time after the earthquake and the values in that column indicate the percentage of realizations in which that component is preventing reoccupancy/functionality at that milestone.

>14 days Immediate >3 days >7 days >1 month >6 months >12 months B1031.011a 0.0 / 0.0 0.0 / 0.0 0.0 / 0.0 0.0 / 0.0 0.0 / 0.0 0.0 / 0.0 0.0 / 0.0 B1035.041 0.0 / 0.0 0.0 / 0.0 0.0 / 0.0 0.0 / 0.0 0.0 / 0.0 0.0 / 0.0 0.0 / 0.0 B1035.051 0.0 / 0.0 0.0 / 0.0 0.0 / 0.0 0.0 / 0.0 0.0 / 0.0 0.0 / 0.0 0.0 / 0.0 0.0 / 0.0 B1071.002 44 / 44 40 / 40 19 / 21 8.9 / 8.2 3.7 / 3.6 0.0 / 0.0 B1071.302 0.0 / 63 0.0 / 61 0.0 / 45 0.0 / 36 0.0 / 35 0.0 / 1.5 0.0 / 0.0 67 / 69 37 / 46 14 / 37 4.0 / 36 0.0 / 1.5 B2011.401 63 / 65 0.0 / 0.0 0.0 / 0.0 C1011.211a 0.0 / 69 0.0 / 64 0.0 / 34 0.0 / 120.0 / 3.8 0.0 / 0.0 0.0 / 69 0.0 / 65 0.0 / 37 0.0 / 14 0.0 / 4.2 0.0 / 0.0 C1011.311a 0.0 / 0.0 C2011.041b **69** / 0.0 **69** / 0.0 **69** / 0.0 **69** / 0.0 **69** / 0.0 2.9 / 0.0 0.0 / 0.0 9.6 / 67 5.0 / 30 2.3 / 9.2 0.6 / 3.7 C3034.001 8.7 / 62 0.0 / 0.00.0 / 0.00.0 / 0.0 D1014.022 0.0 / 0.0 0.0 / 0.0 0.0 / 0.0 0.0 / 0.0 0.0 / 0.0 0.0 / 0.0 D2021.012a 5.6 / 5.6 5.4 / 5.6 4.6 / 5.6 3.8 / 5.6 3.2 / 5.2 0.1 / 0.1 0.0 / 0.0 D2021.012b 0.0 / 0.0 0.0 / 0.0 0.0 / 0.0 0.0 / 0.0 0.0 / 0.0 0.0 / 0.0 0.0 / 0.0 4.5 / 4.5 4.3 / 4.3 D2021.022a 4.5 / 4.5 4.5 / 4.5 4.5 / 4.5 0.0 / 0.0 0.0 / 0.0 D2031.022a 0.0 / 38 0.0 / 38 0.0 / 38 0.0 / 38 0.0 / 36 0.0 / 0.8 0.0 / 0.0 D2031.022b 0.0 / 8.7 0.0 / 8.7 0.0 / 8.7 0.0 / 8.6 0.0 / 8.4 0.0 / 0.2 0.0 / 0.0 D3032.011a 0.0 / 71 0.0 / 71 0.0 / 71 0.0 / 71 0.0 / 67 0.0 / 1.2 0.0 / 0.0 1.9 / 7.8 0.4 / 7.8 D3041.011c 3.6 / 7.8 0.6 / 7.8 0.1 / 7.8 0.0 / 0.7 0.0 / 0.0 D3041.032c 6.4 / 23 5.7 / 23 4.8 / 23 4.3 / 23 3.9 / 23 0.0 / 2.0 0.0 / 0.0

Table 4.6. Percent of realizations affecting building reoccupancy/functionality per component - DE





4.4 MCE $_R$ Intensity

4.4.1 Selected Realizations for 50th percentile

Note that this is a single realization and may not be representative of a general trend. This selected realization is intended to give a sense of what the repair schedule may look like, it is not intended to generalize what the "typical" repair schedule looks like.

This particular realization (MCE_R Percentile = 50) resulted in global failure, no scheduling was computed.



This particular realization (MCE_R Percentile = 49) resulted in global failure, no scheduling was computed.



This particular realization (MCE_R Percentile = 51) resulted in global failure, no scheduling was computed.

4.4.2 Selected Realizations for 90th percentile

Note that this is a single realization and may not be representative of a general trend. This selected realization is intended to give a sense of what the repair schedule may look like, it is not intended to generalize what the "typical" repair schedule looks like.

This particular realization (MCE_R Percentile = 90) resulted in global failure, no scheduling was computed.



4.4.3 Damage to Building Systems

Table 4.7 shows the percentage of realizations that the named system prevents reoccupancy/function for the MCE_R intensity. Note that if a system prevents reoccupancy, it will also prevent functionality. This means that the functionality checks may all be fine, but if the reoccupancy checks indicate the building is not reoccupiable then the building will not be considered functional.

Each column represents a milestone time after the earthquake and the values in that column indicate the percentage of realizations in which that component is preventing reoccupancy/functionality at that milestone.

	Immediate	>3 days	>7 days	>14 days	>1 month	>6 months	>12 months
Building Reoccupancy	also affects fu	nction)					
Red Tag (Structural)	65	65	0.0	0.0	0.0	0.0	0.0
Hazardous Material	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fire Egress	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Entry Door Access	97	0.0	0.0	0.0	0.0	0.0	0.0
Falling hazard	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Entry Door Racking	97	0.0	0.0	0.0	0.0	0.0	0.0
Stairs	34	34	34	34	34	1.8	0.0
Stairway Doors	34	0.0	0.0	0.0	0.0	0.0	0.0
Exterior	34	34	25	13	5.4	0.0	0.0
Interior	11	10	9.4	9.0	8.1	0.4	0.0
Building Function (affe	ets function on	ly, not reocc	cupancy)				
Elevators	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Exterior	30	30	30	30	30	1.6	0.0
Interior	35	34	30	17	8.4	0.2	0.0
Water	28	28	28	28	27	0.9	0.0
Electrical	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HVAC	35	35	35	35	34	2.7	0.0

Table 4.7. Percent of realizations affecting building reoccupancy/function per system - MCE_R



4.4.4 Damage to Individual Components

Table 4.8 shows the percentage of realizations that a specific component prevents reoccupancy/function for the MCE_R intensity. Note that if a component prevents reoccupancy, it will also prevent functionality. Each column represents a milestone time after the earthquake and the values in that column indicate the percentage of realizations in which that component is preventing reoccupancy/functionality at that milestone.

	Immediate	>3 days	>7 days	>14 days	>1 month	>6 months	>12 months
B1031.011a	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
B1035.041	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
B1035.051	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
B1071.002	31 / 31	29 / 30	18 / 19	10 / 10	4.5 / 4.5	0.0 / 0.0	0.0 / 0.0
B1071.302	0.0 / 34	0.0 / 34	0.0 / 32	0.0 / 30	0.0 / 30	0.0 / 1.6	0.0 / 0.0
B2011.401	34 / 35	33 / 34	22 / 32	12 / 31	5.0 / <mark>30</mark>	0.0 / 1.6	0.0 / 0.0
C1011.211a	0.0 / 35	0.0 / 33	0.0 / 21	0.0 / 12	0.0 / 4.7	0.0 / 0.0	0.0 / 0.0
C1011.311a	0.0 / 35	0.0 / 33	0.0 / 22	0.0 / 12	0.0 / 4.8	0.0 / 0.0	0.0 / 0.0
C2011.041b	34 / 0.0	34 / 0.0	34 / 0.0	34 / 0.0	34 / 0.0	1.8 / 0.0	0.0 / 0.0
C3034.001	11 / 34	10 / 33	6.3 / 20	3.7 / 10	1.3 / 4.4	0.0 / 0.0	0.0 / 0.0
D1014.022	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D2021.012a	6.6 / 6.6	6.5 / 6.6	5.9 / 6.6	5.5 / 6.6	4.9 / 6.4	0.2 / 0.2	0.0 / 0.0
D2021.012b	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D2021.022a	6.4 / 6.4	6.4 / 6.4	6.4 / 6.4	6.4 / 6.4	5.9 / 5.9	0.4 / 0.4	0.0 / 0.0
D2031.022a	0.0 / 26	0.0 / 26	0.0 / 26	0.0 / 26	0.0 / 25	0.0 / 0.9	0.0 / 0.0
D2031.022b	0.0 / 10	0.0 / 10	0.0 / 10	0.0 / 10	0.0 / 10	0.0 / 0.4	0.0 / 0.0
D3032.011a	0.0 / 35	0.0 / 35	0.0 / 35	0.0 / 35	0.0 / 33	0.0 / 1.2	0.0 / 0.0
D3041.011c	5.6 / 8.8	3.8 / 8.8	2.1 / 8.8	1.7 / 8.8	0.5 / 8.8	0.0 / 0.9	0.0 / 0.0
D3041.032c	8.4 / 19	8.0 / 19	7.5 / 19	7.1 / 19	6.4 / 19	0.4 / 2.0	0.0 / 0.0

Table 4.8. Percent of realizations affecting building reoccupancy/functionality per component - MCE_R





4.5 2% in 50 years Intensity

4.5.1 Selected Realizations for 50th percentile

Note that this is a single realization and may not be representative of a general trend. This selected realization is intended to give a sense of what the repair schedule may look like, it is not intended to generalize what the "typical" repair schedule looks like.

This particular realization (2% in 50 years Percentile = 50) resulted in global failure, no scheduling was computed.



Note that this is a single realization and may not be representative of a general trend. This selected realization is intended to give a sense of what the repair schedule may look like, it is not intended to generalize what the "typical" repair schedule looks like.

This particular realization (2% in 50 years Percentile = 49) resulted in global failure, no scheduling was computed.



Note that this is a single realization and may not be representative of a general trend. This selected realization is intended to give a sense of what the repair schedule may look like, it is not intended to generalize what the "typical" repair schedule looks like.

This particular realization (2% in 50 years Percentile = 51) resulted in global failure, no scheduling was computed.

4.5.2 Selected Realizations for 90th percentile

Note that this is a single realization and may not be representative of a general trend. This selected realization is intended to give a sense of what the repair schedule may look like, it is not intended to generalize what the "typical" repair schedule looks like.

This particular realization (2% in 50 years Percentile = 90) resulted in global failure, no scheduling was computed.



4.5.3 Damage to Building Systems

Table 4.9 shows the percentage of realizations that the named system prevents reoccupancy/function for the 2% in 50 years intensity. Note that if a system prevents reoccupancy, it will also prevent functionality. This means that the functionality checks may all be fine, but if the reoccupancy checks indicate the building is not reoccupiable then the building will not be considered functional.

Each column represents a milestone time after the earthquake and the values in that column indicate the percentage of realizations in which that component is preventing reoccupancy/functionality at that milestone.

	Immediate	>3 days	>7 days	>14 days	>1 month	>6 months	>12 months
Building Reoccupancy	(also affects fu	nction)					
Red Tag (Structural)	87	87	0.0	0.0	0.0	0.0	0.0
Hazardous Material	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fire Egress	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Entry Door Access	99	0.0	0.0	0.0	0.0	0.0	0.0
Falling hazard	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Entry Door Racking	99	0.0	0.0	0.0	0.0	0.0	0.0
Stairs	13	13	13	13	13	0.8	0.0
Stairway Doors	13	0.0	0.0	0.0	0.0	0.0	0.0
Exterior	13	13	10	6.1	2.5	0.0	0.0
Interior	5.6	5.2	4.8	4.8	4.6	0.1	0.0
Building Function (affe	cts function on	ly, not reocc	upancy)				
Elevators	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Exterior	12	12	12	12	12	0.8	0.0
Interior	13	13	12	8.5	4.8	0.0	0.0
Water	11	11	11	11	11	0.3	0.0
Electrical	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HVAC	13	13	13	13	13	1.0	0.0

Table 4.9. Percent of realizations affecting building reoccupancy/function per system - 2% in 50 years



4.5.4 Damage to Individual Components

Table 4.10 shows the percentage of realizations that a specific component prevents reoccupancy/function for the 2% in 50 years intensity. Note that if a component prevents reoccupancy, it will also prevent functionality.

Each column represents a milestone time after the earthquake and the values in that column indicate the percentage of realizations in which that component is preventing reoccupancy/functionality at that milestone.

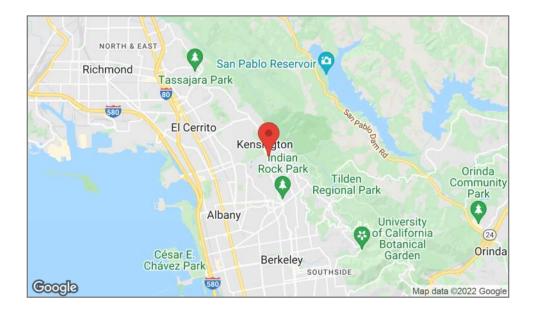
	Immediate	>3 days	>7 days	>14 days	>1 month	>6 months	>12 months
B1031.011a	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
B1035.041	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
B1035.051	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
B1071.002	12 / 12	12 / 12	8.1 / 8.3	5.2 / 5.0	2.0 / 2.0	0.0 / 0.0	0.0 / 0.0
B1071.302	0.0 / 13	0.0 / 13	0.0 / 12	0.0 / 12	0.0 / 12	0.0 / 0.8	0.0 / 0.0
B2011.401	13 / 13	13 / 13	8.8 / 12	5.6 / 12	2.3 / 12	0.0 / 0.8	0.0 / 0.0
C1011.211a	0.0 / 13	0.0 / 12	0.0 / 8.9	0.0 / 5.6	0.0 / 2.3	0.0 / 0.0	0.0 / 0.0
C1011.311a	0.0 / 13	0.0 / 12	0.0 / 8.7	0.0 / 6.1	0.0 / 2.2	0.0 / 0.0	0.0 / 0.0
C2011.041b	13 / 0.0	13 / 0.0	13 / 0.0	13 / 0.0	13 / 0.0	0.8 / 0.0	0.0 / 0.0
C3034.001	5.6 / 13	5.1 / 12	4.0 / 8.4	2.7 / 5.4	1.3 / 2.3	0.0 / 0.0	0.0 / 0.0
D1014.022	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D2021.012a	3.4 / 3.4	3.2 / 3.4	3.0 / 3.4	2.8 / 3.4	2.7 / 3.3	0.1 / 0.1	0.0 / 0.0
D2021.012b	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D2021.022a	3.5 / 3.5	3.5 / 3.5	3.5 / 3.5	3.5 / 3.5	3.5 / 3.5	0.0 / 0.0	0.0 / 0.0
D2031.022a	0.0 / 11	0.0 / 11	0.0 / 11	0.0 / 11	0.0 / 11	0.0 / 0.3	0.0 / 0.0
D2031.022b	0.0 / 5.4	0.0 / 5.4	0.0 / 5.4	0.0 / 5.4	0.0 / 5.3	0.0 / 0.1	0.0 / 0.0
D3032.011a	0.0 / 13	0.0 / 13	0.0 / 13	0.0 / 13	0.0 / 13	0.0 / 0.3	0.0 / 0.0
D3041.011c	3.5 / 5.1	2.3 / 5.1	1.4 / 5.1	1.2 / 5.1	0.6 / 5.1	0.0 / 0.4	0.0 / 0.0
D3041.032c	4.5 / 8.9	4.2 / 8.9	3.9 / 8.9	3.8 / 8.9	3.6 / 8.9	0.1 / 1.0	0.0 / 0.0

Table 4.10. Percent of realizations affecting building reoccupancy/functionality per component - 2% in 50 years



SEISMIC RISK ASSESSMENT REPORT Created with the SP3-RiskModel

Detailed Component Report



Report Generated for:

217 Arlington Avenue, Kensington, CA, 94707 Latitude: 37.90622° Longitude: -122.27875°

Report Generated by:

The SP3-RiskModel Software v1.2.0 of the Seismic Performance Prediction Program (SP3)

March 16, 2022







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7 Disclaimer

1 SUMMARY OF INPUTS AND RISK RESULTS

Risk Model Inputs

Prir	nary	Structural	Properties		
Project Name: Model Name:	Kensington Fire Station Existing WLF w/ Frame	Allow Components to Affect Structural Properties?		Yes	
Building Type: Design Code Year:	WLF: General 1967	Mode Shapes Specified?		No	
Number of Stories:	2	Directional Properties	Dir. 1	Dir. 2	
Occupancy: Address:	Commercial Office	Base Shear Strength (g): Yield Drift (%):	0.419	0.283	
217 Arlington A Kensington, CA		1^{st} Mode Period (T_1) (s):	0.45	0.6	
Latitude: Longitude:	37.90622° -122.27875°				
		Component Information			
Analysis	Options	Selection Method	Cus	stom	
Include Collapse in Analysis Consider Residual Drift:	: Yes Yes	- Building	Stability		
Region Cost Multiplier: Date Cost Multiplier: Occupancy Cost Multiplier:	- - -	Median Collapse Capacity: Beta (Dispersion):	-		
Building Lavo	ut Information	Resp	onses		
Cost per Square Foot:	_	 No responses provided 			
Scale component repair costs building value?	s with No	Donair Ti	me Options		
Total Square Feet:	4,395		-	-+-)	
Aspect Ratio:	1.95	Repair Time Method	ATC-138 (B	cia)	
First Story Height (ft):	13.5	Factors Delaying Start of R	-		
Upper Story Heights (ft):	9	Inspection Financing	Yes		
Vertical Irregularity:	Moderate	Financing Dommitting	Yes		
Plan Irregularity:	Extreme	Permitting	Yes Yes		
Frac. of Full Height Ext. V	Vood Walls	Engineering Mobilization Contractor Mobilization	Yes Yes		
Dir 1 Story 1		Contractor Modifization	168		

Mitigation Factors Inspector on Retainer

Engineer on Retainer

Funding Source

Cash on Hand

Contractor on Retainer

Need HVAC for Function Need Elevator for Function

Include Surge Demand

Frac. of Full Height Ext. Wood Walls

Dir. 1 Story 1	-
Dir. 1 Upper Stories	_
Dir. 2 Story 1	_
Dir. 2 Upper Stories	-

Ground Motion and Soil Information

Site Class:	С
Site Hazard:	SP3 Default

Building Design Info

Level of Detailing (Dir. 1, 2):	Ordinary, Ordinary
Drift Limit (Dir. 1, 2):	1.5%, 1.5%
Risk Category:	IV
Seismic Importance Factor, I_e :	-
Component Importance Factor, I_p :	-



No

No

No

_

_

_

ATC-138 Functional Recovery (Beta) Options

Private Loans



Component Checklist

Stairs and Elevators

- Does the building have stairs?
 - > Yes
 - What type of stairs are in the building?
 - > Light Frame

Interior Finishes

• Does the building have suspended ceilings?

- > Yes
- Are the ceilings laterally supported?
- > Yes
- Does the building contain pendant (non-recessed) lighting?
 - > Yes
 - Are the pendant lights seismically rated?
 - > No

Piping

- Is the building's water piping OSHPD certified or equivalent? > No
- > .

HVAC

Is the HVAC cooling/heating equipment seismically anchored?
 > No

Electrical

- Does the building have a backup battery/generator system? > *No*
- Which best describes the building's electrical system? > No significant electrical equipment (rugged)

Expected Loss

Expected loss in percent of total building value					
Shaking Intensity	Return Period	SEL (%)	SUL (%)		
50% in 50 years	72 Years	4.6	8.1		
10% in 50 years	475 Years	39	67		
DE	481 Years	40	68		
5% in 50 years	975 Years	64	100		
MCE_R	1277 Years	72	100		
2% in 50 years	2475 Years	90	100		

Expected loss in percent of total building value

Repair Time

	Median repair time summary							
	FEMA	A P-58 [†]	ATC-138 I	ATC-138 Functional Recovery (Beta) [‡]				
Intensity	Parallel	Series	Re-Occupancy	Functional	Full			
50% in 50 years	14 days	2.1 weeks	0 days	1.9 months	2.3 months			
10% in 50 years	2.4 months	2.5 months	4.1 months	4.4 months	4.7 months			
DE	2.4 months	2.5 months	4.1 months	4.4 months	4.7 months			
5% in 50 years	11 months	11 months	11 months	11 months	11 months			
MCE_R	11 months	11 months	11 months	11 months	11 months			
2% in 50 years	11 months	11 months	11 months	11 months	11 months			

[†] Does *not* include impedance factors

[‡] Does include impedance factors



2 MOST DAMAGED COMPONENTS

Intensity	Component	Damage State	Expected Repair Cost
50% in 50 years	B1071.302	1	\$1,507
10% in 50 years	B1031.011a	1	\$16,523
DE	B1031.011a	1	\$16,821
5% in 50 years	B1031.011a	1	\$21,343
MCE_R	B1031.011a	1	\$18,853
2% in 50 years	B1031.011a	1	\$8,919

Table 2.1. Most damaged Structural components at each intensity level.

Table 2.2. Most damaged Non-Structural components at each intensity level.

Intensity	Component	Damage State	Expected Repair Cost
50% in 50 years	D1014.022	1	\$14,645
10% in 50 years	C1011.211a	3	\$31,390
DE	C1011.211a	3	\$31,104
5% in 50 years	C1011.211a	3	\$21,129
MCE_R	C1011.211a	3	\$16,921
2% in 50 years	C1011.211a	3	\$6,506

Details of the most damaged components and their damage states:

- **B1031.011a**: Steel Column Base Plates, Column W < 150 plf
 - DS1a: Initiation of crack at the fusion line between the column flange and the base plate weld. Damage in field is either obscured or deemed to not warrant repair. No repair conducted.
 - DS1b: Initiation of crack at the fusion line between the column flange and the base plate weld.
- **B1071.302**: Interior Structural Wall Light framed wood walls with structural panel sheathing, gypsum wallboard on both sides, with hold-downs
 - DS1: Cracking of paint over fasteners or joints.
- **C1011.211a**: Wall Partition Type: Gypsum with wood studs (both sides), Full Height, Fixed Below, Fixed Above
 - DS3: Local and global buckling out-of-plane and crushing of gypsum wallboards. Studs are typically not damaged by failure of the gypsum wallboard, but framing adjustments possible for this damage state.
- **D1014.022**: Hydraulic Elevator Applies to most California Installations prior to 1976, most western states installations prior to 1982 and most U.S installations prior to 1998.
 - DS1a: Damaged controls.
 - DS1b: Damaged vane and hoist-way switches, and or bent cab stabilizers, and or damaged car guide shoes.
 - DS1c: Damaged entrance and car door, and or flooring damage.
 - DS1d: Oil leak in hydraulic line, and or hydraulic tank failure.

3 DETAILED COMPONENT DAMAGE BREAKDOWNS

3.1 Repair Cost

This table shows the expected contribution to repair cost on a per-damage state basis. The header shows the total loss, the loss contribution from collapse, and the loss contribution from residual drift for reference.

The color scale is meant to indicate **relative** performance of components, not absolute performance. A "green" value does not indicate that the value falls in a pre-determined "good" range, just that it performs well compared to other components. Likewise, a "red" value does does not indicate that the value falls in a pre-determined "bad" range, just that it performs worse compared to other components.

	50% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 years
Tot. Loss	60.5k	524k	534k	850k	963k	1.2M
Collapse	0	358k	363k	650k	750k	966k
Residual	0	14.4k	20.7k	82.9k	119k	192k
B1031.01	1a #1 (B1031.011a	a: Steel Column Base	Plates, Colum	n W < 150 plf)		
DS1a	0	0	0	0	0	0
DS1b	34.2	1.24k	1.2k	1.11k	983	416
DS2	16.8	8.84k	9.37k	11.2k	8.25k	4.2k
DS3	0	6.45k	6.26k	9.05k	9.62k	4.31k
Total	51	16.5k	16.8k	21.3 k	18.9k	8.92 k
B1035.04	1 #1 (B1035.041:)	Pre-Northridge WUF	-B beam-colur	nn joint, beam one sid	le of column,	beam depth)
DS1a	0	0	0	0	0	0
DS1b	0	0	0	0	0	0
DS2a	0	0	0	0	0	0
DS2b	0	0	0	0	0	0
DS3	0	0	0	0	0	0
Total	0	0	0	0	0	0
B1035.05	1 #1 (B1035.051:]	Pre-Northridge WUF	-B beam-colur	nn joint, beam both si	ides of colum	ı, beam)
DS1a	0	0	0	0	0	0
DS1b	0	0	0	0	0	0
DS2a	0	0	0	0	0	0
DS2b	0	0	0	0	0	0
DS3	0	0	0	0	0	0
Total	0	0	0	0	0	0
B1071.00	2 #1 (B1071.002: 1	Light framed wood w	alls with struc	tural panel sheathing	, gypsum wall	board)
DS1	990	3.95k	3.97k	1.95k	1.35k	361
DS2	70.8	2.79k	2.77k	1.97k	1.61k	537
DS3	49.6	8.07k	8k	8.87k	7.56k	3.83k
Total	1.11k	14.8k	14.7k	12.8 k	10.5k	4.73 k
B1071.30	2 #1 (B1071.302:)	Interior Structural V	Vall - Light fra	ned wood walls with	structural par	nel)
DS1	840	285	283	177	142	65.8
DS2	329	351	373	131	93.8	26.3
DS3	338	2.63k	2.61k	1.32k	941	227
DS4	0	1.58k	1.46k	1.13k	1.02k	302
DS5	0	2.03k	1.9k	2.61k	2.26k	1.19k
Total	1.51k	6.87k	6.63k	5.37k	4.46k	1.81k
B2011.40	1 #1 (B2011.401:]	Exterior Wall - Light	framed wood	walls with exterior pa	nelized sheatl	ning)
DS1	793	599	580	233	153	40.1
DS2	342	1.07k	1.07k	555	411	114
DS3	462	8.87k	8.82k	7.57k	6.2k	2.65k
Total	1.6k	10.5k	10.5k	8.36k	6.76k	2.81k

Table 3.1.1. Expected contribution to repair cost per damage state (Dollars)





	Table 3.1.1	(Continued). Expected	l contribution t	o repair cost per damag	ge state (Dollar	s)
5	50% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 years
Tot. Loss	60.5k	524k	534k	850k	963k	1.2M
Collapse	0	358k	363k	650k	750k	966k
Residual	0	14.4k	20.7k	82.9k	119k	192k
C1011.211a	a #1 (C1011.211a	a: Wall Partition - Ty	pe: Gypsum w	ith wood studs (both	sides), Full Ho	eight,)
DS1	3.56k	2.05k	2.06k	1.79k	1.55k	783
DS2	3k	1.4k	1.31k	552	327	168
DS3	6.8k	27.9k	27.7k	18.8k	15k	5.55k
Total	13.4k	31.4k	31.1k	21.1 k	16.9k	6.51k
C1011.311a	#1 (C1011.311a	a: Interior of Exterior	r Wall - Type:	Gypsum with wood s	tuds (single-si	ded)
DS1	3.07k	1.12k	1.1k	934	802	370
DS2	3.24k	1.18k	1.1k	357	247	144
DS3	8.24k	28.4k	28.4k	19.2k	14.7k	5.41k
Total	14.6k	30.7 k	30.6k	20.5k	15.8k	5.92k
C2011.041b	#1 (C2011.041)	b: Light frame stair f	ragility. Appr	oximation as a placeh	older until the	ere is)
DS1	419	184	187	65.7	44.2	8.9
DS2	543	1.19k	1.13k	599	408	103
DS3	458	5.74k	5.82k	4.92k	4.11k	1.72k
Total	1.42k	7.12k	7.14k	5.58k	4.57k	1.84k
C3034.001	#1 (C3034.001:]	Independent Pendant	t Lighting - no	n seismic)		
DS1	4.09k	3.75k	3.85k	2.41k	1.76k	582
D1014.022	#1 (D1014.022:	Hydraulic Elevator -	Applies to mo	st California Installat	ions prior to	.)
DS1a	381	459	487	263	243	78.4
DS1b	5.93k	7.59k	7.73k	4.96k	3.98k	1.59k
DS1c	7.15k	10.4k	10.1k	6.53k	4.76k	1.83k
DS1d	1.19k	1.67k	1.45k	1.1k	854	259
Total	14.6k	20.1k	19.8k	12.9 k	9.84k	3.75k
D2021.012a	#1 (D2021.012a	a: Cold or Hot Potabl	e - Small Dian	neter Threaded Steel	- (2.5 inches ir	1)
DS1	1.32	4.26	4.62	4.32	3.26	1.67
DS2	0.49	9.18	11.1	12.9	12.5	7.67
Total	1.81	13.4	15.7	17.2	15.7	9.34
D2021.012b) #1 (D2021.012)	b: Cold or Hot Potabl	le - Small Diar	neter Threaded Steel	- (2.5 inches in	n)
DS1	1.23	5.8	5.64	5.32	4.79	2.15
DS2	1.23	13.2	11.5	19.4	20.8	11.1
Total	2.46	19	17.2	24.7	25.6	13.3
D2021.022a	#1 (D2021.022a	a: Cold or Hot Potabl	e Water Pipin	g (dia > 2.5 inches), S	DC C, PIPINO	J)
DS1	6.24	30.4	31.4	28.6	23.3	12.4
DS2	2.96	70.4	57.8	91.2	98.6	49.4
Total	9.21	101	89.2	120	122	61.8
D2031.022a	#1 (D2031.022a	a: Sanitary Waste Pip	oing - Cast Iro	n w/bell and spigot co	uplings, SDC	C,)
DS1	106	292	274	236	210	93.8
D2031.022b	#1 (D2031.022)	b: Sanitary Waste Pip	oing - Cast Iro	n w/bell and spigot co	ouplings, SDC	C,)
DS1	10.9	26.4	27.5	20.6	16.8	7.53
DS2	12.9	69.2	69.4	92.4	86.4	47
Total	23.8	95.6	96.8	113	103	54.5
D3032.011a	a #1 (D3032.011a	a: Compressor - Capa	acity: Small no	on medical air supply	- Unanchored	equipment)
DS1a	711	752	763	485	390	151
DS1b	2.53k	2.83k	2.73k	1.79k	1.34k	470
Total	3.24k	3.59k	3.49 k	2.28k	1.73k	621



	50% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 years
Tot. Loss	60.5k	524k	534k	850k	963k	1.2M
Collapse	0	358k	363k	650k	750k	966k
Residual	0	14.4k	20.7k	82.9k	119k	192k
D3032.01	1a #2 (D3032.011a	: Compressor - Capa	city: Small no	on medical air supply	- Unanchored	equipment)
DS1a	972	770	771	469	377	136
DS1b	3.49k	2.8k	2.76k	1.8k	1.36k	520
Total	4.46k	3.57k	3.53k	2.27k	1.74k	656
D3041.01	1c #1 (D3041.011c	: HVAC Galvanized S	Sheet Metal D	ucting less than 6 sq.	ft in cross sec	tional)
DS1	6.23	21.8	22.9	22.2	18.9	7.61
DS2	9.16	97.5	105	141	128	77.3
Total	15.4	119	128	164	147	84.9
D3041.03	2c #1 (D3041.032c	: HVAC Drops / Diffu	isers without o	eilings - supported by	y ducting only	- No)
DS1	270	1.32k	1.29k	1.3k	1.12k	572

Table 3.1.1 (*Continued*). Expected contribution to repair cost per damage state (Dollars)



3.2 Repair time

This table shows the expected worker days on a per-damage state basis. The header shows the probability of global failures (collapse and residual drift demolition) for reference.

The color scale is meant to indicate **relative** performance of components, not absolute performance. A "green" value does not indicate that the value falls in a pre-determined "good" range, just that it performs well compared to other components. Likewise, a "red" value does does not indicate that the value falls in a pre-determined "bad" range, just that it performs worse compared to other components.

	50% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 years
P[Col](%)	0.0	27	27	49	56	73
P[Res](%)	0.0	1.1	1.6	6.2	8.9	14
B1031.01	1a #1 (B1031.011a	: Steel Column Base	Plates, Colun	nn W < 150 plf)		
DS1a	0.0	0.0	0.0	0.0	0.0	0.0
DS1b	0.0	0.8	0.9	0.8	0.7	0.2
DS2	0.0	6.1	6.7	7.7	5.7	2.9
DS3	0.0	4.3	3.7	6.2	6.9	3.2
Total	0.0	11	11	15	13	6.3
B1035.04	1 #1 (B1035.041:]	Pre-Northridge WUF-	B beam-colu	mn joint, beam one sid	le of column,	beam depth)
DS1a	0.0	0.0	0.0	0.0	0.0	0.0
DS1b	0.0	0.0	0.0	0.0	0.0	0.0
DS2a	0.0	0.0	0.0	0.0	0.0	0.0
DS2b	0.0	0.0	0.0	0.0	0.0	0.0
DS3	0.0	0.0	0.0	0.0	0.0	0.0
Total	0.0	0.0	0.0	0.0	0.0	0.0
R1035 05	1 #1 (B1035 051·]	Pre-Northridge WUF-	R beam-colu	mn joint, beam both si	ides of colum	n heam)
D1055.05 DS1a	0.0	0.0	0.0	0.0	0.0	0.0
DS1b	0.0	0.0	0.0	0.0	0.0	0.0
DS10 DS2a	0.0	0.0	0.0	0.0	0.0	0.0
DS2b	0.0	0.0	0.0	0.0	0.0	0.0
DS20	0.0	0.0	0.0	0.0	0.0	0.0
Total	0.0	0.0	0.0	0.0	0.0	0.0
R1071-00	2 #1 (B1071 002•]	Light framed wood wa	lls with strue	ctural panel sheathing	ovnsum wall	hoard)
D10/1.00 DS1	0.7	2.8	2.8		, gypsum wan 0.9	0.2
DS1 DS2	0.1	2.0	2.8 1.9	1.4	1.1	0.2
DS2 DS3	0.0	5.6	5.5	6.2	5.3	2.8
Total	0.8	10	10	8.9	7.3	3.4
				med wood walls with		
DS1	0.5	0.2	0.2		0.1	0.0
DS1 DS2	0.3	0.2	0.2	0.1	0.1	0.0
DS2 DS3	0.2	1.5	1.5	0.1	0.0	0.0
DS3 DS4	0.2	1.2	1.5	0.9	0.3	0.1
DS4 DS5				2.0		
Total	0.0 0.8	1.5 4.5	1.4 4.4	2.0 3.8	1.7 3.1	1.0 1.4
		0		walls with exterior pa		0
DS1	1.9	1.8	1.8	0.7	0.5	0.1
DS2	0.6	2.2	2.2	1.1	0.8	0.2
DS3	0.7	13	13	11	9.0	3.8
Total	3.2	17	17	13	10	4.2

Table 3.2.1	Expected	worker	dave ner	damage state	(Worker Days)
Table 5.2.1.	Expected	worker (uays per	uamage state	(WOIKEI Days)



:	50% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 year
P[Col](%)	0.0	27	27	49	56	73
P[Res](%)	0.0	1.1	1.6	6.2	8.9	14
C1011.211	a #1 (C1011.211a	a: Wall Partition - Typ	e: Gvpsum v	vith wood studs (both	sides). Full He	eight)
DS1	1.9	1.2	1.2	1.0	0.9	0.4
DS2	1.7	0.8	0.7	0.3	0.2	0.1
DS3	3.9	16	16	11	8.6	3.1
Total	7.6	18	18	12	10	3.6
C1011.311	a #1 (C1011.311a	: Interior of Exterior	Wall - Type:	Gypsum with wood st	tuds (single-si	ded)
DS1	1.7	0.6	0.6	0.5	0.5	0.2
DS2	1.7	0.7	0.6	0.2	0.2	0.1
DS3	4.6	16	16	11	8.5	3.1
Total	8.1	17	17	11	9.1	3.4
	b #1 (C2011.041)): Light frame stair fr	agility. Appr	oximation as a placeh	older until the	
DS1	0.3	0.1	0.1	0.1	0.0	0.0
DS2	0.4	0.9	0.9	0.4	0.3	0.1
DS3	0.4	4.5	4.6	3.9	3.2	1.3
Total	1.1	5.6	5.6	4.4	3.6	1.4
C3034.001	#1 (C3034.001:]	Independent Pendant	Lighting - no	on seismic)		
DS1	3.0	2.8	2.8	1.7	1.2	0.4
D1014.022	#1 (D1014.022:]	Hydraulic Elevator - A	pplies to mo	st California Installat	ions prior to	.)
DS1a	0.3	0.3	0.3	0.2	0.2	0.1
DS1b	4.3	5.5	5.6	3.6	2.8	1.1
DS1c	5.3	7.2	7.3	4.7	3.5	1.2
DS1d	0.8	1.2	1.1	0.8	0.6	0.2
Total	11	14	14	9.3	7.1	2.6
	a #1 (D2021.012a	: Cold or Hot Potable		neter Threaded Steel ·		
DS1	0.0	0.0	0.0	0.0	0.0	0.0
DS2	0.0	0.0	0.0	0.0	0.0	0.0
Total	0.0	0.0	0.0	0.0	0.0	0.0
		o: Cold or Hot Potable				
DS1	0.0	0.0	0.0	0.0	0.0	0.0
DS2	0.0	0.0	0.0	0.0	0.0	0.0
Total	0.0	0.0	0.0	0.0	0.0	0.0
		: Cold or Hot Potable				
DS1	0.0	0.0	0.0	0.0	0.0	0.0
DS2 Total	0.0 0.0	0.1 0.1	0.0 0.1	0.1 0.1	0.1 0.1	0.0 0.0
D2031.022: DS1	a #1 (D2031.022a 0.1	a: Sanitary Waste Pipi 0.2	ng - Cast Iro 0.2	n w/bell and spigot co 0.2	uplings, SDC 0.2	C,) 0.1
D2031.022 DS1	0.0 #1 (D2031.022)	o: Sanitary Waste Pipi 0.0	ng - Cast Iro	on w/bell and spigot co	uplings, SDC 0.0	C,) 0.0
DS1 DS2	0.0	0.0	0.0	0.0	0.0	0.0
Total	0.0	0.1	0.1	0.1	0.1	0.0
		: Compressor - Capa				
D3032.0113 DS1a	0.6	0.6	0.6	0.4	0.3	0.1
DS1b	0.3	0.4	0.0	0.4	0.3	0.1
Total	1.0	1.0	1.0	0.2	0.2	0.2



	50% in 50 years	10% in 50 years	DE	ys per damage state (W 5% in 50 years	MCE _R	2% in 50 years
	50 % III 50 years	10 % III 50 years	DE	5 % III 50 years	MCER	2 /0 III 50 years
P[Col](%)	0.0	27	27	49	56	73
P[Res](%)	0.0	1.1	1.6	6.2	8.9	14
D3032.01	1a #2 (D3032.011a	: Compressor - Cap	acity: Small no	n medical air supply	- Unanchored	equipment)
DS1a	0.8	0.7	0.6	0.4	0.3	0.1
DS1b	0.5	0.4	0.4	0.2	0.2	0.1
Total	1.3	1.0	1.0	0.6	0.5	0.2
D3041.01	1c #1 (D3041.011c	: HVAC Galvanized	Sheet Metal D	cting less than 6 sq.	ft in cross sec	tional)
DS1	0.0	0.0	0.0	0.0	0.0	0.0
DS2	0.0	0.0	0.0	0.0	0.0	0.0
Total	0.0	0.0	0.1	0.1	0.1	0.0
D3041.03	2c #1 (D3041.032c	: HVAC Drops / Diff	users without c	eilings - supported by	y ducting only	- No)
DS1	0.2	1.1	1.1	1.1	1.0	0.5

3.3 Casualties

Table 3.3.1 shows the total expected casualty results broken into collapse and non-collapse sources. The non-parenthetical values are casualties in terms of number of people and the parenthetical values show the probability of casualty for an individual person placed randomly in the building.

Table 3.3.2 shows the casualty breakdown on a per component basis. The values in this table are in terms of number of people, not probabilities.

The color scale is meant to indicate **relative** performance of components, not absolute performance. A "green" value does not indicate that the value falls in a pre-determined "good" range, just that it performs well compared to other components. Likewise, a "red" value does does not indicate that the value falls in a pre-determined "bad" range, just that it performs worse compared to other components.

	50% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 years
Total Nor	-Collapse Casualt	ies				
Injury	0.0872	0.124	0.125	0.0990	0.0872	0.0582
	(2.03)	(2.90)	(2.91)	(2.30)	(2.03)	(1.36)
Death	0.000847	0.00127	0.00126	0.00105	0.000882	0.000572
Doum	(0.020)	(0.030)	(0.029)	(0.024)	(0.021)	(0.013)
Total Col	lapse Casualties					
Injury	0.00	0.372	0.377	0.675	0.779	1.00
injui j	(0.00)	(8.66)	(8.77)	(15.7)	(18.1)	(23.3)
Death	0.00	0.00376	0.00381	0.00682	0.00787	0.0101
Doum	(0.00)	(0.087)	(0.089)	(0.159)	(0.183)	(0.236)
Total Col	lapse and Non-Col	lapse Casualties				
Injury	0.0872	0.463	0.468	0.726	0.817	1.02
mjarj	(2.03)	(10.8)	(10.9)	(16.9)	(19.0)	(23.7)
Death	0.000847	0.00468	0.00472	0.00735	0.00825	0.0103
Douin	(0.020)	(0.109)	(0.110)	(0.171)	(0.192)	(0.239)

Table 3 3 1	Total expected	l casualties	(Number of	f People (%))
14010 5.5.1.	Total expected	i casuallies	(Internet of	

Table 3.3.2. Expected casualties per component (Number of People)

	50% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 years
C3034.001	#1 (C3034.001:]	Independent Pendan	t Lighting - non	seismic)		
Injury	0.0872	0.124	0.125	0.0988	0.0870	0.0581
Death	0.000847	0.00127	0.00126	0.00105	0.000882	0.000572
D3041.011	c #1 (D3041.011c	: HVAC Galvanized	Sheet Metal Du	cting less than 6 sq.	ft in cross sect	ional)
Injury	0.000001	0.000008	0.000009	0.000015	0.000017	0.000016
Death	0.00	0.00	0.00	0.00	0.00	0.00
D3041.032	c #1 (D3041.032c	: HVAC Drops / Diff	users without c	eilings - supported b	y ducting only	- No)
Injury	0.000026	0.000147	0.000141	0.000154	0.000158	0.000133
Death	0.00	0.00	0.00	0.00	0.00	0.00

3.4 Quantity Damaged

This table shows the expected percentage of the components that are in a given damage state (normalized to the total quantity of that component in the entire building). The small parenthetical value is the probability that any component throughout the building is in that damage state (the percentage of realizations that have a component in that damage state).

All of these values are conditioned on no global failure. The header shows the probability of global failures (collapse and residual drift demolition) for reference.

The color scale is meant to indicate **relative** performance of components, not absolute performance. A "green" value does not indicate that the value falls in a pre-determined "good" range, just that it performs well compared to other components. Likewise, a "red" value does does not indicate that the value falls in a pre-determined "bad" range, just that it performs worse compared to other components.

	50% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 years
P[Col](%)	0.0	27	27	49	56	73
P[Res](%)	0.0	1.1	1.6	6.2	8.9	14
B1031.011	a #1 (B1031.011a	: Steel Column Base	Plates, Colum	n W < 150 plf)		
DS1a	0.6 (1.8)	23 (53)	23 (54)	30 (68)	32 (70)	35 (76)
DS1b	0.0 (0.1)	1.2 (4.6)	1.3 (4.8)	1.8 (7.0)	2.1 (8.3)	1.9 (7.8)
DS2	0.0 (0.0)	6.9 (21)	7.6 (22)	14 (40)	14 (40)	19 (50)
DS3	0.0 (0.0)	4.4 (11)	4.0 (11)	10 (25)	13 (29)	17 (39)
Total	0.6 (1.8)	36 (60)	36 (60)	57 (81)	61 (84)	74 (93)
B1035.041	#1 (B1035.041:]	Pre-Northridge WUF	-B beam-colum	nn joint, beam one sid	le of column,	beam depth)
DS1a	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
DS1b	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
DS2a	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
DS2b	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
DS3	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
Total	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
B1035.051	#1 (B1035.051:]	Pre-Northridge WUF	-B beam-colum	nn joint, beam both si	des of column	ı, beam)
DS1a	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
DS1b	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
DS2a	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
DS2b	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
DS3	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
Total	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
B1071.002	#1 (B1071.002: 1	Light framed wood w	alls with struct	ural panel sheathing	, gypsum wall	board)
DS1	1.9 (25)	13 (80)	14 (81)	11 (68)	10 (65)	7.3 (47)
DS2	0.1 (1.6)	7.9 (59)	7.8 (59)	9.3 (64)	9.8 (68)	8.9 (65)
DS3	0.0 (0.5)	8.8 (61)	8.9 (61)	16 (84)	18 (89)	25 (97)
Total	2.0 (26)	30 (99)	30 (99)	37 (100)	38 (100)	42 (100)
B1071.302	#1 (B1071.302: 1	Interior Structural W	/all - Light fran	ned wood walls with	structural par	nel)
DS1	27 (89)	17 (71)	18 (71)	20 (77)	21 (81)	29 (92)
DS2	5.3 (28)	8.9 (46)	9.2 (47)	5.9 (32)	5.1 (29)	5.3 (34)
DS3	1.8 (9.6)	21 (72)	22 (72)	18 (60)	17 (56)	12 (42)
DS4	0.0 (0.0)	8.2 (34)	7.8 (33)	10 (44)	11 (50)	11 (47)
DS5	0.0 (0.0)	6.7 (22)	6.4 (21)	14 (41)	16 (47)	25 (65)
Total	34 (92)	63 (100)	63 (100)	69 (100)	71 (100)	82 (100)

Table 3.4.1. Expected percentage of damaged components (% of total qty. (% of realizations))



	50% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 year
P[Col](%)	0.0	27	27	49	56	73
P[Res](%)	0.0	1.1	1.6	6.2	8.9	14
R2011 /0	1 #1 (R2011 /01+ I	Exterior Wall - Light f	framed wood	walls with avtariar na	nalizad shaatt	ning)
D2011.40	6.7 (81)	11 (91)	11 (92)	6.9 (74)	5.9 (72)	4.2 (61)
DS1 DS2	1.8 (35)	9.3 (92)	9.3 (93)	7.8 (90)	7.3 (88)	5.6 (81)
DS3	0.9 (16)	25 (97)	25 (98)	34 (100)	36 (100)	42 (100)
Total	9.4 (82)	45 (100)	45 (100)	49 (100)	49 (100)	51 (100)
C1011.21	1a #1 (C1011.211a	: Wall Partition - Typ	e: Gypsum w	ith wood studs (both	sides), Full He	eight,)
DS1	18 (72)	17 (49)	17 (49)	24 (63)	26 (66)	36 (84)
DS2	7.1 (36)	4.8 (24)	4.7 (24)	3.3 (16)	2.5 (11)	4.1 (15)
DS3	5.0 (26)	30 (98)	30 (98)	33 (99)	35 (100)	36 (100)
Total	30 (99)	51 (100)	52 (100)	61 (100)	63 (100)	76 (100)
C1011.31	1a #1 (C1011.311a	: Interior of Exterior	Wall - Type:	Gypsum with wood s	tuds (single-si	ded)
DS1	24 (74)	14 (50)	14 (51)	20 (64)	22 (67)	29 (81)
DS2	10 (34)	5.7 (24)	5.4 (24)	2.8 (13)	2.9 (13)	4.2 (18)
DS3	8.1 (26)	42 (97)	42 (98)	47 (100)	47 (100)	49 (100)
Total	43 (99)	62 (100)	62 (100)	70 (100)	72 (100)	82 (100)
): Light frame stair fr		eximation as a placeh		
DS1	30 (54)	19 (36)	19 (35)	11 (21)	8.6 (17)	4.5 (9.0)
DS2	9.7 (19)	29 (51)	29 (49)	24 (42)	20 (38)	16 (30)
DS3	2.8 (5.5)	48 (76)	49 (77)	65 (90)	70 (94)	80 (98)
Total	43 (75)	97 (100)	96 (100)	99 (100)	99 (100)	100 (100)
		Independent Pendant	0 0			
DS1	38 (88)	77 (99)	77 (99)	87 (100)	90 (100)	95 (100)
		Hydraulic Elevator - A			-	
DS1a	16 (16)	28 (28)	30 (30)	28 (28)	30 (30)	30 (30)
DS1b	26 (26)	47 (47)	48 (48)	48 (48)	50 (50)	53 (53)
DS1c	22 (22)	43 (43)	43 (43)	43 (43)	42 (42)	43 (43)
DS1d	18 (18)	36 (36)	32 (32)	38 (38)	39 (39)	32 (32)
Total	82 (45)	150 (85) *	150 (84) *	160 (87) *	160 (86) *	160 (89) *
		100 is caused by simultan	•		(a. z. · · · ·	`
D2021.01 DS1	2a #1 (D2021.012a 2.8 (5.3)	: Cold or Hot Potable 16 (29)	e - Small Dian 16 (28)	eter Threaded Steel - 25 (41)	-(2.5 inches in)	1) 35 (56)
DS1 DS2	0.2 (0.3)	3.6 (6.6)	4.2 (7.8)	8.0 (14)	20 (45) 10 (19)	15 (26)
Total	2.9 (5.5)	19 (33)	4. 2 (7.8) 20 (33)	33 (50)	36 (56)	51 (69)
		: Cold or Hot Potable				
D2021.01 DS1	2.5 (4.8)	16 (28)	16 (27)	24 (39)	27 (46)	33 (55)
DS1 DS2	0.2 (0.5)	3.6 (6.8)	3.1 (6.1)	8.4 (15)	12 (20)	17 (29)
Total	2.7 (5.2)	19 (33)	19 (31)	32 (48)	39 (57)	50 (70)
		: Cold or Hot Potable				
D2021.02 DS1	2.5 (4.6)	16 (28)	16 (29)	$25_{(41)}$	26 (43)	33 (54)
DS2	0.1 (0.3)	3.8 (7.2)	3.3 (6.3)	8.0 (14)	11 (18)	16 (27)
Total	2.6 (4.8)	20 (32)	19 (33)	33 (50)	37 (54)	49 (68)
D2031.02	2a #1 (D2031.022a	: Sanitary Waste Pipi	ing - Cast Iroi	n w/bell and spigot co	uplings, SDC	C,)
DS1	9.2 (17)	35 (54)	34 (53)	47 (68)	54 (75)	64 (84)
D2031.02	2b #1 (D2031.022h	o: Sanitary Waste Pip	ing - Cast Iro	n w/bell and spigot co	ouplings, SDC	C,)
DS1	7.9 (15)	27 (45)	28 (46)	33 (56)	37 (60)	41 (60)
DS2	0.9 (1.8)	6.6 (12)	6.7 (12)	14 (24)	17 (30)	26 (42)



	50% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 years
P[Col](%)	0.0	27	27	49	56	73
P[Res](%)	0.0	1.1	1.6	6.2	8.9	14
D3032.011	a #1 (D3032.011a	: Compressor - Capa	city: Small no	n medical air supply	- Unanchored	equipment)
DS1a	32 (52)	48 (72)	49 (74)	49 (75)	52 (76)	53 (78)
DS1b	32 (52)	50 (74)	49 (74)	50 (76)	48 (72)	47 (72)
Total	64 (80)	98 (100)	98 (100)	100 (100)	100 (100)	100 (100)
D3032.011	a #2 (D3032.011a	: Compressor - Capa	city: Small no	n medical air supply	- Unanchored	equipment)
DS1a	44 (68)	49 (74)	49 (75)	48 (73)	50 (76)	48 (74)
DS1b	44 (67)	49 (75)	49 (75)	51 (76)	49 (75)	52 (77)
Total	88 (96)	98 (100)	98 (100)	99 (100)	100 (100)	100 (100) *
*Percent of	total quantity above	100 is caused by simultan	eous damage stat	es		
D3041.011	c #1 (D3041.011c	: HVAC Galvanized S	Sheet Metal Du	icting less than 6 sq. :	ft in cross sect	ional)
DS1	2.7 (5.2)	12 (22)	13 (24)	20 (34)	23 (40)	25 (43)
DS2	0.4 (0.8)	5.7 (10)	6.2 (11)	13 (22)	16 (26)	25 (40)
Total	3.1 (6.0)	18 (30)	20 (33)	33 (50)	39 (59)	50 (68)
D3041.032	c #1 (D3041.032c	: HVAC Drops / Diffu	isers without c	eilings - supported by	y ducting only	- No)
DS1	2.9 (5.6)	20 (34)	20 (32)	33 (50)	36 (55)	50 (69)

4 COMPONENT DAMAGEABILITY AND COST OVERVIEW

This section provides an overview of key component parameters for loss assessment. The components are broken into groups such that the specified component modifiers are applied to all components in the given table.

Some notes on the columns are as follows:

- DS: Median (Unit Repair Cost Range): This presents median EDP for each damage state as well as the associated repair cost range to repair one unit of the component (varies based on quantity).
- Max Repair Potential: This is the cost to completely replace this component throughout the building assuming the most expensive damage state for all components (includes volume discounting). The number in parenthesis is the value as a percentage of building replacement value. Note that this does not need to add up to the total building replacement value, but rather gives a sense of how much potential the component has to contribute to the mean loss when it is damaged.

Component	Description	DS: Median (Unit Renair Cost Range)	ax Repair Potential
B1031.011a	Steel Column Base Plates, Column W < 150 plf	EDPPeak Interstory DriftDS1a:0.04(\$0 - \$0)DS1b:0.04(\$21,710 - \$35,279)DS2:0.07(\$31,001 - \$43,765)DS3:0.1(\$36,203 - \$51,110)	\$204,439 (15.4%)
B1035.041	Pre-Northridge WUF-B beam-column joint, beam one side of column, beam depth <= W27	EDPPeak Interstory DriftDS1a:0.017(\$13,420 - \$20,130)DS1b:0.017(\$15,089 - \$22,634)DS2a:0.025(\$16,202 - \$24,303)DS2b:0.025(\$19,585 - \$29,377)DS3:0.03(\$16,202 - \$24,303)	\$58,754 (4.42%)
B1035.051	Pre-Northridge WUF-B beam-column joint, beam both sides of column, beam depth <= W27	EDPPeak Interstory DriftDS1a:0.017(\$19,563 - \$29,344)DS1b:0.017(\$21,232 - \$31,848)DS2a:0.025(\$21,009 - \$31,514)DS2b:0.025(\$26,840 - \$40,260)DS3:0.03(\$21,009 - \$31,514)	\$80,520 (6.06%)
B1071.002	Light framed wood walls with structural panel sheathing, gypsum wallboard and hold-downs	EDPPeak Interstory DriftDS1:0.015(\$1,827 - \$2,969)DS2:0.0262(\$2,532 - \$3,575)DS3:0.0369(\$6,355 - \$8,972)	\$115,343 (8.68%)
B1071.302	Interior Structural Wall - Light framed wood walls with structural panel sheathing, gypsum wallboard on both sides, with hold-downs	EDPPeak Interstory DriftDS1:0.0021(\$175 - \$412)DS2:0.0071(\$374 - \$879)DS3:0.012(\$1,156 - \$2,721)DS4:0.0262(\$2,306 - \$4,256)DS5:0.0369(\$4,079 - \$6,760)	\$32,640 (2.46%)
		Total:	\$491,696 (37.0%)

Table 4.1. "Structural" component list.





Component	Description	DS: Median (Unit Repair Cost Range)	Max Repair Potential
B2011.401	Exterior Wall - Light framed wood walls with exterior panelized sheathing (OSB) and horizontal wood siding, no hold-downs	EDP Peak Interstory Drift DS1: 0.01 (\$175 - \$412) DS2: 0.0175 (\$374 - \$879) DS3: 0.025 (\$1,156 - \$2,721)	(3.75%)
		Total:	\$49,831 (3.75%)

Table 4.2. "Exterior Finishes" component list.

Table 4.3. "Partition Walls"	' component list.
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Component	Description	DS: Median (Unit Repair Cost Range)	Max Repair Potential
C1011.211a	Wall Partition - Type: Gypsum with wood studs (both sides), Full Height, Fixed Below, Fixed Above	EDPPeak Interstory DriftDS1:0.0021(\$1,598 - \$5,328)DS2:0.0071(\$3,428 - \$11,425)DS3:0.012(\$11,297 - \$37,656)	(8.34%)
C1011.311a	Interior of Exterior Wall - Type: Gypsum with wood studs (single-sided gypsum), Full Height, Fixed Below, Fixed Above	EDPPeak Interstory DriftDS1:0.0021(\$904 - \$3,015)DS2:0.0071(\$2,223 - \$7,411)DS3:0.012(\$7,151 - \$23,838)	(5.94%)
		Total:	\$189,772 (14.3%)

Component	Description	DS: Median (Unit Repair Cost Range)	Max Repair Potential
C2011.041b	Light frame stair fragility. Approximation as a placeholder until there is more research on the topic. Damage states from P-58 Light frame stair example. Costing approximated from various online sources for stair replacement.	EDP Peak Interstory Drift DS1: 0.011 (\$487 - \$695 DS2: 0.026 (\$1,043 - \$2,782 DS3: 0.05 (\$3,130 - \$8,346	(1.26%)
		Total:	\$16,692 (1.26%)

Table 4.5.	"Lighting"	component	list.
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Component	Description	DS: Median (Unit Repair Cost Range)	Max Repair Potential
C3034.001	Independent Pendant Lighting - non seismic	EDP Peak Floor Acceleration DS1: 0.6 (\$413 - \$1,377	\$4,131 (0.31%)
		Total:	\$4,131 (0.31%)

SP3

Component	Description	DS: Median (Unit Repair Cost Range) Max Repair Potential
D1014.022	Hydraulic Elevator - Applies to most California Installations prior to 1976, most western states installations prior to 1982 and most U.S installations prior to 1998.	EDP Peak Floor Acceleration DS1a: 0.3 (\$668 - \$2,226) \$33,383 DS1b: 0.3 (\$6,844 - \$22,812) (2.51%) DS1c: 0.3 (\$10,015 - \$33,383) (2.51%) DS1d: 0.3 (\$1,920 - \$6,398) (3.3,383)
		Total: \$33,383 (2.51%)

Table 4.6. "Elevators" component list.

Table 4.7. "Piping"	component list.
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Component	Description	DS: Median (Unit Repair Cost Range)	Max Repair Potential
D2021.012a	Cold or Hot Potable - Small Diameter Threaded Steel - (2.5 inches in diameter or less), SDC C, PIPING FRAGILITY	EDPPeak Floor AccelerationDS1:1.5(\$363 - \$444)DS2:2.6(\$3,317 - \$4,055)	(0.05~%)
D2021.012b	Cold or Hot Potable - Small Diameter Threaded Steel - (2.5 inches in diameter or less), SDC C, BRACING FRAGILITY	EDPPeak Floor AccelerationDS1:1.5(\$476 - \$581)DS2:2.6(\$4,757 - \$5,814)	(0.0+10)
D2021.022a	Cold or Hot Potable Water Piping (dia > 2.5 inches), SDC C, PIPING FRAGILITY	EDPPeak Floor AccelerationDS1:1.5(\$292 - \$974)DS2:2.6(\$2,796 - \$9,319)	(0.1970)
D2031.022a	Sanitary Waste Piping - Cast Iron w/bell and spigot couplings, SDC C, PIPING FRAGILITY	EDP Peak Floor Acceleration DS1: 1.2 (\$2,796 - \$9,319)	\$1,132 (0.09%)
D2031.022b	Sanitary Waste Piping - Cast Iron w/bell and spigot couplings, SDC C, BRACING FRAGILITY	EDPPeak Floor AccelerationDS1:1.2(\$334 - \$1,113)DS2:2.4(\$3,630 - \$12,101)	$(0.11 \ n)$
		Total:	\$6,045 (0.45%)

Table 4.8.	"HVAC"	component	list.
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Component	Description	DS: Median (Unit Repair Cost Range)	Max Repair Potential
D3032.011a	Compressor - Capacity: Small non medical air supply - Unanchored equipment that is not vibration isolated - Equipment fragility only	EDPPeak Floor AccelerationDS1a:0.25(\$939 - \$1,148DS1b:0.25(\$3,380 - \$4,131	(0.5970)
D3032.011a	Compressor - Capacity: Small non medical air supply - Unanchored equipment that is not vibration isolated - Equipment fragility only	EDPPeak Floor AccelerationDS1a:0.25(\$939 - \$1,148)DS1b:0.25(\$3,380 - \$4,131)	(0.5970)

	Idole 1.6 (Commune).		
Component	Description	DS: Median (Repair Cost Range)	Max Repair Potential
D3041.011c	HVAC Galvanized Sheet Metal Ducting less than 6 sq. ft in cross sectional area, SDC D, E, or F	EDPPeak Floor AccelerationDS1:1.5(\$814 - \$995)DS2:2.25(\$7,949 - \$9,716)	$(0.10 \ h)$
D3041.032c	HVAC Drops / Diffusers without ceilings - supported by ducting only - No independent safety wires, SDC D, E, or F	EDP Peak Floor Acceleration DS1: 1.5 (\$3,756 - \$4,590)	\$8,763 (0.66%)
		Total:	\$26,920 (2.03%)

Table 4.8 (Continued). "HVAC" component list.

Table 4.9. Summary of component value breakdown (building replacement value = \$1,328,911).

Component Category	Max Repair Potential	% of Building Replacement Value
Structural	\$491,696	37.0%
Exterior Finishes	\$49,831	3.75%
Partition Walls	\$189,772	14.3%
Other Nonstructural	\$16,692	1.26%
Lighting	\$4,131	0.31%
Elevators	\$33,383	2.51%
Piping	\$6,045	0.45%
HVAC	\$26,920	2.03%
Total	\$818,470	61.6%



5 COMPONENT QUANTITIES AND MODIFICATION FACTORS

Location	Qty. Dir 1	Qty. Dir 2	Qty. ND	Cost Scale	Capacity Scale	Time Scale
B1031.011a (B	1031.011a #1): S	Steel Column Base	e Plates, Column	W < 150 plf		
1	0	4	-	1	1	1
B1035.041 (B1	035.041 #1): Pre	-Northridge WUF	-B beam-columr	joint, beam one si	de of column, bea	am depth <= W2
2	0	2	-	1	1	1
B1035.051 (B1 W27	035.051 #1): Pre	-Northridge WUF	-B beam-colum	n joint, beam both s	sides of column, l	beam depth <=
2	0	2	-	1	1	1
B1071.002 (B1 hold-downs	071.002 #1): Lig	tht framed wood w	alls with structu	ral panel sheathing	, gypsum wallbo	ard and
1	5.8	2.16	-	1	1	1
2	7.4	2.79	-	1	1	1
B1071.302 (B1	071.302 #1): Inte	erior Structural Wa	all - Light frame	d wood walls with	structural panel sl	heathing, gypsun
wallboard on bo	th sides, with hol	ld-downs				
1	4.45	0	_	1	1	1
2	3.51	0	_	1	1	1
		-	framed wood wa	alls with exterior p	anelized sheathin	g (OSB) and
horizontal wood	siding, no hold-			1	1	1
1 2	10.935 7.29	10.65 14.22	-	1	1	1
			-	-	-	-
Fixed Above			pe: Gypsum wit	h wood studs (both		
$\frac{1}{2}$	0.67 1.1	0.7 1.27	-	1	1	1
			_	1	-	-
Height, Fixed B	elow, Fixed Abov	/e	r Wall - Type: G	ypsum with wood		
1-2	0.8	1.5	_	1	1	1
1 2	0.0	1.0				-
C2011.041b (C on the topic. Da	22011.041b #1): mage states from	Light frame stair f		imation as a placeh Costing approximat		
C2011.041b (C on the topic. Da	22011.041b #1): mage states from	Light frame stair f				
C2011.041b (C on the topic. Da stair replacement 1	22011.041b #1): mage states from it. 1	Light frame stair f P-58 Light frame	stair example. (Costing approximat	ed from various of	online sources fo
C2011.041b (C on the topic. Da stair replacement 1	22011.041b #1): mage states from it. 1	Light frame stair f P-58 Light frame 1	stair example. (Costing approximat	ed from various of	online sources fo
C2011.041b (C on the topic. Da stair replacemen 1 C3034.001 (C3 2-R D1014.022 (D1	22011.041b #1): mage states from it. 1 034.001 #1): Inc - 014.022 #1): Hy	Light frame stair f 1 P-58 Light frame 1 lependent Pendant –	stair example. C - Lighting - non s 5 Applies to most	Costing approximat 1 eeismic 1 California Installat	ed from various o 0.5 1	online sources fo 1 1
C2011.041b (C on the topic. Da stair replacemen 1 C3034.001 (C3 2-R D1014.022 (D1	22011.041b #1): mage states from it. 1 034.001 #1): Inc - 014.022 #1): Hy	Light frame stair f 1 P-58 Light frame 1 lependent Pendant – draulic Elevator -	stair example. C - Lighting - non s 5 Applies to most	Costing approximat 1 eeismic 1 California Installat	ed from various o 0.5 1	online sources fo 1 1
C2011.041b (C on the topic. Da stair replacemen 1 C3034.001 (C3 2-R D1014.022 (D1 states installatio G D2021.012a (D	22011.041b #1): mage states from it. 1 034.001 #1): Inc - 014.022 #1): Hy ns prior to 1982 : - 2021.012a #1): (Light frame stair f P-58 Light frame 1 lependent Pendant – draulic Elevator - and most U.S insta	stair example. C Lighting - non s 5 Applies to most illations prior to 1	Costing approximat 1 seismic 1 California Installat 1998.	ed from various o 0.5 1 tions prior to 197	online sources fo 1 1 6, most western 1
C2011.041b (C on the topic. Da stair replacemen 1 C3034.001 (C3 2-R D1014.022 (D1 states installatio G D2021.012a (D	22011.041b #1): mage states from it. 1 034.001 #1): Inc - 014.022 #1): Hy ns prior to 1982 : - 2021.012a #1): (Light frame stair f P-58 Light frame 1 lependent Pendant – draulic Elevator - and most U.S insta	stair example. C Lighting - non s 5 Applies to most illations prior to 1	Costing approximat 1 seismic 1 California Installat 1998. 1	ed from various o 0.5 1 tions prior to 197	online sources fo 1 1 6, most western 1
C2011.041b (C on the topic. Da stair replacemen 1 C3034.001 (C3 2-R D1014.022 (D1 states installatio G D2021.012a (D SDC C, PIPING 2-R D2021.012b (D	22011.041b #1): mage states from it. 1 6034.001 #1): Inc - 014.022 #1): Hy ns prior to 1982 : - 20221.012a #1): G FRAGILITY - 20221.012b #1):	Light frame stair f P-58 Light frame 1 lependent Pendant - draulic Elevator - and most U.S insta - Cold or Hot Potab - Cold or Hot Potab	Lighting - non s 5 Applies to most illations prior to 1 le - Small Diame 0.0441576	Costing approximat 1 ceismic 1 California Installat 1998. 1 eter Threaded Steel	ed from various o 0.5 1 tions prior to 197 1 - (2.5 inches in o 1	online sources fo 1 1 6, most western 1 liameter or less), 1
C2011.041b (C on the topic. Da stair replacemen 1 C3034.001 (C3 2-R D1014.022 (D1 states installatio G D2021.012a (D SDC C, PIPING 2-R D2021.012b (D	22011.041b #1): mage states from it. 1 3034.001 #1): Inc - 014.022 #1): Hy ns prior to 1982 : - 2021.012a #1): G FRAGILITY -	Light frame stair f P-58 Light frame 1 lependent Pendant - draulic Elevator - and most U.S insta - Cold or Hot Potab - Cold or Hot Potab	Lighting - non s 5 Applies to most illations prior to 1 le - Small Diame 0.0441576	Costing approximat l seismic 1 California Installat 1998. 1 ter Threaded Steel 1	ed from various o 0.5 1 tions prior to 197 1 - (2.5 inches in o 1	online sources fo 1 1 6, most western 1 liameter or less), 1
C2011.041b (C on the topic. Da stair replacemen 1 C3034.001 (C3 2-R D1014.022 (D1 states installatio G D2021.012a (D SDC C, PIPING 2-R D2021.012b (D SDC C, BRACI 2-R	22011.041b #1): mage states from it. 1 0034.001 #1): Inc - 014.022 #1): Hy ns prior to 1982 : - 2021.012a #1): 0 5 FRAGILITY - 2021.012b #1): NG FRAGILITY -	Light frame stair f P-58 Light frame 1 lependent Pendant 	Lighting - non s 5 Applies to most illations prior to 1 le - Small Diame 0.0441576 le - Small Diame 0.0441576	Costing approximat 1 seismic 1 California Installat 1998. 1 eter Threaded Steel 1 eter Threaded Steel	ed from various o 0.5 1 tions prior to 197 1 - (2.5 inches in o 1 1 - (2.5 inches in o 1	online sources fo 1 6, most western 1 liameter or less), 1 liameter or less) 1

Table 5.1. Component quantity and modification summary.





	Table 5.1	l (<i>Continued</i>). Co	omponent quantity	and modification	summary.	
Location	Qty. Dir 1	Qty. Dir 2	Qty. ND	Cost Scale	Capacity Scale	Time Scale
D2031.022a (I)2031.022a #1): \$	Sanitary Waste Pi	ping - Cast Iron w	/bell and spigot c	ouplings, SDC C.	PIPING
FRAGILITY			ping cust non a	roon and spigor e	oupgo, 02 0 0,	11110
2-R	-	-	0.0607167	1	1	1
	D2031.022b #1):	Sanitary Waste Pi	ping - Cast Iron v	v/bell and spigot c	ouplings, SDC C,	BRACING
FRAGILITY						
2-R	-	-	0.0607167	1	1	1
)3032.011a #1): (olated - Equipmer		eacity: Small non	medical air supply	- Unanchored eq	uipment that is
G	_	_	2	1	1	1
)3032.011a #2): (olated - Equipmer		oacity: Small non	medical air supply	/ - Unanchored eq	uipment that is
R	_	_	2	1	1	1
D3041.011c (I E, or F)3041.011c #1): H	IVAC Galvanized	l Sheet Metal Duc	ting less than 6 sq	. ft in cross sectio	onal area, SDC D,
2-R	-	-	0.12266	1	1	1
D3041.032c (I safety wires, SI		IVAC Drops / Di	ffusers without ce	ilings - supported	by ducting only -	No independent
2-R	_	_	1	1	1	1

6 FRAGILITY INFORMATION

6.1 B1031.011a #1: (B1031.011a) Steel Column Base Plates, Column W < 150 plf

NISTIR Classification	B1031.011a
Author	Greg Deierlein
Normalized Unit	1.0 each
Engineering Demand Parameter	Peak Interstory Drift
Number of Damage States	3
Is correlated?	No
Is directional?	Yes

Component modifications applied:

Component Group	Structural
Quantity Scale Factor	1.0
Damage Median Scale Factor	1.0
Total Cost Scale Factor	1.391
User cost modification factor	1.0
Regional Cost Scale Factor	1
Date multiplier (to convert from 2011 USD)	1.391
Occupancy Cost Scale Factor	1
Building Value Cost Scale Factor	1

Table 6.1.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

Location	Cost	Time	Capacity
1-2	1	1	1





Table 6.1.2. I	Damage state	progression.
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Damage State	Description	Repair Description	Image
DS1a	Initiation of crack at the fusion line between the column flange and the base plate weld. Dam- age in field is either obscured or deemed to not warrant repair. No repair conducted.	The repair will involve removal of a portion of grade slab, gouging out material surrounding the fracture initiating and re-welding, then re- pair of slab. Field condition is deemed to not warrant repair by field observation. This Dam- age State is Mutually Exclusive with DS2. See fragility DS1 and DS2 probabilities.	
DS1b	Initiation of crack at the fusion line between the column flange and the base plate weld.	The repair will involve removal of a portion of grade slab, gouging out material surround- ing the fracture initiating and re-welding, then repair of slab.	
DS2	Propagation of brittle crack into column and/or base plate.	Depending on the crack trajectory, the repair will range from replacement of a portion of the column or base plate to full replacement of the column base. Replacement will require shoring of column, torch cutting to remove damaged material, and fabrication and field welding to install replacement material.	Not Available
DS3	Complete fracture of the column (or column weld) and disloca- tion of column relative to the base.	Repair would likely involve replacing the en- tire base plate assembly and most of the col- umn in the story above the base plate.	Not Available



Table 6.1.3. Parameters for the damage state distributions. The	e medians reflect a scale factor of $\underline{1.0}$ applied to the default values.
---	--

	DS1a	DS1b	DS2	DS3
Туре	Mut. Excl.	Mut. Excl.	Sequential	Sequential
Probability	0.95	0.05	-	_
Median	0.04	0.04	0.07	0.1
β	0.4	0.4	0.4	0.4

Table 6.1.4. Parameters for the cost distributions. The cost values reflect a total scale factor of **<u>1.391</u>** applied to the default values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor, building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

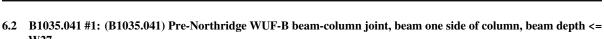
	DS1a	DS1b	DS2	DS3
Distribution Type	LogNormal	LogNormal	LogNormal	LogNormal
Lower Qty.	5.0	5.0	5.0	5.0
Upper Qty.	20.0	20.0	20.0	20.0
Highest Cost Median	\$0	\$35,279	\$43,765	\$51,110
Lowest Cost Median	\$0	\$21,710	\$31,001	\$36,203
β (COV)	0.25	0.41	0.37	0.34

Table 6.1.5. Parameters for the repair time distributions.

	DS1a	DS1b	DS2	DS3
Distribution Type	LogNormal	LogNormal	LogNormal	LogNormal
Lower Qty.	5.0	5.0	5.0	5.0
Upper Qty.	20.0	20.0	20.0	20.0
Highest Median Repair Time (Days)	0	24.62	30.54	35.66
Lowest Median Repair Time (Days)	0	15.15	21.63	25.26
β (COV)	0.35	0.48	0.44	0.42

Table 6.1.6. Life safety information.

	DS1a	DS1b	DS2	DS3
Non-collapse casualties	No	No	No	No
Affected Area				
Serious Injury Median	-	-	-	-
Serious Injury β	-	-	-	-
Loss of Life Median	-	_	_	_
Loss of Life β	-	-	-	-
Can Cause Red Tag	No	No	Yes	Yes
Unsafe Placard Median	_	_	0.25	0.1
Unsafe Placard β	_	-	0.5	0.5



NISTIR Classification	B1035.041	
Author	Greg Deierleir	ı
Normalized Unit	1.0 each	
Engineering Demand Parameter	Peak Interstory	y Drift
Number of Damage States	3	
Is correlated?	No	
Is directional?	Yes	
Component modifications applie	d:	
Component Group		Structural
Component Group Quantity Scale Factor		Structural 1.0
1 1		Structurur
Quantity Scale Factor		1.0
Quantity Scale Factor Damage Median Scale Factor		1.0 1.0
Quantity Scale Factor Damage Median Scale Factor Total Cost Scale Factor		1.0 1.0 1.391

Occupancy Cost Scale Factor

Building Value Cost Scale Factor

W27

Table 6.2.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

1

1

Location	Cost	Time	Capacity
1-2	1	1	1

SP3



		6 I 8	
Damage State	Description	Repair Description	Image
DS1a	Fracture of lower beam flange weld and failure of web bolts (shear tab connection), with frac- tures confined to the weld re- gion.	Repair will typically require gouging out and re-welding of the beam flange weld, repair of shear tab, and replacing shear bolts. Repair and replace partitions at connection.	
DS1b	Similar to DS1, except that fracture propagates into column flanges.	In addition to column measures for DS1, re- pairs to column will be necessary. Cover plate, patch, or replace damaged column flange at connection.	
DS2a	Fracture of upper beam flange weld, without DS1 type dam- age. Fracture is confined to beam flange region.	Repairs will be similar to those required for DS1, except that access to weld will likely require removal and replacement of a portion of the floor slab above the weld.	Not Available
DS2b	Similar to DS3, except that fracture propagates into column flanges.	In addition to column measures for DS3, re- pairs to column will be necessary that will in- volve replacing a portion of the column flange.	Not Available
DS3	Fracture initiating at weld access hole and propagating through beam flange, possibly accompa- nied by local buckling deforma- tions of web and flange.	Repair is similar to that for DS1 except that a portion of the beam web and flange may need to be heat straightened or replaced.	Not Available

Table 6.2.2. Damage state progression.



	DS1a	DS1b	DS2a	DS2b	DS3
Туре	Mut. Excl.	Mut. Excl.	Mut. Excl.	Mut. Excl.	Sequential
Probability	0.75	0.25	0.75	0.25	_
Median	0.017	0.017	0.025	0.025	0.03
eta	0.4	0.4	0.4	0.4	0.4

Table 6.2.3. Parameters for the damage state distributions. The medians reflect a scale factor of **1.0** applied to the default values.

Table 6.2.4. Parameters for the cost distributions. The cost values reflect a total scale factor of **<u>1.391</u>** applied to the default values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor, building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1a	DS1b	DS2a	DS2b	DS3
Distribution Type	Normal	Normal	LogNormal	LogNormal	LogNormal
Lower Qty.	5.0	5.0	5.0	5.0	5.0
Upper Qty.	30.0	30.0	30.0	30.0	30.0
Highest Cost Median	\$20,130	\$22,634	\$24,303	\$29,377	\$24,303
Lowest Cost Median	\$13,420	\$15,089	\$16,202	\$19,585	\$16,202
β (COV)	0.35	0.35	0.32	0.37	0.34

Table 6.2.5. Parameters for the repair time distributions.

	DS1a	DS1b	DS2a	DS2b	DS3
Distribution Type	Normal	Normal	LogNormal	LogNormal	LogNormal
Lower Qty.	5.0	5.0	5.0	5.0	5.0
Upper Qty.	30.0	30.0	30.0	30.0	30.0
Highest Median Repair Time (Days)	8.51	9.57	11.75	12.42	10.28
Lowest Median Repair Time (Days)	5.68	6.38	8.32	8.28	6.85
β (COV)	0.43	0.43	0.41	0.45	0.42

Table 6.2.6. Life safety information.

	DS1a	DS1b	DS2a	DS2b	DS3
Non-collapse casualties	No	No	No	No	No
Affected Area					
Serious Injury Median	-	-	-	-	-
Serious Injury β	-	-	-	-	-
Loss of Life Median	-	-	-	-	-
Loss of Life β	-	-	-	-	-
Can Cause Red Tag	Yes	Yes	Yes	Yes	Yes
Unsafe Placard Median	0.5	0.5	0.5	0.5	0.5
Unsafe Placard β	0.5	0.5	0.5	0.5	0.5



6.3 B1035.051 #1: (B1035.051) Pre-Northridge WUF-B beam-column joint, beam both sides of column, beam depth <= W27

NISTIR Classification Author Normalized Unit	B1035.051 Greg Deierlein 1.0 each
Engineering Demand Parameter	Peak Interstory Drift
Number of Damage States	3
Is correlated?	No
Is directional?	Yes
Component modifications applie	ed:
Component Group	Structural
Quantity Scale Factor	1.0

Quantity Scale Factor	1.0
Damage Median Scale Factor	1.0
Total Cost Scale Factor	1.391
User cost modification factor	1.0
Regional Cost Scale Factor	1
Date multiplier (to convert from 2011 USD)	1.391
Occupancy Cost Scale Factor	1
Building Value Cost Scale Factor	1

Table 6.3.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

Location	Cost	Time	Capacity
1-2	1	1	1



Table 0.5.2. Damage state progression.					
Damage State	Description	Repair Description	Image		
DS1a	Fracture of lower beam flange weld and failure of web bolts (shear tab connection), with frac- tures confined to the weld re- gion.	Repair will typically require gouging out and re-welding of the beam flange weld, repair of shear tab, and replacing shear bolts. Repair and replace partitions at connection.	-		
DS1b	Similar to DS1, except that fracture propagates into column flanges.	In addition to column measures for DS1, re- pairs to column will be necessary. Cover plate, patch, or replace damaged column flange at connection.			
DS2a	Fracture of upper beam flange weld, without DS1 type dam- age. Fracture is confined to beam flange region.	Repairs will be similar to those required for DS1, except that access to weld will likely re- quire removal and replacement of a portion of the floor slab above the weld.	Not Available		
DS2b	Similar to DS3, except that fracture propagates into column flanges.	In addition to column measures for DS3, re- pairs to column will be necessary that will in- volve replacing a portion of the column flange.	Not Available		
DS3	Fracture initiating at weld access hole and propagating through beam flange, possibly accompa- nied by local buckling deforma- tions of web and flange.	Repair is similar to that for DS1 except that a portion of the beam web and flange may need to be heat straightened or replaced.	Not Available		

Table 6.3.2. Damage state progression.



	DS1a	DS1b	DS2a	DS2b	DS3
Туре	Mut. Excl.	Mut. Excl.	Mut. Excl.	Mut. Excl.	Sequential
Probability	0.75	0.25	0.75	0.25	-
Median	0.017	0.017	0.025	0.025	0.03
β	0.4	0.4	0.4	0.4	0.4

Table 6.3.3. Parameters for the damage state distributions. The medians reflect a scale factor of **1.0** applied to the default values.

Table 6.3.4. Parameters for the cost distributions. The cost values reflect a total scale factor of **<u>1.391</u>** applied to the default values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor, building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1a	DS1b	DS2a	DS2b	DS3
Distribution Type	Normal	Normal	Normal	Normal	Normal
Lower Qty.	5.0	5.0	5.0	5.0	5.0
Upper Qty.	30.0	30.0	30.0	30.0	30.0
Highest Cost Median	\$29,344	\$31,848	\$31,514	\$40,260	\$31,514
Lowest Cost Median	\$19,563	\$21,232	\$21,009	\$26,840	\$21,009
β (COV)	0.36	0.36	0.3	0.32	0.33

Table 6.3.5. Parameters for the repair time distributions.

	DS1a	DS1b	DS2a	DS2b	DS3
Distribution Type	Normal	Normal	Normal	Normal	Normal
Lower Qty.	5.0	5.0	5.0	5.0	5.0
Upper Qty.	30.0	30.0	30.0	30.0	30.0
Highest Median Repair Time (Days)	12.41	13.47	16.68	17.03	13.33
Lowest Median Repair Time (Days)	8.27	8.98	12.24	11.35	8.88
β (COV)	0.44	0.44	0.39	0.4	0.41

Table 6.3.6. Life safety information.

	DS1a	DS1b	DS2a	DS2b	DS3
Non-collapse casualties	No	No	No	No	No
Affected Area					
Serious Injury Median	_	_	_	_	_
Serious Injury β	-	-	-	-	-
Loss of Life Median	_	_	_	_	_
Loss of Life β	_	_	_	_	_
Can Cause Red Tag	Yes	Yes	Yes	Yes	Yes
Unsafe Placard Median	0.5	0.5	0.5	0.5	0.5
Unsafe Placard β	0.5	0.5	0.5	0.5	0.5



NISTIR Classification Author Normalized Unit Engineering Demand Parameter Number of Damage States Is correlated?	B1071.002 Andre Filiatrault 100.0 sf Peak Interstory Drift 3 No
Is directional?	Yes
Component modifications appli	ed:
Component Group	Structural
Quantity Scale Factor	1.0
Damage Median Scale Factor	1.0
Total Cost Scale Factor	1.391
User cost modification factor	1.0

Regional Cost Scale Factor

Occupancy Cost Scale Factor

Building Value Cost Scale Factor

Date multiplier (to convert from 2011 USD)

6.4 B1071.002 #1: (B1071.002) Light framed wood walls with structural panel sheathing, gypsum wallboard and holddowns

Table 6.4.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

1

1

1

1.391

Location	Cost	Time	Capacity
1-2	1	1	1

Table 6.4.2.	Damage state	progression.
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Damage	Description	Repair Description	Image
State	Description	Repair Description	mage
DS1	Slight separation of sheathing or nails which come loose.	Remove exterior pliable siding, replace loose nails, reinstall siding.	
DS2	Permanent rotation of sheathing, tear out of nails or sheathing.	Remove exterior pliable siding, remove wood sheathing, install new sheathing, reinstall sid-ing.	
DS3	Fracture of studs, major sill plate cracking.	Remove and replace siding, sheathing, studs and plates. Provide shoring as required.	

Table 6.4.3. Parameters for the damage state distributions. The medians reflect a scale factor of **<u>1.0</u>** applied to the default values.

	DS1	DS2	DS3
Туре	Sequential	Sequential	Sequential
Probability	-	-	-
Median	0.015	0.0262	0.0369
β	0.4	0.19	0.2

Table 6.4.4. Parameters for the cost distributions. The cost values reflect a total scale factor of **<u>1.391</u>** applied to the default values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor, building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1	DS2	DS3
Distribution Type	LogNormal	LogNormal	LogNormal
Lower Qty.	3.0	3.0	3.0
Upper Qty.	8.0	8.0	8.0
Highest Cost Median	\$2,969	\$3,575	\$8,972
Lowest Cost Median	\$1,827	\$2,532	\$6,355
β (COV)	0.19	0.22	0.08

Table 6.4.5. Parameters for the repair time distributions.

	DS1	DS2	DS3
Distribution Type	LogNormal	LogNormal	LogNormal
Lower Qty.	3.0	3.0	3.0
Upper Qty.	8.0	8.0	8.0
Highest Median Repair Time (Days)	2.07	2.5	6.26
Lowest Median Repair Time (Days)	1.27	1.77	4.44
β (COV)	0.31	0.33	0.26

Table 6.4.6. Life safety information.

	DS1	DS2	DS3
Non-collapse casualties Affected Area	No 	No 	No
Serious Injury Median Serious Injury β			
Loss of Life Median Loss of Life β			
Can Cause Red Tag	No	Yes	Yes
Unsafe Placard Median	_	0.5	0.25
Unsafe Placard β	-	0.5	0.5

6.5 B1071.302 #1: (B1071.302) Interior Structural Wall - Light framed wood walls with structural panel sheathing, gypsum wallboard on both sides, with hold-downs

NISTIR Classification	B1071.302	
Author	HBRG (exterio	or only)
Normalized Unit	100.0 sf	
Engineering Demand Parameter	Peak Interstory	y Drift
Number of Damage States	5	
Is correlated?	No	
Is directional?	Yes	
Component modifications applie	ed:	
Component modifications applie Component Group	ed:	Structural
	ed:	Structural 1.0
Component Group	ed:	
Component Group Quantity Scale Factor	d:	1.0
Component Group Quantity Scale Factor Damage Median Scale Factor	d:	1.0 1.0
Component Group Quantity Scale Factor Damage Median Scale Factor Total Cost Scale Factor	d:	1.0 1.0 1.391

Occupancy Cost Scale Factor

Building Value Cost Scale Factor

Table 6.5.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

1

1

Location	Cost	Time	Capacity
1-2	1	1	1





Damage State	Description	Repair Description	Image
DS1	Cracking of paint over fasteners or joints.	Gypsum wallboard repaired by replacing the tape along the seam of two adjacent panels and local areas with popped fasteners, apply- ing new joint compound, sanding, and repaint- ing.	Not Available
DS2	Local and global buckling out- of-plane and crushing of gyp- sum wallboards. Studs are typ- ically not damaged by failure of the gypsum wallboard.	Replace 25 feet of the affected panel along with the application of new tape, joint com- pound, followed by sanding and repainting. Studs are not damaged.	Not Available
DS3	Local and global buckling out- of-plane and crushing of gyp- sum wallboards. Studs are typ- ically not damaged by failure of the gypsum wallboard, but fram- ing adjustments possible for this damage state.	Replace 100 feet of the affected panel along with the application of new tape, joint com- pound, followed by sanding and repainting. Studs are not damaged.	Not Available
DS4	Permanent rotation of sheathing, tear out of nails or sheathing.	Remove interior finish, remove wood sheath- ing, install new sheathing, reinstall and finish interior material.	
DS5	Fracture of studs, major sill plate cracking.	Remove and replace interior finish, sheathing, studs and plates. Provide shoring as required.	

Table 6.5.2. Damage state progression.





	DS1	DS2	DS3	DS4	DS5
Туре	Sequential	Sequential	Sequential	Sequential	Sequential
Probability	-	-	-	-	-
Median	0.0021	0.0071	0.012	0.0262	0.0369
β	0.6	0.45	0.45	0.19	0.2

Table 6.5.3. Parameters for the damage state distributions. The medians reflect a scale factor of **1.0** applied to the default values.

Table 6.5.4. Parameters for the cost distributions. The cost values reflect a total scale factor of **<u>1.391</u>** applied to the default values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor, building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1	DS2	DS3	DS4	DS5
Distribution Type	Normal	Normal	LogNormal	LogNormal	LogNormal
Lower Qty.	3.0	3.0	3.0	3.0	3.0
Upper Qty.	8.0	8.0	8.0	8.0	8.0
Highest Cost Median	\$412	\$879	\$2,721	\$4,256	\$6,760
Lowest Cost Median	\$175	\$374	\$1,156	\$2,306	\$4,079
β (COV)	0.42	0.49	0.1	0.22	0.08

Table 6.5.5. Parameters for the repair time distributions.

	DS1	DS2	DS3	DS4	DS5
Distribution Type	Normal	Normal	LogNormal	LogNormal	LogNormal
Lower Qty.	3.0	3.0	3.0	3.0	3.0
Upper Qty.	8.0	8.0	8.0	8.0	8.0
Highest Median Repair Time (Days)	0.23	0.49	1.52	2.63	4.37
Lowest Median Repair Time (Days)	0.1	0.21	0.65	2.27	3.57
β (COV)	0.52	0.55	0.34	0.33	0.26

Table 6.5.6. Life safety information.

	DS1	DS2	DS3	DS4	DS5
Non-collapse casualties	No	No	No	No	No
Affected Area					
Serious Injury Median	_	_	_	_	_
Serious Injury β	-	-	-	-	-
Loss of Life Median	_	_	_	_	_
Loss of Life β	-	-	-	-	_
Can Cause Red Tag	No	No	No	Yes	Yes
Unsafe Placard Median	_	_	-	0.5	0.25
Unsafe Placard β	-	-	-	0.5	0.5

6.6 B2011.401 #1: (B2011.401) Exterior Wall - Light framed wood walls with exterior panelized sheathing (OSB) and horizontal wood siding, no hold-downs

NISTIR Classification	B2011.401
Author	HBRG (exterior only modifications)
Normalized Unit	100.0 sf
Engineering Demand Parameter	Peak Interstory Drift
Number of Damage States	3
Is correlated?	No
Is directional?	Yes

Component modifications applied:

Component Group	Exterior Finishes
Quantity Scale Factor	1.0
Damage Median Scale Factor	1.0
Total Cost Scale Factor	1.391
User cost modification factor	1.0
Regional Cost Scale Factor	1
Date multiplier (to convert from 2011 USD)	1.391
Occupancy Cost Scale Factor	1
Building Value Cost Scale Factor	1

Table 6.6.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

Location	Cost	Time	Capacity
1-2	1	1	1

Table 6.6.2. Damage state progression.

Damage State	Description	Repair Description	Image
DS1	Slight separation of sheathing or nails which come loose.	Remove exterior pliable siding, replace loose nails, reinstall siding.	
DS2	Permanent rotation of sheathing, tear out of nails or sheathing.	Remove exterior pliable siding, remove wood sheathing, install new sheathing, reinstall sid-ing.	
DS3	Fracture of studs, major sill plate cracking.	Remove and replace siding, sheathing, studs and plates. Provide shoring as required.	





Table 6.6.3. Parameters for the damage state distributions. The medians reflect a scale factor of **<u>1.0</u>** applied to the default values.

	DS1	DS2	DS3
Туре	Sequential	Sequential	Sequential
Probability	-	-	-
Median	0.01	0.0175	0.025
β	0.4	0.4	0.4

Table 6.6.4. Parameters for the cost distributions. The cost values reflect a total scale factor of **<u>1.391</u>** applied to the default values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor, building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1	DS2	DS3
Distribution Type	LogNormal	LogNormal	Normal
Lower Qty.	3.0	3.0	3.0
Upper Qty.	8.0	8.0	8.0
Highest Cost Median	\$412	\$879	\$2,721
Lowest Cost Median	\$175	\$374	\$1,156
β (COV)	0.19	0.22	0.08

Table 6.6.5. Parameters for the repair time distributions.

	DS1	DS2	DS3
Distribution Type	LogNormal	LogNormal	Normal
Lower Qty.	3.0	3.0	3.0
Upper Qty.	8.0	8.0	8.0
Highest Median Repair Time (Days)	0.86	1.08	2.4
Lowest Median Repair Time (Days)	0.53	0.77	1.7
β (COV)	0.31	0.33	0.26

Table 6.6.6. Life safety information.

	DS1	DS2	DS3
Non-collapse casualties Affected Area	No 	No 	No
Serious Injury Median Serious Injury β			-
Loss of Life Median Loss of Life β			
Can Cause Red Tag Unsafe Placard Median Unsafe Placard β	No 	Yes 0.5 0.5	Yes 0.25 0.5

NISTIR Classification Author Normalized Unit Engineering Demand Parameter Number of Damage States	C1011.211a DaveWelch (HBRG) 100.0 lf Peak Interstory Drift 3
Is correlated?	No
Is directional?	Yes
Component modifications applie	ed:
Component Group	Partition Walls
Quantity Scale Factor	1.0
Damage Median Scale Factor	1.0
Total Cost Scale Factor	1.391
User cost modification factor	1.0
User cost modification factor Regional Cost Scale Factor	1.0 1
	1
Regional Cost Scale Factor	1

6.7 C1011.211a #1: (C1011.211a) Wall Partition - Type: Gypsum with wood studs (both sides), Full Height, Fixed Below, Fixed Above

Table 6.7.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

Location	Cost	Time	Capacity
1-2	1	1	1

Table 6.7.2. Damage state progression.

Damage State	Description	Repair Description	Image
DS1	Cracking of paint over fasteners or joints.	Gypsum wallboard repaired by replacing the tape along the seam of two adjacent panels and local areas with popped fasteners, apply- ing new joint compound, sanding, and repaint- ing.	Not Available
DS2	Local and global buckling out- of-plane and crushing of gyp- sum wallboards. Studs are typ- ically not damaged by failure of the gypsum wallboard.	Replace 25 feet of the affected panel along with the application of new tape, joint com- pound, followed by sanding and repainting. Studs are not damaged.	Not Available
DS3	Local and global buckling out- of-plane and crushing of gyp- sum wallboards. Studs are typ- ically not damaged by failure of the gypsum wallboard, but fram- ing adjustments possible for this damage state.	Replace 100 feet of the affected panel along with the application of new tape, joint com- pound, followed by sanding and repainting. Studs are not damaged.	Not Available



	DS1	DS2	DS3
Туре	Sequential	Sequential	Sequential
Probability	-	-	-
Median	0.0021	0.0071	0.012
β	0.6	0.45	0.45

Table 6.7.4. Parameters for the cost distributions. The cost values reflect a total scale factor of **<u>1.391</u>** applied to the default values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor, building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1	DS2	DS3
Distribution Type	Normal	Normal	LogNormal
Lower Qty.	1.0	1.0	1.0
Upper Qty.	10.0	10.0	10.0
Highest Cost Median	\$5,328	\$11,425	\$37,656
Lowest Cost Median	\$1,598	\$3,428	\$11,297
β (COV)	0.42	0.49	0.1

Table 6.7.5. Parameters for the repair time distributions.

	DS1	DS2	DS3
Distribution Type	Normal	Normal	LogNormal
Lower Qty.	1.0	1.0	1.0
Upper Qty.	10.0	10.0	10.0
Highest Median Repair Time (Days)	2.99	6.4	21.1
Lowest Median Repair Time (Days)	0.9	1.92	6.33
β (COV)	0.52	0.55	0.34

Table 6.7.6. Life safety information.

	DS1	DS2	DS3
Non-collapse casualties Affected Area	No 	No 	No
Serious Injury Median Serious Injury β	_	_	
Loss of Life Median Loss of Life β			-
Can Cause Red Tag Unsafe Placard Median Unsafe Placard β	No 	No 	No

6.8 C1011.311a #1: (C1011.311a) Interior of Exterior Wall - Type: Gypsum with wood studs (single-sided gypsum), Full Height, Fixed Below, Fixed Above

NISTIR Classification	C1011.311a
Author	Dave Welch (HBRG)
Normalized Unit	100.0 lf
Engineering Demand Parameter	Peak Interstory Drift
Number of Damage States	3
Is correlated?	No
Is directional?	Yes

Component modifications applied:

Component Group	Partition Walls
Quantity Scale Factor	1.0
Damage Median Scale Factor	1.0
Total Cost Scale Factor	1.391
User cost modification factor	1.0
Regional Cost Scale Factor	1
Date multiplier (to convert from 2011 USD)	1.391
Occupancy Cost Scale Factor	1
Building Value Cost Scale Factor	1

Table 6.8.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

Location	Cost	Time	Capacity
1-2	1	1	1

Table 6.8.2. Damage state progression.

Damage State	Description	Repair Description	Image
DS1	Cracking of paint over fasteners or joints.	Gypsum wallboard repaired by replacing the tape along the seam of two adjacent panels and local areas with popped fasteners, apply- ing new joint compound, sanding, and repaint- ing.	Not Available
DS2	Local and global buckling out- of-plane and crushing of gyp- sum wallboards. Studs are typ- ically not damaged by failure of the gypsum wallboard.	Replace 25 feet of the affected panel along with the application of new tape, joint com- pound, followed by sanding and repainting. Studs are not damaged.	Not Available
DS3	Local and global buckling out- of-plane and crushing of gyp- sum wallboards. Studs are typ- ically not damaged by failure of the gypsum wallboard, but fram- ing adjustments possible for this damage state.	Replace 100 feet of the affected panel along with the application of new tape, joint com- pound, followed by sanding and repainting. Studs are not damaged.	Not Available



	DS1	DS2	DS3
Туре	Sequential	Sequential	Sequential
Probability	-	-	-
Median	0.0021	0.0071	0.012
β	0.6	0.45	0.45

Table 6.8.4. Parameters for the cost distributions. The cost values reflect a total scale factor of **<u>1.391</u>** applied to the default values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor, building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1	DS2	DS3
Distribution Type	Normal	Normal	LogNormal
Lower Qty.	1.0	1.0	1.0
Upper Qty.	10.0	10.0	10.0
Highest Cost Median	\$3,015	\$7,411	\$23,838
Lowest Cost Median	\$904	\$2,223	\$7,151
β (COV)	0.42	0.49	0.1

Table 6.8.5. Parameters for the repair time distributions.

	DS1	DS2	DS3
Distribution Type	Normal	Normal	LogNormal
Lower Qty.	1.0	1.0	1.0
Upper Qty.	10.0	10.0	10.0
Highest Median Repair Time (Days)	1.69	4.15	13.36
Lowest Median Repair Time (Days)	0.51	1.25	4.01
β (COV)	0.52	0.55	0.34

Table 6.8.6. Life safety information.

	DS1	DS2	DS3
Non-collapse casualties Affected Area	No 	No 	No
Serious Injury Median Serious Injury β			-
Loss of Life Median Loss of Life β			
Can Cause Red Tag Unsafe Placard Median Unsafe Placard β	No 	No 	No



6.9 C2011.041b #1: (C2011.041b) Light frame stair fragility. Approximation as a placeholder until there is more research on the topic. Damage states from P-58 Light frame stair example. Costing approximated from various online sources for stair replacement.

NISTIR Classification Author Normalized Unit Engineering Demand Parameter Number of Damage States Is correlated? Is directional?	C2011.041b HBRG 1.0 each Peak Interstory 3 No Yes	y Drift
Component modifications applie	ed:	
Component Group		Other Nonstructural
Quantity Scale Factor		1.0
Damage Median Scale Factor		1.0
Total Cost Scale Factor		1.391
User cost modification factor		1.0
Regional Cost Scale Factor		1
Date multiplier (to convert from	n 2011 USD)	1.391
Occupancy Cost Scale Factor		1
Building Value Cost Scale Fact	or	1

Table 6.9.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

Location	Cost	Time	Capacity
1-2	1	1	0.5

Table 6.9.2. Damage state progression.

Damage State	Description	Repair Description	Image
DS1	Cosmetic Damage.	Repair cosmetic damage.	Not Available
DS2	Structural damage but live load capacity remains intact.	Repair damage.	Not Available
DS3	Loss of live load capacity.	Replace stair.	Not Available

Table 6.9.3. Parameters for the damage state distributions. The medians reflect a scale factor of **<u>1.0</u>** applied to the default values.

	DS1	DS2	DS3
Туре	Sequential	Sequential	Sequential
Probability	-	-	-
Median	0.011	0.026	0.05
β	0.5	0.5	0.5

Table 6.9.4. Parameters for the cost distributions. The cost values reflect a total scale factor of **<u>1.391</u>** applied to the default values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor, building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1	DS2	DS3
Distribution Type	LogNormal	LogNormal	Normal
Lower Qty.	5.0	5.0	5.0
Upper Qty.	10.0	10.0	10.0
Highest Cost Median	\$695	\$2,782	\$8,346
Lowest Cost Median	\$487	\$1,043	\$3,130
β (COV)	0.8	0.6	0.4

Table 6.9.5. Parameters for the repair time distributions.

	DS1	DS2	DS3
Distribution Type	LogNormal	LogNormal	Normal
Lower Qty.	5.0	5.0	5.0
Upper Qty.	10.0	10.0	10.0
Highest Median Repair Time (Days)	0.55	2.21	6.62
Lowest Median Repair Time (Days)	0.39	0.83	2.48
β (COV)	1.0	0.7	0.5

Table 6.9.6. Life safety information.

	DS1	DS2	DS3
Non-collapse casualties Affected Area	No 	No 	No
Serious Injury Median Serious Injury β			
Loss of Life Median Loss of Life β		-	
Can Cause Red Tag Unsafe Placard Median Unsafe Placard β	No 	Yes 0.25 0.1	Yes 0.1 0.5

6.10 C3034.001 #1: (C3034.001) Independent Pendant Lighting - non seismic

NISTIR Classification	C3034.001
Author	Not Given
Normalized Unit	1.0 each
Engineering Demand Parameter	Peak Floor Acceleration
Number of Damage States	1
Is correlated?	No
Is directional?	No

Component modifications applied:

Component Group	Lighting
Quantity Scale Factor	1.0
Damage Median Scale Factor	1.0
Total Cost Scale Factor	1.391
User cost modification factor	1.0
Regional Cost Scale Factor	1
Date multiplier (to convert from 2011 USD)	1.391
Occupancy Cost Scale Factor	1
Building Value Cost Scale Factor	1

Table 6.10.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

Location	Cost	Time	Capacity
G-R	1	1	1

Damage State	Description	Repair Description	Image
DS1	Disassembly of rod system at connections with horizontal light fixture, low cycle fatigue failure of the threaded rod, pullout of rods from ceiling assembly.	Replace damaged lighting components.	Not Available





Table 6.10.3. Parameters for the damage state distributions. The medians reflect a scale factor of 1.0 applied to the default values.

	DS1
Туре	Sequential
Probability	-
Median	0.6
β	0.4

Table 6.10.4. Parameters for the cost distributions. The cost values reflect a total scale factor of **1.391** applied to the default values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor, building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1
Distribution Type	LogNormal
Lower Qty.	5.0
Upper Qty.	10.0
Highest Cost Median	\$1,377
Lowest Cost Median	\$413
β (COV)	0.64

Table 6.10.5. Parameters for the repair time distributions.

	DS1
Distribution Type	LogNormal
Lower Qty.	5.0
Upper Qty.	10.0
Highest Median Repair Time (Days)	0.99
Lowest Median Repair Time (Days)	0.3
β (COV)	0.68

Table 6.10.6.	Life	safety	information.
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	DS1
Non-collapse casualties Affected Area	Yes 100.0 SF
Serious Injury Median Serious Injury β	0.2 0.5
Loss of Life Median Loss of Life β	0.002 0.5
Can Cause Red Tag Unsafe Placard Median Unsafe Placard β	No

6.11 D1014.022 #1: (D1014.022) Hydraulic Elevator - Applies to most California Installations prior to 1976, most western states installations prior to 1982 and most U.S installations prior to 1998.

NISTIR Classification	D1014.022	
Author	Not Given	
Normalized Unit	1.0 each	
Engineering Demand Parameter	Peak Floor Ac	celeration
Number of Damage States	1	
Is correlated?	No	
Is directional?	No	
Component modifications applie	d:	
Component Group		Elevators
Quantity Scale Factor		1.0
Damage Median Scale Factor		1.0
Total Cost Scale Factor		1.391
User cost modification factor		1.0
Regional Cost Scale Factor		1
Regional Cost Scale Factor Date multiplier (to convert from	n 2011 USD)	1 1.391
	n 2011 USD)	

Table 6.11.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

Location	Cost	Time	Capacity
G-R	1	1	1

Table 6.11.2. Damage state progression.

Damage State	Description	Repair Description	Image
DS1a	Damaged controls.	Multiple repairs possible (% change of each): Repair damaged controls (100%)	Not Available
DS1b	Damaged vane and hoist-way switches, and or bent cab stabi- lizers, and or damaged car guide shoes.	Multiple repairs possible ($\%$ change of each): Repair damaged vane and hoist-way switches (41 $\%$), and or repair bent cab stabilizers (41 $\%$), and or repair damaged car guide shoes (41 $\%$).	Not Available
DS1c	Damaged entrance and car door, and or flooring damage.	Multiple repairs possible (% change of each): Repair damage to cab door (68%), and or re- pair cab flooring (46%)	Not Available
DS1d	Oil leak in hydraulic line, and or hydraulic tank failure.	Multiple repairs possible (% change of each): Repair oil leak in hydraulic line (27%), and or hydraulic tank failure (81%)	Not Available





Table 6.11.3. Parameters for the damage state distributions.	The medians reflect a scale factor of $\underline{1.0}$ applied to the default
values.	

