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Evaluation of Static and Response Spectrum Analysis Procedures of SEAOC/UBC for Seismic Isolated Structures

by

C.W. Winters[1] and M.C. Constantinou[2]

March 23, 1993

Technical Report NCEER-93-0004

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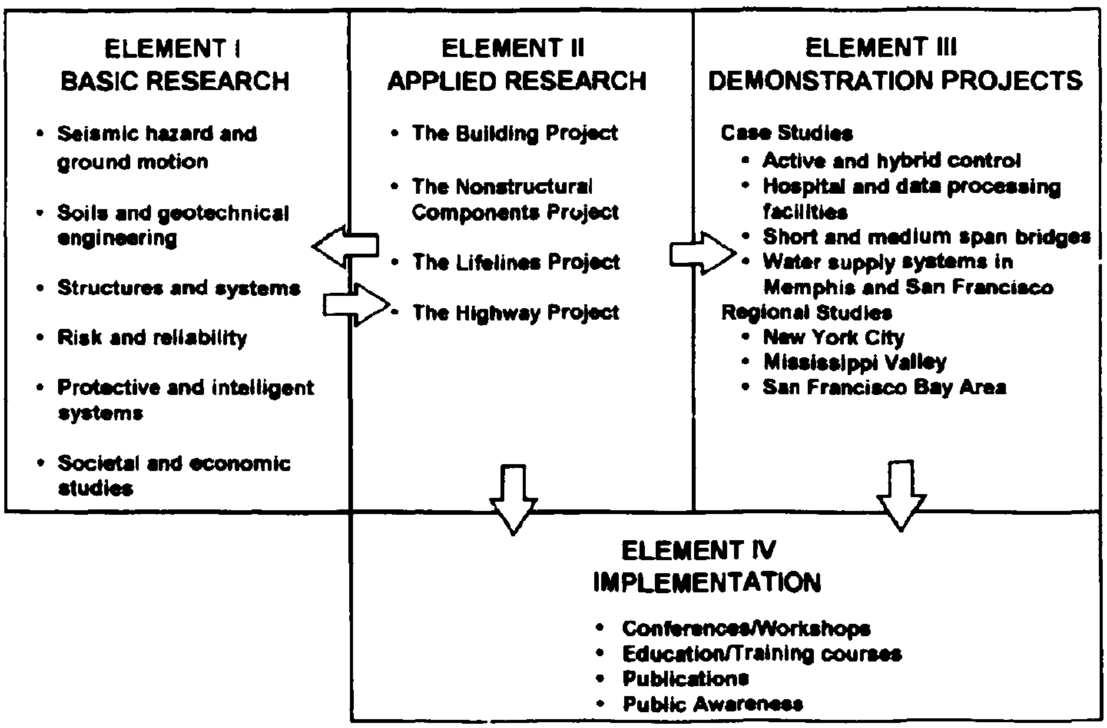
PREFACE

The National Center for Earthquake Engineering Research (NCEER) was established to expand and disseminate knowledge about earthquakes, improve earthquake-resistant design, and implement seismic hazard mitigation procedures to minimize loss of lives and property. The emphasis is on structures in the eastern and central United States and lifelines throughout the country that are found in zones of low, moderate, and high seismicity.

NCEER's research and implementation plan in years six through ten (1991-1996) comprises four interlocked elements, as shown in the figure below. Element I, Basic Research, is carried out to support projects in the Applied Research area. Element II, Applied Research, is the major focus of work for years six through ten. Element III, Demonstration Projects, have been planned to support Applied Research projects, and will be either case studies or regional studies. Element IV, Implementation, will result from activity in the four Applied Research projects, and from Demonstration Projects.



Research in the **Building Project** focuses on the evaluation and retrofit of buildings in regions of moderate seismicity. Emphasis is on lightly reinforced concrete buildings, steel semi-rigid frames, and masonry walls or infills. The research involves small- and medium-scale shake table tests and full-scale component tests at several institutions. In a parallel effort, analytical models and computer programs are being developed to aid in the prediction of the response of these buildings to various types of ground motion.

Two of the short-term products of the **Building Project** will be a monograph on the evaluation of lightly reinforced concrete buildings and a state-of-the-art report on unreinforced masonry.

The **protective and intelligent systems program** constitutes one of the important areas of research in the **Building Project**. Current tasks include the following:

1. Evaluate the performance of full-scale active bracing and active mass dampers already in place in terms of performance, power requirements, maintenance, reliability and cost.
2. Compare passive and active control strategies in terms of structural type, degree of effectiveness, cost and long-term reliability.
3. Perform fundamental studies of hybrid control.
4. Develop and test hybrid control systems.

This report addresses the guidelines and regulations for the design of seismic-isolated structures recently adopted by the Structural Engineers Association of California and the International Conference of Building Officials. The static and response spectrum analysis methods provided in the guidelines are assessed by comparing their results with those obtained from nonlinear dynamic analysis for a class of seismic isolated structures. This comparison is discussed in terms of center bearing displacements, corner bearing displacements, and shear force distribution over the building height over a wide range of structural properties and elastomeric isolation system characteristics.

ABSTRACT

The Structural Engineers Association of California (SEAOC) and the International Conference of Building Officials have adopted guidelines and regulations for the design of seismic-isolated structures. These guidelines and regulations specify procedures for the analysis and design of isolated structures. These procedures include a static analysis method for establishing minimum limits of design, and a dynamic analysis method which includes response spectrum and time history analysis methods.

This report presents a comparison of results of the static and response spectrum analysis methods to results of nonlinear dynamic analysis for a class of seismic-isolated structures. The structures include 1-story (stiff) and 8-story (flexible) superstructures on stiff and medium soil sites and isolation systems described by twenty-two different generic nonlinear hysteretic models, which are representative of a wide range of elastomeric isolation systems.

It is shown that when the response spectrum analysis procedure is properly applied, the static and response spectrum analysis procedures predict results which match the mean of time history results for the bearing displacements and shear forces at the base of the building. However, the static and response spectrum analysis procedures can significantly underpredict the shear force in the upper stories even for the case of low effective damping in the isolation system.

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SECTION 1

INTRODUCTION

Seismic isolation is a relatively old concept that in recent years is being rapidly accepted throughout the world due to current advances in seismic isolation technology. The concept of seismic isolation (or base isolation) is based on the ability to provide a discontinuity between the structure and foundation. This discontinuity decouples the ground vibrations from the structure, causing a reduced level of response than would have been obtained from a fixed-base structure.