	DS1a	DS1b	DS1c	DS1d
Туре	Simultaneous	Simultaneous	Simultaneous	Simultaneous
Probability	0.3	0.49	0.44	0.37
Median	0.3	0.3	0.3	0.3
β	0.3	0.3	0.3	0.3

Table 6.11.4. Parameters for the cost distributions. The cost values reflect a total scale factor of 1.391 applied to the default
values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor,
building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1a	DS1b	DS1c	DS1d
Distribution Type	LogNormal	Normal	Normal	LogNormal
Lower Qty.	5.0	5.0	5.0	5.0
Upper Qty.	10.0	10.0	10.0	10.0
Highest Cost Median	\$2,226	\$22,812	\$33,383	\$6,398
Lowest Cost Median	\$668	\$6,844	\$10,015	\$1,920
β (COV)	0.82	0.32	0.44	0.25

Table 6.11.5. Parameters for the repair time distributions.

	DS1a	DS1b	DS1c	DS1d
Distribution Type	LogNormal	Normal	Normal	LogNormal
Lower Qty.	5.0	5.0	5.0	5.0
Upper Qty.	10.0	10.0	10.0	10.0
Highest Median Repair Time (Days)	1.6	16.4	24	4.6
Lowest Median Repair Time (Days)	0.48	4.92	7.2	1.38
β (COV)	0.86	0.41	0.51	0.36

Table 6.11.6. Life safety information.

	DS1a	DS1b	DS1c	DS1d
Non-collapse casualties Affected Area	No	No	No	No
Serious Injury Median Serious Injury β		-	-	
Loss of Life Median Loss of Life β	-			
Can Cause Red Tag Unsafe Placard Median Unsafe Placard β	No 	No _	No 	No

6.12 D2021.012a #1: (D2021.012a) Cold or Hot Potable - Small Diameter Threaded Steel - (2.5 inches in diameter or less), SDC C, PIPING FRAGILITY

NISTIR Classification	D2021.012a	
Author	Not Given	
Normalized Unit	1000.0 lf	
Engineering Demand Parameter	Peak Floor Ac	celeration
Number of Damage States	2	
Is correlated?	No	
Is directional?	No	
Component modifications applie	d:	
Component Group		Piping
Quantity Scale Factor		1.0
Damage Median Scale Factor		1.0
Total Cost Scale Factor		1.391
User cost modification factor		1.0
Regional Cost Scale Factor		1
Date multiplier (to convert from	n 2011 USD)	1.391
Occupancy Cost Scale Factor		1

Building Value Cost Scale Factor

Table 6.12.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

1

Location	Cost	Time	Capacity
G-R	1	1	1

Table 6.12.2. Damage state progression.

Damage State	Description	Repair Description	Image
DS1	Minor leakage at flange connec- tions - 1 leak per 1000 feet of pipe.	Retighten flange bolts at leaking joints. One joint per 1000 LF.	Not Available
DS2	Pipe Break - 1 break per 1000 feet of pipe.	Replace 20 foot sections of pipe where breaks occur. One repair per 1000 LF.	Not Available



Table 6.12.3. Parameters for the damage state distributions. The medians reflect a scale factor of $\underline{1.0}$ applied to the default values.

	DS1	DS2
Туре	Sequential	Sequential
Probability	_	-
Median	1.5	2.6
β	0.4	0.4

Table 6.12.4. Parameters for the cost distributions. The cost values reflect a total scale factor of 1.391 applied to the default
values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor,
building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1	DS2
Distribution Type	LogNormal	LogNormal
Lower Qty.	1.0	1.0
Upper Qty.	4.0	4.0
Highest Cost Median	\$444	\$4,055
Lowest Cost Median	\$363	\$3,317
β (COV)	0.76	0.41

Table 6.12.5. Parameters for the repair time distributions.

	DS1	DS2
Distribution Type	LogNormal	LogNormal
Lower Qty.	1.0	1.0
Upper Qty.	4.0	4.0
Highest Median Repair Time (Days)	0.34	0.56
Lowest Median Repair Time (Days)	0.28	0.14
β (COV)	0.8	0.48

	DS1	DS2
Non-collapse casualties Affected Area	No 	No
Serious Injury Median Serious Injury β		-
Loss of Life Median Loss of Life β	-	-
Can Cause Red Tag Unsafe Placard Median Unsafe Placard β	No _	No _

6.13 D2021.012b #1: (D2021.012b) Cold or Hot Potable - Small Diameter Threaded Steel - (2.5 inches in diameter or less), SDC C, BRACING FRAGILITY

NISTIR Classification	D2021.012b		
Author	Not Given		
Normalized Unit	1000.0 lf		
Engineering Demand Parameter	Peak Floor Ac	celeration	
Number of Damage States	2		
Is correlated?	No		
Is directional?	No		
Component modifications applied:			
Component Group		Piping	
Quantity Scale Factor		1.0	
Damage Median Scale Factor		1.0	
Total Cost Scale Factor		1.391	
User cost modification factor		1.0	
Regional Cost Scale Factor		1	
Date multiplier (to convert from	n 2011 USD)	1.391	
Occupancy Cost Scale Factor		1	

Building Value Cost Scale Factor

Table 6.13.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

1

Location	Cost	Time	Capacity
G-R	1	1	1

Table 6.13.2. Damage state progression.

Damage State	Description	Repair Description	Image
DS1	Lateral Brace Failure - 1 failure per 1000 feet of pipe.	Replace failed lateral braces. One repair per 1000 LF.	Not Available
DS2	Vertical Brace Failure - 1 failure per 1000 feet of pipe	Replace failed vertical braces. One repair per 1000 LF.	Not Available

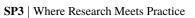




Table 6.13.3. Parameters for the damage state distributions. The medians reflect a scale factor of $\underline{1.0}$ applied to the default values.

	DS1	DS2
Туре	Sequential	Sequential
Probability	_	-
Median	1.5	2.6
β	0.4	0.4

Table 6.13.4. Parameters for the cost distributions. The cost values reflect a total scale factor of 1.391 applied to the default
values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor,
building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1	DS2
Distribution Type	LogNormal	LogNormal
Lower Qty.	1.0	1.0
Upper Qty.	4.0	4.0
Highest Cost Median	\$581	\$5,814
Lowest Cost Median	\$476	\$4,757
β (COV)	0.6	0.07

Table 6.13.5. Parameters for the repair time distributions.

	DS1	DS2
Distribution Type	LogNormal	LogNormal
Lower Qty.	1.0	1.0
Upper Qty.	4.0	4.0
Highest Median Repair Time (Days)	0.44	0.8
Lowest Median Repair Time (Days)	0.36	0.2
β (COV)	0.65	0.26

Table 6.13.6. Life safety information.

DS1	DS2
No	No
-	-
-	-
No _	No _
-	—
	No



6.14 D2021.022a #1: (D2021.022a) Cold or Hot Potable Water Piping (dia > 2.5 inches), SDC C, PIPING FRAGILITY

NISTIR Classification	D2021.022a
Author	Not Given
Normalized Unit	1000.0 lf
Engineering Demand Parameter	Peak Floor Acceleration
Number of Damage States	2
Is correlated?	No
Is directional?	No

Component modifications applied:

Component Group	Piping
Quantity Scale Factor	1.0
Damage Median Scale Factor	1.0
Total Cost Scale Factor	1.391
User cost modification factor	1.0
Regional Cost Scale Factor	1
Date multiplier (to convert from 2011 USD)	1.391
Occupancy Cost Scale Factor	1
Building Value Cost Scale Factor	1

Table 6.14.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

Location	Cost	Time	Capacity
G-R	1	1	1

Table 6.14.2. Damage state progression.

Damage State	Description	Repair Description	Image
DS1	Minor leakage at flange connec- tions - 1 leak per 1000 feet of pipe.	Retighten flange bolts at leaking joints. One joint per 1000 LF.	Not Available
DS2	Pipe Break - 1 break per 1000 feet of pipe.	Replace 20 foot sections of pipe where breaks occur. One repair per 1000 LF.	Not Available



Table 6.14.3. Parameters for the damage state distributions. The medians reflect a scale factor of $\underline{1.0}$ applied to the default values.

	DS1	DS2
Type Probability	Sequential	Sequential
Probability	-	_
Median	1.5	2.6
eta	0.4	0.4

Table 6.14.4. Parameters for the cost distributions. The cost values reflect a total scale factor of 1.391 applied to the default
values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor,
building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1	DS2
Distribution Type	LogNormal	LogNormal
Lower Qty.	5.0	5.0
Upper Qty.	10.0	10.0
Highest Cost Median	\$974	\$9,319
Lowest Cost Median	\$292	\$2,796
β (COV)	0.65	0.4

Table 6.14.5. Parameters for the repair time distributions.

	DS1	DS2
Distribution Type	LogNormal	LogNormal
Lower Qty.	5.0	5.0
Upper Qty.	10.0	10.0
Highest Median Repair Time (Days)	0.74	7.09
Lowest Median Repair Time (Days)	0.22	2.13
β (COV)	0.7	0.47

DS1	DS2
No	No
	-
-	
No	No
_	_
	No - - - -

NISTIR Classification Author Normalized Unit	D2031.022a Not Given 1000.0 lf	
Engineering Demand Parameter	Peak Floor Ac	celeration
Number of Damage States	1	
Is correlated?	No	
Is directional?	No	
Component modifications applie	ed:	
Component Group		Piping
Quantity Scale Factor		1.0
Damage Median Scale Factor		1.0
Total Cost Scale Factor		1.391
User cost modification factor		1.0
Regional Cost Scale Factor		1
Date multiplier (to convert from	n 2011 USD)	1.391
Occupancy Cost Scale Factor		1
Building Value Cost Scale Fac	tor	1

6.15 D2031.022a #1: (D2031.022a) Sanitary Waste Piping - Cast Iron w/bell and spigot couplings, SDC C, PIPING FRAGILITY

Table 6.15.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

Location	Cost	Time	Capacity
G-R	1	1	1

Table 6.15.2. Damage state progression.

Damage State	Description	Repair Description	Image
DS1	Joints break - 1 break per 1000 feet of pipe.	Replace failed 20 ft pipe sections including supports - one per 1000 LF.	Not Available



Table 6.15.3. Parameters for the damage state distributions. The medians reflect a scale factor of $\underline{1.0}$ applied to the default values.

	DS1
Type Probability	Sequential
Probability	-
Median	1.2
β	0.5

Table 6.15.4. Parameters for the cost distributions. The cost values reflect a total scale factor of 1.391 applied to the default
values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor,
building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DC1
	DS1
Distribution Type	Normal
Lower Qty.	5.0
Upper Qty.	10.0
Highest Cost Median	\$9,319
Lowest Cost Median	\$2,796
β (COV)	0.31

Table 6.15.5. Parameters for the repair time distributions.

	DS1
Distribution Type	Normal
Lower Qty.	5.0
Upper Qty.	10.0
Highest Median Repair Time (Days)	7.09
Lowest Median Repair Time (Days)	2.13
β (COV)	0.4

Table 6.15.6. Li	ife safety	information.
------------------	------------	--------------

	DS1
Non-collapse casualties	No
Affected Area	
Serious Injury Median	_
Serious Injury β	_
Loss of Life Median	_
Loss of Life β	_
Can Cause Red Tag	No
Unsafe Placard Median Unsafe Placard β	_
olisale i lacara p	_

D2031.022b #1: (D2031.022b) Sanitary Waste Piping - Cast Iron w/bell and spigot...

D2031.022b

Author	Not Given	
Normalized Unit	1000.0 lf	
Engineering Demand Parameter	Peak Floor A	cceleration
Number of Damage States	2	
Is correlated?	No	
Is directional?	No	
Component modifications applie	ed:	
Component Group		Piping
Quantity Scale Factor		1.0
Damage Median Scale Factor		1.0
Total Cost Scale Factor		1.391
User cost modification factor		1.0
Regional Cost Scale Factor		1
Date multiplier (to convert from	m 2011 USD)	1.391
Occupancy Cost Scale Factor		1
Building Value Cost Scale Fact	tor	1

NISTIR Classification

6.16 D2031.022b #1: (D2031.022b) Sanitary Waste Piping - Cast Iron w/bell and spigot couplings, SDC C, BRACING FRAGILITY

Table 6.16.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

Location	Cost	Time	Capacity
G-R	1	1	1

Table 6.16.2. Damage state progression.

Damage State	Description	Repair Description	Image
DS1	Isolated support failure w/o leak- age - 0.5 support failures per 1000 feet of pipe (assuming sup- ports every 20 feet).	Replace failed supports - 0.5 per 1000 LF.	Not Available
DS2	Multiple supports failure and 60 feet of pipe fail per 1000 feet of pipe (assuming supports every 20 feet).	Replace failed supports and 60 ft pipe per 1000 LF.	Not Available



Table 6.16.3. Parameters for the damage state distributions. The medians reflect a scale factor of $\underline{1.0}$ applied to the default values.

	DS1	DS2
Туре	Sequential	Sequential
Type Probability	-	_
Median	1.2	2.4
β	0.5	0.5

Table 6.16.4. Parameters for the cost distributions. The cost values reflect a total scale factor of 1.391 applied to the default
values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor,
building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1	DS2
Distribution Type	LogNormal	Normal
Lower Qty.	5.0	5.0
Upper Qty.	10.0	10.0
Highest Cost Median	\$1,113	\$12,101
Lowest Cost Median	\$334	\$3,630
β (COV)	0.71	0.28

Table 6.16.5. Parameters for the repair time distributions.

	DS1	DS2
Distribution Type	LogNormal	Normal
Lower Qty.	5.0	5.0
Upper Qty.	10.0	10.0
Highest Median Repair Time (Days)	0.85	9.21
Lowest Median Repair Time (Days)	0.25	2.76
β (COV)	0.75	0.38

Table 6.16.6. Li	fe safety	information.
------------------	-----------	--------------

	DS1	DS2
Non-collapse casualties Affected Area	No 	No
Serious Injury Median Serious Injury β		-
Loss of Life Median Loss of Life β	-	-
Can Cause Red Tag Unsafe Placard Median Unsafe Placard β	No _	No _

6.17 D3032.011a #1: (D3032.011a) Compressor - Capacity: Small non medical air supply - Unanchored equipment that is not vibration isolated - Equipment fragility only

NISTIR Classification Author Normalized Unit Engineering Demand Parameter Number of Damage States Is correlated?	D3032.011a Not Given 1.0 each Peak Floor Ac 1 No	celeration
Is directional?	No	
Component modifications applie	d:	
Component Group		HVAC
Quantity Scale Factor		1.0
Damage Median Scale Factor		1.0
Total Cost Scale Factor		1.391
User cost modification factor		1.0
Regional Cost Scale Factor		1
Date multiplier (to convert from	n 2011 USD)	1.391
Occupancy Cost Scale Factor		1
Building Value Cost Scale Fact	or	1

Table 6.17.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

Location	Cost	Time	Capacity
G-R	1	1	1

Table 6.17.2. Damage state progression.

Damage State	Description	Repair Description	Image
DS1a	Equipment does not function. Motor is damaged.	Repair motor.	
DS1b	Equipment does not function. Equipment damaged beyond re- pair.	Replace equipment.	Not Available





Table 6.17.3. Parameters for the damage state distributions. The medians reflect a scale factor of $\underline{1.0}$ applied to the default values.

	DS1a	DS1b
Туре	Mut. Excl.	Mut. Excl.
Probability	0.5	0.5
Median	0.25	0.25
eta	0.45	0.45

Table 6.17.4. Parameters for the cost distributions. The cost values reflect a total scale factor of 1.391 applied to the default
values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor,
building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1a	DS1b
Distribution Type	LogNormal	LogNormal
Lower Qty.	1.0	1.0
Upper Qty.	5.0	5.0
Highest Cost Median	\$1,148	\$4,131
Lowest Cost Median	\$939	\$3,380
β (COV)	0.17	0.21

Table 6.17.5. Parameters for the repair time distributions.

	DS1a	DS1b
Distribution Type	LogNormal	LogNormal
Lower Qty.	1.0	1.0
Upper Qty.	5.0	5.0
Highest Median Repair Time (Days)	0.97	0.64
Lowest Median Repair Time (Days)	0.79	0.16
β (COV)	0.3	0.32

	DS1a	DS1b
Non-collapse casualties Affected Area	No 	No
Serious Injury Median Serious Injury β		-
Loss of Life Median Loss of Life β	-	-
Can Cause Red Tag Unsafe Placard Median Unsafe Placard β	No 	No

6.18 D3032.011a #2: (D3032.011a) Compressor - Capacity: Small non medical air supply - Unanchored equipment that is not vibration isolated - Equipment fragility only

NISTIR Classification Author Normalized Unit Engineering Demand Parameter Number of Damage States Is correlated?	D3032.011a Not Given 1.0 each Peak Floor Ac 1 No	celeration
Is directional?	No	
Component modifications applie	d:	
Component Group		HVAC
Quantity Scale Factor		1.0
Damage Median Scale Factor		1.0
Total Cost Scale Factor		1.391
User cost modification factor		1.0
Regional Cost Scale Factor		1
Date multiplier (to convert from	n 2011 USD)	1.391
Occupancy Cost Scale Factor		1
Building Value Cost Scale Fact	or	1

Table 6.18.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

Location	Cost	Time	Capacity
G-R	1	1	1

Table 6.18.2. Damage state progression.

Damage State	Description	Repair Description	Image
DS1a	Equipment does not function. Motor is damaged.	Repair motor.	
DS1b	Equipment does not function. Equipment damaged beyond re- pair.	Replace equipment.	Not Available





Table 6.18.3. Parameters for the damage state distributions. The medians reflect a scale factor of $\underline{1.0}$ applied to the default values.

	DS1a	DS1b
Туре	Mut. Excl.	Mut. Excl.
Probability	0.5	0.5
Median	0.25	0.25
eta	0.45	0.45

Table 6.18.4. Parameters for the cost distributions. The cost values reflect a total scale factor of 1.391 applied to the default
values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor,
building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1a	DS1b
Distribution Type	LogNormal	LogNormal
Lower Qty.	1.0	1.0
Upper Qty.	5.0	5.0
Highest Cost Median	\$1,148	\$4,131
Lowest Cost Median	\$939	\$3,380
β (COV)	0.17	0.21

Table 6.18.5. Parameters for the repair time distributions.

	DS1a	DS1b
Distribution Type	LogNormal	LogNormal
Lower Qty.	1.0	1.0
Upper Qty.	5.0	5.0
Highest Median Repair Time (Days)	0.97	0.64
Lowest Median Repair Time (Days)	0.79	0.16
β (COV)	0.3	0.32

Table 6.18.6.	Life safety	information.
---------------	-------------	--------------

	DS1a	DS1b
Non-collapse casualties Affected Area	No 	No
Serious Injury Median Serious Injury β		-
Loss of Life Median Loss of Life β		
Can Cause Red Tag Unsafe Placard Median Unsafe Placard β	No 	No _ _



6.19	D3041.011c #1: (D3041.011c) HVAC Galvanized Sheet Metal Ducting less than 6 sq. ft in cross sectional area,
	SDC D, E, or F

NISTIR Classification Author Normalized Unit Engineering Demand Parameter Number of Damage States Is correlated?	D3041.011c Not Given 1000.0 lf Peak Floor Ac 2 No	celeration
Is directional?	No	
is uncetional.	110	
Component modifications applie	ed:	
Component Group		HVAC
Quantity Scale Factor		1.0
Damage Median Scale Factor		1.0
Total Cost Scale Factor		1.391
User cost modification factor		1.0
Regional Cost Scale Factor		1
Date multiplier (to convert from	n 2011 USD)	1.391
Occupancy Cost Scale Factor		1
Building Value Cost Scale Fact	or	1

Table 6.19.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

Location	Cost	Time	Capacity
G-R	1	1	1

Table 6.19.2. Damage state progression.

Damage State	Description	Repair Description	Image
DS1	Individual supports fail and duct sags - 1 failed support per 1000 feet of ducting.	Replace failed supports and repair ducting in vicinity of failed supports.	Not Available
DS2	Several adjacent supports fail and sections of ducting fall - 60 feet of ducting fail and fall per 1000 foot of ducting.	Replace sections of failed ducting and supports.	Not Available



Table 6.19.3. Parameters for the damage state distributions. The medians reflect a scale factor of $\underline{1.0}$ applied to the default values.

	DS1	DS2
Туре	Sequential	Sequential
Probability	-	-
Median	1.5	2.25
β	0.4	0.4

Table 6.19.4. Parameters for the cost distributions. The cost values reflect a total scale factor of 1.391 applied to the default
values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor,
building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1	DS2
Distribution Type	LogNormal	LogNormal
Lower Qty.	1.0	1.0
Upper Qty.	5.0	5.0
Highest Cost Median	\$995	\$9,716
Lowest Cost Median	\$814	\$7,949
β (COV)	0.37	0.1

Table 6.19.5. Parameters for the repair time distributions.

	DS1	DS2
Distribution Type	LogNormal	LogNormal
Lower Qty.	1.0	1.0
Upper Qty.	5.0	5.0
Highest Median Repair Time (Days)	0.84	2.99
Lowest Median Repair Time (Days)	0.69	1.49
β (COV)	0.44	0.27

Table 6.19.6. Life safety information.

	DS1	DS2
Non-collapse casualties	No	Yes
Affected Area		15.0 SF
Serious Injury Median	_	0.05
Serious Injury β	_	0.5
Loss of Life Median	_	0.0
Loss of Life β	_	0.0
Can Cause Red Tag	No	No
Unsafe Placard Median	_	_
Unsafe Placard β	-	-



6.20 D3041.032c #1: (D3041.032c) HVAC Drops / Diffusers without ceilings - supported by ducting only - No independent safety wires, SDC D, E, or F

NISTIR Classification	D3041.032c	
Author	Not Given	
Normalized Unit	10.0 each	
Engineering Demand Parameter	Peak Floor Ac	celeration
Number of Damage States	1	
Is correlated?	No	
Is directional?	No	
Component modifications applie	d:	
Component Group		HVAC
Quantity Scale Factor		1.0
Damage Median Scale Factor		1.0
Total Cost Scale Factor		1.391
User cost modification factor		1.0
Regional Cost Scale Factor		1
Date multiplier (to convert from	n 2011 USD)	1.391
Occupancy Cost Scale Factor		1
Building Value Cost Scale Factor	or	1

Table 6.20.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

Location	Cost	Time	Capacity
G-R	1	1	1

Table 6.20.2. Damage state progression.

Damage State	Description	Repair Description	Image
DS1	HVAC drops or diffusers dis- lodges and falls.	Replace diffuser/drop and sections of ceiling and ducting in vicinity to which diffuser/drop is connected.	Not Available



Table 6.20.3. Parameters for the damage state distributions. The medians reflect a scale factor of 1.0 applied to the default values.

	DS1
Туре	Sequential
Probability	-
Median	1.5
β	0.4

Table 6.20.4. Parameters for the cost distributions. The cost values reflect a total scale factor of **1.391** applied to the default values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor, building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1
Distribution Type	Normal
Lower Qty.	1.0
Upper Qty.	5.0
Highest Cost Median	\$4,590
Lowest Cost Median	\$3,756
β (COV)	0.21

Table 6.20.5. Parameters for the repair time distributions.

	DS1
Distribution Type	Normal
Lower Qty.	1.0
Upper Qty.	5.0
Highest Median Repair Time (Days)	3.88
Lowest Median Repair Time (Days)	3.18
β (COV)	0.32

Table 6.20.6. Lif	e safety	information.
-------------------	----------	--------------

	DS1
Non-collapse casualties Affected Area	Yes 4.0 SF
Serious Injury Median Serious Injury β	0.1 0.5
Loss of Life Median Loss of Life β	0.0 0.0
Can Cause Red Tag Unsafe Placard Median Unsafe Placard β	No _ _



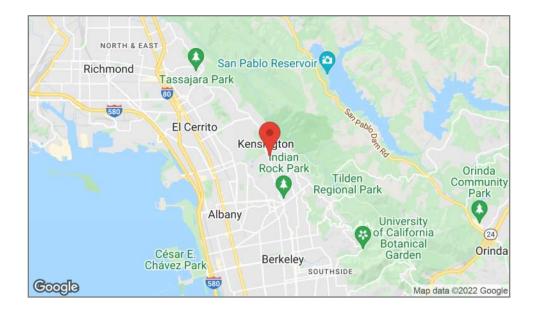
7 DISCLAIMER

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SEISMIC RISK ASSESSMENT REPORT Created with the SP3-RiskModel

Full Detailed Report



Report Generated for:

217 Arlington Avenue, Kensington, CA, 94707 Latitude: 37.90622° Longitude: -122.27875°

Report Generated by:

The SP3-RiskModel Software v1.2.0 of the Seismic Performance Prediction Program (SP3)

March 16, 2022





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1 SUMMARY OF INPUTS AND RISK RESULTS

Risk Model Inputs

I	Primary		Building Design Info				
		on Fire Station WLF on RC	Level of Detailing (Dir. 1, 2): Drift Limit (Dir. 1, 2):	Ordinary, Ordinary –, –			
Building Types: Dir. 1: WL		haar Wall	Risk Category: Seismic Importance Factor, I_e : Component Importance Factor,	IV -	-		
Design Code Year: Number of Stories: Occupancy:	1967 2 Commerce		Structural Prop	-			
Address: 217 Arling	ton Avenue		Allow Components to Affect Structural Properties?	,	Yes		
Kensington, CA, 94707 Latitude: 37.90622 Longitude: -122.2787			Mode Shapes Specified? Directional Properties	No Dir. 1 Dir. 2			
Anal	ysis Options		Base Shear Strength (g): Yield Drift (%): 1^{st} Mode Period (T_1) (s):				
Include Collapse in An Consider Residual Dri Region Cost Multiplie Date Cost Multiplier:	ft:	Yes Yes –	2^{nd} Mode Period (T_2) (s): Component Infor	- mation	_		
Occupancy Cost Multi	plier:		Percent of Building Glazed:				
Duilding L	ayout Inform	otion	Selection Method	Cu	stom		
Cost per Square Foot: Scale component repai	-	– No	Building Stab	ility			
building value?			Median Collapse Capacity: Beta (Dispersion):	_			
Aspect Ratio:1.95First Story Height (ft):13.5Upper Story Heights (ft):9Vertical Irregularity:None		13.5	Responses No responses provided	1			

Ground Motion and Soil Information

_

_

Site Class:	С
Site Hazard:	SP3 Default

Dir. 1 Story 1

Dir. 1 Upper Stories



Repair T	ime Options					
Repair Time Method	ATC-138 (Beta)					
Factors Delaying Start of Repairs						
Inspection	Yes					
Financing	Yes					
Permitting	Yes					

i ci initunig	105
Engineering Mobilization	Yes
Contractor Mobilization	Yes
Mitigation Factors	
Inspector on Retainer	No
Engineer on Retainer	No
Contractor on Retainer	No
Funding Source	Private Loans
Cash on Hand	-

ATC-138 Functional Recovery (Beta) Options

Need HVAC for Function	_
Need Elevator for Function	_
Include Surge Demand	_

Component Checklist

Interior Finishes

- What kind of partition walls does the building have?
 - > Wood Studs
- Does the building have raised access floors > *No*
- Does the building have suspended ceilings?
 - > Yes
 - Are the ceilings laterally supported?
 - > No
- Does the building contain pendant (non-recessed) lighting?
 - > Yes
 - Are the pendant lights seismically rated?

> No Stairs and Elevators

- Does the building have stairs?
 - > Yes
 - What type of stairs are in the building? > *Light Frame*
- Are there elevators in the building?
 - > Yes
 - What type of elevators are in the building?
 - > Hydraulic
 - From which era are the building's elevators?
 - > Pre-1976 California (or pre-1976 California equivalent)

Fire Supression

- Does the building contain a fire sprinkler system?
 - > Yes
 - Does the fire sprinkler system have braced horizontal piping? > *No*
 - Are the fire sprinkler drops OSHPD certified (or equivalent)?

Continued on next page





Component Checklist (*Continued*))

> No

• What type of ceiling do the fire drops enter into? > *Hard*

Piping

- Is the building's water piping OSHPD certified or equivalent? > No
- Is the building's sanitary piping OSHPD certified or equivalent? > *No*
 - What type of couplings do the pipes have?
 - > Bell and spigot

HVAC

• Is the HVAC cooling/heating equipment seismically anchored?

> No

- How is the cooling/heating system configured?
 - > Roof Top Units
 - Are the RTUs used for medical purposes (or equivalent)?

> No

- Are the RTUs small or large?
 - > Small
- Does the building have a control panel?

> Yes

- Is there an HVAC exhaust system in the building?
 - > Yes
 - Is the HVAC exhaust system seismically anchored?
 - > No
- Does the HVAC distribution system meet OSHPD standards (or similar)? > *No*
 - Is there any large diameter ducting (6 SqFt+) in the HVAC system? > *Yes*

Electrical

- Does the building have a backup battery/generator system? > *No*
- Which best describes the building's electrical system?
 No significant electrical equipment (rugged)

Concrete

- Are the building's shear walls low rise or slender?
 - > Low Rise (typically <= 40ft building height)
 - What are the boundary conditions of the walls?
 - > No return flanges or boundary columns
 - What is the typical wall thickness? > 8" to 16"
 - What is the typical wall height?
 - > *Less than 15*'

Expected Loss

Expected loss in percent of total building value					
Shaking Intensity	Return Period	Return Period SEL (%)			
50% in 50 years	72 Years	7.4	15		
10% in 50 years	475 Years	49	80		
DE	481 Years	50	82		
5% in 50 years	975 Years	89	100		
MCE_R	1277 Years	95	100		
2% in 50 years	2475 Years	99	100		

Expected loss in percent of total building value

Repair Time

Median repair time summary									
	FEMA	A P-58 [†]	ATC-138 I	Functional Recov	ery (Beta) [‡]				
Intensity Parallel Series		Re- Occupancy	Functional	Full					
50% in 50 years	2.6 weeks	3.7 weeks	0 days	4 days	2.2 months				
10% in 50 years	4 months	5.3 months	3.9 months	4.4 months	4.5 months				
DE	4.1 months	5.4 months	4.1 months	4.6 months	4.7 months				
5% in 50 years	11 months	11 months	11 months	11 months	11 months				
MCE_R	11 months	11 months	11 months	11 months	11 months				
2% in 50 years	11 months	11 months	11 months	11 months	11 months				

[†] Does *not* include impedance factors

[‡] Does include impedance factors





2 BASIS OF ANALYSIS

This analysis is based on the SP3-RiskModel of the Seismic Performance Prediction Program (SP3) software platform. The underlying analysis methods are based on the FEMA P-58 analytical method, which is a transparent and well documented method developed through a 15 year project (Applied Technology Council, 2018). This project leveraged the previous decades of academic research, funded by a \$16 million investment by the Federal Emergency Management Agency (FEMA). In contrast to many risk assessment methods based on judgment and past earthquake experience, the FEMA P-58 and SP3 analysis are based on engineering-oriented risk evaluation methods.

3 DOCUMENTATION OF SITE AND BUILDING INPUT DATA

Project Name:	Kensington Fire Station
Model Name:	Existing WLF on RC Wall

3.1 Site Information

Address:217 Arlington Avenue, Kensington, CA, 94707Latitude:37.90622°Longitude:-122.27875°

3.2 Building Information

Material Type (Direction 1):	WLF
Material Type (Direction 2):	Cast-in-Place Concrete
Number of Stories:	2
Total Building Square Footage:	1,738
Occupancy Type:	Commercial Office
Total Expected Building Replacement Value:	\$610,816

4 SITE HAZARD INFORMATION

This section presents the site's seismic hazard information. The V_{S30} value is the shear wave velocity in the soil at a depth of 30 meters. This value and the associated site class are presented in Table 4.1.

Table 4.1. Site soil information	
V _{S30} (m/s):	537.0
Site Class:	С
Closest V_{S30} for USGS Hazard Lookup (m/s):	530

Table 4.2 and Figure 4.1 present the spectral acceleration information for this site. The spectral acceleration is a measure of how much force the building will attract in an earthquake. This amount of force is dependent on the intensity of the ground shaking (e.g. 10% in 50 years), as well as a dynamic property of the building known as the "fundamental period". Shorter buildings tend to have smaller fundamental periods and taller buildings tend to have larger fundamental periods. As indicated by Figure 4.1, smaller fundamental periods (with the exception of very short fundamental periods) will attract more force in an earthquake.

The Design Earthquake (DE) and Maximum Considered Earthquake (MCE) are based on the modern code maximum direction spectra and are converted to geometric mean for comparison.

Intensity	Return Period (yrs)	PGA	$S_a(0.2s)$	$S_a(1.0s)$	$S_a(0.29s)$	$S_a(T_1)$ Dir 1	$)/v_{ult}$ † Dir 2
50% in 50 years	72	0.22	0.52	0.17	0.46	0.52	0.35
10% in 50 years	475	0.62	1.50	0.56	1.38	1.76	1.05
DE	481	0.62	1.50	0.57	1.39	1.77	1.05
5% in 50 years	975	0.82	2.03	0.80	1.89	2.50	1.43
MCE_R	1277	0.91	2.26	0.91	2.11	2.83	1.60
2% in 50 years	2475	1.13	2.84	1.19	2.67	3.69	2.03

Table 4.2. Geometric mean spectral acceleration values (in g)

[†] $S_a(T_1)/v_{ult}$ is the ratio of shaking intensity to building strength where in direction 1 $v_{ult} = 0.320$ and $T_1 = 1.01$ s and in direction 2 $v_{ult} = 1.32$ and $T_1 = 0.288$ s (see Table 5.3 for more detailed structural properties)





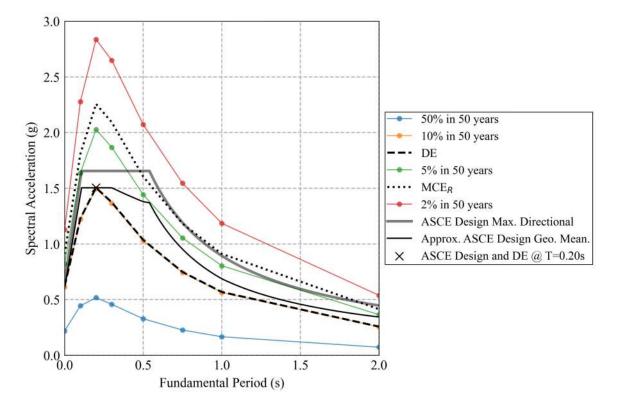


Figure 4.1. Hazard curves for this site. All curves are geometric mean unless otherwise stated.

5 BUILDING DESIGN SUMMARY FROM THE SP3 BUILDING CODE DESIGN DATABASE

5.1 Building Code Design Parameters

The seismic design parameters used to compute the seismic base shear coefficients for this building are presented in Table 5.1. These parameters are specific to the 1967 edition of the Uniform Building Code (International Conference of Building Officials, 1967).

(a) U	UBC 1967 structural system parameters			(b) UBC 1967 site specific parameter			ers
	Parameter	Dir. 1	Dir. 2		Parameter	Value	
	C_d	1	1		Z	1	
	k	1	1.33		Seismic Zone	3	
	<i></i>	1	1.55			5	-

5.2 Modern Building Code Design Parameters (for comparison purposes)

For comparison to modern code, the modern code parameters are presented in Table 5.2.

(a) ASCE/SEI 7-2010 structural system parameters

(b) ASCE/SEI 7-2010 site specific parameters

Parameter	Dir. 1	Dir. 2	Parameter	Val
C_t	0.02	0.02	S_s	2.4
C_d	4	5	S_1	1.03
x	0.75	0.75	S_{ds}	1.65
R	6.5	6	S_{d1}	0.89
Ω_0	3	2.5	SDC	E
			C_u	1.4

(c) ASCE/SEI 7-2010 site specific parameters based on the period of the building

Parameter	Value
$MCE_{R,max}(g)$	2.066
$MCE_{R,geomean}(g)$	1.68
$DE_{max}(g)$	1.377
$DE_{geomean}(g)$	1.12



5.3 Structural Properties

This section summarizes the main structural properties of the building in each direction. These structural properties are used as inputs to the SP3 Structural Response Prediction Engine.

Parameter	Direction 1	Direction 2
General		
Structural System	WLF: General	RC: Cantilever Shear Wall
Building Edge Length (ft)	21	41
Detailing Level	Ordinary	Ordinary
Seismic Strength		
Seismic Design Base Shear Ratio, C_s^{\dagger}	0.100	0.186
C_s with Structural Overstrength	_	0.484
Wind Strength		
Wind Design Base Shear Ratio, v_{wind} [†]	0.114	0.052
v_{wind} with Structural Overstrength	-	0.126
Total Strength		
Strength Governed by	_	seismic
Governing Seismic/Wind with Structural Overstrength	-	0.484
With Gravity System Strength	-	0.564
With Non-structural Strength	-	1.32
Ultimate Base Shear Ratio, v_{ult}	0.320	1.32
Stiffness		
$T_{1,design}$ (s)	0.34	0.46
T_1 with structural overstiffness (s)	-	0.35
T_1 with gravity system (s)	-	0.34
T_1 with non-structural components (s)	1.01	0.32
T_1 empirical lower bound (s)	-	0.11
T_1 empirical upper bound (s)	-	0.29
T_1 Final (s)	1.01	0.29

Table 5.3. Structural properties table

[†] Design base shear values reported as LRFD





5.4 Mode Shapes

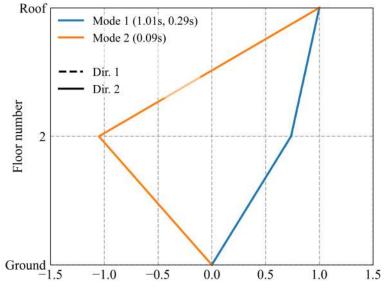


Figure 5.1. Mode shapes

Table 5.4	Mode	shape	values
-----------	------	-------	--------

	Dir. 1	Di	r. 2
	Mode 1	Mode 1	Mode 2
Roof	1.00	1.00	1.00
2	0.738	0.736	-1.05
Ground	0.00	0.00	0.00

6 SP3 PERFORMANCE FACTORS

Table 6.1 compares the seismic design base shear, C_s , to the 475-year shaking (reduced by the modern response modification coefficient, R). Generally speaking, the modern building code design requirements are based on the 475-year event with the exception of extremely high seismic (near-fault) areas that are designed for a lesser deterministic ground motion or the transition region between deterministic and probabilistic portions of the ground motion maps.

The shaking intensity is then reduced by the response modification coefficient, R, based on the ductility level of the system (in anticipation of controlled damage of specially designed elements).

When the ratio of design base shear to the reduced spectra $(C_s / [S_a(T_1)_{475}/R])$ is 1.0, then the building was designed consistent with 10% in 50 year hazard. When the ratio is above 1.0, it was designed higher, so expect better performance (all other things equal), and for ratios below 1.0, expect worse performance.

	Dir. 1	Dir. 2	
Seismic Design Base Shear, C_s 475-year Shaking Intensity, $S_a(T_1)_{475}$ [†] Reduced Spectral Acceleration, $S_a(T_1)_{475}/R^{\ddagger}$	0.100 0.561g 0.086g	0.186 1.38g 0.230g	
Ratio of Design Base Shear to 475-year Shaking Demand, $C_s / [S_a(T_1)_{475}/R]^{\$}$	1.16	0.81	
[†] T_1 includes all sources of overstiffness ($T_{1,dir1} = 1.01$ s and $T_{1,dir2} = 0.288$ s, see Table 5.3).			

Table 6.1. Design base shear vs. 475-year shaking intensity

[‡] Response Modification Coefficient, R, is from the modern code $(R_{dir1} = 6.5 \text{ and } R_{dir2} = 6)$.

Table 6.2 shows a comparison of the properties of the building to the properties of the building if it were constructed using the modern code guidelines. This table only compares the difference in building strength and period, and does not present differences in component damageability. The full SP3-RiskModel analysis does include effects of component damageability differences, so while the metrics in this table are informative, they are not all-encompassing of differences between new and old code design.

	Dir. 1	Dir. 2
Seismic Design Base Shear, C_s		
UBC 1967	0.100	0.186
ASCE/SEI 7-2010 ^{\dagger}	0.382	0.414
Ratio $\frac{C_{s,UBC1967}}{C_{s,ASCE/SEI7-2010}}$	0.262	0.450
Ultimate Base Shear (C_s with Overstrength), v_{ult}		
UBC 1967	0.320	1.32
ASCE/SEI 7-2010	0.713	1.83
Ratio $\frac{v_{ult,UBC1967}}{v_{ult,ASCE/SEI7-2010}}$	0.448	0.721
Period Considering All Sources of Stiffness, T_1 (s)		
UBC 1967	1.01	0.288
ASCE/SEI 7-2010	0.760	0.165

Table 6.2. Comparison of structural properties from UBC 1967 and ASCE/SEI 7-2010

[†] $R_{dir1} = 6.5$ and $R_{dir2} = 6$



7 BUILDING STABILITY

The FEMA P-154 collapse capacity score was calculated as follows using the "very high" seismicity level. The terminology used in this section is consistent with the FEMA P-154 methodology (Applied Technology Council, 2015a):

- $P[COL|MCE_R]_{P-154}$: the probability that the building will be in the HAZUS complete structural damage state when subjected to MCER shaking, times the collapse factor
- $P[COL|MCE_R]_{P-58}$: the probability that the building will be in the HAZUS complete structural damage state when subjected to MCER shaking
- Collapse Factor: expected ratio of collapsed area to total area given that the building is in the HAZUS Complete structural damage state

For a more in-depth explanation of "collapse," refer to Section 4.4.1.5 of FEMA P-155 Third Edition available <u>here</u> (Applied Technology Council, 2015b).

Since the FEMA P-154 building types associated with the two structural systems specified differ, collapse is based on the more vulnerable structural system which in this case was determined to be the direction 1 system, "WLF: General".

FEMA ID:	W2
Basic Score	1.8
Soil	0
Year	0
Plan Irregularity	-0.6
Vertical Irregularity	0
Risk Category [†] (Cat IV)	0
Sum:	1.2
Minimum Allowed:	0.7
Score:	1.2
Dispersion (β):	0.58

Table 7.1. Breakdown of FEMA P-154 score assignment

[†] Non-standard property implemented by SP3

The FEMA P-154 probability of collapse at the MCE_R level event is then calculated as:

$$P[COL|MCE_R]_{P-154} = 10^{-\text{score}}$$

= 10^{-1.2} (FEMA P-155 eqn. 4-1)
= 6.31%

Taking into account the fraction of floor area collapsed (0.33 in this case), the probability of collapse is:

$$P[COL|MCE_R]_{P-58} = P[COL|MCE_R]_{P-154} / \text{Collapse Factor}$$
$$= 6.31\% / 0.33$$
$$= 19.1\%$$

The median collapse capacity (before any direct modifications to the median) is calculated as:

$$S_{a, collapse median, P-58} = \exp\left(\ln(S_{a,MCE_R}) - \operatorname{norminv}\left(P[COL|MCE_R]_{P-58}\right) \cdot \beta\right)$$
$$= \exp\left(\ln(1.51g) - \operatorname{norminv}\left(19.1\%\right) \cdot 0.58\right)$$
$$= 2.50g$$



SP3

where norminv is the inverse of the standard normal cumulative distribution function (CDF). To further refine the collapse capacity, the factors from Table 7.2 were applied to the median collapse S_a .

Table 7.2. Scale factor applied to the median collapse S_a value.

Reason	Factor
Wood Light Frame	0.791

The WLF modification reflects a weighted average of the FEMA P-154 median and the median collapse capacity observed in extensive non-linear dynamic modeling.

The final median for the collapse curve is therefore:

$$S_{a, collapse median, P-58 (adjusted)} = S_{a, collapse median, P-58} \cdot \text{Factors}$$

= 2.50g \cdot 0.791 (Using additional SP3 factors)
= 1.98g

Which corresponds to a probability of collapse at MCE of:

$$P[COL|MCE_R]_{P-58 \ (adjusted)} = 32.0\%$$
 (Using additional SP3 factors)

Figure 7.1 shows the collapse capacity cumulative distribution function used in the analysis.

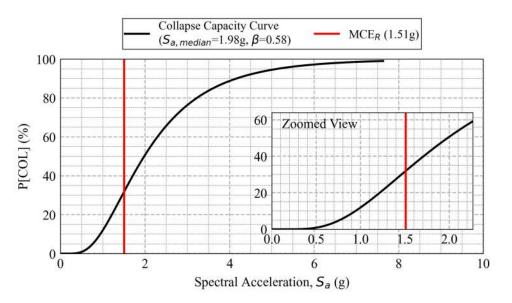


Figure 7.1. Cumulative distribution function for collapse capacity

8 STRUCTURAL RESPONSE PREDICTIONS FROM THE SP3 STRUCTURAL RESPONSE PREDICTION ENGINE

The SP3 Response Prediction Engine predicts the structural responses (typically providing 100 ground motions per intensity level); this is done by using a combination of three-mode elastic modal analysis, coupled with both elastic and inelastic response modifiers mined from the large SP3 Structural Responses Database (with over 4,000,000 response simulations, and growing). These response predictions track all of the important statistical information in the responses (mean, variability, and correlations); this enables a statistically robust vulnerability curve at the end of the risk assessment process.

8.1 Peak Interstory Drift

Peak interstory drift ratio is an important metric for both structural and non-structural components in the building. It measures how much the ceiling of a given story moves relative to the floor, normalized to the height of the story. The greater the interstory drift ratio, the greater the damage to the components on that level. Typical components that are damaged from interstory drift ratio are structural components (beams and columns), gypsum partition walls, and exterior cladding and glazing.

Story	50% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 years
2 1	0.11 0.59	0.78 3.57	0.78 3.61	0.98 5.86	0.99 6.76	1.21 8.88
$\frac{S_a(T_1)}{v_{ult}} =$	= 0.52	1.76	1.77	2.50	2.83	3.69

Table 8.1. Median Peak Interstory Dr	rift demands in direction 1
--------------------------------------	-----------------------------

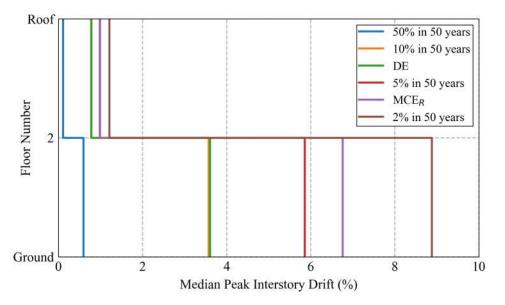


Figure 8.1. Median Peak Interstory Drift demands in direction 1





Story 50 ^e	% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 years	
2	0.09	0.31	0.32	0.54	0.66	1.03	
$\frac{1}{\frac{S_a(T_1)}{S_a(T_1)}} =$	0.17	0.56	0.57	0.75	0.83	2.03	

Table 8.2. Median Peak Interstory Drift demands in direction 2

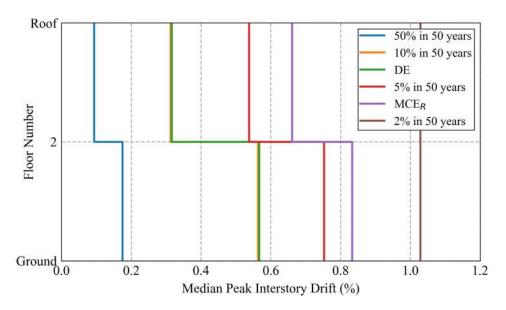


Figure 8.2. Median Peak Interstory Drift demands in direction 2



8.2 Residual Interstory Drift

Residual drift is a metric that informs the need for structural repairs or building demolition (where excessive drifts are present). Residual drift ratio is a measure of how much the building is "leaning over" after the seismic event has ceased. A residual drift of 2% would indicate that the story is laterally displaced 2% of it's height, which equates to about 3.6 inches for a 15 foot tall story.

Story	50% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 years
2 1	0.00 0.00	0.00 0.58	0.00 0.59	0.00 1.60	0.00 2.30	0.05 3.96
$\frac{S_a(T_1)}{v_{ult}} =$	= 0.52	1.76	1.77	2.50	2.83	3.69

Table 8.3. Median Residual Interstory Drift demands in direction 1

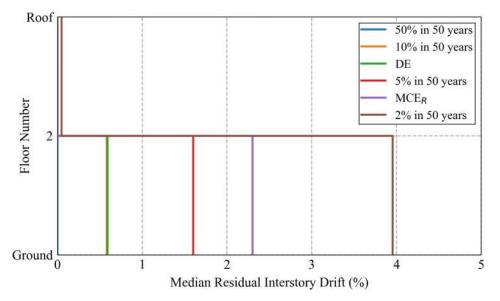


Figure 8.3. Median Residual Interstory Drift demands in direction 1



Story	50% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 years
2 1	0.00 0.00	0.01 0.04	0.01 0.04	0.04 0.07	0.05 0.08	0.10 0.10
$\frac{S_a(T_1)}{v_{ult}} =$	0.35	1.05	1.05	1.43	1.60	2.03

Table 8.4. Median Residual Interstory Drift demands in direction 2

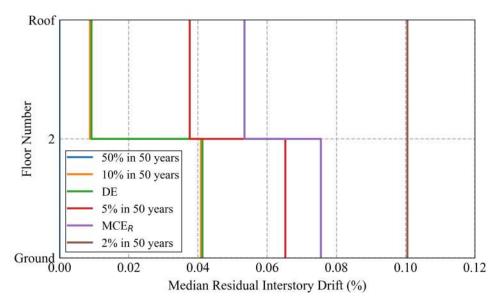


Figure 8.4. Median Residual Interstory Drift demands in direction 2

sP3

8.3 Peak Floor Acceleration

Peak floor acceleration is an an important metric for non-structural components in the building. Components such as piping, HVAC, and electrical switchgear are sensitive to the floor accelerations. High accelerations will typically damage a component itself or cause the component's anchorage to fail, both of which may require repair or replacement of the component.

Floor	50% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 years
Roof	0.33	0.90	0.90	0.97	0.97	1.13
2	0.26	0.85	0.85	0.92	0.95	1.13
Ground	0.22	0.62	0.62	0.82	0.91	1.13
$\frac{S_a(T_1)}{v_{ult}} =$	= 0.52	1.76	1.77	2.50	2.83	3.69

Table 8.5. Median Peak Floor Acceleration demands in direction 1

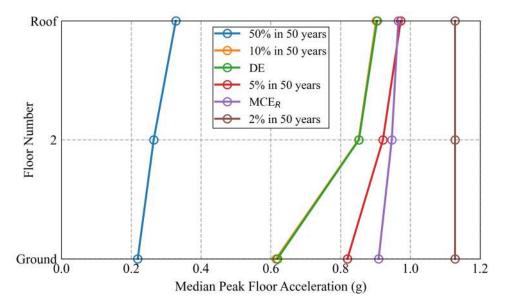


Figure 8.5. Median Peak Floor Acceleration demands in direction 1



Floor	50% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 years
Roof	0.60	1.54	1.55	1.80	1.86	2.01
2	0.41	1.08	1.09	1.32	1.40	1.57
Ground	0.22	0.62	0.62	0.82	0.91	1.13
$\frac{S_a(T_1)}{v_{ult}} =$	= 0.35	1.05	1.05	1.43	1.60	2.03

Table 8.6. Median Peak Floor Acceleration demands in direction 2

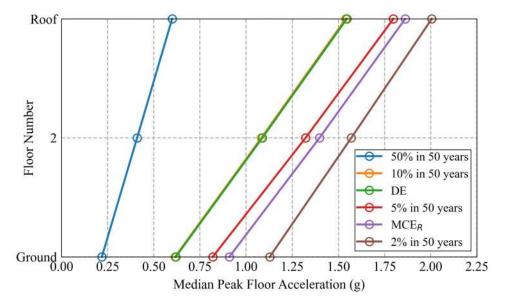


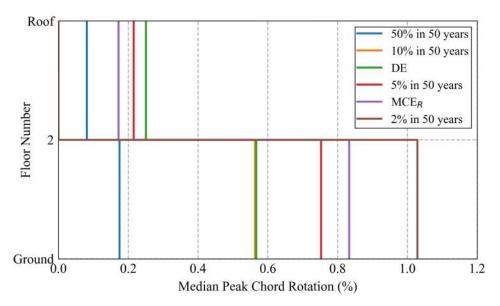
Figure 8.6. Median Peak Floor Acceleration demands in direction 2

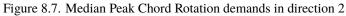
8.4 Peak Chord Rotation

Chord rotation informs how slender shear walls damage. Chord rotation is the difference in drift between two adjacent levels of a building.

Story	50% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 years
2 1	0.08 0.17	0.25 0.56	0.25 0.57	0.22 0.75	0.17 0.83	0.00 1.03
$\frac{S_a(T_1)}{v_{ult}} =$	= 0.35	1.05	1.05	1.43	1.60	2.03

Table 8.7. Median Peak Chord Rotation demands in direction 2







8.5 Max. Residual Interstory Drift

	50% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 years
_	0.00	0.58	0.59	1.60	2.30	3.96
$\frac{S_a(T_1)}{v_{ult}} =$	= 0.52	1.76	1.77	2.50	2.83	3.69

Table 8.8. Median Max. Residual Interstory Drift demands in direction 1

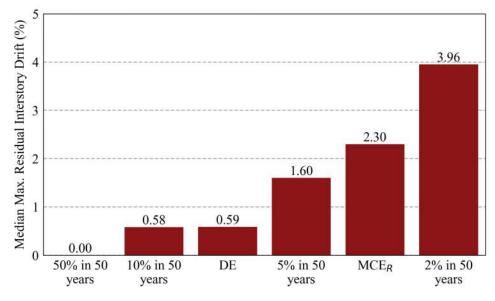


Figure 8.8. Median Max. Residual Interstory Drift demands in direction 1





	50% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 years
-	0.00	0.04	0.04	0.07	0.08	0.10
$\frac{S_a(T_1)}{v_{ult}} =$	= 0.35	1.05	1.05	1.43	1.60	2.03

Table 8.9. Median Max. Residual Interstory Drift demands in direction 2

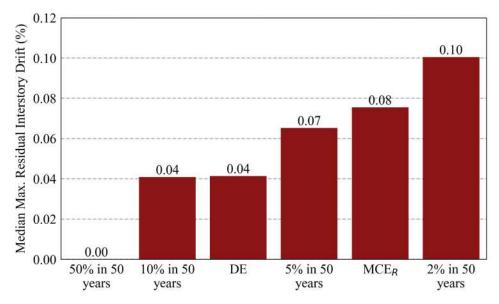


Figure 8.9. Median Max. Residual Interstory Drift demands in direction 2

9 REPAIR COSTS - BY LEVEL OF GROUND MOTION

9.1 Mean and 90th Percentile Repair Costs (SEL and SUL)

The different metrics for repair cost are as follows:

- Mean (SEL): ("Scenario Expected Loss") the average repair cost of the building repair/replacement.
- Median: there is a 50% probability that the repair cost will not exceed this value.
- Fitted SUL: Fitted value of "Scenario Upper Loss".
- Counted 90th Percentile: there is a 90% probability that the repair cost will not exceed this value.

Intensity	PGA (g)	Mean (SEL) (%)	Fitted SUL (%)	Median (%)	Counted 90 th Percentile (%)	$S_a(T_1)$ Dir 1	$)/v_{ult}$ † Dir 2
50% in 50 years	0.22	7.4	15	5.7	15	0.52	0.35
10% in 50 years	0.62	49	80	34	100	1.76	1.05
DE	0.62	50	82	35	100	1.77	1.05
5% in 50 years	0.82	89	100	100	100	2.50	1.43
MCE_R	0.91	95	100	100	100	2.83	1.60
2% in 50 years	1.13	99	100	100	100	3.69	2.03

Table 9.1. Loss metrics normalized by building cost

[†] $S_a(T_1)/v_{ult}$ is the ratio of shaking intensity to building strength where in direction 1 $v_{ult} = 0.320$ and $T_1 = 1.01$ s and in direction 2 $v_{ult} = 1.32$ and $T_1 = 0.288$ s (see Table 5.3 for more detailed structural properties)

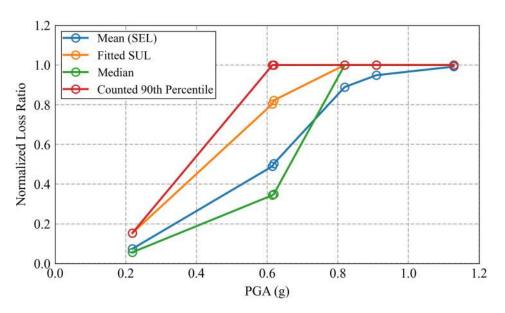


Figure 9.1. Loss metrics across all intensity levels analyzed



10 REPAIR COST BREAKDOWN BY BUILDING COMPONENTS

10.1 Categories for Repair Cost Breakdowns

Repair costs are binned into eight categories as follows:

- Collapse: building demolition and replacement following a collapse.
- Residual: building demolition and replacement following unacceptable residual drifts.
- **Structural**: components of the lateral force resisting system or gravity system (e.g. beam column connections, link beams, shear wall, shear tabs, etc.).
- Partitions: partition wall components (e.g. wood or metal stud gypsum full height partitions).
- Exterior: components placed on the exterior of the building (e.g. cladding, glazing, etc.).
- **Interior**: non-structural components on the interior of the building (e.g. raised access floors, ceilings, lighting).
- **HVAC**: HVAC and plumbing components (e.g. water piping and bracing, sanitary piping, ducting, boilers etc.).
- **Other**: components not included in the categories above (e.g. elevators, user defined components, fire protection components).

10.2 Repair Cost Breakdown for Various Ground Motion Levels

Intensity	Total	Residual	Collapse	Structural	Interior	Partitions	Other	HVAC	Exterior
50% in 50 years	7.4	0.0	0.0	0.7	1.4	1.3	2.6	1.4	0.1
10% in 50 years	49	16	10	7.4	4.9	4.1	4.2	2.0	0.7
DE	50	17	10	7.2	4.8	3.9	4.2	2.0	0.7
5% in 50 years	89	59	24	1.8	1.2	1.0	1.0	0.5	0.2
MCE_R	95	61	31	0.8	0.5	0.5	0.4	0.2	0.1
2% in 50 years	99	51	48	0.1	0.1	0.1	0.1	0.0	0.0

Table 10.1. Expected mean loss per component group (in percent)

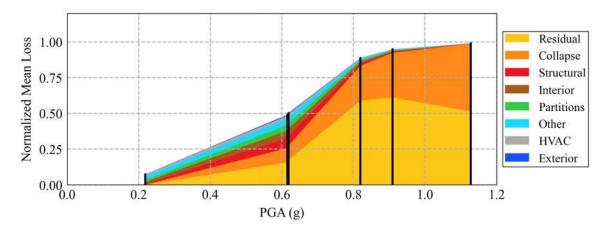


Figure 10.1. Contribution of building components to mean loss ratio





10.3 Repair Cost Breakdown for Expected Annual Loss

The expected annual loss for this building is \$3,237.

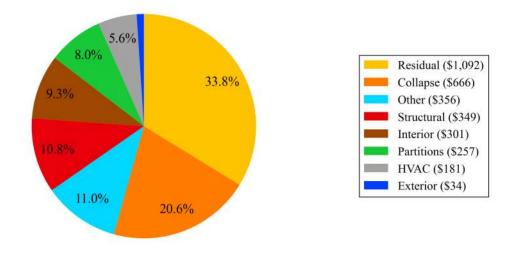


Figure 10.2. Annualized loss breakdown

11 REPAIR TIME AND BUILDING CLOSURE TIME

These downtimes were calculated using the ATC-138 Functional Recovery (Beta) Methodology. This includes all sources of impedance specified by the user; possible sources of impedance considered are listed below.

- Post-earthquake Inspection
- Engineering Mobilization and Review/Re-design
- Financing
- Contractor Mobilization and Bid Process
- Permitting

These capture the time required to start the repairs, since beginning repairs immediately after an earthquake may not be realistic.

	FEMA	A P-58 [†]	ATC-138 Functional Recovery (Beta) ^{\ddagger}		
Intensity	Parallel	Series	Re- Occupancy	Functional	Full
50% in 50 years	2.6 weeks	3.7 weeks	0 days	4 days	2.2 months
10% in 50 years	4 months	5.3 months	3.9 months	4.4 months	4.5 months
DE	4.1 months	5.4 months	4.1 months	4.6 months	4.7 months
5% in 50 years	11 months	11 months	11 months	11 months	11 months
MCE_R	11 months	11 months	11 months	11 months	11 months
2% in 50 years	11 months	11 months	11 months	11 months	11 months

Table 11.1. Median repair time summary

[†] Does *not* include impedance factors

[‡] Does include impedance factors

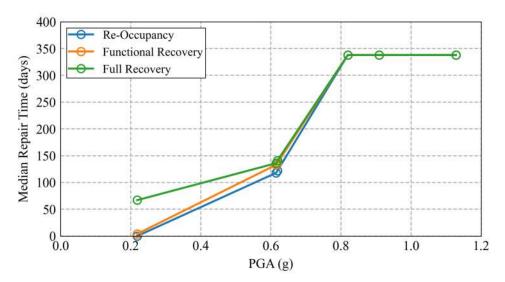


Figure 11.1. Median repair time from the ATC-138 Functional Recovery (Beta) Methodology, includes specified impeding factors





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- Applied Technology Council. 2015b. FEMA P-155: Rapid Visual Screening of Buildings for Potential Seismic Hazards: Supporting Documentation.

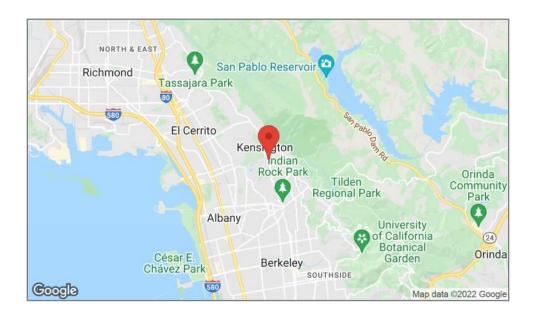
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International Conference of Building Officials. 1967. *Uniform Building Code 1967 Edition*. International Conference of Building Officials.



SEISMIC RISK ASSESSMENT REPORT Created with the SP3-RiskModel

Functional Recovery Time Report using the ATC-138 Functional Recovery (Beta) Methodology



Report Generated for:

217 Arlington Avenue, Kensington, CA, 94707 Latitude: 37.90622° Longitude: -122.27875°

Report Generated by:

The SP3-RiskModel Software v1.2.0 of the Seismic Performance Prediction Program (SP3)

March 16, 2022



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SP3

1 SUMMARY OF INPUTS AND RISK RESULTS

Risk Model Inputs

Primary			Building Design Info			
Project Name: Kensington Fire Station Model Name: Existing WLF on RC Wall Building Types: Dir. 1: WLF: General Dir. 2: RC: Cantilever Shear Wall			Level of Detailing (Dir. 1, 2): Drift Limit (Dir. 1, 2):	Ordinary, Ordinary		
		Risk Category: Seismic Importance Factor, I_e : Component Importance Factor,	-, - IV -			
Design Code Year: Number of Stories: Occupancy:	1967 2 Commerce		Structural Prop	-		
Address: 217 Arling	gton Avenue		Allow Components to Affect Structural Properties?		Yes	
Kensington, CA, 9470 Latitude: 37.9062			Mode Shapes Specified? Directional Properties	No Dir. 1 Dir. 2		
	-122.278		Base Shear Strength (g): Yield Drift (%): 1^{st} Mode Period (T_1) (s):			
Include Collapse in An Consider Residual Dri Region Cost Multiplie	ift:	Yes Yes –	2^{nd} Mode Period (T_2) (s):	_	_	
Date Cost Multiplier: Occupancy Cost Multiplier:		_	Component Infor Percent of Building Glazed:			
			Selection Method	Cu	stom	
Building Layout InformationCost per Square Foot:–Scale component repair costs withNo		Building Stab	ility			
building value?		1 729	Median Collapse Capacity: Beta (Dispersion):			
Aspect Ratio:1.4First Story Height (ft):13Upper Story Heights (ft):9Vertical Irregularity:No		1,738 1.95 13.5 9 None Extreme	Responses No responses provided	1		

Ground Motion and Soil Information

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_

Site Class:	С
Site Hazard:	SP3 Default

Dir. 1 Story 1

Dir. 1 Upper Stories



Repair Time Options				
Repair Time Method	ATC-138 (Beta)			
Factors Delaying Start of	Repairs			
Inspection	Yes			
Financing	Yes			
Permitting	Yes			

Engineering MobilizationYesContractor MobilizationYesMitigation FactorsInspector on RetainerInspector on RetainerNoEngineer on RetainerNoContractor on RetainerNoFunding SourcePrivate LoansCash on Hand-

ATC-138 Functional Recovery (Beta) Options

Need HVAC for Function	_
Need Elevator for Function	_
Include Surge Demand	_

Component Checklist

Interior Finishes

- What kind of partition walls does the building have?
 - > Wood Studs
- Does the building have raised access floors > *No*
- Does the building have suspended ceilings?
 - > Yes
 - Are the ceilings laterally supported?
 - > No
- Does the building contain pendant (non-recessed) lighting?
 - > Yes
 - Are the pendant lights seismically rated?

> No Stairs and Elevators

- Does the building have stairs?
 - > Yes
 - What type of stairs are in the building? > *Light Frame*
- Are there elevators in the building?
 - > Yes
 - What type of elevators are in the building?
 - > Hydraulic
 - From which era are the building's elevators?
 - > Pre-1976 California (or pre-1976 California equivalent)

Fire Supression

- Does the building contain a fire sprinkler system?
 - > Yes
 - Does the fire sprinkler system have braced horizontal piping? > *No*
 - Are the fire sprinkler drops OSHPD certified (or equivalent)?

Continued on next page





Component Checklist (*Continued*))

> No

• What type of ceiling do the fire drops enter into? > *Hard*

Piping

- Is the building's water piping OSHPD certified or equivalent? > *No*
- Is the building's sanitary piping OSHPD certified or equivalent? > *No*
 - What type of couplings do the pipes have?
 - > Bell and spigot

HVAC

• Is the HVAC cooling/heating equipment seismically anchored?

> No

- How is the cooling/heating system configured?
 - > Roof Top Units
 - Are the RTUs used for medical purposes (or equivalent)?

> No

- Are the RTUs small or large?
 - > Small
- Does the building have a control panel?

> Yes

- Is there an HVAC exhaust system in the building?
 - > Yes
 - Is the HVAC exhaust system seismically anchored?
 - > No
- Does the HVAC distribution system meet OSHPD standards (or similar)? > *No*
 - Is there any large diameter ducting (6 SqFt+) in the HVAC system? > *Yes*

Electrical

- Does the building have a backup battery/generator system? > *No*
- Which best describes the building's electrical system?
 No significant electrical equipment (rugged)

Concrete

- Are the building's shear walls low rise or slender?
 - > Low Rise (typically <= 40ft building height)
 - What are the boundary conditions of the walls?
 - > No return flanges or boundary columns
 - What is the typical wall thickness? > 8" to 16"
 - What is the typical wall height?
 - > *Less than 15*'

Expected Loss

LA	pected loss in percen	t of total building va	luc
Shaking Intensity	Return Period	SEL (%)	SUL (%)
50% in 50 years	72 Years	7.4	15
10% in 50 years	475 Years	49	80
DE	481 Years	50	82
5% in 50 years	975 Years	89	100
MCE_R	1277 Years	95	100
2% in 50 years	2475 Years	99	100

Expected loss in percent of total building value

Repair Time

Median repair time summary						
	FEMA	A P-58 [†]	ATC-138 Functional Recovery (Beta) ^{\ddagger}			
Intensity	Parallel	Series	Re- Occupancy	Functional	Full	
50% in 50 years	2.6 weeks	3.7 weeks	0 days	4 days	2.2 months	
10% in 50 years	4 months	5.3 months	3.9 months	4.4 months	4.5 months	
DE	4.1 months	5.4 months	4.1 months	4.6 months	4.7 months	
5% in 50 years	11 months	11 months	11 months	11 months	11 months	
MCE_R	11 months	11 months	11 months	11 months	11 months	
2% in 50 years	11 months	11 months	11 months	11 months	11 months	

[†] Does *not* include impedance factors

[‡] Does include impedance factors



2 FUNCTIONAL RECOVERY OVERVIEW

					Median			90 th Percentile		
Intensity	Return Period	PGA (g)	$\operatorname{Sa}(T_1)^*$	Re- Occ.	Func.	Full	Re- Occ.	Func.	Full	
50% in 50 years	72 years	0.22	0.32	0d	4d	2.2m	3.2m	3.8m	4.7m	
10% in 50 years	475 years	0.62	0.97	3.9m	4.4m	4.5m	11m	11m	11m	
DE	481 years	0.62	0.98	4.1m	4.6m	4.7m	11m	11m	11m	
5% in 50 years	975 years	0.82	1.34	11m	11m	11m	11m	11m	11m	
MCE_R	1277 years	0.91	1.51	11m	11m	11m	11m	11m	11m	
2% in 50 years	2475 years	1.13	1.93	11m	11m	11m	11m	11m	11m	

Table 2.1. Recovery Times from the ATC-138 Functional Recovery (Beta) Methodology

* Sa(T_1) is the spectral acceleration at T_1 where is the mean of T_1 in both directions

Table 2.2. Global Consequences

Intensity	Return Period	PGA (g)	$\operatorname{Sa}(T_1)^*$	P[red tag]	P[collapse]	P[excessive residual]
50% in 50 years	72 years	0.22	0.32	0.0%	0.0%	0.0%
10% in 50 years	475 years	0.62	0.97	26%	10%	16%
DE	481 years	0.62	0.98	28%	10%	17%
5% in 50 years	975 years	0.82	1.34	83%	24%	59%
MCE_R	1277 years	0.91	1.51	92%	31%	61%
2% in 50 years	2475 years	1.13	1.93	99%	48%	51%

* Sa (T_1) is the spectral acceleration at T_1 where is the mean of T_1 in both directions

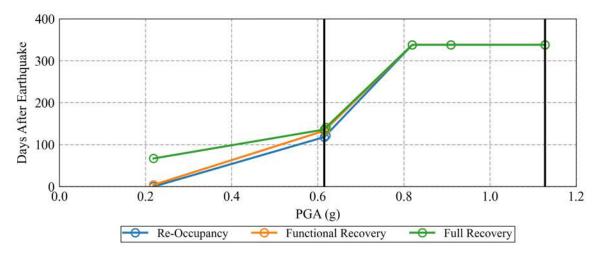


Figure 2.1. ATC-138 Functional Recovery (Beta) Methodology median recovery times





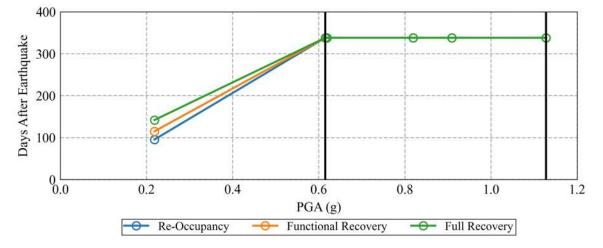


Figure 2.2. ATC-138 Functional Recovery (Beta) Methodology 90^{th} percentile recovery times

3 COMPONENT DAMAGE OVERVIEW

3.1 Most Damaged Components

This section outlines the most damaged component at each intensity. "Most damaged" is determined by cost and does not necessarily mean that it's the main component impeding building function.

Intensity	Component	Damage State	Expected Repair Cost
50% in 50 years	B1044.011	1	\$3,323
10% in 50 years	B1044.011	1	\$33,175
DE	B1044.011	1	\$32,640
5% in 50 years	B1044.011	1	\$7,722
MCE_R	B1044.011	1	\$3,514
2% in 50 years	B1044.011	1	\$685

Table 3.1. Most damaged Structural components at each intensity level.

Table 3.2. Most damaged Non-Structural components at each intensity level.

Intensity	Component	Damage State	Expected Repair Cost
50% in 50 years	D1014.022	1	\$14,674
10% in 50 years	D1014.022	1	\$20,630
DE	D1014.022	1	\$20,309
5% in 50 years	D1014.022	1	\$5,065
MCE_R	D1014.022	1	\$2,087
2% in 50 years	D1014.022	1	\$308

Details of the most damaged components and their damage states:

• **B1044.011**: Rectangular low aspect ratio concrete walls 8"-16" double curtain; with heights of up to 15'

DS1: Cracks with maximum widths greater than 0.04 in but less than 0.12 in.

- **D1014.022**: Hydraulic Elevator Applies to most California Installations prior to 1976, most western states installations prior to 1982 and most U.S installations prior to 1998.
 - DS1a: Damaged controls.
 - DS1b: Damaged vane and hoist-way switches, and or bent cab stabilizers, and or damaged car guide shoes.
 - DS1c: Damaged entrance and car door, and or flooring damage.
 - DS1d: Oil leak in hydraulic line, and or hydraulic tank failure.



sp3

3.2 Worker Days Summary

This table shows the expected worker days on a per-damage state basis. The header shows the probability of global failures (collapse and residual drift demolition) for reference.

The color scale is meant to indicate **relative** performance of components, not absolute performance. A "green" value does not indicate that the value falls in a pre-determined "good" range, just that it performs well compared to other components. Likewise, a "red" value does does not indicate that the value falls in a pre-determined "bad" range, just that it performs worse compared to other components.

	50% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 years					
P[Col](%)	0.0	10	10	24	31	48					
P[Res](%)	0.0	16	17	59	61	51					
B1044.011	#1 (B1044.011:	Rectangular low aspe	ect ratio concre	te walls 8"-16" doubl	e curtain; wit	h)					
DS1	1.5	9.0	8.8	2.1	0.9	0.2					
DS2	0.1	1.8	1.9	0.5	0.2	0.1					
DS3	0.2	7.6	7.6	1.6	0.8	0.1					
Total	1.8	18	18	4.3	1.9	0.3					
B1071.002 #1 (B1071.002: Light framed wood walls with structural panel sheathing, gypsum wallboard)											
DS1	0.6	1.5	1.4	0.3	0.1	0.0					
DS2	0.0	1.2	1.2	0.3	0.1	0.0					
DS3	0.0	5.6	5.4	1.6	0.7	0.1					
Total	0.6	8.3	8.1	2.2	1.0	0.1					
B2011.401	#1 (B2011.401:	Exterior Wall - Light	t framed wood	walls with exterior pa	nelized sheatl	ning)					
DS1	0.4	0.6	0.6	0.1	0.1	0.0					
DS2	0.1	0.5	0.4	0.1	0.0	0.0					
DS3	0.2	3.3	3.2	0.8	0.4	0.1					
Total	0.7	4.4	4.3	1.1	0.5	0.1					
C1011.211	a #1 (C1011.211	a: Wall Partition - Ty	pe: Gypsum w	ith wood studs (both	sides), Full He	eight,)					
DS1	1.2	1.4	1.3	0.3	0.1	0.0					
DS2	0.4	1.1	1.1	0.3	0.1	0.0					
DS3	1.0	5.9	5.7	1.5	0.8	0.1					
Total	2.6	8.4	8.2	2.1	1.0	0.1					
C1011.311	a #1 (C1011.311	a: Interior of Exterio	or Wall - Type:	Gypsum with wood s	tuds (single-si	ded)					
DS1	1.0	1.2	1.1	0.3	0.1	0.0					
DS2	0.3	0.9	0.9	0.2	0.1	0.0					
DS3	0.5	3.5	3.3	0.9	0.4	0.1					
Total	1.8	5.5	5.4	1.4	0.6	0.1					
C2011.041	b #1 (C2011.041	b: Light frame stair	fragility. Appr	oximation as a placeh	older until the	ere is)					
DS1	0.3	0.2	0.2	0.0	0.0	0.0					
DS2	0.3	0.6	0.5	0.1	0.1	0.0					
DS3	0.2	3.2	3.1	0.8	0.4	0.1					
Total	0.7	3.9	3.8	0.9	0.4	0.1					
C3032.001	a #1 (C3032.001)	a: Suspended Ceiling	g, SDC A,B,C, A	Area (A): A < 250, Ve	rt support onl	y)					
DS1	0.1	0.1	0.1	0.0	0.0	0.0					
DS2	0.1	0.4	0.4	0.1	0.0	0.0					
DS3	0.3	3.0	3.0	0.8	0.3	0.0					
Total	0.5	3.5	3.5	0.9	0.4	0.1					

Table 3.3. Expected worker days per damage state (Worker Days)

Continued on next page



50	0% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 years
P[Col](%)	0.0	10	10	24	31	48
P[Res](%)	0.0	16	17	59	61	51
C3032.001b	#1 (C3032.001)	o: Suspended Ceiling,	SDC A.B.C.	Area (A): 250 < A < 1	000. Vert supi	port only)
DS1	0.1	0.1	0.1	0.0	0.0	0.0
DS2	0.1	0.3	0.3	0.1	0.0	0.0
DS3	0.4	3.4	3.3	0.8	0.3	0.1
Total	0.7	3.8	3.8	0.9	0.4	0.1
C3032.001c	#1 (C3032.001c	: Suspended Ceiling, S	SDC A,B,C,	Area (A): 1000 < A < 2	2500, Vert sup	port only)
DS1	0.2	0.1	0.1	0.0	0.0	0.0
DS2	0.2	0.4	0.4	0.1	0.0	0.0
DS3	0.8	4.0	4.1	1.0	0.4	0.1
Total	1.1	4.5	4.6	1.1	0.5	0.1
C3032.001d	#1 (C3032.001	1: Suspended Ceiling,	SDC A,B,C,	Area (A): A > 2500, V	ert support of	nly)
DS1	0.2	0.1	0.1	0.0	0.0	0.0
DS2	0.3	0.4	0.4	0.1	0.0	0.0
DS3	0.9	4.4	4.2	1.0	0.5	0.1
Total	1.5	4.9	4.7	1.1	0.5	0.1
C3034.001 #	1 (C3034.001:	Independent Pendant	Lighting - no	n seismic)		
DS1	2.0	2.8	2.7	0.6	0.3	0.0
D1014.022 #	1 (D1014.022:	Hydraulic Elevator - A	pplies to mo	st California Installat	ions prior to	.)
DS1a	0.2	0.4	0.3	0.1	0.0	0.0
DS1b	4.2	5.7	5.8	1.4	0.6	0.1
DS1c	5.5	7.4	7.6	1.9	0.7	0.1
DS1d	0.9	1.3	1.2	0.3	0.1	0.0
Total	11	15	15	3.6	1.5	0.3
		a: Cold or Hot Potable				
DS1	0.0	0.0	0.0	0.0	0.0	0.0
DS2	0.0	0.0	0.0	0.0	0.0	0.0
Total	0.0	0.0	0.0	0.0	0.0	0.0
		o: Cold or Hot Potable				
DS1	0.0	0.0	0.0	0.0	0.0	0.0
		a: Cold or Hot Potable	-			
DS1	0.0	0.0	0.0	0.0	0.0	0.0
DS2	0.0	0.0	0.0	0.0	0.0	0.0
Total	0.0	0.0	0.0	0.0	0.0	0.0
D2021.023b	#1 (D2021.023)	o: Cold or Hot Potable	Water Pipir	ng (dia > 2.5 inches), S	DC D,E,F, BF	ACING)
DS1	0.0	0.0	0.0	0.0	0.0	0.0
DS2	0.0	0.0	0.0	0.0	0.0	0.0
Total	0.0	0.0	0.0	0.0	0.0	0.0
D2031.022a	#1 (D2031.022a	a: Sanitary Waste Pipi	ng - Cast Iro	n w/bell and spigot co	uplings, SDC	C,)
DS1	0.1	0.3	0.3	0.1	0.0	0.0
D2031.022b	#1 (D2031.022)	o: Sanitary Waste Pipi	ng - Cast Iro	on w/bell and spigot co	uplings, SDC	C,)
DS1	0.0	0.0	0.0	0.0	0.0	0.0
DS2	0.0	0.2	0.2	0.0	0.0	0.0
Total	0.0	0.2	0.2	0.0	0.0	0.0
D3032.011a	#1 (D3032.011a	a: Compressor - Capao	city: Small n	on medical air supply	- Unanchored	equipment)
DS1a	0.5	0.4	0.4	0.1	0.0	0.0
DS1b	0.3	0.2	0.2	0.1	0.0	0.0
Total	0.8	0.6	0.6	0.1	0.1	0.0

Continued on next page



50	0% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 years
P[Col](%)	0.0	10	10	24	31	48
P[Res](%)	0.0	16	17	59	61	51
D3041.011b	#1 (D3041.011)	o: HVAC Galvanized	Sheet Metal I	Ducting less than 6 sq.	ft in cross sec	tional)
DS1	0.0	0.0	0.0	0.0	0.0	0.0
DS2	0.0	0.1	0.1	0.0	0.0	0.0
Total	0.0	0.1	0.1	0.0	0.0	0.0
D3041.012b	#1 (D3041.012)	o: HVAC Galvanized	Sheet Metal I	Oucting - 6 sq. ft cross	sectional area	1 or)
DS1	0.0	0.0	0.0	0.0	0.0	0.0
DS2	0.0	0.0	0.0	0.0	0.0	0.0
Total	0.0	0.0	0.0	0.0	0.0	0.0
D3041.032b	#1 (D3041.032)	o: HVAC Drops / Dif	fusers without	ceilings - supported b	y ducting only	y - No)
DS1	0.6	3.0	2.9	0.7	0.3	0.0
D3041.101a -	#1 (D3041.101a	a: HVAC Fan - Capa	city: all - Unar	chored equipment the	at is not vibra	tion)
DS1	4.2	4.7	4.6	1.1	0.5	0.1
D4011.022a	#1 (D4011.022a	a: Fire Sprinkler Wa	ter Piping - Ho	orizontal Mains and B	ranches - Old	Style)
DS1	0.0	0.0	0.0	0.0	0.0	0.0
DS2	0.0	0.1	0.1	0.0	0.0	0.0
Total	0.0	0.1	0.1	0.0	0.0	0.0

Table 3.3 (*Continued*). Expected worker days per damage state (Worker Days)

3.3 Component Name Reference

This list is provided for reference where only the fragility ID is available.

- **B1044.011**: Rectangular low aspect ratio concrete walls 8"-16" double curtain; with heights of up to 15'
- **B1071.002**: Light framed wood walls with structural panel sheathing, gypsum wallboard and hold-downs
- **B2011.401**: Exterior Wall Light framed wood walls with exterior panelized sheathing (OSB) and horizontal wood siding, no hold-downs
- C1011.211a: Wall Partition Type: Gypsum with wood studs (both sides), Full Height, Fixed Below, Fixed Above
- **C1011.311a**: Interior of Exterior Wall Type: Gypsum with wood studs (single-sided gypsum), Full Height, Fixed Below, Fixed Above
- C2011.041b: Light frame stair fragility. Approximation as a placeholder until there is more research on the topic. Damage states from P-58 Light frame stair example. Costing approximated from various online sources for stair replacement.
- C3032.001a: Suspended Ceiling, SDC A,B,C, Area (A): A < 250, Vert support only
- C3032.001b: Suspended Ceiling, SDC A,B,C, Area (A): 250 < A < 1000, Vert support only
- C3032.001c: Suspended Ceiling, SDC A,B,C, Area (A): 1000 < A < 2500, Vert support only
- C3032.001d: Suspended Ceiling, SDC A,B,C, Area (A): A > 2500, Vert support only
- C3034.001: Independent Pendant Lighting non seismic
- **D1014.022**: Hydraulic Elevator Applies to most California Installations prior to 1976, most western states installations prior to 1982 and most U.S installations prior to 1998.
- **D2021.013a**: Cold or Hot Potable Small Diameter Threaded Steel (2.5 inches in diameter or less), SDC D, E, or F, PIPING FRAGILITY
- **D2021.013b**: Cold or Hot Potable Small Diameter Threaded Steel (2.5 inches in diameter or less), SDC D, E, or F, BRACING FRAGILITY
- D2021.023a: Cold or Hot Potable Water Piping (dia > 2.5 inches), SDC D,E,F, PIPING FRAGILITY
- **D2021.023b**: Cold or Hot Potable Water Piping (dia > 2.5 inches), SDC D,E,F, BRACING FRAGILITY
- D2031.022a: Sanitary Waste Piping Cast Iron w/bell and spigot couplings, SDC C, PIPING FRAGILITY
- D2031.022b: Sanitary Waste Piping Cast Iron w/bell and spigot couplings, SDC C, BRACING FRAGILITY
- D3032.011a: Compressor Capacity: Small non medical air supply Unanchored equipment that is not vibration isolated Equipment fragility only
- D3041.011b: HVAC Galvanized Sheet Metal Ducting less than 6 sq. ft in cross sectional area, SDC C
- D3041.012b: HVAC Galvanized Sheet Metal Ducting 6 sq. ft cross sectional area or greater, SDC C





- D3041.032b: HVAC Drops / Diffusers without ceilings supported by ducting only No independent safety wires, SDC C
- **D3041.101a**: HVAC Fan Capacity: all Unanchored equipment that is not vibration isolated Equipment fragility only
- **D4011.022a**: Fire Sprinkler Water Piping Horizontal Mains and Branches Old Style Victaulic - Thin Wall Steel - No bracing, SDC C, PIPING FRAGILITY

4 DETAILED REOCCUPANCY AND FUNCTIONALITY RESULTS BY GROUND MOTION INTENSITY

4.1 50% in 50 years Intensity

4.1.1 Selected Realizations for 50th percentile

Note that this is a single realization and may not be representative of a general trend. This selected realization is intended to give a sense of what the repair schedule may look like, it is not intended to generalize what the "typical" repair schedule looks like.

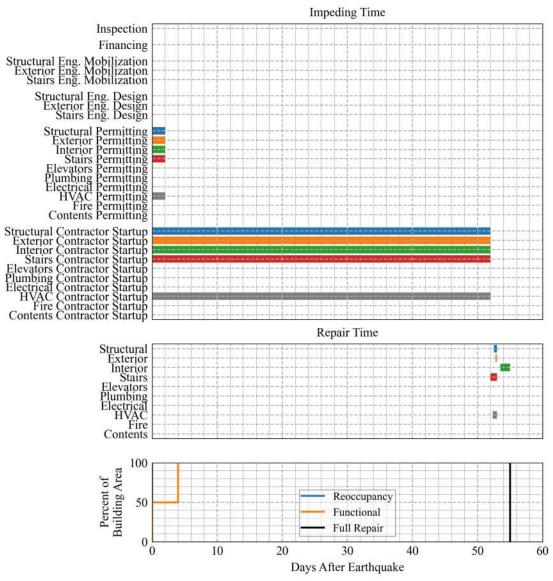


Figure 4.1. 50% in 50 years Percentile = 50





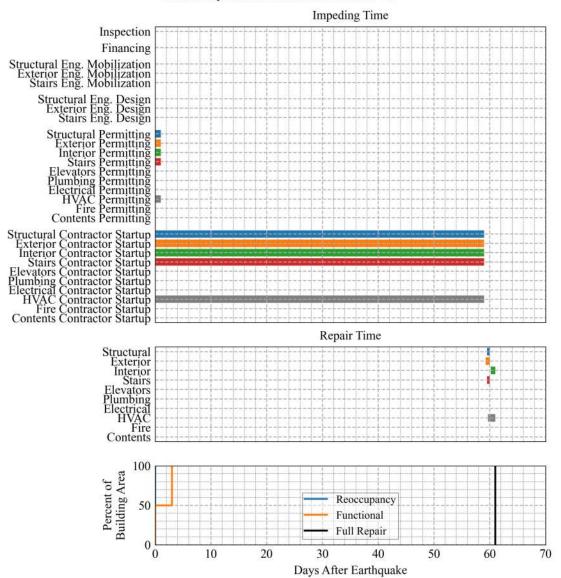


Figure 4.2. 50% in 50 years Percentile = 49



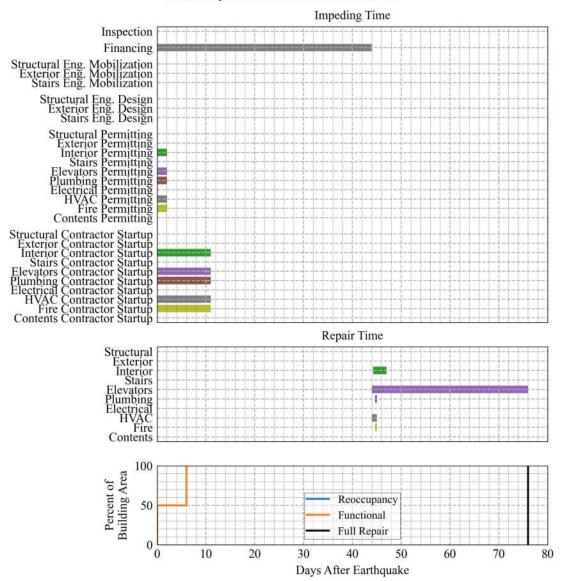


Figure 4.3. 50% in 50 years Percentile = 51

4.1.2 Selected Realizations for 90th percentile

Note that this is a single realization and may not be representative of a general trend. This selected realization is intended to give a sense of what the repair schedule may look like, it is not intended to generalize what the "typical" repair schedule looks like.

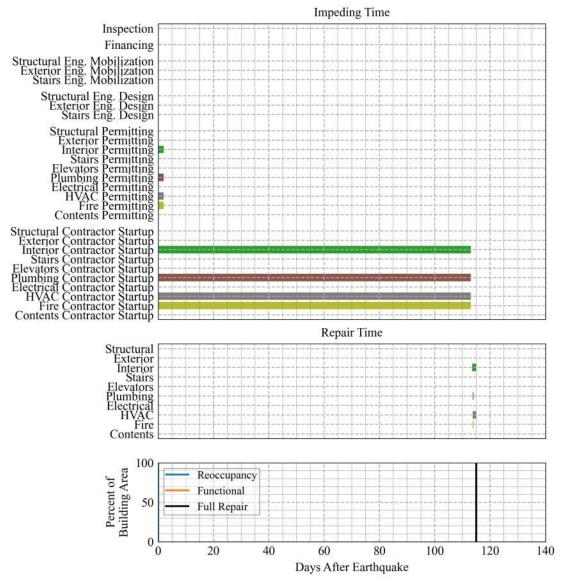


Figure 4.4. 50% in 50 years Percentile = 90



SP3

4.1.3 Damage to Building Systems

Table 4.1 shows the percentage of realizations that the named system prevents reoccupancy/function for the 50% in 50 years intensity. Note that if a system prevents reoccupancy, it will also prevent functionality. This means that the functionality checks may all be fine, but if the reoccupancy checks indicate the building is not reoccupiable then the building will not be considered functional.

Each column represents a milestone time after the earthquake and the values in that column indicate the percentage of realizations in which that component is preventing reoccupancy/functionality at that milestone.

	Immediate	>3 days	>7 days	>14 days	>1 month	>6 months	>12 months
Building Reoccupancy (also affects fu	nction)					
Red Tag (Structural)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hazardous Material	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fire Egress	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Entry Door Access	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Falling hazard	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Entry Door Racking	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Stairs	19	19	19	19	19	0.9	0.0
Stairway Doors	5.0	5.0	5.0	5.0	4.6	0.2	0.0
Exterior	1.2	1.1	0.6	0.2	0.0	0.0	0.0
Interior	25	23	14	7.4	5.8	0.2	0.0
Building Function (affect	ets function on	ly, not reocc	cupancy)				
Elevators	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Exterior	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Interior	14	13	8.4	6.4	5.7	0.2	0.0
Water	32	32	32	31	27	0.7	0.0
Electrical	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HVAC	18	18	18	17	16	0.7	0.0

Table 4.1. Percent of realizations affecting building reoccupancy/function per system - 50% in 50 years

4.1.4 Damage to Individual Components

Table 4.2 shows the percentage of realizations that a specific component prevents reoccupancy/function for the 50% in 50 years intensity. Note that if a component prevents reoccupancy, it will also prevent functionality.

Each column represents a milestone time after the earthquake and the values in that column indicate the percentage of realizations in which that component is preventing reoccupancy/functionality at that milestone.

	Immediate	>3 days	>7 days	>14 days	>1 month	>6 months	>12 months
B1044.011	0.0 / 0.2	0.0 / 0.2	0.0 / 0.2	0.0 / 0.2	0.0 / 0.2	0.0 / 0.0	0.0 / 0.0
B1071.002	0.3 / 0.3	0.3 / 0.2	0.1 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
B2011.401	1.2 / 3.1	1.1 / 2.5	0.6 / 0.4	0.2 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
C1011.211a	0.0 / 7.5	0.0 / 6.8	0.0 / 1.9	0.0 / 0.1	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
C1011.311a	0.0 / 7.8	0.0 / 7.0	0.0 / 2.1	0.0 / 0.1	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
C2011.041b	15 / 0.0	15 / 0.0	15 / 0.0	15 / 0.0	15 / 0.0	0.8 / 0.0	0.0 / 0.0
C3032.001a	9.0 / 3.2	7.2 / 2.8	2.4 / 1.1	0.2 / 0.2	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
C3032.001b	12 / 3.8	8.6 / 3.1	3.5 / 1.6	0.4 / 0.3	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
C3032.001c	17 / 5.2	14 / 4.2	4.7 / 2.1	0.5 / 0.4	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
C3032.001d	20 / 5.7	16 / 5.1	4.9 / 2.0	0.5 / 0.3	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
C3034.001	25 / 10	23 / 9.4	10 / 3.8	1.7 / 0.8	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D1014.022	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D2021.013a	0.5 / 0.5	0.5 / 0.5	0.5 / 0.5	0.5 / 0.5	0.5 / 0.5	0.0 / 0.0	0.0 / 0.0
D2021.013b	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D2021.023a	0.5 / 0.5	0.5 / 0.5	0.5 / 0.5	0.5 / 0.5	0.5 / 0.5	0.0 / 0.0	0.0 / 0.0
D2021.023b	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D2031.022a	0.0 / 31	0.0 / 31	0.0 / 31	0.0 / 30	0.0 / 25	0.0 / 0.7	0.0 / 0.0
D2031.022b	0.0 / 5.2	0.0 / 5.2	0.0 / 5.2	0.0 / 5.1	0.0 / 4.8	0.0 / 0.1	0.0 / 0.0
D3032.011a	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D3041.011b	4.6 / 5.1	2.2 / 5.1	0.0 / 5.1	0.0 / 5.0	0.0 / 4.9	0.0 / 0.1	0.0 / 0.0
D3041.012b	4.5 / 5.2	2.1 / 5.2	0.1 / 5.2	0.0 / 5.1	0.0 / 4.8	0.0 / 0.2	0.0 / 0.0
D3041.032b	13 / 15	13 / 15	9.2 / 15	4.4 / 15	3.2 / 13	0.1 / 0.6	0.0 / 0.0
D3041.101a	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D4011.022a	6.1 / 6.1	6.1 / 6.1	6.1 / 6.1	6.0 / 6.0	5.4 / 5.4	0.2 / 0.2	0.0 / 0.0

Table 4.2. Percent of realizations affecting building reoccupancy/functionality per component - 50% in 50 years





4.2 10% in 50 years Intensity

4.2.1 Selected Realizations for 50th percentile

Note that this is a single realization and may not be representative of a general trend. This selected realization is intended to give a sense of what the repair schedule may look like, it is not intended to generalize what the "typical" repair schedule looks like.

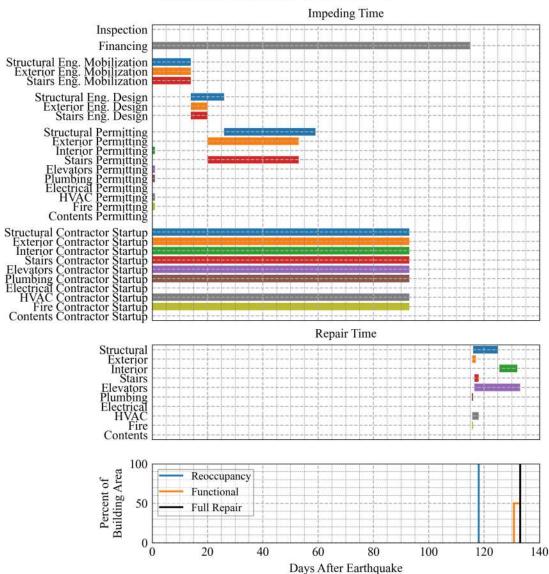


Figure 4.5. 10% in 50 years Percentile = 50



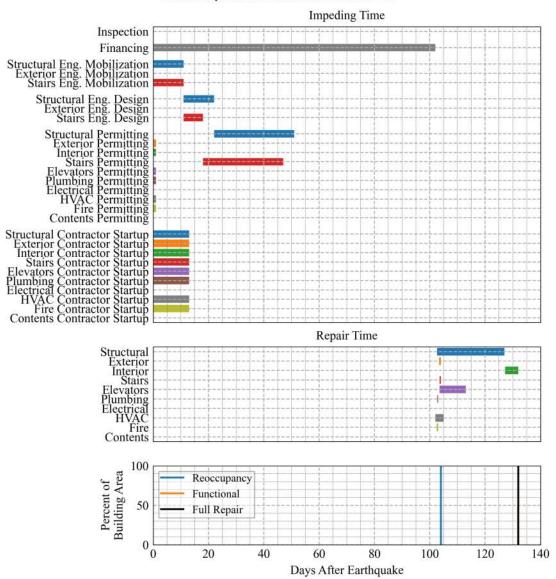


Figure 4.6. 10% in 50 years Percentile = 49



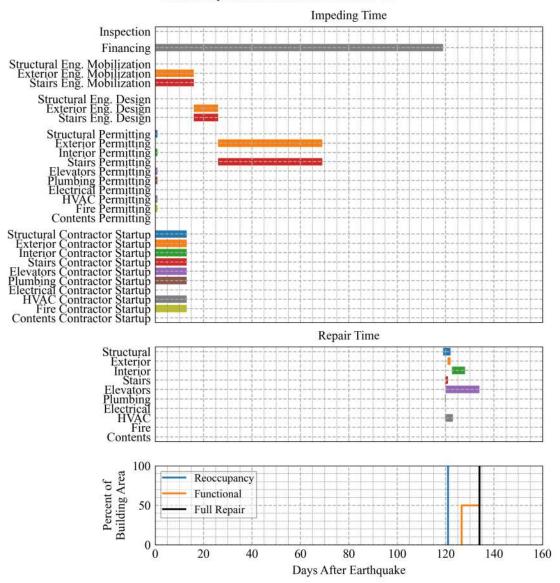


Figure 4.7. 10% in 50 years Percentile = 51

4.2.2 Selected Realizations for 90th percentile

Note that this is a single realization and may not be representative of a general trend. This selected realization is intended to give a sense of what the repair schedule may look like, it is not intended to generalize what the "typical" repair schedule looks like.

This particular realization (10% in 50 years Percentile = 90) resulted in global failure, no scheduling was computed.



sP3

4.2.3 Damage to Building Systems

Table 4.3 shows the percentage of realizations that the named system prevents reoccupancy/function for the 10% in 50 years intensity. Note that if a system prevents reoccupancy, it will also prevent functionality. This means that the functionality checks may all be fine, but if the reoccupancy checks indicate the building is not reoccupiable then the building will not be considered functional.

Each column represents a milestone time after the earthquake and the values in that column indicate the percentage of realizations in which that component is preventing reoccupancy/functionality at that milestone.

	Immediate	>3 days	>7 days	>14 days	>1 month	>6 months	>12 months
Building Reoccupancy (also affects fu	nction)					
Red Tag (Structural)	26	26	0.0	0.0	0.0	0.0	0.0
Hazardous Material	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fire Egress	26	0.0	0.0	0.0	0.0	0.0	0.0
Entry Door Access	83	0.0	0.0	0.0	0.0	0.0	0.0
Falling hazard	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Entry Door Racking	83	0.0	0.0	0.0	0.0	0.0	0.0
Stairs	70	70	70	70	70	2.8	0.0
Stairway Doors	70	25	25	25	24	0.6	0.0
Exterior	51	50	33	8.3	0.0	0.0	0.0
Interior	66	65	53	38	34	0.8	0.0
Building Function (affect	ets function on	ly, not reoco	cupancy)				
Elevators	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Exterior	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Interior	71	67	45	35	33	1.0	0.0
Water	64	64	64	64	62	1.3	0.0
Electrical	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HVAC	59	59	59	59	59	5.0	0.0

Table 4.3. Percent of realizations affecting building reoccupancy/function per system - 10% in 50 years

4.2.4 Damage to Individual Components

Table 4.4 shows the percentage of realizations that a specific component prevents reoccupancy/function for the 10% in 50 years intensity. Note that if a component prevents reoccupancy, it will also prevent functionality.

Each column represents a milestone time after the earthquake and the values in that column indicate the percentage of realizations in which that component is preventing reoccupancy/functionality at that milestone.

	Immediate	>3 days	>7 days	>14 days	>1 month	>6 months	>12 months
B1044.011	0.0 / 16	0.0 / 15	0.0 / 9.6	0.0 / 6.4	0.0 / 5.7	0.0 / 0.4	0.0 / 0.0
B1071.002	39 / 39	36 / 34	17 / 8.7	3.6 / 1.2	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
B2011.401	51 / 59	47 / 52	25 / 14	5.1 / 1.4	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
C1011.211a	0.0 / <mark>68</mark>	0.0 / <mark>62</mark>	0.0 / 23	0.0 / 2.8	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
C1011.311a	0.0 / <mark>69</mark>	0.0 / <mark>63</mark>	0.0 / 24	0.0 / 3.8	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
C2011.041b	<mark>68</mark> / 0.0	2.8 / 0.0	0.0 / 0.0				
C3032.001a	49 / 38	43 / 33	19 / 13	3.4 / 2.9	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
C3032.001b	52 / 41	46 / 35	21 / 15	3.8 / 3.3	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
C3032.001c	60 / 48	54 / 42	24 / 17	3.6 / 3.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
C3032.001d	63 / 53	57 / 45	27 / 18	4.7 / 3.9	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
C3034.001	66 / 69	62 / 62	31 / 21	5.6 / 3.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D1014.022	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D2021.013a	9.6 / 9.6	9.6 / 9.6	9.6 / 9.6	9.6 / 9.6	9.4 / 9.4	0.2 / 0.2	0.0 / 0.0
D2021.013b	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D2021.023a	10 / 10	10 / 10	10 / 10	10 / 10	10.0 / 10.0	0.3 / 0.3	0.0 / 0.0
D2021.023b	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D2031.022a	0.0 / 62	0.0 / <mark>62</mark>	0.0 / <mark>62</mark>	0.0 / 62	0.0 / <mark>60</mark>	0.0 / 1.2	0.0 / 0.0
D2031.022b	0.0 / 33	0.0 / 33	0.0 / 33	0.0 / 33	0.0 / 32	0.0 / 0.8	0.0 / 0.0
D3032.011a	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D3041.011b	33 / 33	16 / 33	1.6 / 33	0.0 / 33	0.0 / 33	0.0 / 3.2	0.0 / 0.0
D3041.012b	33 / 33	16 / 33	1.8 / <mark>33</mark>	0.0 / 33	0.0 / 33	0.0 / 0.6	0.0 / 0.0
D3041.032b	53 / 54	52 / 54	46 / 54	32 / 54	28 / 54	0.7 / 4.8	0.0 / 0.0
D3041.101a	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D4011.022a	32 / 32	32 / 32	32 / 32	32 / 32	31 / 31	0.7 / 0.7	0.0 / 0.0

Table 4.4. Percent of realizations affecting building reoccupancy/functionality per component - 10% in 50 years

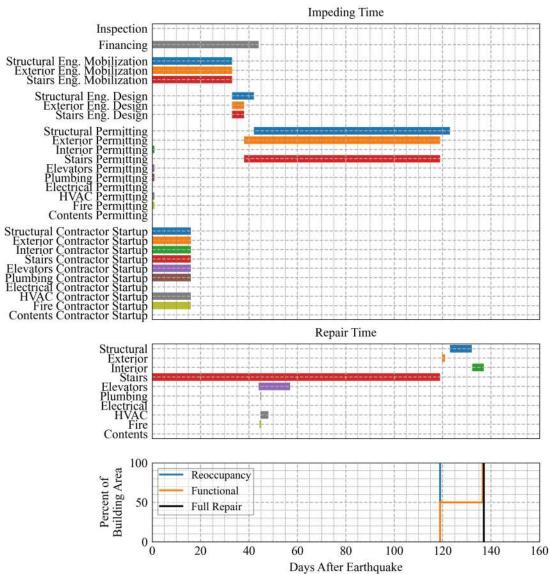




4.3 DE Intensity

4.3.1 Selected Realizations for 50th percentile

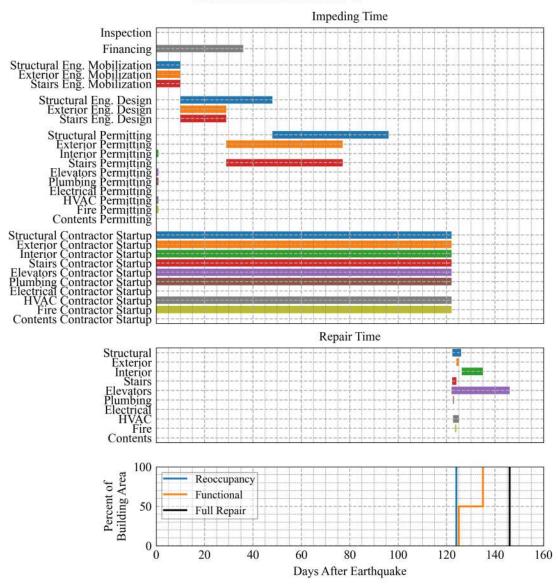
Note that this is a single realization and may not be representative of a general trend. This selected realization is intended to give a sense of what the repair schedule may look like, it is not intended to generalize what the "typical" repair schedule looks like.



DE: Realization for Percentile=50

Figure 4.8. DE Percentile = 50

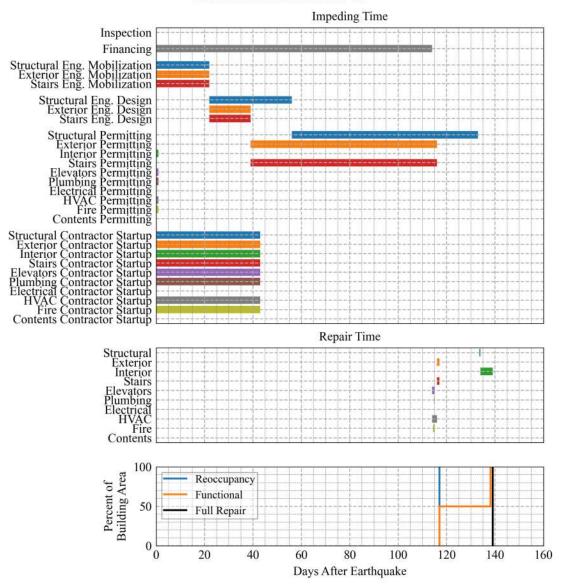




DE: Realization for Percentile=49

Figure 4.9. DE Percentile = 49





DE: Realization for Percentile=51

Figure 4.10. DE Percentile = 51

4.3.2 Selected Realizations for 90th percentile

Note that this is a single realization and may not be representative of a general trend. This selected realization is intended to give a sense of what the repair schedule may look like, it is not intended to generalize what the "typical" repair schedule looks like.

This particular realization (DE Percentile = 90) resulted in global failure, no scheduling was computed.



4.3.3 Damage to Building Systems

Table 4.5 shows the percentage of realizations that the named system prevents reoccupancy/function for the DE intensity. Note that if a system prevents reoccupancy, it will also prevent functionality. This means that the functionality checks may all be fine, but if the reoccupancy checks indicate the building is not reoccupiable then the building will not be considered functional.

Each column represents a milestone time after the earthquake and the values in that column indicate the percentage of realizations in which that component is preventing reoccupancy/functionality at that milestone.

	Immediate	>3 days	>7 days	>14 days	>1 month	>6 months	>12 months
Building Reoccupancy	(also affects fu	nction)					
Red Tag (Structural)	28	28	0.0	0.0	0.0	0.0	0.0
Hazardous Material	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fire Egress	27	0.0	0.0	0.0	0.0	0.0	0.0
Entry Door Access	83	0.0	0.0	0.0	0.0	0.0	0.0
Falling hazard	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Entry Door Racking	83	0.0	0.0	0.0	0.0	0.0	0.0
Stairs	67	67	67	67	67	3.3	0.0
Stairway Doors	68	27	27	27	26	0.8	0.0
Exterior	49	48	32	7.2	0.0	0.0	0.0
Interior	64	63	53	39	35	1.1	0.0
Building Function (affe	ets function on	ly, not reocc	cupancy)				
Elevators	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Exterior	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Interior	69	65	46	36	35	1.2	0.0
Water	62	62	62	62	60	1.6	0.0
Electrical	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HVAC	57	57	57	57	57	5.0	0.0

Table 4.5. Percent of realizations affecting building reoccupancy/function per system - DE



4.3.4 Damage to Individual Components

Table 4.6 shows the percentage of realizations that a specific component prevents reoccupancy/function for the DE intensity. Note that if a component prevents reoccupancy, it will also prevent functionality.

Each column represents a milestone time after the earthquake and the values in that column indicate the percentage of realizations in which that component is preventing reoccupancy/functionality at that milestone.

	Immediate	>3 days	>7 days	>14 days	>1 month	>6 months	>12 months
B1044.011	0.0 / 15	0.0 / 15	0.0 / 10	0.0 / 6.2	0.0 / 5.5	0.0 / 0.4	0.0 / 0.0
B1071.002	37 / 37	35 / 33	17 / 9.4	3.0 / 1.1	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
B2011.401	49 / 57	46 / 50	24 / 15	4.8 / 2.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
C1011.211a	0.0 / 65	0.0 / <mark>60</mark>	0.0 / 24	0.0 / 3.5	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
C1011.311a	0.0 / <mark>66</mark>	0.0 / <mark>60</mark>	0.0 / 25	0.0 / 3.6	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
C2011.041b	<mark>64</mark> / 0.0	3.2 / 0.0	0.0 / 0.0				
C3032.001a	49 / 39	43 / 34	20 / 15	2.9 / 2.4	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
C3032.001b	53 / 42	47 / 36	23 / 17	3.9 / 3.2	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
C3032.001c	59 / 48	53 / 41	24 / 17	3.8 / 3.3	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
C3032.001d	61 / 53	54 / 44	24 / 18	3.4 / 3.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
C3034.001	64 / 67	59 / 59	31 / 24	6.8 / 4.6	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D1014.022	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D2021.013a	8.7 / 8.7	8.7 / 8.7	8.7 / 8.7	8.7 / 8.7	8.4 / 8.4	0.2 / 0.2	0.0 / 0.0
D2021.013b	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D2021.023a	9.5 / 9.5	9.5 / 9.5	9.5 / 9.5	9.5 / 9.5	9.2 / 9.2	0.1 / 0.1	0.0 / 0.0
D2021.023b	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D2031.022a	0.0 / <mark>60</mark>	0.0 / <mark>60</mark>	0.0 / <mark>60</mark>	0.0 / <mark>60</mark>	0.0 / 58	0.0 / 1.6	0.0 / 0.0
D2031.022b	0.0 / 32	0.0 / 32	0.0 / 32	0.0 / 32	0.0 / 31	0.0 / 0.8	0.0 / 0.0
D3032.011a	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D3041.011b	32 / 33	17 / 33	1.8 / 33	0.0 / 33	0.0 / 33	0.0 / 3.1	0.0 / 0.0
D3041.012b	32 / 32	15 / 32	1.9 / 32	0.0 / 32	0.0 / 32	0.0 / 0.6	0.0 / 0.0
D3041.032b	53 / 54	52 / 54	46 / 54	33 / 54	29 / 54	0.8 / 4.8	0.0 / 0.0
D3041.101a	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D4011.022a	34 / 34	34 / 34	34 / 34	34 / 34	33 / 33	1.1 / 1.1	0.0 / 0.0

Table 4.6. Percent of realizations affecting building reoccupancy/functionality per component - DE





4.4 MCE $_R$ Intensity

4.4.1 Selected Realizations for 50th percentile

Note that this is a single realization and may not be representative of a general trend. This selected realization is intended to give a sense of what the repair schedule may look like, it is not intended to generalize what the "typical" repair schedule looks like.

This particular realization (MCE_R Percentile = 50) resulted in global failure, no scheduling was computed.



This particular realization (MCE_R Percentile = 49) resulted in global failure, no scheduling was computed.



This particular realization (MCE_R Percentile = 51) resulted in global failure, no scheduling was computed.

4.4.2 Selected Realizations for 90th percentile

Note that this is a single realization and may not be representative of a general trend. This selected realization is intended to give a sense of what the repair schedule may look like, it is not intended to generalize what the "typical" repair schedule looks like.

This particular realization (MCE_R Percentile = 90) resulted in global failure, no scheduling was computed.



4.4.3 Damage to Building Systems

Table 4.7 shows the percentage of realizations that the named system prevents reoccupancy/function for the MCE_R intensity. Note that if a system prevents reoccupancy, it will also prevent functionality. This means that the functionality checks may all be fine, but if the reoccupancy checks indicate the building is not reoccupiable then the building will not be considered functional.

Each column represents a milestone time after the earthquake and the values in that column indicate the percentage of realizations in which that component is preventing reoccupancy/functionality at that milestone.

	Immediate	>3 days	>7 days	>14 days	>1 month	>6 months	>12 months
Building Reoccupancy (also affects function)							
Red Tag (Structural)	92	92	0.0	0.0	0.0	0.0	0.0
Hazardous Material	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fire Egress	2.8	0.0	0.0	0.0	0.0	0.0	0.0
Entry Door Access	97	0.0	0.0	0.0	0.0	0.0	0.0
Falling hazard	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Entry Door Racking	97	0.0	0.0	0.0	0.0	0.0	0.0
Stairs	7.2	7.2	7.2	7.2	7.2	0.3	0.0
Stairway Doors	7.4	2.7	2.7	2.7	2.6	0.0	0.0
Exterior	6.1	6.0	3.6	1.0	0.0	0.0	0.0
Interior	6.6	6.5	5.4	4.0	3.5	0.0	0.0
Building Function (affects function only, not reoccupancy)							
Elevators	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Exterior	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Interior	7.4	7.1	4.8	3.6	3.3	0.0	0.0
Water	6.4	6.4	6.4	6.4	6.2	0.1	0.0
Electrical	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HVAC	5.9	5.9	5.9	5.9	5.9	0.4	0.0

Table 4.7. Percent of realizations affecting building reoccupancy/function per system - MCE_R



4.4.4 Damage to Individual Components

Table 4.8 shows the percentage of realizations that a specific component prevents reoccupancy/function for the MCE_R intensity. Note that if a component prevents reoccupancy, it will also prevent functionality. Each column represents a milestone time after the earthquake and the values in that column indicate the percentage of realizations in which that component is preventing reoccupancy/functionality at that milestone.

	Immediate	>3 days	>7 days	>14 days	>1 month	>6 months	>12 months
B1044.011	0.0 / 1.6	0.0 / 1.6	0.0 / 1.0	0.0 / 0.7	0.0 / 0.7	0.0 / 0.0	0.0 / 0.0
B1071.002	4.9 / 5.0	4.6 / 4.3	2.2 / 1.2	0.5 / 0.2	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
B2011.401	6.1 / 6.7	5.7 / 5.9	2.6 / 1.4	0.6 / 0.2	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
C1011.211a	0.0 / 7.4	0.0 / 6.8	0.0 / 2.3	0.0 / 0.4	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
C1011.311a	0.0 / 7.4	0.0 / 6.7	0.0 / 2.4	0.0 / 0.2	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
C2011.041b	7.0 / 0.0	7.0 / 0.0	7.0 / 0.0	7.0 / 0.0	7.0 / 0.0	0.3 / 0.0	0.0 / 0.0
C3032.001a	4.9 / 4.4	4.1 / 3.4	2.1 / 1.4	0.3 / 0.2	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
C3032.001b	5.4 / 4.7	4.8 / 4.0	2.5 / 2.0	0.5 / 0.4	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
C3032.001c	5.9 / 5.3	5.4 / 4.5	2.5 / 1.8	0.4 / 0.3	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
C3032.001d	6.3 / 5.8	5.7 / 5.1	2.5 / 1.9	0.5 / 0.4	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
C3034.001	6.6 / 7.2	6.2 / 6.5	3.2 / 2.2	0.5 / 0.2	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D1014.022	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D2021.013a	1.1 / 1.1	1.1 / 1.1	1.1 / 1.1	1.1 / 1.1	1.0 / 1.0	0.0 / 0.0	0.0 / 0.0
D2021.013b	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D2021.023a	1.2 / 1.2	1.2 / 1.2	1.2 / 1.2	1.2 / 1.2	1.2 / 1.2	0.0 / 0.0	0.0 / 0.0
D2021.023b	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D2031.022a	0.0 / 6.4	0.0 / 6.4	0.0 / 6.4	0.0 / 6.4	0.0 / 6.2	0.0 / 0.1	0.0 / 0.0
D2031.022b	0.0 / 3.2	0.0 / 3.2	0.0 / 3.2	0.0 / 3.2	0.0 / 3.1	0.0 / 0.0	0.0 / 0.0
D3032.011a	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D3041.011b	3.4 / 3.4	1.9 / 3.4	0.3 / 3.4	0.0 / 3.4	0.0 / 3.4	0.0 / 0.2	0.0 / 0.0
D3041.012b	3.7 / 3.7	1.7 / 3.7	0.2 / 3.7	0.0 / 3.7	0.0 / 3.6	0.0 / 0.0	0.0 / 0.0
D3041.032b	5.3 / 5.4	5.3 / 5.4	4.6 / 5.4	3.6 / 5.4	3.1 / 5.4	0.0 / 0.4	0.0 / 0.0
D3041.101a	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D4011.022a	3.3 / 3.3	3.3 / 3.3	3.3 / 3.3	3.3 / 3.3	3.2 / 3.2	0.0 / 0.0	0.0 / 0.0

Table 4.8. Percent of realizations affecting building reoccupancy/functionality per component - MCE_R





4.5 2% in 50 years Intensity

4.5.1 Selected Realizations for 50th percentile

Note that this is a single realization and may not be representative of a general trend. This selected realization is intended to give a sense of what the repair schedule may look like, it is not intended to generalize what the "typical" repair schedule looks like.

This particular realization (2% in 50 years Percentile = 50) resulted in global failure, no scheduling was computed.



This particular realization (2% in 50 years Percentile = 49) resulted in global failure, no scheduling was computed.



This particular realization (2% in 50 years Percentile = 51) resulted in global failure, no scheduling was computed.

4.5.2 Selected Realizations for 90th percentile

Note that this is a single realization and may not be representative of a general trend. This selected realization is intended to give a sense of what the repair schedule may look like, it is not intended to generalize what the "typical" repair schedule looks like.

This particular realization (2% in 50 years Percentile = 90) resulted in global failure, no scheduling was computed.



4.5.3 Damage to Building Systems

Table 4.9 shows the percentage of realizations that the named system prevents reoccupancy/function for the 2% in 50 years intensity. Note that if a system prevents reoccupancy, it will also prevent functionality. This means that the functionality checks may all be fine, but if the reoccupancy checks indicate the building is not reoccupiable then the building will not be considered functional.

Each column represents a milestone time after the earthquake and the values in that column indicate the percentage of realizations in which that component is preventing reoccupancy/functionality at that milestone.

-	Immediate	>3 days	>7 days	>14 days	>1 month	>6 months	>12 months
Building Reoccupancy	(also affects fu	nction)					
Red Tag (Structural)	99	99	0.0	0.0	0.0	0.0	0.0
Hazardous Material	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fire Egress	0.4	0.0	0.0	0.0	0.0	0.0	0.0
Entry Door Access	99	0.0	0.0	0.0	0.0	0.0	0.0
Falling hazard	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Entry Door Racking	99	0.0	0.0	0.0	0.0	0.0	0.0
Stairs	1.2	1.2	1.2	1.2	1.2	0.0	0.0
Stairway Doors	1.2	0.4	0.4	0.4	0.4	0.0	0.0
Exterior	1.0	0.9	0.6	0.1	0.0	0.0	0.0
Interior	1.1	1.1	0.9	0.6	0.5	0.0	0.0
Building Function (affe	cts function on	ly, not reocc	upancy)				
Elevators	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Exterior	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Interior	1.2	1.1	0.8	0.6	0.5	0.0	0.0
Water	1.0	1.0	1.0	1.0	0.9	0.0	0.0
Electrical	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HVAC	0.9	0.9	0.9	0.9	0.9	0.0	0.0

Table 4.9. Percent of realizations affecting building reoccupancy/function per system - 2% in 50 years



4.5.4 Damage to Individual Components

Table 4.10 shows the percentage of realizations that a specific component prevents reoccupancy/function for the 2% in 50 years intensity. Note that if a component prevents reoccupancy, it will also prevent functionality.

Each column represents a milestone time after the earthquake and the values in that column indicate the percentage of realizations in which that component is preventing reoccupancy/functionality at that milestone.

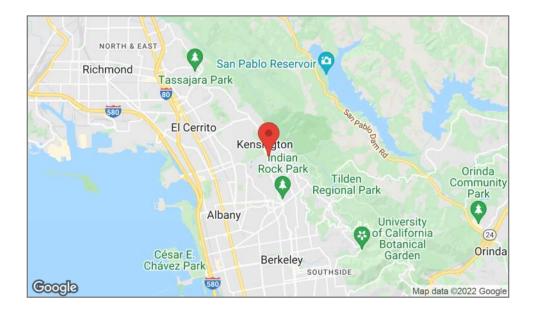
	Immediate	>3 days	>7 days	>14 days	>1 month	>6 months	>12 months
B1044.011	0.0 / 0.4	0.0 / 0.4	0.0 / 0.2	0.0 / 0.2	0.0 / 0.1	0.0 / 0.0	0.0 / 0.0
B1071.002	0.6 / 0.6	0.6 / 0.6	0.3 / 0.1	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
B2011.401	1.0 / 1.1	0.8 / 0.9	0.5 / 0.2	0.1 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
C1011.211a	0.0 / 1.2	0.0 / 1.0	0.0 / 0.3	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
C1011.311a	0.0 / 1.2	0.0 / 1.0	0.0 / 0.4	0.0 / 0.1	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
C2011.041b	1.1 / 0.0	1.1 / 0.0	1.1 / 0.0	1.1 / 0.0	1.1 / 0.0	0.0 / 0.0	0.0 / 0.0
C3032.001a	0.6 / 0.6	0.6 / 0.5	0.3 / 0.2	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
C3032.001b	0.8 / 0.7	0.6 / 0.5	0.1 / 0.1	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
C3032.001c	1.0 / 0.8	0.8 / 0.6	0.4 / 0.3	0.1 / 0.1	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
C3032.001d	1.0 / 0.9	0.9 / 0.8	0.4 / 0.4	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
C3034.001	1.1 / 1.1	1.0 / 1.0	0.4 / 0.2	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D1014.022	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D2021.013a	0.2 / 0.2	0.2 / 0.2	0.2 / 0.2	0.2 / 0.2	0.2 / 0.2	0.0 / 0.0	0.0 / 0.0
D2021.013b	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D2021.023a	0.1 / 0.1	0.1 / 0.1	0.1 / 0.1	0.1 / 0.1	0.1 / 0.1	0.0 / 0.0	0.0 / 0.0
D2021.023b	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D2031.022a	0.0 / 1.0	0.0 / 1.0	0.0 / 1.0	0.0 / 1.0	0.0 / 0.9	0.0 / 0.0	0.0 / 0.0
D2031.022b	0.0 / 0.4	0.0 / 0.4	0.0 / 0.4	0.0 / 0.4	0.0 / 0.3	0.0 / 0.0	0.0 / 0.0
D3032.011a	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D3041.011b	0.4 / 0.4	0.2 / 0.4	0.0 / 0.4	0.0 / 0.4	0.0 / 0.4	0.0 / 0.0	0.0 / 0.0
D3041.012b	0.4 / 0.4	0.3 / 0.4	0.0 / 0.4	0.0 / 0.4	0.0 / 0.4	0.0 / 0.0	0.0 / 0.0
D3041.032b	0.8 / 0.8	0.8 / 0.8	0.6 / 0.8	0.4 / 0.8	0.4 / 0.8	0.0 / 0.0	0.0 / 0.0
D3041.101a	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D4011.022a	0.5 / 0.5	0.5 / 0.5	0.5 / 0.5	0.5 / 0.5	0.4 / 0.4	0.0 / 0.0	0.0 / 0.0

Table 4.10. Percent of realizations affecting building reoccupancy/functionality per component - 2% in 50 years



SEISMIC RISK ASSESSMENT REPORT Created with the SP3-RiskModel

Detailed Component Report



Report Generated for:

217 Arlington Avenue, Kensington, CA, 94707 Latitude: 37.90622° Longitude: -122.27875°

Report Generated by:

The SP3-RiskModel Software v1.2.0 of the Seismic Performance Prediction Program (SP3)

March 16, 2022







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1 SUMMARY OF INPUTS AND RISK RESULTS

Risk Model Inputs

	Primary		Structural Properties			
Project Name: Model Name:		gton Fire Station g WLF on RC Wall	Allow Components to Affect Structural Properties?		Yes	
Building Types: Dir. 1: WL	E: Ganaral		Mode Shapes Specified?		No	
	Cantilever S	bhear Wall	Directional Properties	Dir. 1	Dir. 2	
Design Code Year: Number of Stories:					-	-
Occupancy: Address:		ercial Office	1^{st} Mode Period (T_1) (s): 2^{nd} Mode Period (T_2) (s):	-	-	
217 Arling Kensingtor	ton Avenue , CA, 94707					
Latitude:	37.9062		Component I	nformation		
Longitude:	-122.27	013	Percent of Building Glazed:	_		
A 11-	lysis Option	c.	Selection Method	Cus	stom	
Include Collapse in Ana Consider Residual Drift	lysis:	Yes Yes	Building	Stability		
Region Cost Multiplier:		_	Median Collapse Capacity:	_		
Date Cost Multiplier: Occupancy Cost Multip	lier:	_	Beta (Dispersion):	-		
Building	Layout Infor	mation	Respo	onses		
Cost per Square Foot: Scale component repair building value?	costs with	– No	Repair Tin	ne Options		
Total Square Feet:		1,738	Repair Time Method	ATC-138 (B	eta)	
Aspect Ratio:		1.95	Factors Delaying Start of Re	epairs		
First Story Height (ft): Upper Story Heights (ft)		13.5 9	Inspection	Yes		
Vertical Irregularity:).	None	Financing	Yes		
Plan Irregularity:		Extreme	Permitting	Yes		
			Engineering Mobilization	Yes		
Frac. of Full Height E	xt. Wood Wa	alls	Contractor Mobilization	Yes		
Dir. 1 Story 1		-	Mitigation Factors			
Dir. 1 Upper Stories		_	Inspector on Retainer	No		
			Engineer on Retainer	No		
C	n on J C - 1 T	formation	Contractor on Retainer	No		
Ground Motio		normation	Funding Source	Private Loan	IS	
Site Class:	С		Cash on Hand	_		
Site Hazard:	SP3 Def	ault	ATC-138 Functional Recove	ry (Beta) Optio	ons	
			Need HVAC for Function	_		
		•	Need Elevator for Function	_		
Build	ing Design I	nfo	Include Surge Demand	-		
Level of Detailing (Dir.	1, 2):	Ordinary, Ordinary				
Drift Limit (Dir. 1, 2):		-, -				
Risk Category:	_	IV				
Seismic Importance Fac	tor I ·					

Component Importance Factor, I_p :

_

_

Seismic Importance Factor, I_e :





Component Checklist

Interior Finishes

- What kind of partition walls does the building have? > Wood Studs
- Does the building have raised access floors
- > No
- Does the building have suspended ceilings?
 - > Yes
 - Are the ceilings laterally supported? > No
- Does the building contain pendant (non-recessed) lighting?
 - > Yes
 - Are the pendant lights seismically rated?
 - > No

Stairs and Elevators

- Does the building have stairs?
 - > Yes
 - What type of stairs are in the building? > *Light Frame*
- Are there elevators in the building?
 - > Yes
 - What type of elevators are in the building?
 - > Hydraulic
 - From which era are the building's elevators?
 - > Pre-1976 California (or pre-1976 California equivalent)

Fire Supression

- Does the building contain a fire sprinkler system?
 - > Yes
 - Does the fire sprinkler system have braced horizontal piping? > *No*
 - Are the fire sprinkler drops OSHPD certified (or equivalent)? > *No*
 - What type of ceiling do the fire drops enter into? > Hard

Piping

- Is the building's water piping OSHPD certified or equivalent? > No
- Is the building's sanitary piping OSHPD certified or equivalent? > No
 - What type of couplings do the pipes have?
 - > Bell and spigot

HVAC

- Is the HVAC cooling/heating equipment seismically anchored?
- > No
- How is the cooling/heating system configured?
 - > Roof Top Units
 - Are the RTUs used for medical purposes (or equivalent)? > No
 - Are the RTUs small or large?
 - > Small
 - Does the building have a control panel?
- > Yes
- Is there an HVAC exhaust system in the building?
 - > Yes
 - Is the HVAC exhaust system seismically anchored?
 - > No



Component Checklist (Continued))

- Does the HVAC distribution system meet OSHPD standards (or similar)?
 - > No
 - Is there any large diameter ducting (6 SqFt+) in the HVAC system? > *Yes*

Electrical

- Does the building have a backup battery/generator system? > *No*
- Which best describes the building's electrical system?
 No significant electrical equipment (rugged)

Concrete

- Are the building's shear walls low rise or slender?
 - > Low Rise (typically <= 40ft building height)
 - What are the boundary conditions of the walls?
 - > No return flanges or boundary columns
 - What is the typical wall thickness?
 - > 8" to 16"
 - What is the typical wall height?

> *Less than 15*'

Expected Loss

	Expected loss in percent of total building value							
Shaking Intensity	Return Period	SEL (%)	SUL (%)					
50% in 50 years	72 Years	7.4	15					
10% in 50 years	475 Years	49	80					
DE	481 Years	50	82					
5% in 50 years	975 Years	89	100					
MCE_R	1277 Years	95	100					
2% in 50 years	2475 Years	99	100					

Expected loss in percent of total building value

Repair Time

	Median repair time summary									
	FEMA P-58 [†]			ATC-138 Functional Recovery (Beta) ^{\ddagger}						
Intensity	Parallel	Series	Re-Occupancy	Functional	Full					
50% in 50 years	2.6 weeks	3.7 weeks	0 days	4 days	2.2 months					
10% in 50 years	4 months	5.3 months	3.9 months	4.4 months	4.5 months					
DE	4.1 months	5.4 months	4.1 months	4.6 months	4.7 months					
5% in 50 years	11 months	11 months	11 months	11 months	11 months					
MCE_R	11 months	11 months	11 months	11 months	11 months					
2% in 50 years	11 months	11 months	11 months	11 months	11 months					

[†] Does *not* include impedance factors

[‡] Does include impedance factors



2 MOST DAMAGED COMPONENTS

Intensity	Component	Damage State	Expected Repair Cost
50% in 50 years	B1044.011	1	\$3,323
10% in 50 years	B1044.011	1	\$33,175
DE	B1044.011	1	\$32,640
5% in 50 years	B1044.011	1	\$7,722
MCE_R	B1044.011	1	\$3,514
2% in 50 years	B1044.011	1	\$685

Table 2.1. Most damaged Structural components at each intensity level.

Table 2.2. Most damaged Non-Structural components at each intensity level.

Intensity	Component	Damage State	Expected Repair Cost
50% in 50 years	D1014.022	1	\$14,674
10% in 50 years	D1014.022	1	\$20,630
DE	D1014.022	1	\$20,309
5% in 50 years	D1014.022	1	\$5,065
MCE_R	D1014.022	1	\$2,087
2% in 50 years	D1014.022	1	\$308

Details of the most damaged components and their damage states:

- **B1044.011**: Rectangular low aspect ratio concrete walls 8"-16" double curtain; with heights of up to 15' DS1: Cracks with maximum widths greater than 0.04 in but less than 0.12 in.
- **D1014.022**: Hydraulic Elevator Applies to most California Installations prior to 1976, most western states installations prior to 1982 and most U.S installations prior to 1998.

DS1a: Damaged controls.

- DS1b: Damaged vane and hoist-way switches, and or bent cab stabilizers, and or damaged car guide shoes.
- DS1c: Damaged entrance and car door, and or flooring damage.
- DS1d: Oil leak in hydraulic line, and or hydraulic tank failure.

3 DETAILED COMPONENT DAMAGE BREAKDOWNS

3.1 Repair Cost

This table shows the expected contribution to repair cost on a per-damage state basis. The header shows the total loss, the loss contribution from collapse, and the loss contribution from residual drift for reference.

The color scale is meant to indicate **relative** performance of components, not absolute performance. A "green" value does not indicate that the value falls in a pre-determined "good" range, just that it performs well compared to other components. Likewise, a "red" value does does not indicate that the value falls in a pre-determined "bad" range, just that it performs worse compared to other components.

	50% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 years
Tot. Loss	45.3k	299k	307k	543k	579k	606k
Collapse	0	61.3k	62.6k	149k	191k	290k
Residual	0	95.5k	106k	359k	373k	313k
B1044.01	1 #1 (B1044.011:	Rectangular low aspec	t ratio concre	te walls 8"-16" doubl	e curtain; wit	h)
DS1	2.75k	16.5k	16k	3.83k	1.75k	267
DS2	136	3.27k	3.32k	823	329	108
DS3	432	13.4k	13.3k	3.07k	1.43k	310
Total	3.32k	33.2k	32.6k	7.72k	3.51k	685
B1071.00	2 #1 (B1071.002:	Light framed wood wa	lls with struc	tural panel sheathing	, gypsum wall	board)
DS1	810	2.1k	2.01k	438	194	43.9
DS2	60.5	1.79k	1.71k	436	166	30.9
DS3	43.6	8.1k	7.69k	2.19k	1.04k	117
Total	914	12k	11.4k	3.06k	1.4k	192
B2011.40	1 #1 (B2011.401:	Exterior Wall - Light f	ramed wood	walls with exterior pa	nelized sheath	ning)
DS1	202	273	268	63.5	30.6	5.66
DS2	103	397	359	83.8	33.7	5.49
DS3	181	3.52k	3.48k	889	407	59.1
Total	486	4.19k	4.11 k	1.04 k	471	70.2
C1011.21	1a #1 (C1011.211	a: Wall Partition - Typ	e: Gypsum w	ith wood studs (both	sides), Full He	eight,)
DS1	2.14k	2.42k	2.37k	554	244	34
DS2	812	1.95k	2.01k	509	191	48.3
DS3	1.72k	10.7k	10.2k	2.7k	1.33k	170
Total	4.68k	15k	14.6 k	3.76 k	1.77k	252
C1011.31	1a #1 (C1011.311	a: Interior of Exterior	Wall - Type:	Gypsum with wood s	tuds (single-si	ded)
DS1	1.69k	2.05k	2.03k	431	207	34.7
DS2	510	1.72k	1.61k	460	202	47.1
DS3	938	6.12k	5.9k	1.52k	707	95.6
Total	3.13k	9.89k	9.53k	2.42k	1.12k	177
C2011.04	1b #1 (C2011.041	b: Light frame stair fr	agility. Appr	oximation as a placeh	older until the	ere is)
DS1	313	235	262	55	26.5	4.86
DS2	356	708	633	141	54.8	7.02
DS3	224	4.02k	3.87k	1.01k	464	74.9
Total	893	4.96k	4.76 k	1.21k	546	86.8
C3032.00	1a #1 (C3032.001	a: Suspended Ceiling,	SDC A,B,C, A	Area (A): A < 250, Ver	rt support onl	y)
DS1	77.1	136	141	29.4	11.6	1.84
DS2	138	501	521	141	64.8	8.95
DS3	518	4.5k	4.34k	1.06k	463	58.6
Total	733	5.14k	5k	1.23k	539	69.4

Table 3.1.1. Expected contribution to repair cost per damage state (Dollars)





5	0% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 year
Tot. Loss	45.3k	299k	307k	543k	579k	606k
Collapse	0	61.3k	62.6k	149k	191k	290k
Residual	0	95.5k	106k	359k	373k	313k
C3032.001b	#1 (C3032.001)	o: Suspended Ceiling,	SDC A,B,C,	Area (A): 250 < A < 1	000, Vert supp	port only)
DS1	123	157	150	35.2	15.8	3.15
DS2	214	507	532	122	58.7	10.7
DS3	685	5.18k	5.13k	1.29k	528	70.6
Total	1.02k	5.84k	5.81k	1.45k	603	84.5
C3032.001c	#1 (C3032.001c	: Suspended Ceiling,	SDC A,B,C, A	Area (A): 1000 < A < 2	2500, Vert sup	port only)
DS1	275	167	165	33.1	19.6	2.75
DS2	311	640	634	119	56.5	13.3
DS3	1.17k	6.34k	6.32k	1.58k	655	78.2
Total	1.76k	7.14k	7.12k	1.73k	732	94.2
	#1 (C3032.001c	I: Suspended Ceiling,	SDC A,B,C,	Area (A): A > 2500, V	ert support or	nly)
DS1	371	151	149	31.6	16.4	1.95
DS2	487	668	635	156	64.5	8.72
DS3	1.49k	7.15k	6.95k	1.66k	758	111
Total	2.35k	7.97k	7.74k	1.84k	839	122
		Independent Pendant				
DS1	2.87k	3.81k	3.7 k	938	350	64.7
		Hydraulic Elevator - A	Applies to mos	st California Installat	ions prior to	
DS1a	323	479	498	101	49	14.8
DS1b	5.7k	8.1k	7.86k	1.9k	837	117
DS1c	7.44k	10.3k	10.3k	2.64k	1.04k	135
DS1d	1.21k	1.75k	1.65k	419	158	41.1
Total	14.7k	20.6k	20.3k	5.07k	2.09k	308
		: Cold or Hot Potable				
DS1	2.56	15.8	15.3	3.95	1.65	0.13
DS2	2.45	48.4	42.7	16.8	5.35	1.1
Total	5.01	64.2	58	20.7	7	1.23
		o: Cold or Hot Potable				
DS1	11.8	49	51.4	12.6	5.17	0.62
		: Cold or Hot Potable		-		
DS1		11.6		3.26		0.22
DS2	2.12	41.6	38.9	11.2	5.2	0.46
Total	4.29	53.2	51.2	14.5	6.53	0.68
		o: Cold or Hot Potable	-			
DS1	4.82	12.8	11.6	3.3	1.47	0.2
DS2	2.32	16.6	16.6	4	2.02	0.29
Total	7.14	29.4	28.2	7.31	3.49	0.49
		a: Sanitary Waste Pipi	-			
DS1	171	449	433	111	45.7	7.34
		o: Sanitary Waste Pipi	0			
DS1	16.8	28.9	29.6	6.39	2.94	0.58
DS2	32.3	256	238	63.4	24.2	2.94
Total	49.1	285	268	69.8	27.2	3.52



5	50% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 years
Tot. Loss	45.3k	299k	307k	543k	579k	606k
Collapse	0	61.3k	62.6k	149k	191k	290k
Residual	0	95.5k	106k	359k	373k	313k
D3032.011a	n #1 (D3032.011a	a: Compressor - Cap	acity: Small no	on medical air supply	- Unanchored	equipment)
DS1a	544	424	431	88.8	48.9	8.4
DS1b	1.91k	1.55k	1.44k	372	138	20.4
Total	2.46k	1.98k	1.87k	460	187	28.8
D3041.011b	o #1 (D3041.011)	o: HVAC Galvanized	Sheet Metal D	oucting less than 6 sq.	ft in cross sec	tional)
DS1	8.88	22.2	23.6	5.17	2.05	0.27
DS2	34.3	281	264	73	30.1	3.76
Total	43.2	303	288	78.1	32.2	4.03
D3041.012b	o #1 (D3041.012)	o: HVAC Galvanized	Sheet Metal D	oucting - 6 sq. ft cross	sectional area	u or)
DS1	3.26	8.91	8.56	2.09	0.76	0.13
DS2	11.5	91.7	89	22.8	10.2	1.17
Total	14.8	101	97.6	24.9	11	1.3
D3041.032b	o #1 (D3041.032)	o: HVAC Drops / Dif	fusers without	ceilings - supported b	y ducting only	/ - No)
DS1	761	3.5k	3.44k	869	362	52.9
D3041.101a	a #1 (D3041.101a	a: HVAC Fan - Capa	city: all - Unan	chored equipment the	at is not vibra	tion)
DS1	4.88k	5.6k	5.42k	1.28k	571	88.5
D4011.022a	a #1 (D4011.022a	a: Fire Sprinkler Wa	ter Piping - Ho	rizontal Mains and B	ranches - Old	Style)
DS1	29.1	62.2	57	15.1	6.11	1.48
DS2	46.3	288	294	71.6	31.2	4.07
Total	75.5	350	351	86.8	37.3	5.55

Table 3.1.1 (*Continued*). Expected contribution to repair cost per damage state (Dollars)

3.2 Repair time

This table shows the expected worker days on a per-damage state basis. The header shows the probability of global failures (collapse and residual drift demolition) for reference.

The color scale is meant to indicate **relative** performance of components, not absolute performance. A "green" value does not indicate that the value falls in a pre-determined "good" range, just that it performs well compared to other components. Likewise, a "red" value does does not indicate that the value falls in a pre-determined "bad" range, just that it performs worse compared to other components.

	50% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 years
P[Col](%)	0.0	10	10	24	31	48
P[Res](%)	0.0	16	17	59	61	51
B1044.01	l #1 (B1044.011:]	Rectangular low asp	ect ratio concre	ete walls 8"-16" doubl	e curtain; wit	h)
DS1	1.5	9.0	8.8	2.1	0.9	0.2
DS2	0.1	1.8	1.9	0.5	0.2	0.1
DS3	0.2	7.6	7.6	1.6	0.8	0.1
Total	1.8	18	18	4.3	1.9	0.3
B1071.002	2 #1 (B1071.002: 1	Light framed wood v	valls with struc	tural panel sheathing	, gypsum wall	board)
DS1	0.6	1.5	1.4	0.3	0.1	0.0
DS2	0.0	1.2	1.2	0.3	0.1	0.0
DS3	0.0	5.6	5.4	1.6	0.7	0.1
Total	0.6	8.3	8.1	2.2	1.0	0.1
B2011.40	l #1 (B2011.401:]	Exterior Wall - Light	t framed wood	walls with exterior pa	nelized sheath	ning)
DS1	0.4	0.6	0.6	0.1	0.1	0.0
DS2	0.1	0.5	0.4	0.1	0.0	0.0
DS3	0.2	3.3	3.2	0.8	0.4	0.1
Total	0.7	4.4	4.3	1.1	0.5	0.1
C1011.21	1a #1 (C1011.211a	a: Wall Partition - Ty	pe: Gypsum w	ith wood studs (both	sides), Full He	eight,)
DS1	1.2	1.4	1.3	0.3	0.1	0.0
DS2	0.4	1.1	1.1	0.3	0.1	0.0
DS3	1.0	5.9	5.7	1.5	0.8	0.1
Total	2.6	8.4	8.2	2.1	1.0	0.1
C1011.31	1a #1 (C1011.311;	a: Interior of Exterio	or Wall - Type:	Gypsum with wood s	tuds (single-si	ded)
DS1	1.0	1.2	1.1	0.3	0.1	0.0
DS2	0.3	0.9	0.9	0.2	0.1	0.0
DS3	0.5	3.5	3.3	0.9	0.4	0.1
Total	1.8	5.5	5.4	1.4	0.6	0.1
C2011.04	1b #1 (C2011.041)	b: Light frame stair	fragility. Appr	oximation as a placeh	older until the	ere is)
DS1	0.3	0.2	0.2	0.0	0.0	0.0
DS2	0.3	0.6	0.5	0.1	0.1	0.0
DS3	0.2	3.2	3.1	0.8	0.4	0.1
Total	0.7	3.9	3.8	0.9	0.4	0.1
C3032.00	1a #1 (C3032.001:	a: Suspended Ceiling	sDC A.B.C.	Area (A): A < 250, Ve	rt support onl	v)
DS1	0.1	0.1	0.1	0.0	0.0	0.0
DS2	0.1	0.4	0.4	0.1	0.0	0.0
DS3	0.3	3.0	3.0	0.8	0.3	0.0
Total	0.5	3.5	3.5	0.9	0.4	0.1

Table 3.2.1	Expected	worker dave	nor domogo	state (Worker	Dave)
Table 5.2.1.	Expected	worker days	per uamage	state (worker	Days)

Continued on next page

SP3



	50% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 year
P[Col](%)	0.0	10	10	24	31	48
P[Res](%)	0.0	16	17	59	61	51
C3032.001	lb #1 (C3032.001h	: Suspended Ceiling,	SDC A.B.C.	Area (A): 250 < A < 1	000, Vert supp	oort only)
DS1	0.1	0.1	0.1	0.0	0.0	0.0
DS2	0.1	0.3	0.3	0.1	0.0	0.0
DS3	0.4	3.4	3.3	0.8	0.3	0.1
Total	0.7	3.8	3.8	0.9	0.4	0.1
C3032.001	lc #1 (C3032.001c	: Suspended Ceiling,	SDC A.B.C.	Area (A): 1000 < A < 2	2500, Vert sup	port only)
DS1	0.2	0.1	0.1	0.0	0.0	0.0
DS2	0.2	0.4	0.4	0.1	0.0	0.0
DS3	0.8	4.0	4.1	1.0	0.4	0.1
Total	1.1	4.5	4.6	1.1	0.5	0.1
				Area (A): A > 2500, V		
DS1	0.2	0.1	о.1	0.0	0.0	0.0
DS1 DS2	0.2	0.1	0.1	0.0	0.0	0.0
DS2 DS3	0.5	0.4 4.4	0.4 4.2	0.1	0.0	0.0
DS5 Total	1.5	4.4 4.9	4.2 4.7	1.0 1.1	0.5 0.5	0.1 0.1
					0.5	0.1
	1 #1 (C3034.001: 1 2.0	Independent Pendant 2.8		n seismic) 0.6	0.3	0.0
DS1			2.7			
		-		st California Installat	-	
DS1a	0.2	0.4	0.3	0.1	0.0	0.0
DS1b	4.2	5.7	5.8	1.4	0.6	0.1
DS1c	5.5	7.4	7.6	1.9	0.7	0.1
DS1d	0.9 11	1.3 15	1.2 15	0.3 3.6	0.1 1.5	0.0 0.3
Total						
				neter Threaded Steel		
DS1	0.0	0.0	0.0	0.0	0.0	0.0
DS2 Tatal	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0
Total						
				neter Threaded Steel		
DS1	0.0	0.0	0.0	0.0	0.0	0.0
			-	g (dia > 2.5 inches), Sl		
DS1	0.0	0.0	0.0	0.0	0.0	0.0
DS2	0.0	0.0	0.0	0.0	0.0	0.0
Total	0.0	0.0	0.0	0.0	0.0	0.0
	,		-	ng (dia > 2.5 inches), S		,
DS1	0.0	0.0	0.0	0.0	0.0	0.0
DS2	0.0	0.0	0.0	0.0	0.0	0.0
Total	0.0	0.0	0.0	0.0	0.0	0.0
D2031.022	2a #1 (D2031.022a	: Sanitary Waste Pipi	ng - Cast Iro	n w/bell and spigot co	uplings, SDC	C,)
DS1	0.1	0.3	0.3	0.1	0.0	0.0
D2031.022	2b #1 (D2031.022b	: Sanitary Waste Pipi	ing - Cast Iro	n w/bell and spigot co	ouplings, SDC	C,)
DS1	0.0	0.0	0.0	0.0	0.0	0.0
DS2	0.0	0.2	0.2	0.0	0.0	0.0
Total	0.0	0.2	0.2	0.0	0.0	0.0
D3032.011	la #1 (D3032.011a	: Compressor - Canad	city: Small n	on medical air supply	- Unanchored	equipment)
DS1a	0.5	0.4	0.4	0.1	0.0	0.0
DS1b	0.3	0.2	0.2	0.1	0.0	0.0
Total	0.8	0.6	0.6	0.1	0.1	0.0



5	50% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 years
P[Col](%)	0.0	10	10	24	31	48
P[Res](%)	0.0	16	17	59	61	51
D3041.011b	o #1 (D3041.011)	b: HVAC Galvanized	Sheet Metal I	Ducting less than 6 sq.	ft in cross sec	tional)
DS1	0.0	0.0	0.0	0.0	0.0	0.0
DS2	0.0	0.1	0.1	0.0	0.0	0.0
Total	0.0	0.1	0.1	0.0	0.0	0.0
D3041.012b	o #1 (D3041.012)	b: HVAC Galvanized	Sheet Metal I	Ducting - 6 sq. ft cross	sectional area	1 or)
DS1	0.0	0.0	0.0	0.0	0.0	0.0
DS2	0.0	0.0	0.0	0.0	0.0	0.0
Total	0.0	0.0	0.0	0.0	0.0	0.0
D3041.032b) #1 (D3041.032)	b: HVAC Drops / Dif	fusers without	ceilings - supported b	y ducting only	y - No)
DS1	0.6	3.0	2.9	0.7	0.3	0.0
D3041.101a	a #1 (D3041.101a	a: HVAC Fan - Capa	city: all - Unar	chored equipment the	at is not vibra	tion)
DS1	4.2	4.7	4.6	1.1	0.5	0.1
D4011.022a	a #1 (D4011.022a	a: Fire Sprinkler Wa	ter Piping - Ho	orizontal Mains and B	ranches - Old	Style)
DS1	0.0	0.0	0.0	0.0	0.0	0.0
DS2	0.0	0.1	0.1	0.0	0.0	0.0
Total	0.0	0.1	0.1	0.0	0.0	0.0

3.3 Casualties

Table 3.3.1 shows the total expected casualty results broken into collapse and non-collapse sources. The non-parenthetical values are casualties in terms of number of people and the parenthetical values show the probability of casualty for an individual person placed randomly in the building.

Table 3.3.2 shows the casualty breakdown on a per component basis. The values in this table are in terms of number of people, not probabilities.

The color scale is meant to indicate **relative** performance of components, not absolute performance. A "green" value does not indicate that the value falls in a pre-determined "good" range, just that it performs well compared to other components. Likewise, a "red" value does does not indicate that the value falls in a pre-determined "bad" range, just that it performs worse compared to other components.

	50% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 years
Total Nor	-Collapse Casualt	ies				
Injury	0.0548	0.158	0.157	0.149	0.139	0.116
mjurj	(3.23)	(9.31)	(9.24)	(8.76)	(8.16)	(6.85)
Death	0.000431	0.000748	0.000742	0.000642	0.000586	0.000485
Doum	(0.025)	(0.044)	(0.044)	(0.038)	(0.035)	(0.029)
Total Col	lapse Casualties					
Injury	0.00	0.0555	0.0567	0.135	0.173	0.263
mjarj	(0.00)	(3.27)	(3.34)	(7.96)	(10.2)	(15.5)
Death	0.00	0.000561	0.000573	0.00136	0.00175	0.00266
Douili	(0.00)	(0.033)	(0.034)	(0.080)	(0.103)	(0.157)
Total Col	apse and Non-Col	llapse Casualties				
Injury	0.0548	0.198	0.197	0.247	0.268	0.324
mjarj	(3.23)	(11.7)	(11.6)	(14.6)	(15.8)	(19.1)
Death	0.000431	0.00123	0.00124	0.00185	0.00215	0.00291
Douin	(0.025)	(0.073)	(0.073)	(0.109)	(0.127)	(0.171)

Table 3.3.1.	Total ex	pected	casualties (Number	of People (%))
14010 5.5.11	rotur on	peetea	cubuunteo .	(1 tunnoor	

Table 3.3.2. Expected casualties per component (Number of People)

	50% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 years
C3032.00	1a #1 (C3032.001a	: Suspended Ceiling	g, SDC A,B,C, A	rea (A): A < 250, Ve	rt support only	r)
Injury	0.00148	0.0168	0.0164	0.0169	0.0167	0.0147
Death	0.00	0.00	0.00	0.00	0.00	0.00
C3032.00	1b #1 (C3032.001h	: Suspended Ceiling	g, SDC A,B,C, A	rea (A): 250 < A < 1	000, Vert supp	ort only)
Injury	0.00173	0.0203	0.0204	0.0199	0.0190	0.0190
Death	0.00	0.00	0.00	0.00	0.00	0.00
C3032.00	1c #1 (C3032.001c	: Suspended Ceiling	, SDC A,B,C, A	rea (A): 1000 < A < 2	2500, Vert supp	port only)
Injury	0.00284	0.0220	0.0212	0.0215	0.0204	0.0169
Death	0.00	0.00	0.00	0.00	0.00	0.00
C3032.00	1d #1 (C3032.001d	I: Suspended Ceiling	g, SDC A,B,C, A	rea (A): A > 2500, V	/ert support on	ly)
Injury	0.00440	0.0242	0.0245	0.0248	0.0226	0.0194
Death	0.00	0.00	0.00	0.00	0.00	0.00
C3034.00	1 #1 (C3034.001:]	Independent Pendan	t Lighting - non	seismic)		
Injury	0.0443	0.0742	0.0738	0.0651	0.0594	0.0458
Death	0.000431	0.000748	0.000742	0.000642	0.000586	0.000485



	50% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 years
D3041.01	1b #1 (D3041.011b	: HVAC Galvanized	Sheet Metal Du	icting less than 6 sq.	ft in cross sect	ional)
Injury	0.000003	0.000032	0.000028	0.000032	0.000033	0.000027
Death	0.00	0.00	0.00	0.00	0.00	0.00
D3041.01	2b #1 (D3041.012b	: HVAC Galvanized	Sheet Metal Du	icting - 6 sq. ft cross	s sectional area	or)
Injury	0.000005	0.000053	0.000053	0.000054	0.000055	0.000051
Death	0.00	0.00	0.00	0.00	0.00	0.00
D3041.03	2b #1 (D3041.032b	: HVAC Drops / Diff	users without c	eilings - supported l	by ducting only	- No)
Injury	0.000073	0.000445	0.000438	0.000425	0.000397	0.000334
Death	0.00	0.00	0.00	0.00	0.00	0.00

3.4 Quantity Damaged

This table shows the expected percentage of the components that are in a given damage state (normalized to the total quantity of that component in the entire building). The small parenthetical value is the probability that any component throughout the building is in that damage state (the percentage of realizations that have a component in that damage state).

All of these values are conditioned on no global failure. The header shows the probability of global failures (collapse and residual drift demolition) for reference.

The color scale is meant to indicate **relative** performance of components, not absolute performance. A "green" value does not indicate that the value falls in a pre-determined "good" range, just that it performs well compared to other components. Likewise, a "red" value does does not indicate that the value falls in a pre-determined "bad" range, just that it performs worse compared to other components.

	50% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 years
P[Col](%)	0.0	10	10	24	31	48
P[Res](%)	0.0	16	17	59	61	51
B1044.01	1 #1 (B1044.011:]	Rectangular low aspec	ct ratio concre	te walls 8"-16" doubl	e curtain; wit	h)
DS1	3.9 (13)	36 (76)	36 (76)	38 (78)	36 (77)	35 (86)
DS2	0.1 (0.5)	3.3 (15)	3.4 (16)	3.7 (16)	3.1 (16)	6.1 (26)
DS3	0.2 (0.7)	7.1 (23)	7.3 (23)	7.1 (21)	7.5 (22)	10 (30)
Total	4.2 (13)	46 (78)	47 (78)	48 (80)	47 (79)	52 (89)
B1071.002	2 #1 (B1071.002: 1	Light framed wood wa	alls with struct	ural panel sheathing	, gypsum wall	board)
DS1	3.0 (19)	11 (59)	11 (58)	11 (57)	9.9 (54)	15 (69)
DS2	0.2 (1.2)	7.5 (43)	7.5 (42)	8.5 (47)	7.2 (41)	8.4 (46)
DS3	0.1 (0.3)	14 (53)	14 (52)	17 (65)	17 (65)	12 (53)
Total	3.3 (19)	32 (96)	32 (95)	36 (99)	35 (98)	35 (99)
B2011.40	1 #1 (B2011.401:]	Exterior Wall - Light	framed wood v	walls with exterior pa	nelized sheath	ning)
DS1	5.5 (33)	11 (65)	12 (66)	13 (69)	14 (67)	17 (82)
DS2	1.3 (9.6)	7.5 (50)	6.9 (46)	7.3 (48)	6.6 (43)	7.3 (49)
DS3	0.7 (5.2)	22 (82)	22 (82)	25 (89)	26 (89)	23 (92)
Total	7.5 (37)	41 (99)	40 (99)	45 (100)	46 (100)	47 (99)
C1011.21	1a #1 (C1011.211a	a: Wall Partition - Typ	oe: Gypsum w	ith wood studs (both :	sides), Full He	eight,)
DS1	27 (79)	42 (89)	43 (88)	44 (90)	43 (93)	40 (89)
DS2	4.6 (25)	16 (52)	17 (53)	18 (57)	16 (49)	26 (63)
DS3	3.1 (17)	26 (94)	26 (94)	30 (98)	32 (98)	26 (95)
Total	35 (97)	85 (100)	86 (100)	92 (100)	92 (100)	93 (99)
C1011.31	1a #1 (C1011.311a	a: Interior of Exterior	· Wall - Type: (Gypsum with wood st	tuds (single-si	ded)
DS1	29 (77)	48 (88)	48 (89)	47 (88)	49 (88)	48 (92)
DS2	3.4 (25)	16 (52)	16 (52)	20 (58)	19 (57)	23 (66)
DS3	1.9 (17)	18 (95)	18 (94)	20 (98)	20 (97)	18 (99)
Total	34 (97)	82 (100)	82 (100)	88 (100)	88 (100)	89 (99)
C2011.04	1b #1 (C2011.041)	b: Light frame stair fi	ragility. Appro	eximation as a placeh	older until the	ere is)
DS1	22 (43)	23 (42)	25 (44)	25 (47)	25 (47)	25 (49)
DS2	6.2 (12)	17 (32)	16 (29)	16 (29)	13 (26)	9.9 (20)
DS3	1.4 (2.8)	32 (63)	32 (64)	35 (70)	37 (73)	38 (72)
Total	30 (57)	73 (100)	73 (100)	75 (100)	75 (100)	72 (99)
C3032.00	1a #1 (C3032.001a	a: Suspended Ceiling,	SDC A,B,C, A	Area (A): A < 250, Ver	rt support onl	y)
DS1	8.1 (15)	19 (34)	20 (36)	19 (33)	17 (30)	15 (30)
DS2	2.1 (4.1)	9.6 (18)	10 (20)	10 (20)	11 (21)	9.9 (20)
DS3	3.3 (5.9)	40 (56)	40 (57)	43 (57)	41 (54)	35 (43)
Total	14 (22)	69 (83)	71 (86)	73 (88)	70 (81)	59 (76)

Table 3.4.1. Expected percentage of damaged components (% of total qty. (% of realizations))



	50% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 year
P[Col](%)	0.0	10	10	24	31	48
P[Res](%)	0.0	16	17	59	61	51
C3032.00)16 #1 (C3032 001)	: Suspended Ceiling	SDC A B C	Area (A): 250 < A < 1	000 Vert sunr	ort only)
DS1	12 (22)	23 (39)	22 (39)	20 (37)	23 (38)	25 (46)
DS2	2.9 (5.4)	9.4 (18)	9.7 (18)	8.5 (16)	9.4 (18)	12 (23)
DS3	4.4 (7.8)	45 (62)	47 (64)	51 (70)	46 (63)	39 (53)
Total	20 (31)	78 (90)	79 (91)	80 (92)	79 (88)	76 (86)
C3032.00)1c #1 (C3032.001c	: Suspended Ceiling,	SDC A,B,C, A	rea (A): 1000 < A < 2	2500, Vert sup	port only)
DS1	29 (48)	24 (39)	24 (40)	21 (34)	26 (41)	26 (49)
DS2	4.5 (8.6)	12 (22)	12 (22)	11 (21)	11 (21)	20 (36)
DS3	7.6 (13)	56 (74)	58 (75)	61 (77)	57 (72)	44 (59)
Total	41 (58)	92 (97)	93 (99)	94 (99)	93 (98)	90 (99)
C3032.00	1d #1 (C3032.001d	I: Suspended Ceiling,	SDC A,B,C, A	Area (A): A > 2500, V	ert support or	ıly)
DS1	40 (61)	22 (36)	22 (36)	20 (34)	22 (34)	21 (36)
DS2	6.7 (13)	12 (21)	12 (22)	13 (22)	11 (19)	15 (26)
DS3	9.9 (16)	63 (80)	63 (79)	65 (81)	64 (77)	58 (72)
Total	57 (73)	96 (99)	97 (99)	97 (100)	97 (99)	94 (99)
C3034.00	1 #1 (C3034.001:]	Independent Pendant	Lighting - nor	n seismic)		
DS1	52 (83)	93 (100)	94 (100)	95 (100)	94 (99)	92 (99)
D1014.02	2 #1 (D1014.022:]	Hydraulic Elevator - A	Applies to mos	t California Installat	ions prior to)
DS1a	15 (15)	30 (30)	29 (29)	27 (27)	29 (29)	39 (39)
DS1b	25 (25)	48 (48)	48 (48)	50 (50)	48 (48)	43 (43)
DS1c	22 (22)	41 (41)	42 (42)	46 (46)	40 (40)	36 (36)
DS1d	19 (19)	36 (36)	36 (36)	39 (39)	31 (31)	53 (53)
Total	81 (45)	160 (85) *	150 (86) *	160 (87) *	150 (85) *	170 (82) *
*Percent o	f total quantity above	100 is caused by simultan	eous damage stat	es		
	3a #1 (D2021.013a	: Cold or Hot Potable	e - Small Diam	eter Threaded Steel	- (2.5 inches in	
DS1	2.5 (4.6)	22 (37)	22 (37)	21 (36)	24 (40)	12 (23)
DS2	0.3 (0.5)	7.3 (13)	6.5 (12)	11 (19)	8.4 (14)	9.9 (16)
Total	2.7 (5.0)	29 (45)	28 (44)	33 (48)	32 (48)	21 (36)
D2021.01	3b #1 (D2021.013h	: Cold or Hot Potabl	e - Small Dian	neter Threaded Steel	- (2.5 inches ir	1)
DS1	9.0 (16)	52 (71)	54 (73)	57 (75)	53 (70)	44 (66)
D2021.02	3a #1 (D2021.023a	: Cold or Hot Potable	e Water Piping	g (dia > 2.5 inches), S	DC D,E,F, PIF	PING)
DS1	2.8 (5.3)	21 (37)	22 (37)	22 (38)	24 (40)	23 (36)
DS2	0.3 (0.5)	7.7 (14)	7.3 (13)	9.4 (17)	9.4 (16)	4.9 (9.9)
Total	3.1 (5.6)	29 (45)	29 (45)	32 (47)	33 (48)	28 (36)
D2021.02	3b #1 (D2021.023h	: Cold or Hot Potabl	e Water Piping	g (dia > 2.5 inches), S	DC D,E,F, BR	ACING)
DS1	6.0 (11)	23 (40)	22 (39)	25 (43)	22 (40)	20 (26)
DS2	2.8 (5.2)	28 (44)	31 (49)	32 (47)	33 (50)	28 (36)
Total	8.8 (16)	51 (71)	53 (73)	57 (73)	55 (72)	48 (63)
D2031.02	2a #1 (D2031.022a	: Sanitary Waste Pip	ing - Cast Iron	w/bell and spigot co	uplings, SDC	C,)
DS1	19 (31)	65 (83)	65 (83)	69 (88)	66 (84)	61 (79)
D2031.02	2b #1 (D2031.022b	: Sanitary Waste Pip	ing - Cast Iroi	n w/bell and spigot co	ouplings, SDC	C,)
DS1	15 (26)	36 (58)	37 (60)	39 (62)	38 (61)	43 (66)
DS2	2.8 (5.2)	28 (44)	27 (44)	30 (47)	26 (42)	18 (30)
	18 (29)	64 (82)	65 (83)	69 (86)	64 (82)	61 (79)



Table 3.4.1 (Continued). Expected percentage of damaged components (% of total qty. (% of realizations))

	50% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 years
P[Col](%)	0.0	10	10	24	31	48
P[Res](%)	0.0	16	17	59	61	51
D3032.011	la #1 (D3032.011a	a: Compressor - Capa	city: Small nor	n medical air supply	- Unanchored	equipment)
DS1a	47 (47)	50 (50)	52 (52)	46 (46)	55 (55)	59 (59)
DS1b	47 (47)	50 (50)	48 (48)	54 (54)	45 (45)	39 (39)
Total	94 (94)	100 (100)	100 (100)	100 (100) *	100 (100)	99 (99)
*Percent of	total quantity above	100 is caused by simultan	eous damage state	es		
D3041.011	lb #1 (D3041.011)	b: HVAC Galvanized	Sheet Metal Du	cting less than 6 sq.	ft in cross sec	tional)
DS1	6.8 (13)	22 (40)	25 (43)	24 (42)	21 (38)	20 (39)
DS2	2.7 (5.1)	30 (45)	29 (45)	34 (53)	31 (44)	25 (36)
Total	9.5 (17)	52 (71)	54 (72)	58 (78)	52 (70)	44 (66)
D3041.012	2b #1 (D3041.012)	b: HVAC Galvanized	Sheet Metal Du	icting - 6 sq. ft cross	sectional area	or)
DS1	6.3 (11)	24 (41)	23 (41)	24 (42)	20 (36)	21 (39)
DS2	2.7 (5.2)	29 (45)	29 (44)	33 (48)	32 (49)	23 (33)
Total	9.0 (16)	53 (72)	52 (70)	56 (74)	52 (70)	44 (66)
D3041.032	2b #1 (D3041.032)	b: HVAC Drops / Diff	users without c	eilings - supported b	y ducting only	- No)
DS1	8.4 (15)	53 (73)	53 (74)	59 (77)	54 (71)	44 (66)
D3041.101	la #1 (D3041.101a	a: HVAC Fan - Capac	ity: all - Unanc	hored equipment the	at is not vibrat	ion)
DS1	62 (80)	97 (100)	97 (100)	98 (100)	98 (100)	95 (99)
D4011.022	2a #1 (D4011.022a	a: Fire Sprinkler Wat	er Piping - Hoi	izontal Mains and B	ranches - Old	Style)
DS1	15 (27)	42 (66)	42 (66)	46 (71)	44 (66)	43 (66)
DS2	3.3 (6.1)	27 (43)	29 (46)	30 (49)	28 (43)	25 (39)
Total	19 (31)	70 (86)	72 (87)	76 (91)	72 (87)	67 (79)

4 COMPONENT DAMAGEABILITY AND COST OVERVIEW

This section provides an overview of key component parameters for loss assessment. The components are broken into groups such that the specified component modifiers are applied to all components in the given table.

Some notes on the columns are as follows:

- **DS: Median (Unit Repair Cost Range)**: This presents median EDP for each damage state as well as the associated repair cost range to repair one unit of the component (varies based on quantity).
- Max Repair Potential: This is the cost to completely replace this component throughout the building assuming the most expensive damage state for all components (includes volume discounting). The number in parenthesis is the value as a percentage of building replacement value. Note that this does not need to add up to the total building replacement value, but rather gives a sense of how much potential the component has to contribute to the mean loss when it is damaged.

Component	Description	DS: Median (Unit Repair Cost Range)	Max Repair Potential
B1044.011	Rectangular low aspect ratio concrete walls 8"-16" double curtain; with heights of up to 15'	EDPPeak Interstory DriftDS1:0.0055(\$7,151 - \$10,516)DS2:0.0109(\$18,456 - \$27,141)DS3:0.013(\$34,471 - \$50,692)	(41.8%)
B1071.002	Light framed wood walls with structural panel sheathing, gypsum wallboard and hold-downs	EDP Peak Interstory Drift DS1: 0.015 (\$1,827 - \$2,969) DS2: 0.0262 (\$2,532 - \$3,575) DS3: 0.0369 (\$6,355 - \$8,972)	(9.34%)
		Total:	\$312,343 (51.1%)

Table 4.1. "Structural" component list.

Table 4.2.	"Exterior	Finishes"	component	list.
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Component	Description	DS: Median (Unit Repair Cost Range)	Max Repair Potential
B2011.401	Exterior Wall - Light framed wood walls with exterior panelized sheathing (OSB) and horizontal wood siding, no hold-downs	EDP Peak Interstory Drift DS1: 0.01 (\$175 - \$412) DS2: 0.0175 (\$374 - \$879) DS3: 0.025 (\$1,156 - \$2,721)	(1.70%)
		Total:	\$10,381 (1.70%)

Table 4.3.	"Partition	Walls"	component	list.
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Component	Description	DS: Median (Unit Repair Cost Range)	Max Repair Potential
C1011.211a	Wall Partition - Type: Gypsum with wood studs (both sides), Full Height, Fixed Below, Fixed Above	EDP Peak Interstory Drift DS1: 0.0021 (\$1,598 - \$5,328) DS2: 0.0071 (\$3,428 - \$11,425) DS3: 0.012 (\$11,297 - \$37,656)	(8.76%)





	Table 4.5 (Communed). Tai	tition wans component list.	
Component	Description	DS: Median (Repair Cost Range)	Max Repair Potential
C1011.311a	Interior of Exterior Wall - Type: Gypsum with wood studs (single-sided gypsum), Full Height, Fixed Below, Fixed Above	EDPPeak Interstory DriftDS1:0.0021(\$904 - \$3,015)DS2:0.0071(\$2,223 - \$7,411)DS3:0.012(\$7,151 - \$23,838)	\$44,332 (7.26%)
		Total:	\$97,823 (16.0%)

Table 4.3 (Continued). "Partition Walls" component list.

Component	Description	DS: Median (Unit Repair Cost Range)	Max Repair Potential
C2011.041b	Light frame stair fragility. Approximation as a placeholder until there is more research on the topic. Damage states from P-58 Light frame stair example. Costing approximated from various online sources for stair replacement.	EDPPeak Interstory DriftDS1:0.011(\$487 - \$695)DS2:0.026(\$1,043 - \$2,782)DS3:0.05(\$3,130 - \$8,346)	\$16,692 (2.73%)
D4011.022a	Fire Sprinkler Water Piping - Horizontal Mains and Branches - Old Style Victaulic - Thin Wall Steel - No bracing, SDC C, PIPING FRAGILITY	EDP Peak Floor Acceleration DS1: 1.1 (\$438 - \$536) DS2: 2.4 (\$3,317 - \$4,055)	$(0.25 \ n)$
		Total:	\$18,101 (2.96%)

Table 4.4. "Other Nonstructural" component list.

Table 4.5	"Ceilings"	component list.
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Component	Description	DS: Median (Unit Repair Cost Range)	Max Repair Potential
C3032.001a	Suspended Ceiling, SDC A,B,C, Area (A): A < 250, Vert support only	EDPPeak Floor AccelerationDS1:1.17(\$403 - \$605)DS2:1.58(\$3,157 - \$4,736)DS3:1.82(\$6,496 - \$9,744)	(2.44%)
C3032.001b	Suspended Ceiling, SDC A,B,C, Area (A): 250 < A < 1000, Vert support only	EDPPeak Floor AccelerationDS1:1.01(\$968 - \$1,452)DS2:1.45(\$7,578 - \$11,367)DS3:1.69(\$15,590 - \$23,385)	(2.50%)
C3032.001c	Suspended Ceiling, SDC A,B,C, Area (A): 1000 < A < 2500, Vert support only	EDPPeak Floor AccelerationDS1:0.7(\$2,904 - \$4,357)DS2:1.2(\$22,734 - \$34,101)DS3:1.43(\$46,770 - \$70,155)	(2.50%)
C3032.001d	Suspended Ceiling, SDC A,B,C, Area (A): A > 2500, Vert support only	EDPPeak Floor AccelerationDS1:0.56(\$4,034 - \$6,051)DS2:1.08(\$31,575 - \$47,362)DS3:1.31(\$64,958 - \$97,437)	(2.50%)
		Total:	\$60,646 (9.93%)



Component	Description	DS: Median (Unit Repair Cost Range)	Max Repair Potential
C3034.001	Independent Pendant Lighting - non seismic	EDP Peak Floor Acceleration DS1: 0.6 (\$413 - \$1,377)	\$5,508 (0.90%) \$5,508
		Total:	\$3,508 (0.90%)

Table 4.6. "Lighting" component list.

Component	Description	DS: Median (Unit Repair Cost Range) Max Repair Potential
D1014.022	Hydraulic Elevator - Applies to most California Installations prior to 1976, most western states installations prior to 1982 and most U.S installations prior to 1998.	EDP Peak Floor Acceleration DS1a: 0.3 (\$668 - \$2,226) \$33,383 DS1b: 0.3 (\$6,844 - \$22,812) (5.47%) DS1c: 0.3 (\$10,015 - \$33,383) (5.47%) DS1d: 0.3 (\$1,920 - \$6,398) \$6,398)
		Total: \$33,383 (5.47%)

Table 4.8. "Piping" component list.

Component	Description	DS: Median (Unit Repair Cost Range)	Max Repair Potential
D2021.013a	Cold or Hot Potable - Small Diameter Threaded Steel - (2.5 inches in diameter or less), SDC D, E, or F, PIPING FRAGILITY	EDP Peak Floor Acceleration DS1: 2.25 (\$363 - \$444) DS2: 4.1 (\$3,317 - \$4,055)	\$888 (0.15%)
D2021.013b	Cold or Hot Potable - Small Diameter Threaded Steel - (2.5 inches in diameter or less), SDC D, E, or F, BRACING FRAGILITY	EDP Peak Floor Acceleration DS1: 1.5 (\$476 - \$581)	\$127 (0.02%)
D2021.023a	Cold or Hot Potable Water Piping (dia > 2.5 inches), SDC D,E,F, PIPING FRAGILITY	EDP Peak Floor Acceleration DS1: 2.25 (\$292 - \$974) DS2: 4.1 (\$2,796 - \$9,319)	(0.12.0)
D2021.023b	Cold or Hot Potable Water Piping (dia > 2.5 inches), SDC D,E,F, BRACING FRAGILITY	EDP Peak Floor Acceleration DS1: 1.5 (\$292 - \$974) DS2: 2.25 (\$292 - \$974)	(0.01 /0)
D2031.022a	Sanitary Waste Piping - Cast Iron w/bell and spigot couplings, SDC C, PIPING FRAGILITY	EDP Peak Floor Acceleration DS1: 1.2 (\$2,796 - \$9,319)	\$923 (0.15%)
D2031.022b	Sanitary Waste Piping - Cast Iron w/bell and spigot couplings, SDC C, BRACING FRAGILITY	EDP Peak Floor Acceleration DS1: 1.2 (\$334 - \$1,113) DS2: 2.4 (\$3,630 - \$12,101)	\$1,199 (0.20%)
		Total:	\$3,942 (0.65%)



Component	Description	DS: Median (Unit Repair Cost Range)	Max Repair Potential
D3032.011a	Compressor - Capacity: Small non medical air supply - Unanchored equipment that is not vibration isolated - Equipment fragility only	EDPPeak Floor AccelerationDS1a:0.25(\$939 - \$1,148)DS1b:0.25(\$3,380 - \$4,131)	\$4,131 (0.68%)
D3041.011b	HVAC Galvanized Sheet Metal Ducting less than 6 sq. ft in cross sectional area, SDC C	EDPPeak Floor AccelerationDS1:1.5(\$814 - \$995)DS2:2.25(\$7,949 - \$9,716)	\$1,266 (0.21%)
D3041.012b	HVAC Galvanized Sheet Metal Ducting - 6 sq. ft cross sectional area or greater, SDC C	EDPPeak Floor AccelerationDS1:1.5(\$1,189 - \$1,454)DS2:2.25(\$9,952 - \$12,164)	\$423 (0.07%)
D3041.032b	HVAC Drops / Diffusers without ceilings - supported by ducting only - No independent safety wires, SDC C	EDP Peak Floor Acceleration DS1: 1.5 (\$3,756 - \$4,590)	\$8,763 (1.43%)
D3041.101a	HVAC Fan - Capacity: all - Unanchored equipment that is not vibration isolated - Equipment fragility only	EDPPeak Floor AccelerationDS1:0.5(\$3,317 - \$4,055)	\$7,741 (1.27%)
		Total:	\$22,324 (3.65%)

Table 4.9. "HVAC" component list.

Table 4.10. Summary of component value breakdown (building replacement value = 610,816).

Component Category	Max Repair Potential	% of Building Replacement Value
Structural	\$312,343	51.1%
Exterior Finishes	\$10,381	1.70%
Partition Walls	\$97,823	16.0%
Other Nonstructural	\$18,101	2.96%
Ceilings	\$60,646	9.93%
Lighting	\$5,508	0.90%
Elevators	\$33,383	5.47%
Piping	\$3,942	0.65%
HVAC	\$22,324	3.65%
Total	\$564,452	92.4%

5 COMPONENT QUANTITIES AND MODIFICATION FACTORS

	Ta	ble 5.1. Compone	nt quantity and r	nodification summ	ary.	
Location	Qty. Dir 1	Qty. Dir 2	Qty. ND	Cost Scale	Capacity Scale	Time Scale
B1044.011 (B1	1044.011 #1): Rec	tangular low aspe	ct ratio concrete	walls 8"-16" doubl	e curtain; with he	ights of up to 15'
1	0	7.406	-	1	1	1
B1071.002 (B2 hold-downs	1071.002 #1): Lig	ht framed wood w	alls with structu	ral panel sheathing	, gypsum wallboa	and and
1 2	2.97 1.98	0 4.0275		1 1	1 1	1 1
	2011.401 #1): Ext d siding, no hold-6	•	framed wood wa	alls with exterior pa	anelized sheathing	g (OSB) and
1 2	2.97 1.98	0 4.0275		1 1	1 1	1 1
C1011.211a (O Fixed Above	C1011.211a #1): \	Wall Partition - Ty	pe: Gypsum wit	h wood studs (both	sides), Full Heig	ht, Fixed Below,
1 2	0.265 0.435	0.275 0.5		1 1	1 1	1 1
	C 1011.311a #1): 1 Below, Fixed Abov		r Wall - Type: G	ypsum with wood	studs (single-side	d gypsum), Full
1-2	0.22	0.79	_	1	1	1
stair replaceme	nt. 1	1	-	Costing approximat	0.5	1
	C 3032.001a #1): S	Suspended Ceiling		rea (A): A < 250, 1	Vert support only	1
2-R	_	_	0.7821	1	1	1
C3032.001b (0 2-R	C3032.001b #1): ; _	Suspended Ceiling –	g, SDC A,B,C, A 0.325875	area (A): 250 < A < 1	: 1000, Vert supp 1	ort only 1
	C3032.001c #1): S	Suspended Ceiling		rea (A): 1000 < A	< 2500, Vert supp	ort only
2-R	-	_	0.108625	1	1	1
C3032.001d (2-R	C 3032.001d #1): ; _	Suspended Ceiling –	g, SDC A,B,C, A 0.07821	area (A): A > 2500, 1	, Vert support onl 1	y 1
C3034.001 (C	3034.001 #1): Ind	ependent Pendant	Lighting - non s	eismic		
2-R	-	-	2	1	1	1
	1014.022 #1): Hy ons prior to 1982 a			California Installat 1998.	ions prior to 1976	ó, most western
G	_	-	1	1	1	1
	D2021.013a #1): (, PIPING FRAGII		le - Small Diame	eter Threaded Steel	- (2.5 inches in d	iameter or less),
2-R	, i ii ii to i kaoli –	_	0.109494	1	1	1
	D2021.013b #1): , BRACING FRA		le - Small Diam	eter Threaded Steel	- (2.5 inches in c	liameter or less),
2-R	-	_	0.109494	1	1	1
D2021.023 a (I 2-R	D2021.023a #1): (Cold or Hot Potab	le Water Piping 0.039105	(dia > 2.5 inches),	SDC D,E,F, PIPIN	NG FRAGILITY
∠ - N	-	—	0.039103	1	1	1

Table 5.1. Component quantity and modification summary.





		(Continued). Co		,	summa j.	
Location	Qty. Dir 1	Qty. Dir 2	Qty. ND	Cost Scale	Capacity Scale	Time Scale
D2021.023b (I)2021.023b #1): (Cold or Hot Potab	ble Water Piping	(dia > 2.5 inches),	SDC D,E,F, BRA	ACING
FRAGILITY						
2-R	-	-	0.039105	1	1	1
D2031.022a (I FRAGILITY	D2031.022a #1): S	Sanitary Waste Pi	ping - Cast Iron v	w/bell and spigot c	ouplings, SDC C	, PIPING
2-R	-	-	0.049533	1	1	1
FRAGILITY	D2031.022b #1): S	Sanitary Waste Pi		w/bell and spigot c	ouplings, SDC C	, BRACING
2-R	_	_	0.049533	1	1	1
D3032.011a (I	03032.011a #1): (Compressor - Cap	acity. Small non	medical air supply	- Unanchored ed	minment that is
not vibration is	olated - Equipmen		acity: Sinan non	incurcar an suppry		aipinent that is
not vibration is R			1	1	1	1
R	olated - Equipmen	t fragility only –	1		1	1
R	olated - Equipmen	t fragility only –	1	1	1	1
R D3041.011b (I 2-R	olated - Equipmen - - - - -	t fragility only – HVAC Galvanized	1 d Sheet Metal Du 0.065175	1 Incting less than 6 so 1	1 q. ft in cross secti 1	1 Ional area, SDC C
R D3041.011b (I 2-R	olated - Equipmen - - - - -	t fragility only – HVAC Galvanized	1 d Sheet Metal Du 0.065175	1	1 q. ft in cross secti 1	1 Ional area, SDC C
R D3041.011b (I 2-R D3041.012b (I 2-R	Diated - Equipmen - D3041.011b #1): I - D3041.012b #1): I -	t fragility only - HVAC Galvanized - HVAC Galvanized -	1 d Sheet Metal Du 0.065175 d Sheet Metal Du 0.01738	1 ncting less than 6 so 1	1 q. ft in cross secti 1 ss sectional area 1	1 onal area, SDC (1 or greater, SDC (1
R D3041.011b (I 2-R D3041.012b (I 2-R	Diated - Equipmen - D3041.011b #1): I - D3041.012b #1): I - D3041.032b #1): I	t fragility only - HVAC Galvanized - HVAC Galvanized -	1 d Sheet Metal Du 0.065175 d Sheet Metal Du 0.01738	1 acting less than 6 so 1 acting - 6 sq. ft cro 1	1 q. ft in cross secti 1 ss sectional area 1	1 onal area, SDC (1 or greater, SDC (1
R D3041.011b (I 2-R D3041.012b (I 2-R D3041.032b (I	Diated - Equipmen - D3041.011b #1): I - D3041.012b #1): I - D3041.032b #1): I	t fragility only - HVAC Galvanized - HVAC Galvanized -	1 d Sheet Metal Du 0.065175 d Sheet Metal Du 0.01738	1 acting less than 6 so 1 acting - 6 sq. ft cro 1	1 q. ft in cross secti 1 ss sectional area 1	1 onal area, SDC (1 or greater, SDC (1
R D3041.011b (I 2-R D3041.012b (I 2-R D3041.032b (I safety wires, SI 2-R D3041.101a (I	Diated - Equipmen - D3041.011b #1): I - D3041.012b #1): I - D3041.032b #1): I DC C - D3041.101a #1): F	tt fragility only - HVAC Galvanized - HVAC Galvanized - HVAC Drops / Di -	1 d Sheet Metal Du 0.065175 d Sheet Metal Du 0.01738 ffusers without c 1	1 acting less than 6 so 1 acting - 6 sq. ft cro 1	1 q. ft in cross secti 1 ss sectional area 1 by ducting only 1	1 ional area, SDC (1 or greater, SDC (1 - No independent 1
R D3041.011b (I 2-R D3041.012b (I 2-R D3041.032b (I safety wires, SI 2-R D3041.101a (I Equipment frag	Diated - Equipmen - D3041.011b #1): I - D3041.012b #1): I - D3041.032b #1): I DC C - D3041.101a #1): F	tt fragility only - HVAC Galvanized - HVAC Galvanized - HVAC Drops / Di -	1 d Sheet Metal Du 0.065175 d Sheet Metal Du 0.01738 ffusers without c 1 city: all - Unancl	1 acting less than 6 so 1 acting - 6 sq. ft cro 1 eilings - supported 1 hored equipment th	1 q. ft in cross secti 1 ss sectional area 1 by ducting only 1 at is not vibratio	1 ional area, SDC C 1 or greater, SDC C 1 - No independent 1
R D3041.011b (I 2-R D3041.012b (I 2-R D3041.032b (I safety wires, SI 2-R D3041.101a (I	Diated - Equipmen - D3041.011b #1): I - D3041.012b #1): I - D3041.032b #1): I DC C - D3041.101a #1): F	tt fragility only - HVAC Galvanized - HVAC Galvanized - HVAC Drops / Di -	1 d Sheet Metal Du 0.065175 d Sheet Metal Du 0.01738 ffusers without c 1	1 acting less than 6 so 1 acting - 6 sq. ft cro 1 eilings - supported 1	1 q. ft in cross secti 1 ss sectional area 1 by ducting only 1	1 ional area, SDC C 1 or greater, SDC C 1 - No independent 1
R D3041.011b (I 2-R D3041.012b (I 2-R D3041.032b (I safety wires, SI 2-R D3041.101a (I Equipment frag 2-R D4011.022a (I	olated - Equipmen - - - - - - - - - - - - -	tt fragility only - HVAC Galvanized - HVAC Galvanized - HVAC Drops / Di - HVAC Fan - Capa - - - - - - - - - - - - -	1 d Sheet Metal Du 0.065175 d Sheet Metal Du 0.01738 ffusers without c 1 acity: all - Unancl 1 ter Piping - Horiz	1 acting less than 6 so 1 acting - 6 sq. ft cro 1 eilings - supported 1 hored equipment th	1 q. ft in cross secti 1 ss sectional area 1 by ducting only 1 at is not vibratio 1	1 ional area, SDC C 1 or greater, SDC C 1 - No independent 1 n isolated - 1



6 FRAGILITY INFORMATION

6.1 B1044.011 #1: (B1044.011) Rectangular low aspect ratio concrete walls 8"-16" double curtain; with heights of up to 15'

B1044.011
Andrew Whittaker
144.0 sf
Peak Interstory Drift
3
No
Yes

Component modifications applied:

Component Group	Structural
Quantity Scale Factor	1.0
Damage Median Scale Factor	1.0
Total Cost Scale Factor	1.391
User cost modification factor	1.0
Regional Cost Scale Factor	1
Date multiplier (to convert from 2011 USD)	1.391
Occupancy Cost Scale Factor	1
Building Value Cost Scale Factor	1

Table 6.1.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

Location	Cost	Time	Capacity
1-2	1	1	1



Table 6.1.2.	Damage state	progression.
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Damage State	Description	Repair Description	Image
DS1	Cracks with maximum widths greater than 0.04 in but less than 0.12 in.	Remove furnishings, ceilings and mechanical, electrical and plumping systems (as neces- sary) 5 feet either side of damaged area. Re- place and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plump- ing systems (as necessary).	
DS2	Crushed core concrete; local- ized concrete cracking with widths greater than 0.12 in; buckling of vertical rebar.	(1) Relocate office eqpt & furniture within 6 ft. of wall, both sides. Install protective cov- ers on floor finishes & adjacent curtain wall system. (2) Remove arch. finishes on wall, both sides. (3) Relocate MEP systems within 6 ft. of wall. (4) Prepare & inject grout 330 ft. of crack per 100 ft2 of wall. (5) Remove 15 ft2 per 100 ft2 of wall & 10 1-ft. long sections of #8 buckled vert. rebar. (6) Replace buckled rebar with new rebar, attach to exposed ends of (E) rebar with mech splices; provide 8 #4 seismic ties at 4 in. oc, ea end of wall; re- bend 16 horiz. rebar in wall around new rebar. (7) Install formwork & cast 5ksi concrete into pockets cut in step 5. (8) Strip forms, clean- up, reinstall/return office eqpt., finishes, fur- niture & MEP.	
DS3	Sliding of the wall resulting in large residual displacement; dis- tributed concrete cracking with widths greater than 0.12 in; frac- ture of rebar.	 (1) Relocate eqpt.& furniture within 10 ft. of wall, both sides. Install protection on floor & adjacent walls. (2) Remove wall finishes, both sides. (3) Relocate MEP within 10 ft. of wall. (4) Remove damaged wall in 5-ft.lengths. (5) Install bars: a. 12#9 A706 bars in bz ea. end; mech splices to (E) ; b. #4 A706 dbl sets of seismic ties at 4 in. oc ea bz; c. #4 A706 bar at 6 in. oc, ewef; lap new vert. bars to (E) at top of wall; drill & epoxy bars into wall/fdn at 6 in. oc to match new rebar above. Anchor horiz. Bars in bz with seismic hks or lap 24 in. with (E) horiz. bars. (6) Form wall. Cast 5ksi concrete in 3-ft. lifts; with 1-in. top gap for grout day after casting. (7) Remove forms, clean-up & reinstall/return eqpt, finishes, fur- niture & MEP. 	in the



Table 6.1.3. Parameters for the damage state distributions. The medians reflect a scale factor of **<u>1.0</u>** applied to the default values.

	DS1	DS2	DS3
Туре	Sequential	Sequential	Sequential
Probability	-	-	-
Median	0.0055	0.0109	0.013
β	0.36	0.3	0.36

Table 6.1.4. Parameters for the cost distributions. The cost values reflect a total scale factor of **<u>1.391</u>** applied to the default values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor, building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1	DS2	DS3
Distribution Type	LogNormal	LogNormal	LogNormal
Lower Qty.	3.0	3.0	3.0
Upper Qty.	7.0	7.0	7.0
Highest Cost Median	\$10,516	\$27,141	\$50,692
Lowest Cost Median	\$7,151	\$18,456	\$34,471
β (COV)	0.16	0.13	0.11

Table 6.1.5. Parameters for the repair time distributions.

	DS1	DS2	DS3
Distribution Type	LogNormal	LogNormal	LogNormal
Lower Qty.	3.0	3.0	3.0
Upper Qty.	7.0	7.0	7.0
Highest Median Repair Time (Days)	5.89	15.21	28.4
Lowest Median Repair Time (Days)	4	10.34	19.31
β (COV)	0.29	0.28	0.28

Table 6.1.6. Life safety information.

	DS1	DS2	DS3
Non-collapse casualties Affected Area	No 	No 	No
Serious Injury Median Serious Injury β			
Loss of Life Median Loss of Life β		-	
Can Cause Red Tag Unsafe Placard Median Unsafe Placard β	No _ _	Yes 0.5 0.5	Yes 0.25 0.5

-



NISTIR Classification	B1071.002
Author	Andre Filiatrault
Normalized Unit	100.0 sf
Engineering Demand Parameter	Peak Interstory Drift
Number of Damage States	3
Is correlated?	No
Is directional?	Yes
Component modifications applie	ed:
Component Group	Structural
Quantity Scale Factor	1.0
Damage Median Scale Factor	1.0
Damage Median Scale Factor Total Cost Scale Factor	1.0 1.391
0	

Date multiplier (to convert from 2011 USD)

Occupancy Cost Scale Factor

Building Value Cost Scale Factor

6.2 B1071.002 #1: (B1071.002) Light framed wood walls with structural panel sheathing, gypsum wallboard and holddowns

Table 6.2.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

1

1

1.391

Location	Cost	Time	Capacity
1-2	1	1	1

Table 6.2.2.	Damage state	progression.
--------------	--------------	--------------

Damage State	Description	Repair Description	Image
DS1	Slight separation of sheathing or nails which come loose.	Remove exterior pliable siding, replace loose nails, reinstall siding.	
DS2	Permanent rotation of sheathing, tear out of nails or sheathing.	Remove exterior pliable siding, remove wood sheathing, install new sheathing, reinstall siding.	
DS3	Fracture of studs, major sill plate cracking.	Remove and replace siding, sheathing, studs and plates. Provide shoring as required.	

Table 6.2.3. Parameters for the damage state distributions. The medians reflect a scale factor of **<u>1.0</u>** applied to the default values.

	DS1	DS2	DS3
Туре	Sequential	Sequential	Sequential
Probability	-	-	-
Median	0.015	0.0262	0.0369
β	0.4	0.19	0.2

Table 6.2.4. Parameters for the cost distributions. The cost values reflect a total scale factor of **<u>1.391</u>** applied to the default values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor, building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1	DS2	DS3
Distribution Type	LogNormal	LogNormal	LogNormal
Lower Qty.	3.0	3.0	3.0
Upper Qty.	8.0	8.0	8.0
Highest Cost Median	\$2,969	\$3,575	\$8,972
Lowest Cost Median	\$1,827	\$2,532	\$6,355
β (COV)	0.19	0.22	0.08

Table 6.2.5. Parameters for the repair time distributions.

	DS1	DS2	DS3
Distribution Type	LogNormal	LogNormal	LogNormal
Lower Qty.	3.0	3.0	3.0
Upper Qty.	8.0	8.0	8.0
Highest Median Repair Time (Days)	2.07	2.5	6.26
Lowest Median Repair Time (Days)	1.27	1.77	4.44
β (COV)	0.31	0.33	0.26

Table 6.2.6. Life safety information.

	DS1	DS2	DS3
Non-collapse casualties Affected Area	No 	No 	No
Serious Injury Median Serious Injury β			
Loss of Life Median Loss of Life β			
Can Cause Red Tag Unsafe Placard Median Unsafe Placard β	No 	Yes 0.5 0.5	Yes 0.25 0.5

-

6.3 B2011.401 #1: (B2011.401) Exterior Wall - Light framed wood walls with exterior panelized sheathing (OSB) and horizontal wood siding, no hold-downs

B2011.401
HBRG (exterior only modifications)
100.0 sf
Peak Interstory Drift
3
No
Yes

Component modifications applied:

Component Group	Exterior Finishes
Quantity Scale Factor	1.0
Damage Median Scale Factor	1.0
Total Cost Scale Factor	1.391
User cost modification factor	1.0
Regional Cost Scale Factor	1
Date multiplier (to convert from 2011 USD)	1.391
Occupancy Cost Scale Factor	1
Building Value Cost Scale Factor	1

Table 6.3.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

Location	Cost	Time	Capacity
1-2	1	1	1

Table 6.3.2. Damage state progression.

Damage State	Description	Repair Description	Image
DS1	Slight separation of sheathing or nails which come loose.	Remove exterior pliable siding, replace loose nails, reinstall siding.	
DS2	Permanent rotation of sheathing, tear out of nails or sheathing.	Remove exterior pliable siding, remove wood sheathing, install new sheathing, reinstall siding.	
DS3	Fracture of studs, major sill plate cracking.	Remove and replace siding, sheathing, studs and plates. Provide shoring as required.	



Table 6.3.3. Parameters for the damage state distributions. The medians reflect a scale factor of **<u>1.0</u>** applied to the default values.

	DS1	DS2	DS3
Туре	Sequential	Sequential	Sequential
Probability	-	-	-
Median	0.01	0.0175	0.025
β	0.4	0.4	0.4

Table 6.3.4. Parameters for the cost distributions. The cost values reflect a total scale factor of **<u>1.391</u>** applied to the default values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor, building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1	DS2	DS3
Distribution Type	LogNormal	LogNormal	Normal
Lower Qty.	3.0	3.0	3.0
Upper Qty.	8.0	8.0	8.0
Highest Cost Median	\$412	\$879	\$2,721
Lowest Cost Median	\$175	\$374	\$1,156
β (COV)	0.19	0.22	0.08

Table 6.3.5. Parameters for the repair time distributions.

	DS1	DS2	DS3
Distribution Type	LogNormal	LogNormal	Normal
Lower Qty.	3.0	3.0	3.0
Upper Qty.	8.0	8.0	8.0
Highest Median Repair Time (Days)	0.86	1.08	2.4
Lowest Median Repair Time (Days)	0.53	0.77	1.7
β (COV)	0.31	0.33	0.26

Table 6.3.6. Life safety information.

	DS1	DS2	DS3
Non-collapse casualties Affected Area	No 	No 	No
Serious Injury Median Serious Injury β			-
Loss of Life Median Loss of Life β			
Can Cause Red Tag Unsafe Placard Median Unsafe Placard β	No 	Yes 0.5 0.5	Yes 0.25 0.5

NISTIR Classification Author Normalized Unit Engineering Demand Parameter Number of Damage States Is correlated?	C1011.211a DaveWelch (HBRG) 100.0 lf Peak Interstory Drift 3 No
Is directional?	Yes
Component modifications applie	ed:
Component Group	Partition Walls
Quantity Scale Factor	1.0
Damage Median Scale Factor	1.0
Total Cost Scale Factor	1.391
User cost modification factor	1.0
Regional Cost Scale Factor	1
Date multiplier (to convert from	n 2011 USD) 1.391
Occupancy Cost Scale Factor	1
Building Value Cost Scale Fact	tor 1

6.4 C1011.211a #1: (C1011.211a) Wall Partition - Type: Gypsum with wood studs (both sides), Full Height, Fixed Below, Fixed Above

Table 6.4.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

Location	Cost	Time	Capacity
1-2	1	1	1

Table 6.4.2. Damage state progression.

Damage State	Description	Repair Description	Image
DS1	Cracking of paint over fasteners or joints.	Gypsum wallboard repaired by replacing the tape along the seam of two adjacent panels and local areas with popped fasteners, apply- ing new joint compound, sanding, and repaint- ing.	Not Available
DS2	Local and global buckling out- of-plane and crushing of gyp- sum wallboards. Studs are typ- ically not damaged by failure of the gypsum wallboard.	Replace 25 feet of the affected panel along with the application of new tape, joint com- pound, followed by sanding and repainting. Studs are not damaged.	Not Available
DS3	Local and global buckling out- of-plane and crushing of gyp- sum wallboards. Studs are typ- ically not damaged by failure of the gypsum wallboard, but fram- ing adjustments possible for this damage state.	Replace 100 feet of the affected panel along with the application of new tape, joint com- pound, followed by sanding and repainting. Studs are not damaged.	Not Available



Table 6.4.3. Parameters for the damage state distributions. The medians reflect a scale factor of **<u>1.0</u>** applied to the default values.

	DS1	DS2	DS3
Туре	Sequential	Sequential	Sequential
Probability	-	-	-
Median	0.0021	0.0071	0.012
β	0.6	0.45	0.45

Table 6.4.4. Parameters for the cost distributions. The cost values reflect a total scale factor of **<u>1.391</u>** applied to the default values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor, building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1	DS2	DS3
Distribution Type	Normal	Normal	LogNormal
Lower Qty.	1.0	1.0	1.0
Upper Qty.	10.0	10.0	10.0
Highest Cost Median	\$5,328	\$11,425	\$37,656
Lowest Cost Median	\$1,598	\$3,428	\$11,297
β (COV)	0.42	0.49	0.1

Table 6.4.5. Parameters for the repair time distributions.

	DS1	DS2	DS3
Distribution Type	Normal	Normal	LogNormal
Lower Qty.	1.0	1.0	1.0
Upper Qty.	10.0	10.0	10.0
Highest Median Repair Time (Days)	2.99	6.4	21.1
Lowest Median Repair Time (Days)	0.9	1.92	6.33
β (COV)	0.52	0.55	0.34

Table 6.4.6. Life safety information.

	DS1	DS2	DS3
Non-collapse casualties Affected Area	No 	No 	No
Serious Injury Median Serious Injury β			
Loss of Life Median Loss of Life β		_	
Can Cause Red Tag Unsafe Placard Median Unsafe Placard β	No 	No 	No

6.5 C1011.311a #1: (C1011.311a) Interior of Exterior Wall - Type: Gypsum with wood studs (single-sided gypsum), Full Height, Fixed Below, Fixed Above

NISTIR Classification	C1011.311a
Author	Dave Welch (HBRG)
Normalized Unit	100.0 lf
Engineering Demand Parameter	Peak Interstory Drift
Number of Damage States	3
Is correlated?	No
Is directional?	Yes

Component modifications applied:

Component Group	Partition Walls
Quantity Scale Factor	1.0
Damage Median Scale Factor	1.0
Total Cost Scale Factor	1.391
User cost modification factor	1.0
Regional Cost Scale Factor	1
Date multiplier (to convert from 2011 USD)	1.391
Occupancy Cost Scale Factor	1
Building Value Cost Scale Factor	1

Table 6.5.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

Location	Cost	Time	Capacity
1-2	1	1	1

Table 6.5.2. Damage state progression.

Damage State	Description	Repair Description	Image
DS1	Cracking of paint over fasteners or joints.	Gypsum wallboard repaired by replacing the tape along the seam of two adjacent panels and local areas with popped fasteners, apply- ing new joint compound, sanding, and repaint- ing.	Not Available
DS2	Local and global buckling out- of-plane and crushing of gyp- sum wallboards. Studs are typ- ically not damaged by failure of the gypsum wallboard.	Replace 25 feet of the affected panel along with the application of new tape, joint com- pound, followed by sanding and repainting. Studs are not damaged.	Not Available
DS3	Local and global buckling out- of-plane and crushing of gyp- sum wallboards. Studs are typ- ically not damaged by failure of the gypsum wallboard, but fram- ing adjustments possible for this damage state.	Replace 100 feet of the affected panel along with the application of new tape, joint com- pound, followed by sanding and repainting. Studs are not damaged.	Not Available



	DS1	DS2	DS3
Туре	Sequential	Sequential	Sequential
Probability	-	-	-
Median	0.0021	0.0071	0.012
β	0.6	0.45	0.45

Table 6.5.4. Parameters for the cost distributions. The cost values reflect a total scale factor of **<u>1.391</u>** applied to the default values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor, building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1	DS2	DS3
Distribution Type	Normal	Normal	LogNormal
Lower Qty.	1.0	1.0	1.0
Upper Qty.	10.0	10.0	10.0
Highest Cost Median	\$3,015	\$7,411	\$23,838
Lowest Cost Median	\$904	\$2,223	\$7,151
β (COV)	0.42	0.49	0.1

Table 6.5.5. Parameters for the repair time distributions.

	DS1	DS2	DS3
Distribution Type	Normal	Normal	LogNormal
Lower Qty.	1.0	1.0	1.0
Upper Qty.	10.0	10.0	10.0
Highest Median Repair Time (Days)	1.69	4.15	13.36
Lowest Median Repair Time (Days)	0.51	1.25	4.01
β (COV)	0.52	0.55	0.34

Table 6.5.6. Life safety information.

	DS1	DS2	DS3
Non-collapse casualties Affected Area	No 	No 	No
Serious Injury Median Serious Injury β	_	_	
Loss of Life Median Loss of Life β			-
Can Cause Red Tag Unsafe Placard Median Unsafe Placard β	No 	No 	No



6.6 C2011.041b #1: (C2011.041b) Light frame stair fragility. Approximation as a placeholder until there is more research on the topic. Damage states from P-58 Light frame stair example. Costing approximated from various online sources for stair replacement.

NISTIR Classification Author Normalized Unit Engineering Demand Parameter Number of Damage States Is correlated? Is directional?	C2011.041b HBRG 1.0 each Peak Interstory 3 No Yes	y Drift
Component modifications applie	ed:	
Component Group		Other Nonstructural
Quantity Scale Factor		1.0
Damage Median Scale Factor		1.0
Total Cost Scale Factor		1.391
User cost modification factor		1.0
Regional Cost Scale Factor		1
Date multiplier (to convert from	n 2011 USD)	1.391
Occupancy Cost Scale Factor		1
Building Value Cost Scale Fact	or	1

Table 6.6.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

Location	Cost	Time	Capacity
1-2	1	1	0.5

Table 6.6.2. Damage state progression.

Damage State	Description	Repair Description	Image
DS1	Cosmetic Damage.	Repair cosmetic damage.	Not Available
DS2	Structural damage but live load capacity remains intact.	Repair damage.	Not Available
DS3	Loss of live load capacity.	Replace stair.	Not Available

Table 6.6.3. Parameters for the damage state distributions. The medians reflect a scale factor of **<u>1.0</u>** applied to the default values.

	DS1	DS2	DS3
Туре	Sequential	Sequential	Sequential
Probability	-	-	-
Median	0.011	0.026	0.05
β	0.5	0.5	0.5

Table 6.6.4. Parameters for the cost distributions. The cost values reflect a total scale factor of **<u>1.391</u>** applied to the default values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor, building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1	DS2	DS3
Distribution Type	LogNormal	LogNormal	Normal
Lower Qty.	5.0	5.0	5.0
Upper Qty.	10.0	10.0	10.0
Highest Cost Median	\$695	\$2,782	\$8,346
Lowest Cost Median	\$487	\$1,043	\$3,130
β (COV)	0.8	0.6	0.4

Table 6.6.5. Parameters for the repair time distributions.

	DS1	DS2	DS3
Distribution Type	LogNormal	LogNormal	Normal
Lower Qty.	5.0	5.0	5.0
Upper Qty.	10.0	10.0	10.0
Highest Median Repair Time (Days)	0.55	2.21	6.62
Lowest Median Repair Time (Days)	0.39	0.83	2.48
β (COV)	1.0	0.7	0.5

Table 6.6.6. Life safety information.

	DS1	DS2	DS3
Non-collapse casualties Affected Area	No 	No 	No
Serious Injury Median Serious Injury β			
Loss of Life Median Loss of Life β		-	
Can Cause Red Tag Unsafe Placard Median Unsafe Placard β	No 	Yes 0.25 0.1	Yes 0.1 0.5

6.7 C3032.001a #1: (C3032.001a) Suspended Ceiling, SDC A,B,C, Area (A): A < 250, Vert support only

NISTIR Classification	C3032.001a
Author	Not Given
Normalized Unit	250.0 sf
Engineering Demand Parameter	Peak Floor Acceleration
Number of Damage States	3
Is correlated?	No
Is directional?	No

Component modifications applied:

Component Group	Ceilings
Quantity Scale Factor	1.0
Damage Median Scale Factor	1.0
Total Cost Scale Factor	1.391
User cost modification factor	1.0
Regional Cost Scale Factor	1
Date multiplier (to convert from 2011 USD)	1.391
Occupancy Cost Scale Factor	1
Building Value Cost Scale Factor	1

Table 6.7.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

Location	Cost	Time	Capacity
G-R	1	1	1

Table 6.7.2. Damage state progression.

Damage State	Description	Repair Description	Image
DS1	5 % of ceiling grid and tile damage.	Reinstall, repair, or replace 5% of the ceiling area.	Not Available
DS2	30% of ceiling grid and tile damage.	Replace 30% of the ceiling area.	Not Available
DS3	50% of ceiling grid and tile damage.	Replace the entire ceiling	Not Available



Table 6.7.3. Parameters for the damage state distributions. The medians reflect a scale factor of **<u>1.0</u>** applied to the default values.

	DS1	DS2	DS3
Туре	Sequential	Sequential	Sequential
Probability	-	-	-
Median	1.17	1.58	1.82
eta	0.25	0.25	0.25

Table 6.7.4. Parameters for the cost distributions. The cost values reflect a total scale factor of **<u>1.391</u>** applied to the default values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor, building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1	DS2	DS3
Distribution Type	Normal	LogNormal	LogNormal
Lower Qty.	1.0	1.0	1.0
Upper Qty.	10.0	10.0	10.0
Highest Cost Median	\$605	\$4,736	\$9,744
Lowest Cost Median	\$403	\$3,157	\$6,496
β (COV)	0.55	0.52	0.2

Table 6.7.5. Parameters for the repair time distributions.

	DS1	DS2	DS3
Distribution Type	Normal	LogNormal	LogNormal
Lower Qty.	1.0	1.0	1.0
Upper Qty.	10.0	10.0	10.0
Highest Median Repair Time (Days)	0.42	3.24	6.69
Lowest Median Repair Time (Days)	0.28	2.16	4.46
β (COV)	0.6	0.58	0.32

Table 6.7.6. Life safety information.

	DS1	DS2	DS3
Non-collapse casualties Affected Area	No 	No 	Yes 250.0 SF
Serious Injury Median Serious Injury β			0.1 0.5
Loss of Life Median Loss of Life β			0.0 0.0
Can Cause Red Tag Unsafe Placard Median Unsafe Placard β	No _ _	No _ _	No

-



6.8 C3032.001b #1: (C3032.001b) Suspended Ceiling, SDC A,B,C, Area (A): 250 < A < 1000, Vert support only

NISTIR Classification	C3032.001b
Author	Not Given
Normalized Unit	600.0 sf
Engineering Demand Parameter	Peak Floor Acceleration
Number of Damage States	3
Is correlated?	No
Is directional?	No

Component modifications applied:

Component Group	Ceilings
Quantity Scale Factor	1.0
Damage Median Scale Factor	1.0
Total Cost Scale Factor	1.391
User cost modification factor	1.0
Regional Cost Scale Factor	1
Date multiplier (to convert from 2011 USD)	1.391
Occupancy Cost Scale Factor	1
Building Value Cost Scale Factor	1

Table 6.8.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

Location	Cost	Time	Capacity
G-R	1	1	1

Table 6.8.2. Damage state progression.

Damage State	Description	Repair Description	Image
DS1	5 % of ceiling grid and tile damage.	Reinstall, repair, or replace 5% of the ceiling area.	Not Available
DS2	30% of ceiling grid and tile damage.	Replace 30% of the ceiling area.	Not Available
DS3	50% of ceiling grid and tile damage.	Replace the entire ceiling	Not Available



Table 6.8.3. Parameters for the damage state distributions. The medians reflect a scale factor of **<u>1.0</u>** applied to the default values.

	DS1	DS2	DS3
Туре	Sequential	Sequential	Sequential
Probability	-	-	-
Median	1.01	1.45	1.69
eta	0.25	0.25	0.25

Table 6.8.4. Parameters for the cost distributions. The cost values reflect a total scale factor of **<u>1.391</u>** applied to the default values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor, building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1	DS2	DS3
Distribution Type	Normal	LogNormal	LogNormal
Lower Qty.	1.0	1.0	1.0
Upper Qty.	10.0	10.0	10.0
Highest Cost Median	\$1,452	\$11,367	\$23,385
Lowest Cost Median	\$968	\$7,578	\$15,590
β (COV)	0.55	0.52	0.2

Table 6.8.5. Parameters for the repair time distributions.

	DS1	DS2	DS3
Distribution Type	Normal	LogNormal	LogNormal
Lower Qty.	1.0	1.0	1.0
Upper Qty.	10.0	10.0	10.0
Highest Median Repair Time (Days)	0.94	7.42	15.33
Lowest Median Repair Time (Days)	0.62	4.94	10.23
β (COV)	0.6	0.58	0.32

Table 6.8.6. Life safety information.

	DS1	DS2	DS3
Non-collapse casualties Affected Area	No 	No 	Yes 650.0 SF
Serious Injury Median Serious Injury β			0.1 0.5
Loss of Life Median Loss of Life β			$\begin{array}{c} 0.0\\ 0.0\end{array}$
Can Cause Red Tag Unsafe Placard Median Unsafe Placard β	No 	No 	No

6.9 C3032.001c #1: (C3032.001c) Suspended Ceiling, SDC A,B,C, Area (A): 1000 < A < 2500, Vert support only

NISTIR Classification	C3032.001c
Author	Not Given
Normalized Unit	1800.0 sf
Engineering Demand Parameter	Peak Floor Acceleration
Number of Damage States	3
Is correlated?	No
Is directional?	No

Component modifications applied:

Component Group	Ceilings
Quantity Scale Factor	1.0
Damage Median Scale Factor	1.0
Total Cost Scale Factor	1.391
User cost modification factor	1.0
Regional Cost Scale Factor	1
Date multiplier (to convert from 2011 USD)	1.391
Occupancy Cost Scale Factor	1
Building Value Cost Scale Factor	1

Table 6.9.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

Location	Cost	Time	Capacity
G-R	1	1	1

Table 6.9.2. Damage state progression.