By decoupling the structure from the foundation, the lateral accelerations are reduced and hence the lateral forces are reduced. This decoupling is produced by the introduction of flexibility to the isolated structure. This flexibility shifts the fundamental period of the isolated structure to a period higher than the predominant periods of the seismic excitation. At this higher period, the response accelerations are significantly lower than the response accelerations at the fixed-base period. A consequence of the increased flexibility is an increase in the displacement of the system. This displacement needs to be controlled within acceptable design limits through damping or energy dissipating mechanisms.

Conventional fixed-base structures must resist seismic lateral forces through inelastic deformation of the structural system. Inelastic deformation causes an increase in the natural period of the structure and its ability to dissipate energy. The combined result of these effects is a reduction of inertia forces at the expense of damage to the structural system and to the non-structural components, including possible human injury. This damage can lead to liability suits and very costly repairs or demolition and rebuild costs.

The option of providing an isolation system can significantly reduce costs associated with earthquakes. The isolation system can be designed to limit the inelastic response to the isolation elements and therefore allow the structure to be designed as an elastic or nearly elastic system. Since the isolation system reduces the forces transmitted to the superstructure, the components with 31 different bilinear hysteretic properties using a comprehensive collection of 29 pairs of horizontal earthquake motions. The isolation system properties covered the entire range of interest in seismic isolation, that is, effective periods of 1 to 4 seconds and effective damping of 6% to 39% of critical. In general, the study confirmed the validity of the static analysis procedure on the determination of the isolation system displacement.

The study of Kircher and Lashkari (1989) neglected the following effects:

1. Superstructure flexibility. This prevented the calculation of shear force distributions in the superstructure.
2. Bi-directional interaction effects in the isolation bearings. For hysteretic softening systems, the neglect of this interaction typically results in underestimation of the isolation system displacement (Mokha, 1993). The amount of underestimation is greatest in systems with high characteristic strength and low stiffness.
3. The bilinear hysteretic models used did not strictly apply to frictional systems since they all had a yield displacement of 0.5 inches.

The constraints of the Kircher and Lashkari study have been relaxed in a subsequent study of Theodossiou and Constantinou (1991) which concentrated on sliding isolation systems. This study follows the approach established in the study of Theodossiou and Constantinou (1991), but concentrates on the same generic bilinear hysteretic isolation systems as the study of Kircher and Lashkari (1989).

The study provides a set of nonlinear time history analysis results using the comprehensive collection of 29 pairs of components in the Kircher and Lashkari (1989) study and a set of linear response spectrum analysis results. The response spectrum results and the SEAOC/UBC static analysis limits on bearing displacements and shear force distribution are compared to the results of nonlinear time history analysis and conclusions are drawn.

SECTION 2

SEAOC/UBC DESIGN REQUIREMENTS FOR ISOLATED STRUCTURES

2.1 General Requirements

Since the design techniques of different seismic isolation systems vary, the SEAOC/UBC guidelines only provide general requirements and limits that are expected to prevent an unrealistic design. The design requirements allow the use of two different procedures for determining seismic design quantities. The first procedure is called the static analysis procedure and provides a simple method of calculating lower bound limits for design. The static analysis procedure may be used alone in a few cases, where the structure is located away from active faults, is relatively stiff, and is of regular configuration. For all other cases, the guidelines require the second procedure, a rigorous dynamic analysis procedure to determine response quantities.

2.2 Static Analysis Procedure

The SEAOC/UBC regulations specify the following design displacement for the isolation system:

$$D = \frac{10 Z N S_I T_I}{B} \tag{2.1}$$

where:

D = Design displacement in inches at the center of rigidity of the isolation system in the direction under consideration.

Z = Seismic Zone coefficient (Table 2-I)

N = Near-field response coefficient (Table 2-II)

S_I = Site coefficient for soil profile (Table 2-III)

T_I = Period of isolated structure

B = Effective damping coefficient (Table 2-IV)

The period of the isolated structure is given by

$$T_I = 2\pi \sqrt{\frac{W}{K_{min}\, g}} \qquad (2.2)$$

where:

W = Total seismic dead load

K_{min} = Minimum effective stiffness of the isolation system

g = Acceleration due to gravity

TABLE 2-I Seismic Zone Coefficient Z

Seismic Zone	0	1	2A	2B	3	4
Z	0.05	0.1	0.15	0.2	0.3	0.4

TABLE 2-II Near-Field Response Coefficient N

Closest Distance, d_F to an Active Fault[1]	$d_F > 15$ km	$d_F = 10$ km	$d_F < 5$ km
N	1.0	1.2	1.5

[1]Coefficients other than those listed shall be based on linear interpolation.

TABLE 2-III Site Coefficient S_I

Soil Profile Type	S_1	S_2	S_3	S_4
S_I	1.0	1.5	2.0	2.7

TABLE 2-IV Coefficient B Related to Effective Damping

Effective Damping β (Percent of Critical)[1]	< 2%	5%	10%	20%	30%	40%	> 50%
B	0.8	1.0	1.2	1.5	1.7	1.9	2.0

[1]Coefficients other than those listed shall be based on linear interpolation.

The regulations specify a total design displacement, D_T, based on the geometrical dimensions of the base, that is intended to account for torsional displacement at the corner bearings:

$$D_T = D [1 + 12 \frac{ye}{b^2 + d^2}] \tag{2.3}$$

in which e = eccentricity, y = distance between the center of isolation system rigidity and the point of interest, b and d = plan dimensions of the structure.

For verification of the isolation system stability, the regulations require that the bearings be designed for a displacement 50% larger than this total design displacement, D_T. This displacement is called the total maximum design displacement, D_{TM}, and is defined as the displacement, including torsion, in the maximum credible earthquake:

$$D_{TM} = 1.5 D_T \tag{2.4}$$

The regulations specify the design base shear, V_b, at or below the isolation interface that corresponds to the design displacement:

$$V_b = \frac{K_{max} D}{1.5} \tag{2.5}$$

where K_{max} = maximum effective stiffness of the isolation system. The factor of 1.5 is used to approximate the relation between nominal strength and design allowables. For elements above the isolation interface, the regulations specify the following minimum shear force, V_s, and interstory drift ratios:

$$V_S = \frac{K_{max} D}{R_{WI}} \tag{2.6}$$

$$\max \textit{ interstory drift ratio} \leq \frac{0.010}{R_{WI}} \tag{2.7}$$

where R_{WI} is a reduction factor based on the type of structural system.