Damage State	Description	Repair Description	Image
DS1	5 % of ceiling grid and tile damage.	Reinstall, repair, or replace 5% of the ceiling area.	Not Available
DS2	30% of ceiling grid and tile damage.	Replace 30% of the ceiling area.	Not Available
DS3	50% of ceiling grid and tile damage.	Replace the entire ceiling	Not Available



Table 6.9.3. Parameters for the damage state distributions. The medians reflect a scale factor of **<u>1.0</u>** applied to the default values.

	DS1	DS2	DS3
Туре	Sequential	Sequential	Sequential
Probability	-	-	-
Median	0.7	1.2	1.43
β	0.25	0.25	0.25

Table 6.9.4. Parameters for the cost distributions. The cost values reflect a total scale factor of **<u>1.391</u>** applied to the default values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor, building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1	DS2	DS3
Distribution Type	Normal	LogNormal	LogNormal
Lower Qty.	1.0	1.0	1.0
Upper Qty.	10.0	10.0	10.0
Highest Cost Median	\$4,357	\$34,101	\$70,155
Lowest Cost Median	\$2,904	\$22,734	\$46,770
β (COV)	0.55	0.52	0.2

Table 6.9.5. Parameters for the repair time distributions.

	DS1	DS2	DS3
Distribution Type	Normal	LogNormal	LogNormal
Lower Qty.	1.0	1.0	1.0
Upper Qty.	10.0	10.0	10.0
Highest Median Repair Time (Days)	2.8	21.61	44.5
Lowest Median Repair Time (Days)	1.88	14.39	29.66
β (COV)	0.6	0.58	0.32

Table 6.9.6. Life safety information.

	DS1	DS2	DS3
Non-collapse casualties Affected Area	No 	No 	Yes 1700.0 SF
Serious Injury Median Serious Injury β		-	0.1 0.5
Loss of Life Median Loss of Life β			0.0 0.0
Can Cause Red Tag Unsafe Placard Median Unsafe Placard β	No 	No _ _	No _ _

-



6.10 C3032.001d #1: (C3032.001d) Suspended Ceiling, SDC A,B,C, Area (A): A > 2500, Vert support only

NISTIR Classification	C3032.001d
Author	Not Given
Normalized Unit	2500.0 sf
Engineering Demand Parameter	Peak Floor Acceleration
Number of Damage States	3
Is correlated?	No
Is directional?	No

Component modifications applied:

Component Group	Ceilings
Quantity Scale Factor	1.0
Damage Median Scale Factor	1.0
Total Cost Scale Factor	1.391
User cost modification factor	1.0
Regional Cost Scale Factor	1
Date multiplier (to convert from 2011 USD)	1.391
Occupancy Cost Scale Factor	1
Building Value Cost Scale Factor	1

Table 6.10.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

Location	Cost	Time	Capacity
G-R	1	1	1

Table 6.10.2. Damage state progression.

Damage State	Description	Repair Description	Image
DS1	5 % of ceiling grid and tile damage.	Reinstall, repair, or replace 5% of the ceiling area.	Not Available
DS2	30% of ceiling grid and tile damage.	Replace 30% of the ceiling area.	Not Available
DS3	50% of ceiling grid and tile damage.	Replace the entire ceiling	Not Available

Table 6.10.3. Parameters for the damage state distributions. The medians reflect a scale factor of $\underline{1.0}$ applied to the default values.

	DS1	DS2	DS3
Туре	Sequential	Sequential	Sequential
Probability	-	-	-
Median	0.56	1.08	1.31
β	0.25	0.25	0.25

Table 6.10.4. Parameters for the cost distributions. The cost values reflect a total scale factor of **1.391** applied to the default
values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor,
building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1	DS2	DS3
Distribution Type	Normal	LogNormal	LogNormal
Lower Qty.	1.0	1.0	1.0
Upper Qty.	10.0	10.0	10.0
Highest Cost Median	\$6,051	\$47,362	\$97,437
Lowest Cost Median	\$4,034	\$31,575	\$64,958
β (COV)	0.55	0.52	0.2

Table 6.10.5. Parameters for the repair time distributions.

	DS1	DS2	DS3
Distribution Type	Normal	LogNormal	LogNormal
Lower Qty.	1.0	1.0	1.0
Upper Qty.	10.0	10.0	10.0
Highest Median Repair Time (Days)	3.62	29.09	59.71
Lowest Median Repair Time (Days)	2.38	19.41	39.79
β (COV)	0.6	0.58	0.32

Table 6.10.6. Life safety information.

	DS1	DS2	DS3
Non-collapse casualties Affected Area	No 	No	Yes 2500.0 SF
Serious Injury Median Serious Injury β	-	-	0.1 0.5
Loss of Life Median Loss of Life β	-	-	0.0 0.0
Can Cause Red Tag Unsafe Placard Median Unsafe Placard β	No 	Yes 0.75 0.5	Yes 0.5 0.5

6.11 C3034.001 #1: (C3034.001) Independent Pendant Lighting - non seismic

NISTIR Classification	C3034.001
Author	Not Given
Normalized Unit	1.0 each
Engineering Demand Parameter	Peak Floor Acceleration
Number of Damage States	1
Is correlated?	No
Is directional?	No

Component modifications applied:

Component Group	Lighting
Quantity Scale Factor	1.0
Damage Median Scale Factor	1.0
Total Cost Scale Factor	1.391
User cost modification factor	1.0
Regional Cost Scale Factor	1
Date multiplier (to convert from 2011 USD)	1.391
Occupancy Cost Scale Factor	1
Building Value Cost Scale Factor	1

Table 6.11.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

Location	Cost	Time	Capacity
G-R	1	1	1

Damage State	Description	Repair Description	Image
DS1	Disassembly of rod system at connections with horizontal light fixture, low cycle fatigue failure of the threaded rod, pullout of rods from ceiling assembly.	Replace damaged lighting components.	Not Available





Table 6.11.3. Parameters for the damage state distributions. The medians reflect a scale factor of 1.0 applied to the default values.

	DS1
Туре	Sequential
Probability	-
Median	0.6
β	0.4

Table 6.11.4. Parameters for the cost distributions. The cost values reflect a total scale factor of **1.391** applied to the default values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor, building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1
Distribution Type	LogNormal
Lower Qty.	5.0
Upper Qty.	10.0
Highest Cost Median	\$1,377
Lowest Cost Median	\$413
β (COV)	0.64

Table 6.11.5. Parameters for the repair time distributions.

	DS1
Distribution Type	LogNormal
Lower Qty.	5.0
Upper Qty.	10.0
Highest Median Repair Time (Days)	0.99
Lowest Median Repair Time (Days)	0.3
β (COV)	0.68

Table 6.11.6. L	life safety	information.
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	DS1
Non-collapse casualties Affected Area	Yes 100.0 SF
Serious Injury Median Serious Injury β	0.2 0.5
Loss of Life Median Loss of Life β	0.002 0.5
Can Cause Red Tag Unsafe Placard Median Unsafe Placard β	No

6.12 D1014.022 #1: (D1014.022) Hydraulic Elevator - Applies to most California Installations prior to 1976, most western states installations prior to 1982 and most U.S installations prior to 1998.

NISTIR Classification	D1014.022	
Author	Not Given	
Normalized Unit	1.0 each	
Engineering Demand Parameter	Peak Floor Ac	celeration
Number of Damage States	1	
Is correlated?	No	
Is directional?	No	
Component modifications applie	d:	
Component Group		Elevators
Quantity Scale Factor		1.0
Damage Median Scale Factor		1.0
Total Cost Scale Factor		1.391
User cost modification factor		1.0
Regional Cost Scale Factor		1
Date multiplier (to convert from	n 2011 USD)	1.391
Date multiplier (to convert from Occupancy Cost Scale Factor	n 2011 USD)	1.391 1

Table 6.12.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

Location	Cost	Time	Capacity
G-R	1	1	1

Table 6.12.2. Damage state progression.

Damage State	Description	Repair Description	Image
DS1a	Damaged controls.	Multiple repairs possible (% change of each): Repair damaged controls (100%)	Not Available
DS1b	Damaged vane and hoist-way switches, and or bent cab stabi- lizers, and or damaged car guide shoes.	Multiple repairs possible ($\%$ change of each): Repair damaged vane and hoist-way switches (41 $\%$), and or repair bent cab stabilizers (41 $\%$), and or repair damaged car guide shoes (41 $\%$).	Not Available
DS1c	Damaged entrance and car door, and or flooring damage.	Multiple repairs possible (% change of each): Repair damage to cab door (68%), and or re- pair cab flooring (46%)	Not Available
DS1d	Oil leak in hydraulic line, and or hydraulic tank failure.	Multiple repairs possible (% change of each): Repair oil leak in hydraulic line (27%), and or hydraulic tank failure (81%)	Not Available





Table 6.12.3. Parameters for the damage state distributions.	The medians reflect a scale factor of $\underline{1.0}$ applied to the default
values.	

	DS1a	DS1b	DS1c	DS1d
Туре	Simultaneous	Simultaneous	Simultaneous	Simultaneous
Probability	0.3	0.49	0.44	0.37
Median	0.3	0.3	0.3	0.3
β	0.3	0.3	0.3	0.3

Table 6.12.4. Parameters for the cost distributions. The cost values reflect a total scale factor of **1.391** applied to the default
values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor,
building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1a	DS1b	DS1c	DS1d
Distribution Type	LogNormal	Normal	Normal	LogNormal
Lower Qty.	5.0	5.0	5.0	5.0
Upper Qty.	10.0	10.0	10.0	10.0
Highest Cost Median	\$2,226	\$22,812	\$33,383	\$6,398
Lowest Cost Median	\$668	\$6,844	\$10,015	\$1,920
β (COV)	0.82	0.32	0.44	0.25

Table 6.12.5. Parameters for the repair time distributions.

	DS1a	DS1b	DS1c	DS1d
Distribution Type	LogNormal	Normal	Normal	LogNormal
Lower Qty.	5.0	5.0	5.0	5.0
Upper Qty.	10.0	10.0	10.0	10.0
Highest Median Repair Time (Days)	1.6	16.4	24	4.6
Lowest Median Repair Time (Days)	0.48	4.92	7.2	1.38
β (COV)	0.86	0.41	0.51	0.36

Table 6.12.6. Life safety information.

	DS1a	DS1b	DS1c	DS1d
Non-collapse casualties Affected Area	No	No	No	No
Serious Injury Median Serious Injury β		-	-	
Loss of Life Median Loss of Life β	-			
Can Cause Red Tag Unsafe Placard Median Unsafe Placard β	No 	No _	No 	No

6.13 D2021.013a #1: (D2021.013a) Cold or Hot Potable - Small Diameter Threaded Steel - (2.5 inches in diameter or less), SDC D, E, or F, PIPING FRAGILITY

NISTIR Classification	D2021.013a	
Author	Not Given	
Normalized Unit	1000.0 lf	
Engineering Demand Parameter	Peak Floor Ac	celeration
Number of Damage States	2	
Is correlated?	No	
Is directional?	No	
Component modifications applie	d:	
Component Group		Piping
Quantity Scale Factor		1.0
Damage Median Scale Factor		1.0
Total Cost Scale Factor		1.391
User cost modification factor		1.0
Regional Cost Scale Factor		1
Date multiplier (to convert from	n 2011 USD)	1.391
Occupancy Cost Scale Factor		1
Building Value Cost Scale Fact	or	1

Table 6.13.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

Location	Cost	Time	Capacity
G-R	1	1	1

Table 6.13.2. Damage state progression.

Damage State	Description	Repair Description	Image
DS1	Minor leakage at flange connec- tions - 1 leak per 1000 feet of pipe.	Retighten flange bolts at leaking joints. One joint per 1000 LF.	Not Available
DS2	Pipe Break - 1 break per 1000 feet of pipe.	Replace 20 foot sections of pipe where breaks occur. One repair per 1000 LF.	Not Available



Table 6.13.3. Parameters for the damage state distributions. The medians reflect a scale factor of $\underline{1.0}$ applied to the default values.

	DS1	DS2
Туре	Sequential	Sequential
Probability	_	-
Median	2.25	4.1
eta	0.4	0.4

Table 6.13.4. Parameters for the cost distributions. The cost values reflect a total scale factor of 1.391 applied to the default
values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor,
building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1	DS2
Distribution Type	LogNormal	LogNormal
Lower Qty.	3.0	3.0
Upper Qty.	10.0	10.0
Highest Cost Median	\$444	\$4,055
Lowest Cost Median	\$363	\$3,317
β (COV)	0.76	0.41

Table 6.13.5. Parameters for the repair time distributions.

	DS1	DS2
Distribution Type	LogNormal	LogNormal
Lower Qty.	3.0	3.0
Upper Qty.	10.0	10.0
Highest Median Repair Time (Days)	0.34	3.09
Lowest Median Repair Time (Days)	0.28	2.53
β (COV)	0.8	0.48

Table 6.13.6. Life safety information.

	DS1	DS2
Non-collapse casualties Affected Area	No 	No
Serious Injury Median Serious Injury β	_	
Loss of Life Median Loss of Life β		-
Can Cause Red Tag Unsafe Placard Median Unsafe Placard β	No 	No

6.14 D2021.013b #1: (D2021.013b) Cold or Hot Potable - Small Diameter Threaded Steel - (2.5 inches in diameter or less), SDC D, E, or F, BRACING FRAGILITY

NISTIR Classification	D2021.013b	
Author	Not Given	
Normalized Unit	1000.0 lf	
Engineering Demand Parameter	Peak Floor Ac	celeration
Number of Damage States	1	
Is correlated?	No	
Is directional?	No	
Component modifications applie	d:	
Component Group		Piping
Quantity Scale Factor		1.0
Damage Median Scale Factor		1.0
Total Cost Scale Factor		1.391
User cost modification factor		1.0
Regional Cost Scale Factor		1
Date multiplier (to convert from 2011 USD)		1.391
Occupancy Cost Scale Factor		1
Building Value Cost Scale Fact	or	1

Table 6.14.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

Location	Cost	Time	Capacity
G-R	1	1	1

Table 6.14.2. Damage state progression.

Damage State	Description	Repair Description	Image
DS1	Lateral Brace Failure - 1 failure per 1000 feet of pipe.	Replace failed lateral braces. One repair per 1000 LF.	Not Available



Table 6.14.3. Parameters for the damage state distributions. The medians reflect a scale factor of $\underline{1.0}$ applied to the default values.

	DS1
Type Probability	Sequential
Probability	-
Median	1.5
β	0.4

Table 6.14.4. Parameters for the cost distributions. The cost values reflect a total scale factor of 1.391 applied to the default
values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor,
building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1
Distribution Type	LogNormal
Lower Qty.	3.0
Upper Qty.	10.0
Highest Cost Median	\$581
Lowest Cost Median	\$476
β (COV)	0.6

Table 6.14.5. Parameters for the repair time distributions.

	DS1
Distribution Type	LogNormal
Lower Qty.	3.0
Upper Qty.	10.0
Highest Median Repair Time (Days)	0.44
Lowest Median Repair Time (Days)	0.36
β (COV)	0.65

	DS1
Non-collapse casualties	No
Affected Area	
Serious Injury Median	-
Serious Injury β	_
Loss of Life Median	-
Loss of Life β	-
Can Cause Red Tag	No
Unsafe Placard Median Unsafe Placard β	-
Unsale Flacal d p	—

_



6.15 D2021.023a #1: (D2021.023a) Cold or Hot Potable Water Piping (dia > 2.5 inches), SDC D,E,F, PIPING FRAGILITY

NISTIR Classification Author	D2021.023a Not Given
Normalized Unit Engineering Demand Parameter	1000.0 lf Peak Floor Acceleration
Number of Damage States	2
Is correlated?	No
Is directional?	No

Component modifications applied:

Component Group	Piping
Quantity Scale Factor	1.0
Damage Median Scale Factor	1.0
Total Cost Scale Factor	1.391
User cost modification factor	1.0
Regional Cost Scale Factor	1
Date multiplier (to convert from 2011 USD)	1.391
Occupancy Cost Scale Factor	1
Building Value Cost Scale Factor	1

Table 6.15.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

Location	Cost	Time	Capacity
G-R	1	1	1

Table 6.15.2. Damage state progression.

Damage State	Description	Repair Description	Image
DS1	Minor leakage at flange connec- tions - 1 leak per 1000 feet of pipe.	Retighten flange bolts at leaking joints. One joint per 1000 LF.	Not Available
DS2	Pipe Break - 1 break per 1000 feet of pipe.	Replace 20 foot sections of pipe where breaks occur. One repair per 1000 LF.	Not Available



Table 6.15.3. Parameters for the damage state distributions. The medians reflect a scale factor of $\underline{1.0}$ applied to the default values.

	DS1	DS2
Type Probability	Sequential	Sequential
Probability	-	_
Median	2.25	4.1
eta	0.4	0.4

Table 6.15.4. Parameters for the cost distributions. The cost values reflect a total scale factor of 1.391 applied to the default
values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor,
building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1	DS2
Distribution Type	LogNormal	LogNormal
Lower Qty.	5.0	5.0
Upper Qty.	10.0	10.0
Highest Cost Median	\$974	\$9,319
Lowest Cost Median	\$292	\$2,796
β (COV)	0.65	0.4

Table 6.15.5. Parameters for the repair time distributions.

	DS1	DS2
Distribution Type	LogNormal	LogNormal
Lower Qty.	5.0	5.0
Upper Qty.	10.0	10.0
Highest Median Repair Time (Days)	0.74	7.09
Lowest Median Repair Time (Days)	0.22	2.13
β (COV)	0.7	0.47

Table 6.15.6. Life safety information.

DS1	DS2
No 	No
-	-
	-
No _	No _
-	_
	No



NISTIR Classification	D2021.023b
Author	Not Given
Normalized Unit	1000.0 lf
Engineering Demand Parameter	Peak Floor Acceleration
Number of Damage States	2
Is correlated?	No
Is directional?	No
Component modifications applie	ed:
Component modifications applie Component Group	ed: Piping
1 11	
Component Group	Piping
Component Group Quantity Scale Factor	Piping 1.0
Component Group Quantity Scale Factor Damage Median Scale Factor	Piping 1.0 1.0

Date multiplier (to convert from 2011 USD) 1.391

Occupancy Cost Scale Factor

Building Value Cost Scale Factor

6.16 D2021.023b #1: (D2021.023b) Cold or Hot Potable Water Piping (dia > 2.5 inches), SDC D,E,F, BRACING FRAGILITY

Table 6.16.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

1

1

Location	Cost	Time	Capacity
G-R	1	1	1

Table 6.16.2. Damage state progression.

Damage State	Description	Repair Description	Image
DS1	Lateral Brace Failure - 1 failure per 1000 feet of pipe.	Replace failed lateral braces. One repair per 1000 LF.	Not Available
DS2	Vertical Brace Failure - 1 failure per 1000 feet of pipe	Replace failed vertical braces. One repair per 1000 LF.	Not Available



Table 6.16.3. Parameters for the damage state distributions. The medians reflect a scale factor of $\underline{1.0}$ applied to the default values.

	DS1	DS2
Type Probability	Sequential	Sequential
Probability	_	_
Median	1.5	2.25
β	0.4	0.4

Table 6.16.4. Parameters for the cost distributions. The cost values reflect a total scale factor of 1.391 applied to the default
values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor,
building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1	DS2
Distribution Type	LogNormal	LogNormal
Lower Qty.	5.0	5.0
Upper Qty.	10.0	10.0
Highest Cost Median	\$974	\$974
Lowest Cost Median	\$292	\$292
β (COV)	0.65	0.65

Table 6.16.5. Parameters for the repair time distributions.

	DS1	DS2
Distribution Type	LogNormal	LogNormal
Lower Qty.	5.0	5.0
Upper Qty.	10.0	10.0
Highest Median Repair Time (Days)	0.74	0.74
Lowest Median Repair Time (Days)	0.22	0.22
β (COV)	0.7	0.7

Table 6.16.6. Li	fe safety	information.
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	DS1	DS2
Non-collapse casualties Affected Area	No 	No
Serious Injury Median Serious Injury β		
Loss of Life Median Loss of Life β		-
Can Cause Red Tag Unsafe Placard Median	No _	No _
Unsafe Placard β	-	-

NISTIR Classification Author Normalized Unit Engineering Demand Parameter Number of Damage States Is correlated?	D2031.022a Not Given 1000.0 lf Peak Floor Ac 1 No	cceleration
Is directional?	No	
Component modifications applie	ed:	
Component Group		Piping
Quantity Scale Factor		1.0
Damage Median Scale Factor		1.0
Total Cost Scale Factor		1.391
User cost modification factor		1.0
Regional Cost Scale Factor		1
Date multiplier (to convert from	n 2011 USD)	1.391
Occupancy Cost Scale Factor		1
Building Value Cost Scale Fac	tor	1

6.17 D2031.022a #1: (D2031.022a) Sanitary Waste Piping - Cast Iron w/bell and spigot couplings, SDC C, PIPING FRAGILITY

Table 6.17.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

Location	Cost	Time	Capacity
G-R	1	1	1

Table 6.17.2. Damage state progression.

Damage State	Description	Repair Description	Image
DS1	Joints break - 1 break per 1000 feet of pipe.	Replace failed 20 ft pipe sections including supports - one per 1000 LF.	Not Available



Table 6.17.3. Parameters for the damage state distributions. The medians reflect a scale factor of $\underline{1.0}$ applied to the default values.

	DS1
Type Probability	Sequential
Probability	-
Median	1.2
β	0.5

Table 6.17.4. Parameters for the cost distributions. The cost values reflect a total scale factor of 1.391 applied to the default
values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor,
building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DC1
	DS1
Distribution Type	Normal
Lower Qty.	5.0
Upper Qty.	10.0
Highest Cost Median	\$9,319
Lowest Cost Median	\$2,796
β (COV)	0.31

Table 6.17.5. Parameters for the repair time distributions.

	DS1
Distribution Type	Normal
Lower Qty.	5.0
Upper Qty.	10.0
Highest Median Repair Time (Days)	7.09
Lowest Median Repair Time (Days)	2.13
β (COV)	0.4

Table 6.17.6.	Life	safety	information.
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	DS1
Non-collapse casualties	No
Affected Area	
Serious Injury Median	-
Serious Injury β	_
Loss of Life Median	-
Loss of Life β	-
Can Cause Red Tag	No
Unsafe Placard Median Unsafe Placard β	-
Unsale Flacal d p	—

Author	Not Given	
Normalized Unit	1000.0 lf	
Engineering Demand Parameter	Peak Floor A	cceleration
Number of Damage States	2	
Is correlated?	No	
Is directional?	No	
Component modifications applie	ed:	
Component Group		Piping
Quantity Scale Factor		1.0
Damage Median Scale Factor		1.0
Total Cost Scale Factor		1.391
User cost modification factor		1.0
Regional Cost Scale Factor 1		
Regional Cost Scale Factor		1
Regional Cost Scale Factor Date multiplier (to convert from	n 2011 USD)	1 1.391

Building Value Cost Scale Factor

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NISTIR Classification

6.18 D2031.022b #1: (D2031.022b) Sanitary Waste Piping - Cast Iron w/bell and spigot couplings, SDC C, BRACING FRAGILITY

D2031.022b #1: (D2031.022b) Sanitary Waste Piping - Cast Iron w/bell and spigot...

D2031.022b

Table 6.18.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

1

Location	Cost	Time	Capacity
G-R	1	1	1

Table 6.18.2. Damage state progression.

Damage State	Description	Repair Description	Image
DS1	Isolated support failure w/o leak- age - 0.5 support failures per 1000 feet of pipe (assuming sup- ports every 20 feet).	Replace failed supports - 0.5 per 1000 LF.	Not Available
DS2	Multiple supports failure and 60 feet of pipe fail per 1000 feet of pipe (assuming supports every 20 feet).	Replace failed supports and 60 ft pipe per 1000 LF.	Not Available



Table 6.18.3. Parameters for the damage state distributions. The medians reflect a scale factor of $\underline{1.0}$ applied to the default values.

	DS1	DS2
Туре	Sequential	Sequential
Type Probability	-	_
Median	1.2	2.4
eta	0.5	0.5

Table 6.18.4. Parameters for the cost distributions. The cost values reflect a total scale factor of 1.391 applied to the default
values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor,
building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1	DS2
Distribution Type	LogNormal	Normal
Lower Qty.	5.0	5.0
Upper Qty.	10.0	10.0
Highest Cost Median	\$1,113	\$12,101
Lowest Cost Median	\$334	\$3,630
β (COV)	0.71	0.28

Table 6.18.5. Parameters for the repair time distributions.

	DS1	DS2
Distribution Type	LogNormal	Normal
Lower Qty.	5.0	5.0
Upper Qty.	10.0	10.0
Highest Median Repair Time (Days)	0.85	9.21
Lowest Median Repair Time (Days)	0.25	2.76
β (COV)	0.75	0.38

Table 6.18.6.	Life safety	information.
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	DS1	DS2
Non-collapse casualties Affected Area	No 	No
Serious Injury Median Serious Injury β		-
Loss of Life Median Loss of Life β	_	
Can Cause Red Tag Unsafe Placard Median Unsafe Placard β	No _	No _

6.19 D3032.011a #1: (D3032.011a) Compressor - Capacity: Small non medical air supply - Unanchored equipment that is not vibration isolated - Equipment fragility only

NISTIR Classification Author Normalized Unit Engineering Demand Parameter Number of Damage States Is correlated?	D3032.011a Not Given 1.0 each Peak Floor Ac 1 No	celeration
Is directional?	No	
Component modifications applie	d:	
Component Group		HVAC
Quantity Scale Factor		1.0
Damage Median Scale Factor		1.0
Total Cost Scale Factor		1.391
User cost modification factor		1.0
Regional Cost Scale Factor		1
Date multiplier (to convert from	n 2011 USD)	1.391
Occupancy Cost Scale Factor		1
Building Value Cost Scale Fact	or	1

Table 6.19.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

Location	Cost	Time	Capacity
G-R	1	1	1

Table 6.19.2. Damage state progression.

Damage State	Description	Repair Description	Image
DS1a	Equipment does not function. Motor is damaged.	Repair motor.	
DS1b	Equipment does not function. Equipment damaged beyond re- pair.	Replace equipment.	Not Available





Table 6.19.3. Parameters for the damage state distributions. The medians reflect a scale factor of $\underline{1.0}$ applied to the default values.

	DS1a	DS1b
Туре	Mut. Excl.	Mut. Excl.
Probability	0.5	0.5
Median	0.25	0.25
β	0.45	0.45

Table 6.19.4. Parameters for the cost distributions. The cost values reflect a total scale factor of 1.391 applied to the default
values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor,
building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1a	DS1b
Distribution Type	LogNormal	LogNormal
Lower Qty.	1.0	1.0
Upper Qty.	5.0	5.0
Highest Cost Median	\$1,148	\$4,131
Lowest Cost Median	\$939	\$3,380
β (COV)	0.17	0.21

Table 6.19.5. Parameters for the repair time distributions.

	DS1a	DS1b
Distribution Type	LogNormal	LogNormal
Lower Qty.	1.0	1.0
Upper Qty.	5.0	5.0
Highest Median Repair Time (Days)	0.97	0.64
Lowest Median Repair Time (Days)	0.79	0.16
β (COV)	0.3	0.32

	DS1a	DS1b
Non-collapse casualties Affected Area	No 	No
Serious Injury Median Serious Injury β	-	-
Loss of Life Median Loss of Life β	-	-
Can Cause Red Tag Unsafe Placard Median Unsafe Placard β	No 	No _ _



6.20 D3041.011b #1: (D3041.011b) HVAC Galvanized Sheet Metal Ducting less than 6 sq. ft in cross sectional area, SDC C

NISTIR Classification	D3041.011b	
Author	Not Given	
Normalized Unit	1000.0 lf	
Engineering Demand Parameter	Peak Floor Ac	celeration
Number of Damage States	2	
Is correlated?	No	
Is directional?	No	
Component modifications applie	d:	
Component Group		HVAC
Quantity Scale Factor		1.0
Damage Median Scale Factor		1.0
Total Cost Scale Factor		1.391
User cost modification factor		1.0
Regional Cost Scale Factor		1
Date multiplier (to convert from	n 2011 USD)	1.391
Occupancy Cost Scale Factor		1
Building Value Cost Scale Factor		1

Table 6.20.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

Location	Cost	Time	Capacity
G-R	1	1	1

Table 6.20.2. Damage state progression.

Damage State	Description	Repair Description	Image
DS1	Individual supports fail and duct sags - 1 failed support per 1000 feet of ducting.	Replace failed supports and repair ducting in vicinity of failed supports.	Not Available
DS2	Several adjacent supports fail and sections of ducting fall - 60 feet of ducting fail and fall per 1000 foot of ducting.	Replace sections of failed ducting and supports.	Not Available



Table 6.20.3. Parameters for the damage state distributions. The medians reflect a scale factor of $\underline{1.0}$ applied to the default values.

	DS1	DS2
Туре	Sequential	Sequential
Probability	-	_
Median	1.5	2.25
eta	0.4	0.4

Table 6.20.4. Parameters for the cost distributions. The cost values reflect a total scale factor of 1.391 applied to the default
values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor,
building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1	DS2
Distribution Type	LogNormal	LogNormal
Lower Qty.	1.0	1.0
Upper Qty.	5.0	5.0
Highest Cost Median	\$995	\$9,716
Lowest Cost Median	\$814	\$7,949
β (COV)	0.37	0.1

Table 6.20.5. Parameters for the repair time distributions.

	DS1	DS2
Distribution Type	LogNormal	LogNormal
Lower Qty.	1.0	1.0
Upper Qty.	5.0	5.0
Highest Median Repair Time (Days)	0.84	2.99
Lowest Median Repair Time (Days)	0.69	1.49
β (COV)	0.44	0.27

Table 6.20.6. Life safety information.

DS1	DS2
No	Yes
	15.0 SF
_	0.05
-	0.5
_	0.0
_	0.0
No	No
-	_
-	-
	No - - - - -



6.21 D3041.012b #1: (D3041.012b) HVAC Galvanized Sheet Metal Ducting - 6 sq. ft cross sectional area or greater, SDC C

NISTIR Classification	D3041.012b	
Author	Not Given	
Normalized Unit	1000.0 lf	
Engineering Demand Parameter	Peak Floor Ac	celeration
Number of Damage States	2	
Is correlated?	No	
Is directional?	No	
Component modifications applie	d:	
Component Group		HVAC
Quantity Scale Factor		1.0
Damage Median Scale Factor		1.0
Total Cost Scale Factor		1.391
User cost modification factor		1.0
Regional Cost Scale Factor		1
Date multiplier (to convert from	n 2011 USD)	1.391
Occupancy Cost Scale Factor		1
Building Value Cost Scale Factor	or	1

Table 6.21.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

Location	Cost	Time	Capacity
G-R	1	1	1

Table 6.21.2. Damage state progression.

Damage State	Description	Repair Description	Image
DS1	Individual supports fail and duct sags - 1 failed support per 1000 feet of ducting.	Replace failed supports and repair ducting in vicinity of failed supports.	Not Available
DS2	Several adjacent supports fail and sections of ducting fall - 60 feet of ducting fail and fall per 1000 foot of ducting.	Replace sections of failed ducting and supports.	Not Available



Table 6.21.3. Parameters for the damage state distributions. The medians reflect a scale factor of $\underline{1.0}$ applied to the default values.

	DS1	DS2
Type Probability	Sequential	Sequential
Probability	_	_
Median	1.5	2.25
β	0.4	0.4

Table 6.21.4. Parameters for the cost distributions. The cost values reflect a total scale factor of 1.391 applied to the default
values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor,
building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1	DS2
Distribution Type	LogNormal	LogNormal
Lower Qty.	1.0	1.0
Upper Qty.	5.0	5.0
Highest Cost Median	\$1,454	\$12,164
Lowest Cost Median	\$1,189	\$9,952
β (COV)	0.26	0.08

Table 6.21.5. Parameters for the repair time distributions.

	DS1	DS2
Distribution Type	LogNormal	LogNormal
Lower Qty.	1.0	1.0
Upper Qty.	5.0	5.0
Highest Median Repair Time (Days)	1.23	3.74
Lowest Median Repair Time (Days)	1.01	1.87
β (COV)	0.36	0.26

	DS1	DS2
Non-collapse casualties	No	Yes
Affected Area		50.0 SF
Serious Injury Median	_	0.1
Serious Injury β	_	0.5
Loss of Life Median	_	0.0
Loss of Life β	-	0.0
Can Cause Red Tag	No	No
Unsafe Placard Median	_	—
Unsafe Placard β	-	-



6.22 D3041.032b #1: (D3041.032b) HVAC Drops / Diffusers without ceilings - supported by ducting only - No independent safety wires, SDC C

NISTIR Classification	D3041.032b	
Author	Not Given	
Normalized Unit	10.0 each	
Engineering Demand Parameter	Peak Floor Ac	celeration
Number of Damage States	1	
Is correlated?	No	
Is directional?	No	
Component modifications applie	d:	
Component Group		HVAC
Quantity Scale Factor		1.0
Damage Median Scale Factor		1.0
Total Cost Scale Factor		1.391
User cost modification factor		1.0
Regional Cost Scale Factor		1
Date multiplier (to convert from	n 2011 USD)	1.391
Occupancy Cost Scale Factor		1
Building Value Cost Scale Factor	or	1

Table 6.22.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

Location	Cost	Time	Capacity
G-R	1	1	1

Table 6.22.2. Damage state progression.

Damage State	Description	Repair Description	Image
DS1	HVAC drops or diffusers dis- lodges and falls.	Replace diffuser/drop and sections of ceiling and ducting in vicinity to which diffuser/drop is connected.	Not Available

Table 6.22.3. Parameters for the damage state distributions. The medians reflect a scale factor of 1.0 applied to the default values.

	DS1
Туре	Sequential
Probability	-
Median	1.5
β	0.4

Table 6.22.4. Parameters for the cost distributions. The cost values reflect a total scale factor of **1.391** applied to the default values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor, building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1
Distribution Type	Normal
Lower Qty.	1.0
Upper Qty.	5.0
Highest Cost Median	\$4,590
Lowest Cost Median	\$3,756
β (COV)	0.21

Table 6.22.5. Parameters for the repair time distributions.

	DS1
Distribution Type	Normal
Lower Qty.	1.0
Upper Qty.	5.0
Highest Median Repair Time (Days)	3.88
Lowest Median Repair Time (Days)	3.18
β (COV)	0.32

Table 6.22.6. 1	Life safe	ety inform	nation.
-----------------	-----------	------------	---------

	DS1
Non-collapse casualties Affected Area	Yes 4.0 SF
Serious Injury Median Serious Injury β	0.1 0.5
Loss of Life Median Loss of Life β	0.0 0.0
Can Cause Red Tag Unsafe Placard Median Unsafe Placard β	No



6.23 D3041.101a #1: (D3041.101a) HVAC Fan - Capacity: all - Unanchored equipment that is not vibration isolated - Equipment fragility only

NISTIR Classification	D3041.101a	
Author	Not Given	
Normalized Unit	1.0 each	
Engineering Demand Parameter	Peak Floor Ac	celeration
Number of Damage States	1	
Is correlated?	No	
Is directional?	No	
Component modifications applie	d:	
Component Group		HVAC
Quantity Scale Factor		1.0
Damage Median Scale Factor		1.0
Total Cost Scale Factor		1.391
User cost modification factor		1.0
Regional Cost Scale Factor		1
Date multiplier (to convert from	n 2011 USD)	1.391
Occupancy Cost Scale Factor		1
Building Value Cost Scale Fact	or	1

Table 6.23.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

Location	Cost	Time	Capacity
G-R	1	1	1

Damage State	Description	Repair Description	Image
DS1	Damaged, inoperative.	Replace equipment.	

Table 6.23.3. Parameters for the damage state distributions. The medians reflect a scale factor of $\underline{1.0}$ applied to the default values.

	DS1
Туре	Sequential
Probability	-
Median	0.5
β	0.4

Table 6.23.4. Parameters for the cost distributions. The cost values reflect a total scale factor of 1.391 applied to the default
values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor,
building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1
Distribution Type	LogNormal
Lower Qty.	1.0
Upper Qty.	5.0
Highest Cost Median	\$4,055
Lowest Cost Median	\$3,317
β (COV)	0.14

Table 6.23.5. Parameters for the repair time distributions.

	DS1
	0.01
Distribution Type	LogNormal
Lower Qty.	1.0
Upper Qty.	5.0
Highest Median Repair Time (Days)	3.43
Lowest Median Repair Time (Days)	2.81
β (COV)	0.29

Table 6.23.6.	Life safe	ty information.
---------------	-----------	-----------------

	DS1
Non-collapse casualties	No
Affected Area	
Serious Injury Median	-
Serious Injury β	-
Loss of Life Median	_
Loss of Life β	—
Can Cause Red Tag	No
Unsafe Placard Median Unsafe Placard β	_
onsaid i lacalu p	—

6.24 D4011.022a #1: (D4011.022a) Fire Sprinkler Water Piping - Horizontal Mains and Branches - Old Style Victaulic - Thin Wall Steel - No bracing, SDC C, PIPING FRAGILITY

D4011.022a
Not Given
1000.0 lf
Peak Floor Acceleration
2
No
No
ed:
Other Nonstructural
1.0
1.0
1.391
1.0
1
n 2011 USD) 1.391
1
tor 1

Table 6.24.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

Location	Cost	Time	Capacity
G-R	1	1	1

Table 6.24.2. Damage state progression.

Damage State	Description	Repair Description	Image
DS1	Spraying & Dripping Leakage at joints - 0.02 leaks per 20 ft sec- tion of pipe.	Replace leaking joints and minor water cleanup.	Not Available
DS2	Joints Break - Major Leakage - 0.02 breaks per 20 ft section of pipe.	Replace 20 ft section of pipe, joints and major water cleanup at leaking joints.	Not Available





Table 6.24.3. Parameters for the damage state distributions. The medians reflect a scale factor of $\underline{1.0}$ applied to the default values.

	DS1	DS2
Type Probability	Sequential	Sequential
Probability	-	-
Median	1.1	2.4
β	0.4	0.5

Table 6.24.4. Parameters for the cost distributions. The cost values reflect a total scale factor of 1.391 applied to the default
values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor,
building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1	DS2
Distribution Type	LogNormal	LogNormal
Lower Qty.	3.0	3.0
Upper Qty.	10.0	10.0
Highest Cost Median	\$536	\$4,055
Lowest Cost Median	\$438	\$3,317
β (COV)	0.65	0.41

Table 6.24.5. Parameters for the repair time distributions.

	DS1	DS2
Distribution Type	LogNormal	LogNormal
Lower Qty.	3.0	3.0
Upper Qty.	10.0	10.0
Highest Median Repair Time (Days)	0.45	0.94
Lowest Median Repair Time (Days)	0.37	0.31
β (COV)	0.7	0.48

	DS1	DS2
Non-collapse casualties Affected Area	No 	No
Serious Injury Median Serious Injury β		-
Loss of Life Median Loss of Life β	-	-
Can Cause Red Tag Unsafe Placard Median Unsafe Placard β	No _	No _



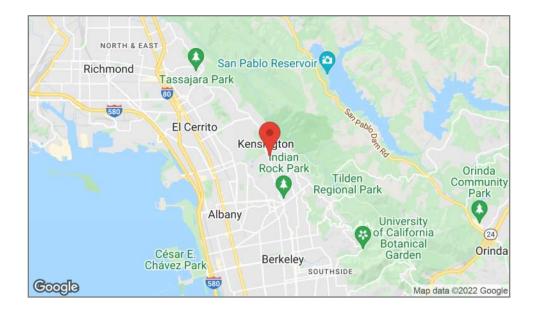
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SEISMIC RISK ASSESSMENT REPORT Created with the SP3-RiskModel

Full Detailed Report



Report Generated for:

217 Arlington Avenue, Kensington, CA, 94707 Latitude: 37.90622° Longitude: -122.27875°

Report Generated by:

The SP3-RiskModel Software v1.2.0 of the Seismic Performance Prediction Program (SP3)

March 16, 2022





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1 SUMMARY OF INPUTS AND RISK RESULTS

Risk Model Inputs

Pi	rimary		Building Desig	n Info	
Project Name: Model Name: Building Type: Year of Construction: Number of Stories:	New WLI WLF: Ge 2022 2	on Fire Station F w/ Frame neral cial Office	Level of Detailing (Dir. 1, 2): Drift Limit (Dir. 1, 2): Risk Category: Seismic Importance Factor, I_e Component Importance Factor		
Occupancy: Address: 217 Arlingt Kensington Latitude: Longitude:		0	Structural Prop Allow Components to Affect Structural Properties?	- Y	ſes
			Mode Shapes Specified? Directional Properties	Dir. 1	No Dir. 2
Analy: Include Collapse in Ana Consider Residual Drift Region Cost Multiplier: Date Cost Multiplier: Occupancy Cost Multipl	t: :	Yes Yes - -	Base Shear Strength (g): Yield Drift (%): 1^{st} Mode Period (T_1) (s):		-
Duthing La		-4:	Component Info Selection Method		stom
Building La Cost per Square Foot: Scale component repair building value?	<u> </u>	– No	Building Stal	bility _	
Total Square Feet: Aspect Ratio: First Story Height (ft): Upper Story Heights (ft Vertical Irregularity: Plan Irregularity:):	4,395 1.95 13.5 9 None None	Beta (Dispersion): Response No responses provided		
Frac. of Full Height E Dir. 1 Story 1 Dir. 1 Upper Stories Dir. 2 Story 1 Dir. 2 Upper Stories		/alls _ _ _ _ _			

Ground Motion and Soil Information

SP3 Default



Repair Time Options

Repair Time Method	ATC-138 (Beta)
Factors Delaying Start of I	Repairs
Inspection	Yes
Financing	Yes
Permitting	Yes
Engineering Mobilization	Yes
Contractor Mobilization	Yes
Mitigation Factors	
Inspector on Retainer	No
Engineer on Retainer	No
Contractor on Retainer	No
Funding Source	Private Loans
Cash on Hand	-

ATC-138 Functional Recovery (Beta) Options

Need HVAC for Function	-
Need Elevator for Function	-
Include Surge Demand	-

Component Checklist

Stairs and Elevators

- Does the building have stairs?
 - > Yes
 - What type of stairs are in the building?
 - > Light Frame

Interior Finishes

- Does the building have suspended ceilings?
 - > Yes
 - Are the ceilings laterally supported?

> Yes

- Does the building contain pendant (non-recessed) lighting?
 - > Yes
 - Are the pendant lights seismically rated? > *Yes*

Piping

- Is the building's water piping OSHPD certified or equivalent?
 - > Yes

HVAC

• Is the HVAC cooling/heating equipment seismically anchored? > *Yes*

Electrical

- Does the building have a backup battery/generator system? > *No*
- Which best describes the building's electrical system?
- > No significant electrical equipment (rugged)



Expected Loss

LA	pected loss in percen	t of total building va	luc
Shaking Intensity	Return Period	SEL (%)	SUL (%)
50% in 50 years	72 Years	0.5	0.9
10% in 50 years	475 Years	9.3	17
DE	481 Years	9.5	17
5% in 50 years	975 Years	14	23
MCE_R	1277 Years	17	27
2% in 50 years	2475 Years	26	42

Expected loss in percent of total building value

Repair Time

	Median repair time summary							
	FEMA	A P-58 [†]	ATC-138 F	Functional Recov	ery (Beta) [‡]			
Intensity	Parallel	Series	Re- Occupancy	Functional	Full			
50% in 50 years	1.4 days	1.5 days	0 days	0 days	6.4 weeks			
10% in 50 years	3.8 weeks	4.8 weeks	11 days	2.8 months	3.4 months			
DE	3.9 weeks	5.1 weeks	12 days	2.8 months	3.5 months			
5% in 50 years	5.7 weeks	7.6 weeks	2.8 months	3.7 months	3.9 months			
MCE_R	6.8 weeks	2.1 months	3.1 months	3.8 months	4.1 months			
2% in 50 years	2.1 months	2.8 months	3.5 months	4.2 months	4.4 months			

[†] Does *not* include impedance factors

[‡] Does include impedance factors





2 BASIS OF ANALYSIS

This analysis is based on the SP3-RiskModel of the Seismic Performance Prediction Program (SP3) software platform. The underlying analysis methods are based on the FEMA P-58 analytical method, which is a transparent and well documented method developed through a 15 year project (Applied Technology Council, 2018). This project leveraged the previous decades of academic research, funded by a \$16 million investment by the Federal Emergency Management Agency (FEMA). In contrast to many risk assessment methods based on judgment and past earthquake experience, the FEMA P-58 and SP3 analysis are based on engineering-oriented risk evaluation methods.

3 DOCUMENTATION OF SITE AND BUILDING INPUT DATA

Project Name:Kensington Fire StationModel Name:New WLF w/ Frame

3.1 Site Information

Address:217 Arlington Avenue, Kensington, CA, 94707Latitude:37.90622°Longitude:-122.27875°

3.2 Building Information

Material Type:	WLF
Number of Stories:	2
Total Building Square Footage:	4,395
Occupancy Type:	Commercial Office
Total Expected Building Replacement Value:	\$1,378,558

4 SITE HAZARD INFORMATION

This section presents the site's seismic hazard information. The V_{S30} value is the shear wave velocity in the soil at a depth of 30 meters. This value and the associated site class are presented in Table 4.1.

Table 4.1. Site soil information	
V _{S30} (m/s):	537.0
Site Class:	С
Closest V_{S30} for USGS Hazard Lookup (m/s):	530

Table 4.2 and Figure 4.1 present the spectral acceleration information for this site. The spectral acceleration is a measure of how much force the building will attract in an earthquake. This amount of force is dependent on the intensity of the ground shaking (e.g. 10% in 50 years), as well as a dynamic property of the building known as the "fundamental period". Shorter buildings tend to have smaller fundamental periods and taller buildings tend to have larger fundamental periods. As indicated by Figure 4.1, smaller fundamental periods (with the exception of very short fundamental periods) will attract more force in an earthquake.

The Design Earthquake (DE) and Maximum Considered Earthquake (MCE) are based on the modern code maximum direction spectra and are converted to geometric mean for comparison.

Intensity	Return Period (yrs)	PGA	$S_a(0.2s)$	$S_a(1.0s)$	$S_a(0.4s)$	$S_a(0.41s)$	$S_a(T_1)$ Dir 1	$)/v_{ult}$ † Dir 2
50% in 50 years	72	0.22	0.52	0.17	0.39	0.39	0.46	0.49
10% in 50 years	475	0.62	1.50	0.56	1.20	1.18	1.41	1.50
DE	481	0.62	1.50	0.57	1.21	1.19	1.42	1.50
5% in 50 years	975	0.82	2.03	0.80	1.66	1.64	1.95	2.07
MCE_R	1277	0.91	2.26	0.91	1.85	1.83	2.17	2.31
2% in 50 years	2475	1.13	2.84	1.19	2.37	2.33	2.77	2.95

Table 4.2. Geometric mean spectral acceleration values (in g)

[†] $S_a(T_1)/v_{ult}$ is the ratio of shaking intensity to building strength where in direction 1 $v_{ult} = 0.854$ and $T_1 = 0.397$ s and in direction 2 $v_{ult} = 0.790$ and $T_1 = 0.409$ s (see Table 5.2 for more detailed structural properties)





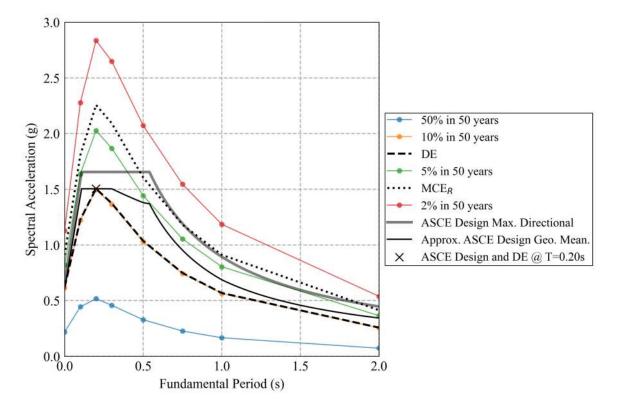


Figure 4.1. Hazard curves for this site. All curves are geometric mean unless otherwise stated.

5 BUILDING DESIGN SUMMARY FROM THE SP3 BUILDING CODE DESIGN DATABASE

5.1 Building Code Design Parameters

The seismic design parameters used to compute the seismic base shear coefficients for this building are presented in Table 5.1. These parameters are specific to ASCE/SEI 7-2010 (American Society of Civil Engineers, 2010).

Table 5.1. Code design parameters

(a) ASCE/SEI 7-2010 structural system parameters

(b) ASCE/SEI 7-2010 site specific parameters

Parameter	Dir. 1	Dir. 2	Parameter	Valu
C_t	0.02	0.02	S_s	2.48
C_d	4	4	S_1	1.03
x	0.75	0.75	S_{ds}	1.65
R	6.5	6.5	S_{d1}	0.89
Ω_0	3	3	SDC	E
			C_u	1.4

(c) ASCE/SEI 7-2010 site specific parameters based on the period of the building

Parameter	Value
$MCE_{R,max}(g)$	2.482
$MCE_{R,geomean}(g)$	2.155
$DE_{max}(g)$	1.655
$DE_{geomean}(g)$	1.437

5.2 Structural Properties

_

This section summarizes the main structural properties of the building in each direction. These structural properties are used as inputs to the SP3 Structural Response Prediction Engine.





Table 5.2. Structural properties table

Parameter	Direction 1	Direction 2
General		
Structural System	WLF: General	WLF: General
Building Edge Length (ft)	33	65
Detailing Level	Special	Special
Seismic Strength		
Seismic Design Base Shear Ratio, C_s †	0.382	0.382
Wind Strength		
Wind Design Base Shear Ratio, v_{wind} [†]	0.180	0.083
Total Strength		
Ultimate Base Shear Ratio, v_{ult}	0.854	0.790
Stiffness		
Design Drift (%)	-	_
$T_{1,design}$ (s)	0.29	0.29
T_1 with non-structural components (s)	0.40	0.41
T_1 Final (s)	0.40	0.41

[†] Design base shear values reported as LRFD



5.3 Mode Shapes

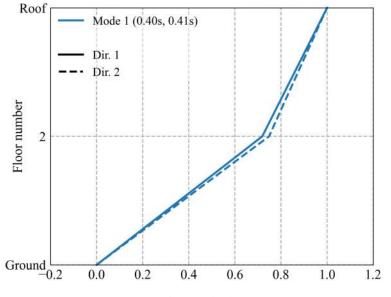


Figure 5.1. Mode shapes

	Dir. 1 Mode 1	Dir. 2 Mode 1
Roof	1.00	1.00
2	0.719	0.748
Ground	0.00	0.00

6 SP3 PERFORMANCE FACTORS

Table 6.1 compares the seismic design base shear, C_s , to the 475-year shaking (reduced by the modern response modification coefficient, R). Generally speaking, the modern building code design requirements are based on the 475-year event with the exception of extremely high seismic (near-fault) areas that are designed for a lesser deterministic ground motion or the transition region between deterministic and probabilistic portions of the ground motion maps.

The shaking intensity is then reduced by the response modification coefficient, R, based on the ductility level of the system (in anticipation of controlled damage of specially designed elements).

When the ratio of design base shear to the reduced spectra $(C_s / [S_a(T_1)_{475}/R])$ is 1.0, then the building was designed consistent with 10% in 50 year hazard. When the ratio is above 1.0, it was designed higher, so expect better performance (all other things equal), and for ratios below 1.0, expect worse performance.

	Dir. 1	Dir. 2
Seismic Design Base Shear, C_s	0.382	0.382
475-year Shaking Intensity, $S_a(T_1)_{475}$ [†]	1.20g	1.18g
Reduced Spectral Acceleration, $S_a(T_1)_{475}/R^{\ddagger}$	0.185g	0.182g
Ratio of Design Base Shear to 475-year Shaking Demand, $C_s/\left[S_a(T_1)_{475}/R ight]$ §	2.07	2.10
[†] T_1 includes all sources of overstiffness ($T_{1,dir1} = 0.397$ s and $T_{1,dir2} = 0.409$ s, see Tabl	e 5.2).	

Table 6.1. Design base shear vs. 475-year shaking intensity

[‡] Response Modification Coefficient, R, is from the modern code ($R_{dir1} = 6.5$ and $R_{dir2} = 6.5$).

7 BUILDING STABILITY

The FEMA P-154 collapse capacity score was calculated as follows using the "very high" seismicity level. The terminology used in this section is consistent with the FEMA P-154 methodology (Applied Technology Council, 2015a):

- $P[COL|MCE_R]_{P-154}$: the probability that the building will be in the HAZUS complete structural damage state when subjected to MCER shaking, times the collapse factor
- $P[COL|MCE_R]_{P-58}$: the probability that the building will be in the HAZUS complete structural damage state when subjected to MCER shaking
- Collapse Factor: expected ratio of collapsed area to total area given that the building is in the HAZUS Complete structural damage state

For a more in-depth explanation of "collapse," refer to Section 4.4.1.5 of FEMA P-155 Third Edition available <u>here</u> (Applied Technology Council, 2015b).

FEMA ID:	W2
Basic Score	1.8
Soil	0
Year	2
Plan Irregularity	0
Vertical Irregularity	0
Risk Category [†] (Cat IV)	0.8
Sum:	4.6
Minimum Allowed:	0.7
Score:	4.6
Dispersion (β):	0.58

Table 7.1. Breakdown of FEMA P-154 score assignment

[†] Non-standard property implemented by SP3

The FEMA P-154 probability of collapse at the MCE_R level event is then calculated as:

$$P[COL|MCE_R]_{P-154} = 10^{-\text{score}}$$

= 10^{-4.6} (FEMA P-155 eqn. 4-1)
= 0.00251%

Taking into account the fraction of floor area collapsed (0.33 in this case), the probability of collapse is:

$$P[COL|MCE_R]_{P-58} = P[COL|MCE_R]_{P-154} / \text{Collapse Factor}$$
$$= 0.00251\% / 0.33$$
$$= 0.00761\%$$

The median collapse capacity (before any direct modifications to the median) is calculated as:

$$S_{a, collapse median, P-58} = \exp\left(\ln(S_{a,MCE_R}) - \operatorname{norminv}\left(P[COL|MCE_R]_{P-58}\right) \cdot \beta\right)$$
$$= \exp\left(\ln(1.84g) - \operatorname{norminv}\left(0.00761\%\right) \cdot 0.58\right)$$
$$= 16.6q$$

where norminv is the inverse of the standard normal cumulative distribution function (CDF).



To further refine the collapse capacity, the factors from Table 7.2 were applied to the median collapse S_a .

Table 7.2. Scale factor applied to the me	nedian collapse S_a value.
---	------------------------------

Reason	Factor
Wood Light Frame	0.388

The WLF modification reflects a weighted average of the FEMA P-154 median and the median collapse capacity observed in extensive non-linear dynamic modeling.

The final median for the collapse curve is therefore:

$$S_{a, collapse median, P-58 (adjusted)} = S_{a, collapse median, P-58} \cdot \text{Factors}$$

= 16.6g \cdot 0.388 (Using additional SP3 factors)
= 6.43g

Which corresponds to a probability of collapse at MCE of:

$$P[COL|MCE_R]_{P-58 \ (adjusted)} = 1.55\%$$
 (Using additional SP3 factors)

Figure 7.1 shows the collapse capacity cumulative distribution function used in the analysis.

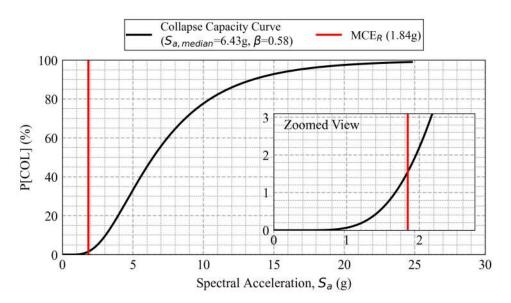


Figure 7.1. Cumulative distribution function for collapse capacity



8 STRUCTURAL RESPONSE PREDICTIONS FROM THE SP3 STRUCTURAL RESPONSE PREDICTION ENGINE

The SP3 Response Prediction Engine predicts the structural responses (typically providing 100 ground motions per intensity level); this is done by using a combination of three-mode elastic modal analysis, coupled with both elastic and inelastic response modifiers mined from the large SP3 Structural Responses Database (with over 4,000,000 response simulations, and growing). These response predictions track all of the important statistical information in the responses (mean, variability, and correlations); this enables a statistically robust vulnerability curve at the end of the risk assessment process.

8.1 Peak Interstory Drift

Peak interstory drift ratio is an important metric for both structural and non-structural components in the building. It measures how much the ceiling of a given story moves relative to the floor, normalized to the height of the story. The greater the interstory drift ratio, the greater the damage to the components on that level. Typical components that are damaged from interstory drift ratio are structural components (beams and columns), gypsum partition walls, and exterior cladding and glazing.

Story	50% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 years
2 1	0.05 0.18	0.30 1.37	0.30 1.38	0.46 2.16	0.50 2.57	0.58 3.76
$\frac{S_a(T_1)}{v_{ult}} =$	= 0.46	1.41	1.42	1.95	2.17	2.77

Table 8.1. Median Peak Interstory Drift dema	nds in direction 1
--	--------------------

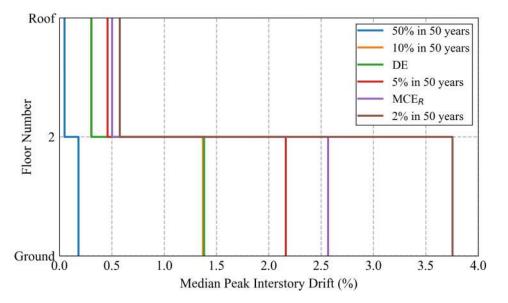


Figure 8.1. Median Peak Interstory Drift demands in direction 1





Story	50% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 years
2 1	0.04 0.20	0.28 1.48	0.28 1.49	0.40 2.36	0.43 2.80	0.48 4.03
$\frac{S_a(T_1)}{v_{ult}} =$	= 0.49	1.50	1.50	2.07	2.31	2.95

Table 8.2. Median Peak Interstory Drift demands in direction 2

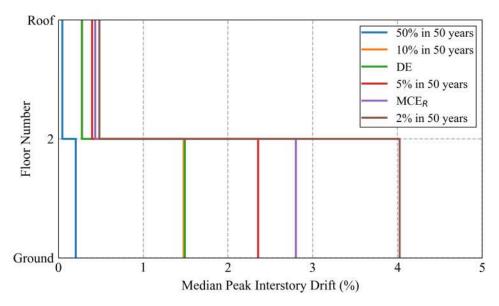


Figure 8.2. Median Peak Interstory Drift demands in direction 2



8.2 Residual Interstory Drift

Residual drift is a metric that informs the need for structural repairs or building demolition (where excessive drifts are present). Residual drift ratio is a measure of how much the building is "leaning over" after the seismic event has ceased. A residual drift of 2% would indicate that the story is laterally displaced 2% of it's height, which equates to about 3.6 inches for a 15 foot tall story.

Story	50% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 years
2 1	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.14	0.00 0.22	0.00 0.44
$\frac{S_a(T_1)}{v_{ult}} =$	= 0.46	1.41	1.42	1.95	2.17	2.77

Table 8.3. Median Residual Interstory Drift demands in direction 1

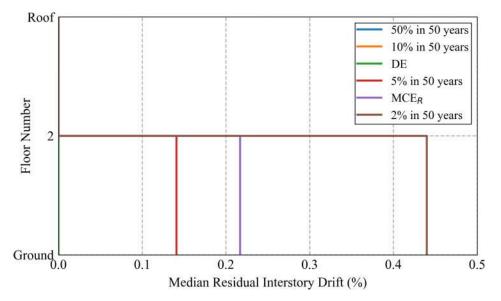


Figure 8.3. Median Residual Interstory Drift demands in direction 1



Story	50% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 years
2 1	0.00 0.00	0.00 0.01	0.00 0.02	0.00 0.18	0.00 0.26	0.00 0.49
$\frac{S_a(T_1)}{v_{ult}} =$	= 0.49	1.50	1.50	2.07	2.31	2.95

Table 8.4. Median Residual Interstory Drift demands in direction 2

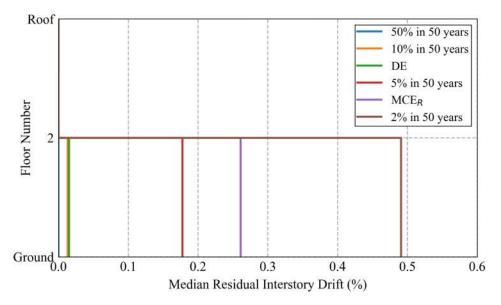


Figure 8.4. Median Residual Interstory Drift demands in direction 2

8.3 Peak Floor Acceleration

Peak floor acceleration is an an important metric for non-structural components in the building. Components such as piping, HVAC, and electrical switchgear are sensitive to the floor accelerations. High accelerations will typically damage a component itself or cause the component's anchorage to fail, both of which may require repair or replacement of the component.

Floor	50% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 years
Roof	0.32	0.98	0.99	1.14	1.19	1.22
2	0.25	0.97	0.97	1.05	1.10	1.19
Ground	0.22	0.62	0.62	0.82	0.91	1.13
$\frac{S_a(T_1)}{v_{ult}} =$	= 0.46	1.41	1.42	1.95	2.17	2.77

Table 8.5. Median Peak Floor Acceleration demands in direction 1

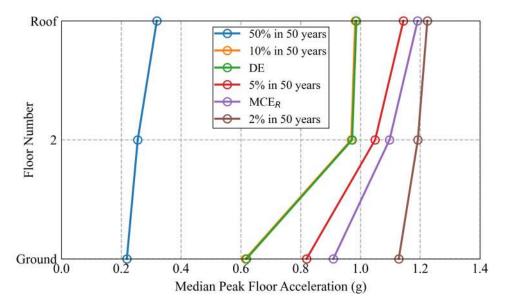


Figure 8.5. Median Peak Floor Acceleration demands in direction 1





Floor	50% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 years
Roof	0.32	0.96	0.97	1.11	1.14	1.15
2	0.26	0.94	0.94	1.01	1.07	1.14
Ground	0.22	0.62	0.62	0.82	0.91	1.13
$\frac{S_a(T_1)}{v_{ult}} =$	= 0.49	1.50	1.50	2.07	2.31	2.95

Table 8.6. Median Peak Floor Acceleration demands in direction 2

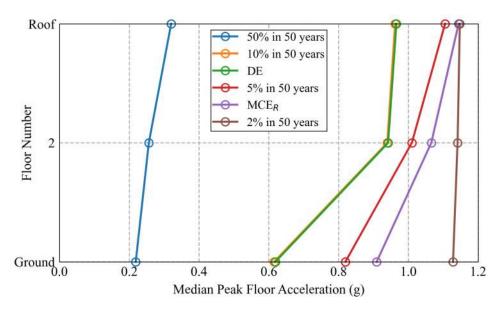


Figure 8.6. Median Peak Floor Acceleration demands in direction 2

8.4 Max. Residual Interstory Drift

	50% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 years
_	0.00	0.00	0.00	0.14	0.22	0.44
$\frac{S_a(T_1)}{v_{ult}} =$	= 0.46	1.41	1.42	1.95	2.17	2.77

Table 8.7. Median Max. Residual Interstory Drift demands in direction 1

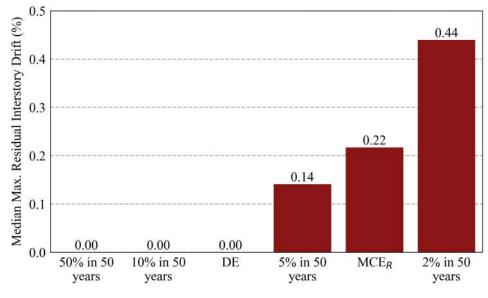


Figure 8.7. Median Max. Residual Interstory Drift demands in direction 1





	50% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 years
_	0.00	0.01	0.02	0.18	0.26	0.49
$\frac{S_a(T_1)}{v_{ult}} =$	= 0.49	1.50	1.50	2.07	2.31	2.95

Table 8.8. Median Max. Residual Interstory Drift demands in direction 2

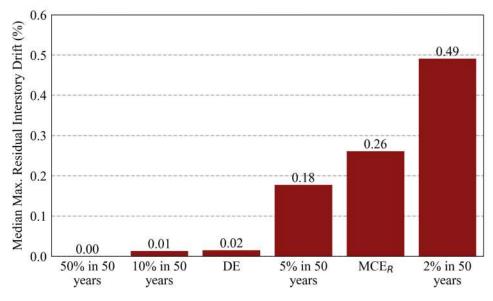


Figure 8.8. Median Max. Residual Interstory Drift demands in direction 2

9 REPAIR COSTS - BY LEVEL OF GROUND MOTION

9.1 Mean and 90th Percentile Repair Costs (SEL and SUL)

The different metrics for repair cost are as follows:

- Mean (SEL): ("Scenario Expected Loss") the average repair cost of the building repair/replacement.
- Median: there is a 50% probability that the repair cost will not exceed this value.
- Fitted SUL: Fitted value of "Scenario Upper Loss".
- Counted 90th Percentile: there is a 90% probability that the repair cost will not exceed this value.

Intensity	PGA (g)	Mean (SEL) (%)	Fitted SUL (%)	Median (%)	Counted 90 th Percentile (%)	$S_a(T_1)$ Dir 1	$)/v_{ult}$ † Dir 2
50% in 50 years	0.22	0.5	0.9	0.4	0.9	0.46	0.49
10% in 50 years	0.62	9.3	17	7.7	17	1.41	1.50
DE	0.62	9.5	17	8.0	17	1.42	1.50
5% in 50 years	0.82	14	23	12	23	1.95	2.07
MCE_R	0.91	17	27	14	27	2.17	2.31
2% in 50 years	1.13	26	42	19	42	2.77	2.95

Table 9.1. Loss metrics normalized by building cost

[†] $S_a(T_1)/v_{ult}$ is the ratio of shaking intensity to building strength where in direction 1 $v_{ult} = 0.854$ and $T_1 = 0.397$ s and in direction 2 $v_{ult} = 0.790$ and $T_1 = 0.409$ s (see Table 5.2 for more detailed structural properties)

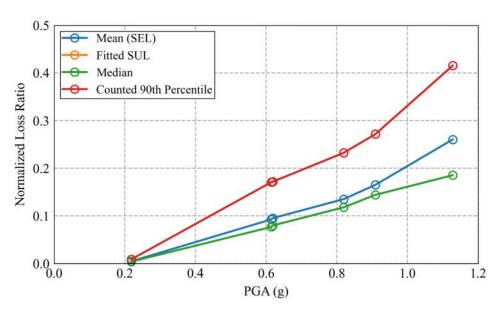


Figure 9.1. Loss metrics across all intensity levels analyzed



10 REPAIR COST BREAKDOWN BY BUILDING COMPONENTS

10.1 Categories for Repair Cost Breakdowns

Repair costs are binned into eight categories as follows:

- Collapse: building demolition and replacement following a collapse.
- Residual: building demolition and replacement following unacceptable residual drifts.
- **Structural**: components of the lateral force resisting system or gravity system (e.g. beam column connections, link beams, shear wall, shear tabs, etc.).
- Partitions: partition wall components (e.g. wood or metal stud gypsum full height partitions).
- **Exterior**: components placed on the exterior of the building (e.g. cladding, glazing, etc.).
- **Interior**: non-structural components on the interior of the building (e.g. raised access floors, ceilings, lighting).
- **HVAC**: HVAC and plumbing components (e.g. water piping and bracing, sanitary piping, ducting, boilers etc.).
- **Other**: components not included in the categories above (e.g. elevators, user defined components, fire protection components).

10.2 Repair Cost Breakdown for Various Ground Motion Levels

Intensity	Total	Structural	Residual	Interior	Partitions	Collapse	Exterior	HVAC	Other
50% in 50 years	0.5	0.1	0.0	0.0	0.3	0.0	0.0	0.0	0.0
10% in 50 years	9.3	1.4	0.0	3.2	3.4	0.0	0.4	0.7	0.2
DE	9.5	1.4	0.0	3.3	3.4	0.0	0.4	0.7	0.2
5% in 50 years	14	3.0	0.0	4.2	4.3	0.0	0.7	0.9	0.3
MCE_R	17	3.9	0.4	4.9	4.5	0.5	0.9	0.9	0.4
2% in 50 years	26	5.7	5.5	4.8	4.5	3.2	1.0	0.9	0.5

Table 10.1. Expected mean loss per component group (in percent)

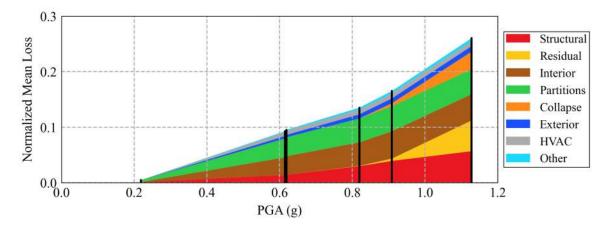


Figure 10.1. Contribution of building components to mean loss ratio





10.3 Repair Cost Breakdown for Expected Annual Loss

The expected annual loss for this building is \$1,236.

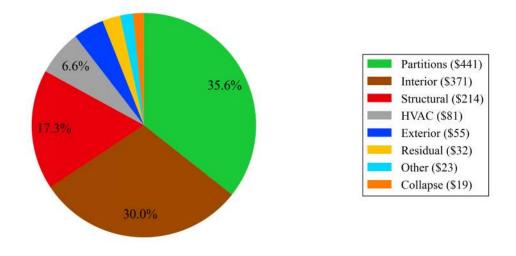


Figure 10.2. Annualized loss breakdown

11 REPAIR TIME AND BUILDING CLOSURE TIME

These downtimes were calculated using the ATC-138 Functional Recovery (Beta) Methodology. This includes all sources of impedance specified by the user; possible sources of impedance considered are listed below.

- Post-earthquake Inspection
- Engineering Mobilization and Review/Re-design
- Financing
- Contractor Mobilization and Bid Process
- Permitting

These capture the time required to start the repairs, since beginning repairs immediately after an earthquake may not be realistic.

	FEMA	FEMA P-58 [†]		ATC-138 Functional Recovery (Beta) [‡]			
Intensity	Parallel	Series	Re- Occupancy	Functional	Full		
50% in 50 years	1.4 days	1.5 days	0 days	0 days	6.4 weeks		
10% in 50 years	3.8 weeks	4.8 weeks	11 days	2.8 months	3.4 months		
DE	3.9 weeks	5.1 weeks	12 days	2.8 months	3.5 months		
5% in 50 years	5.7 weeks	7.6 weeks	2.8 months	3.7 months	3.9 months		
MCE_R	6.8 weeks	2.1 months	3.1 months	3.8 months	4.1 months		
2% in 50 years	2.1 months	2.8 months	3.5 months	4.2 months	4.4 months		

Table 11.1. Median repair time summary

[†] Does *not* include impedance factors

[‡] Does include impedance factors

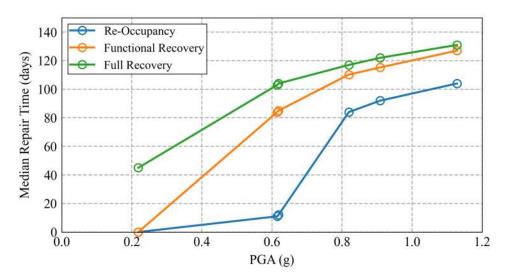


Figure 11.1. Median repair time from the ATC-138 Functional Recovery (Beta) Methodology, includes specified impeding factors





12 DISCLAIMER

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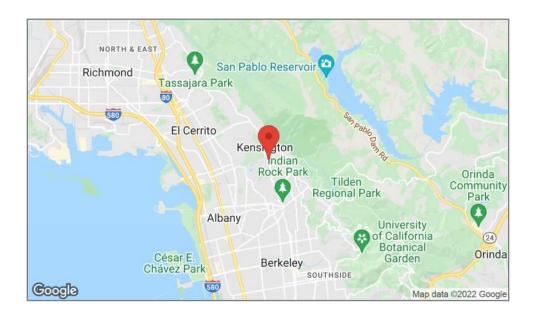
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SEISMIC RISK ASSESSMENT REPORT Created with the SP3-RiskModel

Functional Recovery Time Report using the ATC-138 Functional Recovery (Beta) Methodology



Report Generated for:

217 Arlington Avenue, Kensington, CA, 94707 Latitude: 37.90622° Longitude: -122.27875°

Report Generated by:

The SP3-RiskModel Software v1.2.0 of the Seismic Performance Prediction Program (SP3)

March 16, 2022



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				. –



1 SUMMARY OF INPUTS AND RISK RESULTS

Risk Model Inputs

Pi	rimary		Building Design Info				
Project Name: Model Name: Building Type: Year of Construction: Number of Stories: Occupancy:	New WLI WLF: Ge 2022 2	on Fire Station F w/ Frame neral cial Office	Level of Detailing (Dir. 1, 2): Drift Limit (Dir. 1, 2): Risk Category: Seismic Importance Factor, I_e Component Importance Factor				
Address: 217 Arlingt Kensington Latitude: Longitude:	on Avenue	0	Structural Pro Allow Components to Affect Structural Properties?	-	Yes		
			Mode Shapes Specified?] Dir. 1	No Dir. 2		
Include Collapse in Ana Consider Residual Drift	t:	Yes Yes	Directional PropertiesBase Shear Strength (g):Yield Drift (%): 1^{st} Mode Period (T_1) (s):	- - -	- - -		
Region Cost Multiplier: Date Cost Multiplier: Occupancy Cost Multip		- - -	Component Info	rmation			
Building La	vout Inform	ation	Selection Method	Cus	stom		
Cost per Square Foot: Scale component repair building value?	-	– No	Building Stal	bility _			
Total Square Feet: Aspect Ratio: First Story Height (ft): Upper Story Heights (ft Vertical Irregularity:):	4,395 1.95 13.5 9 None	Beta (Dispersion): Response No responses provided	-			
Plan Irregularity: Frac. of Full Height E Dir. 1 Story 1 Dir. 1 Upper Stories Dir. 2 Story 1 Dir. 2 Upper Stories		None /alls _ _ _ _					

Ground Motion and Soil Information

SP3 Default



SP3

Repair Time Options

Repair Time Method	ATC-138 (Beta)						
Factors Delaying Start of Repairs							
Inspection	Yes						
Financing	Yes						
Permitting	Yes						
Engineering Mobilization	Yes						
Contractor Mobilization	Yes						
Mitigation Factors							
Inspector on Retainer	No						
Engineer on Retainer	No						
Contractor on Retainer	No						
Funding Source	Private Loans						
Cash on Hand	-						

ATC-138 Functional Recovery (Beta) Options

Need HVAC for Function	-
Need Elevator for Function	-
Include Surge Demand	-

Component Checklist

Stairs and Elevators

- Does the building have stairs?
 - > Yes
 - What type of stairs are in the building?
 - > Light Frame

Interior Finishes

- Does the building have suspended ceilings?
 - > Yes
 - Are the ceilings laterally supported?

> Yes

- Does the building contain pendant (non-recessed) lighting?
 - > Yes
 - Are the pendant lights seismically rated? > *Yes*

Piping

- Is the building's water piping OSHPD certified or equivalent?
 - > Yes

HVAC

• Is the HVAC cooling/heating equipment seismically anchored? > *Yes*

Electrical

- Does the building have a backup battery/generator system? > *No*
- Which best describes the building's electrical system?
- > No significant electrical equipment (rugged)



Expected Loss

Expected loss in percent of total bunding value				
Shaking Intensity	Return Period	SEL (%)	SUL (%)	
50% in 50 years	72 Years	0.5	0.9	
10% in 50 years	475 Years	9.3	17	
DE	481 Years	9.5	17	
5% in 50 years	975 Years	14	23	
MCE_R	1277 Years	17	27	
2% in 50 years	2475 Years	26	42	

Expected loss in percent of total building value

Repair Time

Median repair time summary								
	FEMA	A P-58 [†]	ATC-138 I	Functional Recov	ery (Beta) [‡]			
Intensity	Parallel	Series	Re- Occupancy	Functional	Full			
50% in 50 years	1.4 days	1.5 days	0 days	0 days	6.4 weeks			
10% in 50 years	3.8 weeks	4.8 weeks	11 days	2.8 months	3.4 months			
DE	3.9 weeks	5.1 weeks	12 days	2.8 months	3.5 months			
5% in 50 years	5.7 weeks	7.6 weeks	2.8 months	3.7 months	3.9 months			
MCE_R	6.8 weeks	2.1 months	3.1 months	3.8 months	4.1 months			
2% in 50 years	2.1 months	2.8 months	3.5 months	4.2 months	4.4 months			

[†] Does *not* include impedance factors

[‡] Does include impedance factors



2 FUNCTIONAL RECOVERY OVERVIEW

					Median			90 th Percentile		
Intensity	Return Period	PGA (g)	$\operatorname{Sa}(T_1)^*$	Re- Occ.	Func.	Full	Re- Occ.	Func.	Full	
50% in 50 years	72 years	0.22	0.39	0d	0d	6.4w	0d	0d	3.7m	
10% in 50 years	475 years	0.62	1.19	11d	2.8m	3.4m	4.2m	5.1m	5.5m	
DE	481 years	0.62	1.20	12d	2.8m	3.5m	4.4m	5.3m	5.6m	
5% in 50 years	975 years	0.82	1.65	2.8m	3.7m	3.9m	5.1m	5.8m	5.9m	
MCE_R	1277 years	0.91	1.84	3.1m	3.8m	4.1m	5.3m	6.1m	6.3m	
2% in 50 years	2475 years	1.13	2.35	3.5m	4.2m	4.4m	6.7m	7.5m	7.6m	

Table 2.1. Recovery Times from the ATC-138 Functional Recovery (Beta) Methodology

* Sa (T_1) is the spectral acceleration at T_1 where is the mean of T_1 in both directions

Table 2.2. Global Consequences

Intensity	Return Period	PGA (g)	$\operatorname{Sa}(T_1)^*$	P[red tag]	P[collapse]	P[excessive residual]
50% in 50 years	72 years	0.22	0.39	0.0%	0.0%	0.0%
10% in 50 years	475 years	0.62	1.19	0.0%	0.0%	0.0%
DE	481 years	0.62	1.20	0.0%	0.0%	0.0%
5% in 50 years	975 years	0.82	1.65	0.0%	0.0%	0.0%
MCE_R	1277 years	0.91	1.84	0.9%	0.5%	0.4%
2% in 50 years	2475 years	1.13	2.35	8.7%	3.2%	5.5%

* Sa (T_1) is the spectral acceleration at T_1 where is the mean of T_1 in both directions

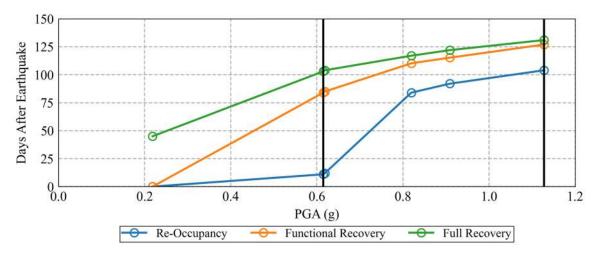


Figure 2.1. ATC-138 Functional Recovery (Beta) Methodology median recovery times





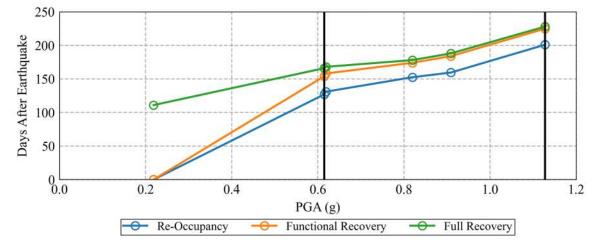


Figure 2.2. ATC-138 Functional Recovery (Beta) Methodology 90^{th} percentile recovery times

3 COMPONENT DAMAGE OVERVIEW

3.1 Most Damaged Components

This section outlines the most damaged component at each intensity. "Most damaged" is determined by cost and does not necessarily mean that it's the main component impeding building function.

Intensity	Component	Damage State	Expected Repair Cost
50% in 50 years	B1071.302	1	\$1,368
10% in 50 years	B1071.302	1	\$9,629
DE	B1071.302	1	\$9,731
5% in 50 years	B1071.302	1	\$16,072
MCE_R	B1031.011a	1	\$18,918
2% in 50 years	B1031.011a	1	\$34,920

Table 3.1. Most damaged Structural components at each intensity level.

Table 3.2. Most damaged Non-Structural components at each intensity level.

Intensity	Component	Damage State	Expected Repair Cost
50% in 50 years	C1011.311a	1	\$3,176
10% in 50 years	C1011.311a	1	\$31,144
DE	C1011.311a	1	\$31,440
5% in 50 years	C1011.311a	3	\$38,842
MCE_R	C1011.311a	3	\$40,722
2% in 50 years	C1011.311a	3	\$40,630

Details of the most damaged components and their damage states:

- B1031.011a: Steel Column Base Plates, Column W < 150 plf
 - DS1a: Initiation of crack at the fusion line between the column flange and the base plate weld. Damage in field is either obscured or deemed to not warrant repair. No repair conducted.
 - DS1b: Initiation of crack at the fusion line between the column flange and the base plate weld.
- **B1071.302**: Interior Structural Wall Light framed wood walls with structural panel sheathing, gypsum wallboard on both sides, with hold-downs
 - DS1: Cracking of paint over fasteners or joints.
- **C1011.311a**: Interior of Exterior Wall Type: Gypsum with wood studs (single-sided gypsum), Full Height, Fixed Below, Fixed Above
 - DS1: Cracking of paint over fasteners or joints.
 - DS3: Local and global buckling out-of-plane and crushing of gypsum wallboards. Studs are typically not damaged by failure of the gypsum wallboard, but framing adjustments possible for this damage state.



3.2 Worker Days Summary

This table shows the expected worker days on a per-damage state basis. The header shows the probability of global failures (collapse and residual drift demolition) for reference.

The color scale is meant to indicate **relative** performance of components, not absolute performance. A "green" value does not indicate that the value falls in a pre-determined "good" range, just that it performs well compared to other components. Likewise, a "red" value does not indicate that the value falls in a pre-determined "bad" range, just that it performs worse compared to other components.

50	0% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 years
P[Col](%)	0.0	0.0	0.0	0.0	0.5	3.2
P[Res](%)	0.0	0.0	0.0	0.0	0.4	5.5
B1031.011a	#1 (B1031.011a	: Steel Column Base H	Plates, Colum	n W < 150 plf)		
DS1a	0.0	0.0	0.0	0.0	0.0	0.0
DS1b	0.0	0.2	0.4	0.7	0.9	1.3
DS2	0.0	1.1	1.3	4.5	7.3	13
DS3	0.0	0.3	0.5	2.5	5.0	10
Total	0.0	1.6	2.2	7.7	13	24
B1035.041 #	1 (B1035.041:]	Pre-Northridge WUF-	B beam-colu	mn joint, beam one sid	le of column,	beam depth)
DS1a	0.0	0.0	0.0	0.1	0.1	0.2
DS1b	0.0	0.0	0.0	0.0	0.1	0.1
DS2a	0.0	0.0	0.0	0.0	0.0	0.1
DS2b	0.0	0.0	0.0	0.0	0.0	0.0
DS3	0.0	0.0	0.0	0.0	0.0	0.0
Total	0.0	0.0	0.0	0.2	0.2	0.3
B1035.051 #	1 (B1035.051:]	Pre-Northridge WUF-	B beam-colu	mn joint, beam both si	ides of colum	n, beam)
DS1a	0.0	0.0	0.0	0.1	0.3	0.3
DS1b	0.0	0.0	0.0	0.1	0.1	0.1
DS2a	0.0	0.0	0.0	0.0	0.0	0.1
DS2b	0.0	0.0	0.0	0.0	0.0	0.0
DS3	0.0	0.0	0.0	0.0	0.0	0.0
Total	0.0	0.0	0.0	0.2	0.4	0.5
B1071.202 #	1 (B1071.202:]	Exterior Structural Wa	all - Light fra	amed wood walls with	structural pa	nel)
DS1	0.0	2.7	2.6	2.5	2.3	1.4
DS2	0.0	1.0	1.0	1.9	2.1	2.0
DS3	0.0	1.2	1.2	4.4	6.1	10
Total	0.0	4.9	4.9	8.9	11	13
B1071.302 #	1 (B1071.302:]	Interior Structural Wa	ll - Light fra	med wood walls with	structural par	nel)
DS1	0.6	0.4	0.4	0.3	0.3	0.3
DS2	0.1	0.4	0.5	0.4	0.4	0.3
DS3	0.1	2.4	2.3	2.2	2.0	1.2
DS4	0.0	1.9	2.0	3.7	4.0	3.6
DS5	0.0	1.7	1.7	6.1	8.9	14
Total	0.8	6.9	7.0	13	16	19
B2011.401 #	1 (B2011.401:]	Exterior Wall - Light f	ramed wood	walls with exterior pa	nelized sheat	ning)
D2011.401 #	0.1	2.8	2.8	2.5	2.3	1.6
DS1 DS2	0.0	2.2	2.0	2.5	2.4	1.8
DS3	0.0	5.9	5.8	12	15	18
Total	0.1	11	11	17	19	22

Table 3.3. Expected worker days per damage state (Worker Days)

Continued on next page



	Table	3.3 (Continued). Expect	ed worker da	ys per damage state (We	orker Days)	
50	% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 years
P[Col](%)	0.0	0.0	0.0	0.0	0.5	3.2
P[Res](%)	0.0	0.0	0.0	0.0	0.4	5.5
C1011.211a	#1 (C1011.211a	a: Wall Partition - Type	e: Gypsum y	vith wood studs (both	sides), Full Ho	eight)
DS1	0.7	1.1	1.2	1.0	1.0	0.8
DS2	0.1	1.0	1.0	1.0	1.0	0.8
DS3	0.1	6.7	6.6	9.3	10	10
Total	0.9	8.8	8.8	11	12	12
C1011.311a	#1 (C1011.311a	a: Interior of Exterior	Wall - Type:	Gypsum with wood s	tuds (single-si	ded)
DS1	1.4	2.0	2.0	1.7	1.7	1.4
DS2	0.2	2.1	2.0	1.9	1.7	1.5
DS3	0.1	13	13	18	20	20
Total	1.8	17	18	22	23	23
		b: Light frame stair fra		oximation as a placeh	older until the	
DS1	0.0	0.5	0.5	0.4	0.4	0.3
DS2	0.0	0.7	0.7	1.2	1.3	1.4
DS3	0.0	0.6	0.7	2.1	2.7	4.3
Total	0.0	1.8	1.9	3.7	4.5	6.0
C3032.004a ‡	#1 (C3032.004a	a: Suspended Ceiling, S	SDC D,E,F (Ip=1.5), Area (A): A <	250, Vert & I	Lat)
DS1	0.0	0.3	0.3	0.3	0.3	0.3
DS2	0.0	0.4	0.4	0.6	0.5	0.5
DS3	0.0	4.0	4.3	6.0	7.1	6.7
Total	0.0	4.7	5.0	6.9	8.0	7.6
C3032.004b i	#1 (C3032.004)	b: Suspended Ceiling,	SDC D,E,F (Ip=1.5), Area (A): 250) < A < 1000, V	Vert & Lat)
DS1	0.0	0.4	0.4	0.4	0.4	0.4
DS2	0.0	0.7	0.6	0.9	0.9	0.9
DS3	0.0	4.7	5.1	6.9	8.0	8.3
Total	0.0	5.8	6.2	8.2	9.3	10
	#1 (C3032.004c	: Suspended Ceiling, S	SDC D,E,F (I	(p=1.5), Area (A): 100	0 < A < 2500,	
DS1	0.0	0.7	0.7	0.7	0.7	0.7
DS2	0.0	0.9	1.0	1.2	1.4	1.3
DS3	0.0	5.5	5.6	7.9	9.4	8.7
Total	0.0	7.0	7.3	10	11	11
C3032.004d a	#1 (C3032.004	d: Suspended Ceiling,	SDC D,E,F (Ip=1.5), Area (A): A >	> 2500, Vert &	: Lat)
DS1	0.0	0.7	0.8	0.8	0.8	0.8
DS2	0.0	1.2	1.2	1.4	1.7	1.5
DS3	0.0	5.6	5.9	7.4	9.1	9.0
Total	0.0	7.6	7.9	10	12	11
C3034.002 #1	1 (C3034.002:	Independent Pendant l		ismically rated)		
DS1	0.1	3.1	3.3	3.5	3.6	3.3
		a: Cold or Hot Potable				,
DS1	0.0	0.0	0.0	0.0	0.0	0.0
DS2	0.0	0.0	0.0	0.1	0.1	0.1
Total	0.0	0.1	0.1	0.1	0.1	0.1
		b: Cold or Hot Potable				
DS1	0.0	0.1	0.1	0.1	0.1	0.1
		a: Cold or Hot Potable	-			
DS1	0.0	0.0	0.0	0.0	0.0	0.0
DS2	0.0	0.0	0.0	0.1	0.1	0.1
Total	0.0	0.1	0.1	0.1	0.1	0.1

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50	% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 years
P[Col](%)	0.0	0.0	0.0	0.0	0.5	3.2
P[Res](%)	0.0	0.0	0.0	0.0	0.4	5.5
D2021.023b #	#1 (D2021.023I	o: Cold or Hot Potable	Water Pipir	g (dia > 2.5 inches), S	DC D,E,F, BR	ACING)
DS1	0.0	0.0	0.0	0.0	0.0	0.0
DS2	0.0	0.0	0.0	0.0	0.0	0.0
Total	0.0	0.1	0.1	0.1	0.1	0.1
D2031.013b #	#1 (D2031.013)	o: Sanitary Waste Pipi	ng - Cast Iro	n w/flexible couplings	, SDC D,E,F,	BRACING)
DS1	0.0	0.0	0.0	0.1	0.1	0.1
D3032.013c #	‡1 (D3032.013c	: Compressor - Capac	ity: Small no	on medical air supply	- Equipment t	hat is)
DS1a	0.0	0.0	0.0	0.0	0.0	0.0
DS1b	0.0	0.0	0.0	0.0	0.0	0.0
DS1c	0.0	0.0	0.0	0.0	0.0	0.0
DS1d	0.0	0.0	0.0	0.1	0.1	0.1
Total	0.0	0.0	0.0	0.1	0.2	0.2
D3032.013c #	‡2 (D3032.013c	: Compressor - Capac	ity: Small no	on medical air supply	- Equipment t	hat is)
DS1a	0.0	0.1	0.1	0.1	0.1	0.1
DS1b	0.0	0.1	0.1	0.2	0.2	0.1
DS1c	0.0	0.1	0.1	0.2	0.2	0.1
DS1d	0.0	0.6	0.5	0.7	0.8	0.7
Total	0.0	0.9	0.8	1.2	1.2	1.1
D3041.011c #	‡1 (D3041.011c	: HVAC Galvanized S	heet Metal D	ucting less than 6 sq.	ft in cross sec	tional)
DS1	0.0	0.1	0.1	0.1	0.1	0.1
DS2	0.0	0.2	0.2	0.2	0.3	0.3
Total	0.0	0.3	0.3	0.3	0.3	0.3
D3041.032c #	‡1 (D3041.032c	: HVAC Drops / Diffus	sers without	ceilings - supported by	y ducting only	- No)
DS1	0.2	6.0	6.4	7.0	7.6	7.3

3.3 Component Name Reference

This list is provided for reference where only the fragility ID is available.

- B1031.011a: Steel Column Base Plates, Column W < 150 plf
- **B1035.041**: Pre-Northridge WUF-B beam-column joint, beam one side of column, beam depth <= W27
- B1035.051: Pre-Northridge WUF-B beam-column joint, beam both sides of column, beam depth <= W27
- **B1071.202**: Exterior Structural Wall Light framed wood walls with structural panel sheathing, with hold-downs
- **B1071.302**: Interior Structural Wall Light framed wood walls with structural panel sheathing, gypsum wallboard on both sides, with hold-downs
- **B2011.401**: Exterior Wall Light framed wood walls with exterior panelized sheathing (OSB) and horizontal wood siding, no hold-downs
- C1011.211a: Wall Partition Type: Gypsum with wood studs (both sides), Full Height, Fixed Below, Fixed Above
- **C1011.311a**: Interior of Exterior Wall Type: Gypsum with wood studs (single-sided gypsum), Full Height, Fixed Below, Fixed Above
- C2011.041b: Light frame stair fragility. Approximation as a placeholder until there is more research on the topic. Damage states from P-58 Light frame stair example. Costing approximated from various online sources for stair replacement.
- C3032.004a: Suspended Ceiling, SDC D,E,F (Ip=1.5), Area (A): A < 250, Vert & Lat support
- **C3032.004b**: Suspended Ceiling, SDC D,E,F (Ip=1.5), Area (A): 250 < A < 1000, Vert & Lat support
- **C3032.004c**: Suspended Ceiling, SDC D,E,F (Ip=1.5), Area (A): 1000 < A < 2500, Vert & Lat support
- C3032.004d: Suspended Ceiling, SDC D,E,F (Ip=1.5), Area (A): A > 2500, Vert & Lat support
- C3034.002: Independent Pendant Lighting seismically rated
- **D2021.013a**: Cold or Hot Potable Small Diameter Threaded Steel (2.5 inches in diameter or less), SDC D, E, or F, PIPING FRAGILITY
- **D2021.013b**: Cold or Hot Potable Small Diameter Threaded Steel (2.5 inches in diameter or less), SDC D, E, or F, BRACING FRAGILITY
- D2021.023a: Cold or Hot Potable Water Piping (dia > 2.5 inches), SDC D,E,F, PIPING FRAGILITY
- **D2021.023b**: Cold or Hot Potable Water Piping (dia > 2.5 inches), SDC D,E,F, BRACING FRAGILITY
- D2031.013b: Sanitary Waste Piping Cast Iron w/flexible couplings, SDC D,E,F, BRACING FRAGILITY
- D3032.013c: Compressor Capacity: Small non medical air supply Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints Combined anchorage/isolator & equipment fragility





- D3041.011c: HVAC Galvanized Sheet Metal Ducting less than 6 sq. ft in cross sectional area, SDC D, E, or F
- **D3041.032c**: HVAC Drops / Diffusers without ceilings supported by ducting only No independent safety wires, SDC D, E, or F

4 DETAILED REOCCUPANCY AND FUNCTIONALITY RESULTS BY GROUND MOTION INTENSITY

4.1 50% in 50 years Intensity

4.1.1 Selected Realizations for 50th percentile

Note that this is a single realization and may not be representative of a general trend. This selected realization is intended to give a sense of what the repair schedule may look like, it is not intended to generalize what the "typical" repair schedule looks like.

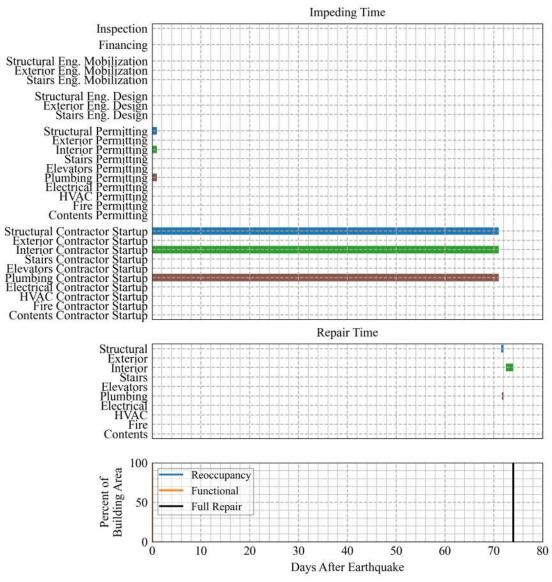


Figure 4.1. 50% in 50 years Percentile = 50





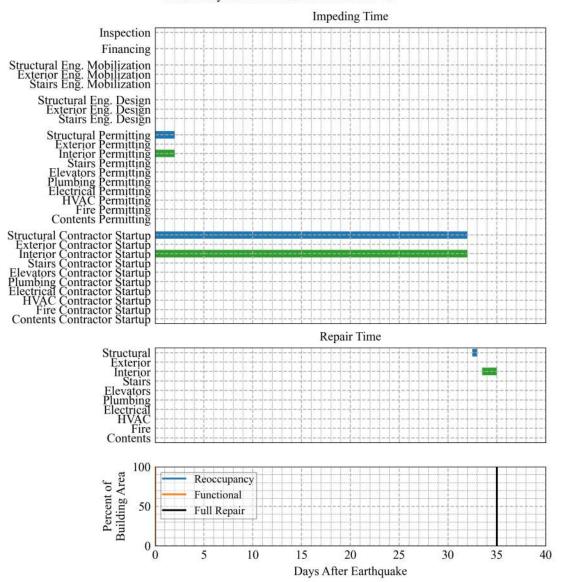


Figure 4.2. 50% in 50 years Percentile = 49



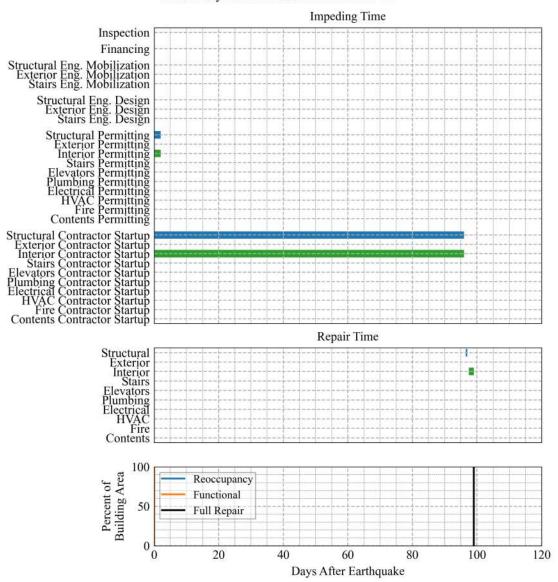


Figure 4.3. 50% in 50 years Percentile = 51

4.1.2 Selected Realizations for 90th percentile

Note that this is a single realization and may not be representative of a general trend. This selected realization is intended to give a sense of what the repair schedule may look like, it is not intended to generalize what the "typical" repair schedule looks like.

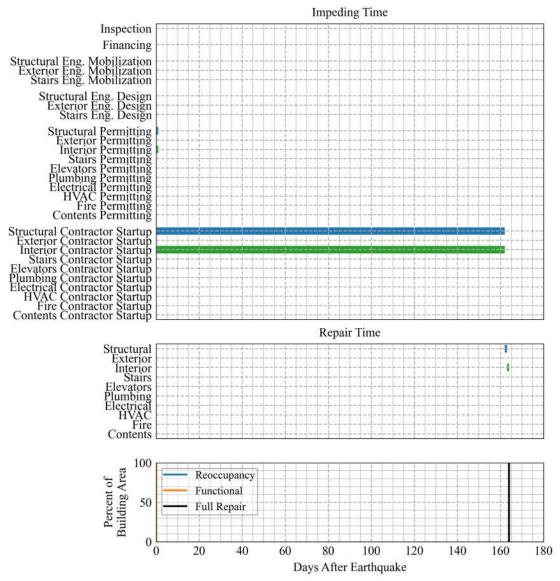


Figure 4.4. 50% in 50 years Percentile = 90



4.1.3 Damage to Building Systems

Table 4.1 shows the percentage of realizations that the named system prevents reoccupancy/function for the 50% in 50 years intensity. Note that if a system prevents reoccupancy, it will also prevent functionality. This means that the functionality checks may all be fine, but if the reoccupancy checks indicate the building is not reoccupiable then the building will not be considered functional.

Each column represents a milestone time after the earthquake and the values in that column indicate the percentage of realizations in which that component is preventing reoccupancy/functionality at that milestone.

	Immediate	>3 days	>7 days	>14 days	>1 month	>6 months	>12 months
Building Reoccupancy	(also affects fu	nction)					
Red Tag (Structural)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hazardous Material	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fire Egress	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Entry Door Access	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Falling hazard	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Entry Door Racking	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Stairs	0.1	0.1	0.1	0.1	0.1	0.0	0.0
Stairway Doors	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Exterior	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Interior	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Building Function (affe	cts function on	ly, not reocc	upancy)				
Elevators	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Exterior	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Interior	0.5	0.5	0.3	0.0	0.0	0.0	0.0
Water	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Electrical	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HVAC	1.7	1.7	1.7	1.6	1.3	0.0	0.0

Table 4.1. Percent of realizations affecting building reoccupancy/function per system - 50% in 50 years



4.1.4 Damage to Individual Components

Table 4.2 shows the percentage of realizations that a specific component prevents reoccupancy/function for the 50% in 50 years intensity. Note that if a component prevents reoccupancy, it will also prevent functionality.

Each column represents a milestone time after the earthquake and the values in that column indicate the percentage of realizations in which that component is preventing reoccupancy/functionality at that milestone.

	Immediate	>3 days	>7 days	>14 days	>1 month	>6 months	>12 months
B1031.011a	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
B1035.041	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
B1035.051	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
B1071.202	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
B1071.302	0.0 / 0.3	0.0 / 0.2	0.0 / 0.1	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
B2011.401	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
C1011.211a	0.0 / 0.1	0.0 / 0.1	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
C1011.311a	0.0 / 0.5	0.0 / 0.5	0.0 / 0.3	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
C2011.041b	0.1 / 0.0	0.1 / 0.0	0.1 / 0.0	0.1 / 0.0	0.1 / 0.0	0.0 / 0.0	0.0 / 0.0
C3032.004a	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
C3032.004b	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
C3032.004c	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
C3032.004d	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
C3034.002	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D2021.013a	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D2021.013b	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D2021.023a	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D2021.023b	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D2031.013b	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D3032.013c	0.0 / 1.1	0.0 / 1.1	0.0 / 1.1	0.0 / 1.1	0.0 / 0.9	0.0 / 0.0	0.0 / 0.0
D3041.011c	0.0 / 0.1	0.0 / 0.1	0.0 / 0.1	0.0 / 0.1	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D3041.032c	0.0 / 0.5	0.0 / 0.5	0.0 / 0.5	0.0 / 0.5	0.0 / 0.4	0.0 / 0.0	0.0 / 0.0

Table 4.2. Percent of realizations affecting building reoccupancy/functionality per component - 50% in 50 years





4.2 10% in 50 years Intensity

4.2.1 Selected Realizations for 50th percentile

Note that this is a single realization and may not be representative of a general trend. This selected realization is intended to give a sense of what the repair schedule may look like, it is not intended to generalize what the "typical" repair schedule looks like.

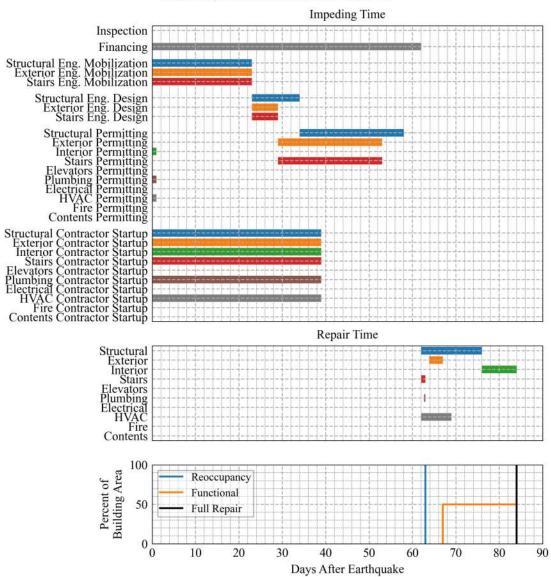


Figure 4.5. 10% in 50 years Percentile = 50



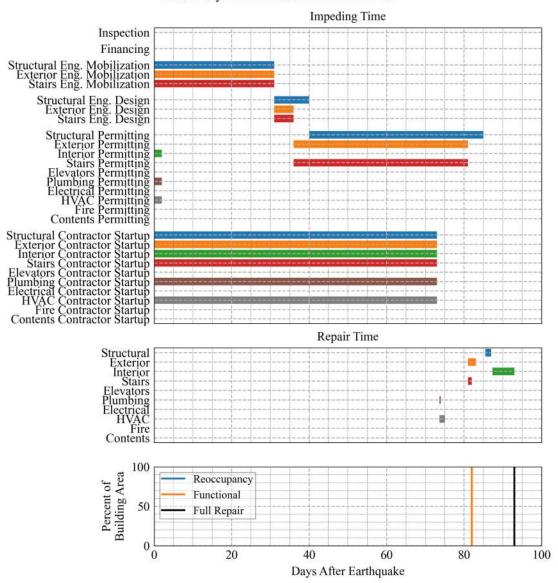


Figure 4.6. 10% in 50 years Percentile = 49



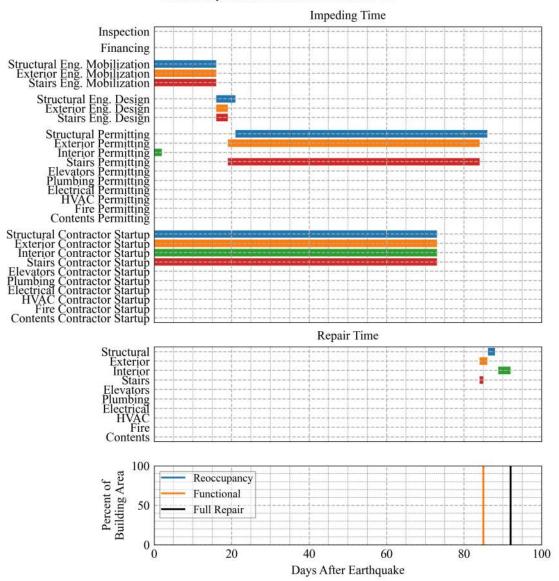
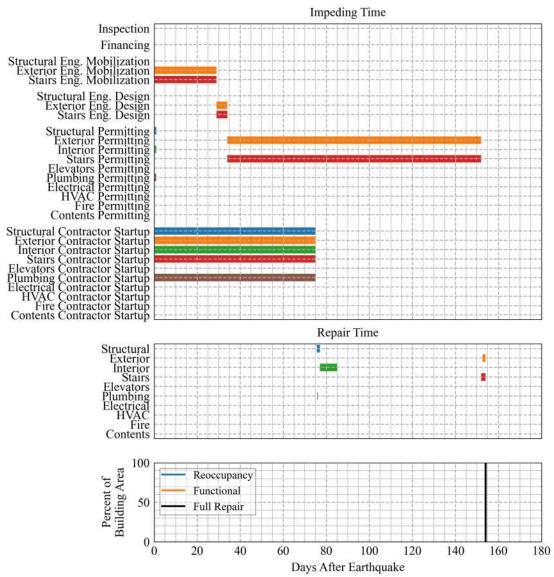


Figure 4.7. 10% in 50 years Percentile = 51

4.2.2 Selected Realizations for 90th percentile

Note that this is a single realization and may not be representative of a general trend. This selected realization is intended to give a sense of what the repair schedule may look like, it is not intended to generalize what the "typical" repair schedule looks like.