The distribution of forces over the height of the structure is specified by

$$F_X = \frac{V_S \, w_x}{\sum_{i=1}^{n} w_i} \tag{2.8}$$

where w_i, w_x represent the portion of total seismic dead load assigned to level i or x. Inherent in equation (2.8) is the assumption of constant acceleration over the entire height of the isolated structure.

2.3 Dynamic Analysis Procedure

2.3.1 Conditions for Use

The dynamic analysis procedure is classified as time history analysis or as response spectrum analysis. The time history analysis is the most rigorous analysis procedure since linear or nonlinear behavior can be modeled, while for response spectrum analysis, only linear systems or equivalent linear systems can be modeled. The dynamic analysis procedure is required for design of the following structures:

1. The structure is located within 15 km of an active fault.

2. The structure is located on a soil profile with a site factor S_3 or S_4 (soft or very soft soils).
3. The structure is located in seismic zone number 0, 1, 2A, or 2B.
4. The structure above the isolation interface is greater than 4 stories or 65 feet, in height.
5. The isolated period of the structure is greater than 3 seconds.
6. The isolated period of the structure is less than 3 times the elastic fixed-base period of the structure above the isolation system.
7. The structure above the isolation system is of irregular configuration.

Furthermore, a time history analysis is required under the following conditions:

1. The structure is located on a soil profile with a site factor S_4.
2. The isolation system limits the maximum credible earthquake displacement to less than 1.5 times the design-basis earthquake displacement.
3. The effective stiffness of the isolation system at the design displacement is less than one third of the effective stiffness at 20 percent of the design displacement.
4. The isolation system is not capable of producing a restoring force at the total design displacement of at least 0.025W greater than the lateral force at 50% of the total design displacement.
5. The isolation system has force-deflection properties which are dependent of the rate of loading or dependent of vertical load and bilateral load.

2.3.2 Response Spectrum Analysis

The regulations specify that the response spectrum analysis shall be performed using a damping value equal to the effective damping of the isolation system or 30 percent of critical, whichever is less. Response spectrum analysis used to determine the total design displacement and the total maximum displacement must include simultaneous excitation of the model by 100 percent of the most critical direction of ground motion and 30 percent of the ground motion on the orthogonal axis.

Isolated structures with an isolated period, T_I greater than 3.0 seconds, or located on a soil type profile of S_3 or S_4, or located within 15 km of an active fault or located in Seismic Zone No. 1, 2A or 2B require properly substantiated, site-specific spectra for design. The regulations specify that all other isolated structures not requiring site-specific spectra be designed using response spectra based on spectral shapes of Figure 2-1. These design spectra must not be taken as less than the normalized response spectra given in Figure 2-1 for the appropriate soil type, scaled by the seismic zone coefficient.

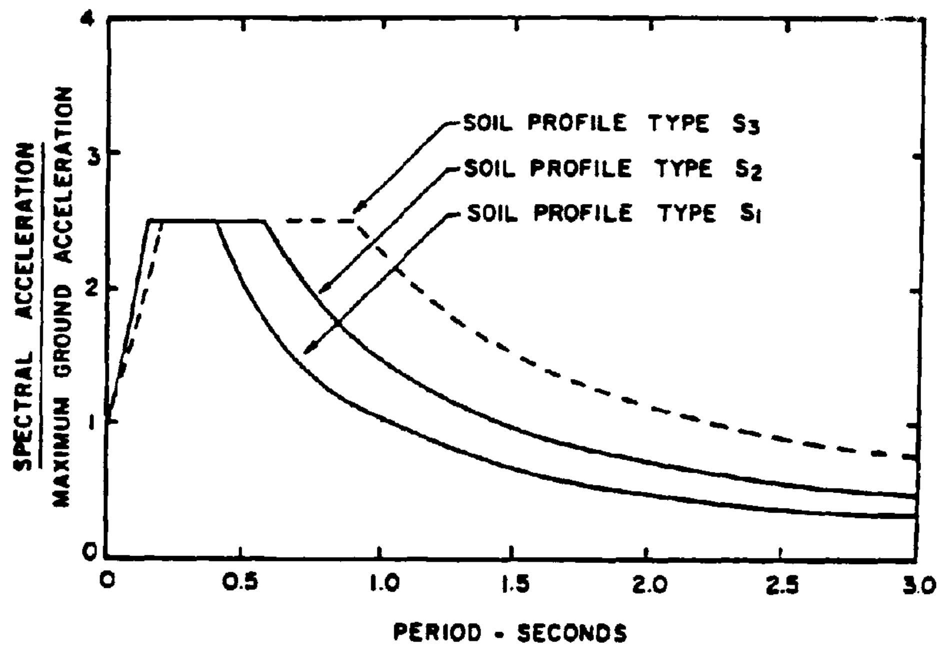


FIGURE 2-1 Normalized Uniform Building Code Response Spectra Shapes

2.3.3 Time History Analysis

The regulations specify that time history analysis be performed with pairs of horizontal ground motion time-history components, selected from at least three recorded events. These motions must be scaled such that the square root sum of the squares (SRSS) of their 5-percent damped spectra does not fall below 1.3 times the 5-percent damped spectrum of the design basis earthquake by more than 10 percent in the period range of T_I, as determined by equation (2-2), for periods from T_I minus 1.0 seconds to T_I plus 2.0 seconds. The duration of the time histories must be consistent with the magnitude and source characteristics of the design basis earthquake (or maximum credible earthquake). Time histories developed for sites within 15 km of a major active fault must incorporate near-fault phenomena. The maximum response of the parameter of interest calculated by the three time history analyses must be used for design.

The time history analysis must account for the following in detail:

1. Spatial distribution of isolators.
2. Torsional effects.
3. Effect of overturning/uplift forces.
4. Effects of vertical load, rate of loading and bi-directional interaction on the force-deflection properties of the isolators.

2.3.4 Lower Bound Limits for Dynamic Analysis Procedure

Certain lower bound limits confine the response values obtained through a dynamic analysis procedure. When the factored lateral shear force on structural elements, determined using either response spectrum analysis or time history analysis, is less than the lower bound limits, then all response parameters, including member forces and moments must be adjusted upward proportionally. The lower bound limits are described below.