10% in 50 years: Realization for Percentile=90

Figure 4.8. 10% in 50 years Percentile = 90



4.2.3 Damage to Building Systems

Table 4.3 shows the percentage of realizations that the named system prevents reoccupancy/function for the 10% in 50 years intensity. Note that if a system prevents reoccupancy, it will also prevent functionality. This means that the functionality checks may all be fine, but if the reoccupancy checks indicate the building is not reoccupiable then the building will not be considered functional.

Each column represents a milestone time after the earthquake and the values in that column indicate the percentage of realizations in which that component is preventing reoccupancy/functionality at that milestone.

-	Immediate	>3 days	>7 days	>14 days	>1 month	>6 months	>12 months
Building Reoccupancy	(also affects fu	nction)					
Red Tag (Structural)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hazardous Material	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fire Egress	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Entry Door Access	1.0	0.0	0.0	0.0	0.0	0.0	0.0
Falling hazard	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Entry Door Racking	1.0	0.0	0.0	0.0	0.0	0.0	0.0
Stairs	40	40	40	40	40	1.6	0.0
Stairway Doors	2.6	0.0	0.0	0.0	0.0	0.0	0.0
Exterior	56	53	29	6.9	0.4	0.0	0.0
Interior	31	27	14	8.4	7.2	0.2	0.0
Building Function (affe	cts function on	ly, not reocc	upancy)				
Elevators	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Exterior	17	17	17	17	17	0.9	0.0
Interior	71	66	35	12	4.7	0.1	0.0
Water	7.8	7.8	7.8	7.6	7.0	0.2	0.0
Electrical	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HVAC	60	60	60	59	56	3.6	0.0

Table 4.3. Percent of realizations affecting building reoccupancy/function per system - 10% in 50 years



4.2.4 Damage to Individual Components

Table 4.4 shows the percentage of realizations that a specific component prevents reoccupancy/function for the 10% in 50 years intensity. Note that if a component prevents reoccupancy, it will also prevent functionality.

Each column represents a milestone time after the earthquake and the values in that column indicate the percentage of realizations in which that component is preventing reoccupancy/functionality at that milestone.

	Immediate	>3 days	>7 days	>14 days	>1 month	>6 months	>12 months
B1031.011a	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
B1035.041	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
B1035.051	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
B1071.202	20 / 18	18 / 17	7.6 / 14	1.8 / 13	0.3 / 13	0.0 / 0.7	0.0 / 0.0
B1071.302	0.0 / 71	0.0 / <mark>66</mark>	0.0 / 34	0.0 / 18	0.0 / 17	0.0 / 0.9	0.0 / 0.0
B2011.401	56 / 63	53 / 58	27 / 27	5.9 / 17	0.4 / 17	0.0 / 0.9	0.0 / 0.0
C1011.211a	0.0 / <mark>65</mark>	0.0 / 58	0.0 / 17	0.0 / 2.0	0.0 / 0.3	0.0 / 0.0	0.0 / 0.0
C1011.311a	0.0 / <mark>70</mark>	0.0 / <mark>65</mark>	0.0 / 32	0.0 / 7.8	0.0 / 0.5	0.0 / 0.0	0.0 / 0.0
C2011.041b	40 / 0.0	40 / 0.0	40 / 0.0	40 / 0.0	40 / 0.0	1.6 / 0.0	0.0 / 0.0
C3032.004a	18 / 12	<u>16</u> / 10	5.5 / 3.3	1.0 / 0.6	0.2 / 0.1	0.0 / 0.0	0.0 / 0.0
C3032.004b	19 / 14	16 / 12	5.1 / 4.1	0.9 / 0.6	0.1 / 0.1	0.0 / 0.0	0.0 / 0.0
C3032.004c	22 / 16	17 / 13	5.9 / 4.0	1.0 / 0.7	0.2 / 0.2	0.0 / 0.0	0.0 / 0.0
C3032.004d	23 / 18	19 / 14	6.4 / 4.2	1.1 / 0.9	0.2 / 0.1	0.0 / 0.0	0.0 / 0.0
C3034.002	31 / 56	26 / 50	9.8 / 16	1.8 / 1.8	0.2 / 0.4	0.0 / 0.0	0.0 / 0.0
D2021.013a	4.7 / 4.7	4.7 / 4.7	4.7 / 4.7	4.6 / 4.6	4.3 / 4.3	0.1 / 0.1	0.0 / 0.0
D2021.013b	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D2021.023a	4.4 / 4.4	4.4 / 4.4	4.4 / 4.4	4.3 / 4.3	4.0 / 4.0	0.1 / 0.1	0.0 / 0.0
D2021.023b	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D2031.013b	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D3032.013c	0.0 / 31	0.0 / 31	0.0 / 31	0.0 / 30	0.0 / <mark>26</mark>	0.0 / 0.7	0.0 / 0.0
D3041.011c	19 / 31	9.6 / 3 1	1.0 / <mark>31</mark>	0.3 / 31	0.1 / 31	0.0 / 2.6	0.0 / 0.0
D3041.032c	30 / 58	26 / 56	13 / 49	8.0 / 43	6.8 / <mark>40</mark>	0.2 / 3.1	0.0 / 0.0

Table 4.4. Percent of realizations affecting building reoccupancy/functionality per component - 10% in 50 years





4.3 DE Intensity

4.3.1 Selected Realizations for 50th percentile

Note that this is a single realization and may not be representative of a general trend. This selected realization is intended to give a sense of what the repair schedule may look like, it is not intended to generalize what the "typical" repair schedule looks like.

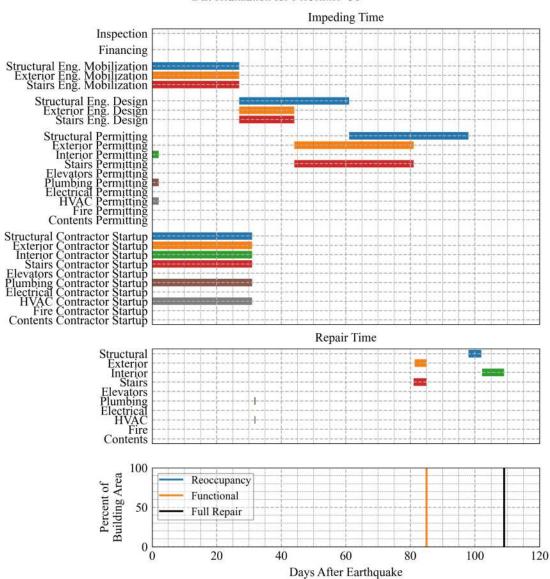


Figure 4.9. DE Percentile = 50



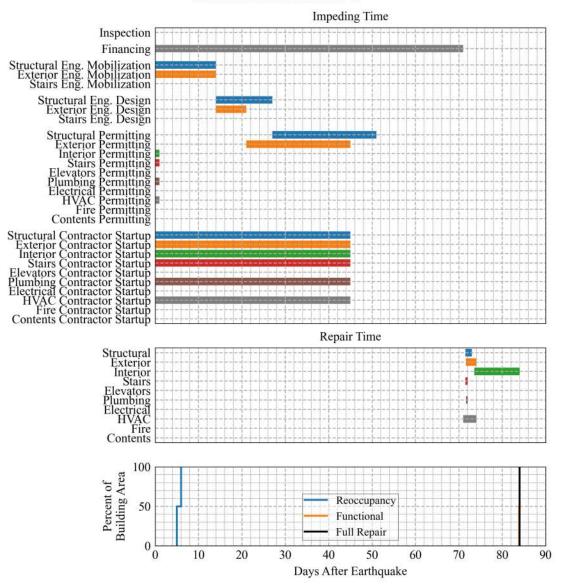


Figure 4.10. DE Percentile = 49



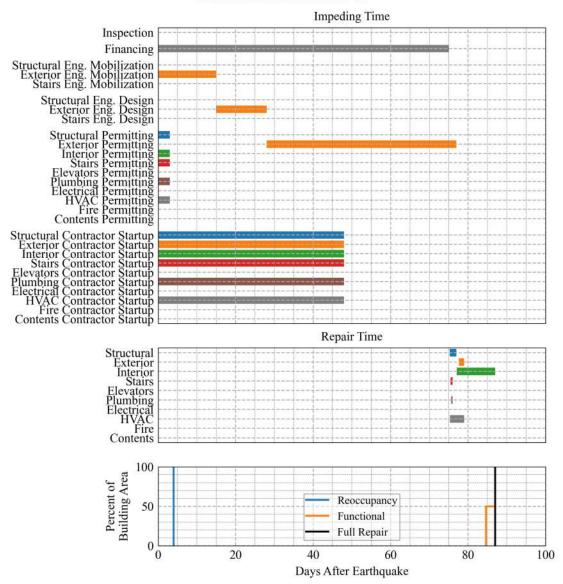


Figure 4.11. DE Percentile = 51

4.3.2 Selected Realizations for 90th percentile

Note that this is a single realization and may not be representative of a general trend. This selected realization is intended to give a sense of what the repair schedule may look like, it is not intended to generalize what the "typical" repair schedule looks like.

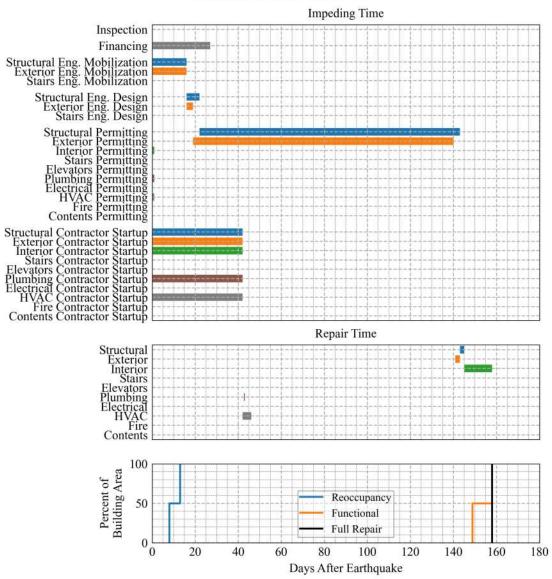


Figure 4.12. DE Percentile = 90



4.3.3 Damage to Building Systems

Table 4.5 shows the percentage of realizations that the named system prevents reoccupancy/function for the DE intensity. Note that if a system prevents reoccupancy, it will also prevent functionality. This means that the functionality checks may all be fine, but if the reoccupancy checks indicate the building is not reoccupiable then the building will not be considered functional.

Each column represents a milestone time after the earthquake and the values in that column indicate the percentage of realizations in which that component is preventing reoccupancy/functionality at that milestone.

	Immediate	>3 days	>7 days	>14 days	>1 month	>6 months	>12 months
Building Reoccupancy	(also affects fu	nction)					
Red Tag (Structural)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hazardous Material	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fire Egress	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Entry Door Access	2.0	0.0	0.0	0.0	0.0	0.0	0.0
Falling hazard	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Entry Door Racking	2.0	0.0	0.0	0.0	0.0	0.0	0.0
Stairs	42	42	42	42	42	1.2	0.0
Stairway Doors	3.8	0.0	0.0	0.0	0.0	0.0	0.0
Exterior	56	53	30	7.3	0.5	0.0	0.0
Interior	34	31	17	9.9	8.6	0.0	0.0
Building Function (affe	cts function on	ly, not reocc	cupancy)				
Elevators	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Exterior	17	17	17	17	17	0.8	0.0
Interior	73	68	38	12	5.4	0.0	0.0
Water	9.2	9.2	9.2	9.2	8.4	0.0	0.0
Electrical	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HVAC	61	61	61	61	59	4.0	0.0

Table 4.5. Percent of realizations affecting building reoccupancy/function per system - DE



4.3.4 Damage to Individual Components

Table 4.6 shows the percentage of realizations that a specific component prevents reoccupancy/function for the DE intensity. Note that if a component prevents reoccupancy, it will also prevent functionality.

Each column represents a milestone time after the earthquake and the values in that column indicate the percentage of realizations in which that component is preventing reoccupancy/functionality at that milestone.

	Immediate	>3 days	>7 days	>14 days	>1 month	>6 months	>12 months
B1031.011a	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
B1035.041	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
B1035.051	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
B1071.202	21 / 18	19 / 17	7.7 / 14	1.9 / <mark>14</mark>	0.4 / 14	0.0 / 0.6	0.0 / 0.0
B1071.302	0.0 / 73	0.0 / <mark>68</mark>	0.0 / 34	0.0 / 19	0.0 / 17	0.0 / 0.8	0.0 / 0.0
B2011.401	56 / 65	52 / 59	28 / 29	6.7 / 18	0.5 / 17	0.0 / 0.8	0.0 / 0.0
C1011.211a	0.0 / 67	0.0 / 59	0.0 / 18	0.0 / 2.0	0.0 / 0.4	0.0 / 0.0	0.0 / 0.0
C1011.311a	0.0 / 73	0.0 / <mark>67</mark>	0.0 / 34	0.0 / 7.8	0.0 / 0.5	0.0 / 0.0	0.0 / 0.0
C2011.041b	42 / 0.0	42 / 0.0	42 / 0.0	42 / 0.0	42 / 0.0	1.2 / 0.0	0.0 / 0.0
C3032.004a	19 / 12	16 / 10	5.8 / 3.7	1.1 / 0.8	0.2 / 0.2	0.0 / 0.0	0.0 / 0.0
C3032.004b	21 / 14	18 / 11	5.8 / 3.6	0.7 / 0.3	0.2 / 0.1	0.0 / 0.0	0.0 / 0.0
C3032.004c	23 / 16	19 / 13	5.8 / 3.8	0.8 / 0.7	0.2 / 0.2	0.0 / 0.0	0.0 / 0.0
C3032.004d	24 / 18	20 / 15	6.6 / 4.4	1.6 / 1.0	0.2 / 0.2	0.0 / 0.0	0.0 / 0.0
C3034.002	34 / 59	29 / 52	11 / 1 <mark>6</mark>	1.8 / 2.2	0.2 / 0.4	0.0 / 0.0	0.0 / 0.0
D2021.013a	5.3 / 5.3	5.3 / 5.3	5.3 / 5.3	5.3 / 5.3	4.9 / 4.9	0.0 / 0.0	0.0 / 0.0
D2021.013b	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D2021.023a	5.3 / 5.3	5.3 / 5.3	5.3 / 5.3	5.3 / 5.3	4.8 / 4.8	0.0 / 0.0	0.0 / 0.0
D2021.023b	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D2031.013b	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D3032.013c	0.0 / 30	0.0 / 30	0.0 / 30	0.0 / 30	0.0 / 27	0.0 / 0.7	0.0 / 0.0
D3041.011c	21 / 32	10 / 32	1.3 / 32	0.4 / 32	0.1 / 32	0.0 / 2.4	0.0 / 0.0
D3041.032c	32 / 61	30 / 60	16 / 52	9.4 / 47	8.2 / 44	0.0 / 3.3	0.0 / 0.0

Table 4.6. Percent of realizations affecting building reoccupancy/functionality per component - DE





4.4 MCE $_R$ Intensity

4.4.1 Selected Realizations for 50th percentile

Note that this is a single realization and may not be representative of a general trend. This selected realization is intended to give a sense of what the repair schedule may look like, it is not intended to generalize what the "typical" repair schedule looks like.

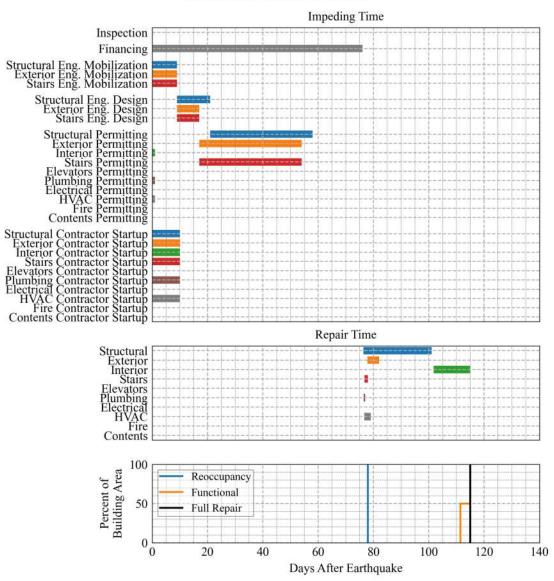


Figure 4.13. MCE_R Percentile = 50



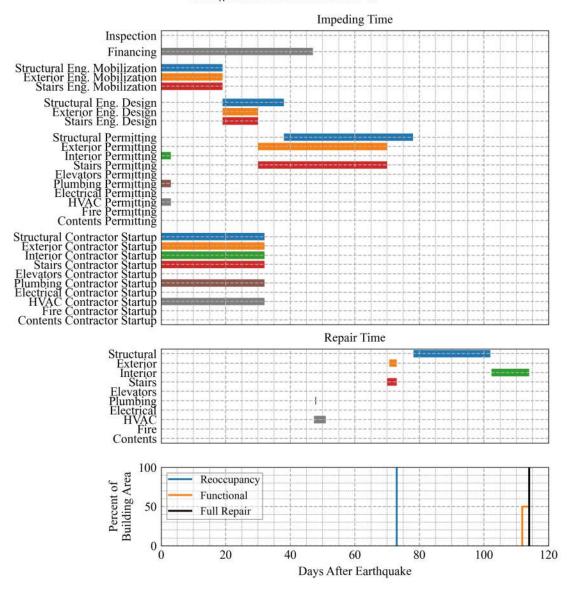


Figure 4.14. MCE_R Percentile = 49



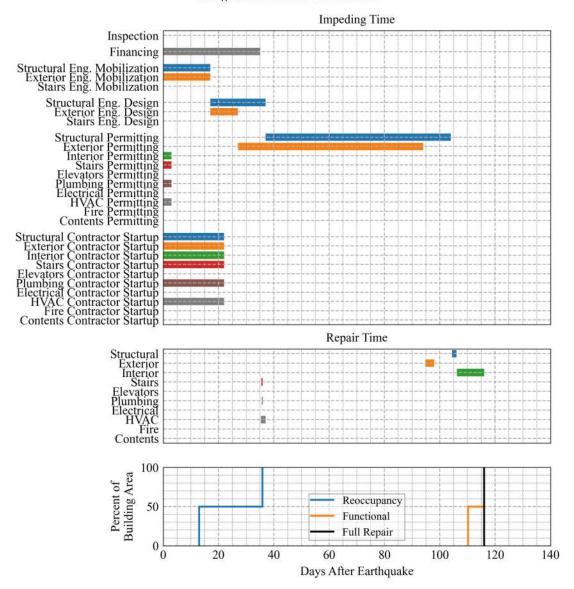


Figure 4.15. MCE_R Percentile = 51

4.4.2 Selected Realizations for 90th percentile

Note that this is a single realization and may not be representative of a general trend. This selected realization is intended to give a sense of what the repair schedule may look like, it is not intended to generalize what the "typical" repair schedule looks like.

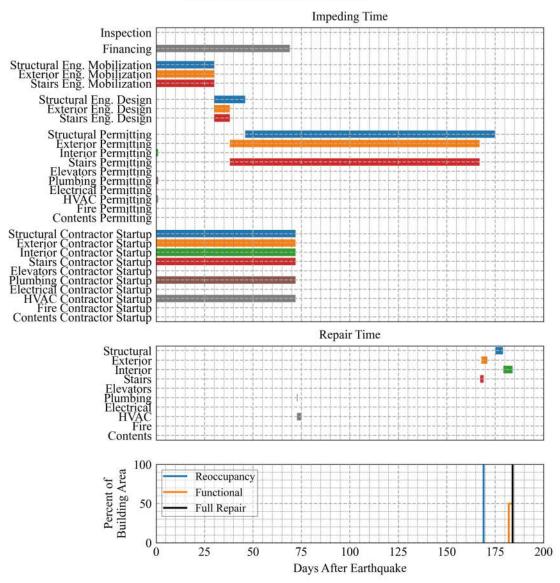


Figure 4.16. MCE_R Percentile = 90



4.4.3 Damage to Building Systems

Table 4.7 shows the percentage of realizations that the named system prevents reoccupancy/function for the MCE_R intensity. Note that if a system prevents reoccupancy, it will also prevent functionality. This means that the functionality checks may all be fine, but if the reoccupancy checks indicate the building is not reoccupiable then the building will not be considered functional.

Each column represents a milestone time after the earthquake and the values in that column indicate the percentage of realizations in which that component is preventing reoccupancy/functionality at that milestone.

	Immediate	>3 days	>7 days	>14 days	>1 month	>6 months	>12 months
Building Reoccupancy (also affects function)							
Red Tag (Structural)	0.9	0.9	0.0	0.0	0.0	0.0	0.0
Hazardous Material	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fire Egress	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Entry Door Access	82	0.0	0.0	0.0	0.0	0.0	0.0
Falling hazard	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Entry Door Racking	82	0.0	0.0	0.0	0.0	0.0	0.0
Stairs	79	79	79	79	79	3.7	0.0
Stairway Doors	89	0.0	0.0	0.0	0.0	0.0	0.0
Exterior	94	91	59	21	4.7	0.0	0.0
Interior	49	45	27	19	16	0.2	0.0
Building Function (affects function only, not reoccupancy)							
Elevators	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Exterior	77	77	77	77	77	5.5	0.0
Interior	96	92	57	24	13	0.1	0.0
Water	14	14	14	14	14	0.2	0.0
Electrical	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HVAC	74	74	74	74	73	7.7	0.0

Table 4.7. Percent of realizations affecting building reoccupancy/function per system - MCE_R



4.4.4 Damage to Individual Components

Table 4.8 shows the percentage of realizations that a specific component prevents reoccupancy/function for the MCE_R intensity. Note that if a component prevents reoccupancy, it will also prevent functionality. Each column represents a milestone time after the earthquake and the values in that column indicate the percentage of realizations in which that component is preventing reoccupancy/functionality at that milestone.

	Immediate	>3 days	>7 days	>14 days	>1 month	>6 months	>12 months
B1031.011a	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
B1035.041	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
B1035.051	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
B1071.202	70 / 70	65 / 69	32 / 68	12 / 67	4.1 / <mark>67</mark>	0.0 / 5.0	0.0 / 0.0
B1071.302	0.0 / <mark>96</mark>	0.0 / <mark>94</mark>	0.0 / 83	0.0 / 78	0.0 / 77	0.0 / 5.5	0.0 / 0.0
B2011.401	94 / 95	90 / 93	51 / 81	18 / 77	4.5 / 77	0.0 / 4.8	0.0 / 0.0
C1011.211a	0.0 / <mark>95</mark>	0.0 / <mark>86</mark>	0.0 / 33	0.0 / 9.5	0.0 / 3.9	0.0 / 0.0	0.0 / 0.0
C1011.311a	0.0 / <mark>96</mark>	0.0 / <mark>90</mark>	0.0 / <mark>49</mark>	0.0 / 17	0.0 / 4.7	0.0 / 0.0	0.0 / 0.0
C2011.041b	79 / 0.0	79 / 0.0	79 / 0.0	79 / 0.0	79 / 0.0	3.7 / 0.0	0.0 / 0.0
C3032.004a	32 / 22	28 / 20	12 / 8.2	4.4 / 3.0	1.8 / 1.4	0.0 / 0.0	0.0 / 0.0
C3032.004b	33 / 24	29 / 20	12 / 9.4	5.2 / 4.0	1.9 / 1.6	0.0 / 0.0	0.0 / 0.0
C3032.004c	37 / 29	31 / 24	13 / 10	5.1 / 4.2	2.0 / 1.7	0.0 / 0.0	0.0 / 0.0
C3032.004d	39 / 31	34 / 26	14 / 11	5.6 / 4.4	2.0 / 1.5	0.0 / 0.0	0.0 / 0.0
C3034.002	49 / 81	43 / 74	20 / 29	7.0 / 8.9	2.5 / 3.8	0.0 / 0.0	0.0 / 0.0
D2021.013a	8.4 / 8.4	8.4 / 8.4	8.4 / 8.4	8.4 / 8.4	8.2 / 8.2	0.1 / 0.1	0.0 / 0.0
D2021.013b	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D2021.023a	8.5 / 8.5	8.5 / 8.5	8.5 / 8.5	8.5 / 8.5	8.2 / 8.2	0.2 / 0.2	0.0 / 0.0
D2021.023b	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D2031.013b	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D3032.013c	0.0 / 41	0.0 / 41	0.0 / 41	0.0 / 41	0.0 / <mark>39</mark>	0.0 / 1.0	0.0 / 0.0
D3041.011c	32 / 44	19 / 44	5.5 / 44	3.4 / 44	1.3 / 44	0.0 / 5.4	0.0 / 0.0
D3041.032c	48 / 75	44 / 74	27 / 67	18 / 59	15 / 57	0.2 / 6.3	0.0 / 0.0

Table 4.8. Percent of realizations affecting building reoccupancy/functionality per component - MCE_R





4.5 2% in 50 years Intensity

4.5.1 Selected Realizations for 50th percentile

Note that this is a single realization and may not be representative of a general trend. This selected realization is intended to give a sense of what the repair schedule may look like, it is not intended to generalize what the "typical" repair schedule looks like.

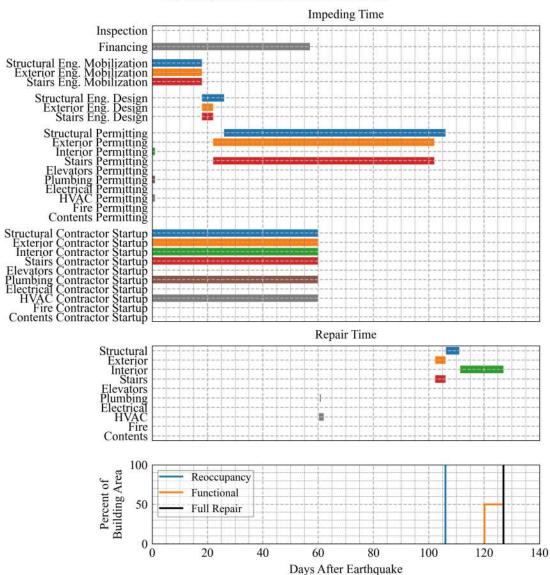


Figure 4.17. 2% in 50 years Percentile = 50



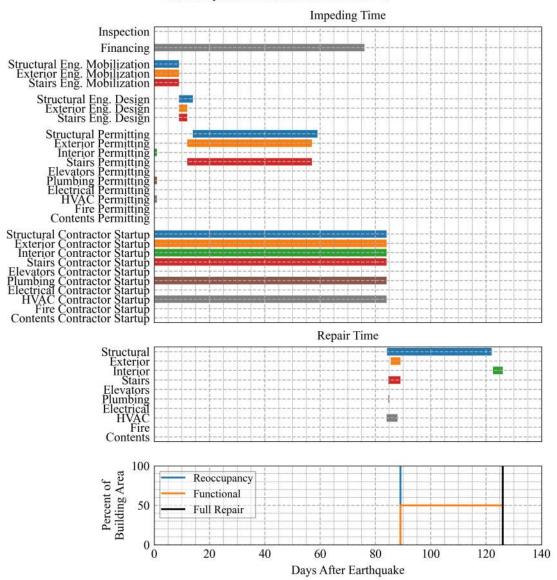


Figure 4.18. 2% in 50 years Percentile = 49



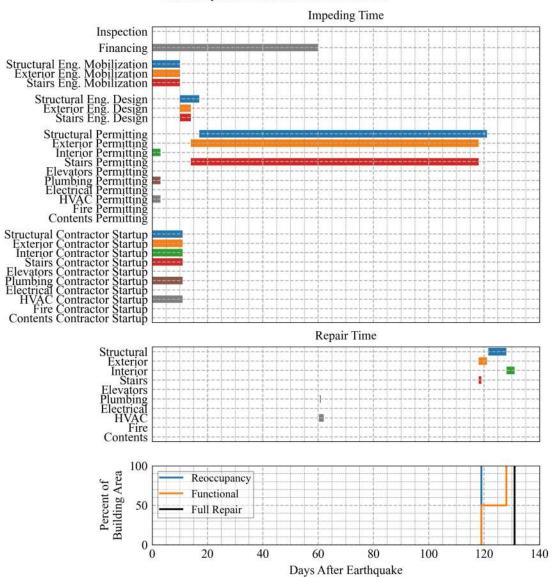
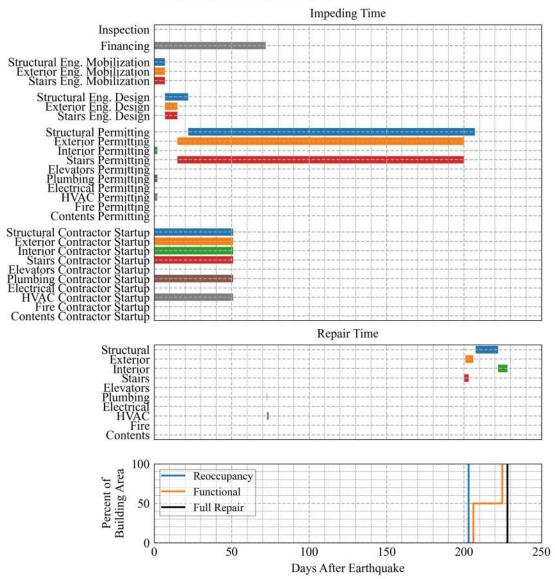


Figure 4.19. 2% in 50 years Percentile = 51

4.5.2 Selected Realizations for 90th percentile

Note that this is a single realization and may not be representative of a general trend. This selected realization is intended to give a sense of what the repair schedule may look like, it is not intended to generalize what the "typical" repair schedule looks like.



2% in 50 years: Realization for Percentile=90

Figure 4.20. 2% in 50 years Percentile = 90



4.5.3 Damage to Building Systems

Table 4.9 shows the percentage of realizations that the named system prevents reoccupancy/function for the 2% in 50 years intensity. Note that if a system prevents reoccupancy, it will also prevent functionality. This means that the functionality checks may all be fine, but if the reoccupancy checks indicate the building is not reoccupiable then the building will not be considered functional.

Each column represents a milestone time after the earthquake and the values in that column indicate the percentage of realizations in which that component is preventing reoccupancy/functionality at that milestone.

	Immediate	>3 days	>7 days	>14 days	>1 month	>6 months	>12 months		
Building Reoccupancy	Building Reoccupancy (also affects function)								
Red Tag (Structural)	8.7	8.7	0.0	0.0	0.0	0.0	0.0		
Hazardous Material	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
Fire Egress	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
Entry Door Access	94	0.0	0.0	0.0	0.0	0.0	0.0		
Falling hazard	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
Entry Door Racking	94	0.0	0.0	0.0	0.0	0.0	0.0		
Stairs	84	84	84	84	84	3.9	0.0		
Stairway Doors	88	0.0	0.0	0.0	0.0	0.0	0.0		
Exterior	90	89	65	28	9.2	0.0	0.0		
Interior	47	43	30	22	18	0.2	0.0		
Building Function (affe	cts function on	ly, not reocc	upancy)						
Elevators	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
Exterior	86	86	86	86	86	5.9	0.0		
Interior	91	89	64	32	16	0.2	0.0		
Water	15	15	15	15	15	0.2	0.0		
Electrical	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
HVAC	68	68	68	68	67	7.3	0.0		

Table 4.9. Percent of realizations affecting building reoccupancy/function per system - 2% in 50 years



4.5.4 Damage to Individual Components

Table 4.10 shows the percentage of realizations that a specific component prevents reoccupancy/function for the 2% in 50 years intensity. Note that if a component prevents reoccupancy, it will also prevent functionality.

Each column represents a milestone time after the earthquake and the values in that column indicate the percentage of realizations in which that component is preventing reoccupancy/functionality at that milestone.

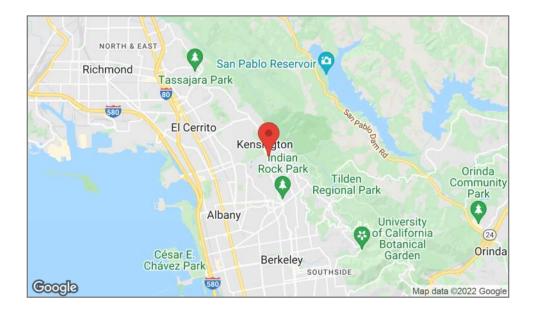
	Immediate	>3 days	>7 days	>14 days	>1 month	>6 months	>12 months
B1031.011a	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
B1035.041	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
B1035.051	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
B1071.202	83 / 83	77 / 83	44 / 82	20 / 82	8.1 / <mark>82</mark>	0.0 / 5.7	0.0 / 0.0
B1071.302	0.0 / <mark>91</mark>	0.0 / <mark>90</mark>	0.0 / <mark>88</mark>	0.0 / <mark>87</mark>	0.0 / <mark>86</mark>	0.0 / 5.9	0.0 / 0.0
B2011.401	90 / 91	86 / 90	53 / 88	25 / 86	8.5 / <mark>86</mark>	0.0 / 4.3	0.0 / 0.0
C1011.211a	0.0 / <mark>90</mark>	0.0 / 85	0.0 / <mark>40</mark>	0.0 / 18	0.0 / 7.7	0.0 / 0.0	0.0 / 0.0
C1011.311a	0.0 / <mark>91</mark>	0.0 / <mark>86</mark>	0.0 / 55	0.0 / 25	0.0 / 8.6	0.0 / 0.0	0.0 / 0.0
C2011.041b	<mark>84</mark> / 0.0	3.9 / 0.0	0.0 / 0.0				
C3032.004a	30 / 24	26 / 21	14 / 11	7.3 / 6.0	3.1 / 2.5	0.0 / 0.0	0.0 / 0.0
C3032.004b	32 / 26	28 / 23	15 / 13	7.8 / 6.7	3.2 / 2.9	0.0 / 0.0	0.0 / 0.0
C3032.004c	34 / 29	30 / 25	16 / 13	8.2 / 6.7	3.5 / 3.0	0.0 / 0.0	0.0 / 0.0
C3032.004d	36 / 33	32 / 29	16 / 15	8.7 / 8.5	3.7 / 3.3	0.0 / 0.0	0.0 / 0.0
C3034.002	47 / 79	42 / 75	23 / 36	11 / <mark>16</mark>	4.5 / 6.8	0.0 / 0.0	0.0 / 0.0
D2021.013a	8.6 / 8.6	8.6 / 8.6	8.6 / 8.6	8.6 / 8.6	8.3 / 8.3	0.2 / 0.2	0.0 / 0.0
D2021.013b	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D2021.023a	9.6 / 9.6	9.6 / 9.6	9.6 / 9.6	9.6 / 9.6	9.4 / 9.4	0.2 / 0.2	0.0 / 0.0
D2021.023b	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D2031.013b	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D3032.013c	0.0 / 34	0.0 / 34	0.0 / 34	0.0 / 34	0.0 / 33	0.0 / 0.6	0.0 / 0.0
D3041.011c	32 / 42	19 / 42	8.6 / 42	6.7 / 42	2.7 / 42	0.0 / 4.9	0.0 / 0.0
D3041.032c	46 / 72	42 / 72	29 / 66	21 / 59	17 / 56	0.2 / 6.2	0.0 / 0.0

Table 4.10. Percent of realizations affecting building reoccupancy/functionality per component - 2% in 50 years



SEISMIC RISK ASSESSMENT REPORT Created with the SP3-RiskModel

Detailed Component Report



Report Generated for:

217 Arlington Avenue, Kensington, CA, 94707 Latitude: 37.90622° Longitude: -122.27875°

Report Generated by:

The SP3-RiskModel Software v1.2.0 of the Seismic Performance Prediction Program (SP3)

March 16, 2022







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1 SUMMARY OF INPUTS AND RISK RESULTS

Risk Model Inputs

P	rimary	Structural Properties			
Project Name: Model Name:	Kensington Fire Station New WLF w/ Frame	Allow Components to Affect Structural Properties?	Yes	Yes	
Building Type:WLF: GeneralYear of Construction:2022		Mode Shapes Specified?	No)	
Number of Stories:	2	Directional Properties	Dir. 1	Dir. 2	
Occupancy: Address:	Commercial Office	Base Shear Strength (g): Yield Drift (%):		_	
217 Arlington Avenue Kensington, CA, 94707		1^{st} Mode Period (T_1) (s):			
Latitude: Longitude:	27.90622° -122.27875°			_	
		Component Information			
Analy	ysis Options	Selection Method	Custor	n	
Include Collapse in Analy Consider Residual Drift:	vsis: Yes Yes	- Building S	Stability		
Region Cost Multiplier: Date Cost Multiplier: Occupancy Cost Multiplie		Median Collapse Capacity: Beta (Dispersion):	-		
	ayout Information	- Respo	nses		
Cost per Square Foot:		- No responses provided			
Scale component repair co building value?	osts with No				
e		Repair Tin	e Options		
Total Square Feet:	4,395	Repair Time Method	ATC-138 (Beta)	
Aspect Ratio: First Story Height (ft):	1.95 13.5	Factors Delaying Start of Re	pairs		
Upper Story Heights (ft):	13.5 9	Inspection	Yes		
Vertical Irregularity:	None	Financing	Yes		
Di T I I I	N	Permitting	Ves		

Frac. of Full Height Ext. Wood Walls

Plan Irregularity:

Dir. 1 Story 1	-
Dir. 1 Upper Stories	-
Dir. 2 Story 1	_
Dir. 2 Upper Stories	-

None

Ground Motion and Soil Information

Site Class:	С	
Site Hazard:	SP3 Default	

Building Design Info

Level of Detailing (Dir. 1, 2):	-, -
Drift Limit (Dir. 1, 2):	-, -
Risk Category:	IV
Seismic Importance Factor, I_e :	_
Component Importance Factor, I_p :	_

Repair Time Options						
Repair Time Method	ATC-138 (Beta)					
Factors Delaying Start of Re	pairs					
Inspection	Yes					
Financing	Yes					
Permitting	Yes					
Engineering Mobilization	Yes					
Contractor Mobilization	Yes					
Mitigation Factors						
Inspector on Retainer	No					
Engineer on Retainer	No					
Contractor on Retainer	No					
Funding Source	Private Loans					
Cash on Hand	-					
ATC-138 Functional Recover	ry (Beta) Options					
Need HVAC for Function	_					
Need Elevator for Function	_					
Include Surge Demand	-					





Component Checklist

Stairs and Elevators

- Does the building have stairs?
 - > Yes
 - What type of stairs are in the building?
 - > Light Frame

Interior Finishes

• Does the building have suspended ceilings?

- > Yes
- Are the ceilings laterally supported?
- > Yes
- Does the building contain pendant (non-recessed) lighting?
 - > Yes
 - Are the pendant lights seismically rated?
 - > Yes

Piping

- Is the building's water piping OSHPD certified or equivalent? > *Yes*
- > .

HVAC

• Is the HVAC cooling/heating equipment seismically anchored? > *Yes*

Electrical

- Does the building have a backup battery/generator system? > *No*
- Which best describes the building's electrical system? > No significant electrical equipment (rugged)

Expected Loss

Expected loss in percent of total building value					
Shaking Intensity	Return Period	SEL (%)	SUL (%)		
50% in 50 years	72 Years	0.5	0.9		
10% in 50 years	475 Years	9.3	17		
DE	481 Years	9.5	17		
5% in 50 years	975 Years	14	23		
MCE_R	1277 Years	17	27		
2% in 50 years	2475 Years	26	42		

Expected loss in percent of total building value

Repair Time

	Median repair time summary					
	FEMA	A P-58 [†]	ATC-138 Functional Recovery (Beta) [‡]			
Intensity	Parallel	Series	Re-Occupancy	Functional	Full	
50% in 50 years	1.4 days	1.5 days	0 days	0 days	6.4 weeks	
10% in 50 years	3.8 weeks	4.8 weeks	11 days	2.8 months	3.4 months	
DE	3.9 weeks	5.1 weeks	12 days	2.8 months	3.5 months	
5% in 50 years	5.7 weeks	7.6 weeks	2.8 months	3.7 months	3.9 months	
MCE_R	6.8 weeks	2.1 months	3.1 months	3.8 months	4.1 months	
2% in 50 years	2.1 months	2.8 months	3.5 months	4.2 months	4.4 months	

[†] Does *not* include impedance factors

[‡] Does include impedance factors



2 MOST DAMAGED COMPONENTS

Intensity	Component	Damage State	Expected Repair Cost
50% in 50 years	B1071.302	1	\$1,368
10% in 50 years	B1071.302	1	\$9,629
DE	B1071.302	1	\$9,731
5% in 50 years	B1071.302	1	\$16,072
MCE_R	B1031.011a	1	\$18,918
2% in 50 years	B1031.011a	1	\$34,920

Table 2.1. Most damaged Structural components at each intensity level.

Table 2.2. Most damaged Non-Structural components at each intensity level.

Intensity	Component	Damage State	Expected Repair Cost
50% in 50 years	C1011.311a	1	\$3,176
10% in 50 years	C1011.311a	1	\$31,144
DE	C1011.311a	1	\$31,440
5% in 50 years	C1011.311a	3	\$38,842
MCE_R	C1011.311a	3	\$40,722
2% in 50 years	C1011.311a	3	\$40,630

Details of the most damaged components and their damage states:

- **B1031.011a**: Steel Column Base Plates, Column W < 150 plf
 - DS1a: Initiation of crack at the fusion line between the column flange and the base plate weld. Damage in field is either obscured or deemed to not warrant repair. No repair conducted.
 - DS1b: Initiation of crack at the fusion line between the column flange and the base plate weld.
- **B1071.302**: Interior Structural Wall Light framed wood walls with structural panel sheathing, gypsum wallboard on both sides, with hold-downs

DS1: Cracking of paint over fasteners or joints.

- **C1011.311a**: Interior of Exterior Wall Type: Gypsum with wood studs (single-sided gypsum), Full Height, Fixed Below, Fixed Above
 - DS1: Cracking of paint over fasteners or joints.
 - DS3: Local and global buckling out-of-plane and crushing of gypsum wallboards. Studs are typically not damaged by failure of the gypsum wallboard, but framing adjustments possible for this damage state.

3 DETAILED COMPONENT DAMAGE BREAKDOWNS

3.1 Repair Cost

This table shows the expected contribution to repair cost on a per-damage state basis. The header shows the total loss, the loss contribution from collapse, and the loss contribution from residual drift for reference.

The color scale is meant to indicate **relative** performance of components, not absolute performance. A "green" value does not indicate that the value falls in a pre-determined "good" range, just that it performs well compared to other components. Likewise, a "red" value does does not indicate that the value falls in a pre-determined "bad" range, just that it performs worse compared to other components.

	50% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 years
Tot. Loss	6.69k	128k	131k	186k	228k	359k
Collapse	0	0	0	0	7.42k	43.5k
Residual	0	0	0	551	5.51k	76.1k
B1031.01	1a #1 (B1031.011a	a: Steel Column Base	e Plates, Colum	n W < 150 plf)		
DS1a	0	0	0	0	0	0
DS1b	0	331	639	1.22k	1.47k	1.75k
DS2	0	1.53k	1.7k	6.59k	9.91k	18.6k
DS3	0	529	725	3.65k	7.53k	14.6k
Total	0	2.4k	3.07k	11.5k	18.9k	34.9 k
B1035.04	1 #1 (B1035.041:]	Pre-Northridge WUI	F-B beam-colur	nn joint, beam one sid	le of column,	beam depth)
DS1a	0	14.4	34	255	281	442
DS1b	0	0	0	48	168	93.7
DS2a	0	0	0	28.4	20.8	95.2
DS2b	0	0	0	34.3	15.6	27.1
DS3	0	0	0	3.91	61.4	55.3
Total	0	14.4	34	370	547	713
B1035.05	1 #1 (B1035.051:]	Pre-Northridge WUI	F-B beam-colur	nn joint, beam both si	ides of colum	n, beam)
DS1a	0	23.1	67.8	380	609	646
DS1b	0	7.74	17.5	156	137	216
DS2a	0	0	0	16.2	40.3	128
DS2b	0	0	0	0	52.6	0
DS3	0	0	0	7.56	48.7	111
Total	0	30.8	85.3	559	888	1.1k
B1071.20	2 #1 (B1071.202:]	Exterior Structural V	Wall - Light fra	med wood walls with	structural pa	nel)
DS1	13.2	3.89k	3.77k	3.58k	3.22k	2k
DS2	0	1.39k	1.44k	2.73k	3.04k	2.79k
DS3	0	1.78k	1.75k	6.36k	8.76k	14.1k
Total	13.2	7.06k	6.97k	12.7k	15k	18.9 k
B1071.30	2 #1 (B1071.302:]	Interior Structural V	Vall - Light fra	med wood walls with	structural par	nel)
DS1	1.13k	716	734	606	556	471
DS2	143	811	844	698	625	478
DS3	91.7	4.23k	4.13k	3.98k	3.57k	2.16k
DS4	0	1.92k	2.03k	3.71k	4.03k	3.7k
DS5	0	1.96k	1.99k	7.08k	10.1k	15.9k
Total	1.37k	9.63k	9.73k	16.1k	18.9k	22.7k
B2011.40	1 #1 (B2011.401:]	Exterior Wall - Light	t framed wood	walls with exterior pa	nelized sheatl	ning)
DS1	50.3	957	942	834	758	537
DS2	7.03	1.07k	1.07k	1.21k	1.19k	864
DS3	2.87	3.98k	3.97k	8.26k	10k	12.4k
Total	60.2	6k	5.98k	10.3k	12k	13.8k

Table 3.1.1. Expected contribution to repair cost per damage state (Dollars)





	Table 3.1.1	(Continued). Expected	contribution t	o repair cost per damag	ge state (Dollar	5)
	50% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 years
Tot. Loss	6.69k	128k	131k	186k	228k	359k
Collapse	0	0	0	0	7.42k	43.5k
Residual	0	0	0	551	5.51k	76.1k
C1011.21	la #1 (C1011.211a	a: Wall Partition - Typ	oe: Gypsum w	rith wood studs (both	sides), Full He	eight,)
DS1	1.22k	2.05k	2.05k	1.83k	1.71k	1.45k
DS2	195	1.79k	1.82k	1.78k	1.67k	1.44k
DS3	117	12k	11.9k	16.9k	18.2k	18.6k
Total	1.53k	15.9k	15.7k	20.5 k	21.6 k	21.5k
C1011.31	la #1 (C1011.311a	a: Interior of Exterior	Wall - Type:	Gypsum with wood s	tuds (single-si	ded)
DS1	2.58k	3.49k	3.55k	3.01k	2.89k	2.48k
DS2	375	3.69k	3.73k	3.4k	3.18k	2.68k
DS3	219	24k	24.2k	32.4k	34.6k	35.5k
Total	3.18k	31.1k	31.4 k	38.8k	40.7 k	40.6k
	lb #1 (C2011.041)	o: Light frame stair fi		_		
DS1	12.7	581	591	586	482	315
DS2	1.5	905	948	1.5k	1.74k	1.71k
DS3	0	823	878	2.62k	3.4k	5.51k
Total	14.2	2.31k	2.42k	4.71k	5.63k	7.53k
C3032.004	4a #1 (C3032.004a	a: Suspended Ceiling,	SDC D,E,F (I	p=1.5), Area (A): A <	250, Vert & I	_at)
DS1	1.26	364	374	418	458	448
DS2	0	635	710	857	833	719
DS3	25.7	5.94k	6.24k	8.64k	10.2k	10k
Total	27	6.94k	7.32k	9.91k	11.4k	11 .2 k
C3032.004	4b #1 (C3032.004)	o: Suspended Ceiling,	SDC D,E,F ([p=1.5), Area (A): 250) < A < 1000, V	/ert & Lat)
DS1	4.84	607	581	608	730	663
DS2	16.6	979	962	1.25k	1.39k	1.34k
DS3	11.5	7.24k	7.77k	10.5k	12.2k	12.2k
Total	33	8.83k	9.32k	12.4 k	14.3k	14.2k
C3032.004	4c #1 (C3032.004c	: Suspended Ceiling,	SDC D,E,F (I	p=1.5), Area (A): 100	0 < A < 2500,	Vert &)
DS1	22.5	1.03k	1.03k	1.09k	1.06k	1.07k
DS2	8.08	1.44k	1.62k	1.83k	2.22k	2.01k
DS3	0	8.79k	9.05k	12.6k	15.1k	13.8k
Total	30.6	11.3k	11.7k	15.5k	18.4 k	16.9k
C3032.004	4d #1 (C3032.004	1: Suspended Ceiling,	SDC D.E.F ([p=1.5), Area (A): A >	> 2500, Vert &	Lat)
DS1	37.5	1.22k	1.3k	1.34k	1.34k	1.25k
DS2	10.8	1.93k	1.85k	2.36k	2.79k	2.41k
DS3	0	9.08k	9.7k	12.3k	14.8k	14.7k
Total	48.3	12.2k	12.9 k	16k	18.9 k	18.4 k
C3034.002	2 #1 (C3034.002:]	Independent Pendant	Lighting - sei	smically rated)		
DS1	134	4.54k	4.62k	4.77k	5.05k	4.88k
D2021.013	3a #1 (D2021.013a	a: Cold or Hot Potable	e - Small Dian	neter Threaded Steel	- (2.5 inches in)
D2021.01.	0.14	37.3	41.2	47.1	54	53.5
DS2	0	57.8	59.7	86.8	97.2	103
Total	0.14	95.1	101	134	151	157
D2021.01	3b #1 (D2021.013)	o: Cold or Hot Potabl	e - Small Diar	neter Threaded Steel	- (2.5 inches ir	ı)
D2021.01.	3.55	134	143	158	- (2.5 menes n 174	165
		a: Cold or Hot Potable				
D2021.02. DS1	0.06	30.5	31.8	g (dia > 2.5 menes), 5. 38.3	рс р,е,г, рн 42.7	38.9
DOI	0.00					
DS2	0	43.3	51.5	79.6	83	90.9



5	0% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 year
Tot. Loss	6.69k	128k	131k	186k	228k	359k
Collapse	0	0	0	0	7.42k	43.5k
Residual	0	0	0	551	5.51k	76.1k
D2021.023b	#1 (D2021.023)	o: Cold or Hot Potabl	e Water Pipin	g (dia > 2.5 inches), S	DC D,E,F, BR	ACING)
DS1	1.37	48.4	47.5	50.2	52.1	49.4
DS2	0.19	34.7	37.9	45.3	52.2	48.3
Total	1.57	83.1	85.5	95.5	104	97.6
D2031.013b	#1 (D2031.013)	o: Sanitary Waste Pip	ing - Cast Iro	n w/flexible couplings	, SDC D,E,F,	BRACING)
DS1	1.25	57.5	58.8	73.7	82	77.9
D3032.013c	#1 (D3032.013c	: Compressor - Capa	city: Small no	n medical air supply	- Equipment t	hat is)
DS1a	0	5.86	4.97	15.4	23.1	34.6
DS1b	0	20	17.9	53.1	70.6	81.8
DS1c	0	4.6	7.93	19.3	21.9	30.9
DS1d	2.39	36.2	37.2	77.2	110	158
Total	2.39	66.6	68	165	225	305
D3032.013c	#2 (D3032.013c	: Compressor - Capa	city: Small no	n medical air supply	- Equipment t	hat is)
DS1a	2.1	110	128	157	172	155
DS1b	8.84	393	425	520	536	444
DS1c	7.26	158	161	201	207	176
DS1d	25.3	684	562	874	902	809
Total	43.5	1.34k	1.28k	1.75k	1.82 k	1.58k
D3041.011c	#1 (D3041.011c	: HVAC Galvanized S	Sheet Metal D	ucting less than 6 sq.	ft in cross sec	tional)
DS1	2.34	79.9	82.8	84.3	87.2	83.3
DS2	1.75	584	616	745	874	842
Total	4.1	664	699	829	962	925
D3041.032c	#1 (D3041.032c	: HVAC Drops / Diffu	sers without	ceilings - supported by	y ducting only	- No)
DS1	191	7.07k	7.52k	8.46k	9.07k	8.66k



3.2 Repair time

This table shows the expected worker days on a per-damage state basis. The header shows the probability of global failures (collapse and residual drift demolition) for reference.

The color scale is meant to indicate **relative** performance of components, not absolute performance. A "green" value does not indicate that the value falls in a pre-determined "good" range, just that it performs well compared to other components. Likewise, a "red" value does does not indicate that the value falls in a pre-determined "bad" range, just that it performs worse compared to other components.

	50% in 50 years	10% in 50 years	DE	5% in 50 years	MCE _R	2% in 50 years
P[Col](%)	0.0	0.0	0.0	0.0	0.5	3.2
P[Res](%)	0.0	0.0	0.0	0.0	0.4	5.5
		: Steel Column Base F	lates, Colum	n W < 150 plf)		
DS1a	0.0	0.0	0.0	0.0	0.0	0.0
DS1b	0.0	0.2	0.4	0.7	0.9	1.3
DS2	0.0	1.1	1.3	4.5	7.3	13
DS3	0.0	0.3	0.5	2.5	5.0	10
Total	0.0	1.6	2.2	7.7	13	24
B1035.04	1 #1 (B1035.041: H	Pre-Northridge WUF-I	B beam-colur	nn joint, beam one sid	le of column,	beam depth)
DS1a	0.0	0.0	0.0	0.1	0.1	0.2
DS1b	0.0	0.0	0.0	0.0	0.1	0.1
DS2a	0.0	0.0	0.0	0.0	0.0	0.1
DS2b	0.0	0.0	0.0	0.0	0.0	0.0
DS3	0.0	0.0	0.0	0.0	0.0	0.0
Total	0.0	0.0	0.0	0.2	0.2	0.3
B1035.05	1 #1 (B1035.051: I	Pre-Northridge WUF-l	B beam-colur	nn joint, beam both s	ides of column	ı, beam)
DS1a	0.0	0.0	0.0	0.1	0.3	0.3
DS1b	0.0	0.0	0.0	0.1	0.1	0.1
DS2a	0.0	0.0	0.0	0.0	0.0	0.1
DS2b	0.0	0.0	0.0	0.0	0.0	0.0
DS3	0.0	0.0	0.0	0.0	0.0	0.0
Total	0.0	0.0	0.0	0.2	0.4	0.5
B1071.20	2 #1 (B1071.202: H	Exterior Structural Wa	all - Light fra	med wood walls with	structural par	nel)
DS1	0.0	2.7	2.6	2.5	2.3	1.4
DS2	0.0	1.0	1.0	1.9	2.1	2.0
DS3	0.0	1.2	1.2	4.4	6.1	10
Total	0.0	4.9	4.9	8.9	11	13
B1071.30	2 #1 (B1071.302: I	nterior Structural Wa	ll - Light fra	med wood walls with	structural par	nel)
DS1	0.6	0.4	0.4	0.3	0.3	0.3
DS2	0.1	0.4	0.5	0.4	0.4	0.3
DS3	0.1	2.4	2.3	2.2	2.0	1.2
DS4	0.0	1.9	2.0	3.7	4.0	3.6
DS5	0.0	1.7	1.7	6.1	8.9	14
Total	0.8	6.9	7.0	13	16	19
B2011.40	1 #1 (B2011.401: H	Exterior Wall - Light f	ramed wood	walls with exterior pa	nelized sheath	ning)
DS1	0.1	2.8	2.8	2.5	2.3	1.6
DS2	0.0	2.2	2.2	2.5	2.4	1.8
DS3	0.0	5.9	5.8	12	15	18
Total	0.1	11	11	17	19	22

Table 3.2.1	Expected	worker days	per damage	state (Worker Days)
			1 0	· · · ·



5	0% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 year
P[Col](%)	0.0	0.0	0.0	0.0	0.5	3.2
P[Res](%)	0.0	0.0	0.0	0.0	0.4	5.5
C1011.211a	#1 (C1011.211a	a: Wall Partition - Typ	e: Gypsum v	vith wood studs (both :	sides). Full He	eight)
DS1	0.7	1.1	1.2	1.0	1.0	0.8
DS2	0.1	1.0	1.0	1.0	1.0	0.8
DS3	0.1	6.7	6.6	9.3	10	10
Total	0.9	8.8	8.8	11	12	12
C1011.311a	#1 (C1011.311a	: Interior of Exterior	Wall - Type:	Gypsum with wood st	tuds (single-si	ded)
DS1	1.4	2.0	2.0	1.7	1.7	1.4
DS2	0.2	2.1	2.0	1.9	1.7	1.5
DS3	0.1	13	13	18	20	20
Total	1.8	17	18	22	23	23
	#1 (C2011 041)					
DS1		b: Light frame stair fr				
DS1 DS2	0.0	0.5	0.5 0.7	0.4	0.4	0.3
	0.0	0.7		1.2	1.3	1.4
DS3 Total	0.0 0.0	0.6 1.8	0.7 1.9	2.1 3.7	2.7 4.5	4.3 6.0
		: Suspended Ceiling,				
DS1	0.0	0.3	0.3	0.3	0.3	0.3
DS2	0.0	0.4	0.4	0.6	0.5	0.5
DS3	0.0	4.0	4.3	6.0	7.1	6.7
Total	0.0	4.7	5.0	6.9	8.0	7.6
C3032.004b	#1 (C3032.004)	: Suspended Ceiling,	SDC D,E,F (Ip=1.5), Area (A): 250	< A < 1000, V	Vert & Lat)
DS1	0.0	0.4	0.4	0.4	0.4	0.4
DS2	0.0	0.7	0.6	0.9	0.9	0.9
DS3	0.0	4.7	5.1	6.9	8.0	8.3
Total	0.0	5.8	6.2	8.2	9.3	10
C3032.004c	#1 (C3032.004c	: Suspended Ceiling, S	SDC D,E,F (l	p=1.5), Area (A): 100	0 < A < 2500,	Vert &)
DS1	0.0	0.7	0.7	0.7	0.7	0.7
DS2	0.0	0.9	1.0	1.2	1.4	1.3
DS3	0.0	5.5	5.6	7.9	9.4	8.7
Total	0.0	7.0	7.3	10	11	11
C3032.004d	#1 (C3032.004d	I: Suspended Ceiling,	SDC D.E.F (Ip=1.5), Area (A): A >	2500, Vert &	Lat)
DS1	0.0	0.7	0.8	0.8	0.8	0.8
DS2	0.0	1.2	1.2	1.4	1.7	1.5
DS3	0.0	5.6	5.9	7.4	9.1	9.0
Total	0.0	7.6	7.9	10	12	11
C3034.002 #	±1 (C3034.002;]	Independent Pendant	Lighting - sei	smically rated)		
DS1	0.1	3.1	3.3	3.5	3.6	3.3
D2021 013a	#1 (D2021 013g	: Cold or Hot Potable	- Small Diar	neter Threaded Steel .	. (2.5 inches ir	•)
D2021.013a DS1	0.0	0.0	0.0	0.0	0.0	0.0
DS1 DS2	0.0	0.0	0.0	0.1	0.0	0.0
Total	0.0	0.1	0.1	0.1	0.1	0.1
D2021 013b	#1 (1)2021 013): Cold or Hot Potable	- Small Dia			
D2021.0130 DS1	0.0	0.1	0.1	0.1	0.1	0.1
		: Cold or Hot Potable				
D2021.025a DS1	#1 (D2021.025a 0.0		0.0	g (uia > 2.5 menes), Si 0.0	0.0	0.0
DS1 DS2	0.0	0.0	0.0	0.0	0.0	0.0
	0.0	0.0	0.0	0.1	0.1	0.1



5	0% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 years
P[Col](%)	0.0	0.0	0.0	0.0	0.5	3.2
P[Res](%)	0.0	0.0	0.0	0.0	0.4	5.5
D2021.023b	#1 (D2021.023)	o: Cold or Hot Potable	Water Pipir	g (dia > 2.5 inches), S	DC D,E,F, BR	ACING)
DS1	0.0	0.0	0.0	0.0	0.0	0.0
DS2	0.0	0.0	0.0	0.0	0.0	0.0
Total	0.0	0.1	0.1	0.1	0.1	0.1
D2031.013b	#1 (D2031.013)	o: Sanitary Waste Pipi	ng - Cast Iro	n w/flexible couplings	, SDC D,E,F,	BRACING)
DS1	0.0	0.0	0.0	0.1	0.1	0.1
D3032.013c	#1 (D3032.013c	: Compressor - Capac	ity: Small no	on medical air supply	- Equipment t	hat is)
DS1a	0.0	0.0	0.0	0.0	0.0	0.0
DS1b	0.0	0.0	0.0	0.0	0.0	0.0
DS1c	0.0	0.0	0.0	0.0	0.0	0.0
DS1d	0.0	0.0	0.0	0.1	0.1	0.1
Total	0.0	0.0	0.0	0.1	0.2	0.2
D3032.013c	#2 (D3032.013c	: Compressor - Capac	ity: Small no	on medical air supply	- Equipment t	hat is)
DS1a	0.0	0.1	0.1	0.1	0.1	0.1
DS1b	0.0	0.1	0.1	0.2	0.2	0.1
DS1c	0.0	0.1	0.1	0.2	0.2	0.1
DS1d	0.0	0.6	0.5	0.7	0.8	0.7
Total	0.0	0.9	0.8	1.2	1.2	1.1
D3041.011c	#1 (D3041.011c	: HVAC Galvanized S	heet Metal D	ucting less than 6 sq.	ft in cross sec	ional)
DS1	0.0	0.1	0.1	0.1	0.1	0.1
DS2	0.0	0.2	0.2	0.2	0.3	0.3
Total	0.0	0.3	0.3	0.3	0.3	0.3
D3041.032c	#1 (D3041.032d	: HVAC Drops / Diffus	sers without	ceilings - supported by	v ducting only	- No)
DS1	0.2	6.0	6.4	7.0	7.6	7.3

3.3 Casualties

Table 3.3.1 shows the total expected casualty results broken into collapse and non-collapse sources. The non-parenthetical values are casualties in terms of number of people and the parenthetical values show the probability of casualty for an individual person placed randomly in the building.

Table 3.3.2 shows the casualty breakdown on a per component basis. The values in this table are in terms of number of people, not probabilities.

The color scale is meant to indicate **relative** performance of components, not absolute performance. A "green" value does not indicate that the value falls in a pre-determined "good" range, just that it performs well compared to other components. Likewise, a "red" value does does not indicate that the value falls in a pre-determined "bad" range, just that it performs worse compared to other components.

	50% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 years
Total Nor	-Collapse Casualt	ies				
Injury	0.000021	0.0547	0.0640	0.0844	0.0990	0.103
mjurj	(0.000)	(1.27)	(1.49)	(1.96)	(2.31)	(2.40)
Death	0.00	0.00	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Total Col	apse Casualties					
Injury	0.00	0.00	0.00	0.00	0.00743	0.0435
	(0.00)	(0.00)	(0.00)	(0.00)	(0.173)	(1.01)
Death	0.00	0.00	0.00	0.00	0.000075	0.000439
Doum	(0.00)	(0.00)	(0.00)	(0.00)	(0.002)	(0.010)
Total Col	apse and Non-Col	lapse Casualties				
Injury	0.000021	0.0547	0.0640	0.0844	0.106	0.143
mjarj	(0.000)	(1.27)	(1.49)	(1.96)	(2.47)	(3.34)
Death	0.00	0.00	0.00	0.00	0.000075	0.000439
Death	(0.00)	(0.00)	(0.00)	(0.00)	(0.002)	(0.010)

Table 3.3.1. Total expected casualties (Number of People (%))

Table 3.3.2. Expected casualties per component (Number of People)

	50% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 years
C3032.00	4a #1 (C3032.004a	a: Suspended Ceiling	, SDC D,E,F (Ip	=1.5), Area (A): A <	< 250, Vert & L	at)
Injury	0.000002	0.0121	0.0133	0.0192	0.0211	0.0247
Death	0.00	0.00	0.00	0.00	0.00	0.00
C3032.00	4b #1 (C3032.004)	b: Suspended Ceiling	g, SDC D,E,F (Ij	p=1.5), Area (A): 250	0 < A < 1000, V	ert & Lat)
Injury	0.00	0.0134	0.0169	0.0209	0.0259	0.0253
Death	0.00	0.00	0.00	0.00	0.00	0.00
C3032.00	4c #1 (C3032.004c	: Suspended Ceiling	, SDC D,E,F (Ip	=1.5), Area (A): 100	00 < A < 2500, V	Vert &)
Injury	0.00	0.0141	0.0160	0.0207	0.0252	0.0248
Death	0.00	0.00	0.00	0.00	0.00	0.00
C3032.00	4d #1 (C3032.004	d: Suspended Ceiling	g, SDC D,E,F (Ij	o=1.5), Area (A): A :	> 2500, Vert &	Lat)
Injury	0.00	0.0143	0.0169	0.0226	0.0259	0.0274
Death	0.00	0.00	0.00	0.00	0.00	0.00
D3041.01	1c #1 (D3041.011c	: HVAC Galvanized	Sheet Metal Du	cting less than 6 sq.	ft in cross sect	ional)
Injury	0.000001	0.000052	0.000058	0.000071	0.000072	0.000079
Death	0.00	0.00	0.00	0.00	0.00	0.00





4	50% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 year
3041.032	: #1 (D3041.032c	: HVAC Drops / Diff	users without ce	lings - supported b	y ducting only	- No)
3041.0320 Injury	#1 (D3041.032c 0.000018	: HVAC Drops / Diff 0.000698	users without ce 0.000776	lings - supported b 0.000928	y ducting only 0.000962	- No) 0.000967

3.4 Quantity Damaged

This table shows the expected percentage of the components that are in a given damage state (normalized to the total quantity of that component in the entire building). The small parenthetical value is the probability that any component throughout the building is in that damage state (the percentage of realizations that have a component in that damage state).

All of these values are conditioned on no global failure. The header shows the probability of global failures (collapse and residual drift demolition) for reference.

The color scale is meant to indicate **relative** performance of components, not absolute performance. A "green" value does not indicate that the value falls in a pre-determined "good" range, just that it performs well compared to other components. Likewise, a "red" value does does not indicate that the value falls in a pre-determined "bad" range, just that it performs worse compared to other components.

	50% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 years
P[Col](%)	0.0	0.0	0.0	0.0	0.5	3.2
P[Res](%)	0.0	0.0	0.0	0.0	0.4	5.5
B1031.011	a #1 (B1031.011a	a: Steel Column Base	Plates, Colum	n W < 150 plf)		
DS1a	0.0 (0.0)	6.5 (18)	6.6 (18)	15 (38)	20 (48)	28 (65)
DS1b	0.0 (0.0)	0.2 (0.8)	0.5 (1.8)	0.8 (3.1)	0.9 (3.7)	1.3 (5.0)
DS2	0.0 (0.0)	0.9 (2.8)	1.0 (3.5)	3.8 (11)	5.7 (17)	11 (32)
DS3	0.0 (0.0)	0.3 (0.8)	0.3 (1.0)	1.9 (4.9)	3.7 (8.9)	7.6 (18)
Total	0.0 (0.0)	7.8 (19)	8.5 (19)	22 (41)	30 (54)	48 (74)
B1035.041	#1 (B1035.041:]	Pre-Northridge WUF	-B beam-colun	nn joint, beam one sid	le of column,	beam depth)
DS1a	0.0 (0.0)	0.0 (0.1)	0.1 (0.2)	0.6 (1.2)	0.8 (1.5)	1.2 (2.3)
DS1b	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.1 (0.2)	0.4 (0.7)	0.2 (0.4)
DS2a	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.1 (0.1)	0.0 (0.1)	0.2 (0.4)
DS2b	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.1 (0.1)	0.0 (0.0)	0.0 (0.1)
DS3	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.1 (0.2)	0.1 (0.3)
Total	0.0 (0.0)	0.0 (0.1)	0.1 (0.2)	0.9 (1.7)	1.3 (2.3)	1.9 (3.2)
B1035.051	#1 (B1035.051:]	Pre-Northridge WUF	-B beam-colun	nn joint, beam both si	des of column	ı, beam)
DS1a	0.0 (0.0)	0.0 (0.1)	0.1 (0.2)	0.6 (1.2)	1.1 (2.1)	1.2 (2.3)
DS1b	0.0 (0.0)	0.0 (0.0)	0.0 (0.1)	0.3 (0.5)	0.2 (0.5)	0.3 (0.7)
DS2a	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.1 (0.1)	0.2 (0.4)
DS2b	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.1 (0.1)	0.0 (0.0)
DS3	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.1 (0.1)	0.2 (0.3)
Total	0.0 (0.0)	0.1 (0.1)	0.2 (0.3)	0.9 (1.6)	1.6 (2.8)	1.9 (3.4)
B1071.202	2 #1 (B1071.202: 1	Exterior Structural W	Vall - Light fra	med wood walls with	structural par	nel)
DS1	0.0 (0.8)	16 (85)	16 (86)	17 (87)	16 (84)	11 (71)
DS2	0.0 (0.0)	4.6 (40)	4.9 (41)	9.8 (65)	11 (70)	11 (72)
DS3	0.0 (0.0)	2.7 (20)	2.7 (21)	10 (57)	14 (71)	25 (90)
Total	0.0 (0.8)	23 (96)	23 (96)	37 (100)	41 (100)	47 (100)
B1071.302	2 #1 (B1071.302: 1	Interior Structural W	all - Light fran	ned wood walls with s	structural par	el)
DS1	27 (97)	31 (99)	32 (99)	27 (99)	24 (98)	22 (98)
DS2	1.8 (16)	17 (87)	17 (88)	14 (84)	13 (81)	11 (76)
DS3	0.4 (3.8)	28 (93)	28 (92)	26 (91)	24 (89)	16 (75)
DS4	0.0 (0.0)	6.4 (40)	6.8 (41)	12 (64)	14 (69)	13 (69)
DS5	0.0 (0.0)	3.7 (19)	3.8 (20)	13 (56)	19 (70)	33 (90)
Total	30 (98)	86 (100)	87 (100)	93 (100)	94 (100)	95 (100)

Table 3.4.1. Expected percentage of damaged components (% of total qty. (% of realizations))



	50% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 year
P[Col](%)	0.0	0.0	0.0	0.0	0.5	3.2
P[Res](%)	0.0	0.0	0.0	0.0	0.4	5.5
32011.40 °	#1 (B2011.401: F	Exterior Wall - Light f	framed wood v	valls with exterior na	nelized sheath	ning)
DS1	0.4 (8.0)	17 (97)	17 (96)	15 (97)	14 (96)	11 (91)
DS1 DS2	0.0 (0.7)	9.1 (90)	9.1 (90)	11 (92)	10 (92)	8.1 (86)
DS2 DS3	0.0 (0.1)	11 (82)	11 (83)	23 (98)	28 (99)	38 (100)
Total	0.5 (8.2)	37 (100)	37 (100)	49 (100)	53 (100)	57 (100)
		: Wall Partition - Typ				-
DS1	22 (70)	37 (88)	37 (89)	33 (86) 15	31 (83)	29 (82)
DS2	1.6 (6.4)	15 (50)	15 (50)	15 (49)	15 (48)	13 (46)
DS3	0.3 (1.2)	31 (89)	30 (88)	43 (98)	47 (99)	52 (100)
Total	24 (76)	83 (100)	83 (100)	91 (100)	93 (100)	94 (100)
		: Interior of Exterior			-	
DS1	23 (71)	37 (89)	37 (89)	33 (87)	32 (85)	29 (82)
DS2	1.3 (4.9)	15 (51)	15 (50)	14 (50)	14 (49)	12 (45)
DS3	0.2 (0.9)	31 (88)	31 (90)	43 (98)	47 (99)	52 (100)
Total	24 (76)	83 (100)	83 (100)	90 (100)	92 (100)	94 (100)
2011.04	lb #1 (C2011.041b	: Light frame stair fr	agility. Appro	ximation as a placeh	older until the	ere is)
DS1	1.0 (2.0)	43 (66)	41 (66)	41 (65)	36 (61)	26 (46)
DS2	0.0 (0.1)	16 (31)	17 (32)	27 (46)	31 (52)	34 (57)
DS3	0.0 (0.0)	4.9 (9.9)	5.2 (10)	16 (30)	21 (38)	35 (60)
Total	1.1 (2.1)	64 (91)	63 (91)	83 (98)	88 (99)	95 (100)
C3032.004	- 4a #1 (C3032.004a	: Suspended Ceiling,	SDC D.E.F (I	n=1.5). Area (A): A <	250. Vert & I	at)
DS1	0.0 (0.1)	11 (20)	11 (20)	12 (23)	13 (24)	14 (26)
DS2	0.0 (0.0)	2.4 (4.7)	2.5 (4.8)	3.3 (6.4)	3.3 (6.6)	3.2 (6.4)
DS3	0.0 (0.1)	11 (19)	11 (20)	16 (27)	19 (32)	21 (33)
Total	0.1 (0.2)	24 (38)	25 (40)	32 (48)	36 (53)	38 (55)
C3032.004	4b #1 (C3032.004b	: Suspended Ceiling,	SDC D.E.F (I	n=1.5). Area (A): 250) < A < 1000. V	/ert & Lat)
DS1	0.1 (0.2)	15 (28)	15 (27)	16 (29)	18 (33)	18 (33)
DS2	0.1 (0.1)	3.3 (6.6)	3.3 (6.6)	4.1 (7.9)	4.4 (8.7)	4.6 (8.8)
DS2 DS3	0.0 (0.0)	12 (20)	12 (22)	17 (28)	20 (32)	22 (35)
Total	0.0 (0.0) 0.2 (0.3)	30 (46)	31 (48)	37 (54)	42 (61)	45 (63)
		: Suspended Ceiling,				
DS1	0.6 (1.1)	26 (44)	26 (44)	28 (47)	27 (46)	29 (49)
DS2	0.0 (0.0)	4.5 (8.6)	5.1 (10)	6.0 (12)	7.2 (14)	6.9 (14)
DS3	0.0 (0.0)	14 (23)	14 (24)	20 (32)	23 (37)	24 (37)
Total	0.6 (1.1)	44 (62)	45 (64)	53 (72)	58 (76)	59 (78)
		: Suspended Ceiling,	, , ,	• • • • •	<i>,</i>	· · ·
DS1	0.9 (1.7)	31 (51)	33 (55)	33 (55)	33 (55)	34 (58)
DS2	0.0 (0.1)	6.3 (12)	6.2 (12)	7.6 (14)	8.9 (17)	8.3 (16)
DS3	0.0 (0.0)	14 (24)	15 (26)	19 (31)	23 (37)	25 (40)
Total	0.9 (1.8)	51 (70)	54 (73)	60 (78)	66 (83)	68 (85)
23034.00	2 #1 (C3034.002: 1	ndependent Pendant	Lighting - seis	mically rated)		
DS1	1.0 (8.0)	42 (91)	43 (91)	50 (94)	55 (95)	56 (97)
D2021.01	3a #1 (D2021.013a	: Cold or Hot Potable	e - Small Diam	eter Threaded Steel	- (2.5 inches in	ı)
DS1	0.1 (0.2)	15 (27)	16 (29)	19 (34)	23 (39)	24 (39)
DS1 DS2	0.0 (0.0)	2.4 (4.7)	2.7 (5.3)	4.1 (7.7)	4.5 (8.5)	5.1 (9.4)
Total	0.1 (0.2)	18 (30)	19 (32)	23 (38)	27 (44)	29 (45)
		: Cold or Hot Potable				



5	0% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 years
P[Col](%)	0.0	0.0	0.0	0.0	0.5	3.2
P[Res](%)	0.0	0.0	0.0	0.0	0.4	5.5
D2021.023a	#1 (D2021.023a	a: Cold or Hot Potabl	e Water Piping	g (dia > 2.5 inches), S	DC D,E,F, PH	PING)
DS1	0.1 (0.1)	16 (27)	17 (29)	19 (33)	23 (38)	23 (39)
DS2	0.0 (0.0)	2.4 (4.4)	2.7 (5.3)	4.2 (7.9)	4.6 (8.6)	5.8 (10)
Total	0.1 (0.1)	18 (30)	19 (33)	23 (38)	27 (43)	29 (45)
D2021.023b	#1 (D2021.023)	b: Cold or Hot Potabl	le Water Piping	g (dia > 2.5 inches), S	DC D,E,F, BR	ACING)
DS1	0.8 (1.5)	24 (41)	25 (43)	26 (45)	28 (48)	28 (48)
DS2	0.1 (0.3)	18 (30)	19 (33)	23 (38)	28 (43)	28 (43)
Total	0.9 (1.8)	42 (61)	44 (65)	49 (69)	55 (75)	56 (76)
D2031.013b	#1 (D2031.013	b: Sanitary Waste Pip	oing - Cast Iroi	n w/flexible couplings	, SDC D,E,F,	BRACING)
DS1	0.4 (0.8)	21 (35)	22 (37)	26 (43)	29 (47)	31 (49)
D3032.013c	#1 (D3032.013d	: Compressor - Capa	city: Small no	n medical air supply	- Equipment t	hat is)
DS1a	0.0 (0.0)	0.8 (0.8)	0.8 (0.8)	2.2 (2.2)	3.2 (3.2)	5.5 (5.5)
DS1b	0.0 (0.0)	0.4 (0.4)	0.4 (0.4)	1.1 (1.1)	1.5 (1.5)	2.0 (2.0)
DS1c	0.0 (0.0)	0.4 (0.4)	0.6 (0.6)	1.7 (1.7)	1.9 (1.9)	3.0 (3.0)
DS1d	0.0 (0.0)	0.8 (0.8)	0.8 (0.8)	1.5 (1.5)	2.4 (2.4)	3.6 (3.6)
Total	0.0 (0.0)	2.5 (2.5)	2.6 (2.6)	6.4 (6.4)	8.9 (8.9)	14 (14)
D3032.013c	#2 (D3032.013d	: Compressor - Capa	city: Small no	n medical air supply	- Equipment t	hat is)
DS1a	0.2 (0.3)	8.7 (16)	9.5 (17)	12 (22)	13 (24)	12 (23)
DS1b	0.1 (0.2)	4.1 (7.7)	4.4 (8.4)	5.5 (11)	5.9 (11)	5.1 (9.7)
DS1c	0.3 (0.6)	6.9 (13)	7.1 (13)	8.9 (17)	9.2 (17)	8.6 (16)
DS1d	0.2 (0.5)	7.1 (14)	6.0 (11)	9.1 (17)	9.9 (19)	9.2 (17)
Total	0.8 (1.4)	27 (42)	27 (41)	35 (53)	38 (56)	35 (52)
	#1 (D3041.011c	: HVAC Galvanized	Sheet Metal Du	cting less than 6 sq.	ft in cross sect	tional)
DS1	0.8 (1.6)	24 (42)	25 (44)	26 (45)	27 (45)	27 (47)
DS2	0.1 (0.1)	18 (31)	19 (32)	23 (38)	28 (44)	29 (46)
Total	0.8 (1.7)	43 (63)	45 (66)	49 (70)	54 (75)	56 (76)
D3041.032c	#1 (D3041.032d	: HVAC Drops / Diffu	users without c	eilings - supported by	y ducting only	- No)
DS1	1.0 (3.5)	42 (77)	45 (80)	50 (85)	55 (88)	57 (88)

4 COMPONENT DAMAGEABILITY AND COST OVERVIEW

This section provides an overview of key component parameters for loss assessment. The components are broken into groups such that the specified component modifiers are applied to all components in the given table.

Some notes on the columns are as follows:

- **DS: Median (Unit Repair Cost Range)**: This presents median EDP for each damage state as well as the associated repair cost range to repair one unit of the component (varies based on quantity).
- Max Repair Potential: This is the cost to completely replace this component throughout the building assuming the most expensive damage state for all components (includes volume discounting). The number in parenthesis is the value as a percentage of building replacement value. Note that this does not need to add up to the total building replacement value, but rather gives a sense of how much potential the component has to contribute to the mean loss when it is damaged.

Component	Description	UN: Median (Unit Repair Cost Range)	Iax Repair Potential
B1031.011a	Steel Column Base Plates, Column W < 150 plf	EDPPeak Interstory DriftDS1a:0.04(\$0 - \$0)DS1b:0.04(\$21,710 - \$35,279)DS2:0.07(\$31,001 - \$43,765)DS3:0.1(\$36,203 - \$51,110)	\$204,439 (14.8%)
B1035.041	Pre-Northridge WUF-B beam-column joint, beam one side of column, beam depth <= W27	EDPPeak Interstory DriftDS1a:0.017(\$13,420 - \$20,130)DS1b:0.017(\$15,089 - \$22,634)DS2a:0.025(\$16,202 - \$24,303)DS2b:0.025(\$19,585 - \$29,377)DS3:0.03(\$16,202 - \$24,303)	\$58,754 (4.26%)
B1035.051	Pre-Northridge WUF-B beam-column joint, beam both sides of column, beam depth <= W27	EDPPeak Interstory DriftDS1a:0.017(\$19,563 - \$29,344)DS1b:0.017(\$21,232 - \$31,848)DS2a:0.025(\$21,009 - \$31,514)DS2b:0.025(\$26,840 - \$40,260)DS3:0.03(\$21,009 - \$31,514)	\$80,520 (5.84%)
B1071.202	Exterior Structural Wall - Light framed wood walls with structural panel sheathing, with hold-downs	EDPPeak Interstory DriftDS1:0.015(\$947 - \$1,539)DS2:0.0262(\$1,366 - \$1,928)DS3:0.0369(\$3,033 - \$4,281)	\$60,423 (4.38%)
B1071.302	Interior Structural Wall - Light framed wood walls with structural panel sheathing, gypsum wallboard on both sides, with hold-downs	EDPPeak Interstory DriftDS1:0.0021(\$175 - \$412)DS2:0.0071(\$374 - \$879)DS3:0.012(\$1,156 - \$2,721)DS4:0.0262(\$2,306 - \$4,256)DS5:0.0369(\$4,079 - \$6,760)	\$54,243 (3.93%)
		Total:	\$458,379 (33.3%)

Table 4.1. "Structural" component list.





Component	Description	DS: Median (Unit Repair Cost Range)	Max Repair Potential
B2011.401	Exterior Wall - Light framed wood walls with exterior panelized sheathing (OSB) and horizontal wood siding, no hold-downs	EDPPeak Interstory DriftDS1:0.01(\$175 - \$412)DS2:0.0175(\$374 - \$879)DS3:0.025(\$1,156 - \$2,721)	\$35,785 (2.60%)
		Total:	\$35,785 (2.60%)

Table 4.2. "Exterior Finishes" component list.

Table 4.3.	"Partition	Walls"	component list	•
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Component	Description	DS: Median (Unit Repair Cost Range)	Max Repair Potential
C1011.211a	Wall Partition - Type: Gypsum with wood studs (both sides), Full Height, Fixed Below, Fixed Above	EDPPeak Interstory DriftDS1:0.0021(\$1,598 - \$5,328)DS2:0.0071(\$3,428 - \$11,425)DS3:0.012(\$11,297 - \$37,656)	(2.83%)
C1011.311a	Interior of Exterior Wall - Type: Gypsum with wood studs (single-sided gypsum), Full Height, Fixed Below, Fixed Above	EDPPeak Interstory DriftDS1:0.0021(\$904 - \$3,015)DS2:0.0071(\$2,223 - \$7,411)DS3:0.012(\$7,151 - \$23,838)	(5.27%)
		Total:	\$111,727 (8.10%)

Component	Description	DS: Median (Unit Repair Cost Range)	Max Repair Potential
C2011.041b	Light frame stair fragility. Approximation as a placeholder until there is more research on the topic. Damage states from P-58 Light frame stair example. Costing approximated from various online sources for stair replacement.	EDP Peak Interstory Drift DS1: 0.011 (\$487 - \$695 DS2: 0.026 (\$1,043 - \$2,782 DS3: 0.05 (\$3,130 - \$8,346) (1.21%)
		Total:	\$16,692 (1.21%)

Table 4.5.	"Ceilings"	component list.
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Component	Description	DS: Median (Unit Repair Cost Range)	Max Repair Potential
C3032.004a	Suspended Ceiling, SDC D,E,F (Ip=1.5), Area (A): A < 250, Vert & Lat support	EDP Peak Floor Acceleration DS1: 1.92 (\$303 - \$1,008) DS2: 2.34 (\$2,368 - \$7,894) DS3: 2.48 (\$4,872 - \$16,240)	(3.59%)

Component	Description	DS: Median (Repair Cost Range)	Max Repair Potential
C3032.004b	Suspended Ceiling, SDC D,E,F (Ip=1.5), Area (A): 250 < A < 1000, Vert & Lat support	EDPPeak Floor AccelerationDS1:1.76(\$726 - \$2,420)DS2:2.26(\$5,683 - \$18,945)DS3:2.44(\$11,692 - \$38,975)	(4.42%)
C3032.004c	Suspended Ceiling, SDC D,E,F (Ip=1.5), Area (A): 1000 < A < 2500, Vert & Lat support	EDPPeak Floor AccelerationDS1:1.45(\$2,178 - \$7,261)DS2:2.1(\$17,050 - \$56,835)DS3:2.34(\$35,077 - \$116,925)	(4.66%)
C3032.004d	Suspended Ceiling, SDC D,E,F (Ip=1.5), Area (A): A > 2500, Vert & Lat support	EDPPeak Floor AccelerationDS1:1.31(\$3,025 - \$10,085)DS2:2.03(\$23,681 - \$78,937)DS3:2.29(\$48,719 - \$162,396)	(4.66%)
		Total:	\$238,938 (17.3%)

Table 4.5 (Continued). "Ceilings" component list.

Table 4.6. "Lighting" component list.

Component	Description	DS: Median (Unit Repair Cost Range)	Max Repair Potential
C3034.002	Independent Pendant Lighting - seismically rated	EDP Peak Floor Acceleration DS1: 1.5 (\$413 - \$1,377)	\$4,131 (0.30%)
		Total:	\$4,131 (0.30%)

Component	Description	DS: Median (Unit Repair Cost Range)	Max Repair Potential
D2021.013a	Cold or Hot Potable - Small Diameter Threaded Steel - (2.5 inches in diameter or less), SDC D, E, or F, PIPING FRAGILITY	EDP Peak Floor Acceleration DS1: 2.25 (\$363 - \$444) DS2: 4.1 (\$3,317 - \$4,055)	$(0.10 \ h)$
D2021.013b	Cold or Hot Potable - Small Diameter Threaded Steel - (2.5 inches in diameter or less), SDC D, E, or F, BRACING FRAGILITY	EDP Peak Floor Acceleration DS1: 1.5 (\$476 - \$581)	\$322 (0.02%)
D2021.023a	Cold or Hot Potable Water Piping (dia > 2.5 inches), SDC D,E,F, PIPING FRAGILITY	EDPPeak Floor AccelerationDS1:2.25(\$292 - \$974)DS2:4.1(\$2,796 - \$9,319)	(0.15~%)
D2021.023b	Cold or Hot Potable Water Piping (dia > 2.5 inches), SDC D,E,F, BRACING FRAGILITY	EDPPeak Floor AccelerationDS1:1.5(\$292 - \$974)DS2:2.25(\$292 - \$974)	(0.01 /0)

Table 4.7. "Piping" component list.





Table 4.7 (Continued).	"Piping"	component list.
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Component	Description	DS: Median (Repair Cost Range)	Max Repair Potential
D2031.013b	Sanitary Waste Piping - Cast Iron w/flexible couplings, SDC D,E,F, BRACING FRAGILITY	EDP Peak Floor Acceleration DS1: 2.25 (\$334 - \$1,113)	\$279 (0.02%)
		Total:	\$4,882 (0.35%)

Description	DN: Median (Unit Repair Cost Range)	x Repair otential
Compressor - Capacity: Small non medical air supply - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Combined anchorage/isolator & equipment fragility	EDPPeak Floor AccelerationDS1a:3.2(\$563 - \$689)DS1b:3.2(\$3,943 - \$4,820)DS1c:3.2(\$939 - \$1,148)DS1d:3.2(\$3,943 - \$4,820)	\$4,820 (0.35%)
Compressor - Capacity: Small non medical air supply - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Combined anchorage/isolator & equipment fragility	EDPPeak Floor AccelerationDS1a:2.05(\$563 - \$689)DS1b:2.05(\$3,943 - \$4,820)DS1c:2.05(\$939 - \$1,148)DS1d:2.05(\$3,943 - \$4,820)	\$9,201 (0.67%)
HVAC Galvanized Sheet Metal Ducting less than 6 sq. ft in cross sectional area, SDC D, E, or F	EDPPeak Floor AccelerationDS1:1.5(\$814 - \$995)DS2:2.25(\$7,949 - \$9,716)	\$3,203 (0.23%)
HVAC Drops / Diffusers without ceilings - supported by ducting only - No independent safety wires, SDC D, E, or F	EDPPeak Floor AccelerationDS1:1.5(\$3,756 - \$4,590)Total:	\$15,857 (1.15%) \$33,081 (2.40%)
	Compressor - Capacity: Small non medical air supply - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Combined anchorage/isolator & equipment fragility Compressor - Capacity: Small non medical air supply - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Combined anchorage/isolator & equipment fragility HVAC Galvanized Sheet Metal Ducting less than 6 sq. ft in cross sectional area, SDC D, E, or F HVAC Drops / Diffusers without ceilings - supported by ducting only - No	DescriptionDS: Median (Unit Repair Cost Range)PerCompressor - Capacity: Small non medical air supply - Equipment that is either hard anchorage/isolator & equipment fragilityEDPPeak Floor Acceleration DS1a: 3.2 (\$563 - \$689)Seismic snubbers/restraints - Combined anchorage/isolator & equipment fragilityDS1c: 3.2 (\$3,943 - \$4,820)Compressor - Capacity: Small non medical air supply - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Combined anchorage/isolator & equipment fragilityEDPPeak Floor Acceleration DS1a: 2.05 (\$3,943 - \$4,820)Compressor - Capacity: Small non medical air supply - Equipment that is either hard anchorage/isolator & equipment fragilityEDPPeak Floor Acceleration DS1a: 2.05 (\$3,943 - \$4,820)MVAC Galvanized Sheet Metal Ducting less than 6 sq. ft in cross sectional area, SDC D, E, or FEDPPeak Floor Acceleration DS1: 1.5 (\$814 - \$995) DS2: 2.25 (\$7,949 - \$9,716)HVAC Drops / Diffusers without ceilings - supported by ducting only - No independent safety wires, SDC D, E, or FEDPPeak Floor Acceleration DS1: 1.5 (\$3,756 - \$4,590)

Table 4.8. "HVAC" component list.

Table 4.9. Summary of component value breakdown (building replacement value = \$1,378,558).

Component Category	Max Repair Potential	% of Building Replacement Value
Structural	\$458,379	33.3%
Exterior Finishes	\$35,785	2.60%
Partition Walls	\$111,727	8.10%
Other Nonstructural	\$16,692	1.21%
Ceilings	\$238,938	17.3%
Lighting	\$4,131	0.30%
Piping	\$4,882	0.35%
HVAC	\$33,081	2.40%
Total	\$903,614	65.5%

5 COMPONENT QUANTITIES AND MODIFICATION FACTORS

Location	Qty. Dir 1	Qty. Dir 2	Qty. ND	Cost Scale	Capacity Scale	Time Scale
B1031.011a (B	1031.011a #1): S	Steel Column Base	e Plates, Column	W < 150 plf		
1	0	4	-	1	1	1
B1035.041 (B1	035.041 #1): Pre	-Northridge WUF	-B beam-columr	i joint, beam one si	de of column, bea	am depth <= W27
2	0	2	_	1	1	1
B1035.051 (B1 W27	035.051 #1): Pre	-Northridge WUF	-B beam-colum	n joint, beam both s	sides of column, l	peam depth <=
2	0	2	-	1	1	1
B1071.202 (B1 hold-downs	071.202 #1): Ext	terior Structural W	all - Light frame	ed wood walls with	structural panel	sheathing, with
1	8.201	2.295	-	1	1	1
2	4.725	4.703	_	1	1	1
	071.302 #1): Intendent of the sides, with hold be a second state of the sides of th		all - Light frame	d wood walls with	structural panel sl	heathing, gypsum
1	2.295	5.873	-	1	1	1
2	2.16	2.97	_	1	1	1
	011.401 #1): Ext l siding, no hold-		framed wood wa	alls with exterior pa	anelized sheathin	g (OSB) and
1	7.783	7.678	-	1	1	1
2	5.248	10.2384	_	1	1	1
C1011.211a (C Fixed Above	21011.211a #1): `	Wall Partition - Ty	pe: Gypsum wit	h wood studs (both	sides), Full Heig	ht, Fixed Below,
1-2	0.26	0.26	_	1	1	1
Height, Fixed B	elow, Fixed Abov	/e	r Wall - Type: G	ypsum with wood		
	0.666666667	1.314285714	_	1	1	1
1-2					1.1	
C2011.041b (Con the topic. Da	C2011.041b #1): mage states from	Light frame stair f 1 P-58 Light frame		imation as a placeh Costing approximat		
C2011.041b (C on the topic. Da	C2011.041b #1): mage states from					
C2011.041b (Con the topic. Dastair replacement 1	22011.041b #1): mage states from nt. 1	n P-58 Light frame	stair example. (Costing approximat	ed from various o	online sources for 1
C2011.041b (C on the topic. Da stair replacemen 1 C3032.004a (C 2-R	22011.041b #1): Image states from tt. 1 23032.004a #1): 5 -	1 P-58 Light frame 1 Suspended Ceiling –	stair example. (- s, SDC D,E,F (Ip 1.97775	Costing approximat 1 ==1.5), Area (A): A 1	ed from various o 1 a < 250, Vert & L 1	online sources for 1 at support 1
C2011.041b (Con the topic. Dastair replacement 1 C3032.004a (Con 2-R	22011.041b #1): Image states from tt. 1 23032.004a #1): 5 -	1 P-58 Light frame 1 Suspended Ceiling –	stair example. (- s, SDC D,E,F (Ip 1.97775	Costing approximat	ed from various o 1 a < 250, Vert & L 1	online sources for 1 at support 1
C2011.041b (C on the topic. Da stair replacemer 1 C3032.004a (C 2-R C3032.004b (C 2-R	C2011.041b #1): umage states from ht. C3032.004a #1): C3032.004b #1): -	1 P-58 Light frame 1 Suspended Ceiling – Suspended Ceiling –	stair example. C - s, SDC D,E,F (Ip 1.97775 g, SDC D,E,F (Ip 0.8240625	Costing approximat 1 p=1.5), Area (A): A 1 p=1.5), Area (A): 2 1	ed from various o 1 4 < 250, Vert & L 1 50 < A < 1000, V 1	online sources fo 1 at support 1 ert & Lat suppor 1
C2011.041b (C on the topic. Da stair replacemer 1 C3032.004a (C 2-R C3032.004b (C 2-R	C2011.041b #1): umage states from ht. C3032.004a #1): C3032.004b #1): -	1 P-58 Light frame 1 Suspended Ceiling – Suspended Ceiling –	stair example. C - s, SDC D,E,F (Ip 1.97775 g, SDC D,E,F (Ip 0.8240625	Costing approximat 1 p=1.5), Area (A): A 1 p=1.5), Area (A): 2	ed from various o 1 4 < 250, Vert & L 1 50 < A < 1000, V 1	online sources fo 1 at support 1 ert & Lat suppor 1
C2011.041b (C on the topic. Da stair replacemen 1 C3032.004a (C 2-R C3032.004b (C 2-R C3032.004c (C 2-R	22011.041b #1): umage states from ht. 23032.004a #1): - 23032.004b #1): - 3032.004c #1): S -	NP-58 Light frame 1 Suspended Ceiling - Suspended Ceiling - Suspended Ceiling -	stair example. C 	Costing approximat 1 p=1.5), Area (A): A 1 p=1.5), Area (A): 2 1 =1.5), Area (A): 10 1	ed from various o 1 x < 250, Vert & L 1 50 < A < 1000, V 1 00 < A < 2500, V 1	online sources fo 1 at support 1 fert & Lat suppor 1 fert & Lat suppor 1
C2011.041b (C on the topic. Da stair replacemen 1 C3032.004a (C 2-R C3032.004b (C 2-R C3032.004c (C 2-R	22011.041b #1): umage states from ht. 23032.004a #1): - 23032.004b #1): - 3032.004c #1): S -	NP-58 Light frame 1 Suspended Ceiling - Suspended Ceiling - Suspended Ceiling -	stair example. C 	Costing approximat 1 p=1.5), Area (A): A 1 p=1.5), Area (A): 2 1	ed from various o 1 x < 250, Vert & L 1 50 < A < 1000, V 1 00 < A < 2500, V 1	online sources fo 1 at support 1 fert & Lat suppor 1 fert & Lat suppor 1
C2011.041b (C on the topic. Da stair replacemen 1 C3032.004a (C 2-R C3032.004b (C 2-R C3032.004c (C 2-R C3032.004d (C 2-R	C2011.041b #1): umage states from nt. C3032.004a #1): C3032.004b #1): C3032.004c #1): C3032.004d #1):	I Suspended Ceiling - Suspended Ceiling - Suspended Ceiling - Suspended Ceiling - Suspended Ceiling -	stair example. C , SDC D,E,F (Ip 1.97775 , SDC D,E,F (Ip 0.8240625 , SDC D,E,F (Ip 0.2746875 , SDC D,E,F (Ip 0.197775	Costing approximat 1 p=1.5), Area (A): A 1 p=1.5), Area (A): 2 1 =1.5), Area (A): 10 1 p=1.5), Area (A): A 1	ed from various o 1 x < 250, Vert & L 1 50 < A < 1000, V 1 000 < A < 2500, V 1 x > 2500, Vert & 1	online sources fo 1 at support 1 fert & Lat suppor 1 fert & Lat support 1 Lat support
C2011.041b (C on the topic. Da stair replacemen 1 C3032.004a (C 2-R C3032.004b (C 2-R C3032.004c (C 2-R C3032.004d (C 2-R	C2011.041b #1): umage states from nt. C3032.004a #1): C3032.004b #1): C3032.004c #1): C3032.004d #1):	NP-58 Light frame 1 Suspended Ceiling - Suspended Ceiling - Suspended Ceiling -	stair example. C , SDC D,E,F (Ip 1.97775 , SDC D,E,F (Ip 0.8240625 , SDC D,E,F (Ip 0.2746875 , SDC D,E,F (Ip 0.197775	Costing approximat 1 p=1.5), Area (A): A 1 p=1.5), Area (A): 2 1 =1.5), Area (A): 10 1 p=1.5), Area (A): A 1	ed from various o 1 x < 250, Vert & L 1 50 < A < 1000, V 1 000 < A < 2500, V 1 x > 2500, Vert & 1	online sources fo 1 at support 1 fert & Lat suppor 1 fert & Lat support 1 Lat support
C2011.041b (C on the topic. Da stair replacemer 1 C3032.004a (C 2-R C3032.004b (C 2-R C3032.004c (C 2-R C3032.004d (C 2-R C3032.004d (C 2-R C3032.004d (C 2-R C3032.004d (C 2-R	C2011.041b #1): umage states from nt. C3032.004a #1): C3032.004b #1): C3032.004c #1): C3032.004c #1): C3032.004d #1):	I Suspended Ceiling - Suspended Ceiling - Suspended Ceiling - Suspended Ceiling - Suspended Ceiling - Suspended Ceiling - Cold or Hot Potab	stair example. C - s, SDC D,E,F (IF 1.97775 g, SDC D,E,F (IF 0.8240625 , SDC D,E,F (IP 0.2746875 g, SDC D,E,F (IF 0.197775 Lighting - seisn 5	Costing approximat 1 p=1.5), Area (A): A 1 p=1.5), Area (A): 2 1 =1.5), Area (A): 10 1 p=1.5), Area (A): A 1	ed from various o 1 x < 250, Vert & L 1 50 < A < 1000, V 1 000 < A < 2500, V 1 x > 2500, Vert & 1 1	online sources fo 1 at support 1 fert & Lat support 1 Lat support 1 1

Table 5.1. Component quantity and modification summary.





Location	Qty. Dir 1	Qty. Dir 2	Qty. ND	Cost Scale	Capacity Scale	Time Scale
D2021.013b (I	D2021.013b #1):	Cold or Hot Potal	ole - Small Diame	eter Threaded Stee	l - (2.5 inches in c	liameter or less),
SDC D, E, or F	, BRACING FRA	GILITY				
2-R	_	_	0.276885	1	1	1
D2021.023a (I)2021.023a #1);	Cold or Hot Potal	ole Water Piping (dia > 2.5 inches),	SDC D.E.F. PIPII	NG FRAGILITY
2-R	_	_	0.0988875	1	1	1
Daga1 0001 (1	DA0A1 0AAL #1)		1 W/ (D')			CINC
FRAGILITY	D2021.0230 #1):	Cold of Hot Potal	ble water Piping	(dia > 2.5 inches),	SDC D,E,F, BRA	CING
2-R	-	-	0.0988875	1	1	1
FRAGILITY 2-R	-	-	0.1252575	1	1	1
				medical air supply Combined anchora		
G	-	-	1	1	1	1 1
D3032.013c (I)3032.013c #2): (Compressor - Cap	acity: Small non	medical air supply	- Equipment that	is either hard
				Combined anchora		
R	-	-	2	1	1	1
)3041.011c #1):]	HVAC Galvanized	l Sheet Metal Duo	cting less than 6 sq	. ft in cross sectio	onal area, SDC l
E, or F			0.1648125	1	1	1
2-R	_	_	0.1048125	1	1	1
	2041 022a #1)+ 1	HVAC Drops / Di	ffusers without ce	ilings - supported	by ducting only -	No independent
D3041.032c (I safety wires, SI				0 11		

6 FRAGILITY INFORMATION

6.1 B1031.011a #1: (B1031.011a) Steel Column Base Plates, Column W < 150 plf

NISTIR Classification	B1031.011a
Author	Greg Deierlein
Normalized Unit	1.0 each
Engineering Demand Parameter	Peak Interstory Drift
Number of Damage States	3
Is correlated?	No
Is directional?	Yes

Component modifications applied:

Component Group	Structural
Quantity Scale Factor	1.0
Damage Median Scale Factor	1.0
Total Cost Scale Factor	1.391
User cost modification factor	1.0
Regional Cost Scale Factor	1
Date multiplier (to convert from 2011 USD)	1.391
Occupancy Cost Scale Factor	1
Building Value Cost Scale Factor	1

Table 6.1.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

Location	Cost	Time	Capacity
1-2	1	1	1





Table 6.1.2. I	Damage state	progression.
----------------	--------------	--------------

Damage State	Description	Repair Description	Image
DS1a	Initiation of crack at the fusion line between the column flange and the base plate weld. Dam- age in field is either obscured or deemed to not warrant repair. No repair conducted.	The repair will involve removal of a portion of grade slab, gouging out material surrounding the fracture initiating and re-welding, then re- pair of slab. Field condition is deemed to not warrant repair by field observation. This Dam- age State is Mutually Exclusive with DS2. See fragility DS1 and DS2 probabilities.	
DS1b	Initiation of crack at the fusion line between the column flange and the base plate weld.	The repair will involve removal of a portion of grade slab, gouging out material surround- ing the fracture initiating and re-welding, then repair of slab.	
DS2	Propagation of brittle crack into column and/or base plate.	Depending on the crack trajectory, the repair will range from replacement of a portion of the column or base plate to full replacement of the column base. Replacement will require shoring of column, torch cutting to remove damaged material, and fabrication and field welding to install replacement material.	Not Available
DS3	Complete fracture of the column (or column weld) and disloca- tion of column relative to the base.	Repair would likely involve replacing the en- tire base plate assembly and most of the col- umn in the story above the base plate.	Not Available



Table 6.1.3. Parameters for the damage state distributions	. The medians reflect a scale fac	tor of <u>1.0</u> applied to	the default va	ilues.
	564	5.64	DCA	

	DS1a	DS1b	DS2	DS3
Туре	Mut. Excl.	Mut. Excl.	Sequential	Sequential
Probability	0.95	0.05	-	_
Median	0.04	0.04	0.07	0.1
eta	0.4	0.4	0.4	0.4

Table 6.1.4. Parameters for the cost distributions. The cost values reflect a total scale factor of **<u>1.391</u>** applied to the default values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor, building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

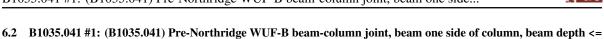
	DS1a	DS1b	DS2	DS3
Distribution Type	LogNormal	LogNormal	LogNormal	LogNormal
Lower Qty.	5.0	5.0	5.0	5.0
Upper Qty.	20.0	20.0	20.0	20.0
Highest Cost Median	\$0	\$35,279	\$43,765	\$51,110
Lowest Cost Median	\$0	\$21,710	\$31,001	\$36,203
β (COV)	0.25	0.41	0.37	0.34

Table 6.1.5. Parameters for the repair time distributions.