2.3.4.1 Isolation System and Structural Elements Below the Isolation Interface

1. The total design displacement of the isolation system shall not be taken as less than 90 percent of D_T as specified by equation (2.3).
2. The total maximum displacement of the isolation system shall not be taken as less than 80 percent of D_{TM} as specified by equation (2.4).
3. The design lateral shear force on the isolation system and structural elements below the isolation interface shall not be taken as less than 90 percent of V_b as prescribed by equation (2.5).

2.3.4.2 Structural Elements Above the Isolation Interface

1. The design lateral shear force on the structure above the isolation interface, if regular in configuration, shall not be taken as less than 80 percent of V_S as prescribed by equation (2.6), nor less than the limits listed below:
   a. The lateral seismic force of a fixed-base structure of the same weight, W, and a period equal to the isolated period, T_I.
   b. The base shear corresponding to the design wind load.
   c. The lateral seismic force required to fully activate the system (eg. yield level of a softening system, ultimate capacity of a sacrificial wind-restraint system or the static friction level of a sliding system).

   EXCEPTION: The design lateral shear force on the structure above the isolation interface, if regular in configuration, may be taken as less than 80 percent of V_s, but not less than 60 percent of V_s, when time history analysis is used for design of the structure.

2. The design lateral shear force on the structure above the isolation interface, if irregular in configuration, shall not be taken as less than V_S as prescribed by equation (2.6), nor less than the limits listed above in 1a, 1b and 1c.

EXCEPTION: The design lateral shear force on the structure above the isolation interface, if irregular in configuration, may be taken as less than V_s, but not less than 80 percent of V_s, when time history analysis is used for design of the structure.

2.3.4.3 Drift Limits

Maximum interstory drift corresponding to the design lateral force must not exceed the following limits:

1. The maximum interstory drift ratio of the structure above the isolation system, calculated by response spectrum analysis, shall not exceed $0.015/R_{WI}$.
2. The maximum interstory drift ratio of the structure above the isolation system, calculated by time history analysis considering the force-deflection characteristics of nonlinear elements of the lateral force resisting system, shall not exceed $0.020/R_{WI}$.
3. The secondary effects of the maximum credible earthquake lateral displacement (delta) of the structure above the isolation system combined with gravity forces shall be investigated if the interstory drift ratio exceeds $0.010/R_{WI}$.

SECTION 3

MODELS OF STRUCTURE AND ISOLATION SYSTEM

3.1 Introduction

The study of Kircher and Lashkari (1989) established a procedure for evaluating the SEAOC/UBC regulations. In this procedure, a comprehensive collection of 29 pairs of scaled earthquake motions are used in time history analyses of an isolated structure supported by 45 isolators. The earthquake motions are representative of Seismic Zone 4 and soil conditions S_1 or S_2. The results of the time history analyses are used to obtain statistical response quantities for comparison to the results obtained by the procedures of the SEAOC/UBC regulations.

This study follows the procedure established by Kircher and Lashkari (1989) but accounts for the following which were neglected in the Kircher and Lashkari study:

1. Flexibility of the superstructure, and
2. Bi-directional interaction effects at the isolation bearings.

In this way, a new collection of nonlinear time history analysis results is created for comparison to the results obtained by the static and response spectrum analysis procedures of SEAOC/UBC. This new collection of results includes data on the distribution of shear force over the height of isolated structures. Furthermore, the new collection of results on the bearing displacements is considered more accurate than the results of Kircher and Lashkari (1989) because they were obtained with a more realistic model of the isolation system. A description of the superstructure and isolation system models, together with the results on the effects of bi-directional interaction are presented in the succeeding sections.

3.2 Superstructure Configuration

The superstructure models used in this study were representative of one and eight story moment resisting frames. The plan view of the structure (shown in Figure 3-1) consisted of four bays by eight bays, creating a rectangular configuration. Each bay was square, measuring 20 feet by 20 feet. The height of all stories was 12 feet.

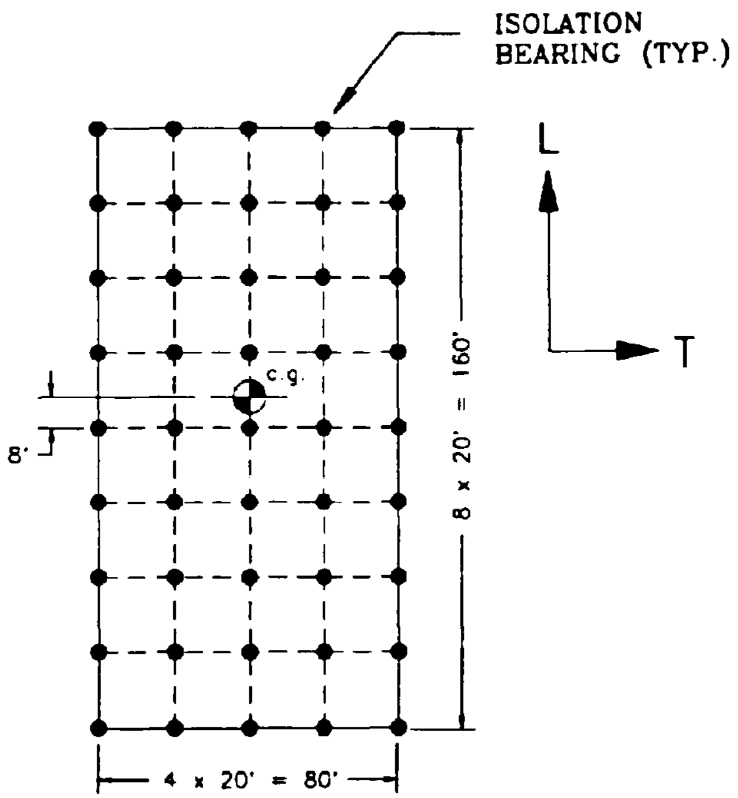


Figure 3-1 Plan View of the Base of the Building Models and Location of the Isolation Bearings

Both the 1-story and the 8-story superstructures had equal stiffnesses in the transverse and longitudinal directions. In the 8-story superstructure, the first three stories had the same stiffness, the next three stories had 0.75 times the stiffness of the first three stories and the top two stories had half the stiffness of the first three stories. The weight of each floor was 1280 kips (based on dead plus seismic live load of 100 psf). This created a total weight (including the base) of 2560 kips for the 1-story superstructure and 11520 kips for the 8-story superstructure. The mass on each floor, including the base, was asymmetric so that an eccentricity of 5% of the longest plan dimension (longitudinal) was created.

The horizontal stiffness and weight of the superstructure created a fundamental period of 0.2 seconds for the 1-story fixed-base superstructure and of 1.14 seconds for the 8-story fixed-base superstructure under elastic conditions. These values are representative of moment resisting type frames with the heights used. The distribution of stiffnesses to the columns was selected in such way as to result in a torsional period of 0.58 times the translational period, in the absence of eccentricities.

The properties of the 1-story and 8-story superstructures are tabulated in Tables 3-I and 3-II, respectively. The free vibrational dynamic characteristics of the two fixed-base superstructure systems are listed in Tables 3-III and 3-IV. They were obtained in dynamic analysis of the systems based on a shear type representation with three degrees of freedom per floor. The fundamental period of the two structures in the transverse direction is slightly larger than 0.2 seconds and 1.14 seconds because of the effect of the mass eccentricity in the longitudinal direction. The dynamic characteristics of the 8-story superstructure account for nine out of twenty four modes. The contribution of the higher modes was assumed insignificant since they correspond to periods of less than 0.19 seconds.

3.3 Isolation Systems

Since most commercially available isolation systems (softening systems) can be reasonably well modeled by bilinear behavior, the nonlinear force-deflection characteristics of the isolation systems used in this study were modeled by bilinear hysteretic elements. These isolation systems used, were identical to the systems analyzed in the Kircher and Lashkari (1989) study. Specific isolation systems were selected for this study that were applicable to only S_1 and S_2 type (stiff

TABLE 3-I Properties for 1-story Structure

Story / Floor	Weight (Kips)	Rotational Inertia (Kips-in-sec^2)	Stiffness (Kips/in)	Rotational Stiffness (Kips-in)	Eccentricity (ft)	
					Longitudinal	Transverse
1	1280	1272642.5	3271.0	3733792620	8	0
Base	1280	1272642.5			8	0

TABLE 3-II Properties for 8-story Structure

Story / Floor	Weight (Kips)	Rotational Inertia (Kips-in-sec^2)	Stiffness (Kips/in)	Rotational Stiffness (Kips-in)	Eccentricity (ft)	
					Longitudinal	Transverse
8	1280	1272642.5	1700.9	1997933760	8	0
7	1280	1272642.5	1700.9	1997933760	8	0
6	1280	1272642.5	2551.3	2996900640	8	0
5	1280	1272642.5	2551.3	2996900640	8	0
4	1280	1272642.5	2551.3	2996900640	8	0
3	1280	1272642.5	3401.8	3995867520	8	0
2	1280	1272642.5	3401.8	3995867520	8	0
1	1280	1272642.5	3401.8	3995867520	8	0
Base	1280	1272642.5			8	0

TABLE 3-III Dynamic Characteristics of 1-story Superstructure (Including 5 % mass Eccentricity)

Floor	Mode								
	1			2			3		
	L Component	T Component	Rotational Component	L Component	T Component	Rotational Component	L Component	T Component	Rotational Component
1	0.000	0.547	6.898 E-05	0.549	0.000	0.000	0.000	-0.0427	8.837 E-04

	1	2	3
Period (sec)	0.201	0.200	0.116
Frequency (Hz)	4.970	4.998	8.637
Modal damping ratio	0.03	0.03	0.03

TABLE 3-IV Dynamic Characteristics of 8-story Superstructure (Including 5 % mass Eccentricity)

Floor	Mode								
	1			2			3		
	L Component	T Component	Rotational Component	L Component	T Component	Rotational Component	L Component	T Component	Rotational Component
8	0.000	0.285	3.440 E-05	0.286	0.000	0.000	0.000	-0.0213	4.598 E-04
7	0.000	0.268	3.237 E-05	0.269	0.000	0.000	0.000	-0.0200	4.326 E-04
6	0.000	0.235	2.842 E-05	0.236	0.000	0.000	0.000	-0.0176	3.798 E-04
5	0.000	0.204	2.466 E-05	0.205	0.000	0.000	0.000	-0.0153	3.296 E-04
4	0.000	0.165	1.993 E-05	0.166	0.000	0.000	0.000	-0.0124	2.664 E-04
3	0.000	0.119	1.442 E-05	0.120	0.000	0.000	0.000	-0.0089	1.927 E-04
2	0.000	0.082	0.986 E-05	0.082	0.000	0.000	0.000	-0.0061	1.317 E-04
1	0.000	0.041	0.500 E-05	0.042	0.000	0.000	0.000	-0.0031	0.668 E-04

	1	2	3
Period (sec)	1.147	1.140	0.651
Frequency (Hz)	0.872	0.877	1.537
Modal damping ratio	0.03	0.03	0.03

TABLE 3-IV Continued

Floor	Mode								
	4			5			6		
	L Component	T Component	Rotational Component	L Component	T Component	Rotational Component	L Component	T Component	Rotational Component
8	0.000	-0.290	-3.505 E-05	-0.291	0.000	0.000	0.000	0.236	2.850 E-05
7	0.000	-0.165	-1.989 E-05	-0.166	0.000	0.000	0.000	-0.023	-0.279 E-05
6	0.000	0.032	0.386 E-05	0.032	0.000	0.000	0.000	-0.257	-3.101 E-05
5	0.000	0.154	1.858 E-05	0.154	0.000	0.000	0.000	-0.225	-2.713 E-05
4	0.000	0.231	2.795 E-05	0.232	0.000	0.000	0.000	-0.028	-0.034 E-05
3	0.000	0.242	2.926 E-05	0.243	0.000	0.000	0.000	0.189	2.283 E-05
2	0.000	0.198	2.392 E-05	0.199	0.000	0.000	0.000	0.248	2.996 E-05
1	0.000	0.111	1.341 E-05	0.111	0.000	0.000	0.000	0.171	2.065 E-05

Period (sec)	0.424	0.422	0.266
Frequency (Hz)	2.357	2.371	3.756
Modal damping ratio	0.03	0.03	0.03

TABLE 3-IV Continued

Floor	Mode								
	7			8			9		
	L Component	T Component	Rotational Component	L Component	T Component	Rotational Component	L Component	T Component	Rotational Component
8	0.237	0.000	0.000	0.000	0.022	-4.684 E-04	0.000	-0.223	-2.692 E-05
7	-0.023	0.000	0.000	0.000	0.012	-2.659 E-04	0.000	0.254	3.063 E-05
6	-0.258	0.000	0.000	0.000	-0.002	-0.516 E-04	0.000	0.188	2.270 E-05
5	-0.225	0.000	0.000	0.000	-0.012	2.483 E-04	0.000	-0.124	-1.493 E-05
4	-0.028	0.000	0.000	0.000	-0.017	3.735 E-04	0.000	-0.259	-3.129 E-05
3	0.189	0.000	0.000	0.000	-0.018	3.911 E-04	0.000	-0.025	-0.305 E-05
2	0.249	0.000	0.000	0.000	-0.015	3.197 E-04	0.000	0.177	2.138 E-05
1	0.171	0.000	0.000	0.000	-0.008	1.792 E-04	0.000	0.190	2.297 E-05

Period (sec)	0.265	0.241	0.191
Frequency (Hz)	3.778	4.154	5.241
Modal damping ratio	0.03	0.03	0.03

and medium) soils. Each isolation system had a different "characteristic" strength (or yield force) and post yielding stiffness in order to create a set of isolation schemes that range from almost linear to highly nonlinear. It is expected that these isolated building models would represent the dynamic characteristics of a significant portion of feasible isolation schemes.