	DS1a	DS1b	DS2	DS3
Distribution Type	LogNormal	LogNormal	LogNormal	LogNormal
Lower Qty.	5.0	5.0	5.0	5.0
Upper Qty.	20.0	20.0	20.0	20.0
Highest Median Repair Time (Days)	0	24.62	30.54	35.66
Lowest Median Repair Time (Days)	0	15.15	21.63	25.26
β (COV)	0.35	0.48	0.44	0.42

Table 6.1.6. Life safety information.

	DS1a	DS1b	DS2	DS3
Non-collapse casualties	No	No	No	No
Affected Area				
Serious Injury Median	-	-	-	-
Serious Injury β	-	-	-	-
Loss of Life Median	-	_	_	_
Loss of Life β	-	-	-	-
Can Cause Red Tag	No	No	Yes	Yes
Unsafe Placard Median	_	_	0.25	0.1
Unsafe Placard β	_	-	0.5	0.5



SP

NISTIR Classification	B1035.041
Author	Greg Deierlein
Normalized Unit	1.0 each
Engineering Demand Parameter	Peak Interstory Drift
Number of Damage States	3
Is correlated?	No
Is directional?	Yes
Component modifications applie	ed:
Component Group	Structure

W27

Component Group Structural Quantity Scale Factor 1.0 Damage Median Scale Factor 1.0 Total Cost Scale Factor 1.391 User cost modification factor 1.0 Regional Cost Scale Factor 1 Date multiplier (to convert from 2011 USD) 1.391 Occupancy Cost Scale Factor 1

Building Value Cost Scale Factor

Table 6.2.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

1

Location	Cost	Time	Capacity
1-2	1	1	1



Damage State	Description	Repair Description	Image			
DS1a	Fracture of lower beam flange weld and failure of web bolts (shear tab connection), with frac- tures confined to the weld re- gion.	Repair will typically require gouging out and re-welding of the beam flange weld, repair of shear tab, and replacing shear bolts. Repair and replace partitions at connection.				
DS1b	Similar to DS1, except that fracture propagates into column flanges.	In addition to column measures for DS1, re- pairs to column will be necessary. Cover plate, patch, or replace damaged column flange at connection.				
DS2a	Fracture of upper beam flange weld, without DS1 type dam- age. Fracture is confined to beam flange region.	Repairs will be similar to those required for DS1, except that access to weld will likely re- quire removal and replacement of a portion of the floor slab above the weld.	Not Available			
DS2b	Similar to DS3, except that fracture propagates into column flanges.	In addition to column measures for DS3, re- pairs to column will be necessary that will in- volve replacing a portion of the column flange.	Not Available			
DS3	Fracture initiating at weld access hole and propagating through beam flange, possibly accompa- nied by local buckling deforma- tions of web and flange.	Repair is similar to that for DS1 except that a portion of the beam web and flange may need to be heat straightened or replaced.	Not Available			

Table 6.2.2. Damage state progression.



	DS1a	DS1b	DS2a	DS2b	DS3
Туре	Mut. Excl.	Mut. Excl.	Mut. Excl.	Mut. Excl.	Sequential
Probability	0.75	0.25	0.75	0.25	_
Median	0.017	0.017	0.025	0.025	0.03
eta	0.4	0.4	0.4	0.4	0.4

Table 6.2.3. Parameters for the damage state distributions. The medians reflect a scale factor of **1.0** applied to the default values.

Table 6.2.4. Parameters for the cost distributions. The cost values reflect a total scale factor of **<u>1.391</u>** applied to the default values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor, building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1a	DS1b	DS2a	DS2b	DS3
Distribution Type	Normal	Normal	LogNormal	LogNormal	LogNormal
Lower Qty.	5.0	5.0	5.0	5.0	5.0
Upper Qty.	30.0	30.0	30.0	30.0	30.0
Highest Cost Median	\$20,130	\$22,634	\$24,303	\$29,377	\$24,303
Lowest Cost Median	\$13,420	\$15,089	\$16,202	\$19,585	\$16,202
β (COV)	0.35	0.35	0.32	0.37	0.34

Table 6.2.5. Parameters for the repair time distributions.

	DS1a	DS1b	DS2a	DS2b	DS3
Distribution Type	Normal	Normal	LogNormal	LogNormal	LogNormal
Lower Qty.	5.0	5.0	5.0	5.0	5.0
Upper Qty.	30.0	30.0	30.0	30.0	30.0
Highest Median Repair Time (Days)	8.51	9.57	11.75	12.42	10.28
Lowest Median Repair Time (Days)	5.68	6.38	8.32	8.28	6.85
β (COV)	0.43	0.43	0.41	0.45	0.42

Table 6.2.6. Life safety information.

	DS1a	DS1b	DS2a	DS2b	DS3
Non-collapse casualties	No	No	No	No	No
Affected Area					
Serious Injury Median	-	-	-	-	-
Serious Injury β	-	-	-	-	-
Loss of Life Median	-	-	-	-	-
Loss of Life β	-	-	-	-	-
Can Cause Red Tag	Yes	Yes	Yes	Yes	Yes
Unsafe Placard Median	0.5	0.5	0.5	0.5	0.5
Unsafe Placard β	0.5	0.5	0.5	0.5	0.5



6.3 B1035.051 #1: (B1035.051) Pre-Northridge WUF-B beam-column joint, beam both sides of column, beam depth <= W27

NISTIR Classification Author Normalized Unit	B1035.051 Greg Deierlein 1.0 each
Engineering Demand Parameter	Peak Interstory Drift
Number of Damage States	3
Is correlated?	No
Is directional?	Yes
Component modifications applie	ed:
Component Group	Structural
Quantity Scale Factor	1.0

Quantity Scale Factor	1.0
Damage Median Scale Factor	1.0
Total Cost Scale Factor	1.391
User cost modification factor	1.0
Regional Cost Scale Factor	1
Date multiplier (to convert from 2011 USD)	1.391
Occupancy Cost Scale Factor	1
Building Value Cost Scale Factor	1

Table 6.3.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

Location	Cost	Time	Capacity
1-2	1	1	1



	Table 0.5.2. Damage state progression.				
Damage State	Description	Repair Description	Image		
DS1a	Fracture of lower beam flange weld and failure of web bolts (shear tab connection), with frac- tures confined to the weld re- gion.	Repair will typically require gouging out and re-welding of the beam flange weld, repair of shear tab, and replacing shear bolts. Repair and replace partitions at connection.			
DS1b	Similar to DS1, except that fracture propagates into column flanges.	In addition to column measures for DS1, re- pairs to column will be necessary. Cover plate, patch, or replace damaged column flange at connection.			
DS2a	Fracture of upper beam flange weld, without DS1 type dam- age. Fracture is confined to beam flange region.	Repairs will be similar to those required for DS1, except that access to weld will likely re- quire removal and replacement of a portion of the floor slab above the weld.	Not Available		
DS2b	Similar to DS3, except that fracture propagates into column flanges.	In addition to column measures for DS3, re- pairs to column will be necessary that will in- volve replacing a portion of the column flange.	Not Available		
DS3	Fracture initiating at weld access hole and propagating through beam flange, possibly accompa- nied by local buckling deforma- tions of web and flange.	Repair is similar to that for DS1 except that a portion of the beam web and flange may need to be heat straightened or replaced.	Not Available		

Table 6.3.2. Damage state progression.



	DS1a	DS1b	DS2a	DS2b	DS3
Туре	Mut. Excl.	Mut. Excl.	Mut. Excl.	Mut. Excl.	Sequential
Probability	0.75	0.25	0.75	0.25	_
Median	0.017	0.017	0.025	0.025	0.03
eta	0.4	0.4	0.4	0.4	0.4

Table 6.3.3. Parameters for the damage state distributions. The medians reflect a scale factor of **1.0** applied to the default values.

Table 6.3.4. Parameters for the cost distributions. The cost values reflect a total scale factor of **<u>1.391</u>** applied to the default values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor, building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1a	DS1b	DS2a	DS2b	DS3
Distribution Type	Normal	Normal	Normal	Normal	Normal
Lower Qty.	5.0	5.0	5.0	5.0	5.0
Upper Qty.	30.0	30.0	30.0	30.0	30.0
Highest Cost Median	\$29,344	\$31,848	\$31,514	\$40,260	\$31,514
Lowest Cost Median	\$19,563	\$21,232	\$21,009	\$26,840	\$21,009
β (COV)	0.36	0.36	0.3	0.32	0.33

Table 6.3.5. Parameters for the repair time distributions.

	DS1a	DS1b	DS2a	DS2b	DS3
Distribution Type	Normal	Normal	Normal	Normal	Normal
Lower Qty.	5.0	5.0	5.0	5.0	5.0
Upper Qty.	30.0	30.0	30.0	30.0	30.0
Highest Median Repair Time (Days)	12.41	13.47	16.68	17.03	13.33
Lowest Median Repair Time (Days)	8.27	8.98	12.24	11.35	8.88
β (COV)	0.44	0.44	0.39	0.4	0.41

Table 6.3.6. Life safety information.

	DS1a	DS1b	DS2a	DS2b	DS3
Non-collapse casualties	No	No	No	No	No
Affected Area					
Serious Injury Median	_	_	_	_	_
Serious Injury β	-	-	-	-	-
Loss of Life Median	_	_	_	_	_
Loss of Life β	_	_	_	_	_
Can Cause Red Tag	Yes	Yes	Yes	Yes	Yes
Unsafe Placard Median	0.5	0.5	0.5	0.5	0.5
Unsafe Placard β	0.5	0.5	0.5	0.5	0.5



6.4 B1071.202 #1: (B1071.202) Exterior Structural Wall - Light framed wood walls with structural panel sheathing, with hold-downs

NISTIR Classification	B1071.202	
Author	HBRG (exterio	or only)
Normalized Unit	100.0 sf	
Engineering Demand Parameter	Peak Interstory	/ Drift
Number of Damage States	3	
Is correlated?	No	
Is directional?	Yes	
Component modifications applie	d:	
Component Group		Structural
Component Group Quantity Scale Factor		Structural 1.0
1 1		
Quantity Scale Factor		1.0
Quantity Scale Factor Damage Median Scale Factor		1.0 1.0
Quantity Scale Factor Damage Median Scale Factor Total Cost Scale Factor		1.0 1.0 1.391
Quantity Scale Factor Damage Median Scale Factor Total Cost Scale Factor User cost modification factor	n 2011 USD)	1.0 1.0 1.391 1.0
Quantity Scale Factor Damage Median Scale Factor Total Cost Scale Factor User cost modification factor Regional Cost Scale Factor	n 2011 USD)	1.0 1.0 1.391 1.0 1

Table 6.4.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

Location	Cost	Time	Capacity
1-2	1	1	1

Table 6.4.2.	Damage state	progression.
--------------	--------------	--------------

Damage State	Description	Repair Description	Image
DS1	Slight separation of sheathing or nails which come loose.	Remove exterior pliable siding, replace loose nails, reinstall siding.	
DS2	Permanent rotation of sheathing, tear out of nails or sheathing.	Remove exterior pliable siding, remove wood sheathing, install new sheathing, reinstall siding.	
DS3	Fracture of studs, major sill plate cracking.	Remove and replace siding, sheathing, studs and plates. Provide shoring as required.	



Table 6.4.3. Parameters for the damage state distributions. The medians reflect a scale factor of **<u>1.0</u>** applied to the default values.

	DS1	DS2	DS3
Туре	Sequential	Sequential	Sequential
Probability	-	-	-
Median	0.015	0.0262	0.0369
β	0.4	0.19	0.2

Table 6.4.4. Parameters for the cost distributions. The cost values reflect a total scale factor of **<u>1.391</u>** applied to the default values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor, building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1	DS2	DS3
Distribution Type	LogNormal	LogNormal	LogNormal
Lower Qty.	3.0	3.0	3.0
Upper Qty.	8.0	8.0	8.0
Highest Cost Median	\$1,539	\$1,928	\$4,281
Lowest Cost Median	\$947	\$1,366	\$3,033
β (COV)	0.19	0.22	0.08

Table 6.4.5. Parameters for the repair time distributions.

	DS1	DS2	DS3
Distribution Type	LogNormal	LogNormal	LogNormal
Lower Qty.	3.0	3.0	3.0
Upper Qty.	8.0	8.0	8.0
Highest Median Repair Time (Days)	1.07	1.35	2.99
Lowest Median Repair Time (Days)	0.66	0.95	2.12
β (COV)	0.31	0.33	0.26

Table 6.4.6. Life safety information.

	DS1	DS2	DS3
Non-collapse casualties Affected Area	No 	No 	No
Serious Injury Median Serious Injury β	_		
Loss of Life Median Loss of Life β	_	_	
Can Cause Red Tag Unsafe Placard Median Unsafe Placard β	No _ _	Yes 0.5 0.5	Yes 0.25 0.5

-

6.5 B1071.302 #1: (B1071.302) Interior Structural Wall - Light framed wood walls with structural panel sheathing, gypsum wallboard on both sides, with hold-downs

NISTIR Classification	B1071.302	
Author	HBRG (exterio	or only)
Normalized Unit	100.0 sf	
Engineering Demand Parameter	Peak Interstory	y Drift
Number of Damage States	5	
Is correlated?	No	
Is directional?	Yes	
Component modifications applie	ed:	
Component modifications applie Component Group	ed:	Structural
	ed:	Structural 1.0
Component Group	ed:	
Component Group Quantity Scale Factor	d:	1.0
Component Group Quantity Scale Factor Damage Median Scale Factor	d:	1.0 1.0
Component Group Quantity Scale Factor Damage Median Scale Factor Total Cost Scale Factor	d:	1.0 1.0 1.391

Occupancy Cost Scale Factor

Building Value Cost Scale Factor

Table 6.5.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

1

1

Location	Cost	Time	Capacity
1-2	1	1	1





Damage State	Description	Repair Description	Image
DS1	Cracking of paint over fasteners or joints.	Gypsum wallboard repaired by replacing the tape along the seam of two adjacent panels and local areas with popped fasteners, apply- ing new joint compound, sanding, and repaint- ing.	Not Available
DS2	Local and global buckling out- of-plane and crushing of gyp- sum wallboards. Studs are typ- ically not damaged by failure of the gypsum wallboard.	Replace 25 feet of the affected panel along with the application of new tape, joint com- pound, followed by sanding and repainting. Studs are not damaged.	Not Available
DS3	Local and global buckling out- of-plane and crushing of gyp- sum wallboards. Studs are typ- ically not damaged by failure of the gypsum wallboard, but fram- ing adjustments possible for this damage state.	Replace 100 feet of the affected panel along with the application of new tape, joint com- pound, followed by sanding and repainting. Studs are not damaged.	Not Available
DS4	Permanent rotation of sheathing, tear out of nails or sheathing.	Remove interior finish, remove wood sheath- ing, install new sheathing, reinstall and finish interior material.	
DS5	Fracture of studs, major sill plate cracking.	Remove and replace interior finish, sheathing, studs and plates. Provide shoring as required.	

Table 6.5.2. Damage state progression.





	DS1	DS2	DS3	DS4	DS5
Туре	Sequential	Sequential	Sequential	Sequential	Sequential
Probability	-	_	-	-	_
Median	0.0021	0.0071	0.012	0.0262	0.0369
eta	0.6	0.45	0.45	0.19	0.2

Table 6.5.3. Parameters for the damage state distributions. The medians reflect a scale factor of **1.0** applied to the default values.

Table 6.5.4. Parameters for the cost distributions. The cost values reflect a total scale factor of **<u>1.391</u>** applied to the default values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor, building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1	DS2	DS3	DS4	DS5
Distribution Type	Normal	Normal	LogNormal	LogNormal	LogNormal
Lower Qty.	3.0	3.0	3.0	3.0	3.0
Upper Qty.	8.0	8.0	8.0	8.0	8.0
Highest Cost Median	\$412	\$879	\$2,721	\$4,256	\$6,760
Lowest Cost Median	\$175	\$374	\$1,156	\$2,306	\$4,079
β (COV)	0.42	0.49	0.1	0.22	0.08

Table 6.5.5. Parameters for the repair time distributions.

	DS1	DS2	DS3	DS4	DS5
Distribution Type	Normal	Normal	LogNormal	LogNormal	LogNormal
Lower Qty.	3.0	3.0	3.0	3.0	3.0
Upper Qty.	8.0	8.0	8.0	8.0	8.0
Highest Median Repair Time (Days)	0.23	0.49	1.52	2.63	4.37
Lowest Median Repair Time (Days)	0.1	0.21	0.65	2.27	3.57
β (COV)	0.52	0.55	0.34	0.33	0.26

Table 6.5.6. Life safety information.

	DS1	DS2	DS3	DS4	DS5
Non-collapse casualties	No	No	No	No	No
Affected Area					
Serious Injury Median	_	_	_	_	_
Serious Injury β	-	-	-	-	_
Loss of Life Median	_	_	_	_	_
Loss of Life β	-	-	-	-	_
Can Cause Red Tag	No	No	No	Yes	Yes
Unsafe Placard Median	_	_	-	0.5	0.25
Unsafe Placard β	-	-	-	0.5	0.5

6.6 B2011.401 #1: (B2011.401) Exterior Wall - Light framed wood walls with exterior panelized sheathing (OSB) and horizontal wood siding, no hold-downs

NISTIR Classification	B2011.401
Author	HBRG (exterior only modifications)
Normalized Unit	100.0 sf
Engineering Demand Parameter	Peak Interstory Drift
Number of Damage States	3
Is correlated?	No
Is directional?	Yes

Component modifications applied:

Component Group	Exterior Finishes
Quantity Scale Factor	1.0
Damage Median Scale Factor	1.0
Total Cost Scale Factor	1.391
User cost modification factor	1.0
Regional Cost Scale Factor	1
Date multiplier (to convert from 2011 USD)	1.391
Occupancy Cost Scale Factor	1
Building Value Cost Scale Factor	1

Table 6.6.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

Location	Cost	Time	Capacity
1-2	1	1	1

Table 6.6.2. Damage state progression.

Damage State	Description	Repair Description	Image
DS1	Slight separation of sheathing or nails which come loose.	Remove exterior pliable siding, replace loose nails, reinstall siding.	
DS2	Permanent rotation of sheathing, tear out of nails or sheathing.	Remove exterior pliable siding, remove wood sheathing, install new sheathing, reinstall siding.	
DS3	Fracture of studs, major sill plate cracking.	Remove and replace siding, sheathing, studs and plates. Provide shoring as required.	

Table 6.6.3. Parameters for the damage state distributions. The medians reflect a scale factor of **<u>1.0</u>** applied to the default values.

	DS1	DS2	DS3
Туре	Sequential	Sequential	Sequential
Probability	-	-	-
Median	0.01	0.0175	0.025
β	0.4	0.4	0.4

Table 6.6.4. Parameters for the cost distributions. The cost values reflect a total scale factor of **<u>1.391</u>** applied to the default values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor, building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1	DS2	DS3
Distribution Type	LogNormal	LogNormal	Normal
Lower Qty.	3.0	3.0	3.0
Upper Qty.	8.0	8.0	8.0
Highest Cost Median	\$412	\$879	\$2,721
Lowest Cost Median	\$175	\$374	\$1,156
β (COV)	0.19	0.22	0.08

Table 6.6.5. Parameters for the repair time distributions.

	DS1	DS2	DS3
Distribution Type	LogNormal	LogNormal	Normal
Lower Qty.	3.0	3.0	3.0
Upper Qty.	8.0	8.0	8.0
Highest Median Repair Time (Days)	0.86	1.08	2.4
Lowest Median Repair Time (Days)	0.53	0.77	1.7
β (COV)	0.31	0.33	0.26

Table 6.6.6. Life safety information.

	DS1	DS2	DS3
Non-collapse casualties Affected Area	No 	No 	No
Serious Injury Median Serious Injury β			-
Loss of Life Median Loss of Life β			
Can Cause Red Tag Unsafe Placard Median Unsafe Placard β	No 	Yes 0.5 0.5	Yes 0.25 0.5

NISTIR Classification Author Normalized Unit Engineering Demand Parameter Number of Damage States Is correlated?	C1011.211a DaveWelch (HBRG) 100.0 If Peak Interstory Drift 3 No
Is directional?	Yes
is directional?	105
Component modifications applie	ed:
Component Group	Partition Walls
Quantity Scale Factor	1.0
Damage Median Scale Factor	1.0
Total Cost Scale Factor	1.391
User cost modification factor	1.0
eser cost mounication factor	1.0
Regional Cost Scale Factor	1
	1
Regional Cost Scale Factor	1

6.7 C1011.211a #1: (C1011.211a) Wall Partition - Type: Gypsum with wood studs (both sides), Full Height, Fixed Below, Fixed Above

Table 6.7.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

Location	Cost	Time	Capacity
1-2	1	1	1

Table 6.7.2. Damage state progression.

Damage State	Description	Repair Description	Image
DS1	Cracking of paint over fasteners or joints.	Gypsum wallboard repaired by replacing the tape along the seam of two adjacent panels and local areas with popped fasteners, apply- ing new joint compound, sanding, and repaint- ing.	Not Available
DS2	Local and global buckling out- of-plane and crushing of gyp- sum wallboards. Studs are typ- ically not damaged by failure of the gypsum wallboard.	Replace 25 feet of the affected panel along with the application of new tape, joint com- pound, followed by sanding and repainting. Studs are not damaged.	Not Available
DS3	Local and global buckling out- of-plane and crushing of gyp- sum wallboards. Studs are typ- ically not damaged by failure of the gypsum wallboard, but fram- ing adjustments possible for this damage state.	Replace 100 feet of the affected panel along with the application of new tape, joint com- pound, followed by sanding and repainting. Studs are not damaged.	Not Available



	DS1	DS2	DS3
Туре	Sequential	Sequential	Sequential
Probability	-	-	-
Median	0.0021	0.0071	0.012
β	0.6	0.45	0.45

Table 6.7.4. Parameters for the cost distributions. The cost values reflect a total scale factor of **<u>1.391</u>** applied to the default values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor, building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1	DS2	DS3
Distribution Type	Normal	Normal	LogNormal
Lower Qty.	1.0	1.0	1.0
Upper Qty.	10.0	10.0	10.0
Highest Cost Median	\$5,328	\$11,425	\$37,656
Lowest Cost Median	\$1,598	\$3,428	\$11,297
β (COV)	0.42	0.49	0.1

Table 6.7.5. Parameters for the repair time distributions.

	DS1	DS2	DS3
Distribution Type	Normal	Normal	LogNormal
Lower Qty.	1.0	1.0	1.0
Upper Qty.	10.0	10.0	10.0
Highest Median Repair Time (Days)	2.99	6.4	21.1
Lowest Median Repair Time (Days)	0.9	1.92	6.33
β (COV)	0.52	0.55	0.34

Table 6.7.6. Life safety information.

	DS1	DS2	DS3
Non-collapse casualties Affected Area	No 	No 	No
Serious Injury Median Serious Injury β	_	_	
Loss of Life Median Loss of Life β			-
Can Cause Red Tag Unsafe Placard Median Unsafe Placard β	No 	No 	No

6.8 C1011.311a #1: (C1011.311a) Interior of Exterior Wall - Type: Gypsum with wood studs (single-sided gypsum), Full Height, Fixed Below, Fixed Above

NISTIR Classification	C1011.311a
Author	Dave Welch (HBRG)
Normalized Unit	100.0 lf
Engineering Demand Parameter	Peak Interstory Drift
Number of Damage States	3
Is correlated?	No
Is directional?	Yes

Component modifications applied:

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Component Group	Partition Walls
Quantity Scale Factor	1.0
Damage Median Scale Factor	1.0
Total Cost Scale Factor	1.391
User cost modification factor	1.0
Regional Cost Scale Factor	1
Date multiplier (to convert from 2011 USD)	1.391
Occupancy Cost Scale Factor	1
Building Value Cost Scale Factor	1

Table 6.8.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

Location	Cost	Time	Capacity
1-2	1	1	1

Table 6.8.2. Damage state progression.

Damage State	Description	Repair Description	Image
DS1	Cracking of paint over fasteners or joints.	Gypsum wallboard repaired by replacing the tape along the seam of two adjacent panels and local areas with popped fasteners, apply- ing new joint compound, sanding, and repaint- ing.	Not Available
DS2	Local and global buckling out- of-plane and crushing of gyp- sum wallboards. Studs are typ- ically not damaged by failure of the gypsum wallboard.	Replace 25 feet of the affected panel along with the application of new tape, joint com- pound, followed by sanding and repainting. Studs are not damaged.	Not Available
DS3	Local and global buckling out- of-plane and crushing of gyp- sum wallboards. Studs are typ- ically not damaged by failure of the gypsum wallboard, but fram- ing adjustments possible for this damage state.	Replace 100 feet of the affected panel along with the application of new tape, joint com- pound, followed by sanding and repainting. Studs are not damaged.	Not Available



Table 6.8.3. Parameters for the damage state distributions. The medians reflect a scale factor of **<u>1.0</u>** applied to the default values.

	DS1	DS2	DS3
Туре	Sequential	Sequential	Sequential
Probability	-	-	-
Median	0.0021	0.0071	0.012
β	0.6	0.45	0.45

Table 6.8.4. Parameters for the cost distributions. The cost values reflect a total scale factor of **<u>1.391</u>** applied to the default values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor, building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1	DS2	DS3
Distribution Type	Normal	Normal	LogNormal
Lower Qty.	1.0	1.0	1.0
Upper Qty.	10.0	10.0	10.0
Highest Cost Median	\$3,015	\$7,411	\$23,838
Lowest Cost Median	\$904	\$2,223	\$7,151
β (COV)	0.42	0.49	0.1

Table 6.8.5. Parameters for the repair time distributions.

	DS1	DS2	DS3
Distribution Type	Normal	Normal	LogNormal
Lower Qty.	1.0	1.0	1.0
Upper Qty.	10.0	10.0	10.0
Highest Median Repair Time (Days)	1.69	4.15	13.36
Lowest Median Repair Time (Days)	0.51	1.25	4.01
β (COV)	0.52	0.55	0.34

Table 6.8.6. Life safety information.

	DS1	DS2	DS3
Non-collapse casualties Affected Area	No 	No 	No
Serious Injury Median Serious Injury β			
Loss of Life Median Loss of Life β		_	
Can Cause Red Tag Unsafe Placard Median Unsafe Placard β	No 	No 	No



6.9 C2011.041b #1: (C2011.041b) Light frame stair fragility. Approximation as a placeholder until there is more research on the topic. Damage states from P-58 Light frame stair example. Costing approximated from various online sources for stair replacement.

NISTIR Classification Author Normalized Unit Engineering Demand Parameter Number of Damage States Is correlated? Is directional?	C2011.041b HBRG 1.0 each Peak Interstory 3 No Yes	y Drift
Component modifications applie	ed:	
Component Group		Other Nonstructural
Quantity Scale Factor		1.0
Damage Median Scale Factor		1.0
Total Cost Scale Factor		1.391
User cost modification factor		1.0
Regional Cost Scale Factor		1
Date multiplier (to convert from	n 2011 USD)	1.391
Occupancy Cost Scale Factor		1
Building Value Cost Scale Fact	or	1

Table 6.9.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

Location	Cost	Time	Capacity
1-2	1	1	1

Table 6.9.2. Damage state progression.

Damage State	Description	Repair Description	Image
DS1	Cosmetic Damage.	Repair cosmetic damage.	Not Available
DS2	Structural damage but live load capacity remains intact.	Repair damage.	Not Available
DS3	Loss of live load capacity.	Replace stair.	Not Available

Table 6.9.3. Parameters for the damage state distributions. The medians reflect a scale factor of **<u>1.0</u>** applied to the default values.

	DS1	DS2	DS3
Туре	Sequential	Sequential	Sequential
Probability	-	-	-
Median	0.011	0.026	0.05
β	0.5	0.5	0.5

Table 6.9.4. Parameters for the cost distributions. The cost values reflect a total scale factor of **<u>1.391</u>** applied to the default values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor, building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1	DS2	DS3
Distribution Type	LogNormal	LogNormal	Normal
Lower Qty.	5.0	5.0	5.0
Upper Qty.	10.0	10.0	10.0
Highest Cost Median	\$695	\$2,782	\$8,346
Lowest Cost Median	\$487	\$1,043	\$3,130
β (COV)	0.8	0.6	0.4

Table 6.9.5. Parameters for the repair time distributions.

	DS1	DS2	DS3
Distribution Type	LogNormal	LogNormal	Normal
Lower Qty.	5.0	5.0	5.0
Upper Qty.	10.0	10.0	10.0
Highest Median Repair Time (Days)	0.55	2.21	6.62
Lowest Median Repair Time (Days)	0.39	0.83	2.48
β (COV)	1.0	0.7	0.5

Table 6.9.6. Life safety information.

	DS1	DS2	DS3
Non-collapse casualties Affected Area	No 	No 	No
Serious Injury Median Serious Injury β			
Loss of Life Median Loss of Life β		-	
Can Cause Red Tag Unsafe Placard Median Unsafe Placard β	No 	Yes 0.25 0.1	Yes 0.1 0.5

6.10 C3032.004a #1: (C3032.004a) Suspended Ceiling, SDC D,E,F (Ip=1.5), Area (A): A < 250, Vert & Lat support

NISTIR Classification	C3032.004a
Author	Not Given
Normalized Unit	250.0 sf
Engineering Demand Parameter	Peak Floor Acceleration
Number of Damage States	3
Is correlated?	No
Is directional?	No

Component modifications applied:

Component Group	Ceilings
Quantity Scale Factor	1.0
Damage Median Scale Factor	1.0
Total Cost Scale Factor	1.391
User cost modification factor	1.0
Regional Cost Scale Factor	1
Date multiplier (to convert from 2011 USD)	1.391
Occupancy Cost Scale Factor	1
Building Value Cost Scale Factor	1

Table 6.10.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

Location	Cost	Time	Capacity
G-R	1	1	1

Table 6.10.2. Damage state progression.

Damage State	Description	Repair Description	Image
DS1	5 % of ceiling grid and tile damage.	Reinstall, repair, or replace 5% of the ceiling area.	Not Available
DS2	30% of ceiling grid and tile damage.	Replace 30% of the ceiling area.	Not Available
DS3	50% of ceiling grid and tile damage.	Replace the entire ceiling	Not Available

SP3

Table 6.10.3. Parameters for the damage state distributions. The medians reflect a scale factor of $\underline{1.0}$ applied to the default values.

	DS1	DS2	DS3
Туре	Sequential	Sequential	Sequential
Probability	-	-	-
Median	1.92	2.34	2.48
β	0.3	0.3	0.3

Table 6.10.4. Parameters for the cost distributions. The cost values reflect a total scale factor of **1.391** applied to the default
values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor,
building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1	DS2	DS3
Distribution Type	Normal	LogNormal	LogNormal
Lower Qty.	1.0	1.0	1.0
Upper Qty.	10.0	10.0	10.0
Highest Cost Median	\$1,008	\$7,894	\$16,240
Lowest Cost Median	\$303	\$2,368	\$4,872
β (COV)	0.55	0.52	0.2

Table 6.10.5. Parameters for the repair time distributions.

	DS1	DS2	DS3
Distribution Type	Normal	LogNormal	LogNormal
Lower Qty.	1.0	1.0	1.0
Upper Qty.	10.0	10.0	10.0
Highest Median Repair Time (Days)	0.7	5.41	11.15
Lowest Median Repair Time (Days)	0.21	1.62	3.34
β (COV)	0.6	0.58	0.32

Table 6.10.6. Life safety information.

	DS1	DS2	DS3
Non-collapse casualties Affected Area	No 	No 	Yes 250.0 SF
Serious Injury Median Serious Injury β			0.1 0.5
Loss of Life Median Loss of Life β		-	$\begin{array}{c} 0.0 \\ 0.0 \end{array}$
Can Cause Red Tag Unsafe Placard Median Unsafe Placard β	No _	No _	No _

NISTIR Classification	C3032.004b	
Author	Not Given	
Normalized Unit	600.0 sf	
Engineering Demand Parameter	Peak Floor Ac	celeration
Number of Damage States	3	
Is correlated?	No	
Is directional?	No	
Component modifications appli	ed:	
Component Group		Ceilings
Component Group Quantity Scale Factor		Ceilings 1.0
1 1		U
Quantity Scale Factor		1.0
Quantity Scale Factor Damage Median Scale Factor		1.0 1.0
Quantity Scale Factor Damage Median Scale Factor Total Cost Scale Factor		1.0 1.0 1.391
Quantity Scale Factor Damage Median Scale Factor Total Cost Scale Factor User cost modification factor	n 2011 USD)	1.0 1.0 1.391 1.0
Quantity Scale Factor Damage Median Scale Factor Total Cost Scale Factor User cost modification factor Regional Cost Scale Factor	n 2011 USD)	1.0 1.0 1.391 1.0 1
Quantity Scale Factor Damage Median Scale Factor Total Cost Scale Factor User cost modification factor Regional Cost Scale Factor Date multiplier (to convert from		1.0 1.0 1.391 1.0 1 1.391

6.11 C3032.004b #1: (C3032.004b) Suspended Ceiling, SDC D,E,F (Ip=1.5), Area (A): 250 < A < 1000, Vert & Lat support

Table 6.11.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

Location	Cost	Time	Capacity
G-R	1	1	1

Table 6.11.2. Damage state progression.

Damage State	Description	Repair Description	Image
DS1	5 % of ceiling grid and tile damage.	Reinstall, repair, or replace 5% of the ceiling area.	Not Available
DS2	30% of ceiling grid and tile damage.	Replace 30% of the ceiling area.	Not Available
DS3	50% of ceiling grid and tile damage.	Replace the entire ceiling	Not Available



Table 6.11.3. Parameters for the damage state distributions. The medians reflect a scale factor of $\underline{1.0}$ applied to the default values.

	DS1	DS2	DS3
Туре	Sequential	Sequential	Sequential
Probability	-	-	-
Median	1.76	2.26	2.44
β	0.3	0.3	0.3

Table 6.11.4. Parameters for the cost distributions. The cost values reflect a total scale factor of 1.391 applied to the default
values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor,
building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1	DS2	DS3
Distribution Type	Normal	LogNormal	LogNormal
Lower Qty.	1.0	1.0	1.0
Upper Qty.	10.0	10.0	10.0
Highest Cost Median	\$2,420	\$18,945	\$38,975
Lowest Cost Median	\$726	\$5,683	\$11,692
β (COV)	0.55	0.52	0.2

Table 6.11.5. Parameters for the repair time distributions.

	DS1	DS2	DS3
Distribution Type	Normal	LogNormal	LogNormal
Lower Qty.	1.0	1.0	1.0
Upper Qty.	10.0	10.0	10.0
Highest Median Repair Time (Days)	1.57	12.39	25.55
Lowest Median Repair Time (Days)	0.46	3.7	7.67
β (COV)	0.6	0.58	0.32

Table 6.11.6. Life safety information.

DS1	DS2	DS3
No 	No 	Yes 650.0 SF
		0.1 0.5
	-	$\begin{array}{c} 0.0\\ 0.0\end{array}$
No _	No _	No _
	No - - - -	No No

NISTIR Classification Author Normalized Unit Engineering Demand Parameter Number of Damage States Is correlated?	C3032.004c Not Given 1800.0 sf Peak Floor Ac 3 No	celeration
Is directional?	No	
Component modifications applie	ed:	
Component Group		Ceilings
Quantity Scale Factor		1.0
Damage Median Scale Factor		1.0
Total Cost Scale Factor		1.391
User cost modification factor		1.0
Regional Cost Scale Factor		1
Date multiplier (to convert from	n 2011 USD)	1.391
Occupancy Cost Scale Factor		1
Building Value Cost Scale Fact	tor	1

6.12 C3032.004c #1: (C3032.004c) Suspended Ceiling, SDC D,E,F (Ip=1.5), Area (A): 1000 < A < 2500, Vert & Lat support

Table 6.12.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

Location	Cost	Time	Capacity
G-R	1	1	1

Table 6.12.2. Damage state progression.

Damage State	Description	Repair Description	Image
DS1	5 % of ceiling grid and tile damage.	Reinstall, repair, or replace 5% of the ceiling area.	Not Available
DS2	30% of ceiling grid and tile damage.	Replace 30% of the ceiling area.	Not Available
DS3	50% of ceiling grid and tile damage.	Replace the entire ceiling	Not Available

Table 6.12.3. Parameters for the damage state distributions.	The medians reflect a scale factor of $\underline{1.0}$ applied to the default
values.	

	DS1	DS2	DS3
Туре	Sequential	Sequential	Sequential
Probability	-	-	-
Median	1.45	2.1	2.34
β	0.3	0.3	0.3

Table 6.12.4. Parameters for the cost distributions. The cost values reflect a total scale factor of 1.391 applied to the default
values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor,
building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1	DS2	DS3
Distribution Type	Normal	LogNormal	LogNormal
Lower Qty.	1.0	1.0	1.0
Upper Qty.	10.0	10.0	10.0
Highest Cost Median	\$7,261	\$56,835	\$116,925
Lowest Cost Median	\$2,178	\$17,050	\$35,077
β (COV)	0.55	0.52	0.2

Table 6.12.5. Parameters for the repair time distributions.

	DS1	DS2	DS3
Distribution Type	Normal	LogNormal	LogNormal
Lower Qty.	1.0	1.0	1.0
Upper Qty.	10.0	10.0	10.0
Highest Median Repair Time (Days)	4.64	36.03	74.17
Lowest Median Repair Time (Days)	1.42	10.79	22.25
β (COV)	0.6	0.58	0.32

Table 6.12.6. Life safety information.

	DS1	DS2	DS3
Non-collapse casualties Affected Area	No 	No 	Yes 1700.0 SF
Serious Injury Median Serious Injury β			0.1 0.5
Loss of Life Median Loss of Life β			0.0 0.0
Can Cause Red Tag Unsafe Placard Median Unsafe Placard β	No -	No _	No _
Unsaid Fladalu p	—	—	—

6.13 C3032.004d #1: (C3032.004d) Suspended Ceiling, SDC D,E,F (Ip=1.5), Area (A): A > 2500, Vert & Lat support

NISTIR Classification	C3032.004d
Author	Not Given
Normalized Unit	2500.0 sf
Engineering Demand Parameter	Peak Floor Acceleration
Number of Damage States	3
Is correlated?	No
Is directional?	No

Component modifications applied:

Component Group	Ceilings
Quantity Scale Factor	1.0
Damage Median Scale Factor	1.0
Total Cost Scale Factor	1.391
User cost modification factor	1.0
Regional Cost Scale Factor	1
Date multiplier (to convert from 2011 USD)	1.391
Occupancy Cost Scale Factor	1
Building Value Cost Scale Factor	1

Table 6.13.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

Location	Cost	Time	Capacity
G-R	1	1	1

Table 6.13.2. Damage state progression.

Damage State	Description	Repair Description	Image
DS1	5 % of ceiling grid and tile damage.	Reinstall, repair, or replace 5% of the ceiling area.	Not Available
DS2	30% of ceiling grid and tile damage.	Replace 30% of the ceiling area.	Not Available
DS3	50% of ceiling grid and tile damage.	Replace the entire ceiling	Not Available





Table 6.13.3. Parameters for the damage state distributions. The medians reflect a scale factor of $\underline{1.0}$ applied to the default values.

	DS1	DS2	DS3
Туре	Sequential	Sequential	Sequential
Probability	_	-	-
Median	1.31	2.03	2.29
β	0.3	0.3	0.3

Table 6.13.4. Parameters for the cost distributions. The cost values reflect a total scale factor of 1.391 applied to the default
values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor,
building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1	DS2	DS3
Distribution Type	Normal	LogNormal	LogNormal
Lower Qty.	1.0	1.0	1.0
Upper Qty.	10.0	10.0	10.0
Highest Cost Median	\$10,085	\$78,937	\$162,396
Lowest Cost Median	\$3,025	\$23,681	\$48,719
β (COV)	0.55	0.52	0.2

Table 6.13.5. Parameters for the repair time distributions.

	DS1	DS2	DS3
Distribution Type	Normal	LogNormal	LogNormal
Lower Qty.	1.0	1.0	1.0
Upper Qty.	10.0	10.0	10.0
Highest Median Repair Time (Days)	6.09	48.45	99.54
Lowest Median Repair Time (Days)	1.76	14.57	29.83
β (COV)	0.6	0.58	0.32

Table 6.13.6. Life safety information.

	DS1	DS2	DS3
Non-collapse casualties Affected Area	No 	No 	Yes 2500.0 SF
Serious Injury Median Serious Injury β			0.1 0.5
Loss of Life Median Loss of Life β			$\begin{array}{c} 0.0\\ 0.0\end{array}$
Can Cause Red Tag Unsafe Placard Median Unsafe Placard β	No 	Yes 0.75 0.5	Yes 0.5 0.5

6.14 C3034.002 #1: (C3034.002) Independent Pendant Lighting - seismically rated

NISTIR Classification	C3034.002
Author	Not Given
Normalized Unit	1.0 each
Engineering Demand Parameter	Peak Floor Acceleration
Number of Damage States	1
Is correlated?	No
Is directional?	No

Component modifications applied:

Component Group	Lighting
Quantity Scale Factor	1.0
Damage Median Scale Factor	1.0
Total Cost Scale Factor	1.391
User cost modification factor	1.0
Regional Cost Scale Factor	1
Date multiplier (to convert from 2011 USD)	1.391
Occupancy Cost Scale Factor	1
Building Value Cost Scale Factor	1

Table 6.14.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

Location	Cost	Time	Capacity
G-R	1	1	1

Damage State	Description	Repair Description	Image
DS1	Disassembly of rod system at connections with horizontal light fixture, low cycle fatigue failure of the threaded rod, pullout of rods from ceiling assembly.	Replace damaged lighting components.	Not Available



Table 6.14.3. Parameters for the damage state distributions. The medians reflect a scale factor of 1.0 applied to the default values.

	DS1
Туре	Sequential
Probability	-
Median	1.5
β	0.4

Table 6.14.4. Parameters for the cost distributions. The cost values reflect a total scale factor of **1.391** applied to the default values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor, building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1
Distribution Type	LogNormal
Lower Qty.	5.0
Upper Qty.	10.0
Highest Cost Median	\$1,377
Lowest Cost Median	\$413
β (COV)	0.64

Table 6.14.5. Parameters for the repair time distributions.

	DS1
Distribution Type	LogNormal
Lower Qty.	5.0
Upper Qty.	10.0
Highest Median Repair Time (Days)	0.99
Lowest Median Repair Time (Days)	0.3
β (COV)	0.68

	DS1
Non-collapse casualties Affected Area	No
Serious Injury Median Serious Injury β	
Loss of Life Median Loss of Life β	
Can Cause Red Tag Unsafe Placard Median Unsafe Placard β	No _ _

6.15 D2021.013a #1: (D2021.013a) Cold or Hot Potable - Small Diameter Threaded Steel - (2.5 inches in diameter or less), SDC D, E, or F, PIPING FRAGILITY

NISTIR Classification	D2021.013a	
Author	Not Given	
Normalized Unit	1000.0 lf	
Engineering Demand Parameter	Peak Floor Ac	celeration
Number of Damage States	2	
Is correlated?	No	
Is directional?	No	
Component modifications applie	d:	
Component Group		Piping
Quantity Scale Factor		1.0
Damage Median Scale Factor		1.0
Total Cost Scale Factor		1.391
User cost modification factor		1.0
Regional Cost Scale Factor		1
Date multiplier (to convert from	n 2011 USD)	1.391
Occupancy Cost Scale Factor		1
Building Value Cost Scale Fact	or	1

Table 6.15.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

Location	Cost	Time	Capacity
G-R	1	1	1

Table 6.15.2. Damage state progression.

Damage State	Description	Repair Description	Image
DS1	Minor leakage at flange connec- tions - 1 leak per 1000 feet of pipe.	Retighten flange bolts at leaking joints. One joint per 1000 LF.	Not Available
DS2	Pipe Break - 1 break per 1000 feet of pipe.	Replace 20 foot sections of pipe where breaks occur. One repair per 1000 LF.	Not Available



Table 6.15.3. Parameters for the damage state distributions. The medians reflect a scale factor of $\underline{1.0}$ applied to the default values.

	DS1	DS2
Туре	Sequential	Sequential
Probability	_	-
Median	2.25	4.1
β	0.4	0.4

Table 6.15.4. Parameters for the cost distributions. The cost values reflect a total scale factor of 1.391 applied to the default
values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor,
building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1	DS2
Distribution Type	LogNormal	LogNormal
Lower Qty.	3.0	3.0
Upper Qty.	10.0	10.0
Highest Cost Median	\$444	\$4,055
Lowest Cost Median	\$363	\$3,317
β (COV)	0.76	0.41

Table 6.15.5. Parameters for the repair time distributions.

	DS1	DS2
Distribution Type	LogNormal	LogNormal
Lower Qty.	3.0	3.0
Upper Qty.	10.0	10.0
Highest Median Repair Time (Days)	0.34	3.09
Lowest Median Repair Time (Days)	0.28	2.53
β (COV)	0.8	0.48

Table 6.15.6. Life safety information.

DS1	DS2
No 	No
-	
-	-
No _	No _
-	_
	No - - -

6.16 D2021.013b #1: (D2021.013b) Cold or Hot Potable - Small Diameter Threaded Steel - (2.5 inches in diameter or less), SDC D, E, or F, BRACING FRAGILITY

NISTIR Classification Author Normalized Unit Engineering Demand Parameter	D2021.013b Not Given 1000.0 lf Peak Floor Acc	celeration
Number of Damage States	1	
Is correlated?	No	
Is directional?	No	
Component modifications applie	d:	
Component Group		Piping
Quantity Scale Factor		1.0
Damage Median Scale Factor		1.0
Total Cost Scale Factor		1.391
User cost modification factor		1.0
Regional Cost Scale Factor		1
Date multiplier (to convert from 2011 USD)		1.391
Occupancy Cost Scale Factor		1
Building Value Cost Scale Factor	or	1

Table 6.16.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

Location	Cost	Time	Capacity
G-R	1	1	1

Table 6.16.2. Damage state progression.

Damage State	Description	Repair Description	Image
DS1	Lateral Brace Failure - 1 failure per 1000 feet of pipe.	Replace failed lateral braces. One repair per 1000 LF.	Not Available





Table 6.16.3. Parameters for the damage state distributions. The medians reflect a scale factor of 1.0 applied to the default values.

	DS1
Туре	Sequential
Probability	-
Median	1.5
β	0.4

Table 6.16.4. Parameters for the cost distributions. The cost values reflect a total scale factor of **1.391** applied to the default values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor, building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1
Distribution Type	LogNormal
Lower Qty.	3.0
Upper Qty.	10.0
Highest Cost Median	\$581
Lowest Cost Median	\$476
β (COV)	0.6

Table 6.16.5. Parameters for the repair time distributions.

	DS1
Distribution Type	LogNormal
Lower Qty.	3.0
Upper Qty.	10.0
Highest Median Repair Time (Days)	0.44
Lowest Median Repair Time (Days)	0.36
β (COV)	0.65

Table 6.16.6.	Life safety	information.
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	DS1
Non-collapse casualties Affected Area	No
Serious Injury Median Serious Injury β	
Loss of Life Median Loss of Life β	
Can Cause Red Tag Unsafe Placard Median Unsafe Placard β	No _ _



6.17 D2021.023a #1: (D2021.023a) Cold or Hot Potable Water Piping (dia > 2.5 inches), SDC D,E,F, PIPING FRAGILITY

NISTIR Classification Author Normalized Unit Engineering Demand Parameter Number of Damage States Is correlated?	D2021.023a Not Given 1000.0 lf Peak Floor Acceleration 2 No
e	2
Is directional?	No

Component modifications applied:

Component Group	Piping
Quantity Scale Factor	1.0
Damage Median Scale Factor	1.0
Total Cost Scale Factor	1.391
User cost modification factor	1.0
Regional Cost Scale Factor	1
Date multiplier (to convert from 2011 USD)	1.391
Occupancy Cost Scale Factor	1
Building Value Cost Scale Factor	1

Table 6.17.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

Location	Cost	Time	Capacity
G-R	1	1	1

Table 6.17.2. Damage state progression.

Damage State	Description	Repair Description	Image
DS1	Minor leakage at flange connec- tions - 1 leak per 1000 feet of pipe.	Retighten flange bolts at leaking joints. One joint per 1000 LF.	Not Available
DS2	Pipe Break - 1 break per 1000 feet of pipe.	Replace 20 foot sections of pipe where breaks occur. One repair per 1000 LF.	Not Available



Table 6.17.3. Parameters for the damage state distributions. The medians reflect a scale factor of $\underline{1.0}$ applied to the default values.

	DS1	DS2
Type Probability	Sequential	Sequential
Probability	-	_
Median	2.25	4.1
eta	0.4	0.4

Table 6.17.4. Parameters for the cost distributions. The cost values reflect a total scale factor of 1.391 applied to the default
values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor,
building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1	DS2
Distribution Type	LogNormal	LogNormal
Lower Qty.	5.0	5.0
Upper Qty.	10.0	10.0
Highest Cost Median	\$974	\$9,319
Lowest Cost Median	\$292	\$2,796
β (COV)	0.65	0.4

Table 6.17.5. Parameters for the repair time distributions.

	DS1	DS2
Distribution Type	LogNormal	LogNormal
Lower Qty.	5.0	5.0
Upper Qty.	10.0	10.0
Highest Median Repair Time (Days)	0.74	7.09
Lowest Median Repair Time (Days)	0.22	2.13
β (COV)	0.7	0.47

	DS1	DS2
Non-collapse casualties Affected Area	No	No
Affected Area		
Serious Injury Median	_	_
Serious Injury β	_	-
Loss of Life Median	_	_
Loss of Life β	_	-
Can Cause Red Tag	No	No
Unsafe Placard Median	_	-
Unsafe Placard β	-	_



NISTIR Classification	D2021.023b
Author	Not Given
Normalized Unit	1000.0 lf
Engineering Demand Parameter	Peak Floor Acceleration
Number of Damage States	2
Is correlated?	No
Is directional?	No
Component modifications appli	ed:
Component Group	Piping
Quantity Scale Factor	1.0
Damage Median Scale Factor	1.0
Total Cost Scale Factor	1.391
User cost modification factor	1.0
Regional Cost Scale Factor	1
Date multiplier (to convert from	m 2011 USD) 1.391
Occupancy Cost Scale Factor	1

Building Value Cost Scale Factor

6.18 D2021.023b #1: (D2021.023b) Cold or Hot Potable Water Piping (dia > 2.5 inches), SDC D,E,F, BRACING FRAGILITY

Table 6.18.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

1

Location	Cost	Time	Capacity
G-R	1	1	1

Table 6.18.2. Damage state progression.

Damage State	Description	Repair Description	Image
DS1	Lateral Brace Failure - 1 failure per 1000 feet of pipe.	Replace failed lateral braces. One repair per 1000 LF.	Not Available
DS2	Vertical Brace Failure - 1 failure per 1000 feet of pipe	Replace failed vertical braces. One repair per 1000 LF.	Not Available



Table 6.18.3. Parameters for the damage state distributions. The medians reflect a scale factor of $\underline{1.0}$ applied to the default values.

	DS1	DS2
Type Probability	Sequential	Sequential
Probability	_	_
Median	1.5	2.25
β	0.4	0.4

Table 6.18.4. Parameters for the cost distributions. The cost values reflect a total scale factor of 1.391 applied to the default
values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor,
building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1	DS2
Distribution Type	LogNormal	LogNormal
Lower Qty.	5.0	5.0
Upper Qty.	10.0	10.0
Highest Cost Median	\$974	\$974
Lowest Cost Median	\$292	\$292
β (COV)	0.65	0.65

Table 6.18.5. Parameters for the repair time distributions.

	DS1	DS2
Distribution Type	LogNormal	LogNormal
Lower Qty.	5.0	5.0
Upper Qty.	10.0	10.0
Highest Median Repair Time (Days)	0.74	0.74
Lowest Median Repair Time (Days)	0.22	0.22
β (COV)	0.7	0.7

DS1	DS2
No	No
	-
-	
No	No
_	_
	No - - - -

6.19 D2031.013b #1: (D2031.013b) Sanitary Waste Piping - Cast Iron w/flexible couplings, SDC D,E,F, BRACING FRAGILITY

NISTIR Classification	D2031.013b	
Author	Not Given	
Normalized Unit	1000.0 lf	
Engineering Demand Parameter	Peak Floor Ac	celeration
Number of Damage States	1	
Is correlated?	No	
Is directional?	No	
Component modifications applie	ed:	
Component Group		Piping
		r8
Quantity Scale Factor		1.0
1 1		1 0
Quantity Scale Factor		1.0
Quantity Scale Factor Damage Median Scale Factor		1.0 1.0
Quantity Scale Factor Damage Median Scale Factor Total Cost Scale Factor		1.0 1.0 1.391
Quantity Scale Factor Damage Median Scale Factor Total Cost Scale Factor User cost modification factor	n 2011 USD)	1.0 1.0 1.391 1.0
Quantity Scale Factor Damage Median Scale Factor Total Cost Scale Factor User cost modification factor Regional Cost Scale Factor	n 2011 USD)	1.0 1.0 1.391 1.0 1
Quantity Scale Factor Damage Median Scale Factor Total Cost Scale Factor User cost modification factor Regional Cost Scale Factor Date multiplier (to convert from		1.0 1.0 1.391 1.0 1 1.391

Table 6.19.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

Location	Cost	Time	Capacity
G-R	1	1	1

Table 6.19.2. Damage state progression.

Damage State	Description	Repair Description	Image
DS1	Isolated support failure w/o leak- age - 0.5 support failures per 1000 feet of pipe (assuming sup- ports every 20 feet).	Replace failed supports.	Not Available





Table 6.19.3. Parameters for the damage state distributions. The medians reflect a scale factor of $\underline{1.0}$ applied to the default values.

	DS1
Туре	Sequential
Probability	-
Median	2.25
β	0.5

Table 6.19.4. Parameters for the cost distributions. The cost values reflect a total scale factor of 1.391 applied to the default
values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor,
building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1
Distribution Type	LogNormal
Lower Qty.	5.0
Upper Qty.	10.0
Highest Cost Median	\$1,113
Lowest Cost Median	\$334
β (COV)	0.58

Table 6.19.5. Parameters for the repair time distributions.

	DS1
Distribution Type	LogNormal
Lower Qty.	5.0
Upper Qty.	10.0
Highest Median Repair Time (Days)	0.85
Lowest Median Repair Time (Days)	0.25
β (COV)	0.63

	DS1
Non-collapse casualties	No
Affected Area	
Serious Injury Median	-
Serious Injury β	_
Loss of Life Median	-
Loss of Life β	-
Can Cause Red Tag	No
Unsafe Placard Median Unsafe Placard β	-
Unsale Flacal d p	—



6.20 D3032.013c #1: (D3032.013c) Compressor - Capacity: Small non medical air supply - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Combined anchorage/isolator & equipment fragility

NISTIR Classification Author Normalized Unit Engineering Demand Parameter Number of Damage States	D3032.013c Not Given 1.0 each Peak Floor Ac	celeration
Is correlated?	No	
Is directional?	No	
Component modifications applie	ed:	
Component Group		HVAC
Quantity Scale Factor		1.0
Damage Median Scale Factor		1.0
Total Cost Scale Factor		1.391
User cost modification factor		1.0
Regional Cost Scale Factor		1
Date multiplier (to convert from	n 2011 USD)	1.391
Occupancy Cost Scale Factor		1
Building Value Cost Scale Fact	or	1

Table 6.20.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

Location	Cost	Time	Capacity
G-R	1	1	1

Table 6.20.2.	Damage state progression.
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Damage State	Description	Repair Description	Image
DS1a	Anchorage failure.	Repair anchorage and concrete pad and re- mount equipment.	
DS1b	Anchorage failure & Equipment damaged beyond repair.	Replace equipment including attached utili- ties in addition to repairing anchorage and concrete pad.	Not Available
DS1c	Motor damaged but anchorage is OK.	Repair Motor - Anchorage and Concrete do not require repair.	Not Available
DS1d	Equipment damaged beyond re- pair but anchorage is OK.	Replace and install equipment including new anchorage if anchorage is post-installed.	Not Available



Table 6.20.3. Parameters for the damage state distributions. The medians reflect a scale factor of $\underline{1.0}$ applied to the default values.

	DS1a	DS1b	DS1c	DS1d
Туре	Mut. Excl.	Mut. Excl.	Mut. Excl.	Mut. Excl.
Probability	0.35	0.15	0.25	0.25
Median	3.197	3.197	3.197	3.197
eta	0.5	0.5	0.5	0.5

Table 6.20.4. Parameters for the cost distributions. The cost values reflect a total scale factor of 1.391 applied to the default
values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor,
building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1a	DS1b	DS1c	DS1d
Distribution Type	LogNormal	LogNormal	LogNormal	LogNormal
Lower Qty.	1.0	1.0	1.0	1.0
Upper Qty.	5.0	5.0	5.0	5.0
Highest Cost Median	\$689	\$4,820	\$1,148	\$4,820
Lowest Cost Median	\$563	\$3,943	\$939	\$3,943
β (COV)	0.55	0.26	0.17	0.26

Table 6.20.5. Parameters for the repair time distributions.

	DS1a	DS1b	DS1c	DS1d
Distribution Type	LogNormal	LogNormal	LogNormal	LogNormal
Lower Qty.	1.0	1.0	1.0	1.0
Upper Qty.	5.0	5.0	5.0	5.0
Highest Median Repair Time (Days)	0.58	1.48	0.97	4.08
Lowest Median Repair Time (Days)	0.48	0.74	0.79	3.34
β (COV)	0.6	0.36	0.3	0.36

Table 6.20.6. Life safety information.

	DS1a	DS1b	DS1c	DS1d
Non-collapse casualties Affected Area	No	No 	No	No
Serious Injury Median Serious Injury β				-
Loss of Life Median Loss of Life β			_	-
Can Cause Red Tag Unsafe Placard Median Unsafe Placard β	No 	No 	No 	No



6.21 D3032.013c #2: (D3032.013c) Compressor - Capacity: Small non medical air supply - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Combined anchorage/isolator & equipment fragility

NISTIR Classification Author Normalized Unit Engineering Demand Parameter Number of Damage States Is correlated?	D3032.013c Not Given 1.0 each Peak Floor Ac 1 No	celeration
Is directional?	No	
Component modifications applie	d:	
Component Group		HVAC
Quantity Scale Factor		1.0
Damage Median Scale Factor		1.0
Total Cost Scale Factor		1.391
User cost modification factor		1.0
Regional Cost Scale Factor		1
Date multiplier (to convert from	n 2011 USD)	1.391
Occupancy Cost Scale Factor		1
Building Value Cost Scale Fact	or	1

Table 6.21.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

Location	Cost	Time	Capacity
G-R	1	1	1

Table 6.21.2.	Damage state	progression.
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Damage State	Description	Repair Description	Image
DS1a	Anchorage failure.	Repair anchorage and concrete pad and re- mount equipment.	
DS1b	Anchorage failure & Equipment damaged beyond repair.	Replace equipment including attached utili- ties in addition to repairing anchorage and concrete pad.	Not Available
DS1c	Motor damaged but anchorage is OK.	Repair Motor - Anchorage and Concrete do not require repair.	Not Available
DS1d	Equipment damaged beyond re- pair but anchorage is OK.	Replace and install equipment including new anchorage if anchorage is post-installed.	Not Available



Table 6.21.3. Parameters for the damage state distributions. The medians reflect a scale factor of $\underline{1.0}$ applied to the default values.

	DS1a	DS1b	DS1c	DS1d
Туре	Mut. Excl.	Mut. Excl.	Mut. Excl.	Mut. Excl.
Probability	0.35	0.15	0.25	0.25
Median	2.046	2.046	2.046	2.046
β	0.5	0.5	0.5	0.5

Table 6.21.4. Parameters for the cost distributions. The cost values reflect a total scale factor of 1.391 applied to the default
values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor,
building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1a	DS1b	DS1c	DS1d
Distribution Type	LogNormal	LogNormal	LogNormal	LogNormal
Lower Qty.	1.0	1.0	1.0	1.0
Upper Qty.	5.0	5.0	5.0	5.0
Highest Cost Median	\$689	\$4,820	\$1,148	\$4,820
Lowest Cost Median	\$563	\$3,943	\$939	\$3,943
β (COV)	0.55	0.26	0.17	0.26

Table 6.21.5. Parameters for the repair time distributions.

	DS1a	DS1b	DS1c	DS1d
Distribution Type	LogNormal	LogNormal	LogNormal	LogNormal
Lower Qty.	1.0	1.0	1.0	1.0
Upper Qty.	5.0	5.0	5.0	5.0
Highest Median Repair Time (Days)	0.58	1.48	0.97	4.08
Lowest Median Repair Time (Days)	0.48	0.74	0.79	3.34
β (COV)	0.6	0.36	0.3	0.36

Table 6.21.6. Life safety information.

	DS1a	DS1b	DS1c	DS1d
Non-collapse casualties Affected Area	No	No 	No	No
Serious Injury Median Serious Injury β				-
Loss of Life Median Loss of Life β			_	-
Can Cause Red Tag Unsafe Placard Median Unsafe Placard β	No 	No 	No 	No



6.22	D3041.011c #1: (D3041.011c) HVAC Galvanized Sheet Metal Ducting less than 6 sq. ft in cross sectional area,
	SDC D, E, or F

NISTIR Classification Author Normalized Unit	D3041.011c Not Given 1000.0 lf	
Engineering Demand Parameter	Peak Floor Ac	celeration
Number of Damage States	2	
Is correlated?	No	
Is directional?	No	
Component modifications applie	d:	
Component Group		HVAC
Quantity Scale Factor		1.0
Damage Median Scale Factor		1.0
Total Cost Scale Factor		1.391
User cost modification factor		1.0
Regional Cost Scale Factor		1
Date multiplier (to convert from	n 2011 USD)	1.391
Occupancy Cost Scale Factor		1
Building Value Cost Scale Fact	or	1

Table 6.22.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

Location	Cost	Time	Capacity
G-R	1	1	1

Table 6.22.2. Damage state progression.

Damage State	Description	Repair Description	Image
DS1	Individual supports fail and duct sags - 1 failed support per 1000 feet of ducting.	Replace failed supports and repair ducting in vicinity of failed supports.	Not Available
DS2	Several adjacent supports fail and sections of ducting fall - 60 feet of ducting fail and fall per 1000 foot of ducting.	Replace sections of failed ducting and supports.	Not Available



Table 6.22.3. Parameters for the damage state distributions. The medians reflect a scale factor of $\underline{1.0}$ applied to the default values.

	DS1	DS2
Type Probability	Sequential	Sequential
Probability	-	-
Median	1.5	2.25
β	0.4	0.4

Table 6.22.4. Parameters for the cost distributions. The cost values reflect a total scale factor of 1.391 applied to the default
values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor,
building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1	DS2
Distribution Type	LogNormal	LogNormal
Lower Qty.	1.0	1.0
Upper Qty.	5.0	5.0
Highest Cost Median	\$995	\$9,716
Lowest Cost Median	\$814	\$7,949
β (COV)	0.37	0.1

Table 6.22.5. Parameters for the repair time distributions.

	DS1	DS2
Distribution Type	LogNormal	LogNormal
Lower Qty.	1.0	1.0
Upper Qty.	5.0	5.0
Highest Median Repair Time (Days)	0.84	2.99
Lowest Median Repair Time (Days)	0.69	1.49
β (COV)	0.44	0.27

Table 6.22.6. Life safety information.

DS1	DS2
No	Yes
	15.0 SF
_	0.05
-	0.5
_	0.0
_	0.0
No	No
-	_
-	-
	No - - - - -



6.23 D3041.032c #1: (D3041.032c) HVAC Drops / Diffusers without ceilings - supported by ducting only - No independent safety wires, SDC D, E, or F

NISTIR Classification	D3041.032c	
Author	Not Given	
Normalized Unit	10.0 each	
Engineering Demand Parameter	Peak Floor Ac	celeration
Number of Damage States	1	
Is correlated?	No	
Is directional?	No	
Component modifications applie	d:	
Component Group		HVAC
Quantity Scale Factor		1.0
Damage Median Scale Factor		1.0
Total Cost Scale Factor		1.391
User cost modification factor		1.0
Regional Cost Scale Factor		1
Date multiplier (to convert from	n 2011 USD)	1.391
Occupancy Cost Scale Factor		1
Building Value Cost Scale Factor	or	1

Table 6.23.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

Location	Cost	Time	Capacity
G-R	1	1	1

Table 6.23.2. Damage state progression.

Damage State	Description	Repair Description	Image
DS1	HVAC drops or diffusers dis- lodges and falls.	Replace diffuser/drop and sections of ceiling and ducting in vicinity to which diffuser/drop is connected.	Not Available

Table 6.23.3. Parameters for the damage state distributions. The medians reflect a scale factor of $\underline{1.0}$ applied to the default values.

	DS1
Туре	Sequential
Probability	-
Median	1.5
β	0.4

Table 6.23.4. Parameters for the cost distributions. The cost values reflect a total scale factor of 1.391 applied to the default
values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor,
building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1
Distribution Type	Normal
Lower Qty.	1.0
Upper Qty.	5.0
Highest Cost Median	\$4,590
Lowest Cost Median	\$3,756
β (COV)	0.21

Table 6.23.5. Parameters for the repair time distributions.

	DS1
Distribution Type	Normal
Lower Qty.	1.0
Upper Qty.	5.0
Highest Median Repair Time (Days)	3.88
Lowest Median Repair Time (Days)	3.18
β (COV)	0.32

Table 6.23.6. Life	safety	information.
--------------------	--------	--------------

	DS1
Non-collapse casualties Affected Area	Yes 4.0 SF
Serious Injury Median Serious Injury β	0.1 0.5
Loss of Life Median Loss of Life β	0.0 0.0
Can Cause Red Tag Unsafe Placard Median Unsafe Placard β	No



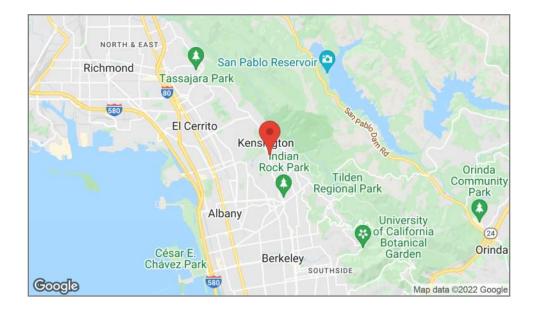
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SEISMIC RISK ASSESSMENT REPORT Created with the SP3-RiskModel

Full Detailed Report



Report Generated for:

217 Arlington Avenue, Kensington, CA Latitude: 37.90622° Longitude: -122.27875°

Report Generated by:

The SP3-RiskModel Software v1.2.0 of the Seismic Performance Prediction Program (SP3)

March 16, 2022





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1 SUMMARY OF INPUTS AND RISK RESULTS

Risk Model Inputs

P	rimary	Building Design Info			
Project Name:	Kensington Fire Station	Level of Detailing (Dir. 1, 2):	Spe	Special,	
Model Name:	New WLF on RC Wall		Orc	linary	
Building Types:		Drift Limit (Dir. 1, 2):	-, -	-	
Dir. 1: WLI	F: General	Risk Category:	IV		
Dir. 2: RC:	Cantilever Shear Wall	Seismic Importance Factor, I_e :	_		
V	2022	Component Importance Factor,	I_p : –		
Year of Construction:	2022				
Number of Stories:	2				
Occupancy: Address:	Commercial Office	Structural Prop	oerties		
	an Auanua	Allow Components to Affect			
217 Arlington Avenue Kensington, CA Latitude: 37.90622°		Structural Properties?	•	Yes	
		-			
Longitude: -122.27875°		Mode Shapes Specified? No		No	
Longitude.	-122.27875	Directional Properties	Dir. 1	Dir. 2	
		Base Shear Strength (g):	_	1.317	
Analy	sis Options	Yield Drift (%):	_	_	
Include Collapse in An	alysis: Yes	1^{st} Mode Period (T_1) (s):	_	0.29	
Consider Residual Drif		2^{nd} Mode Period (T_1) (s):	_	0.09	
Region Cost Multiplier	: –				
Date Cost Multiplier:	_				
Occupancy Cost Multip	plier: –	Component Information			
		Percent of Building Glazed:	_		
		Selection Method	Cus	stom	

Building	Layout I	nformation

Cost per Square Foot: Scale component repair costs with building value?	– Yes
Total Square Feet:	1,738
Aspect Ratio:	1.95
First Story Height (ft):	13.5
Upper Story Heights (ft):	9
Vertical Irregularity:	None
Plan Irregularity:	None
Frac. of Full Height Ext. Wood Wa	alls
Dir. 1 Story 1	_
Dir. 1 Upper Stories	-

Ground Motion and Soil Information

Site Class:	С
Site Hazard:	SP3 Default

Structural Properties				
Allow Components to Affect Structural Properties?	Ŋ	les		
Mode Shapes Specified? No				
Directional Properties	Dir. 1	Dir. 2		
Base Shear Strength (g):	_	1.317		
Yield Drift (%):	-	-		
1^{st} Mode Period (T_1) (s):	_	0.29		
2^{nd} Mode Period (T_2) (s):	-	0.09		

Component Information			
Percent of Building Glazed:	-		
Selection Method	Custom		

Building Stability

Median Collapse Capacity:	_	
Beta (Dispersion):	_	

Responses

No responses provided

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Repair Time Options

Repair Time Method	ATC-138 (Beta)
Factors Delaying Start of I	Repairs
Inspection	Yes
Financing	Yes
Permitting	Yes
Engineering Mobilization	Yes
Contractor Mobilization	Yes
Mitigation Factors	
Inspector on Retainer	No
Engineer on Retainer	No
Contractor on Retainer	No
Funding Source	Private Loans
Cash on Hand	_

ATC-138 Functional Recovery (Beta) Options

Need HVAC for Function	-
Need Elevator for Function	_
Include Surge Demand	_

Component Checklist

Interior Finishes

- What kind of partition walls does the building have?
 - > Wood Studs
- Does the building have raised access floors > *No*
- Does the building have suspended ceilings?
 - > Yes
 - Are the ceilings laterally supported?

> Yes

- What is the Ip factor used to design the ceilings?
 - > 1.5
- Does the building contain pendant (non-recessed) lighting?

> Yes

• Are the pendant lights seismically rated?

> Yes

Stairs and Elevators

• Does the building have stairs?

> Yes

- What type of stairs are in the building?
 - > Light Frame
- Are there elevators in the building?
 - > Yes
 - What type of elevators are in the building?
 - > Hydraulic
 - From which era are the building's elevators?
 - > post-1976 California (or post-1976 California equivalent)

Fire Supression

- Does the building contain a fire sprinkler system?
 - > Yes
 - Does the fire sprinkler system have braced horizontal piping?

Continued on next page





- > Yes
- Are the horizontal mains OSHPD certified (or equivalent)? > Yes
- Are the fire sprinkler drops OSHPD certified (or equivalent)?
 - > Yes
 - What type of ceiling do the fire drops enter into? > Hard

Piping

- Is the building's water piping OSHPD certified or equivalent?
 - > Yes
- Is the building's sanitary piping OSHPD certified or equivalent? > Yes
 - What type of couplings do the pipes have?
 - > Flexible

HVAC

• Is the HVAC cooling/heating equipment seismically anchored?

> Yes

- How is the cooling/heating system configured?
 - > Roof Top Units
 - Are the RTUs used for medical purposes (or equivalent)?
 - > No
 - Are the RTUs small or large?

> Small

- Does the building have a control panel?
 - > No
- Is there an HVAC exhaust system in the building?
 - > Yes
 - Is the HVAC exhaust system seismically anchored?
 - > Yes
- Does the HVAC distribution system meet OSHPD standards (or similar)? > Yes

 - Is there any large diameter ducting (6 SqFt+) in the HVAC system? > Yes

Electrical

• Does the building have a backup battery/generator system? > No

Concrete

- Are the building's shear walls low rise or slender?
 - > Low Rise (typically <= 40ft building height)
 - What are the boundary conditions of the walls?
 - > No return flanges or boundary columns
 - What is the typical wall thickness?
 - > 8" to 16"
 - What is the typical wall height?
 - > Less than 15'



Expected Loss

Expected loss in percent of total building value			
Shaking Intensity	Return Period	SEL (%)	SUL (%)
50% in 50 years	72 Years	3.2	7.7
10% in 50 years	475 Years	27	46
DE	481 Years	27	47
5% in 50 years	975 Years	45	75
MCE_R	1277 Years	52	84
2% in 50 years	2475 Years	72	100

Expected loss in percent of total building value

Repair Time

Median repair time summary						
	FEMA	A P-58 [†]	ATC-138 Functional Recovery (Beta) [‡]			
Intensity	Parallel	Series	Re- Occupancy	Functional	Full	
50% in 50 years	4.8 days	6.1 days	0 days	0 days	7 weeks	
10% in 50 years	2.8 months	3.6 months	2.2 months	3.5 months	3.8 months	
DE	2.7 months	3.5 months	2.3 months	3.6 months	3.8 months	
5% in 50 years	4.1 months	5.4 months	3.2 months	4.2 months	4.3 months	
MCE_R	4.7 months	6 months	3.6 months	4.6 months	4.7 months	
2% in 50 years	11 months	11 months	11 months	11 months	11 months	

[†] Does *not* include impedance factors

[‡] Does include impedance factors





2 BASIS OF ANALYSIS

This analysis is based on the SP3-RiskModel of the Seismic Performance Prediction Program (SP3) software platform. The underlying analysis methods are based on the FEMA P-58 analytical method, which is a transparent and well documented method developed through a 15 year project (Applied Technology Council, 2018). This project leveraged the previous decades of academic research, funded by a \$16 million investment by the Federal Emergency Management Agency (FEMA). In contrast to many risk assessment methods based on judgment and past earthquake experience, the FEMA P-58 and SP3 analysis are based on engineering-oriented risk evaluation methods.

3 DOCUMENTATION OF SITE AND BUILDING INPUT DATA

Project Name:Kensington Fire StationModel Name:New WLF on RC Wall

3.1 Site Information

Address: 217 Arlington Avenue, Kensington, CA Latitude: 37.90622° Longitude: -122.27875°

3.2 Building Information

Material Type (Direction 1):WLFMaterial Type (Direction 2):Cast-in-Place ConcreteNumber of Stories:2Total Building Square Footage:1,738Occupancy Type:Commercial OfficeTotal Expected Building Replacement Value:\$610,816

4 SITE HAZARD INFORMATION

This section presents the site's seismic hazard information. The V_{S30} value is the shear wave velocity in the soil at a depth of 30 meters. This value and the associated site class are presented in Table 4.1.

Table 4.1. Site soil information				
V _{S30} (m/s):	537.0			
Site Class:	С			
Closest V_{S30} for USGS Hazard Lookup (m/s):	530			

Table 4.2 and Figure 4.1 present the spectral acceleration information for this site. The spectral acceleration is a measure of how much force the building will attract in an earthquake. This amount of force is dependent on the intensity of the ground shaking (e.g. 10% in 50 years), as well as a dynamic property of the building known as the "fundamental period". Shorter buildings tend to have smaller fundamental periods and taller buildings tend to have larger fundamental periods. As indicated by Figure 4.1, smaller fundamental periods (with the exception of very short fundamental periods) will attract more force in an earthquake.

The Design Earthquake (DE) and Maximum Considered Earthquake (MCE) are based on the modern code maximum direction spectra and are converted to geometric mean for comparison.

Intensity	Return Period (yrs)	PGA	$S_a(0.2s)$	$S_a(1.0s)$	$S_a(0.51s)$	$S_a(0.29s)$	$S_a(T_1)$ Dir 1	$)/v_{ult}$ [†] Dir 2
50% in 50 years	72	0.22	0.52	0.17	0.32	0.46	0.67	0.35
10% in 50 years	475	0.62	1.50	0.56	1.02	1.38	2.11	1.05
DE	481	0.62	1.50	0.57	1.03	1.39	2.12	1.05
5% in 50 years	975	0.82	2.03	0.80	1.43	1.88	2.95	1.43
MCE_R	1277	0.91	2.26	0.91	1.59	2.11	3.29	1.60
2% in 50 years	2475	1.13	2.84	1.19	2.05	2.67	4.24	2.03

Table 4.2. Geometric mean spectral acceleration values (in g)

[†] $S_a(T_1)/v_{ult}$ is the ratio of shaking intensity to building strength where in direction 1 $v_{ult} = 0.484$ and $T_1 = 0.509$ s and in direction 2 $v_{ult} = 1.32$ and $T_1 = 0.290$ s (see Table 5.2 for more detailed structural properties)





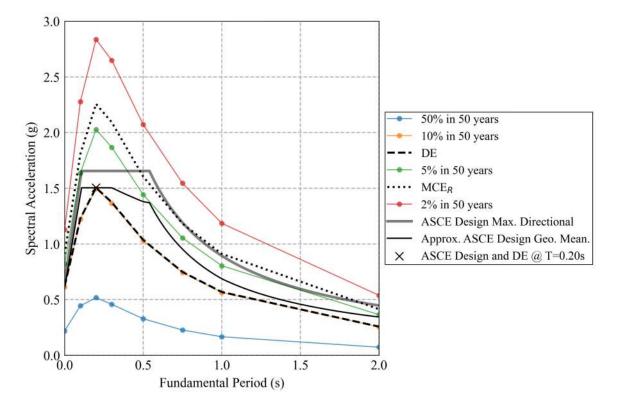


Figure 4.1. Hazard curves for this site. All curves are geometric mean unless otherwise stated.

5 BUILDING DESIGN SUMMARY FROM THE SP3 BUILDING CODE DESIGN DATABASE

5.1 Building Code Design Parameters

The seismic design parameters used to compute the seismic base shear coefficients for this building are presented in Table 5.1. These parameters are specific to ASCE/SEI 7-2010 (American Society of Civil Engineers, 2010).

Table 5.1. Code design parameters

(a) ASCE/SEI 7-2010 structural system parameters

(b) ASCE/SEI 7-2010 site specific parameters

Parameter	Dir. 1	Dir. 2	Parameter	Val
C_t	0.02	0.02	S_s	2.4
C_d	4	4.5	S_1	1.0
x	0.75	0.75	S_{ds}	1.6
R	6.5	5	S_{d1}	0.8
Ω_0	3	2.5	SDC	E
			C_u	1.

(c) ASCE/SEI 7-2010 site specific parameters based on the period of the building

Parameter	Value
$MCE_{R,max}(g)$	2.482
$MCE_{R,geomean}(g)$	2.159
$DE_{max}(g)$	1.655
$DE_{geomean}(g)$	1.439

5.2 Structural Properties

This section summarizes the main structural properties of the building in each direction. These structural properties are used as inputs to the SP3 Structural Response Prediction Engine.





Parameter	Direction 1	Direction 2	
General			
Structural System	WLF: General	RC: Cantilever Shear Wall	
Building Edge Length (ft)	21	41	
Detailing Level	Special	Ordinary	
Seismic Strength			
Seismic Design Base Shear Ratio, C_s [†]	0.382	0.496	
C_s with Structural Overstrength	-	1.19	
Wind Strength			
Wind Design Base Shear Ratio, v_{wind} [†]	0.131	0.060	
v_{wind} with Structural Overstrength	_	0.144	
Total Strength			
Strength Governed by	-	seismic	
Governing Seismic/Wind with Structural Overstrength	-	1.19	
With Gravity System Strength	-	1.27	
With Non-structural Strength	-	2.03	
Ultimate Base Shear Ratio, v_{ult}	0.484	1.32 [‡]	
Stiffness			
Design Drift (%)	-	1.00	
$T_{1,design}$ (s)	0.29	0.46^{\ddagger}	
T_1 with structural overstiffness (s)	-	0.36	
T_1 with gravity system (s)	-	0.35	
T_1 with non-structural components (s)	0.51	0.33	
T_1 empirical lower bound (s)	-	0.09	
T_1 empirical upper bound (s)	-	0.27	
T_1 Final (s)	0.51	0.29^{\ddagger}	

Table 5.2. Structural properties table

[†] Design base shear values reported as LRFD
 [‡] User defined, not SP3 default



5.3 Mode Shapes

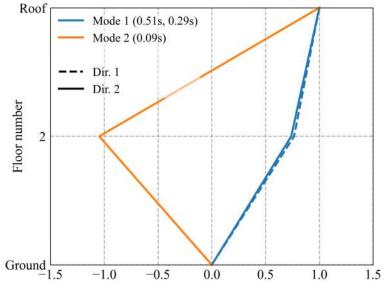


Figure 5.1. Mode shapes

	Dir. 1	Dir. 2		
	Mode 1	Mode 1	Mode 2	
Roof	1.00	1.00	1.00	
2	0.765	0.739	-1.05	
Ground	0.00	0.00	0.00	

6 SP3 PERFORMANCE FACTORS

Table 6.1 compares the seismic design base shear, C_s , to the 475-year shaking (reduced by the modern response modification coefficient, R). Generally speaking, the modern building code design requirements are based on the 475-year event with the exception of extremely high seismic (near-fault) areas that are designed for a lesser deterministic ground motion or the transition region between deterministic and probabilistic portions of the ground motion maps.

The shaking intensity is then reduced by the response modification coefficient, R, based on the ductility level of the system (in anticipation of controlled damage of specially designed elements).

When the ratio of design base shear to the reduced spectra $(C_s / [S_a(T_1)_{475}/R])$ is 1.0, then the building was designed consistent with 10% in 50 year hazard. When the ratio is above 1.0, it was designed higher, so expect better performance (all other things equal), and for ratios below 1.0, expect worse performance.

	Dir. 1	Dir. 2			
Seismic Design Base Shear, C_s	0.382	0.496			
475-year Shaking Intensity, $S_a(T_1)_{475}$ [†]	1.02g	1.38g			
Reduced Spectral Acceleration, $S_a(T_1)_{475}/R^{\ddagger}$	0.157g	0.230g			
Ratio of Design Base Shear to 475-year Shaking Demand, $C_s/\left[S_a(T_1)_{475}/R ight]$ §	2.44	2.16			
[†] T_1 includes all sources of overstiffness ($T_{1,dir1} = 0.509$ s and $T_{1,dir2} = 0.290$ s, see Table 5.2).					

Table 6.1. Design base shear vs. 475-year shaking intensity

[‡] Response Modification Coefficient, R, is from the modern code ($R_{dir1} = 6.5$ and $R_{dir2} = 6$).

7 BUILDING STABILITY

The FEMA P-154 collapse capacity score was calculated as follows using the "very high" seismicity level. The terminology used in this section is consistent with the FEMA P-154 methodology (Applied Technology Council, 2015a):

- $P[COL|MCE_R]_{P-154}$: the probability that the building will be in the HAZUS complete structural damage state when subjected to MCER shaking, times the collapse factor
- $P[COL|MCE_R]_{P-58}$: the probability that the building will be in the HAZUS complete structural damage state when subjected to MCER shaking
- Collapse Factor: expected ratio of collapsed area to total area given that the building is in the HAZUS Complete structural damage state

For a more in-depth explanation of "collapse," refer to Section 4.4.1.5 of FEMA P-155 Third Edition available <u>here</u> (Applied Technology Council, 2015b).

Since the FEMA P-154 building types associated with the two structural systems specified differ, collapse is based on the more vulnerable structural system which in this case was determined to be the direction 1 system, "WLF: General".

FEMA ID:	W2
Basic Score	1.8
Soil	0
Year	2
Plan Irregularity	0
Vertical Irregularity	0
Risk Category [†] (Cat IV)	0.8
Sum:	4.6
Minimum Allowed:	0.7
Score:	4.6
Dispersion (β):	0.58

Table 7.1. Breakdown of FEMA P-154 score assignment

[†] Non-standard property implemented by SP3

The FEMA P-154 probability of collapse at the MCE_R level event is then calculated as:

$$P[COL|MCE_R]_{P-154} = 10^{-\text{score}}$$

= 10^{-4.6} (FEMA P-155 eqn. 4-1)
= 0.00251%

Taking into account the fraction of floor area collapsed (0.33 in this case), the probability of collapse is:

$$P[COL|MCE_R]_{P-58} = P[COL|MCE_R]_{P-154} / \text{Collapse Factor}$$
$$= 0.00251\% / 0.33$$
$$= 0.00761\%$$

The median collapse capacity (before any direct modifications to the median) is calculated as:

$$S_{a, collapse median, P-58} = \exp\left(\ln(S_{a,MCE_R}) - \operatorname{norminv}\left(P[COL|MCE_R]_{P-58}\right) \cdot \beta\right)$$
$$= \exp\left(\ln(1.85g) - \operatorname{norminv}\left(0.00761\%\right) \cdot 0.58\right)$$
$$= 16.6g$$



where norminv is the inverse of the standard normal cumulative distribution function (CDF). To further refine the collapse capacity, the factors from Table 7.2 were applied to the median collapse S_{a} .

Table 7.2. Scale factor applied to the median collapse S_a value.

Reason	Factor
Wood Light Frame	0.237

The WLF modification reflects a weighted average of the FEMA P-154 median and the median collapse capacity observed in extensive non-linear dynamic modeling.

The final median for the collapse curve is therefore:

$$S_{a, collapse median, P-58 (adjusted)} = S_{a, collapse median, P-58} \cdot \text{Factors}$$

= 16.6g \cdot 0.237 (Using additional SP3 factors)
= 3.94g

Which corresponds to a probability of collapse at MCE of:

$$P[COL|MCE_R]_{P-58 \ (adjusted)} = 9.64\%$$
 (Using additional SP3 factors)

Figure 7.1 shows the collapse capacity cumulative distribution function used in the analysis.

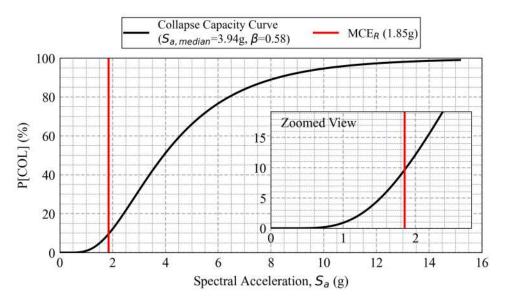


Figure 7.1. Cumulative distribution function for collapse capacity



8 STRUCTURAL RESPONSE PREDICTIONS FROM THE SP3 STRUCTURAL RESPONSE PREDICTION ENGINE

The SP3 Response Prediction Engine predicts the structural responses (typically providing 100 ground motions per intensity level); this is done by using a combination of three-mode elastic modal analysis, coupled with both elastic and inelastic response modifiers mined from the large SP3 Structural Responses Database (with over 4,000,000 response simulations, and growing). These response predictions track all of the important statistical information in the responses (mean, variability, and correlations); this enables a statistically robust vulnerability curve at the end of the risk assessment process.

8.1 Peak Interstory Drift

Peak interstory drift ratio is an important metric for both structural and non-structural components in the building. It measures how much the ceiling of a given story moves relative to the floor, normalized to the height of the story. The greater the interstory drift ratio, the greater the damage to the components on that level. Typical components that are damaged from interstory drift ratio are structural components (beams and columns), gypsum partition walls, and exterior cladding and glazing.

Story	50% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 years
2 1	0.05 0.36	0.34 2.30	0.34 2.32	0.38 3.64	0.43 4.14	0.62 5.68
$\frac{S_a(T_1)}{v_{ult}} =$	= 0.67	2.11	2.12	2.95	3.29	4.24

Table 8.1. Median Peak Interstory Drift dema	nds in direction 1
--	--------------------

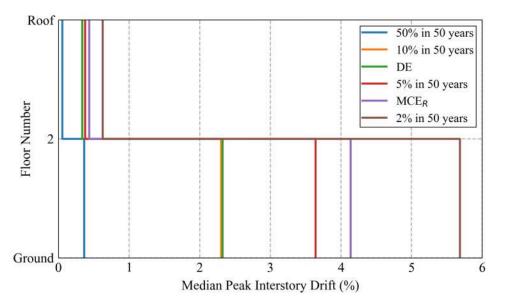


Figure 8.1. Median Peak Interstory Drift demands in direction 1





Story	50% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 years
2 1	0.10 0.18	0.32 0.58	0.32 0.58	0.55 0.77	0.68 0.86	1.06 1.06
$\frac{S_a(T_1)}{v_{ult}} =$	= 0.35	1.05	1.05	1.43	1.60	2.03

Table 8.2. Median Peak Interstory Drift demands in direction 2

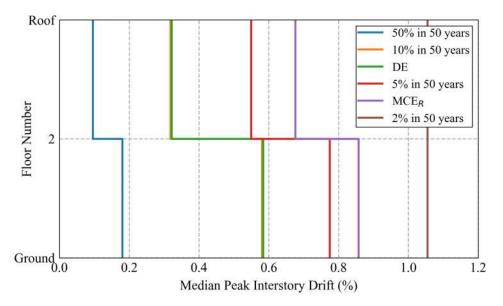


Figure 8.2. Median Peak Interstory Drift demands in direction 2



8.2 Residual Interstory Drift

Residual drift is a metric that informs the need for structural repairs or building demolition (where excessive drifts are present). Residual drift ratio is a measure of how much the building is "leaning over" after the seismic event has ceased. A residual drift of 2% would indicate that the story is laterally displaced 2% of it's height, which equates to about 3.6 inches for a 15 foot tall story.

Story	50% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 years
2 1	0.00 0.00	0.00 0.18	0.00 0.19	0.00 0.43	0.00 0.53	0.00 0.82
$\frac{S_a(T_1)}{v_{ult}} =$	= 0.67	2.11	2.12	2.95	3.29	4.24

Table 8.3. Median Residual Interstory Drift demands in direction 1

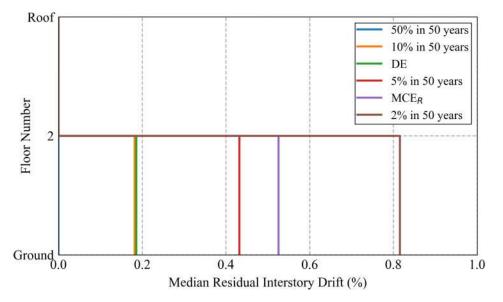


Figure 8.3. Median Residual Interstory Drift demands in direction 1



Story	50% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 years
2 1	0.00 0.00	0.01 0.04	0.01 0.04	0.04 0.07	0.05 0.08	0.10 0.10
$\frac{S_a(T_1)}{v_{ult}} =$	0.35	1.05	1.05	1.43	1.60	2.03

Table 8.4. Median Residual Interstory Drift demands in direction 2

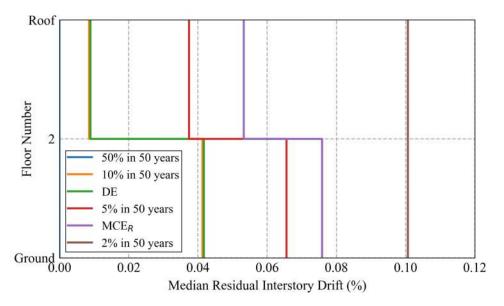


Figure 8.4. Median Residual Interstory Drift demands in direction 2

8.3 Peak Floor Acceleration

Peak floor acceleration is an an important metric for non-structural components in the building. Components such as piping, HVAC, and electrical switchgear are sensitive to the floor accelerations. High accelerations will typically damage a component itself or cause the component's anchorage to fail, both of which may require repair or replacement of the component.

Floor	50% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 years
Roof	0.34	0.82	0.82	0.83	0.91	1.13
2	0.29	0.75	0.75	0.83	0.91	1.13
Ground	0.22	0.62	0.62	0.82	0.91	1.13
$\frac{S_a(T_1)}{v_{ult}} =$	= 0.67	2.11	2.12	2.95	3.29	4.24

Table 8.5. Median Peak Floor Acceleration demands in direction 1

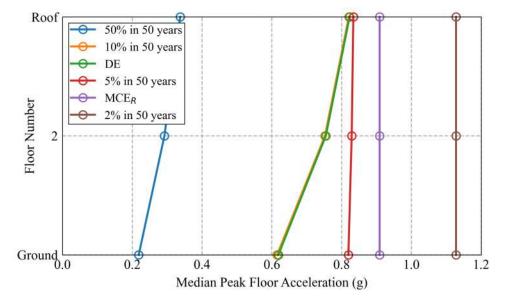


Figure 8.5. Median Peak Floor Acceleration demands in direction 1





Floor	50% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 years
Roof	0.55	1.42	1.43	1.70	1.77	1.91
2	0.38	1.03	1.03	1.27	1.35	1.51
Ground	0.22	0.62	0.62	0.82	0.91	1.13
$\frac{S_a(T_1)}{v_{ult}} =$	= 0.35	1.05	1.05	1.43	1.60	2.03

Table 8.6. Median Peak Floor Acceleration demands in direction 2

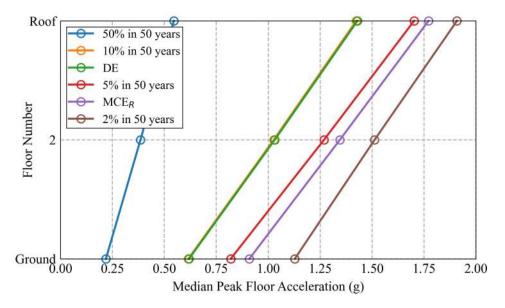


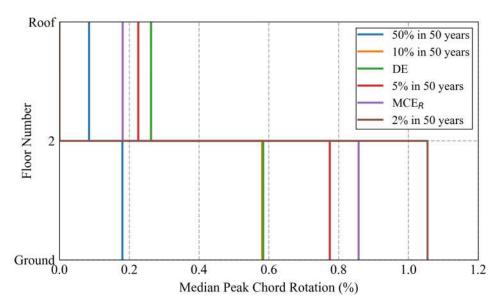
Figure 8.6. Median Peak Floor Acceleration demands in direction 2

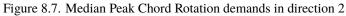
8.4 Peak Chord Rotation

Chord rotation informs how slender shear walls damage. Chord rotation is the difference in drift between two adjacent levels of a building.

Story	50% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 years
2 1	0.08 0.18	0.26 0.58	0.26 0.58	0.23 0.77	0.18 0.86	0.00 1.06
$\frac{S_a(T_1)}{v_{ult}} =$	= 0.35	1.05	1.05	1.43	1.60	2.03

Table 8.7. Median Peak Chord Rotation demands in direction 2







8.5 Max. Residual Interstory Drift

	50% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 years
_	0.00	0.18	0.19	0.43	0.53	0.82
$\frac{S_a(T_1)}{v_{ult}} =$	= 0.67	2.11	2.12	2.95	3.29	4.24

Table 8.8. Median Max. Residual Interstory Drift demands in direction 1

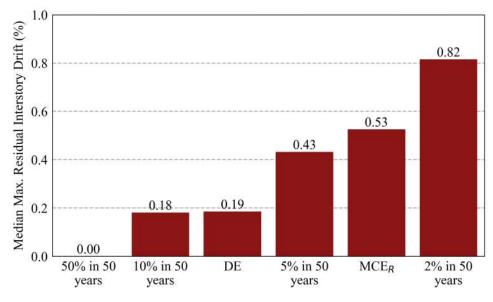


Figure 8.8. Median Max. Residual Interstory Drift demands in direction 1





	50% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 years
_	0.00	0.04	0.04	0.07	0.08	0.10
$\frac{S_a(T_1)}{v_{ult}} =$	= 0.35	1.05	1.05	1.43	1.60	2.03

Table 8.9. Median Max. Residual Interstory Drift demands in direction 2

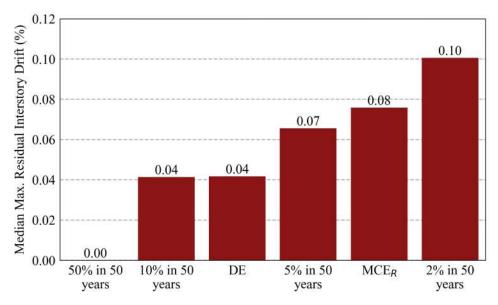


Figure 8.9. Median Max. Residual Interstory Drift demands in direction 2

9 REPAIR COSTS - BY LEVEL OF GROUND MOTION

9.1 Mean and 90th Percentile Repair Costs (SEL and SUL)

The different metrics for repair cost are as follows:

- Mean (SEL): ("Scenario Expected Loss") the average repair cost of the building repair/replacement.
- Median: there is a 50% probability that the repair cost will not exceed this value.
- Fitted SUL: Fitted value of "Scenario Upper Loss".
- Counted 90th Percentile: there is a 90% probability that the repair cost will not exceed this value.

Intensity	PGA (g)	Mean (SEL) (%)	Fitted SUL (%)	Median (%)	Counted 90 th Percentile (%)	$S_a(T_1)$ Dir 1	$)/v_{ult}$ † Dir 2
50% in 50 years	0.22	3.2	7.7	1.4	8.8	0.67	0.35
10% in 50 years	0.62	27	46	24	46	2.11	1.05
DE	0.62	27	47	24	47	2.12	1.05
5% in 50 years	0.82	45	75	37	100	2.95	1.43
MCE_R	0.91	52	84	42	100	3.29	1.60
2% in 50 years	1.13	72	100	100	100	4.24	2.03

Table 9.1. Loss metrics normalized by building cost

[†] $S_a(T_1)/v_{ult}$ is the ratio of shaking intensity to building strength where in direction 1 $v_{ult} = 0.484$ and $T_1 = 0.509s$ and in direction 2 $v_{ult} = 1.32$ and $T_1 = 0.290s$ (see Table 5.2 for more detailed structural properties)

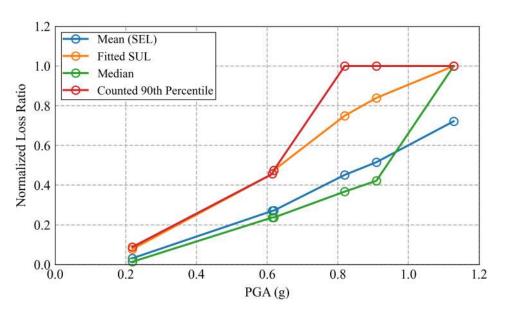


Figure 9.1. Loss metrics across all intensity levels analyzed



10 REPAIR COST BREAKDOWN BY BUILDING COMPONENTS

10.1 Categories for Repair Cost Breakdowns

Repair costs are binned into eight categories as follows:

- Collapse: building demolition and replacement following a collapse.
- Residual: building demolition and replacement following unacceptable residual drifts.
- **Structural**: components of the lateral force resisting system or gravity system (e.g. beam column connections, link beams, shear wall, shear tabs, etc.).
- Partitions: partition wall components (e.g. wood or metal stud gypsum full height partitions).
- **Exterior**: components placed on the exterior of the building (e.g. cladding, glazing, etc.).
- **Interior**: non-structural components on the interior of the building (e.g. raised access floors, ceilings, lighting).
- **HVAC**: HVAC and plumbing components (e.g. water piping and bracing, sanitary piping, ducting, boilers etc.).
- **Other**: components not included in the categories above (e.g. elevators, user defined components, fire protection components).

10.2 Repair Cost Breakdown for Various Ground Motion Levels

Intensity	Total	Residual	Collapse	Structural	Partitions	Interior	Other	HVAC	Exterior
50% in 50 years	3.2	0.0	0.0	0.6	0.9	0.3	1.0	0.4	0.0
10% in 50 years	27	0.3	1.0	9.7	4.6	4.4	4.5	1.8	0.7
DE	27	0.3	1.1	9.6	4.6	4.6	4.4	1.8	0.7
5% in 50 years	45	10.0	5.8	12	5.1	5.2	4.3	1.8	0.8
MCE_R	52	14	8.7	12	5.1	5.1	4.2	1.8	0.8
2% in 50 years	72	33	18	9.2	4.0	3.5	2.7	1.2	0.5

Table 10.1. Expected mean loss per component group (in percent)

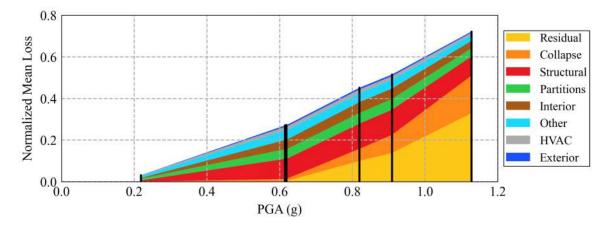


Figure 10.1. Contribution of building components to mean loss ratio





10.3 Repair Cost Breakdown for Expected Annual Loss

The expected annual loss for this building is \$1,741.

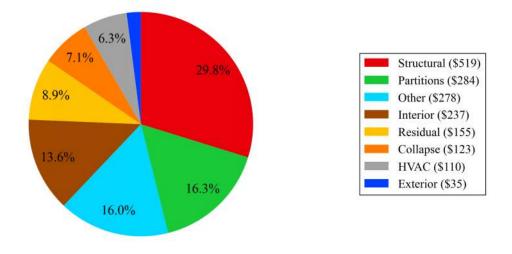


Figure 10.2. Annualized loss breakdown

11 REPAIR TIME AND BUILDING CLOSURE TIME

These downtimes were calculated using the ATC-138 Functional Recovery (Beta) Methodology. This includes all sources of impedance specified by the user; possible sources of impedance considered are listed below.

- Post-earthquake Inspection
- Engineering Mobilization and Review/Re-design
- Financing
- Contractor Mobilization and Bid Process
- Permitting

These capture the time required to start the repairs, since beginning repairs immediately after an earthquake may not be realistic.

	FEMA	A P-58 [†]	ATC-138 Functional Recovery (Beta) [‡]			
Intensity	Parallel	Series	Re- Occupancy	Functional	Full	
50% in 50 years	4.8 days	6.1 days	0 days	0 days	7 weeks	
10% in 50 years	2.8 months	3.6 months	2.2 months	3.5 months	3.8 months	
DE	2.7 months	3.5 months	2.3 months	3.6 months	3.8 months	
5% in 50 years	4.1 months	5.4 months	3.2 months	4.2 months	4.3 months	
MCE_R	4.7 months	6 months	3.6 months	4.6 months	4.7 months	
2% in 50 years	11 months	11 months	11 months	11 months	11 months	

Table 11.1. Median repair time summary

[†] Does *not* include impedance factors

[‡] Does include impedance factors

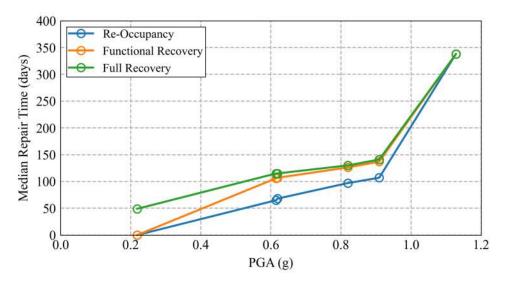


Figure 11.1. Median repair time from the ATC-138 Functional Recovery (Beta) Methodology, includes specified impeding factors





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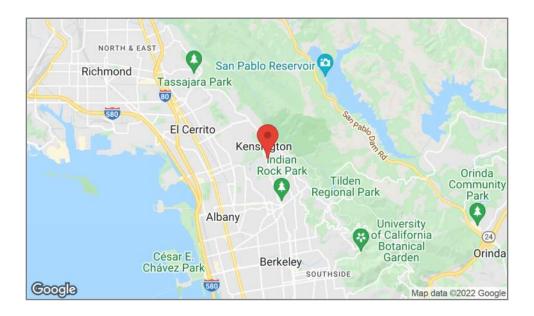
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SEISMIC RISK ASSESSMENT REPORT Created with the SP3-RiskModel

Functional Recovery Time Report using the ATC-138 Functional Recovery (Beta) Methodology



Report Generated for:

217 Arlington Avenue, Kensington, CA Latitude: 37.90622° Longitude: -122.27875°

Report Generated by:

The SP3-RiskModel Software v1.2.0 of the Seismic Performance Prediction Program (SP3)

March 16, 2022



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SP3

1 SUMMARY OF INPUTS AND RISK RESULTS

Risk Model Inputs

Primary		Building Design Info		
Project Name:	Kensington Fire Station	Level of Detailing (Dir. 1, 2):	Special,	
Model Name:	New WLF on RC Wall		Ord	linary
Building Types:		Drift Limit (Dir. 1, 2):	-, -	-
Dir. 1: WL	F: General	Risk Category:	IV	
Dir. 2: RC: Cantilever Shear Wall		Seismic Importance Factor, I_e :	-	
Veen of Constantions	2022	Component Importance Factor	I_p : –	
Year of Construction:	2022			
Number of Stories:	2			
Occupancy: Address:	Commercial Office	Structural Prop	Structural Properties	
217 Arlingt Kensington		Allow Components to Affect Structural Properties?	Yes	
Latitude:	37.90622°	-		
Longitude:	-122.27875°	Mode Shapes Specified?	No	
Longhude.	122.27075	- Directional Properties	Dir. 1	Dir. 2
		Base Shear Strength (g):	_	1.317
Analy	sis Options	Yield Drift (%):	-	_
Include Collapse in Ana	alysis: Yes	1^{st} Mode Period (T_1) (s):	_	0.29
Consider Residual Drif	t: Yes	2^{nd} Mode Period (T_2) (s):	_	0.09
Region Cost Multiplier	-			
Date Cost Multiplier:	_			
Occupancy Cost Multip	•			
		Percent of Building Glazed:	_	
		Solartion Mathed	Cu	tom

Building	Layout	Information

Cost per Square Foot:	_		
Scale component repair costs with	Yes		
building value?			
Total Square Feet:	1,738		
Aspect Ratio:	1.95		
First Story Height (ft):	13.5		
Upper Story Heights (ft):	9		
Vertical Irregularity:	None		
Plan Irregularity:	None		
Frac. of Full Height Ext. Wood Walls			
Dir. 1 Story 1	_		
Dir. 1 Upper Stories	-		

Ground Motion and Soil Information

Site Class:	С
Site Hazard:	SP3 Default

Structural Properties		
Allow Components to Affect Structural Properties?	Yes	
Mode Shapes Specified?	No	
Directional Properties	Dir. 1	Dir. 2
Base Shear Strength (g):	_	1.317
Yield Drift (%):	-	-
1^{st} Mode Period (T_1) (s):	_	0.29
2^{nd} Mode Period (T_2) (s):	_	0.09

Component Information		
Percent of Building Glazed:	_	
Selection Method	Custom	

Building Stability

Median Collapse Capacity:	_	
Beta (Dispersion):	_	

Responses

No responses provided

SP3 | Where Research Meets Practice



Repair Time Options

Repair Time Method	ATC-138 (Beta)
Factors Delaying Start of I	Repairs
Inspection	Yes
Financing	Yes
Permitting	Yes
Engineering Mobilization	Yes
Contractor Mobilization	Yes
Mitigation Factors	
Inspector on Retainer	No
Engineer on Retainer	No
Contractor on Retainer	No
Funding Source	Private Loans
Cash on Hand	_

ATC-138 Functional Recovery (Beta) Options

Need HVAC for Function	-
Need Elevator for Function	_
Include Surge Demand	_

Component Checklist

Interior Finishes

- What kind of partition walls does the building have?
 - > Wood Studs
- Does the building have raised access floors > *No*
- Does the building have suspended ceilings?
 - > Yes
 - Are the ceilings laterally supported?