The idealized bilinear hysteretic model of the isolation systems is shown in Figure 3-2. The model is characterized by the initial and unloading stiffness, K_1, the post-yielding stiffness, K_2, the yield force, F_y and the yield displacement, D_y. For a particular displacement amplitude, D, the isolation system may be described by equivalent linear-viscous properties in accordance with the SEAOC/UBC guidelines. These properties are the effective period, T_1, given by equation (2.2) with K_{min} equal to K_{eff} and the effective damping ratio, β

$$\beta = \frac{W_D}{2\pi K_{eff} D^2} \tag{3.1}$$

where W_D = area enclosed by the hysteresis loop.

The analyzed isolation systems were selected from Kircher and Lashkari (1989). All had a yield displacement D_y = 0.5 in. Their force-displacement characteristics are depicted in Figures 3-3 and 3-4. Their nonlinear properties and equivalent linear properties are given in Tables 3-V and 3-VI. The equivalent linear properties are based on the design displacement, D, as calculated by the static analysis procedure of SEAOC/UBC. It may be seen that the properties of the analyzed isolation systems cover the period range of 1.5 to 3 secs and the effective damping range of 6 to 39% of critical.

3.4 Nonlinear Time History Analysis

Nonlinear time history analyses were performed with computer code 3D-BASIS (Nagarajaiah et al, 1991). Each of the 45 isolators was explicitly modeled by a smooth bilinear hysteretic element with bi-directional interaction capability. All 45 isolators had identical properties.

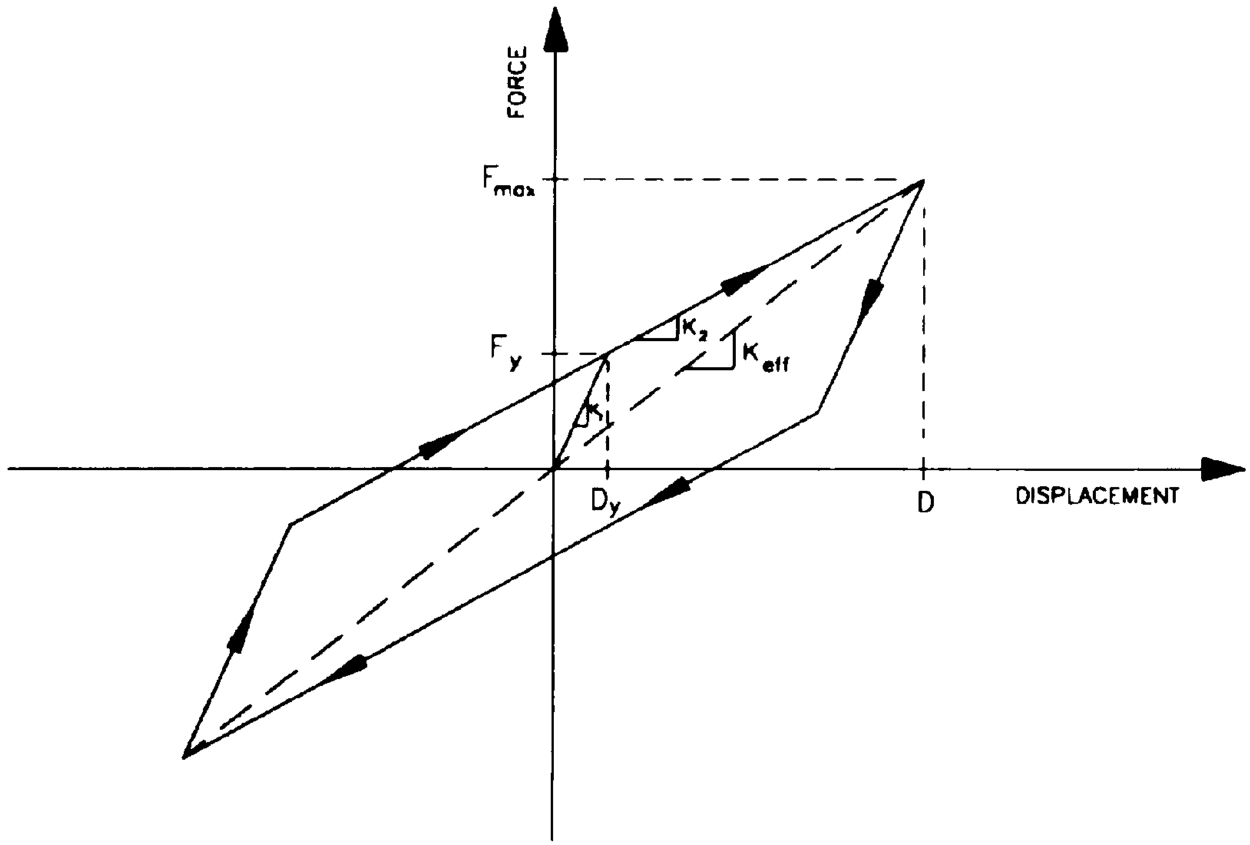


FIGURE 3-2 Idealized Properties of the Isolation Systems

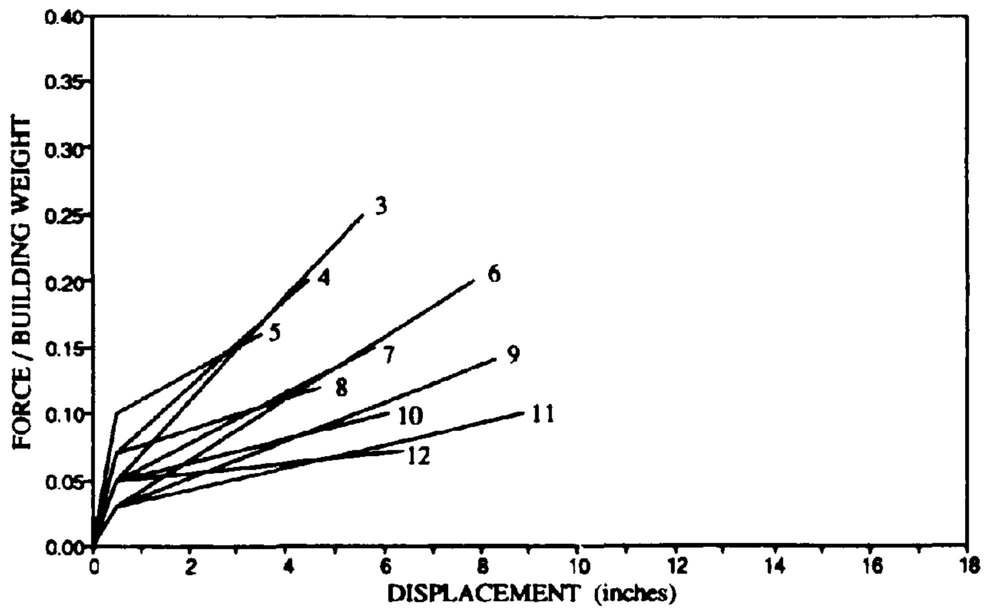


FIGURE 3-3 Force-Displacement Characteristics of the Isolation Systems Analyzed on Stiff Soil Sites

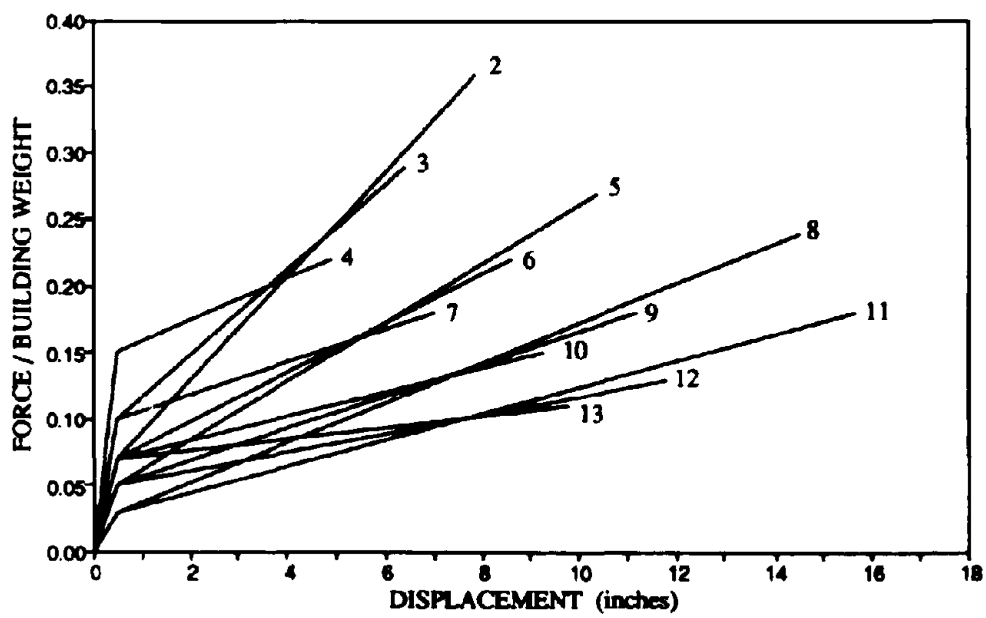


FIGURE 3-4 Force-Displacement Characteristics of the Isolation Systems Analyzed on Medium Soil Sites

TABLE 3-V Properties of Isolation Systems Analyzed on Stiff Soil Profiles (S_1)

Isolation System Type Number	Equivalent Linear Properties		Design Parameters		Parameters in Nonlinear Analysis		
	Period (sec)	Damping Ratio (%)	D (inches)	$\frac{F_{max}}{W}$	$\frac{YIELD\ FORCE}{W}$	D_y (inches)	$\alpha = \frac{K_2}{K_1}$
3	1.5	7	5.6	0.25	0.05	0.5	0.39216
4	1.5	15	4.5	0.20	0.07	0.5	0.23214
5	1.5	31	3.5	0.16	0.10	0.5	0.10000
6	2.0	6	7.9	0.20	0.03	0.5	0.38288
7	2.0	16	5.8	0.15	0.05	0.5	0.18868
8	2.0	30	4.7	0.12	0.07	0.5	0.085034
9	2.5	10	8.3	0.14	0.03	0.5	0.23504
10	2.5	27	6.1	0.10	0.05	0.5	0.089286
11	3.0	16	8.9	0.10	0.03	0.5	0.13889
12	3.0	39	6.4	0.073	0.05	0.5	0.038983

TABLE 3-VI Properties of Isolation Systems Analyzed on Medium Soil Profiles (S_2)

Isolation System Type Number	Equivalent Linear Properties		Design Parameters		Parameters in Nonlinear Analysis		
	Period (sec)	Damping Ratio (%)	D (inches)	$\frac{F_{max}}{W}$	$\frac{YIELD\ FORCE}{W}$	D_y (inches)	$\alpha = \frac{K_2}{K_1}$
2	1.5	8	7.9	0.36	0.07	0.5	0.27992
3	1.5	17	6.4	0.29	0.10	0.5	0.16102
4	1.5	37	4.9	0.22	0.15	0.5	0.053030
5	2.0	9	10.4	0.27	0.05	0.5	0.22222
6	2.0	17	8.6	0.22	0.07	0.5	0.13228
7	2.0	31	7.0	0.18	0.10	0.5	0.061538
8	2.5	6	14.5	0.24	0.03	0.5	0.25000
9	2.5	15	11.2	0.18	0.05	0.5	0.12150
10	2.5	26	9.3	0.15	0.07	0.5	0.064935
11	3.0	9	15.7	0.18	0.03	0.5	0.16447
12	3.0	22	11.8	0.13	0.05	0.5	0.070796
13	3.0	37	9.8	0.11	0.07	0.5	0.030722

The model of isolation bearings in this study differed from the model used by Kircher and Lashkari (1989) in the following aspects. First, the transition from elastic to the post-yielding range is smooth rather than abrupt. Second, the forces in the two orthogonal directions of each bearing exhibit circular interaction. The significance of these differences is investigated next.