> Yes

- What is the Ip factor used to design the ceilings?
 - > 1.5
- Does the building contain pendant (non-recessed) lighting?

> Yes

• Are the pendant lights seismically rated?

> Yes

Stairs and Elevators

• Does the building have stairs?

> Yes

- What type of stairs are in the building?
 - > Light Frame
- Are there elevators in the building?
 - > Yes
 - What type of elevators are in the building?
 - > Hydraulic
 - From which era are the building's elevators?
 - > post-1976 California (or post-1976 California equivalent)

Fire Supression

- Does the building contain a fire sprinkler system?
 - > Yes
 - Does the fire sprinkler system have braced horizontal piping?

Continued on next page





- > Yes
- Are the horizontal mains OSHPD certified (or equivalent)? > Yes
- Are the fire sprinkler drops OSHPD certified (or equivalent)?
 - > Yes
 - What type of ceiling do the fire drops enter into? > Hard

Piping

- Is the building's water piping OSHPD certified or equivalent?
 - > Yes
- Is the building's sanitary piping OSHPD certified or equivalent? > Yes
 - What type of couplings do the pipes have?
 - > Flexible

HVAC

• Is the HVAC cooling/heating equipment seismically anchored?

> Yes

- How is the cooling/heating system configured?
 - > Roof Top Units
 - Are the RTUs used for medical purposes (or equivalent)?
 - > No
 - Are the RTUs small or large?

> Small

- Does the building have a control panel?
 - > No
- Is there an HVAC exhaust system in the building?
 - > Yes
 - Is the HVAC exhaust system seismically anchored?
 - > Yes
- Does the HVAC distribution system meet OSHPD standards (or similar)? > Yes

 - Is there any large diameter ducting (6 SqFt+) in the HVAC system? > Yes

Electrical

• Does the building have a backup battery/generator system? > No

Concrete

- Are the building's shear walls low rise or slender?
 - > Low Rise (typically <= 40ft building height)
 - What are the boundary conditions of the walls?
 - > No return flanges or boundary columns
 - What is the typical wall thickness?
 - > 8" to 16"
 - What is the typical wall height?
 - > Less than 15'



Expected Loss

LA	Expected loss in percent of total building value							
Shaking Intensity	Return Period	SEL (%)	SUL (%)					
50% in 50 years	72 Years	3.2	7.7					
10% in 50 years	475 Years	27	46					
DE	481 Years	27	47					
5% in 50 years	975 Years	45	75					
MCE_R	1277 Years	52	84					
2% in 50 years	2475 Years	72	100					

Expected loss in percent of total building value

Repair Time

	Median repair time summary								
	FEMA	A P-58 [†]	ATC-138 F	Functional Recov	ery (Beta) [‡]				
Intensity	Parallel	Parallel Series		Functional	Full				
50% in 50 years	4.8 days	6.1 days	0 days	0 days	7 weeks				
10% in 50 years	2.8 months	3.6 months	2.2 months	3.5 months	3.8 months				
DE	2.7 months	3.5 months	2.3 months	3.6 months	3.8 months				
5% in 50 years	4.1 months	5.4 months	3.2 months	4.2 months	4.3 months				
MCE_R	4.7 months	6 months	3.6 months	4.6 months	4.7 months				
2% in 50 years	11 months	11 months	11 months	11 months	11 months				

[†] Does *not* include impedance factors

[‡] Does include impedance factors



2 FUNCTIONAL RECOVERY OVERVIEW

					Median		90^{t}	90 th Percentile	
Intensity	Return Period	PGA (g)	$\operatorname{Sa}(T_1)^*$	Re- Occ.	Func.	Full	Re- Occ.	Func.	Full
50% in 50 years	72 years	0.22	0.39	0d	0d	7w	0d	6.6w	4m
10% in 50 years	475 years	0.62	1.20	2.2m	3.5m	3.8m	4.9m	5.9m	6m
DE	481 years	0.62	1.21	2.3m	3.6m	3.8m	4.8m	5.7m	5.9m
5% in 50 years	975 years	0.82	1.66	3.2m	4.2m	4.3m	11m	11m	11m
MCE_R	1277 years	0.91	1.85	3.6m	4.6m	4.7m	11m	11m	11m
2% in 50 years	2475 years	1.13	2.36	11m	11m	11m	11m	11m	11m

Table 2.1. Recovery Times from the ATC-138 Functional Recovery (Beta) Methodology

* Sa (T_1) is the spectral acceleration at T_1 where is the mean of T_1 in both directions

Table 2.2. Global Consequences

Intensity	Return Period	PGA (g)	$\operatorname{Sa}(T_1)^*$	P[red tag]	P[collapse]	P[excessive residual]
50% in 50 years	72 years	0.22	0.39	0.0%	0.0%	0.0%
10% in 50 years	475 years	0.62	1.20	1.3%	1.0%	0.3%
DE	481 years	0.62	1.21	1.4%	1.1%	0.3%
5% in 50 years	975 years	0.82	1.66	16%	5.8%	10.0%
MCE_R	1277 years	0.91	1.85	23%	8.7%	14%
2% in 50 years	2475 years	1.13	2.36	51%	18%	33%

* Sa (T_1) is the spectral acceleration at T_1 where is the mean of T_1 in both directions

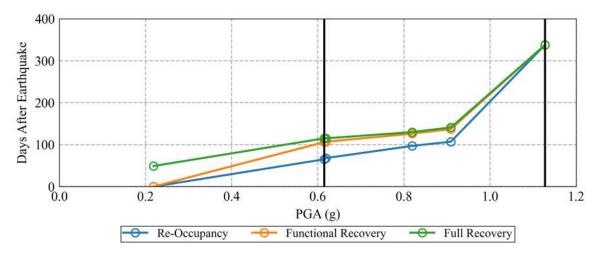


Figure 2.1. ATC-138 Functional Recovery (Beta) Methodology median recovery times





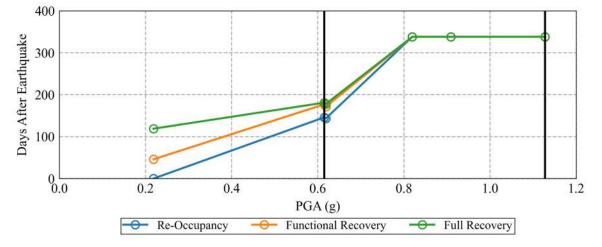


Figure 2.2. ATC-138 Functional Recovery (Beta) Methodology 90^{th} percentile recovery times

3 COMPONENT DAMAGE OVERVIEW

3.1 Most Damaged Components

This section outlines the most damaged component at each intensity. "Most damaged" is determined by cost and does not necessarily mean that it's the main component impeding building function.

Intensity	Component	Damage State	Expected Repair Cost
50% in 50 years	B1044.011	1	\$3,640
10% in 50 years	B1044.011	1	\$54,073
DE	B1044.011	1	\$53,309
5% in 50 years	B1044.011	1	\$67,194
MCE_R	B1044.011	1	\$66,878
2% in 50 years	B1044.011	1	\$51,183

Table 3.1. Most damaged Structural components at each intensity level.

Table 3.2. Most damaged Non-Structural components at each intensity level.

Intensity	Component	Damage State	Expected Repair Cost
50% in 50 years	D1014.021	1	\$5,819
10% in 50 years	D1014.021	1	\$24,935
DE	D1014.021	1	\$24,302
5% in 50 years	D1014.021	1	\$22,464
MCE_R	D1014.021	1	\$21,878
2% in 50 years	D1014.021	1	\$14,010

Details of the most damaged components and their damage states:

• **B1044.011**: Rectangular low aspect ratio concrete walls 8"-16" double curtain; with heights of up to 15'

DS1: Cracks with maximum widths greater than 0.04 in but less than 0.12 in.

- **D1014.021**: Hydraulic Elevator Applies to most California Installations 1976 or later, most western states installations postdating 1982 and most U.S installations postdating 1998.
 - DS1a: Damaged controls.
 - DS1b: Damaged vane and hoist-way switches, and or bent cab stabilizers, and or damaged car guide shoes.
 - DS1c: Damaged entrance and car door, and or flooring damage.
 - DS1d: Oil leak in hydraulic line, and or hydraulic tank failure.



3.2 Worker Days Summary

This table shows the expected worker days on a per-damage state basis. The header shows the probability of global failures (collapse and residual drift demolition) for reference.

The color scale is meant to indicate **relative** performance of components, not absolute performance. A "green" value does not indicate that the value falls in a pre-determined "good" range, just that it performs well compared to other components. Likewise, a "red" value does does not indicate that the value falls in a pre-determined "bad" range, just that it performs worse compared to other components.

	50% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 years
P[Col](%)	0.0	1.0	1.1	5.8	8.7	18
P[Res](%)	0.0	0.3	0.3	10.0	14	33
B1044.011	#1 (B1044.011:	Rectangular low asp	ect ratio concre	ete walls 8"-16" doubl	e curtain; wit	h)
DS1	1.6	13	13	12	11	6.7
DS2	0.1	3.5	3.5	4.4	4.4	3.8
DS3	0.2	14	14	22	22	18
Total	2.0	30	30	38	37	29
B1071.202	#1 (B1071.202:	Exterior Structural V	Wall - Light fra	med wood walls with	structural pa	nel)
DS1	0.1	1.1	1.0	0.7	0.7	0.4
DS2	0.0	0.8	0.8	0.8	0.7	0.4
DS3	0.0	1.8	1.9	3.3	3.3	2.8
Total	0.1	3.6	3.8	4.8	4.7	3.6
B2011.401	#1 (B2011.401:	Exterior Wall - Light	t framed wood	walls with exterior pa	nelized sheatl	ning)
DS1	0.2	0.7	0.7	0.6	0.6	0.5
DS2	0.0	0.7	0.7	0.5	0.4	0.3
DS3	0.0	3.1	3.2	3.9	3.9	2.9
Total	0.2	4.5	4.6	5.0	4.9	3.6
C1011.211	a #1 (C1011.211)	a: Wall Partition - Ty	vne: Gynsum w	vith wood studs (both	sides), Full Ho	eight)
DS1	1.1	2.1	2.1	1.6	1.4	0.7
DS1 DS2	0.2	1.2	1.2	1.3	1.4	1.1
DS3	0.3	5.6	5.6	6.8	7.0	5.8
Total	1.7	8.9	8.9	10	10	7.5
	a #1 (C1011.311)	a: Interior of Exterio	or Wall - Type:	Gypsum with wood s	tuds (single-si	ded)
DS1	1.0	1.6	1.5	1.2	1.0	0.5
DS2	0.2	1.2	1.2	1.4	1.5	1.1
DS3	0.2	4.1	4.0	5.2	5.4	4.6
Total	1.3	6.9	6.8	7.8	7.8	6.1
	b #1 (C2011.041	h: Light frame stair	fragility. Annr	oximation as a placeh	older until the	ere is)
DS1	0.0	0.3	0.3	0.3	0.2	0.2
DS1 DS2	0.0	0.6	0.7	0.7	0.2	0.5
DS2 DS3	0.0	1.0	1.0	1.7	1.7	1.4
Total	0.0	2.0	2.0	2.6	2.6	2.0
C3032.004	a #1 (C3032.004	a: Suspended Ceiling	SDC D E F ([p=1.5), Area (A): A <	250 Vert & I	(at)
DS1	0.0	0.1	0.1	0.1	0.1	0.1
DS1 DS2	0.0	0.2	0.2	0.2	0.1	0.1
DS2 DS3	0.0	3.2	3.3	4.0	4.0	2.7
Total	0.2	3.5	3.7	4.3	4.3	2.9
10101	U+#	010	5.1	700		tinued on next page

Table 3.3. Expected worker days per damage state (Worker Days)

Continued on next page





	50% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 year
P[Col](%)	0.0	1.0	1.1	5.8	8.7	18
P[Res](%)	0.0	0.3	0.3	10.0	14	33
C3032.004	b #1 (C3032.004)	: Suspended Ceiling,	SDC D,E,F (Ip=1.5), Area (A): 250) < A < 1000, V	Vert & Lat)
DS1	0.0	0.1	0.2	0.1	0.1	0.1
DS2	0.0	0.3	0.3	0.3	0.3	0.2
DS3	0.2	3.2	3.5	4.3	3.9	2.8
Total	0.2	3.7	3.9	4.7	4.3	3.1
C3032.004	c #1 (C3032.004c	: Suspended Ceiling, S	SDC D,E,F (l	p=1.5), Area (A): 100	0 < A < 2500,	Vert &)
DS1	0.1	0.2	0.2	0.2	0.2	0.1
DS2	0.1	0.4	0.5	0.4	0.4	0.4
DS3	0.1	3.4	3.6	4.3	4.1	2.8
Total	0.2	4.1	4.4	4.9	4.7	3.3
C3032.004	d #1 (C3032.004d	I: Suspended Ceiling,	SDC D,E,F (Ip=1.5), Area (A): A >	2500, Vert &	Lat)
DS1	0.1	0.3	0.3	0.2	0.2	0.1
DS2	0.1	0.5	0.5	0.4	0.4	0.3
DS3	0.2	3.6	3.7	4.4	4.2	2.9
Total	0.4	4.4	4.4	5.0	4.9	3.3
C3034.002	#1 (C3034.002:]	Independent Pendant	Lighting - sei	smically rated)		
DS1	0.3	1.9	1.9	1.9	1.9	1.2
D1014.021	#1 (D1014.021:]	Hydraulic Elevator - A	opplies to mo	st California Installati	ions 1976 or)
DS1a	0.1	0.4	0.4	0.4	0.3	0.2
DS1b	1.7	6.6	6.4	6.1	5.8	3.8
DS1c	2.1	9.3	8.6	7.5	7.6	4.9
DS1d	0.3	1.3	1.3	1.3	1.2	0.7
Total	4.2	18	17	15	15	10
D2021.014	a #1 (D2021.014a	: Cold or Hot Potable	- Small Diar	neter Threaded Steel -	- (2.5 inches ir	ı)
DS1	0.0	0.0	0.0	0.0	0.0	0.0
DS2	0.0	0.0	0.0	0.1	0.1	0.0
Total	0.0	0.1	0.1	0.1	0.1	0.0
D2021.014	b #1 (D2021.014)	o: Cold or Hot Potable	- Small Dia	neter Threaded Steel	- (2.5 inches i	n)
DS1	0.0	0.0	0.0	0.0	0.0	0.0
D2021.024	a #1 (D2021.024;	: Cold or Hot Potable	Water Pinin	g (dia > 2.5 inches). Sl	DC D.E.F (OS	SPHD or)
DS1	0.0	0.0	0.0	0.0	0.0	0.0
DS2	0.0	0.0	0.0	0.0	0.0	0.0
Total	0.0	0.0	0.0	0.1	0.1	0.0
D2021.024	b #1 (D2021.024)	o: Cold or Hot Potable	Water Pinir	g (dia > 2.5 inches), S	DC D.E.F (OS	SPHD or)
DS1	0.0	0.0	0.0	0.0	0.0	0.0
DS1 DS2	0.0	0.0	0.0	0.0	0.0	0.0
Total	0.0	0.0	0.0	0.0	0.0	0.0
02031 014): Sanitary Waste Pipi			SDC D F F (OSHPD or)
DS1	0.0	0.0	0.0	0.0	, 5DC D,L,I (0.0	0.0
D3032.013	c #1 (D3032.013c	: Compressor - Capac	ity: Small no	on medical air sunnly .	- Equipment f	hat is)
DS052.015 DS1a	0.0	0.1	0.1	0.1	0.1	0.1
DS1b	0.0	0.1	0.1	0.1	0.1	0.1
DS1c	0.0	0.1	0.1	0.1	0.1	0.1
DS1d	0.0	0.4	0.4	0.4	0.4	0.3
0510						

Continued on next page



50	0% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 years
P[Col](%)	0.0	1.0	1.1	5.8	8.7	18
P[Res](%)	0.0	0.3	0.3	10.0	14	33
D3041.011d	#1 (D3041.011d	1: HVAC Galvanized	Sheet Metal I	Ducting less than 6 sq.	ft in cross sec	tional)
DS1	0.0	0.0	0.0	0.0	0.0	0.0
DS2	0.0	0.1	0.1	0.1	0.1	0.1
Total	0.0	0.1	0.1	0.1	0.1	0.1
D3041.012d	#1 (D3041.012d	I: HVAC Galvanized	Sheet Metal I	Oucting - 6 sq. ft cross	sectional area	1 or)
DS1	0.0	0.0	0.0	0.0	0.0	0.0
DS2	0.0	0.0	0.0	0.0	0.0	0.0
Total	0.0	0.0	0.0	0.0	0.0	0.0
D3041.032d	#1 (D3041.032d	l: HVAC Drops / Diff	users without	ceilings - supported b	y ducting only	y - No)
DS1	0.6	3.7	3.8	3.7	3.5	2.3
D3041.103c	#1 (D3041.103c	: HVAC Fan - Capac	ity: all - Equi	pment that is either h	ard anchored	or is)
DS1a	0.1	0.4	0.4	0.4	0.4	0.2
DS1b	0.0	0.1	0.1	0.1	0.1	0.1
DS1c	0.7	2.3	2.3	2.1	2.0	1.2
Total	0.9	2.8	2.8	2.6	2.5	1.5
D3067.012c	#1 (D3067.012c	: Control Panel - Caj	pacity: all - E	uipment that is eithe	r hard anchor	ed or)
DS1a	0.0	0.0	0.0	0.0	0.0	0.0
DS1b	0.0	0.2	0.2	0.3	0.3	0.2
DS1c	0.0	0.5	0.6	0.7	0.7	0.6
Total	0.0	0.7	0.8	1.0	1.0	0.8
D4011.024a	#1 (D4011.024a	: Fire Sprinkler Wat	er Piping - Ho	orizontal Mains and B	ranches - Old	Style)
DS1	0.0	0.0	0.0	0.0	0.0	0.0
DS2	0.0	0.0	0.0	0.0	0.0	0.0
Total	0.0	0.1	0.1	0.1	0.1	0.1

3.3 Component Name Reference

This list is provided for reference where only the fragility ID is available.

- **B1044.011**: Rectangular low aspect ratio concrete walls 8"-16" double curtain; with heights of up to 15'
- **B1071.202**: Exterior Structural Wall Light framed wood walls with structural panel sheathing, with hold-downs
- **B2011.401**: Exterior Wall Light framed wood walls with exterior panelized sheathing (OSB) and horizontal wood siding, no hold-downs
- C1011.211a: Wall Partition Type: Gypsum with wood studs (both sides), Full Height, Fixed Below, Fixed Above
- **C1011.311a**: Interior of Exterior Wall Type: Gypsum with wood studs (single-sided gypsum), Full Height, Fixed Below, Fixed Above
- C2011.041b: Light frame stair fragility. Approximation as a placeholder until there is more research on the topic. Damage states from P-58 Light frame stair example. Costing approximated from various online sources for stair replacement.
- C3032.004a: Suspended Ceiling, SDC D,E,F (Ip=1.5), Area (A): A < 250, Vert & Lat support
- C3032.004b: Suspended Ceiling, SDC D,E,F (Ip=1.5), Area (A): 250 < A < 1000, Vert & Lat support
- C3032.004c: Suspended Ceiling, SDC D,E,F (Ip=1.5), Area (A): 1000 < A < 2500, Vert & Lat support
- C3032.004d: Suspended Ceiling, SDC D,E,F (Ip=1.5), Area (A): A > 2500, Vert & Lat support
- C3034.002: Independent Pendant Lighting seismically rated
- **D1014.021**: Hydraulic Elevator Applies to most California Installations 1976 or later, most western states installations postdating 1982 and most U.S installations postdating 1998.
- **D2021.014a**: Cold or Hot Potable Small Diameter Threaded Steel (2.5 inches in diameter or less), SDC D, E, or F (OSHPD or sim), PIPING FRAGILITY
- **D2021.014b**: Cold or Hot Potable Small Diameter Threaded Steel (2.5 inches in diameter or less), SDC D, E, or F (OSHPD or sim), BRACING FRAGILITY
- **D2021.024a**: Cold or Hot Potable Water Piping (dia > 2.5 inches), SDC D,E,F (OSPHD or sim), PIPING FRAGILITY
- **D2021.024b**: Cold or Hot Potable Water Piping (dia > 2.5 inches), SDC D,E,F (OSPHD or sim), BRACING FRAGILITY
- **D2031.014b**: Sanitary Waste Piping Cast Iron w/flexible couplings, SDC D,E,F (OSHPD or sim), BRACING FRAGILITY
- D3032.013c: Compressor Capacity: Small non medical air supply Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints Combined anchorage/isolator & equipment fragility
- **D3041.011d**: HVAC Galvanized Sheet Metal Ducting less than 6 sq. ft in cross sectional area, SDC D, E, or F (OSHPD or sim)
- D3041.012d: HVAC Galvanized Sheet Metal Ducting 6 sq. ft cross sectional area or greater,





SDC D, E, or F (OSHPD or sim)

- **D3041.032d**: HVAC Drops / Diffusers without ceilings supported by ducting only No independent safety wires, SDC D, E, or F (OSHPD or sim)
- D3041.103c: HVAC Fan Capacity: all Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Combined anchorage/isolator & equipment fragility
- D3067.012c: Control Panel Capacity: all Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Combined anchorage/isolator & equipment fragility
- **D4011.024a**: Fire Sprinkler Water Piping Horizontal Mains and Branches Old Style Victaulic - Thin Wall Steel - with designed bracing, SDC D, E, or F (OSHPD or sim), PIPING FRAGILITY

4 DETAILED REOCCUPANCY AND FUNCTIONALITY RESULTS BY GROUND MOTION INTENSITY

4.1 50% in 50 years Intensity

4.1.1 Selected Realizations for 50th percentile

Note that this is a single realization and may not be representative of a general trend. This selected realization is intended to give a sense of what the repair schedule may look like, it is not intended to generalize what the "typical" repair schedule looks like.

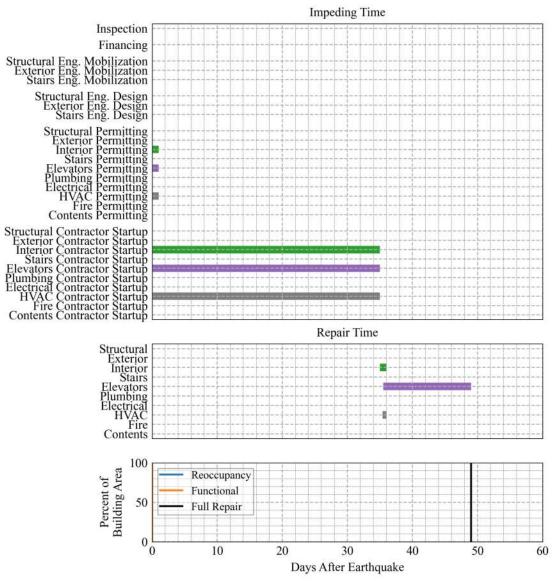


Figure 4.1. 50% in 50 years Percentile = 50





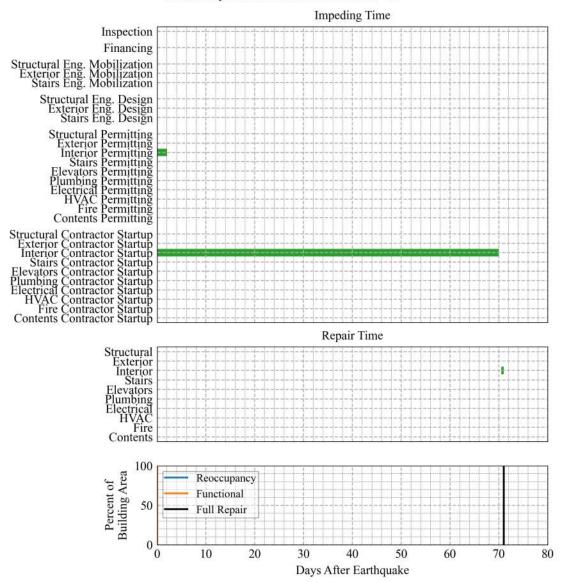


Figure 4.2. 50% in 50 years Percentile = 49



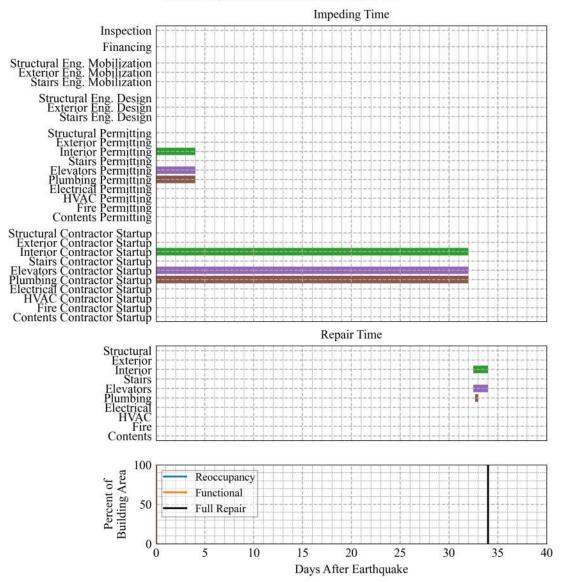


Figure 4.3. 50% in 50 years Percentile = 51

4.1.2 Selected Realizations for 90th percentile

Note that this is a single realization and may not be representative of a general trend. This selected realization is intended to give a sense of what the repair schedule may look like, it is not intended to generalize what the "typical" repair schedule looks like.

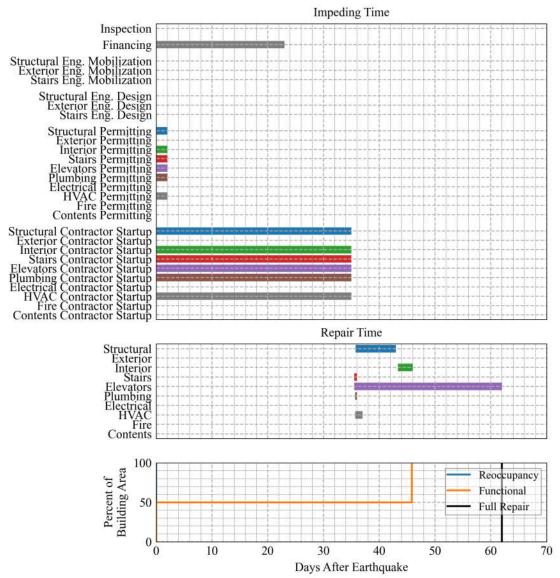


Figure 4.4. 50% in 50 years Percentile = 90



4.1.3 Damage to Building Systems

Table 4.1 shows the percentage of realizations that the named system prevents reoccupancy/function for the 50% in 50 years intensity. Note that if a system prevents reoccupancy, it will also prevent functionality. This means that the functionality checks may all be fine, but if the reoccupancy checks indicate the building is not reoccupiable then the building will not be considered functional.

Each column represents a milestone time after the earthquake and the values in that column indicate the percentage of realizations in which that component is preventing reoccupancy/functionality at that milestone.

	Immediate	>3 days	>7 days	>14 days	>1 month	>6 months	>12 months			
Building Reoccupancy	Building Reoccupancy (also affects function)									
Red Tag (Structural)	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
Hazardous Material	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
Fire Egress	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
Entry Door Access	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
Falling hazard	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
Entry Door Racking	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
Stairs	1.4	1.4	1.4	1.4	1.3	0.0	0.0			
Stairway Doors	0.8	0.8	0.8	0.8	0.7	0.0	0.0			
Exterior	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
Interior	5.2	4.8	3.1	1.5	1.1	0.0	0.0			
Building Function (affe	cts function on	ly, not reocc	upancy)							
Elevators	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
Exterior	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
Interior	3.2	3.1	1.8	1.1	1.0	0.0	0.0			
Water	0.6	0.6	0.6	0.5	0.4	0.0	0.0			
Electrical	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
HVAC	15	15	15	15	12	0.2	0.0			

Table 4.1. Percent of realizations affecting building reoccupancy/function per system - 50% in 50 years



4.1.4 Damage to Individual Components

Table 4.2 shows the percentage of realizations that a specific component prevents reoccupancy/function for the 50% in 50 years intensity. Note that if a component prevents reoccupancy, it will also prevent functionality.

Each column represents a milestone time after the earthquake and the values in that column indicate the percentage of realizations in which that component is preventing reoccupancy/functionality at that milestone.

	Immediate	>3 days	>7 days	>14 days	>1 month	>6 months	>12 months
B1044.011	0.0 / 0.1	0.0 / 0.1	0.0 / 0.1	0.0 / 0.1	0.0 / 0.1	0.0 / 0.0	0.0 / 0.0
B1071.202	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
B2011.401	0.0 / 0.3	0.0 / 0.3	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
C1011.211a	0.0 / 1.8	0.0 / 1.8	0.0 / 0.5	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
C1011.311a	0.0 / 2.1	0.0 / 2.0	0.0 / 0.7	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
C2011.041b	0.6 / 0.0	0.6 / 0.0	0.6 / 0.0	0.6 / 0.0	0.6 / 0.0	0.0 / 0.0	0.0 / 0.0
C3032.004a	1.8 / 0.5	1.3 / 0.2	0.4 / 0.1	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
C3032.004b	1.6 / 0.5	1.3 / 0.4	0.6 / 0.2	0.1 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
C3032.004c	1.8 / 0.3	1.4 / 0.2	0.5 / 0.1	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
C3032.004d	2.4 / 0.6	2.0 / 0.6	0.8 / 0.4	0.1 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
C3034.002	5.0 / 1.1	4.3 / 1.0	2.2 / 0.6	0.2 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D1014.021	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D2021.014a	0.2 / 0.2	0.2 / 0.2	0.2 / 0.2	0.2 / 0.2	0.2 / 0.2	0.0 / 0.0	0.0 / 0.0
D2021.014b	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D2021.024a	0.3 / 0.3	0.3 / 0.3	0.3 / 0.3	0.3 / 0.3	0.3 / 0.3	0.0 / 0.0	0.0 / 0.0
D2021.024b	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D2031.014b	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D3032.013c	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D3041.011d	2.0 / 3.8	1.0 / 3.8	0.0 / 3.8	0.0 / 3.7	0.0 / 3.2	0.0 / 0.1	0.0 / 0.0
D3041.012d	0.2 / 0.2	0.2 / 0.2	0.0 / 0.2	0.0 / 0.2	0.0 / 0.2	0.0 / 0.0	0.0 / 0.0
D3041.032d	4.2 / 13	4.0 / 13	2.4 / 13	1.1 / 13	0.8 / 11	0.0 / 0.2	0.0 / 0.0
D3041.103c	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D3067.012c	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D4011.024a	0.9 / 0.9	0.9 / 0.9	0.9 / 0.9	0.9 / 0.9	0.8 / 0.8	0.0 / 0.0	0.0 / 0.0

Table 4.2. Percent of realizations affecting building reoccupancy/functionality per component - 50% in 50 years





4.2 10% in 50 years Intensity

4.2.1 Selected Realizations for 50th percentile

Note that this is a single realization and may not be representative of a general trend. This selected realization is intended to give a sense of what the repair schedule may look like, it is not intended to generalize what the "typical" repair schedule looks like.

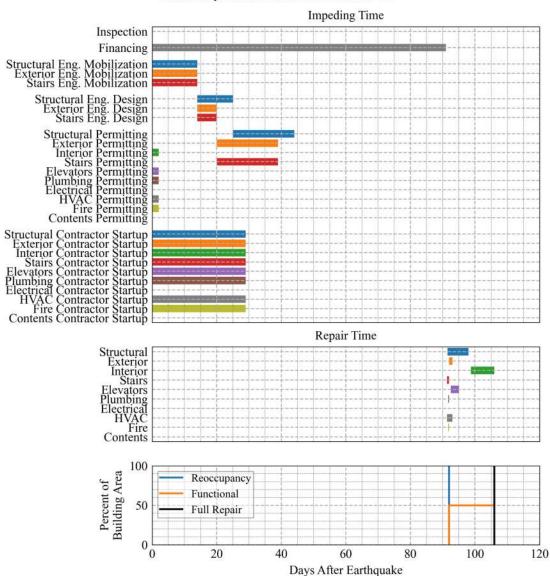


Figure 4.5. 10% in 50 years Percentile = 50



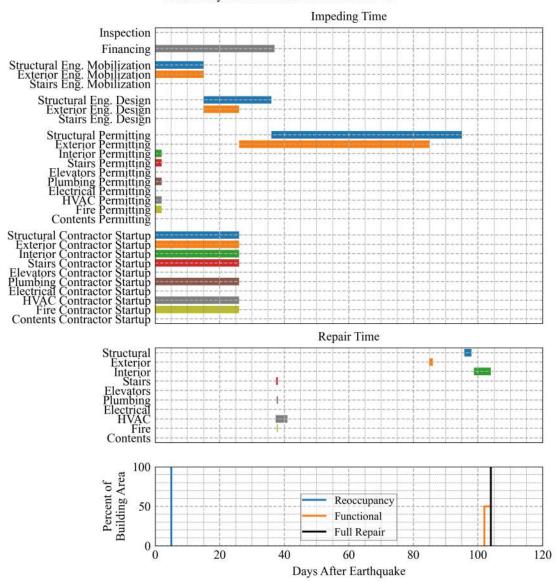


Figure 4.6. 10% in 50 years Percentile = 49



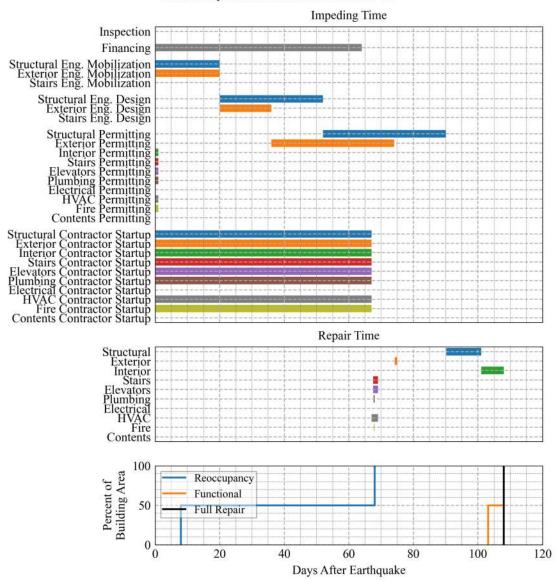
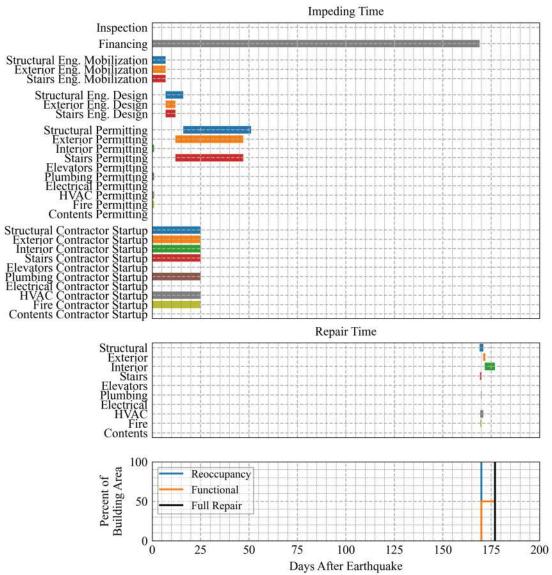


Figure 4.7. 10% in 50 years Percentile = 51

4.2.2 Selected Realizations for 90th percentile

Note that this is a single realization and may not be representative of a general trend. This selected realization is intended to give a sense of what the repair schedule may look like, it is not intended to generalize what the "typical" repair schedule looks like.



10% in 50 years: Realization for Percentile=90

Figure 4.8. 10% in 50 years Percentile = 90



4.2.3 Damage to Building Systems

Table 4.3 shows the percentage of realizations that the named system prevents reoccupancy/function for the 10% in 50 years intensity. Note that if a system prevents reoccupancy, it will also prevent functionality. This means that the functionality checks may all be fine, but if the reoccupancy checks indicate the building is not reoccupiable then the building will not be considered functional.

Each column represents a milestone time after the earthquake and the values in that column indicate the percentage of realizations in which that component is preventing reoccupancy/functionality at that milestone.

	Immediate	>3 days	>7 days	>14 days	>1 month	>6 months	>12 months
Building Reoccupancy	(also affects fu	nction)					
Red Tag (Structural)	1.3	1.3	0.0	0.0	0.0	0.0	0.0
Hazardous Material	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fire Egress	8.6	0.0	0.0	0.0	0.0	0.0	0.0
Entry Door Access	52	0.0	0.0	0.0	0.0	0.0	0.0
Falling hazard	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Entry Door Racking	52	0.0	0.0	0.0	0.0	0.0	0.0
Stairs	52	52	52	52	51	2.2	0.0
Stairway Doors	72	13	13	13	13	0.4	0.0
Exterior	45	44	27	6.7	0.0	0.0	0.0
Interior	50	49	38	27	24	0.6	0.0
Building Function (affe	cts function on	ly, not reocc	upancy)				
Elevators	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Exterior	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Interior	83	78	43	26	23	1.1	0.0
Water	17	17	17	17	16	0.3	0.0
Electrical	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HVAC	72	72	72	72	71	6.7	0.0

Table 4.3. Percent of realizations affecting building reoccupancy/function per system - 10% in 50 years



4.2.4 Damage to Individual Components

Table 4.4 shows the percentage of realizations that a specific component prevents reoccupancy/function for the 10% in 50 years intensity. Note that if a component prevents reoccupancy, it will also prevent functionality.

Each column represents a milestone time after the earthquake and the values in that column indicate the percentage of realizations in which that component is preventing reoccupancy/functionality at that milestone.

	Immediate	>3 days	>7 days	>14 days	>1 month	>6 months	>12 months
B1044.011	0.0 / 24	0.0 / 23	0.0 / 14	0.0 / 7.8	0.0 / 6.5	0.0 / 0.6	0.0 / 0.0
B1071.202	28 / 28	26 / 24	12 / 5.5	2.7 / 0.4	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
B2011.401	45 / 59	43 / 51	22 / 11	4.5 / 0.5	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
C1011.211a	0.0 / 78	0.0 / <mark>70</mark>	0.0 / 24	0.0 / 2.5	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
C1011.311a	0.0 / <mark>80</mark>	0.0 / 72	0.0 / 25	0.0 / 2.7	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
C2011.041b	43 / 0.0	43 / 0.0	43 / 0.0	43 / 0.0	43 / 0.0	1.8 / 0.0	0.0 / 0.0
C3032.004a	30 / 21	27 / 19	12 / 8.2	1.7 / 1.4	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
C3032.004b	31 / 23	27 / 20	13 / 8.7	1.9 / 1.6	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
C3032.004c	36 / 25	30 / 21	14 / 8.8	1.4 / 1.3	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
C3032.004d	37 / 27	32 / 23	15 / 9.9	2.3 / 1.9	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
C3034.002	49 / 50	45 / 44	24 / 17	5.6 / 3.2	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D1014.021	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D2021.014a	11 / 11	11 / 11	11 / 11	11 / 11	10 / 10	0.2 / 0.2	0.0 / 0.0
D2021.014b	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D2021.024a	11 / 11	11 / 11	11 / 11	11 / 11	10 / 10	0.2 / 0.2	0.0 / 0.0
D2021.024b	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D2031.014b	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D3032.013c	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D3041.011d	31 / 38	16 / 38	1.3 / 38	0.0 / 38	0.0 / 38	0.0 / 3.6	0.0 / 0.0
D3041.012d	7.8 / 8.2	3.7 / 8.2	0.6 / 8.2	0.0 / 8.2	0.0 / 7.8	0.0 / 0.2	0.0 / 0.0
D3041.032d	45 / 68	43 / 68	34 / 68	24 / 68	21 / 67	0.6 / 6.2	0.0 / 0.0
D3041.103c	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D3067.012c	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D4011.024a	17 / 17	17 / 17	17 / 17	17 / 17	16 / 16	0.5 / 0.5	0.0 / 0.0

Table 4.4. Percent of realizations affecting building reoccupancy/functionality per component - 10% in 50 years





4.3 DE Intensity

4.3.1 Selected Realizations for 50th percentile

Note that this is a single realization and may not be representative of a general trend. This selected realization is intended to give a sense of what the repair schedule may look like, it is not intended to generalize what the "typical" repair schedule looks like.

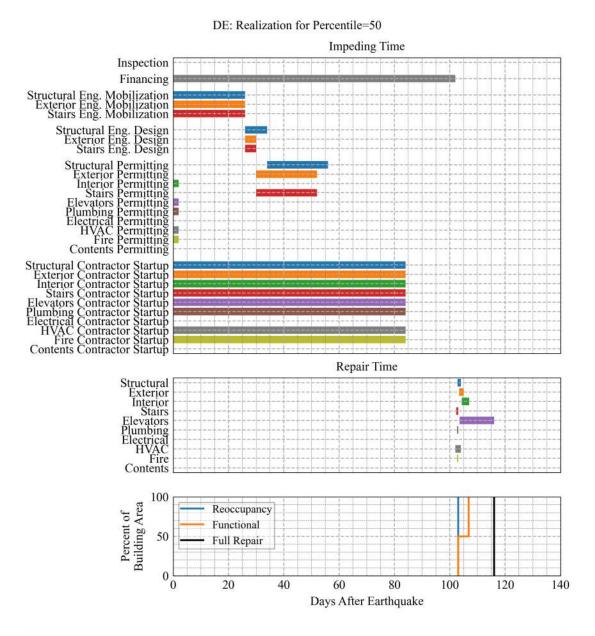
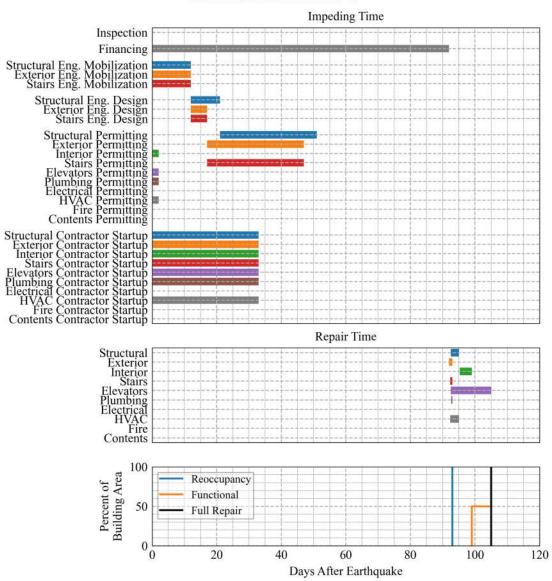


Figure 4.9. DE Percentile = 50

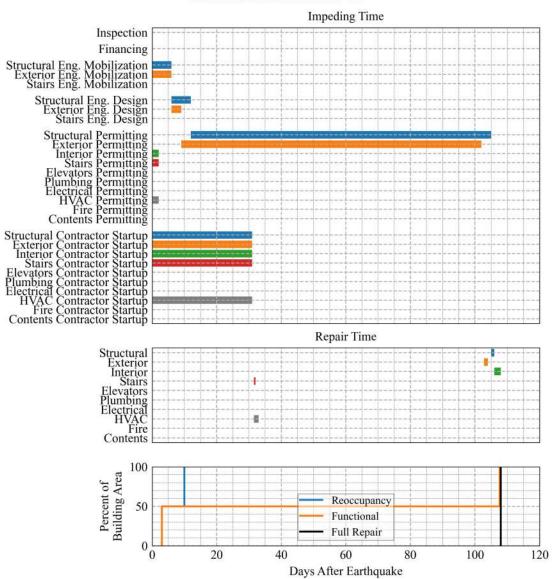




DE: Realization for Percentile=49

Figure 4.10. DE Percentile = 49



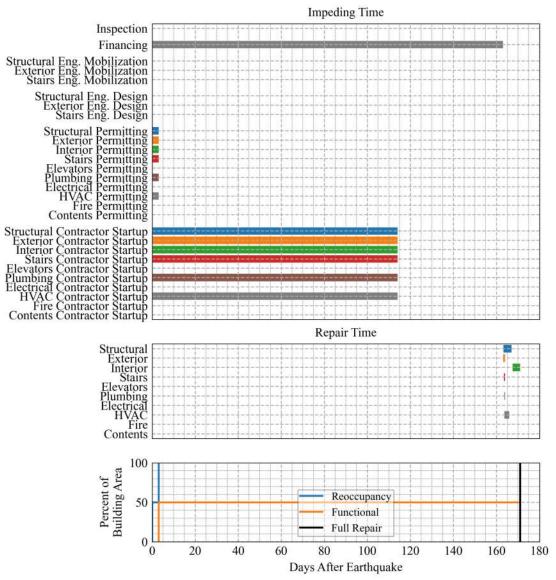


DE: Realization for Percentile=51

Figure 4.11. DE Percentile = 51

4.3.2 Selected Realizations for 90th percentile

Note that this is a single realization and may not be representative of a general trend. This selected realization is intended to give a sense of what the repair schedule may look like, it is not intended to generalize what the "typical" repair schedule looks like.



DE: Realization for Percentile=90

Figure 4.12. DE Percentile = 90



4.3.3 Damage to Building Systems

Table 4.5 shows the percentage of realizations that the named system prevents reoccupancy/function for the DE intensity. Note that if a system prevents reoccupancy, it will also prevent functionality. This means that the functionality checks may all be fine, but if the reoccupancy checks indicate the building is not reoccupiable then the building will not be considered functional.

Each column represents a milestone time after the earthquake and the values in that column indicate the percentage of realizations in which that component is preventing reoccupancy/functionality at that milestone.

	Immediate	>3 days	>7 days	>14 days	>1 month	>6 months	>12 months			
Building Reoccupancy	Building Reoccupancy (also affects function)									
Red Tag (Structural)	1.4	1.4	0.0	0.0	0.0	0.0	0.0			
Hazardous Material	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
Fire Egress	10	0.0	0.0	0.0	0.0	0.0	0.0			
Entry Door Access	54	0.0	0.0	0.0	0.0	0.0	0.0			
Falling hazard	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
Entry Door Racking	54	0.0	0.0	0.0	0.0	0.0	0.0			
Stairs	54	54	54	54	54	1.9	0.0			
Stairway Doors	72	14	14	14	14	0.3	0.0			
Exterior	47	45	28	6.7	0.0	0.0	0.0			
Interior	53	51	40	28	26	0.6	0.0			
Building Function (affe	cts function on	ly, not reocc	cupancy)							
Elevators	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
Exterior	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
Interior	84	78	45	28	25	1.0	0.0			
Water	17	17	17	17	16	0.3	0.0			
Electrical	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
HVAC	72	72	72	72	72	5.4	0.0			

Table 4.5. Percent of realizations affecting building reoccupancy/function per system - DE



4.3.4 Damage to Individual Components

Table 4.6 shows the percentage of realizations that a specific component prevents reoccupancy/function for the DE intensity. Note that if a component prevents reoccupancy, it will also prevent functionality.

Each column represents a milestone time after the earthquake and the values in that column indicate the percentage of realizations in which that component is preventing reoccupancy/functionality at that milestone.

	Immediate	>3 days	>7 days	>14 days	>1 month	>6 months	>12 months
B1044.011	0.0 / 24	0.0 / 23	0.0 / 15	0.0 / 8.8	0.0 / 7.5	0.0 / 0.7	0.0 / 0.0
B1071.202	30 / 30	28 / 26	12 / 5.9	2.4 / 0.5	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
B2011.401	47 / 61	44 / 52	24 / 12	4.5 / 0.8	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
C1011.211a	0.0 / <mark>79</mark>	0.0 / 71	0.0 / 26	0.0 / 2.8	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
C1011.311a	0.0 / <mark>80</mark>	0.0 / 72	0.0 / 26	0.0 / 2.8	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
C2011.041b	<mark>46</mark> / 0.0	46 / 0.0	46 / 0.0	46 / 0.0	<mark>46</mark> / 0.0	1.7 / 0.0	0.0 / 0.0
C3032.004a	32 / 22	29 / 20	13 / 8.8	2.1 / 1.7	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
C3032.004b	34 / 24	31 / 22	14 / 9.7	2.2 / 1.8	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
C3032.004c	37 / 27	32 / 22	13 / 8.8	2.0 / 1.5	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
C3032.004d	38 / 27	33 / 23	14 / 9.8	2.1 / 1.8	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
C3034.002	52 / 52	48 / 47	24 / 17	4.8 / 2.7	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D1014.021	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D2021.014a	11 / 11	11 / 11	11 / 11	11 / 11	11 / 11	0.2 / 0.2	0.0 / 0.0
D2021.014b	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D2021.024a	11 / 11	11 / 11	11 / 11	11 / 11	10 / 10	0.2 / 0.2	0.0 / 0.0
D2021.024b	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D2031.014b	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D3032.013c	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D3041.011d	33 / 41	16 / 41	2.0 / 41	0.0 / 41	0.0 / 41	0.0 / 3.3	0.0 / 0.0
D3041.012d	7.8 / 8.1	3.6 / 8.1	0.5 / 8.1	0.0 / 8.1	0.0 / 7.8	0.0 / 0.2	0.0 / 0.0
D3041.032d	48 / 69	46 / 69	36 / 69	26 / 69	23 / 68	0.5 / 5.3	0.0 / 0.0
D3041.103c	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D3067.012c	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D4011.024a	18 / 18	18 / 18	18 / 18	18 / 18	18 / 18	0.5 / 0.5	0.0 / 0.0

Table 4.6. Percent of realizations affecting building reoccupancy/functionality per component - DE

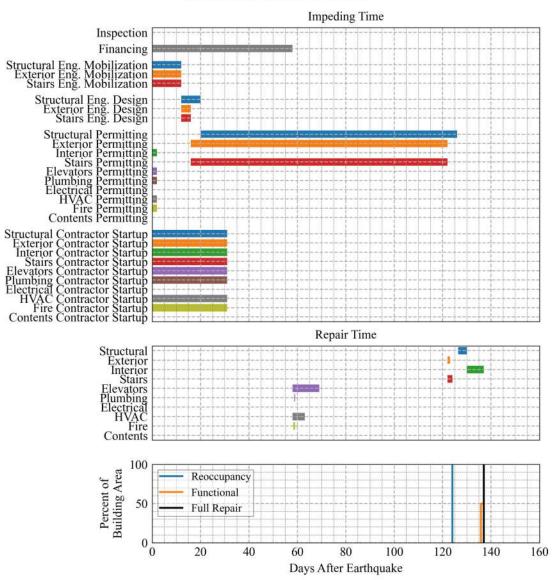




4.4 MCE $_R$ Intensity

4.4.1 Selected Realizations for 50th percentile

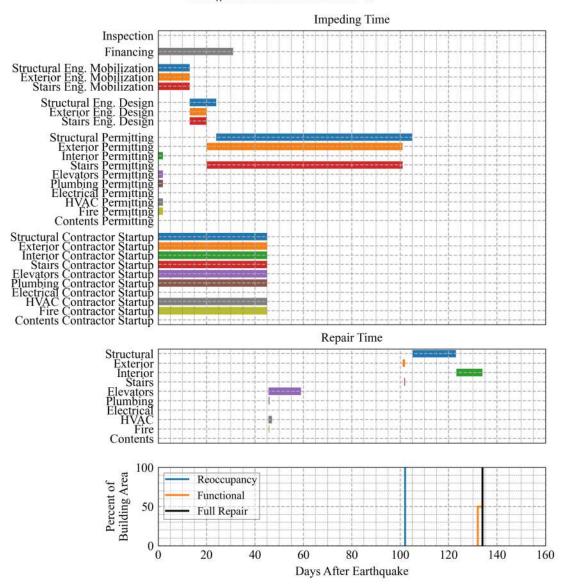
Note that this is a single realization and may not be representative of a general trend. This selected realization is intended to give a sense of what the repair schedule may look like, it is not intended to generalize what the "typical" repair schedule looks like.



MCE_R: Realization for Percentile=50

Figure 4.13. MCE_R Percentile = 50

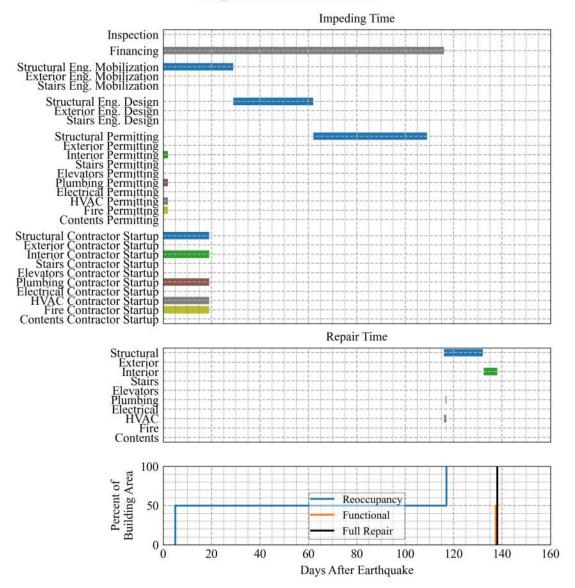




MCE_R: Realization for Percentile=49

Figure 4.14. MCE_R Percentile = 49





MCE_R: Realization for Percentile=51

Figure 4.15. MCE_R Percentile = 51

4.4.2 Selected Realizations for 90th percentile

Note that this is a single realization and may not be representative of a general trend. This selected realization is intended to give a sense of what the repair schedule may look like, it is not intended to generalize what the "typical" repair schedule looks like.

This particular realization (MCE_R Percentile = 90) resulted in global failure, no scheduling was computed.



4.4.3 Damage to Building Systems

Table 4.7 shows the percentage of realizations that the named system prevents reoccupancy/function for the MCE_R intensity. Note that if a system prevents reoccupancy, it will also prevent functionality. This means that the functionality checks may all be fine, but if the reoccupancy checks indicate the building is not reoccupiable then the building will not be considered functional.

Each column represents a milestone time after the earthquake and the values in that column indicate the percentage of realizations in which that component is preventing reoccupancy/functionality at that milestone.

	Immediate	>3 days	>7 days	>14 days	>1 month	>6 months	>12 months			
Building Reoccupancy (Building Reoccupancy (also affects function)									
Red Tag (Structural)	23	23	0.0	0.0	0.0	0.0	0.0			
Hazardous Material	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
Fire Egress	17	0.0	0.0	0.0	0.0	0.0	0.0			
Entry Door Access	82	0.0	0.0	0.0	0.0	0.0	0.0			
Falling hazard	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
Entry Door Racking	82	0.0	0.0	0.0	0.0	0.0	0.0			
Stairs	60	60	60	60	60	2.6	0.0			
Stairway Doors	71	17	17	17	16	0.1	0.0			
Exterior	61	59	40	10	0.0	0.0	0.0			
Interior	51	50	42	32	28	0.2	0.0			
Building Function (affe	cts function on	ly, not reocc	cupancy)							
Elevators	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
Exterior	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
Interior	76	72	47	33	30	1.1	0.0			
Water	21	21	21	21	21	0.2	0.0			
Electrical	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
HVAC	64	64	64	64	64	6.2	0.0			

Table 4.7. Percent of realizations affecting building reoccupancy/function per system - MCE_R



4.4.4 Damage to Individual Components

Table 4.8 shows the percentage of realizations that a specific component prevents reoccupancy/function for the MCE_R intensity. Note that if a component prevents reoccupancy, it will also prevent functionality. Each column represents a milestone time after the earthquake and the values in that column indicate the percentage of realizations in which that component is preventing reoccupancy/functionality at that milestone.

			• •		•		
	Immediate	>3 days	>7 days	>14 days	>1 month	>6 months	>12 months
B1044.011	0.0 / 36	0.0 / 36	0.0 / 25	0.0 / 16	0.0 / 13	0.0 / 1.0	0.0 / 0.0
B1071.202	48 / 48	45 / 43	22 / 13	4.0 / 1.4	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
B2011.401	61 / 68	57 / 60	31 / 18	6.6 / 2.1	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
C1011.211a	0.0 / 75	0.0 / <mark>68</mark>	0.0 / 27	0.0 / 5.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
C1011.311a	0.0 / 75	0.0 / <mark>68</mark>	0.0 / 28	0.0 / 4.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
C2011.041b	55 / 0.0	55 / 0.0	55 / 0.0	55 / 0.0	55 / 0.0	2.6 / 0.0	0.0 / 0.0
C3032.004a	34 / 29	31 / 26	16 / 12	2.9 / 2.4	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
C3032.004b	36 / 29	32 / 26	15 / 12	2.6 / 2.3	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
C3032.004c	38 / 33	34 / 29	16 / 12	2.6 / 2.5	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
C3032.004d	40 / 35	36 / 30	16 / 13	2.4 / 2.1	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
C3034.002	51 / 56	47 / 51	25 / 20	5.1 / 3.5	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D1014.021	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D2021.014a	14 / 14	14 / 14	14 / 14	14 / 14	14 / 14	0.1 / 0.1	0.0 / 0.0
D2021.014b	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D2021.024a	15 / 15	15 / 15	15 / 15	15 / 15	14 / 14	0.1 / 0.1	0.0 / 0.0
D2021.024b	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D2031.014b	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D3032.013c	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D3041.011d	36 / 41	19 / 41	1.6 / <mark>41</mark>	0.0 / 41	0.0 / 41	0.0 / 4.0	0.0 / 0.0
D3041.012d	11 / 11	5.6 / 11	0.5 / 11	0.0 / 11	0.0 / 11	0.0 / 0.1	0.0 / 0.0
D3041.032d	47 / 61	46 / 61	39 / 61	30 / 61	26 / 61	0.2 / 6.0	0.0 / 0.0
D3041.103c	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D3067.012c	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D4011.024a	21 / 21	21 / 21	21 / 21	21 / 21	21 / 21	0.2 / 0.2	0.0 / 0.0

Table 4.8. Percent of realizations affecting building reoccupancy/functionality per component - MCE_R





4.5 2% in 50 years Intensity

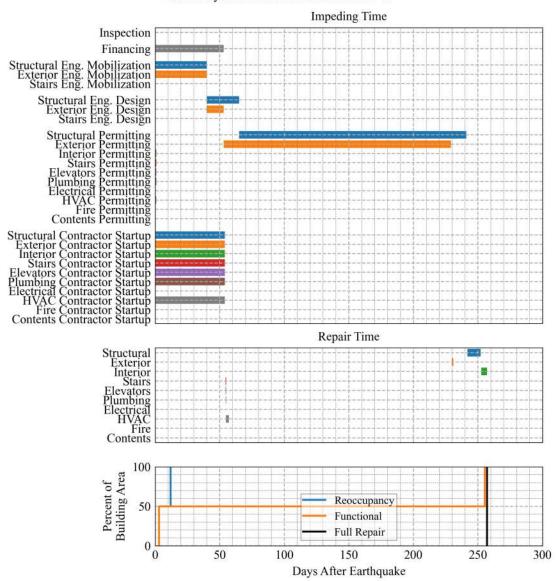
4.5.1 Selected Realizations for 50th percentile

Note that this is a single realization and may not be representative of a general trend. This selected realization is intended to give a sense of what the repair schedule may look like, it is not intended to generalize what the "typical" repair schedule looks like.

This particular realization (2% in 50 years Percentile = 50) resulted in global failure, no scheduling was computed.



Note that this is a single realization and may not be representative of a general trend. This selected realization is intended to give a sense of what the repair schedule may look like, it is not intended to generalize what the "typical" repair schedule looks like.



2% in 50 years: Realization for Percentile=49

Figure 4.16. 2% in 50 years Percentile = 49



Note that this is a single realization and may not be representative of a general trend. This selected realization is intended to give a sense of what the repair schedule may look like, it is not intended to generalize what the "typical" repair schedule looks like.

This particular realization (2% in 50 years Percentile = 51) resulted in global failure, no scheduling was computed.

4.5.2 Selected Realizations for 90th percentile

Note that this is a single realization and may not be representative of a general trend. This selected realization is intended to give a sense of what the repair schedule may look like, it is not intended to generalize what the "typical" repair schedule looks like.

This particular realization (2% in 50 years Percentile = 90) resulted in global failure, no scheduling was computed.



4.5.3 Damage to Building Systems

Table 4.9 shows the percentage of realizations that the named system prevents reoccupancy/function for the 2% in 50 years intensity. Note that if a system prevents reoccupancy, it will also prevent functionality. This means that the functionality checks may all be fine, but if the reoccupancy checks indicate the building is not reoccupiable then the building will not be considered functional.

Each column represents a milestone time after the earthquake and the values in that column indicate the percentage of realizations in which that component is preventing reoccupancy/functionality at that milestone.

	Immediate	>3 days	>7 days	>14 days	>1 month	>6 months	>12 months
Building Reoccupancy	(also affects fu	nction)					
Red Tag (Structural)	51	51	0.0	0.0	0.0	0.0	0.0
Hazardous Material	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fire Egress	12	0.0	0.0	0.0	0.0	0.0	0.0
Entry Door Access	91	0.0	0.0	0.0	0.0	0.0	0.0
Falling hazard	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Entry Door Racking	91	0.0	0.0	0.0	0.0	0.0	0.0
Stairs	41	41	41	41	41	2.1	0.0
Stairway Doors	47	10	10	10	10	0.4	0.0
Exterior	44	43	30	8.0	0.0	0.0	0.0
Interior	34	33	28	21	19	0.8	0.0
Building Function (affe	cts function on	ly, not reocc	upancy)				
Elevators	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Exterior	0.1	0.1	0.1	0.1	0.1	0.0	0.0
Interior	48	47	35	24	21	1.9	0.0
Water	14	14	14	14	14	0.4	0.0
Electrical	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HVAC	41	41	41	41	41	5.3	0.0

Table 4.9. Percent of realizations affecting building reoccupancy/function per system - 2% in 50 years



4.5.4 Damage to Individual Components

Table 4.10 shows the percentage of realizations that a specific component prevents reoccupancy/function for the 2% in 50 years intensity. Note that if a component prevents reoccupancy, it will also prevent functionality.

Each column represents a milestone time after the earthquake and the values in that column indicate the percentage of realizations in which that component is preventing reoccupancy/functionality at that milestone.

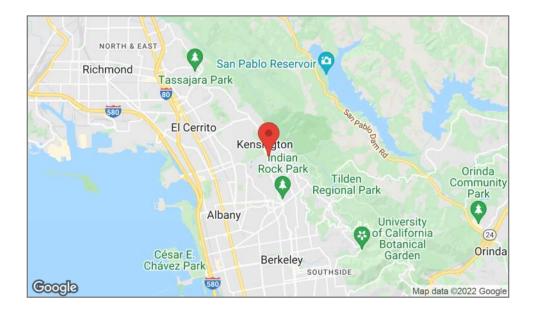
	Immediate	>3 days	>7 days	>14 days	>1 month	>6 months	>12 months
B1044.011	0.0 / 29	0.0 / 28	0.0 / 21	0.0 / 14	0.0 / 12	0.0 / 1.4	0.0 / 0.0
B1071.202	38 / 37	35 / 33	18 / 12	3.2 / 1.6	0.0 / 0.1	0.0 / 0.0	0.0 / 0.0
B2011.401	44 / 47	41 / 42	22 / 14	5.4 / 2.1	0.0 / 0.1	0.0 / 0.0	0.0 / 0.0
C1011.211a	0.0 / <mark>48</mark>	0.0 / 44	0.0 / 19	0.0 / 3.1	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
C1011.311a	0.0 / <mark>48</mark>	0.0 / 44	0.0 / 21	0.0 / 3.2	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
C2011.041b	<mark>39</mark> / 0.0	<mark>39</mark> / 0.0	39 / 0.0	<mark>39</mark> / 0.0	<mark>39</mark> / 0.0	2.0 / 0.0	0.0 / 0.0
C3032.004a	24 / 21	22 / 19	11 / 8.3	1.7 / 1.6	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
C3032.004b	25 / 22	22 / 20	10 / 8.7	1.7 / 1.4	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
C3032.004c	27 / 25	23 / 21	11 / 8.7	1.8 / 1.4	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
C3032.004d	27 / 25	25 / 23	11 / 8.6	2.1 / 1.9	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
C3034.002	34 / 40	31 / 36	16 / 15	3.2 / 2.3	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D1014.021	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D2021.014a	9.5 / 9.5	9.5 / 9.5	9.5 / 9.5	9.5 / 9.5	9.3 / 9.3	0.3 / 0.3	0.0 / 0.0
D2021.014b	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D2021.024a	8.7 / 8.7	8.7 / 8.7	8.7 / 8.7	8.7 / 8.7	8.5 / 8.5	0.3 / 0.3	0.0 / 0.0
D2021.024b	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D2031.014b	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D3032.013c	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D3041.011d	25 / 29	12 / 29	1.0 / <mark>29</mark>	0.0 / 29	0.0 / 29	0.0 / 3.7	0.0 / 0.0
D3041.012d	7.0 / 7.1	3.6 / 7.1	0.3 / 7.1	0.0 / 7.1	0.0 / 7.0	0.0 / 0.3	0.0 / 0.0
D3041.032d	32 / 40	31 / 40	26 / 40	20 / 40	18 / 40	0.7 / 4.9	0.0 / 0.0
D3041.103c	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D3067.012c	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0	0.0 / 0.0
D4011.024a	14 / 14	14 / 14	14 / 14	14 / 14	13 / 13	0.6 / 0.6	0.0 / 0.0

Table 4.10. Percent of realizations affecting building reoccupancy/functionality per component - 2% in 50 years



SEISMIC RISK ASSESSMENT REPORT Created with the SP3-RiskModel

Detailed Component Report



Report Generated for:

217 Arlington Avenue, Kensington, CA Latitude: 37.90622° Longitude: -122.27875°

Report Generated by:

The SP3-RiskModel Software v1.2.0 of the Seismic Performance Prediction Program (SP3)

March 16, 2022





SP3

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1 SUMMARY OF INPUTS AND RISK RESULTS

Risk Model Inputs

1	Primary		Structural Properties			
Project Name: Model Name:	-	n Fire Station F on RC Wall	Allow Components to Affect Structural Properties?		Yes	
Building Types: Dir. 1: WLF	: General		Mode Shapes Specified?		No	
	Cantilever She	ar Wall	Directional Properties	Dir. 1	Dir. 2	
Year of Construction: Number of Stories:	2022 2		Base Shear Strength (g): Yield Drift (%):	-	1.317	
Occupancy: Address:	Commerci	ial Office	The 1^{st} Mode Period (T_1) (s): 2^{nd} Mode Period (T_2) (s):		0.29 0.09	
217 Arlingto Kensington,						
Latitude:	37.90622°		Component I	nformation		
Longitude:	-122.2787	5°	- Percent of Building Glazed:	mormation		
			Selection Method	– Cus	stom	
Anal	ysis Options			Cue	stom	
Include Collapse in Anal Consider Residual Drift:	ysis:	Yes Yes	Building	Stability		
Region Cost Multiplier: Date Cost Multiplier:		_	Median Collapse Capacity: Beta (Dispersion):			
Occupancy Cost Multipli	er:	-	-			
			Respo	nses		
Building L	ayout Informa	ation	No responses provided			
Cost per Square Foot: Scale component repair c building value?	costs with	– Yes	Repair Tin	ne Ontions		
Total Square Feet:		1,738	Repair Time Method	ATC-138 (B	eta)	
Aspect Ratio:		1.95	Factors Delaying Start of Re)	
First Story Height (ft):		13.5	Inspection	Yes		
Upper Story Heights (ft):		9 N	Financing	Yes		
Vertical Irregularity: Plan Irregularity:		None None	Permitting	Yes		
			Engineering Mobilization	Yes		
Frac. of Full Height Ext	t. Wood Walls	5	Contractor Mobilization	Yes		
Dir. 1 Story 1 Dir. 1 Upper Stories		_	Mitigation Factors			
11			Inspector on Retainer	No		
			Engineer on Retainer	No No		
Ground Motion	and Soil Info	ormation	Contractor on Retainer Funding Source	No Private Loan	IS	
Site Class:	С		Cash on Hand	-		
Site Hazard:	SP3 Defau	lt	ATC-138 Functional Recove	rv (Beta) Ontio	ons	
			Need HVAC for Function			
_			Need Elevator for Function	-		
	ng Design Info		Include Surge Demand	-		
Level of Detailing (Dir. 1	, 2):	Special, Ordinary				
Drift Limit (Dir. 1, 2):		•				
Risk Category:		-, - IV				
Seismic Importance Facto	or, I_e :					
Component Importance I del						



SP3

Component Importance Factor, I_p :

_



Component Checklist

Interior Finishes

- What kind of partition walls does the building have? > Wood Studs
- Does the building have raised access floors
- > No
- Does the building have suspended ceilings?
 - > Yes
 - Are the ceilings laterally supported?
 - > Yes
 - What is the Ip factor used to design the ceilings?
 - > 1.5
- Does the building contain pendant (non-recessed) lighting?
 - > Yes
 - Are the pendant lights seismically rated?
- > Yes
- Stairs and Elevators
 - Does the building have stairs?
 - > Yes
 - What type of stairs are in the building?
 - > Light Frame
 - Are there elevators in the building?
 - > Yes
 - What type of elevators are in the building?
 - > Hydraulic
 - From which era are the building's elevators?
 - > post-1976 California (or post-1976 California equivalent)

Fire Supression

- Does the building contain a fire sprinkler system?
 - > Yes
 - Does the fire sprinkler system have braced horizontal piping? > *Yes*
 - Are the horizontal mains OSHPD certified (or equivalent)? > Yes
 - Are the fire sprinkler drops OSHPD certified (or equivalent)? > Yes
 - What type of ceiling do the fire drops enter into?
 - > Hard

Piping

- Is the building's water piping OSHPD certified or equivalent?
 - > Yes
- Is the building's sanitary piping OSHPD certified or equivalent? > *Yes*
 - What type of couplings do the pipes have?
 - > Flexible

HVAC

- Is the HVAC cooling/heating equipment seismically anchored?
 - > Yes
 - How is the cooling/heating system configured?
 - > Roof Top Units
 - Are the RTUs used for medical purposes (or equivalent)?
 - > No
 - Are the RTUs small or large?
 - > Small
 - Does the building have a control panel?
 - > No



Component Checklist (Continued))

- Is there an HVAC exhaust system in the building?
 - > Yes
 - Is the HVAC exhaust system seismically anchored? > *Yes*
- Does the HVAC distribution system meet OSHPD standards (or similar)? > *Yes*
 - Is there any large diameter ducting (6 SqFt+) in the HVAC system?
 - > Yes

Electrical

- Does the building have a backup battery/generator system?
 - > No

Concrete

- Are the building's shear walls low rise or slender?
 - > Low Rise (typically <= 40ft building height)
 - What are the boundary conditions of the walls?
 - > No return flanges or boundary columns
 - What is the typical wall thickness?

> 8" to 16"

- What is the typical wall height?
- > Less than 15'

Expected Loss

	Expected loss in percent of total building value							
Shaking Intensity	Return Period	SEL (%)	SUL (%)					
50% in 50 years	72 Years	3.2	7.7					
10% in 50 years	475 Years	27	46					
DE	481 Years	27	47					
5% in 50 years	975 Years	45	75					
MCE_R	1277 Years	52	84					
2% in 50 years	2475 Years	72	100					

Expected loss in percent of total building value

Repair Time

	Median repair time summary									
	FEMA	P-58 [†]	ATC-138 I	ATC-138 Functional Recovery (Beta) [‡]						
Intensity	Parallel	Series	Re-Occupancy	Functional	Full					
50% in 50 years	4.8 days	6.1 days	0 days	0 days	7 weeks					
10% in 50 years	2.8 months	3.6 months	2.2 months	3.5 months	3.8 months					
DE	2.7 months	3.5 months	2.3 months	3.6 months	3.8 months					
5% in 50 years	4.1 months	5.4 months	3.2 months	4.2 months	4.3 months					
MCE_R	4.7 months	6 months	3.6 months	4.6 months	4.7 months					
2% in 50 years	11 months	11 months	11 months	11 months	11 months					

[†] Does *not* include impedance factors

[‡] Does include impedance factors



2 MOST DAMAGED COMPONENTS

Intensity	Component	Damage State	Expected Repair Cost
50% in 50 years	B1044.011	1	\$3,640
10% in 50 years	B1044.011	1	\$54,073
DE	B1044.011	1	\$53,309
5% in 50 years	B1044.011	1	\$67,194
MCE_R	B1044.011	1	\$66,878
2% in 50 years	B1044.011	1	\$51,183

Table 2.1. Most damaged Structural components at each intensity level.

Table 2.2. Most damaged Non-Structural components at each intensity level.

Intensity	Component	Damage State	Expected Repair Cost
50% in 50 years	D1014.021	1	\$5,819
10% in 50 years	D1014.021	1	\$24,935
DE	D1014.021	1	\$24,302
5% in 50 years	D1014.021	1	\$22,464
MCE_R	D1014.021	1	\$21,878
2% in 50 years	D1014.021	1	\$14,010

Details of the most damaged components and their damage states:

- **B1044.011**: Rectangular low aspect ratio concrete walls 8"-16" double curtain; with heights of up to 15' DS1: Cracks with maximum widths greater than 0.04 in but less than 0.12 in.
- **D1014.021**: Hydraulic Elevator Applies to most California Installations 1976 or later, most western states installations postdating 1982 and most U.S installations postdating 1998.

DS1a: Damaged controls.

- DS1b: Damaged vane and hoist-way switches, and or bent cab stabilizers, and or damaged car guide shoes.
- DS1c: Damaged entrance and car door, and or flooring damage.
- DS1d: Oil leak in hydraulic line, and or hydraulic tank failure.

3 DETAILED COMPONENT DAMAGE BREAKDOWNS

3.1 Repair Cost

This table shows the expected contribution to repair cost on a per-damage state basis. The header shows the total loss, the loss contribution from collapse, and the loss contribution from residual drift for reference.

The color scale is meant to indicate **relative** performance of components, not absolute performance. A "green" value does not indicate that the value falls in a pre-determined "good" range, just that it performs well compared to other components. Likewise, a "red" value does does not indicate that the value falls in a pre-determined "bad" range, just that it performs worse compared to other components.

	50% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 years
Tot. Loss	19.3k	165k	166k	276k	315k	441k
Collapse	0	6.19k	6.51k	35.6k	53.2k	110k
Residual	0	1.71k	1.71k	60.8k	84.3k	201k
B1044.01	1 #1 (B1044.011:	Rectangular low aspec	t ratio concre	te walls 8"-16" doubl	e curtain; wit	h)
DS1	2.97k	23.2k	22.6k	20.6k	20k	11.8k
DS2	196	6.18k	6.27k	7.96k	8.07k	6.65k
DS3	475	24.7k	24.4k	38.6k	38.8k	32.8k
Total	3.64k	54.1k	53.3k	67.2k	66.9k	51.2k
B1071.20	2 #1 (B1071.202:)	Exterior Structural W	all - Light fra	med wood walls with	structural par	nel)
DS1	100	1.49k	1.49k	1.04k	973	668
DS2	1.4	1.15k	1.16k	1.13k	1.06k	568
DS3	0	2.56k	2.77k	4.73k	4.82k	3.95k
Total	102	5.2k	5.42k	6.9k	6.86k	5.18k
B2011.40	1 #1 (B2011.401:	Exterior Wall - Light f	framed wood	walls with exterior pa	nelized sheath	ning)
DS1	71.8	344	342	261	258	195
DS2	24.5	524	524	397	330	201
DS3	20.1	3.47k	3.62k	4.31k	4.2k	2.84k
Total	116	4.34k	4.48 k	4.97 k	4.79 k	3.24 k
C1011.21	1a #1 (C1011.211	a: Wall Partition - Typ	e: Gypsum w	ith wood studs (both	sides), Full He	eight,)
DS1	1.94k	3.66k	3.66k	2.94k	2.49k	1.23k
DS2	455	2.16k	2.07k	2.26k	2.49k	1.89k
DS3	579	10.1k	10.1k	12k	12.4k	10.2k
Total	2.97 k	15.9k	15.8k	17.2k	17.4k	13.3k
C1011.31	1a #1 (C1011.311a	a: Interior of Exterior	Wall - Type:	Gypsum with wood s	tuds (single-si	ded)
DS1	1.76k	2.79k	2.8k	2.16k	1.85k	855
DS2	325	2.16k	2.2k	2.56k	2.57k	1.93k
DS3	301	7.27k	7.12k	9.1k	9.61k	8.17k
Total	2.38k	12.2k	12.1k	13.8k	14k	11k
C2011.04	1b #1 (C2011.041	b: Light frame stair fr	agility. Appr	oximation as a placeh	older until the	ere is)
DS1	53.1	403	403	334	298	186
DS2	20.7	817	887	879	860	554
DS3	0	1.27k	1.23k	2.04k	2.23k	1.82k
Total	73.8	2.49k	2.52k	3.25k	3.39k	2.56k
C3032.00	4a #1 (C3032.004a	a: Suspended Ceiling,	SDC D,E,F (I	p=1.5), Area (A): A <	250, Vert & I	Lat)
DS1	18.8	166	176	170	147	102
DS2	43.9	312	354	382	295	215
DS3	220	4.74k	4.87k	5.81k	5.87k	3.99k
Total	283	5.22k	5.4k	6.36k	6.31k	4.31k

Table 3.1.1. Expected contribution to repair cost per damage state (Dollars)





	50% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 year
Tot. Loss	19.3k	165k	166k	276k	315k	441k
Collapse	0	6.19k	6.51k	35.6k	53.2k	110k
Residual	0	1.71k	1.71k	60.8k	84.3k	201k
C3032.00	4b #1 (C3032.004	b: Suspended Ceiling,	SDC D,E,F (I	(p=1.5), Area (A): 250) < A < 1000, V	Vert & Lat)
DS1	32.6	216	230	208	218	129
DS2	33	485	479	436	443	305
DS3	226	4.9k	5.32k	6.45k	5.89k	4.28k
Total	292	5.6k	6.03k	7.1k	6.55k	4.71 k
	4c #1 (C3032.004	c: Suspended Ceiling,	SDC D,E,F (I			
DS1	79.2	358	381	323	302	190
DS2	68.2	680	727	660	634	545
DS3	220	5.46k	5.69k	6.83k	6.62k	4.39k
Total	367	6.5k	6.8k	7.81k	7.55k	5.13k
		d: Suspended Ceiling,				
DS1	109	410	461	394	353	223
DS2	85.9	851	804	696	711	474
DS3	363	5.86k	6.09k	6.93k	6.8k	4.82k
Total	558	7.12k	7.36k	8.02k	7.87k	5.52k
		Independent Pendant		-		
DS1	426	2.63k	2.71k	2.7k	2.64 k	1.75k
		Hydraulic Elevator - A				
DS1a	137	562	531	518	532	319
DS1b	2.37k	9.37k	9.4k	9k	8.58k	5.66k
DS1c	2.91k	13.1k	12.4k	11k	11k	6.97k
DS1d	401	1.92k	1.93k	1.91k	1.74k	1.07k
Total	5.82k	24.9k	24.3k	22.5k	21.9 k	14k
		a: Cold or Hot Potable				
DS1	1.95	18.8	18	21.5	18.1	12.9
DS2	1.03	51.3	57.7	83.2	74.7	46.9
Total	2.98	70.1	75.7	105	92.8	59.8
		b: Cold or Hot Potable				
DS1	9.83	60.7	62.2	66.5	60.8	38.7
		a: Cold or Hot Potable				
DS1	1.24	14.8				10.7
DS2	1.24	45.4	43.8	66.2	66.7	37.1
Total	2.48	60.2	60.5	82	81.9	47.8
		b: Cold or Hot Potable	-			
DS1	4.05	16.3	17	14.2	13.4	9.64
DS2	1.54	19.8	19.6	22.9	22.9	15.6
Total	5.59	36.1	36.6	37.1	36.3	25.2
		b: Sanitary Waste Pip	0	1 0		· · · · ·
DS1	1.09	17	18.1	20.7	21	14.5
		c: Compressor - Capa	-			
DS1a	12.9	96.7	91.1	101	89	61
DS1b	44.7	284	281	271	262	210
DS1c	21.6	110	108	116	116	69.3
DS1d	71.6	449	482 963	478	515 981	317
Total	151	939		966		658



5	0% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 years
Tot. Loss	19.3k	165k	166k	276k	315k	441k
Collapse	0	6.19k	6.51k	35.6k	53.2k	110k
Residual	0	1.71k	1.71k	60.8k	84.3k	201k
D3041.011d	#1 (D3041.011	d: HVAC Galvanized	Sheet Metal D	ucting less than 6 sq.	ft in cross sec	tional)
DS1	6.65	30.9	29.1	27.3	23.7	15.6
DS2	26.1	314	335	379	369	255
Total	32.8	345	364	406	393	271
D3041.012d	#1 (D3041.012	d: HVAC Galvanized	Sheet Metal D	ucting - 6 sq. ft cross	sectional area	1 or)
DS1	0.06	1.78	1.56	1.95	2.16	1.32
DS2	0.52	19.4	19.9	31.6	27.4	17.6
Total	0.58	21.2	21.4	33.5	29.5	19
D3041.032d	#1 (D3041.032	d: HVAC Drops / Diff	users without	ceilings - supported b	y ducting only	y - No)
DS1	677	4.39k	4.44 k	4.36k	4.23k	2.79 k
D3041.103c	#1 (D3041.103c	: HVAC Fan - Capac	ity: all - Equip	ment that is either ha	ard anchored	or is)
DS1a	144	475	480	449	438	290
DS1b	313	1.01k	1.03k	994	914	606
DS1c	836	2.7k	2.73k	2.48k	2.33k	1.47k
Total	1.29k	4.18k	4.23k	3.92k	3.68k	2.37k
	#1 (D3067.012c	e: Control Panel - Cap	oacity: all - Eq	-	r hard anchor	ed or)
DS1a	2.05	51.3	56.2	72.4	75.6	60.5
DS1b	8.02	211	213	315	350	214
DS1c	28	592	677	844	810	754
Total	38.1	855	947	1.23k	1.24k	1.03k
D4011.024a	#1 (D4011.024a	a: Fire Sprinkler Wat	er Piping - Ho	rizontal Mains and B	ranches - Old	Style)
DS1	5.54	45.6	47.9	46.9	42.4	30.5
DS2	7.36	132	149	198	183	117
Total	12.9	178	197	244	226	147

3.2 Repair time

This table shows the expected worker days on a per-damage state basis. The header shows the probability of global failures (collapse and residual drift demolition) for reference.

The color scale is meant to indicate **relative** performance of components, not absolute performance. A "green" value does not indicate that the value falls in a pre-determined "good" range, just that it performs well compared to other components. Likewise, a "red" value does does not indicate that the value falls in a pre-determined "bad" range, just that it performs worse compared to other components.

	50% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 years
P[Col](%)	0.0	1.0	1.1	5.8	8.7	18
P[Res](%)	0.0	0.3	0.3	10.0	14	33
B1044.01	1 #1 (B1044.011:	Rectangular low asp	ect ratio concre	te walls 8"-16" doubl	e curtain; wit	h)
DS1	1.6	13	13	12	11	6.7
DS2	0.1	3.5	3.5	4.4	4.4	3.8
DS3	0.2	14	14	22	22	18
Total	2.0	30	30	38	37	29
B1071.20	2 #1 (B1071.202:	Exterior Structural	Wall - Light fra	med wood walls with	structural par	nel)
DS1	0.1	1.1	1.0	0.7	0.7	0.4
DS2	0.0	0.8	0.8	0.8	0.7	0.4
DS3	0.0	1.8	1.9	3.3	3.3	2.8
Total	0.1	3.6	3.8	4.8	4.7	3.6
B2011.40	1 #1 (B2011.401:	Exterior Wall - Light	t framed wood	walls with exterior pa	nelized sheath	ning)
DS1	0.2	0.7	0.7	0.6	0.6	0.5
DS2	0.0	0.7	0.7	0.5	0.4	0.3
DS3	0.0	3.1	3.2	3.9	3.9	2.9
Total	0.2	4.5	4.6	5.0	4.9	3.6
C1011.21	1a #1 (C1011.211	a: Wall Partition - Ty	pe: Gypsum w	ith wood studs (both	sides), Full He	eight,)
DS1	1.1	2.1	2.1	1.6	1.4	0.7
DS2	0.2	1.2	1.2	1.3	1.4	1.1
DS3	0.3	5.6	5.6	6.8	7.0	5.8
Total	1.7	8.9	8.9	10	10	7.5
C1011.31	1a #1 (C1011.311	a: Interior of Exterio	or Wall - Type:	Gypsum with wood s	tuds (single-si	ded)
DS1	1.0	1.6	1.5	1.2	1.0	0.5
DS2	0.2	1.2	1.2	1.4	1.5	1.1
DS3	0.2	4.1	4.0	5.2	5.4	4.6
Total	1.3	6.9	6.8	7.8	7.8	6.1
C2011.04	1b #1 (C2011.041	b: Light frame stair	fragility. Appr	oximation as a placeh	older until the	ere is)
DS1	0.0	0.3	0.3	0.3	0.2	0.2
DS2	0.0	0.6	0.7	0.7	0.7	0.5
DS3	0.0	1.0	1.0	1.7	1.7	1.4
Total	0.1	2.0	2.0	2.6	2.6	2.0
C3032.00	4a #1 (C3032.004	a: Suspended Ceiling	, SDC D,E,F (l	p=1.5), Area (A): A <	250, Vert & I	Lat)
DS1	0.0	0.1	0.1	0.1	0.1	0.1
DS2	0.0	0.2	0.2	0.2	0.2	0.1
DS3	0.2	3.2	3.3	4.0	4.0	2.7
Total	0.2	3.5	3.7	4.3	4.3	2.9

Continued on next page

SP3



4	50% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 year
P[Col](%)	0.0	1.0	1.1	5.8	8.7	18
P[Res](%)	0.0	0.3	0.3	10.0	14	33
C3032.0041	b #1 (C3032.004)	b: Suspended Ceiling, S	SDC D.E.F (Ip=1.5), Area (A): 25() < A < 1000, V	Vert & Lat)
DS1	0.0	0.1	0.2	0.1	0.1	0.1
DS2	0.0	0.3	0.3	0.3	0.3	0.2
DS3	0.2	3.2	3.5	4.3	3.9	2.8
Total	0.2	3.7	3.9	4.7	4.3	3.1
C3032.004d	c #1 (C3032.004c	: Suspended Ceiling, S	SDC D,E,F (I	p=1.5), Area (A): 100	0 < A < 2500,	Vert &)
DS1	0.1	0.2	0.2	0.2	0.2	0.1
DS2	0.1	0.4	0.5	0.4	0.4	0.4
DS3	0.1	3.4	3.6	4.3	4.1	2.8
Total	0.2	4.1	4.4	4.9	4.7	3.3
C3032.004d	d #1 (C3032.004d	d: Suspended Ceiling,	SDC D,E,F (Ip=1.5), Area (A): A >	> 2500, Vert &	Lat)
DS1	0.1	0.3	0.3	0.2	0.2	0.1
DS2	0.1	0.5	0.5	0.4	0.4	0.3
DS3	0.2	3.6	3.7	4.4	4.2	2.9
Total	0.4	4.4	4.4	5.0	4.9	3.3
C3034.002	#1 (C3034.002:]	Independent Pendant I	Lighting - se	smically rated)		
DS1	0.3	1.9	1.9	1.9	1.9	1.2
D1014.021	#1 (D1014.021:]	Hydraulic Elevator - A	pplies to mo	st California Installat	ions 1976 or)
DS1a	0.1	0.4	0.4	0.4	0.3	0.2
DS1b	1.7	6.6	6.4	6.1	5.8	3.8
DS1c	2.1	9.3	8.6	7.5	7.6	4.9
DS1d	0.3	1.3	1.3	1.3	1.2	0.7
Total	4.2	18	17	15	15	10
		a: Cold or Hot Potable				
DS1	0.0	0.0	0.0	0.0	0.0	0.0
DS2	0.0	0.0	0.0	0.1	0.1	0.0
Total	0.0	0.1	0.1	0.1	0.1	0.0
		b: Cold or Hot Potable				
DS1	0.0	0.0	0.0	0.0	0.0	0.0
		a: Cold or Hot Potable	-			
DS1	0.0	0.0	0.0	0.0	0.0	0.0
DS2	0.0	0.0	0.0	0.0	0.0	0.0
Total	0.0	0.0	0.0	0.1	0.1	0.0
		b: Cold or Hot Potable	-			
DS1	0.0	0.0	0.0	0.0	0.0	0.0
DS2	0.0	0.0	0.0	0.0	0.0	0.0
Total	0.0	0.0	0.0	0.0	0.0	0.0
		b: Sanitary Waste Pipi	0			
DS1	0.0	0.0	0.0	0.0	0.0	0.0
		: Compressor - Capac	•			
DS1a	0.0	0.1	0.1	0.1	0.1	0.1
DS1b	0.0	0.1	0.1	0.1	0.1	0.1
DS1c	0.0	0.1	0.1	0.1	0.1	0.1
DS1d	0.0	0.4	0.4	0.4	0.4	0.3
Total	0.1	0.6	0.7	0.7	0.7	0.4



	50% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 years
P[Col](%)	0.0	1.0	1.1	5.8	8.7	18
P[Res](%)	0.0	0.3	0.3	10.0	14	33
D3041.01	1d #1 (D3041.011d	I: HVAC Galvanized S	heet Metal I	oucting less than 6 sq.	ft in cross sec	tional)
DS1	0.0	0.0	0.0	0.0	0.0	0.0
DS2	0.0	0.1	0.1	0.1	0.1	0.1
Total	0.0	0.1	0.1	0.1	0.1	0.1
D3041.01	2d #1 (D3041.012d	I: HVAC Galvanized S	heet Metal I	Oucting - 6 sq. ft cross	sectional area	a or)
DS1	0.0	0.0	0.0	0.0	0.0	0.0
DS2	0.0	0.0	0.0	0.0	0.0	0.0
Total	0.0	0.0	0.0	0.0	0.0	0.0
D3041.03	2d #1 (D3041.032d	l: HVAC Drops / Diffu	sers without	ceilings - supported b	y ducting only	y - No)
DS1	0.6	3.7	3.8	3.7	3.5	2.3
D3041.10	3c #1 (D3041.103c	: HVAC Fan - Capacit	y: all - Equi	oment that is either ha	ard anchored	or is)
DS1a	0.1	0.4	0.4	0.4	0.4	0.2
DS1b	0.0	0.1	0.1	0.1	0.1	0.1
DS1c	0.7	2.3	2.3	2.1	2.0	1.2
Total	0.9	2.8	2.8	2.6	2.5	1.5
D3067.01	2c #1 (D3067.012c	: Control Panel - Capa	acity: all - Eo	uipment that is eithe	r hard anchor	ed or)
DS1a	0.0	0.0	0.0	0.0	0.0	0.0
DS1b	0.0	0.2	0.2	0.3	0.3	0.2
DS1c	0.0	0.5	0.6	0.7	0.7	0.6
Total	0.0	0.7	0.8	1.0	1.0	0.8
D4011.02	4a #1 (D4011.024a	: Fire Sprinkler Wate	r Piping - Ho	orizontal Mains and B	ranches - Old	Style)
DS1	0.0	0.0	0.0	0.0	0.0	0.0
DS2	0.0	0.0	0.0	0.0	0.0	0.0
Total	0.0	0.1	0.1	0.1	0.1	0.1

3.3 Casualties

Table 3.3.1 shows the total expected casualty results broken into collapse and non-collapse sources. The nonparenthetical values are casualties in terms of number of people and the parenthetical values show the probability of casualty for an individual person placed randomly in the building.

Table 3.3.2 shows the casualty breakdown on a per component basis. The values in this table are in terms of number of people, not probabilities.

The color scale is meant to indicate **relative** performance of components, not absolute performance. A "green" value does not indicate that the value falls in a pre-determined "good" range, just that it performs well compared to other components. Likewise, a "red" value does does not indicate that the value falls in a pre-determined "bad" range, just that it performs worse compared to other components.

	50% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 years
Total Non	-Collapse Casualt	ies				
Injury	0.00200	0.0370	0.0369	0.0517	0.0570	0.0615
	(0.118)	(2.18)	(2.17)	(3.05)	(3.36)	(3.63)
Death	0.00	0.00	0.00	0.00	0.00	0.00
Doum	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Total Coll	apse Casualties					
Injury	0.00	0.00560	0.00589	0.0322	0.0482	0.0999
mjurj	(0.00)	(0.330)	(0.347)	(1.90)	(2.84)	(5.89)
Death	0.00	0.000057	0.000060	0.000325	0.000487	0.00101
Doutin	(0.00)	(0.003)	(0.004)	(0.019)	(0.029)	(0.059)
Total Coll	apse and Non-Col	lapse Casualties				
Injury	0.00200	0.0422	0.0424	0.0809	0.100	0.150
mjury	(0.118)	(2.49)	(2.50)	(4.77)	(5.91)	(8.86)
Death	0.00	0.000057	0.000060	0.000325	0.000487	0.00101
Death	(0.00)	(0.003)	(0.004)	(0.019)	(0.029)	(0.059)

Table 3.3.1. Total expected casualties (Number of People (%))

Table 3.3.2. Expected casualties per component (Number of People)

	50% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_B	2% in 50 years		
	5	5		5		5		
C3032.00	4a #1 (C3052.004a	: Suspended Ceiling	g, SDC D,E,F (Ip)=1.5), Area (A): A <	< 250, vert & L	at)		
Injury	0.000682	0.00868	0.00749	0.0112	0.0137	0.0136		
Death	0.00	0.00	0.00	0.00	0.00	0.00		
C3032.004b #1 (C3032.004b: Suspended Ceiling, SDC D,E,F (Ip=1.5), Area (A): 250 < A < 1000, Vert & Lat)								
Injury	0.000412	0.00902	0.00965	0.0141	0.0145	0.0150		
Death	0.00	0.00	0.00	0.00	0.00	0.00		
C3032.00	C3032.004c #1 (C3032.004c: Suspended Ceiling, SDC D,E,F (Ip=1.5), Area (A): 1000 < A < 2500, Vert &)							
Injury	0.000278	0.00879	0.00920	0.0121	0.0131	0.0154		
Death	0.00	0.00	0.00	0.00	0.00	0.00		
C3032.00	4d #1 (C3032.004d	I: Suspended Ceiling	g, SDC D,E,F (Ip	5=1.5), Area (A): A :	> 2500, Vert &	Lat)		
Injury	0.000561	0.01000	0.0101	0.0137	0.0152	0.0169		
Death	0.00	0.00	0.00	0.00	0.00	0.00		
D3041.01	1d #1 (D3041.011d	l: HVAC Galvanized	l Sheet Metal Du	icting less than 6 sq.	. ft in cross sect	tional)		
Injury	0.000002	0.000027	0.000029	0.000036	0.000040	0.000043		
Death	0.00	0.00	0.00	0.00	0.00	0.00		





	50% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 years
D3041.012	1 #1 (D3041.012d	: HVAC Galvanized	Sheet Metal Du	icting - 6 sq. ft cross	s sectional area	or)
Injury	0.000000	0.000011	0.000010	0.000018	0.000018	0.000019
Death	0.00	0.00	0.00	0.00	0.00	0.00
D3041.032	l #1 (D3041.032d	l: HVAC Drops / Diff	users without c	eilings - supported	by ducting only	- No)
Injury	0.000066	0.000426	0.000441	0.000500	0.000527	0.000512
Death	0.00	0.00	0.00	0.00	0.00	0.00

3.4 Quantity Damaged

This table shows the expected percentage of the components that are in a given damage state (normalized to the total quantity of that component in the entire building). The small parenthetical value is the probability that any component throughout the building is in that damage state (the percentage of realizations that have a component in that damage state).

All of these values are conditioned on no global failure. The header shows the probability of global failures (collapse and residual drift demolition) for reference.

The color scale is meant to indicate **relative** performance of components, not absolute performance. A "green" value does not indicate that the value falls in a pre-determined "good" range, just that it performs well compared to other components. Likewise, a "red" value does does not indicate that the value falls in a pre-determined "bad" range, just that it performs worse compared to other components.

	50% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 years
P[Col](%)	0.0	1.0	1.1	5.8	8.7	18
P[Res](%)	0.0	0.3	0.3	10.0	14	33
B1044.01	1 #1 (B1044.011:]	Rectangular low aspe	ct ratio concre	te walls 8"-16" doubl	e curtain; wit	h)
DS1	4.2 (15)	39 (80)	38 (78)	42 (83)	45 (87)	42 (83)
DS2	0.1 (0.7)	4.6 (22)	4.6 (21)	7.1 (32)	7.8 (35)	10 (43)
DS3	0.2 (0.8)	9.9 (28)	9.9 (28)	19 (45)	20 (48)	27 (60)
Total	4.5 (15)	53 (83)	53 (81)	68 (91)	73 (95)	80 (96)
B1071.20	2 #1 (B1071.202:]	Exterior Structural W	Vall - Light fra	med wood walls with	structural par	nel)
DS1	0.8 (5.0)	12 (57)	12 (57)	10 (45)	11 (46)	12 (53)
DS2	0.0 (0.1)	7.7 (38)	7.7 (38)	8.9 (44)	9.0 (44)	7.9 (38)
DS3	0.0 (0.0)	7.6 (29)	8.2 (31)	17 (56)	18 (62)	24 (77)
Total	0.8 (5.0)	28 (88)	28 (90)	36 (97)	38 (99)	45 (99)
B2011.40	1 #1 (B2011.401:]	Exterior Wall - Light	framed wood	valls with exterior pa	nelized sheath	ning)
DS1	2.2 (14)	11 (56)	11 (55)	11 (54)	12 (58)	17 (73)
DS2	0.4 (2.6)	7.8 (48)	7.7 (46)	7.3 (43)	7.0 (41)	7.9 (44)
DS3	0.1 (0.7)	17 (64)	17 (66)	25 (85)	28 (90)	33 (96)
Total	2.6 (14)	35 (97)	36 (97)	44 (99)	47 (100)	58 (100)
C1011.21	1a #1 (C1011.211a	a: Wall Partition - Ty	pe: Gypsum w	ith wood studs (both :	sides), Full He	eight,)
DS1	25 (80)	48 (92)	48 (92)	45 (90)	42 (88)	33 (78)
DS2	2.5 (14)	13 (46)	13 (45)	17 (52)	19 (57)	24 (65)
DS3	1.0 (5.8)	19 (86)	19 (87)	26 (96)	30 (98)	39 (99)
Total	28 (91)	80 (100)	80 (100)	88 (100)	92 (100)	96 (100)
C1011.31	1a #1 (C1011.311a	a: Interior of Exterio	r Wall - Type:	Gypsum with wood st	tuds (single-si	ded)
DS1	29 (79)	50 (92)	50 (92)	45 (90)	42 (88)	30 (78)
DS2	2.2 (15)	15 (46)	16 (47)	22 (53)	24 (57)	28 (66)
DS3	0.6 (4.9)	16 (87)	16 (86)	24 (95)	28 (97)	38 (99)
Total	32 (90)	81 (100)	81 (100)	90 (100)	94 (100)	96 (100)
C2011.04	1b #1 (C2011.041)	b: Light frame stair f	ragility. Appro	ximation as a placeh	older until the	ere is)
DS1	3.7 (7.3)	29 (50)	28 (49)	28 (47)	26 (45)	27 (46)
DS2	0.3 (0.6)	15 (29)	16 (31)	19 (37)	20 (38)	20 (37)
DS3	0.0 (0.0)	7.7 (15)	7.6 (15)	15 (29)	17 (33)	22 (44)
Total	4.0 (8.0)	51 (88)	52 (89)	61 (96)	63 (97)	68 (99)
C3032.00	4a #1 (C3032.004a	a: Suspended Ceiling,	SDC D,E,F (I	p=1.5), Area (A): A <	250, Vert & I	Lat)
DS1	1.2 (2.3)	11 (20)	11 (21)	13 (24)	12 (22)	13 (24)
DS2	0.3 (0.6)	2.7 (5.3)	2.8 (5.6)	3.4 (6.6)	3.1 (6.1)	3.8 (7.5)
DS3	0.9 (1.7)	19 (30)	20 (32)	28 (42)	31 (44)	33 (47)
Total	2.4 (4.4)	33 (47)	34 (50)	44 (61)	46 (62)	50 (67)

Table 3.4.1. Expected percentage of damaged components (% of total qty. (% of realizations))





PiRes (%) 0.0 0.3 0.3 10.0 14 33 C3032.004b #1 (C3032.004b: Suspended Ceiling, SDC D,E,F (Ip=1.5), Area (A): 250 < A < 1000, Vert & Lat DS1 2.2 4:40 14 (20) 15 (20) 15 (20) 18 (20) 17 (20) 15 (20) 18 (20) 17 (20) 15 (20) 18 (20) 17 (20) 15 (20) 18 (20) 17 (20) 15 (20) 18 (20) 17 (20) 15 (20) 18 (20)		50% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 year
C3032.004b: Suspended Ceiling, SDC D.E.F (Ip=1.5), Area (A): 250 < A < 1000, Vert & Lat DS1 2.2.4.6 14.65 15.07 15.05 18.07 17 DS2 0.4 wn 3.8.63 3.8.64 4.2.a3 4.6.61 50 50 DS3 0.9 un 20.09 21.03 30.49 30.49 34.4 Total 3.5.65 38.60 40.67 50.67 53.60 56 C3032.004c #1 (C3032.004c: Suspended Ceiling, SDC D,E,F (Ip=1.5), Area (A): 1000 < A < 2500, Vert & A.) DS1 50.80 23.40 24.40 24.40 24.40 24.40 24.60 24.60 24.60 24.60 24.60 24.60 24.60 24.60 24.60 24.60 24.60 24.60 25.60 26.70 26.70 26.70 26.70 26.70 26.70 26.70 26.70 27.70 27.70 27.70 27.70 27.74 27.70 27.74 27.74 27.74 27.74 27.74 27.74 27.74 27.74 27.74 27.74 27.74 27.74 27.74 27.74 27.74 27.74 27.74 27.74	P[Col](%)	0.0	1.0	1.1	5.8	8.7	18
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	P[Res](%)	0.0	0.3	0.3	10.0	14	33
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	C3032.00	4b #1 (C3032.004)	o: Suspended Ceiling.	SDC D.E.F (I	p=1.5), Area (A): 250	< A < 1000, V	Vert & Lat)
DS2 0.4 a_{22} 3.8 a_{23} 3.8 a_{24} 4.2 a_{23} 4.6 a_{21} 5.0 a_{21} DS1 0.9 a_{23} 20 a_{20} 21 a_{33} 30 a_{44} 30 a_{41} 24 a_{50} 24 a_{50} 24 a_{50} 24 a_{50} 24 a_{50} 24 a_{50} 25 a_{50} 26 a_{50} 26 a_{50} 26 a_{50} 29 a_{50} 29 a_{50} 29 a_{50} 29 a_{50} 28 a_{50} 36 $a_$			1 0,		• • • • •	,	17 (30)
DS3 0.9 (m) 20 (m) 21 (m) 30 (m) 30 (m) 34 (m) Total 3.5 (m) 38 (m) 40 (m) 50 (m) 53 (m) 56 C3032.004c #1 (C3032.004c: Suspended Ceiling, SDC D, E, F (Ip=1.5), Area (A): 1000 < A < 2500, Vert & La)							5.0 (9.5)
Total 3.5 a.s) 38 a.s) 40 cm 50 cm 53 a.s) 56 C3032.004c #1 (C3032.004c; Suspended Ceiling, SDC D,E,F (Ip=1.5), Area (A): 1000 < A < 2500, Vert &)					30 (44)	30 (43)	34 (48)
DS1 5.0 est 23 ett 24 est 33 est 35 est 36 est							56 (72)
DS2 0.6 (i2) 5.8 (ii) 6.1 (ii) 6.6 (ii) 6.7 (ii) 8.5 (iii) DS3 0.9 (iii) 22 (iii) 32 (iii) 32 (iii) 33 (iii) 35 (iii) DS1 6.5 (iii) 6.1 (iii) 6.1 (iii) 6.1 (iii) 6.4 (iii) 7.0 (iii) 6.4 (iii) 7.0 (iii) 7.4 (iii) 7.3 (iii) DS1 6.9 (iii) 2.7 (iii) 6.8 (iii) 6.4 (iii) 7.0 (iii) 7.4 (iii) 7.3 (iii) DS3 1.4 (iii) 2.3 (iii) 5.9 (iii) 6.8 (iii) 7.1 (iii) 3.5 (iii) 3.6 (iiii) 3.6 (iiii) 3.6 (iiii) <td>C3032.00</td> <td>4c #1 (C3032.004c</td> <td>: Suspended Ceiling,</td> <td>SDC D,E,F (Ij</td> <td>o=1.5), Area (A): 100</td> <td>0 < A < 2500,</td> <td>Vert &)</td>	C3032.00	4c #1 (C3032.004c	: Suspended Ceiling,	SDC D,E,F (Ij	o=1.5), Area (A): 100	0 < A < 2500,	Vert &)
DS3 0.9 (1.6) 22 (26) 23 (26) 32 (46) 33 (47) 35 (7) C3032.004d #1 (C3032.004/: Supended Celling, SDC D,E,F (Ip=1.5), Area (A): A > 2500, Vert & Lat) DS1 6.9 (12) 27 (46) 29 (46) 29 (47) 29 (40) DS1 6.9 (12) 27 (46) 29 (47) 33 (47) 35 (40) 7.4 (14) 7.3 (7.5) DS1 6.4 (12) 7.0 (12) 7.4 (14) 7.3 (7.5) 7.6 (8.0) 71 (85) 76 (8.0) 71 (85) 76 (8.0) 71 (85) 75 (80) 71 (85) 76 (8.0) 71 (85) 76 (7.5) 7.6	DS1	5.0 (9.1)	23 (41)	24 (42)	24 (42)	24 (41)	25 (44)
Total 6.5 (m) 51 (m) 53 (m) 63 (m) 64 (m) 69 C3032.004d #1 (C3032.004: Suspended Ceiling, SDC D,E,F (Ip=1.5), Area (A): A > 2500, Vert & Lat) DS1 6.9 (m) 27 (m) 29 (m) 38 (m) 10 (m) 35 (m) 35 (m) 36 (m) 36 (m) 37 (m) 35 (m) 36 (m) 36 (m) 36 (m) 36 (m) 31 (m) 35 (m) 36 (m)	DS2	0.6 (1.2)	5.8 (11)	6.1 (12)	6.6 (13)	6.7 (13)	8.5 (16)
C3032.004d #1 (C3032.004d: Suspended Ceiling, SDC D,E,F (1p=1.5), Area (A): A > 2500, Vert & Lat) DS1 6.9 (12) 27 (46) 29 (46) 29 (46) 29 (47) 31 (47) 35 (50) 35 (50) 35 (57)	DS3	0.9 (1.8)	22 (34)	23 (36)	32 (46)	33 (47)	35 (51)
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	Total	6.5 (11)	51 (68)	53 (70)	63 (78)	64 (80)	69 (83)
DS2 0.7 (ij) 7.4 (ij) 7.4 (ij) 7.3 (ij) DS3 1.4 (ij) 23 (ij) 24 (ij) 33 (ij) 35 (ij) 38 (ij) Total 9.1 (ij) 57 (ij) 57 (ij) 59 (ij) 68 (ij) 71 (ij) 75 C3034.002: Independent Pendant Lighting - seismically rated) DS1 7.5 (ij) 49 (ij) 50 (ij) 59 (ij) 59 (ij) 62 (ij) 64 D014.021: Hydraulic Elevator Applies to most California Installations 1976 or) DS1 6.2 (iii) 31 (ij) 31 (ij) 35 (ij) 31 (ij) 35 (ij) 31 (ij) 35 (ij)	C 3032.0 0	4d #1 (C3032.004d	I: Suspended Ceiling,	SDC D,E,F (I	p=1.5), Area (A): A >	2500, Vert &	Lat)
DS3 1.4 (α 7) 23 (α 0) 24 (α 7) 33 (α 7) 35 (α 0) 38 (α Total 9.1 (α 5) 57 (α 0 59 (α 0 68 (α 5) 71 (α 5) 75 C3034.002 #1 (C3034.002: Independent Pendant Lighting - seismically rated) 59 (α 0 62 (α 0 64 67 68 71 (α 5) 75 DS1 7.5 (α 0 49 (α 0 59 (α 0 59 (α 0 62 (α 0 62 (α 0 64 64 67 64 60 61 61 62 (α 0 61 (α 0 63 61 (α 0 61 (α 0 63 60 (α 0 63 (α 0 61 (α 0 63 60 (α 0 63 (α 0 60 (α 0 63 (α 0 60 (α 0 63 (α 0		6.9 (12)			29 (48)	29 (47)	29 (49)
Total 9.1 (15) 57 (74) 59 (76) 68 (80) 71 (85) 75 C3034.002 #1 (C3034.002: Independent Pendant Lighting - seismically rated) DS1 7.5 (20) 49 (00) 50 (81) 59 (80) 62 (90) 64 D1014.021 #1 (D1014.021: Hydraulic Elevator - Applies to most California Installations 1976 or) DS1 (6.2 (62) 26 (20) 25 (25) 28 (28) 30 (00) 31 (31) DS1 (6.3 (62) 26 (20) 41 (41) 46 (46) 48 (46) 50 (60) DS1 (6.3 (63) 31 (31) 31 (31) 35 (35) 36 (3	DS2	0.7 (1.5)	6.8 (13)	6.4 (12)		7.4 (14)	7.3 (14)
C3034.002 : Independent Pendent Lighting - seismically rated) DS1 7.5 (20) 49 (20) 50 (81) 59 (80) 62 (20) 64 D1014.021 : Hydraulic Elevator - Applies to most California Installations 1976 or) DS1a 6.2 (62) 25 (25) 28 (28) 30 (80) 31 (20) DS1b 10 (10) 42 (42) 41 (41) 46 (46) 48 (46) 50 (20) DS1c 8.8 (85) 40 (40) 38 (38) 40 (40) 43 (43) 43 (43) DS1d 6.3 (63) 31 (01) 35 (35) 35 (35) 35 (35) 35 (35) 150 (82) 160 (86) 166 (87) <	DS3	1.4 (2.7)		24 (37)	33 (47)	35 (50)	38 (54)
DS1 7.5 (20) 49 (60) 50 (81) 59 (86) 62 (80) 64 D1014.021 #1 (D1014.021: Hydraulic Elevator - Applies to most California Installations 1976 or) DS1a 6.2 (62) 26 (26) 25 (25) 28 (28) 30 (20) 31 (20) DS1b 10 (10) 42 (42) 41 (41) 46 (46) 48 (48) 50 (20) DS1c 8.8 (8.5) 40 (40) 38 (38) 40 (40) 43 (31) 43 (33) 43 (40) 43 (43) 43 (43) DS1d 6.3 (6.5) 31 (31) 31 (31) 35 (55) 36 (55) 36 (55) 36 (55)	Total	9.1 (15)	57 (74)	59 (76)	68 (83)	71 (85)	75 (87)
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	C 3034.0 0	2 #1 (C3034.002:]		Lighting - seis	mically rated)		
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	DS1	7.5 (20)	49 (80)	50 (81)	59 (88)	62 (89)	64 (90)
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	D1014.02		Hydraulic Elevator - A	Applies to mos	t California Installati	ions 1976 or)
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	DS1a	6.2 (6.2)	26 (26)	25 (25)	28 (28)	30 (30)	31 (31)
DS1d 6.3 (6.3) 31 (31) 31 (31) 35 (55) 35 (55) 35 (57) 160 (98) 75 (57) 160 (98) 75 (57) 160 (98) 75 (57) 75 (77) 76 (77)	DS1b	10 (10)	42 (42)	41 (41)	46 (46)	48 (48)	50 (50)
Total32 (r)140 (rs)*130 (rs)*150 (rs)*160 (s)*160 (s)*Percent of total quantity above 100 is caused by simulareous damage statesD2021.014a #1 (D2021.014:: Cold or Hot Potab:: - Small Diameter Threaded Steel - (2.5 inches in)DS11.9 (s.6)19 (s.3)20 (s.4)25 (s.3)25 (s.2)27 (s.2)DS20.1 (s.2)6.0 (1)6.4 (1)11 (18)11 (19)11 (s.2)Total2.0 (s.8)25 (s.0)26 (s.1)36 (s.3)36 (s.2)38D2021.014b #1 (D2021.014b:: Cold or Hot Potab:: - Small Diameter Threaded Steel - (2.5 inches in)DS17.8 (s.4)48 (s?)49 (s?)60 (rs)63 (r9)63D2021.024a #1 (D2021.024a:: Cold or Hot Potab:: Vater Piping (dia > 2.5 inches), SDC D,E,F (OSPHD or)DS11.8 (s.4)20 (s.5)21 (s.6)25 (s.3)27 (s.4)29 (s.6)DS20.2 (s.3)6.2 (11)6.1 (11)11 (18)11 (19)11 (s.6)DS11.8 (s.4)20 (s.5)21 (s.6)2.5 inches), SDC D,E,F (OSPHD or)DS11.8 (s.4)20 (s.5)21 (s.6)2.5 (s.6)38 (s.6)40D2021.024b #1 (D2021.024b:: Cold or Hot Potab:Vater Piping (dia > 2.5 inches), SDC D,E,F (OSPHD or)DS11.8 (s.4)20 (s.5)21 (s.6)2.5 (s.6)38 (s.6)40D201.024b #1 (D2021.024b:: Cold or Hot Potab:Vater Piping (dia > 2.5 inches), SDC D,E,F (OSP	DS1c	8.8 (8.8)	40 (40)	38 (38)	40 (40)	43 (43)	43 (43)
Percent of total quantity above 100 is caused by simultaneous damage states D2021.014a #1 (D2021.014a: Cold or Hot Potable - Small Diameter Threaded Steel - (2.5 inches in) DS1 1.9 (3.6) 19 (3) 20 (34) 25 (43) 25 (42) 27 (40) DS2 0.1 (0.2) 6.0 (11) 6.4 (11) 11 (18) 11 (19) 11 (19) 11 (19) Total 2.0 (3.8) 25 (40) 26 (41) 36 (53) 36 (52) 38 D021.014b #1 (D2021.014b: Cold or Hot Potable - Small Diameter Threaded Steel - (2.5 inches in) DS1 7.8 (4) 48 (67) 49 (67) 60 (78) 63 (79) 63 D2021.024a: Cold or Hot Potable Water Piping (dia > 2.5 inches), SDC D,E,F (OSPHD or) DS1 1.8 (3.4) 20 (35) 21 (36) 25 (43) 27 (40) 29 (60) DS2 0.2 (0.3) 6.2 (11) 6.1 (11) 11 (18) 11 (19) 11 (10) 11 (10) 11 (10) 11 (10) 11 (10) 11 (10) 11 (10) 11 (10) 11 (10) 11 (10) 11 (10) 11 (10) 11 (10) 11 (10) 11 (10) 11 (10) 11 (10) 11 (10	DS1d	6.3 (6.3)			35 (35)		35 (35)
D2021.014a #1 (D2021.014a: Cold or Hot Potable - Small Diameter Threaded Steel - (2.5 inches in) DS1 1.9 (3.6) 19 (33) 20 (34) 25 (43) 25 (42) 27 (20) DS2 0.1 (02) 6.0 (11) 6.4 (11) 11 (18) 11 (19) 11 (19) Total 2.0 (38) 25 (40) 26 (41) 36 (53) 36 (52) 38 D2021.014b #1 (D2021.014b: Cold or Hot Potable - Small Diameter Threaded Steel - (2.5 inches in) DS1 7.8 (14) 48 (67) 49 (67) 60 (78) 63 (79) 63 D2021.014b #1 (D2021.024a: Cold or Hot Potable Water Piping (dia > 2.5 inches), SDC D,E,F (OSPHD or) DS1 1.8 (3.4) 20 (35) 21 (36) 25 (43) 27 (44) 29 (20) DS1 1.8 (3.4) 20 (35) 21 (36) 25 (43) 27 (44) 29 (20) DS2 0.2 (0.3) 6.2 (11) 6.1 (11) 11 (18) 11 (19) 11 (10) DS1 1.8 (3.4) 20 (35) 23 (41) 23 (40) 24 (41) 26 (40) DS2 0.2 (0.3) 6.2 (11) 21 (30) 24 (41) 26 (40) 26 (40) 38 (55) 41 (40) DS1 </td <td></td> <td></td> <td></td> <td></td> <td></td> <td>160 (84) *</td> <td>160 (87) *</td>						160 (84) *	160 (87) *
$\begin{array}{c c c c c c c c c c c c c c c c c c c $		1 2	•	e			
DS20.1 (0.2)6.0 (11)6.4 (11)11 (18)11 (19)11 (19)11 (10)Total2.0 (3.8)2.5 (40)2.6 (41)3.6 (53)3.6 (53)3.6 (52)3.8D2021.014b #1 (D2021.014b: Cold or Hot PotableDS17.8 (14)48 (67)49 (67)60 (78)63 (79)63D2021.024a #1 (D2021.024a: Cold or Hot PotableWater Piping (dia > 2.5 inches), SDC D,E,F (OSPHD or)DS11.8 (3.4)20 (35)21 (36)25 (43)27 (44)29 (40)DS20.2 (0.3)6.2 (11)6.1 (11)11 (18)11 (19)11 (9)DS11.8 (3.4)20 (35)21 (36)25 (43)27 (44)29 (40)DS20.2 (0.3)6.2 (11)11 (11)11 (18)11 (19)11 (10)DS11.8 (3.4)20 (35)21 (36)25 (43)38 (53)40D2021.024b: Cold or Hot PotableWater Piping (dia > 2.5 inches), SDC D,E,F (OSPHD or)DS15.7 (11)22 (29)23 (41)23 (40)24 (41)26 (40)DS15.7 (11)22 (29)23 (41)23 (40)24 (41)26 (40)DS15.7 (11)22 (39)17 (20)26 (40)36 (55)<							
Total2.0 (3.8)25 (40)26 (41)36 (53)36 (52)38D2021.014b #1 (D2021.014b Cold or Hot PotabDS17.8 (4)48 (67)49 (67)60 (78)63 (79)63D2021.024a #1 (D2021.024b Cold or Hot PotabWater Piping (dia > 2.5 inches), SDC D,E,F (OSPHD or)DS11.8 (3.4)20 (35)21 (36)25 (43)27 (44)29 (60)DS20.2 (0.3)6.2 (11)6.1 (11)11 (18)11 (19)11 (19)Total2.0 (3.7)26 (41)2.7 (42)36 (53)38 (54)40D2021.024b #1 (D2021.024bCold or Hot PotabWater Piping (dia > 2.5 inches), SDC D,E,F (OSPHD or)DS15.7 (11)22 (39)23 (41)23 (40)24 (41)26 (60)DS22.2 (4.0)26 (41)26 (40)36 (53)38 (55)41 (10)DS15.7 (11)22 (39)23 (41)23 (40)24 (41)26 (60)DS22.2 (4.0)26 (41)26 (40)36 (53)38 (55)41 (10)DS15.7 (11)12 (2 (3)13 (12)27 (23)DS15.7 (11)22 (39)23 (40)25 (79)22 (78)DS15.7 (11)22 (39)23 (40)25 (79)70DS10.9 (1.7)16 (27)17 (29)22 (36)25 (39)27DS10.9 (1.7)16							27 (45)
D2021.014b #1 (D2021.014b: Cold or Hot Potable - Small Diameter Threaded Steel - (2.5 inches in) DS1 7.8 (ii) 48 (cr) 49 (cr) 60 (r8) 63 (r9) 63 D2021.024a #1 (D2021.024a: Cold or Hot Potable Water Piping (dia > 2.5 inches), SDC D,E,F (OSPHD or) DS1 1.8 (3.4) 20 (35) 21 (36) 25 (43) 27 (44) 29 (cr) DS2 0.2 (0.3) 6.2 (11) 6.1 (11) 11 (18) 11 (19) 11 (cr) Total 2.0 (37) 26 (41) 27 (42) 36 (53) 38 (s4) 40 D2021.024b #1 (D2021.024b: Cold or Hot Potable Water Piping (dia > 2.5 inches), SDC D,E,F (OSPHD or) DS1 5.7 (11) 22 (39) 23 (41) 23 (40) 24 (41) 26 (cr) DS2 2.2 (40) 26 (41) 26 (40) 36 (53) 38 (55) 41 (cr) DS1 5.7 (11) 22 (39) 23 (41) 23 (40) 24 (41) 26 (cr) DS2 2.2 (40) 26 (41) 26 (40) 36 (53) 38 (55) 41 (cr) D1031.014b #1 (D2031.014b: Sanitary Waste Piping - Cast Iron w/flexible couplings, SDC D,E,F (OS							11 (19)
DS17.8 (4)48 (67)49 (67)60 (78)63 (79)63D2021.024a #1 (D2021.024a: Cold or Hot Potable Water Piping (dia > 2.5 inches), SDC D,E,F (OSPHD or)DS11.8 (3.4)20 (35)21 (36)25 (43)27 (44)29 (60)DS20.2 (0.3)6.2 (11)6.1 (11)11 (18)11 (19)11 (19)Total2.0 (3.7)26 (41)27 (42)36 (53)38 (54)40D2021.024b #1 (D2021.024b: Cold or Hot Potable Water Piping (dia > 2.5 inches), SDC D,E,F (OSPHD or)DS15.7 (11)22 (39)23 (41)23 (40)24 (41)26 (40)DS22.2 (4.0)26 (41)26 (40)36 (53)38 (55)41 (70)DS15.7 (11)22 (39)23 (41)23 (40)24 (41)26 (70)DS22.2 (4.0)26 (41)26 (40)36 (53)38 (55)41 (70)DS17.8 (14)48 (67)49 (67)59 (77)62 (78)67D2031.014b #1 (D2031.014b: Sanitary Waste Piping - Cast Iron w/flexible couplings, SDC D,E,F (OSHPD or)DS10.9 (1.7)16 (27)17 (29)22 (36)25 (39)27D3032.013c #1 (D3032.013c: Compressor - Capacity: Small non medical air supply - Equipment that is)DS1a2.1 (2.1)15 (15)15 (15)17 (17)17 (17)18 (70)DS1a0.9 (9.9)6.1 (6.1)6.0 (6.0)6.5 (6.5)7.0 (7.0)8.7 (70)DS1c1.8 (1.8)9.7 (9.7)9.6 (9.6)12 (12) </td <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>38 (56)</td>							38 (56)
D2021.024a #1 (D2021.024a: Cold or Hot Potable Water Piping (dia > 2.5 inches), SDC D,E,F (OSPHD or) DS1 1.8 (3.4) 20 (35) 21 (36) 25 (43) 27 (44) 29 (20) DS2 0.2 (0.3) 6.2 (11) 6.1 (11) 11 (18) 11 (19) 11 (19) Total 2.0 (3.7) 26 (41) 27 (42) 36 (53) 38 (54) 40 D2021.024b: Cold or Hot Potable Water Piping (dia > 2.5 inches), SDC D,E,F (OSPHD or) DS1 5.7 (11) 22 (39) 23 (41) 23 (40) 24 (41) 26 (40) DS2 2.2 (4.0) 26 (41) 26 (40) 36 (53) 38 (55) 41 (20) DS2 2.2 (4.0) 26 (41) 26 (40) 36 (53) 38 (55) 41 (20) DS1 7.8 (14) 48 (67) 49 (67) 59 (77) 62 (78) 67 D2031.014b #1 (D2031.014b: Sanitary Waste Piping - Cast Iron w/flexible couplings, SDC D,E,F (OSHPD or) DS1 0.9 (1.7) 16 (27) 17 (29) 22 (36) 25 (39) 27 D3032.013c #1 (D3032.013c: Compressor - Capacity: Small non medical air supply - Equipment that is) DS1a 2.1 (2.1) 15							
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$\begin{array}{c c c c c c c c c c c c c c c c c c c $							
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DS1c 1.8 (1.8) 9.7 (9.7) 9.6 (9.6) 12 (12) 13 (13) 12 (18 (18) 9 7
UN(0) = UN(0) = UU(0) = UU(0							12 (12)
	DS1d	1.3 (1.3)	9.4 (9.4)	9.9 (9.9)	12 (12)	14 (14)	13 (13) 53 (53)



	50% in 50 years	10% in 50 years	DE	5% in 50 years	MCE_R	2% in 50 years
P[Col](%)	0.0	1.0	1.1	5.8	8.7	18
P[Res](%)	0.0	0.3	0.3	10.0	14	33
D3041.011	d #1 (D3041.011d	I: HVAC Galvanized	Sheet Metal D	ucting less than 6 sq.	ft in cross sec	tional)
DS1	5.2 (10)	24 (42)	23 (40)	25 (43)	24 (41)	24 (42)
DS2	2.0 (3.8)	25 (39)	27 (41)	36 (53)	37 (53)	41 (58)
Total	7.3 (13)	49 (67)	50 (68)	60 (78)	61 (76)	65 (82)
D3041.012	2d #1 (D3041.012d	I: HVAC Galvanized	Sheet Metal D	ucting - 6 sq. ft cross	sectional area	1 or)
DS1	0.1 (0.2)	3.5 (6.6)	3.2 (6.2)	4.7 (8.8)	5.4 (10)	5.2 (10)
DS2	0.1 (0.2)	4.6 (8.3)	4.7 (8.2)	8.9 (16)	8.4 (14)	8.6 (15)
Total	0.2 (0.5)	8.2 (14)	7.9 (14)	14 (22)	14 (23)	14 (23)
D3041.032	2d #1 (D3041.032d	l: HVAC Drops / Diff	users without o	eilings - supported b	y ducting only	v - No)
DS1	7.6 (13)	49 (69)	51 (69)	58 (76)	61 (79)	64 (81)
D3041.103	3c #1 (D3041.103c	: HVAC Fan - Capac	ity: all - Equip	ment that is either ha	ard anchored	or is)
DS1a	6.7 (13)	23 (40)	23 (40)	26 (45)	28 (47)	29 (49)
DS1b	3.2 (6.1)	10 (19)	10 (20)	12 (22)	12 (22)	13 (23)
DS1c	10 (19)	35 (56)	35 (56)	38 (59)	38 (62)	38 (61)
Total	20 (33)	68 (87)	69 (86)	76 (92)	78 (92)	80 (93)
D3067.012	c #1 (D3067.012c	: Control Panel - Caj	pacity: all - Eq	uipment that is either	r hard anchor	ed or)
DS1a	0.2 (0.2)	6.8 (6.8)	7.4 (7.4)	11 (11)	12 (12)	16 (16)
DS1b	0.1 (0.1)	3.0 (3.0)	2.9 (2.9)	5.2 (5.2)	6.3 (6.3)	6.2 (6.2)
DS1c	0.4 (0.4)	9.5 (9.5)	11 (11)	16 (16)	17 (17)	24 (24)
Total	0.8 (0.8)	19 (19)	21 (21)	32 (32)	36 (36)	46 (46)
D4011.024	la #1 (D4011.024a	: Fire Sprinkler Wat	er Piping - Ho	rizontal Mains and B	ranches - Old	Style)
DS1	3.2 (6.1)	25 (42)	26 (43)	29 (48)	30 (49)	33 (54)
DS2	0.5 (0.9)	9.8 (17)	11 (18)	16 (26)	17 (28)	17 (28)
Total	3.7 (6.8)	35 (51)	36 (53)	45 (63)	47 (65)	51 (68)

4 COMPONENT DAMAGEABILITY AND COST OVERVIEW

This section provides an overview of key component parameters for loss assessment. The components are broken into groups such that the specified component modifiers are applied to all components in the given table.

Some notes on the columns are as follows:

- **DS: Median (Unit Repair Cost Range)**: This presents median EDP for each damage state as well as the associated repair cost range to repair one unit of the component (varies based on quantity).
- Max Repair Potential: This is the cost to completely replace this component throughout the building assuming the most expensive damage state for all components (includes volume discounting). The number in parenthesis is the value as a percentage of building replacement value. Note that this does not need to add up to the total building replacement value, but rather gives a sense of how much potential the component has to contribute to the mean loss when it is damaged.

Component	Description	DS: Median (Unit Repair Cost Range)	Max Repair Potential
B1044.011	Rectangular low aspect ratio concrete walls 8"-16" double curtain; with heights of up to 15'	EDP Peak Interstory Drift DS1: 0.0055 (\$7,151 - \$10,516) DS2: 0.0109 (\$18,456 - \$27,141) DS3: 0.013 (\$34,471 - \$50,692)	(41.8%)
B1071.202	Exterior Structural Wall - Light framed wood walls with structural panel sheathing, with hold-downs	EDP Peak Interstory Drift DS1: 0.015 (\$947 - \$1,539) DS2: 0.0262 (\$1,366 - \$1,928) DS3: 0.0369 (\$3,033 - \$4,281)	(3.97%)
		Total:	\$279,654 (45.8%)

Table 4.1. "Structural" component list.

Table 4.2.	"Exterior	Finishes"	component	list.

Component	Description	DS: Median (Unit Repair Cost Range)	Max Repair Potential
B2011.401	Exterior Wall - Light framed wood walls with exterior panelized sheathing (OSB) and horizontal wood siding, no hold-downs	EDP Peak Interstory Drift DS1: 0.01 (\$175 - \$412) DS2: 0.0175 (\$374 - \$879) DS3: 0.025 (\$1,156 - \$2,721)	(1.52%)
		Total:	\$9,297 (1.52%)

Table 4.3.	"Partition	Walls"	component	list.
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Component	Description	DS: Median (Unit Repair Cost Range)	Max Repair Potential
C1011.211a	Wall Partition - Type: Gypsum with wood studs (both sides), Full Height, Fixed Below, Fixed Above	EDP Peak Interstory Drift DS1: 0.0021 (\$1,598 - \$5,328) DS2: 0.0071 (\$3,428 - \$11,425) DS3: 0.012 (\$11,297 - \$37,656)	(8.76%)



Table 4.3 (Continued). "Partition Walls" component list.			
Component	Description	DS: Median (Repair Cost Range)	Max Repair Potential
C1011.311a	Interior of Exterior Wall - Type: Gypsum with wood studs (single-sided gypsum), Full Height, Fixed Below, Fixed Above	EDP Peak Interstory Drift DS1: 0.0021 (\$904 - \$3,015) DS2: 0.0071 (\$2,223 - \$7,411) DS3: 0.012 (\$7,151 - \$23,838)	(7.26%)
		Total:	\$97,823 (16.0%)

Table 4.4. "Other Nonstructural" component list.

Component	Description	DS: Median (Unit Repair Cost Range)	Max Repair Potential
С2011.041Ь	Light frame stair fragility. Approximation as a placeholder until there is more research on the topic. Damage states from P-58 Light frame stair example. Costing approximated from various online sources for stair replacement.	EDPPeak Interstory DriftDS1:0.011(\$487 - \$695)DS2:0.026(\$1,043 - \$2,782)DS3:0.05(\$3,130 - \$8,346)	(2.73%)
D4011.024a	Fire Sprinkler Water Piping - Horizontal Mains and Branches - Old Style Victaulic - Thin Wall Steel - with designed bracing, SDC D, E, or F (OSHPD or sim), PIPING FRAGILITY	EDPPeak Floor AccelerationDS1:1.9(\$438 - \$536)DS2:3.4(\$3,317 - \$4,055)	\$1,409 (0.23%)
		Total:	\$18,101 (2.96%)

Table 4.5. "Ceilings" component list.

Component	Description	DS: Median (Unif Repair Cost Range)	Repair ential
C3032.004a	Suspended Ceiling, SDC D,E,F (Ip=1.5), Area (A): A < 250, Vert & Lat support	EDPPeak Floor AccelerationDS1:1.92(\$303 - \$1,008)DS2:2.34(\$2,368 - \$7,894)DS3:2.48(\$4,872 - \$16,240)	\$24,287 (3.98%)
C3032.004b	Suspended Ceiling, SDC D,E,F (Ip=1.5), Area (A): 250 < A < 1000, Vert & Lat support	EDPPeak Floor AccelerationDS1:1.76(\$726 - \$2,420)DS2:2.26(\$5,683 - \$18,945)DS3:2.44(\$11,692 - \$38,975)	\$25,402 (4.16%)
C3032.004c	Suspended Ceiling, SDC D,E,F (Ip=1.5), Area (A): 1000 < A < 2500, Vert & Lat support	EDPPeak Floor AccelerationDS1:1.45(\$2,178 - \$7,261)DS2:2.1(\$17,050 - \$56,835)DS3:2.34(\$35,077 - \$116,925)	\$25,402 (4.16%)



Component	Description	DS: Median (Repair Cost Range)	Max Repair Potential
C3032.004d	Suspended Ceiling, SDC D,E,F (Ip=1.5), Area (A): A > 2500, Vert & Lat support	EDPPeak Floor AccelerationDS1:1.31(\$3,025 - \$10,085)DS2:2.03(\$23,681 - \$78,937)DS3:2.29(\$48,719 - \$162,396)	(4.16%)
		Total:	\$100,493 (16.5%)

Table 4.5 (Continued). "Ceilings" component list.

Table 4.6. "Lighting" component list.

Component	Description	DS: Median (Unit Repair Cost Range)	Max Repair Potential
C3034.002	Independent Pendant Lighting - seismically rated	EDP Peak Floor Acceleration DS1: 1.5 (\$413 - \$1,377)	\$5,508 (0.90%)
		Total:	\$5,508 (0.90%)

Table 4.7. "Elevators" component list.

Component	Description	DS: Median (Unit Repair Cost Range) Max Repair Potential
D1014.021	Hydraulic Elevator - Applies to most California Installations 1976 or later, most western states installations postdating 1982 and most U.S installations postdating 1998.	EDPPeak Floor AccelerationDS1a:0.5(\$668 - \$2,226)\$33,383DS1b:0.5(\$6,844 - \$22,812)(5.47%)DS1c:0.5(\$10,015 - \$33,383)DS1d:0.5DS1d:0.5(\$1,920 - \$6,398)\$6,398)
		Total: \$33,383 (5.47%)

Table 4.8.	"Piping"	component	list.
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Component	Description	DS: Median (Unit Repair Cost Range)	Max Repair Potential
D2021.014a	Cold or Hot Potable - Small Diameter Threaded Steel - (2.5 inches in diameter or less), SDC D, E, or F (OSHPD or sim), PIPING FRAGILITY	EDP Peak Floor Acceleration DS1: 2.25 (\$363 - \$444) DS2: 4.1 (\$3,317 - \$4,055)	(0.15%)
D2021.014b	Cold or Hot Potable - Small Diameter Threaded Steel - (2.5 inches in diameter or less), SDC D, E, or F (OSHPD or sim), BRACING FRAGILITY	EDP Peak Floor Acceleration DS1: 1.5 (\$476 - \$581)	\$127 (0.02%)
D2021.024a	Cold or Hot Potable Water Piping (dia > 2.5 inches), SDC D,E,F (OSPHD or sim), PIPING FRAGILITY	EDPPeak Floor AccelerationDS1:2.25(\$292 - \$974)DS2:4.1(\$2,796 - \$9,319)	(0.1270)

	Table 4.8 (Commune).	i iping component list.	
Component	Description	DS: Median (Repair Cost Range)	Max Repair Potential
D2021.024b	Cold or Hot Potable Water Piping (dia > 2.5 inches), SDC D,E,F (OSPHD or sim), BRACING FRAGILITY	EDPPeak Floor AccelerationDS1:1.5(\$292 - \$974)DS2:2.25(\$292 - \$974)	\$76 (0.01%)
D2031.014b	Sanitary Waste Piping - Cast Iron w/flexible couplings, SDC D,E,F (OSHPD or sim), BRACING FRAGILITY	EDP Peak Floor Acceleration DS1: 3 (\$334 - \$1,113)	\$110 (0.02%)
		Total:	\$1,931 (0.32%)

Table 4.8 (Continued). "Piping" component list.

Component	Description		ax Repair otential
D3032.013c	Compressor - Capacity: Small non medical air supply - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Combined anchorage/isolator & equipment fragility	EDPPeak Floor AccelerationDS1a:2.05(\$563 - \$689)DS1b:2.05(\$3,943 - \$4,820)DS1c:2.05(\$939 - \$1,148)DS1d:2.05(\$3,943 - \$4,820)	\$4,820 (0.79%)
D3041.011d	HVAC Galvanized Sheet Metal Ducting less than 6 sq. ft in cross sectional area, SDC D, E, or F (OSHPD or sim)	EDPPeak Floor AccelerationDS1:1.5(\$814 - \$995)DS2:2.25(\$7,949 - \$9,716)	\$1,266 (0.21%)
D3041.012d	HVAC Galvanized Sheet Metal Ducting - 6 sq. ft cross sectional area or greater, SDC D, E, or F (OSHPD or sim)	EDPPeak Floor AccelerationDS1:3.75(\$1,189 - \$1,454)DS2:4.5(\$9,952 - \$12,164)	\$423 (0.07%)
D3041.032d	HVAC Drops / Diffusers without ceilings - supported by ducting only - No independent safety wires, SDC D, E, or F (OSHPD or sim)	EDPPeak Floor AccelerationDS1:1.5(\$3,756 - \$4,590)	\$8,763 (1.43%)
D3041.103c	HVAC Fan - Capacity: all - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Combined anchorage/isolator & equipment fragility	EDPPeak Floor AccelerationDS1a:1.07(\$876 - \$1,071)DS1b:1.07(\$4,194 - \$5,126)DS1c:1.07(\$3,317 - \$4,055)	\$9,785 (1.60%)
D3067.012c	Control Panel - Capacity: all - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Combined anchorage/isolator & equipment fragility	EDPPeak Floor AccelerationDS1a:1.6(\$626 - \$765)DS1b:1.6(\$5,821 - \$7,115)DS1c:1.6(\$5,195 - \$6,350)	\$7,115 (1.16%)
		Total:	\$32,172 (5.27%)

Table 4.9. "HVAC" component list.





Table 4.10. Summary of component value breakdown (building replacement value = 610,816).

Component Category	Max Repair Potential	% of Building Replacement Value
Structural	\$279,654	45.8%
Exterior Finishes	\$9,297	1.52%
Partition Walls	\$97,823	16.0%
Other Nonstructural	\$18,101	2.96%
Ceilings	\$100,493	16.5%
Lighting	\$5,508	0.90%
Elevators	\$33,383	5.47%
Piping	\$1,931	0.32%
HVAC	\$32,172	5.27%
Total	\$578,363	94.7%

5 COMPONENT QUANTITIES AND MODIFICATION FACTORS

	Ta	ble 5.1. Compone	nt quantity and r	nodification summ	ary.	
Location	Qty. Dir 1	Qty. Dir 2	Qty. ND	Cost Scale	Capacity Scale	Time Scale
B1044.011 (B1	044.011 #1): Rec	tangular low aspe	ct ratio concrete	walls 8"-16" doubl	le curtain; with he	eights of up to 15'
1	0	7.41	_	1	1	1
B1071.202 (B1 hold-downs	.071.202 #1): Ext	erior Structural W	all - Light frame	ed wood walls with	structural panel s	sheathing, with
1 2	2.97 1.98	0 3.015	_	1 1	1 1	1 1
			framed wood wa	alls with exterior p	anelized sheathin	g (OSB) and
horizontal wood	l siding, no hold- 2.97	downs 0		1	1	1
1 2	1.98	3.015	_	1	1 1	1
C1011.211a (C Fixed Above	C1011.211a #1): `	Wall Partition - Ty	pe: Gypsum wit	h wood studs (both	sides), Full Heig	ht, Fixed Below,
1 2	0.265 0.435	0.275 0.5		1 1	1 1	1 1
	C 1011.311a #1): 1 elow, Fixed Abov		r Wall - Type: G	ypsum with wood	studs (single-side	d gypsum), Full
1-2	0.22	0.79	-	1	1	1
	amage states from			imation as a placeh Costing approximat 1		
C3032.004a (C	3032.004a #1)· 5	Suspended Ceiling	SDC D E F (Ir	=1.5), Area (A): A	< 250 Vert & L	at support
2-R	_	-	0.7821	1	1	1
C3032.004b (C	C3032.004b #1):	Suspended Ceiling	g, SDC D,E,F (Ip 0.325875	=1.5), Area (A): 2	50 < A < 1000, V	ert & Lat support
	3032 0040 #1): 5	uspanded Cailing		=1.5), Area (A): 10	$100 < \Lambda < 2500$ V	art & I at support
2-R		–	0.108625	-1.5), Alea (A). 10 1	1	1
C3032.004d (C 2-R	C3032.004d #1):	Suspended Ceiling _	g, SDC D,E,F (I _I 0.07821	0=1.5), Area (A): A	$x > 2500$, Vert & $\frac{1}{1}$	Lat support 1
C3034.002 (C3	3034.002 #1): Ind	lependent Pendant	Lighting - seisn	nically rated		
2-R	_	_	2	1	1	1
		draulic Elevator - 32 and most U.S in		California Installat lating 1998.	tions 1976 or late	r, most western
G	_	-	1	1	1	1
		Cold or Hot Potab , PIPING FRAGII		eter Threaded Steel	- (2.5 inches in d	liameter or less),
2-R	_	-	0.109494	1	1	1
		Cold or Hot Potab , BRACING FRA		eter Threaded Steel	l - (2.5 inches in c	liameter or less),
2-R	-	-	0.109494	1	1	1
D2021.024a (E PIPING FRAGI		Cold or Hot Potab	le Water Piping	dia > 2.5 inches), $dia > 2.5$	SDC D,E,F (OSP	HD or sim),
2-R	-	_	0.039105	1	1	1

Table 5.1. Component quantity and modification summary.





Table 5.1 (Continued). Component quantity and modification summary.						
Location	Qty. Dir 1	Qty. Dir 2	Qty. ND	Cost Scale	Capacity Scale	Time Scale
D2021.024b ()	D2021.024b #1):	Cold or Hot Potat	ble Water Piping	(dia > 2.5 inches),	SDC D,E,F (OSP	HD or sim),
BRACING FR.	AGILITY					
2-R	_	-	0.039105	1	1	1
D2031.014b (I BRACING FR.		Sanitary Waste Pi	ping - Cast Iron	w/flexible coupling	gs, SDC D,E,F (O	SHPD or sim),
2-R	_	-	0.049533	1	1	1
				medical air supply Combined anchora		
R	-	-	1	1	1	1
E, or F (OSHP)		HVAC Galvanized		cting less than 6 sc	q. ft in cross section	onal area, SDC D,
2-R	_	_	0.065175	1	1	1
D3041.012d (I E, or F (OSHP)		HVAC Galvanized	l Sheet Metal Du	cting - 6 sq. ft cros	ss sectional area o	or greater, SDC D,
2-R	_	_	0.01738	1	1	1
	D3041.032d #1): 1 DC D, E, or F (OS	•	ffusers without c	eilings - supported	l by ducting only -	- No independent
2-R	-	-	1	1	1	1
				nent that is either h lator & equipment		s vibration
2-R	_	-	1	1	1	1
				ipment that is eithe lator & equipment		or is vibration
G	_	_	1	1	1	1
D4011.024a (l	D4011.024a #1):]	Fire Sprinkler Wa	ter Piping - Horiz	zontal Mains and H	Branches - Old Sty	le Victaulic -
				or sim), PIPING FI		
2-R	_	-	0.1738	1	1	1



6 FRAGILITY INFORMATION

6.1 B1044.011 #1: (B1044.011) Rectangular low aspect ratio concrete walls 8"-16" double curtain; with heights of up to 15'

B1044.011
Andrew Whittaker
144.0 sf
Peak Interstory Drift
3
No
Yes

Component modifications applied:

Component Group	Structural
Quantity Scale Factor	1.0
Damage Median Scale Factor	1.0
Total Cost Scale Factor	1.391
User cost modification factor	1.0
Regional Cost Scale Factor	1
Date multiplier (to convert from 2011 USD)	1.391
Occupancy Cost Scale Factor	1
Building Value Cost Scale Factor	1

Table 6.1.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

Location	Cost	Time	Capacity
1-2	1	1	1



Table 6.1.2.	Damage state	progression.
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Damage State	Description	Repair Description	Image
DS1	Cracks with maximum widths greater than 0.04 in but less than 0.12 in.	Remove furnishings, ceilings and mechanical, electrical and plumping systems (as neces- sary) 5 feet either side of damaged area. Re- place and repair finishes. Replace furnishings, ceilings and mechanical, electrical and plump- ing systems (as necessary).	
DS2	Crushed core concrete; local- ized concrete cracking with widths greater than 0.12 in; buckling of vertical rebar.	(1) Relocate office eqpt & furniture within 6 ft. of wall, both sides. Install protective cov- ers on floor finishes & adjacent curtain wall system. (2) Remove arch. finishes on wall, both sides. (3) Relocate MEP systems within 6 ft. of wall. (4) Prepare & inject grout 330 ft. of crack per 100 ft2 of wall. (5) Remove 15 ft2 per 100 ft2 of wall & 10 1-ft. long sections of #8 buckled vert. rebar. (6) Replace buckled rebar with new rebar, attach to exposed ends of (E) rebar with mech splices; provide 8 #4 seismic ties at 4 in. oc, ea end of wall; re- bend 16 horiz. rebar in wall around new rebar. (7) Install formwork & cast 5ksi concrete into pockets cut in step 5. (8) Strip forms, clean- up, reinstall/return office eqpt., finishes, fur- niture & MEP.	
DS3	Sliding of the wall resulting in large residual displacement; dis- tributed concrete cracking with widths greater than 0.12 in; frac- ture of rebar.	 (1) Relocate eqpt.& furniture within 10 ft. of wall, both sides. Install protection on floor & adjacent walls. (2) Remove wall finishes, both sides. (3) Relocate MEP within 10 ft. of wall. (4) Remove damaged wall in 5-ft.lengths. (5) Install bars: a. 12#9 A706 bars in bz ea. end; mech splices to (E) ; b. #4 A706 dbl sets of seismic ties at 4 in. oc ea bz; c. #4 A706 bar at 6 in. oc, ewef; lap new vert. bars to (E) at top of wall; drill & epoxy bars into wall/fdn at 6 in. oc to match new rebar above. Anchor horiz. Bars in bz with seismic hks or lap 24 in. with (E) horiz. bars. (6) Form wall. Cast 5ksi concrete in 3-ft. lifts; with 1-in. top gap for grout day after casting. (7) Remove forms, clean-up & reinstall/return eqpt, finishes, fur- niture & MEP. 	in the



Table 6.1.3. Parameters for the damage state distributions. The medians reflect a scale factor of **<u>1.0</u>** applied to the default values.

	DS1	DS2	DS3
Туре	Sequential	Sequential	Sequential
Probability	-	-	-
Median	0.0055	0.0109	0.013
β	0.36	0.3	0.36

Table 6.1.4. Parameters for the cost distributions. The cost values reflect a total scale factor of **<u>1.391</u>** applied to the default values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor, building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1	DS2	DS3
Distribution Type	LogNormal	LogNormal	LogNormal
Lower Qty.	3.0	3.0	3.0
Upper Qty.	7.0	7.0	7.0
Highest Cost Median	\$10,516	\$27,141	\$50,692
Lowest Cost Median	\$7,151	\$18,456	\$34,471
β (COV)	0.16	0.13	0.11

Table 6.1.5. Parameters for the repair time distributions.

	DS1	DS2	DS3
Distribution Type	LogNormal	LogNormal	LogNormal
Lower Qty.	3.0	3.0	3.0
Upper Qty.	7.0	7.0	7.0
Highest Median Repair Time (Days)	5.89	15.21	28.4
Lowest Median Repair Time (Days)	4	10.34	19.31
β (COV)	0.29	0.28	0.28

Table 6.1.6. Life safety information.

	DS1	DS2	DS3
Non-collapse casualties Affected Area	No 	No 	No
Serious Injury Median Serious Injury β			-
Loss of Life Median Loss of Life β			
Can Cause Red Tag Unsafe Placard Median Unsafe Placard β	No 	Yes 0.5 0.5	Yes 0.25 0.5

.....



6.2 B1071.202 #1: (B1071.202) Exterior Structural Wall - Light framed wood walls with structural panel sheathing, with hold-downs

NISTIR Classification	B1071.202	
Author	HBRG (exterio	or only)
Normalized Unit	100.0 sf	
Engineering Demand Parameter	Peak Interstory	/ Drift
Number of Damage States	3	
Is correlated?	No	
Is directional?	Yes	
Component modifications applie	d:	
Component Group		Structural
Component Group Quantity Scale Factor		Structural 1.0
1 1		
Quantity Scale Factor		1.0
Quantity Scale Factor Damage Median Scale Factor		1.0 1.0
Quantity Scale Factor Damage Median Scale Factor Total Cost Scale Factor		1.0 1.0 1.391
Quantity Scale Factor Damage Median Scale Factor Total Cost Scale Factor User cost modification factor	n 2011 USD)	1.0 1.0 1.391 1.0
Quantity Scale Factor Damage Median Scale Factor Total Cost Scale Factor User cost modification factor Regional Cost Scale Factor	n 2011 USD)	1.0 1.0 1.391 1.0 1

Table 6.2.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

Location	Cost	Time	Capacity
1-2	1	1	1

Table 6.2.2.	Damage state	progression.
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Damage State	Description	Repair Description	Image
DS1	Slight separation of sheathing or nails which come loose.	Remove exterior pliable siding, replace loose nails, reinstall siding.	
DS2	Permanent rotation of sheathing, tear out of nails or sheathing.	Remove exterior pliable siding, remove wood sheathing, install new sheathing, reinstall sid-ing.	
DS3	Fracture of studs, major sill plate cracking.	Remove and replace siding, sheathing, studs and plates. Provide shoring as required.	



Table 6.2.3. Parameters for the damage state distributions. The medians reflect a scale factor of **<u>1.0</u>** applied to the default values.

	DS1	DS2	DS3
Туре	Sequential	Sequential	Sequential
Probability	-	-	-
Median	0.015	0.0262	0.0369
β	0.4	0.19	0.2

Table 6.2.4. Parameters for the cost distributions. The cost values reflect a total scale factor of **<u>1.391</u>** applied to the default values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor, building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1	DS2	DS3
Distribution Type	LogNormal	LogNormal	LogNormal
Lower Qty.	3.0	3.0	3.0
Upper Qty.	8.0	8.0	8.0
Highest Cost Median	\$1,539	\$1,928	\$4,281
Lowest Cost Median	\$947	\$1,366	\$3,033
β (COV)	0.19	0.22	0.08

Table 6.2.5. Parameters for the repair time distributions.

	DS1	DS2	DS3
Distribution Type	LogNormal	LogNormal	LogNormal
Lower Qty.	3.0	3.0	3.0
Upper Qty.	8.0	8.0	8.0
Highest Median Repair Time (Days)	1.07	1.35	2.99
Lowest Median Repair Time (Days)	0.66	0.95	2.12
β (COV)	0.31	0.33	0.26

Table 6.2.6. Life safety information.

	DS1	DS2	DS3
Non-collapse casualties Affected Area	No 	No 	No
Serious Injury Median Serious Injury β			-
Loss of Life Median Loss of Life β			
Can Cause Red Tag Unsafe Placard Median Unsafe Placard β	No 	Yes 0.5 0.5	Yes 0.25 0.5

-

6.3 B2011.401 #1: (B2011.401) Exterior Wall - Light framed wood walls with exterior panelized sheathing (OSB) and horizontal wood siding, no hold-downs

NISTIR Classification	B2011.401
Author	HBRG (exterior only modifications)
Normalized Unit	100.0 sf
Engineering Demand Parameter	Peak Interstory Drift
Number of Damage States	3
Is correlated?	No
Is directional?	Yes

Component modifications applied:

Component Group	Exterior Finishes
Quantity Scale Factor	1.0
Damage Median Scale Factor	1.0
Total Cost Scale Factor	1.391
User cost modification factor	1.0
Regional Cost Scale Factor	1
Date multiplier (to convert from 2011 USD)	1.391
Occupancy Cost Scale Factor	1
Building Value Cost Scale Factor	1

Table 6.3.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

Location	Cost	Time	Capacity
1-2	1	1	1

Table 6.3.2. Damage state progression.

Damage State	Description	Repair Description	Image
DS1	Slight separation of sheathing or nails which come loose.	Remove exterior pliable siding, replace loose nails, reinstall siding.	
DS2	Permanent rotation of sheathing, tear out of nails or sheathing.	Remove exterior pliable siding, remove wood sheathing, install new sheathing, reinstall sid-ing.	
DS3	Fracture of studs, major sill plate cracking.	Remove and replace siding, sheathing, studs and plates. Provide shoring as required.	



Table 6.3.3. Parameters for the damage state distributions. The medians reflect a scale factor of **<u>1.0</u>** applied to the default values.

	DS1	DS2	DS3
Туре	Sequential	Sequential	Sequential
Probability	-	-	-
Median	0.01	0.0175	0.025
β	0.4	0.4	0.4

Table 6.3.4. Parameters for the cost distributions. The cost values reflect a total scale factor of **<u>1.391</u>** applied to the default values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor, building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1	DS2	DS3
Distribution Type	LogNormal	LogNormal	Normal
Lower Qty.	3.0	3.0	3.0
Upper Qty.	8.0	8.0	8.0
Highest Cost Median	\$412	\$879	\$2,721
Lowest Cost Median	\$175	\$374	\$1,156
β (COV)	0.19	0.22	0.08

Table 6.3.5. Parameters for the repair time distributions.

	DS1	DS2	DS3
Distribution Type	LogNormal	LogNormal	Normal
Lower Qty.	3.0	3.0	3.0
Upper Qty.	8.0	8.0	8.0
Highest Median Repair Time (Days)	0.86	1.08	2.4
Lowest Median Repair Time (Days)	0.53	0.77	1.7
β (COV)	0.31	0.33	0.26

Table 6.3.6. Life safety information.

	DS1	DS2	DS3
Non-collapse casualties Affected Area	No 	No 	No
Serious Injury Median Serious Injury β			-
Loss of Life Median Loss of Life β			
Can Cause Red Tag Unsafe Placard Median Unsafe Placard β	No 	Yes 0.5 0.5	Yes 0.25 0.5

NISTIR Classification Author Normalized Unit Engineering Demand Parameter Number of Damage States Is correlated?	C1011.211a DaveWelch (HBRG) 100.0 lf Peak Interstory Drift 3 No
Is directional?	Yes
Component modifications applie	
Component Group	Partition Walls
Quantity Scale Factor	1.0
Damage Median Scale Factor	1.0
Total Cost Scale Factor	1.391
User cost modification factor	1.0
Regional Cost Scale Factor	1
Date multiplier (to convert from	n 2011 USD) 1.391
Occupancy Cost Scale Factor	1
Building Value Cost Scale Fact	or 1

6.4 C1011.211a #1: (C1011.211a) Wall Partition - Type: Gypsum with wood studs (both sides), Full Height, Fixed Below, Fixed Above

Table 6.4.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

Location	Cost	Time	Capacity
1-2	1	1	1

Table 6.4.2. Damage state progression.

Damage State	Description	Repair Description	Image
DS1	Cracking of paint over fasteners or joints.	Gypsum wallboard repaired by replacing the tape along the seam of two adjacent panels and local areas with popped fasteners, apply- ing new joint compound, sanding, and repaint- ing.	Not Available
DS2	Local and global buckling out- of-plane and crushing of gyp- sum wallboards. Studs are typ- ically not damaged by failure of the gypsum wallboard.	Replace 25 feet of the affected panel along with the application of new tape, joint com- pound, followed by sanding and repainting. Studs are not damaged.	Not Available
DS3	Local and global buckling out- of-plane and crushing of gyp- sum wallboards. Studs are typ- ically not damaged by failure of the gypsum wallboard, but fram- ing adjustments possible for this damage state.	Replace 100 feet of the affected panel along with the application of new tape, joint com- pound, followed by sanding and repainting. Studs are not damaged.	Not Available



Table 6.4.3. Parameters for the damage state distributions. The medians reflect a scale factor of **<u>1.0</u>** applied to the default values.

	DS1	DS2	DS3
Туре	Sequential	Sequential	Sequential
Probability	-	-	-
Median	0.0021	0.0071	0.012
β	0.6	0.45	0.45

Table 6.4.4. Parameters for the cost distributions. The cost values reflect a total scale factor of **<u>1.391</u>** applied to the default values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor, building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1	DS2	DS3
Distribution Type	Normal	Normal	LogNormal
Lower Qty.	1.0	1.0	1.0
Upper Qty.	10.0	10.0	10.0
Highest Cost Median	\$5,328	\$11,425	\$37,656
Lowest Cost Median	\$1,598	\$3,428	\$11,297
β (COV)	0.42	0.49	0.1

Table 6.4.5. Parameters for the repair time distributions.

	DS1	DS2	DS3
Distribution Type	Normal	Normal	LogNormal
Lower Qty.	1.0	1.0	1.0
Upper Qty.	10.0	10.0	10.0
Highest Median Repair Time (Days)	2.99	6.4	21.1
Lowest Median Repair Time (Days)	0.9	1.92	6.33
β (COV)	0.52	0.55	0.34

Table 6.4.6. Life safety information.

	DS1	DS2	DS3
Non-collapse casualties Affected Area	No 	No 	No
Serious Injury Median Serious Injury β			
Loss of Life Median Loss of Life β		_	
Can Cause Red Tag Unsafe Placard Median Unsafe Placard β	No 	No 	No

6.5 C1011.311a #1: (C1011.311a) Interior of Exterior Wall - Type: Gypsum with wood studs (single-sided gypsum), Full Height, Fixed Below, Fixed Above

NISTIR Classification	C1011.311a
Author	Dave Welch (HBRG)
Normalized Unit	100.0 lf
Engineering Demand Parameter	Peak Interstory Drift
Number of Damage States	3
Is correlated?	No
Is directional?	Yes

Component modifications applied:

Component Group	Partition Walls
Quantity Scale Factor	1.0
Damage Median Scale Factor	1.0
Total Cost Scale Factor	1.391
User cost modification factor	1.0
Regional Cost Scale Factor	1
Date multiplier (to convert from 2011 USD)	1.391
Occupancy Cost Scale Factor	1
Building Value Cost Scale Factor	1

Table 6.5.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

Location	Cost	Time	Capacity
1-2	1	1	1

Table 6.5.2. Damage state progression.

Damage State	Description	Repair Description	Image
DS1	Cracking of paint over fasteners or joints.	Gypsum wallboard repaired by replacing the tape along the seam of two adjacent panels and local areas with popped fasteners, apply- ing new joint compound, sanding, and repaint- ing.	Not Available
DS2	Local and global buckling out- of-plane and crushing of gyp- sum wallboards. Studs are typ- ically not damaged by failure of the gypsum wallboard.	Replace 25 feet of the affected panel along with the application of new tape, joint com- pound, followed by sanding and repainting. Studs are not damaged.	Not Available
DS3	Local and global buckling out- of-plane and crushing of gyp- sum wallboards. Studs are typ- ically not damaged by failure of the gypsum wallboard, but fram- ing adjustments possible for this damage state.	Replace 100 feet of the affected panel along with the application of new tape, joint com- pound, followed by sanding and repainting. Studs are not damaged.	Not Available

	DS1	DS2	DS3
Туре	Sequential	Sequential	Sequential
Probability	-	-	-
Median	0.0021	0.0071	0.012
β	0.6	0.45	0.45

Table 6.5.4. Parameters for the cost distributions. The cost values reflect a total scale factor of **<u>1.391</u>** applied to the default values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor, building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1	DS2	DS3
Distribution Type	Normal	Normal	LogNormal
Lower Qty.	1.0	1.0	1.0
Upper Qty.	10.0	10.0	10.0
Highest Cost Median	\$3,015	\$7,411	\$23,838
Lowest Cost Median	\$904	\$2,223	\$7,151
β (COV)	0.42	0.49	0.1

Table 6.5.5. Parameters for the repair time distributions.

	DS1	DS2	DS3
Distribution Type	Normal	Normal	LogNormal
Lower Qty.	1.0	1.0	1.0
Upper Qty.	10.0	10.0	10.0
Highest Median Repair Time (Days)	1.69	4.15	13.36
Lowest Median Repair Time (Days)	0.51	1.25	4.01
β (COV)	0.52	0.55	0.34

Table 6.5.6. Life safety information.

	DS1	DS2	DS3
Non-collapse casualties Affected Area	No 	No 	No
Serious Injury Median Serious Injury β			-
Loss of Life Median Loss of Life β			-
Can Cause Red Tag Unsafe Placard Median Unsafe Placard β	No 	No 	No



6.6 C2011.041b #1: (C2011.041b) Light frame stair fragility. Approximation as a placeholder until there is more research on the topic. Damage states from P-58 Light frame stair example. Costing approximated from various online sources for stair replacement.

NISTIR Classification Author Normalized Unit Engineering Demand Parameter Number of Damage States Is correlated? Is directional?	C2011.041b HBRG 1.0 each Peak Interstory 3 No Yes	y Drift
Component modifications applie	ed:	
Component Group		Other Nonstructural
Quantity Scale Factor		1.0
Damage Median Scale Factor		1.0
Total Cost Scale Factor		1.391
User cost modification factor		1.0
Regional Cost Scale Factor		1
Date multiplier (to convert from	n 2011 USD)	1.391
Occupancy Cost Scale Factor		1
Building Value Cost Scale Fact	or	1

Table 6.6.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

Location	Cost	Time	Capacity
1-2	1	1	1

Table 6.6.2. Damage state progression.

Damage State	Description	Repair Description	Image
DS1	Cosmetic Damage.	Repair cosmetic damage.	Not Available
DS2	Structural damage but live load capacity remains intact.	Repair damage.	Not Available
DS3	Loss of live load capacity.	Replace stair.	Not Available

Table 6.6.3. Parameters for the damage state distributions. The medians reflect a scale factor of **<u>1.0</u>** applied to the default values.

	DS1	DS2	DS3
Туре	Sequential	Sequential	Sequential
Probability	-	-	-
Median	0.011	0.026	0.05
β	0.5	0.5	0.5

Table 6.6.4. Parameters for the cost distributions. The cost values reflect a total scale factor of **<u>1.391</u>** applied to the default values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor, building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1	DS2	DS3
Distribution Type	LogNormal	LogNormal	Normal
Lower Qty.	5.0	5.0	5.0
Upper Qty.	10.0	10.0	10.0
Highest Cost Median	\$695	\$2,782	\$8,346
Lowest Cost Median	\$487	\$1,043	\$3,130
β (COV)	0.8	0.6	0.4

Table 6.6.5. Parameters for the repair time distributions.

	DS1	DS2	DS3
Distribution Type	LogNormal	LogNormal	Normal
Lower Qty.	5.0	5.0	5.0
Upper Qty.	10.0	10.0	10.0
Highest Median Repair Time (Days)	0.55	2.21	6.62
Lowest Median Repair Time (Days)	0.39	0.83	2.48
β (COV)	1.0	0.7	0.5

Table 6.6.6. Life safety information.

	DS1	DS2	DS3
Non-collapse casualties Affected Area	No 	No 	No
Serious Injury Median Serious Injury β			
Loss of Life Median Loss of Life β		-	
Can Cause Red Tag Unsafe Placard Median Unsafe Placard β	No 	Yes 0.25 0.1	Yes 0.1 0.5

6.7 C3032.004a #1: (C3032.004a) Suspended Ceiling, SDC D,E,F (Ip=1.5), Area (A): A < 250, Vert & Lat support

NISTIR Classification	C3032.004a
Author	Not Given
Normalized Unit	250.0 sf
Engineering Demand Parameter	Peak Floor Acceleration
Number of Damage States	3
Is correlated?	No
Is directional?	No

Component modifications applied:

Component Group	Ceilings
Quantity Scale Factor	1.0
Damage Median Scale Factor	1.0
Total Cost Scale Factor	1.391
User cost modification factor	1.0
Regional Cost Scale Factor	1
Date multiplier (to convert from 2011 USD)	1.391
Occupancy Cost Scale Factor	1
Building Value Cost Scale Factor	1

Table 6.7.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

Location	Cost	Time	Capacity
G-R	1	1	1

Table 6.7.2. Damage state progression.

Damage State	Description	Repair Description	Image
DS1	5 % of ceiling grid and tile damage.	Reinstall, repair, or replace 5% of the ceiling area.	Not Available
DS2	30% of ceiling grid and tile damage.	Replace 30% of the ceiling area.	Not Available
DS3	50% of ceiling grid and tile damage.	Replace the entire ceiling	Not Available



Table 6.7.3. Parameters for the damage state distributions. The medians reflect a scale factor of **<u>1.0</u>** applied to the default values.

	DS1	DS2	DS3
Туре	Sequential	Sequential	Sequential
Probability	-	-	-
Median	1.92	2.34	2.48
β	0.3	0.3	0.3

Table 6.7.4. Parameters for the cost distributions. The cost values reflect a total scale factor of **<u>1.391</u>** applied to the default values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor, building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1	DS2	DS3
Distribution Type	Normal	LogNormal	LogNormal
Lower Qty.	1.0	1.0	1.0
Upper Qty.	10.0	10.0	10.0
Highest Cost Median	\$1,008	\$7,894	\$16,240
Lowest Cost Median	\$303	\$2,368	\$4,872
β (COV)	0.55	0.52	0.2

Table 6.7.5. Parameters for the repair time distributions.

	DS1	DS2	DS3
Distribution Type	Normal	LogNormal	LogNormal
Lower Qty.	1.0	1.0	1.0
Upper Qty.	10.0	10.0	10.0
Highest Median Repair Time (Days)	0.7	5.41	11.15
Lowest Median Repair Time (Days)	0.21	1.62	3.34
β (COV)	0.6	0.58	0.32

Table 6.7.6. Life safety information.

	DS1	DS2	DS3
Non-collapse casualties Affected Area	No 	No 	Yes 250.0 SF
Serious Injury Median Serious Injury β			0.1 0.5
Loss of Life Median Loss of Life β			0.0 0.0
Can Cause Red Tag Unsafe Placard Median Unsafe Placard β	No _	No _	No _

-

NISTIR Classification Author Normalized Unit Engineering Demand Parameter Number of Damage States Is correlated?	C3032.004b Not Given 600.0 sf Peak Floor Ac 3 No	celeration
Is directional?	No	
Component modifications applie	ed:	
Component Group		Ceilings
Quantity Scale Factor		1.0
Damage Median Scale Factor		1.0
Total Cost Scale Factor		1.391
User cost modification factor		1.0
Regional Cost Scale Factor	1	
Date multiplier (to convert fror	1.391	
Occupancy Cost Scale Factor		1
Building Value Cost Scale Fact	tor	1

6.8 C3032.004b #1: (C3032.004b) Suspended Ceiling, SDC D,E,F (Ip=1.5), Area (A): 250 < A < 1000, Vert & Lat support

Table 6.8.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

Location	Cost	Time	Capacity
G-R	1	1	1

Table 6.8.2. Damage state progression.

Damage State	Description	Repair Description	Image
DS1	5 % of ceiling grid and tile damage.	Reinstall, repair, or replace 5% of the ceiling area.	Not Available
DS2	30% of ceiling grid and tile damage.	Replace 30% of the ceiling area.	Not Available
DS3	50% of ceiling grid and tile damage.	Replace the entire ceiling	Not Available



Table 6.8.3. Parameters for the damage state distributions. The medians reflect a scale factor of **<u>1.0</u>** applied to the default values.

	DS1	DS2	DS3
Туре	Sequential	Sequential	Sequential
Probability	_	-	_
Median	1.76	2.26	2.44
β	0.3	0.3	0.3

Table 6.8.4. Parameters for the cost distributions. The cost values reflect a total scale factor of **<u>1.391</u>** applied to the default values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor, building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1	DS2	DS3
Distribution Type	Normal	LogNormal	LogNormal
Lower Qty.	1.0	1.0	1.0
Upper Qty.	10.0	10.0	10.0
Highest Cost Median	\$2,420	\$18,945	\$38,975
Lowest Cost Median	\$726	\$5,683	\$11,692
β (COV)	0.55	0.52	0.2

Table 6.8.5. Parameters for the repair time distributions.

	DS1	DS2	DS3
Distribution Type	Normal	LogNormal	LogNormal
Lower Qty.	1.0	1.0	1.0
Upper Qty.	10.0	10.0	10.0
Highest Median Repair Time (Days)	1.57	12.39	25.55
Lowest Median Repair Time (Days)	0.46	3.7	7.67
β (COV)	0.6	0.58	0.32

Table 6.8.6. Life safety information.

	DS1	DS2	DS3
Non-collapse casualties Affected Area	No 	No 	Yes 650.0 SF
Serious Injury Median Serious Injury β	-		0.1 0.5
Loss of Life Median Loss of Life β	-		0.0 0.0
Can Cause Red Tag Unsafe Placard Median Unsafe Placard β	No 	No 	No

-

NISTIR Classification	C3032.004c Not Given	
Normalized Unit	1800.0 sf	
Engineering Demand Parameter	Peak Floor Ac	celeration
Number of Damage States	3	
Is correlated?	No	
Is directional?	No	
Component modifications applie	ed:	
Component Group		Ceilings
Quantity Scale Factor		1.0
Damage Median Scale Factor		1.0
Total Cost Scale Factor		1.391
User cost modification factor		1.0
Regional Cost Scale Factor		1
Date multiplier (to convert from	n 2011 USD)	1.391
Occupancy Cost Scale Factor		1
Building Value Cost Scale Fact	tor	1

6.9 C3032.004c #1: (C3032.004c) Suspended Ceiling, SDC D,E,F (Ip=1.5), Area (A): 1000 < A < 2500, Vert & Lat support

Table 6.9.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

Location	Cost	Time	Capacity
G-R	1	1	1

Table 6.9.2. Damage state progression.

Damage State	Description	Repair Description	Image
DS1	5 % of ceiling grid and tile damage.	Reinstall, repair, or replace 5% of the ceiling area.	Not Available
DS2	30% of ceiling grid and tile damage.	Replace 30% of the ceiling area.	Not Available
DS3	50% of ceiling grid and tile damage.	Replace the entire ceiling	Not Available



Table 6.9.3. Parameters for the damage state distributions. The medians reflect a scale factor of **<u>1.0</u>** applied to the default values.

	DS1	DS2	DS3
Туре	Sequential	Sequential	Sequential
Probability	_	-	-
Median	1.45	2.1	2.34
β	0.3	0.3	0.3

Table 6.9.4. Parameters for the cost distributions. The cost values reflect a total scale factor of **<u>1.391</u>** applied to the default values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor, building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1	DS2	DS3
Distribution Type	Normal	LogNormal	LogNormal
Lower Qty.	1.0	1.0	1.0
Upper Qty.	10.0	10.0	10.0
Highest Cost Median	\$7,261	\$56,835	\$116,925
Lowest Cost Median	\$2,178	\$17,050	\$35,077
β (COV)	0.55	0.52	0.2

Table 6.9.5. Parameters for the repair time distributions.

	DS1	DS2	DS3
Distribution Type	Normal	LogNormal	LogNormal
Lower Qty.	1.0	1.0	1.0
Upper Qty.	10.0	10.0	10.0
Highest Median Repair Time (Days)	4.64	36.03	74.17
Lowest Median Repair Time (Days)	1.42	10.79	22.25
β (COV)	0.6	0.58	0.32

Table 6.9.6. Life safety information.

	DS1	DS2	DS3
Non-collapse casualties Affected Area	No 	No 	Yes 1700.0 SF
Serious Injury Median Serious Injury β		-	0.1 0.5
Loss of Life Median Loss of Life β			$\begin{array}{c} 0.0\\ 0.0\end{array}$
Can Cause Red Tag Unsafe Placard Median Unsafe Placard β	No 	No 	No

6.10 C3032.004d #1: (C3032.004d) Suspended Ceiling, SDC D,E,F (Ip=1.5), Area (A): A > 2500, Vert & Lat support

NISTIR Classification	C3032.004d
Author	Not Given
Normalized Unit	2500.0 sf
Engineering Demand Parameter	Peak Floor Acceleration
Number of Damage States	3
Is correlated?	No
Is directional?	No

Component modifications applied:

Component Group	Ceilings
Quantity Scale Factor	1.0
Damage Median Scale Factor	1.0
Total Cost Scale Factor	1.391
User cost modification factor	1.0
Regional Cost Scale Factor	1
Date multiplier (to convert from 2011 USD)	1.391
Occupancy Cost Scale Factor	1
Building Value Cost Scale Factor	1

Table 6.10.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

Location	Cost	Time	Capacity
G-R	1	1	1

Table 6.10.2. Damage state progression.

Damage State	Description	Repair Description	Image
DS1	5 % of ceiling grid and tile damage.	Reinstall, repair, or replace 5% of the ceiling area.	Not Available
DS2	30% of ceiling grid and tile damage.	Replace 30% of the ceiling area.	Not Available
DS3	50% of ceiling grid and tile damage.	Replace the entire ceiling	Not Available



Table 6.10.3. Parameters for the damage state distributions. The medians reflect a scale factor of $\underline{1.0}$ applied to the default values.

	DS1	DS2	DS3
Туре	Sequential	Sequential	Sequential
Probability	_	-	_
Median	1.31	2.03	2.29
eta	0.3	0.3	0.3

Table 6.10.4. Parameters for the cost distributions. The cost values reflect a total scale factor of **1.391** applied to the default
values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor,
building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1	DS2	DS3
Distribution Type	Normal	LogNormal	LogNormal
Lower Qty.	1.0	1.0	1.0
Upper Qty.	10.0	10.0	10.0
Highest Cost Median	\$10,085	\$78,937	\$162,396
Lowest Cost Median	\$3,025	\$23,681	\$48,719
β (COV)	0.55	0.52	0.2

Table 6.10.5. Parameters for the repair time distributions.

	DS1	DS2	DS3
Distribution Type	Normal	LogNormal	LogNormal
Lower Qty.	1.0	1.0	1.0
Upper Qty.	10.0	10.0	10.0
Highest Median Repair Time (Days)	6.09	48.45	99.54
Lowest Median Repair Time (Days)	1.76	14.57	29.83
β (COV)	0.6	0.58	0.32

Table 6.10.6. Life safety information.

DS1	DS2	DS3
No 	No 	Yes 2500.0 SF
		0.1 0.5
_		0.0 0.0
No _ _	Yes 0.75 0.5	Yes 0.5 0.5
	No - - - -	No No - - - - - - - - - - - - No Yes - 0.75

6.11 C3034.002 #1: (C3034.002) Independent Pendant Lighting - seismically rated

NISTIR Classification	C3034.002
Author	Not Given
Normalized Unit	1.0 each
Engineering Demand Parameter	Peak Floor Acceleration
Number of Damage States	1
Is correlated?	No
Is directional?	No

Component modifications applied:

Component Group	Lighting
Quantity Scale Factor	1.0
Damage Median Scale Factor	1.0
Total Cost Scale Factor	1.391
User cost modification factor	1.0
Regional Cost Scale Factor	1
Date multiplier (to convert from 2011 USD)	1.391
Occupancy Cost Scale Factor	1
Building Value Cost Scale Factor	1

Table 6.11.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

Location	Cost	Time	Capacity
G-R	1	1	1

Damage State	Description	Repair Description	Image
DS1	Disassembly of rod system at connections with horizontal light fixture, low cycle fatigue failure of the threaded rod, pullout of rods from ceiling assembly.	Replace damaged lighting components.	Not Available



Table 6.11.3. Parameters for the damage state distributions. The medians reflect a scale factor of $\underline{1.0}$ applied to the default values.

	DS1
Туре	Sequential
Probability	-
Median	1.5
β	0.4

Table 6.11.4. Parameters for the cost distributions. The cost values reflect a total scale factor of 1.391 applied to the default
values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor,
building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1
Distribution Type	LogNormal
Lower Qty.	5.0
Upper Qty.	10.0
Highest Cost Median	\$1,377
Lowest Cost Median	\$413
β (COV)	0.64

Table 6.11.5. Parameters for the repair time distributions.

	DS1
Distribution Type	LogNormal
Lower Qty.	5.0
Upper Qty.	10.0
Highest Median Repair Time (Days)	0.99
Lowest Median Repair Time (Days)	0.3
β (COV)	0.68

Table 6.11.6.	Life s	safety	information.
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	DS1
Non-collapse casualties	No
Affected Area	
Serious Injury Median	-
Serious Injury β	_
Loss of Life Median	-
Loss of Life β	-
Can Cause Red Tag	No
Unsafe Placard Median Unsafe Placard β	-
Unsale Flacal d p	—

6.12 D1014.021 #1: (D1014.021) Hydraulic Elevator - Applies to most California Installations 1976 or later, most western states installations postdating 1982 and most U.S installations postdating 1998.

NISTIR Classification	D1014.021	
Author	Not Given	
Normalized Unit	1.0 each	
Engineering Demand Parameter	Peak Floor Ac	celeration
Number of Damage States	1	
Is correlated?	No	
Is directional?	No	
Component modifications applie	d:	
Component Group		Elevators
Quantity Scale Factor		1.0
Damage Median Scale Factor		1.0
Total Cost Scale Factor		1.391
User cost modification factor		1.0
Regional Cost Scale Factor		1
Date multiplier (to convert from	n 2011 USD)	1.391
Occupancy Cost Scale Factor		1
Building Value Cost Scale Fact	or	1

Table 6.12.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

Location	Cost	Time	Capacity
G-R	1	1	1

Table 6.12.2. Damage state progression.

Damage State	Description	Repair Description	Image
DS1a	Damaged controls.	Multiple repairs possible (% change of each): Repair damaged controls (100%)	Not Available
DS1b	Damaged vane and hoist-way switches, and or bent cab stabi- lizers, and or damaged car guide shoes.	Multiple repairs possible ($\%$ change of each): Repair damaged vane and hoist-way switches (41 $\%$), and or repair bent cab stabilizers (41 $\%$), and or repair damaged car guide shoes (41 $\%$).	Not Available
DS1c	Damaged entrance and car door, and or flooring damage.	Multiple repairs possible (% change of each): Repair damage to doors (68%), and or repair flooring (46%)	Not Available
DS1d	Oil leak in hydraulic line, and or hydraulic tank failure.	Multiple repairs possible (% change of each): Repair oil leak in hydraulic line (27%), and or hydraulic tank failure (81%)	Not Available





Table 6.12.3. Parameters for the damage state distributions.	The medians reflect a scale factor of $\underline{1.0}$ applied to the default
values.	

	DS1a	DS1b	DS1c	DS1d
Туре	Simultaneous	Simultaneous	Simultaneous	Simultaneous
Probability	0.3	0.49	0.44	0.37
Median	0.5	0.5	0.5	0.5
eta	0.3	0.3	0.3	0.3

Table 6.12.4. Parameters for the cost distributions. The cost values reflect a total scale factor of 1.391 applied to the default
values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor,
building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1a	DS1b	DS1c	DS1d
Distribution Type	LogNormal	Normal	Normal	LogNormal
Lower Qty.	5.0	5.0	5.0	5.0
Upper Qty.	10.0	10.0	10.0	10.0
Highest Cost Median	\$2,226	\$22,812	\$33,383	\$6,398
Lowest Cost Median	\$668	\$6,844	\$10,015	\$1,920
β (COV)	0.82	0.32	0.44	0.25

Table 6.12.5. Parameters for the repair time distributions.

	DS1a	DS1b	DS1c	DS1d
Distribution Type	LogNormal	Normal	Normal	LogNormal
Lower Qty.	5.0	5.0	5.0	5.0
Upper Qty.	10.0	10.0	10.0	10.0
Highest Median Repair Time (Days)	1.53	15.68	22.94	4.4
Lowest Median Repair Time (Days)	0.46	4.7	6.88	1.32
β (COV)	0.86	0.41	0.51	0.36

Table 6.12.6. Life safety information.

	DS1a	DS1b	DS1c	DS1d
Non-collapse casualties	No	No	No	No
Affected Area				
Serious Injury Median	_	_	_	_
Serious Injury β	-	-	-	-
Loss of Life Median	_	_	_	_
Loss of Life β	-	-	-	-
Can Cause Red Tag	No	No	No	No
Unsafe Placard Median	_	_	_	_
Unsafe Placard β	-	-	-	-

6.13 D2021.014a #1: (D2021.014a) Cold or Hot Potable - Small Diameter Threaded Steel - (2.5 inches in diameter or less), SDC D, E, or F (OSHPD or sim), PIPING FRAGILITY

NISTIR Classification Author Normalized Unit Engineering Demand Parameter	D2021.014a Not Given 1000.0 lf Peak Floor Ac	celeration
Number of Damage States	2	
Is correlated?	No	
Is directional?	No	
Component modifications applie	d:	
Component Group		Piping
Quantity Scale Factor		1.0
Damage Median Scale Factor		1.0
Total Cost Scale Factor		1.391
User cost modification factor		1.0
Regional Cost Scale Factor		1
Date multiplier (to convert from	n 2011 USD)	1.391
Occupancy Cost Scale Factor		1
Building Value Cost Scale Factor	or	1

Table 6.13.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

Location	Cost	Time	Capacity
G-R	1	1	1

Table 6.13.2. Damage state progression.

Damage State	Description	Repair Description	Image
DS1	Minor leakage at flange connec- tions - 1 leak per 1000 feet of pipe.	Retighten flange bolts at leaking joints. One joint per 1000 LF.	Not Available
DS2	Pipe Break - 1 break per 1000 feet of pipe.	Replace 20 foot sections of pipe where breaks occur. One repair per 1000 LF.	Not Available



Table 6.13.3. Parameters for the damage state distributions. The medians reflect a scale factor of $\underline{1.0}$ applied to the default values.

	DS1	DS2
Туре	Sequential	Sequential
Probability	_	-
Median	2.25	4.1
β	0.4	0.4

Table 6.13.4. Parameters for the cost distributions. The cost values reflect a total scale factor of 1.391 applied to the default
values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor,
building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1	DS2
Distribution Type	LogNormal	LogNormal
Lower Qty.	3.0	3.0
Upper Qty.	10.0	10.0
Highest Cost Median	\$444	\$4,055
Lowest Cost Median	\$363	\$3,317
β (COV)	0.76	0.41

Table 6.13.5. Parameters for the repair time distributions.

	DS1	DS2
Distribution Type	LogNormal	LogNormal
Lower Qty.	3.0	3.0
Upper Qty.	10.0	10.0
Highest Median Repair Time (Days)	0.34	3.09
Lowest Median Repair Time (Days)	0.28	2.53
β (COV)	0.8	0.48

Table 6.13.6. Life safety information.

DS1	DS2
No 	No
-	-
	-
No -	No -
-	-
	No - - -

6.14 D2021.014b #1: (D2021.014b) Cold or Hot Potable - Small Diameter Threaded Steel - (2.5 inches in diameter or less), SDC D, E, or F (OSHPD or sim), BRACING FRAGILITY

NISTIR Classification Author Normalized Unit Engineering Demand Parameter Number of Damage States	D2021.014b Not Given 1000.0 lf Peak Floor Ac 1	celeration
Is correlated?	No	
Is directional?	No	
Component modifications applie	d:	
Component Group		Piping
Quantity Scale Factor		1.0
Damage Median Scale Factor		1.0
Total Cost Scale Factor		1.391
User cost modification factor		1.0
Regional Cost Scale Factor		1
Date multiplier (to convert from	n 2011 USD)	1.391
Occupancy Cost Scale Factor		1
Building Value Cost Scale Factor	or	1

Table 6.14.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

Location	Cost	Time	Capacity
G-R	1	1	1

Table 6.14.2. Damage state progression.

Damage State	Description	Repair Description	Image
DS1	Lateral Brace Failure - 1 failure per 1000 feet of pipe.	Replace failed lateral braces. One repair per 1000 LF.	Not Available





Table 6.14.3. Parameters for the damage state distributions. The medians reflect a scale factor of 1.0 applied to the default values.

	DS1
Type Probability	Sequential
Probability	-
Median	1.5
β	0.4

Table 6.14.4. Parameters for the cost distributions. The cost values reflect a total scale factor of **1.391** applied to the default values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor, building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1
Distribution Type	LogNormal
Lower Qty.	3.0
Upper Qty.	10.0
Highest Cost Median	\$581
Lowest Cost Median	\$476
β (COV)	0.6

Table 6.14.5. Parameters for the repair time distributions.

	DS1
Distribution Type	LogNormal
Lower Qty.	3.0
Upper Qty.	10.0
Highest Median Repair Time (Days)	0.44
Lowest Median Repair Time (Days)	0.36
β (COV)	0.65

	DS1
Non-collapse casualties Affected Area	No
Serious Injury Median Serious Injury β	
Loss of Life Median Loss of Life β	
Can Cause Red Tag Unsafe Placard Median Unsafe Placard β	No _ _



6.15 D2021.024a #1: (D2021.024a) Cold or Hot Potable Water Piping (dia > 2.5 inches), SDC D,E,F (OSPHD or sim), PIPING FRAGILITY

NISTIR Classification	D2021.024a	
Author	Not Given	
Normalized Unit	1000.0 lf	
Engineering Demand Parameter	Peak Floor Ac	celeration
Number of Damage States	2	
Is correlated?	No	
Is directional?	No	
Component modifications applie	d:	
Component Group		Piping
Quantity Scale Factor		1.0
Damage Median Scale Factor		1.0
Total Cost Scale Factor		1.391
User cost modification factor		1.0
Regional Cost Scale Factor		1
Date multiplier (to convert from	n 2011 USD)	1.391
Occupancy Cost Scale Factor		1
Building Value Cost Scale Factor	or	1

Table 6.15.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

Location	Cost	Time	Capacity
G-R	1	1	1

Table 6.15.2. Damage state progression.

Damage State	Description	Repair Description	Image
DS1	Minor leakage at flange connec- tions - 1 leak per 1000 feet of pipe.	Retighten flange bolts at leaking joints. One joint per 1000 LF.	Not Available
DS2	Pipe Break - 1 break per 1000 feet of pipe.	Replace 20 foot sections of pipe where breaks occur. One repair per 1000 LF.	Not Available



Table 6.15.3. Parameters for the damage state distributions. The medians reflect a scale factor of $\underline{1.0}$ applied to the default values.

	DS1	DS2
Type Probability	Sequential	Sequential
Probability	-	_
Median	2.25	4.1
eta	0.4	0.4

Table 6.15.4. Parameters for the cost distributions. The cost values reflect a total scale factor of 1.391 applied to the default
values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor,
building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1	DS2
Distribution Type	LogNormal	LogNormal
Lower Qty.	5.0	5.0
Upper Qty.	10.0	10.0
Highest Cost Median	\$974	\$9,319
Lowest Cost Median	\$292	\$2,796
β (COV)	0.65	0.4

Table 6.15.5. Parameters for the repair time distributions.

	DS1	DS2
Distribution Type	LogNormal	LogNormal
Lower Qty.	5.0	5.0
Upper Qty.	10.0	10.0
Highest Median Repair Time (Days)	0.74	7.09
Lowest Median Repair Time (Days)	0.22	2.13
β (COV)	0.7	0.47

Table 6.15.6. Life safety information.

DS1	DS2
No 	No
-	-
	-
No _	No _
-	_
	No



6.16 D2021.024b #1: (D2021.024b) Cold or Hot Potable Water Piping (dia > 2.5 inches), SDC D,E,F (OSPHD or sim), BRACING FRAGILITY

NISTIR Classification	D2021.024b	
Author	Not Given	
Normalized Unit	1000.0 lf	
Engineering Demand Parameter	Peak Floor Ac	celeration
Number of Damage States	2	
Is correlated?	No	
Is directional?	No	
Component modifications applie	d:	
Component Group		Piping
Quantity Scale Factor		1.0
Damage Median Scale Factor		1.0
Total Cost Scale Factor		1.391
User cost modification factor		1.0
Regional Cost Scale Factor		1
Date multiplier (to convert from	n 2011 USD)	1.391
Occupancy Cost Scale Factor		1
Building Value Cost Scale Factor		1

Table 6.16.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

Location	Cost	Time	Capacity
G-R	1	1	1

Table 6.16.2. Damage state progression.

Damage State	Description	Repair Description	Image
DS1	Lateral Brace Failure - 1 failure per 1000 feet of pipe.	Replace failed lateral braces. One repair per 1000 LF.	Not Available
DS2	Vertical Brace Failure - 1 failure per 1000 feet of pipe	Replace failed vertical braces. One repair per 1000 LF.	Not Available



Table 6.16.3. Parameters for the damage state distributions. The medians reflect a scale factor of $\underline{1.0}$ applied to the default values.

	DS1	DS2
Type Probability	Sequential	Sequential
Probability	_	_
Median	1.5	2.25
β	0.4	0.4

Table 6.16.4. Parameters for the cost distributions. The cost values reflect a total scale factor of 1.391 applied to the default
values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor,
building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1	DS2
Distribution Type	LogNormal	LogNormal
Lower Qty.	5.0	5.0
Upper Qty.	10.0	10.0
Highest Cost Median	\$974	\$974
Lowest Cost Median	\$292	\$292
β (COV)	0.65	0.65

Table 6.16.5. Parameters for the repair time distributions.

	DS1	DS2
Distribution Type	LogNormal	LogNormal
Lower Qty.	5.0	5.0
Upper Qty.	10.0	10.0
Highest Median Repair Time (Days)	0.74	0.74
Lowest Median Repair Time (Days)	0.22	0.22
β (COV)	0.7	0.7

Table 6.16.6. Li	fe safety	information.
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	DS1	DS2
Non-collapse casualties Affected Area	No 	No
Serious Injury Median Serious Injury β		
Loss of Life Median Loss of Life β	_	_
Can Cause Red Tag Unsafe Placard Median Unsafe Placard β	No 	No

6.17 D2031.014b #1: (D2031.014b) Sanitary Waste Piping - Cast Iron w/flexible couplings, SDC D,E,F (OSHPD or sim), BRACING FRAGILITY

D2031.014b	
Not Given	
1000.0 lf	
Peak Floor Ac	celeration
1	
No	
No	
d:	
	Piping
	1.0
	1.0
	1.391
	1.0
	1
n 2011 USD)	1.391
	1
or	1
	Not Given 1000.0 lf Peak Floor Ac 1 No No d: a 2011 USD)

Table 6.17.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

Location	Cost	Time	Capacity
G-R	1	1	1

Table 6.17.2. Damage state progression.

Damage State	Description	Repair Description	Image
DS1	Isolated support failure w/o leak- age - 0.5 support failures per 1000 feet of pipe (assuming sup- ports every 20 feet).	Replace failed supports.	Not Available



Table 6.17.3. Parameters for the damage state distributions. The medians reflect a scale factor of $\underline{1.0}$ applied to the default values.

	DS1
Type Probability	Sequential
Probability	-
Median	3
β	0.5

Table 6.17.4. Parameters for the cost distributions. The cost values reflect a total scale factor of 1.391 applied to the default
values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor,
building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1
Distribution Type	LogNormal
Lower Qty.	5.0
Upper Qty.	10.0
Highest Cost Median	\$1,113
Lowest Cost Median	\$334
β (COV)	0.58

Table 6.17.5. Parameters for the repair time distributions.

	DS1
Distribution Type	LogNormal
Lower Qty.	5.0
Upper Qty.	10.0
Highest Median Repair Time (Days)	0.85
Lowest Median Repair Time (Days)	0.25
β (COV)	0.63

Table 6.17.6.	Life	safety	information.
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	DS1
Non-collapse casualties	No
Affected Area	
Serious Injury Median	-
Serious Injury β	_
Loss of Life Median	-
Loss of Life β	-
Can Cause Red Tag	No
Unsafe Placard Median Unsafe Placard β	-
Unsale Flacal d p	—



6.18 D3032.013c #1: (D3032.013c) Compressor - Capacity: Small non medical air supply - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Combined anchorage/isolator & equipment fragility

NISTIR Classification Author Normalized Unit Engineering Demand Parameter Number of Damage States	D3032.013c Not Given 1.0 each Peak Floor Ac	celeration
Is correlated?	No	
Is directional?	No	
Component modifications applie	ed:	
Component Group		HVAC
Quantity Scale Factor		1.0
Damage Median Scale Factor		1.0
Total Cost Scale Factor		1.391
User cost modification factor		1.0
Regional Cost Scale Factor		1
Date multiplier (to convert from	n 2011 USD)	1.391
Occupancy Cost Scale Factor		1
Building Value Cost Scale Fact	or	1

Table 6.18.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

Location	Cost	Time	Capacity
G-R	1	1	1

Table 6.18.2. I	Damage state	progression.
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Damage State	Description	Repair Description	Image
DS1a	Anchorage failure.	Repair anchorage and concrete pad and re- mount equipment.	
DS1b	Anchorage failure & Equipment damaged beyond repair.	Replace equipment including attached utili- ties in addition to repairing anchorage and concrete pad.	Not Available
DS1c	Motor damaged but anchorage is OK.	Repair Motor - Anchorage and Concrete do not require repair.	Not Available
DS1d	Equipment damaged beyond re- pair but anchorage is OK.	Replace and install equipment including new anchorage if anchorage is post-installed.	Not Available



Table 6.18.3. Parameters for the damage state distributions. The medians reflect a scale factor of $\underline{1.0}$ applied to the default values.

	DS1a	DS1b	DS1c	DS1d
Туре	Mut. Excl.	Mut. Excl.	Mut. Excl.	Mut. Excl.
Probability	0.35	0.15	0.25	0.25
Median	2.046	2.046	2.046	2.046
β	0.5	0.5	0.5	0.5

Table 6.18.4. Parameters for the cost distributions. The cost values reflect a total scale factor of 1.391 applied to the default
values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor,
building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1a	DS1b	DS1c	DS1d
Distribution Type	LogNormal	LogNormal	LogNormal	LogNormal
Lower Qty.	1.0	1.0	1.0	1.0
Upper Qty.	5.0	5.0	5.0	5.0
Highest Cost Median	\$689	\$4,820	\$1,148	\$4,820
Lowest Cost Median	\$563	\$3,943	\$939	\$3,943
β (COV)	0.55	0.26	0.17	0.26

Table 6.18.5. Parameters for the repair time distributions.

	DS1a	DS1b	DS1c	DS1d
Distribution Type	LogNormal	LogNormal	LogNormal	LogNormal
Lower Qty.	1.0	1.0	1.0	1.0
Upper Qty.	5.0	5.0	5.0	5.0
Highest Median Repair Time (Days)	0.58	1.48	0.97	4.08
Lowest Median Repair Time (Days)	0.48	0.74	0.79	3.34
β (COV)	0.6	0.36	0.3	0.36

Table 6.18.6. Life safety information.

	DS1a	DS1b	DS1c	DS1d
Non-collapse casualties Affected Area	No 	No	No 	No
Serious Injury Median Serious Injury β	-		-	
Loss of Life Median Loss of Life β	-	-	-	
Can Cause Red Tag Unsafe Placard Median Unsafe Placard β	No 	No 	No 	No



6.19 D3041.011d #1: (D3041.011d) HVAC Galvanized Sheet Metal Ducting less than 6 sq. ft in cross sectional area, SDC D, E, or F (OSHPD or sim)

NISTIR Classification	D3041.011d	
Author	Not Given	
Normalized Unit	1000.0 lf	
Engineering Demand Parameter	Peak Floor Ac	celeration
Number of Damage States	2	
Is correlated?	No	
Is directional?	No	
Component modifications applie	d:	
Component Group		HVAC
Quantity Scale Factor		1.0
Damage Median Scale Factor		1.0
Total Cost Scale Factor		1.391
User cost modification factor		1.0
Regional Cost Scale Factor		1
Date multiplier (to convert from	n 2011 USD)	1.391
Occupancy Cost Scale Factor		1
Building Value Cost Scale Factor		1

Table 6.19.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

Location	Cost	Time	Capacity
G-R	1	1	1

Table 6.19.2. Damage state progression.

Damage State	Description	Repair Description	Image
DS1	Individual supports fail and duct sags - 1 failed support per 1000 feet of ducting.	Replace failed supports and repair ducting in vicinity of failed supports.	Not Available
DS2	Several adjacent supports fail and sections of ducting fall - 60 feet of ducting fail and fall per 1000 foot of ducting.	Replace sections of failed ducting and supports.	Not Available



Table 6.19.3. Parameters for the damage state distributions. The medians reflect a scale factor of $\underline{1.0}$ applied to the default values.

	DS1	DS2
Type Probability	Sequential	Sequential
Probability	_	_
Median	1.5	2.25
β	0.4	0.4

Table 6.19.4. Parameters for the cost distributions. The cost values reflect a total scale factor of 1.391 applied to the default
values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor,
building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1	DS2
Distribution Type	LogNormal	LogNormal
Lower Qty.	1.0	1.0
Upper Qty.	5.0	5.0
Highest Cost Median	\$995	\$9,716
Lowest Cost Median	\$814	\$7,949
β (COV)	0.37	0.1

Table 6.19.5. Parameters for the repair time distributions.

	DS1	DS2
Distribution Type	LogNormal	LogNormal
Lower Qty.	1.0	1.0
Upper Qty.	5.0	5.0
Highest Median Repair Time (Days)	0.84	2.99
Lowest Median Repair Time (Days)	0.69	1.49
β (COV)	0.44	0.27

Table 6.19.6. Life safety information.

DS1	DS2
No	Yes
	15.0 SF
_	0.05
_	0.5
_	0.0
-	0.0
No	No
-	-
_	_
	No - - - -



NISTIR Classification Author Normalized Unit Engineering Demand Parameter	D3041.012d Not Given 1000.0 If Peak Floor Acceleration
Number of Damage States	2
Is correlated?	No
Is directional?	No
Component modifications applie	
Component Group	HVAC
Quantity Scale Factor	1.0
Damage Median Scale Factor	1.0
Total Cost Scale Factor	1.391
User cost modification factor	1.0
Regional Cost Scale Factor	1
Date multiplier (to convert from	n 2011 USD) 1.391
Occupancy Cost Scale Factor	1
Building Value Cost Scale Fac	tor 1

6.20 D3041.012d #1: (D3041.012d) HVAC Galvanized Sheet Metal Ducting - 6 sq. ft cross sectional area or greater, SDC D, E, or F (OSHPD or sim)

Table 6.20.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

Location	Cost	Time	Capacity
G-R	1	1	1

Table 6.20.2. Damage state progression.

Damage State	Description	Repair Description	Image
DS1	Individual supports fail and duct sags - 1 failed support per 1000 feet of ducting.	Replace failed supports and repair ducting in vicinity of failed supports.	Not Available
DS2	Several adjacent supports fail and sections of ducting fall - 60 feet of ducting fail and fall per 1000 foot of ducting.	Replace sections of failed ducting and supports.	Not Available



Table 6.20.3. Parameters for the damage state distributions. The medians reflect a scale factor of $\underline{1.0}$ applied to the default values.

	DS1	DS2
Туре	Sequential	Sequential
Probability	_	-
Median	3.75	4.5
eta	0.4	0.4

Table 6.20.4. Parameters for the cost distributions. The cost values reflect a total scale factor of 1.391 applied to the default
values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor,
building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1	DS2
Distribution Type	LogNormal	LogNormal
Lower Qty.	1.0	1.0
Upper Qty.	5.0	5.0
Highest Cost Median	\$1,454	\$12,164
Lowest Cost Median	\$1,189	\$9,952
β (COV)	0.26	0.08

Table 6.20.5. Parameters for the repair time distributions.

	DS1	DS2
Distribution Type	LogNormal	LogNormal
Lower Qty.	1.0	1.0
Upper Qty.	5.0	5.0
Highest Median Repair Time (Days)	1.23	3.74
Lowest Median Repair Time (Days)	1.01	1.87
β (COV)	0.36	0.26

	DS1	DS2
Non-collapse casualties	No	Yes
Affected Area		50.0 SF
Serious Injury Median	_	0.1
Serious Injury β	_	0.5
Loss of Life Median	_	0.0
Loss of Life β	-	0.0
Can Cause Red Tag	No	No
Unsafe Placard Median	_	_
Unsafe Placard β	_	_

6.21 D3041.032d #1: (D3041.032d) HVAC Drops / Diffusers without ceilings - supported by ducting only - No independent safety wires, SDC D, E, or F (OSHPD or sim)

NISTIR Classification	D3041.032d	
Author	Not Given	
Normalized Unit	10.0 each	
Engineering Demand Parameter	Peak Floor Ac	celeration
Number of Damage States	1	
Is correlated?	No	
Is directional?	No	
Component modifications applie	d:	
Component Group		HVAC
Quantity Scale Factor		1.0
Damage Median Scale Factor		1.0
Total Cost Scale Factor		1.391
User cost modification factor		1.0
Regional Cost Scale Factor		1
Date multiplier (to convert from	n 2011 USD)	1.391
Occupancy Cost Scale Factor		1
Building Value Cost Scale Fact	or	1

Table 6.21.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

Location	Cost	Time	Capacity
G-R	1	1	1

Table 6.21.2. Damage state progression.

Damage State	Description	Repair Description	Image
DS1	HVAC drops or diffusers dis- lodges and falls.	Replace diffuser/drop and sections of ceiling and ducting in vicinity to which diffuser/drop is connected.	Not Available



Table 6.21.3. Parameters for the damage state distributions. The medians reflect a scale factor of 1.0 applied to the default values.

	DS1
Туре	Sequential
Probability	-
Median	1.5
β	0.4

Table 6.21.4. Parameters for the cost distributions. The cost values reflect a total scale factor of **1.391** applied to the default values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor, building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1
Distribution Type	Normal
Lower Qty.	1.0
Upper Qty.	5.0
Highest Cost Median	\$4,590
Lowest Cost Median	\$3,756
β (COV)	0.21

Table 6.21.5. Parameters for the repair time distributions.

	DS1
Distribution Type	Normal
Lower Qty.	1.0
Upper Qty.	5.0
Highest Median Repair Time (Days)	3.88
Lowest Median Repair Time (Days)	3.18
β (COV)	0.32

Table 6.21.6.	Life safet	y information.
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	DC1
	DS1
Non-collapse casualties	Yes
Affected Area	4.0 SF
Serious Injury Median	0.1
Serious Injury β	0.5
Loss of Life Median	0.0
Loss of Life β	0.0
Can Cause Red Tag	No
Unsafe Placard Median	_
Unsafe Placard β	-

6.22 D3041.103c #1: (D3041.103c) HVAC Fan - Capacity: all - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Combined anchorage/isolator & equipment fragility

NISTIR Classification Author Normalized Unit Engineering Demand Parameter Number of Damage States Is correlated?	D3041.103c Not Given 1.0 each Peak Floor Ac 1 No	celeration
Is directional?	No	
Component modifications applie	d:	
Component Group		HVAC
Quantity Scale Factor		1.0
Damage Median Scale Factor		1.0
Total Cost Scale Factor		1.391
User cost modification factor		1.0
Regional Cost Scale Factor		1
Date multiplier (to convert from	n 2011 USD)	1.391
Occupancy Cost Scale Factor		1
Building Value Cost Scale Fact	or	1

Table 6.22.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

Location	Cost	Time	Capacity
G-R	1	1	1

Table 6.22.2.	Damage s	tate progression.
---------------	----------	-------------------

Damage State	Description	Repair Description	Image
DS1a	Anchorage failure.	Repair anchorage and remount equipment.	
DS1b	Anchorage failure & Equipment damaged beyond repair.	Repair anchorage and replace equipment.	Not Available
DS1c	Damaged, Inoperative but an- chorage is OK	Repair equipment.	Not Available



Table 6.22.3. Parameters for the damage state distributions. The medians reflect a scale factor of $\underline{1.0}$ applied to the default values.

	DS1a	DS1b	DS1c
Туре	Mut. Excl.	Mut. Excl.	Mut. Excl.
Probability	0.35	0.15	0.5
Median	1.066	1.066	1.066
β	0.5	0.5	0.5

Table 6.22.4. Parameters for the cost distributions. The cost values reflect a total scale factor of 1.391 applied to the default
values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor,
building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1a	DS1b	DS1c
Distribution Type	LogNormal	LogNormal	LogNormal
Lower Qty.	1.0	1.0	1.0
Upper Qty.	5.0	5.0	5.0
Highest Cost Median	\$1,071	\$5,126	\$4,055
Lowest Cost Median	\$876	\$4,194	\$3,317
β (COV)	0.34	0.18	0.14

Table 6.22.5. Parameters for the repair time distributions.

	DS1a	DS1b	DS1c
Distribution Type	LogNormal	LogNormal	LogNormal
Lower Qty.	1.0	1.0	1.0
Upper Qty.	5.0	5.0	5.0
Highest Median Repair Time (Days)	0.91	0.79	3.43
Lowest Median Repair Time (Days)	0.74	0.2	2.81
β (COV)	0.42	0.31	0.29

Table 6.22.6. Life safety information.

	DS1a	DS1b	DS1c
Non-collapse casualties Affected Area	No 	No 	No
Serious Injury Median Serious Injury β		-	
Loss of Life Median Loss of Life β			
Can Cause Red Tag Unsafe Placard Median Unsafe Placard β	No _ _	No 	No

6.23 D3067.012c #1: (D3067.012c) Control Panel - Capacity: all - Equipment that is either hard anchored or is vibration isolated with seismic snubbers/restraints - Combined anchorage/isolator & equipment fragility

NISTIR Classification	D3067.012c	
Author	Not Given	
Normalized Unit	1.0 each	
Engineering Demand Parameter	Peak Floor Ac	celeration
Number of Damage States	1	
Is correlated?	No	
Is directional?	No	
Component modifications applie	d:	
Component Group		HVAC
Quantity Scale Factor		1.0
Damage Median Scale Factor		1.0
Total Cost Scale Factor		1.391
User cost modification factor		1.0
Regional Cost Scale Factor		1
Date multiplier (to convert from	n 2011 USD)	1.391
Occupancy Cost Scale Factor		1
Building Value Cost Scale Fact	or	1

Table 6.23.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

Location	Cost	Time	Capacity
G-R	1	1	1

Table 6.23.2. Damage state progression.

Damage State	Description	Repair Description	Image
DS1a	Anchorage failure.	Repair anchorage and concrete pad and re- mount equipment.	Not Available
DS1b	Anchorage failure & Equipment damaged beyond repair.	Replace equipment including attached utili- ties in addition to repairing anchorage and concrete pad.	
D\$1c	Damaged, Inoperative but an- chorage is OK	Replace some components (relays, circuit boards	Not Available



Table 6.23.3. Parameters for the damage state distributions. The medians reflect a scale factor of $\underline{1.0}$ applied to the default values.

	DS1a	DS1b	DS1c
Туре	Mut. Excl.	Mut. Excl.	Mut. Excl.
Probability	0.35	0.15	0.5
Median	1.598	1.598	1.598
β	0.5	0.5	0.5

Table 6.23.4. Parameters for the cost distributions. The cost values reflect a total scale factor of 1.391 applied to the default
values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor,
building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1a	DS1b	DS1c
Distribution Type	Normal	Normal	Normal
Lower Qty.	1.0	1.0	1.0
Upper Qty.	5.0	5.0	5.0
Highest Cost Median	\$765	\$7,115	\$6,350
Lowest Cost Median	\$626	\$5,821	\$5,195
β (COV)	0.28	0.19	0.18

Table 6.23.5. Parameters for the repair time distributions.

	DS1a	DS1b	DS1c
Distribution Type	Normal	Normal	Normal
Lower Qty.	1.0	1.0	1.0
Upper Qty.	5.0	5.0	5.0
Highest Median Repair Time (Days)	0.24	6.02	5.37
Lowest Median Repair Time (Days)	0.12	4.92	4.39
β (COV)	0.38	0.32	0.31

Table 6.23.6. Life safety information.

	DS1a	DS1b	DS1c
Non-collapse casualties Affected Area	No 	No 	No
Serious Injury Median Serious Injury β			
Loss of Life Median Loss of Life β			- -
Can Cause Red Tag Unsafe Placard Median Unsafe Placard β	No 	No 	No

6.24 D4011.024a #1: (D4011.024a) Fire Sprinkler Water Piping - Horizontal Mains and Branches - Old Style Victaulic - Thin Wall Steel - with designed bracing, SDC D, E, or F (OSHPD or sim), PIPING FRAGILITY

NISTIR Classification Author Normalized Unit Engineering Demand Parameter	D4011.024a Not Given 1000.0 If Peak Floor Acceleration 2
Number of Damage States Is correlated?	2 No
Is directional?	No
Component modifications applie	ed:
Component Group	Other Nonstructural
Quantity Scale Factor	1.0
Damage Median Scale Factor	1.0
Total Cost Scale Factor	
Total Cost Seale Tactor	1.391
User cost modification factor	1.391 1.0
User cost modification factor	1.0 1
User cost modification factor Regional Cost Scale Factor	1.0 1

Table 6.24.1. Per-level fragility modifications (applied in addition to the values shown for the fragility).

Location	Cost	Time	Capacity
G-R	1	1	1

Table 6.24.2. Damage state progression.

Damage State	Description	Repair Description	Image
DS1	Spraying & Dripping Leakage at joints - 0.02 leaks per 20 ft sec- tion of pipe.	Replace leaking joints and minor water cleanup.	Not Available
DS2	Joints Break - Major Leakage - 0.02 breaks per 20 ft section of pipe.	Replace 20 ft section of pipe, joints and major water cleanup at leaking joints.	Not Available





Table 6.24.3. Parameters for the damage state distributions. The medians reflect a scale factor of $\underline{1.0}$ applied to the default values.

	DS1	DS2
Туре	Sequential	Sequential
Probability	-	-
Median	1.9	3.4
β	0.4	0.4

Table 6.24.4. Parameters for the cost distributions. The cost values reflect a total scale factor of 1.391 applied to the default
values. This scale factor includes the user input scale factor, a regional scale factor, an occupancy scale factor,
building value scale factor, and scale factor to convert the initial 2011 cost estimate to modern day costs.

	DS1	DS2
Distribution Type	LogNormal	LogNormal
Lower Qty.	3.0	3.0
Upper Qty.	10.0	10.0
Highest Cost Median	\$536	\$4,055
Lowest Cost Median	\$438	\$3,317
β (COV)	0.65	0.41

Table 6.24.5. Parameters for the repair time distributions.

	DS1	DS2
Distribution Type	LogNormal	LogNormal
Lower Qty.	3.0	3.0
Upper Qty.	10.0	10.0
Highest Median Repair Time (Days)	0.45	0.94
Lowest Median Repair Time (Days)	0.37	0.31
β (COV)	0.7	0.48

	DS1	DS2
Non-collapse casualties Affected Area	No 	No
Serious Injury Median Serious Injury β		-
Loss of Life Median Loss of Life β	-	
Can Cause Red Tag Unsafe Placard Median Unsafe Placard β	No _	No _



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