3.4.1 Comparison of Smooth 3D-BASIS Model and Idealized Bilinear Hysteretic Model for Isolation Bearings

The idealized bilinear hysteretic model shown in Figure 3-2, exhibits an abrupt change from elastic to post-yielding stiffness at displacements equal to D_y and $(D - 2D_y)$. The actual behavior of elastomeric isolation bearings is rather different. The change in stiffness occurs smoothly over a finite displacement interval. This smooth transition between the two stages is realistically modeled in computer code 3D-BASIS.

In order to investigate the significance of this difference in modeling bilinear hysteretic behavior, analyses were performed with the smooth and the idealized bilinear hysteretic models. To avoid masking the results, the superstructure of the isolated system was considered rigid and the excitation was applied in only the longitudinal (L) direction so that the response occurred in only that direction. Note that mass eccentricity exists only in the longitudinal direction (see Figure 3-1).

Isolation system type No. 7 (T_I = 2.0 secs, β = 31%) for medium soil type (S_2) was analyzed with excitation being the components No. 25-T and No. 26-T of the scaled earthquake motions used in the nonlinear time history analyses (see Table 4-II for details). A comparison of responses obtained by the two models is shown in Figures 3-5 and 3-6. Evidently, the hysteresis loops trace nearly identical paths with only very small difference in the calculated peak response.

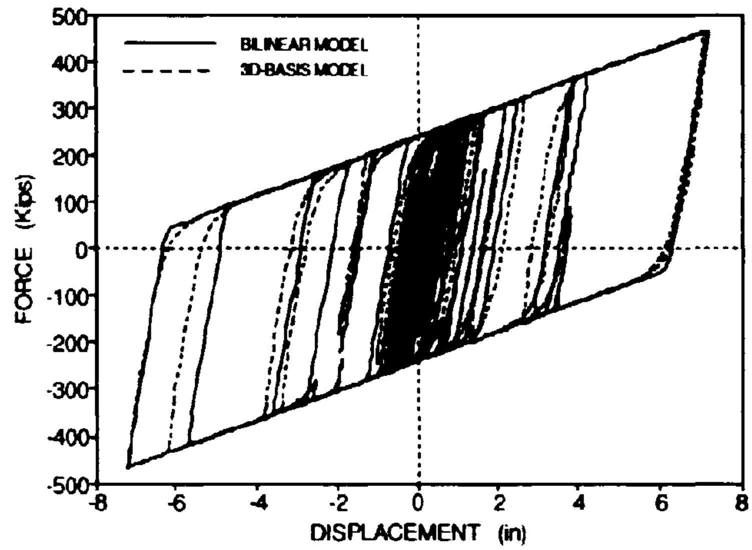


FIGURE 3-5 Force-Displacement Loops for Isolation System Type No. 7 (T_1 = 2.0 sec, β = 31%), Soil Type S_2, Excitation No. 25 San Fernando (241) T-direction only

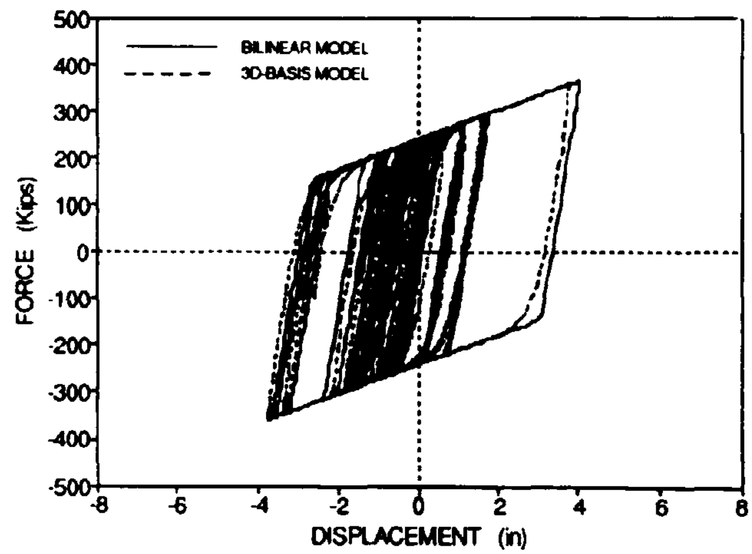


FIGURE 3-6 Force-Displacement Loops for Isolation System Type No. 7 (T_1 = 2.0 sec, β = 31%), Soil Type S_2, Excitation No. 26 San Fernando (458) T-direction only

3.4.2 Comparison of Uniaxial and Biaxial Interaction Models for Isolation Bearings

The significance of the bi-directional interaction effect in sliding isolation bearings has been demonstrated by Mokha et al, (1993). In general, consideration of this effect results in larger bearing displacements. This conclusion is expected to hold true for all bilinear hysteretic (non-stiffening) isolation systems since they differ from sliding systems with restoring force in only the level of the yield displacement.

Figure 3-7 illustrates the differences between models of isolation bearings with and without bidirectional interaction. A valid model for isolation bearings should exhibit identical force-displacement characteristics in all directions, as it would have been the case for a circular rubber bearing. In this case, the yield surface (or curve) is circular. A model without due regard to the bi-directional interaction effects consists of two uniaxial bilinear hysteretic elements placed along the principal directions of the bearing. Effectively in this case, the yield surface is square as shown in Figure 3-7. The implications are apparent. For motion along a direction other than the two orthogonal ones, the yield force and yield displacement are larger than F_y and D_y, respectively. Effectively, the model without bidirectional interaction effects exhibits more characteristic strength. The result is a reduction in bearing displacement.

To demonstrate the significance of neglecting the bi-directional interaction effects, the 1-story isolated structure was analyzed with and without due regard for the bidirectional interaction effects. Analyses were performed for isolation system types No. 6, 8 and 12 on soil type S_1 and isolation system types No. 5, 7, 9 and 13 on soil type S_2 (see Tables 3-V and 3-VI). The excitation consisted of the collection of scaled pairs of earthquake motions as described in section 4. Detailed results for each earthquake motion and isolation system type are presented in Appendix A. Table 3-VII presents a summary of the results in terms of the mean and mean plus one standard deviation (σ) of the bearing displacements and structural shear force. It may be observed that bearing displacements in the case without bidirectional interaction are typically less (exception is system type No. 13, soil type S_2) than the case with bidirectional interaction effects.

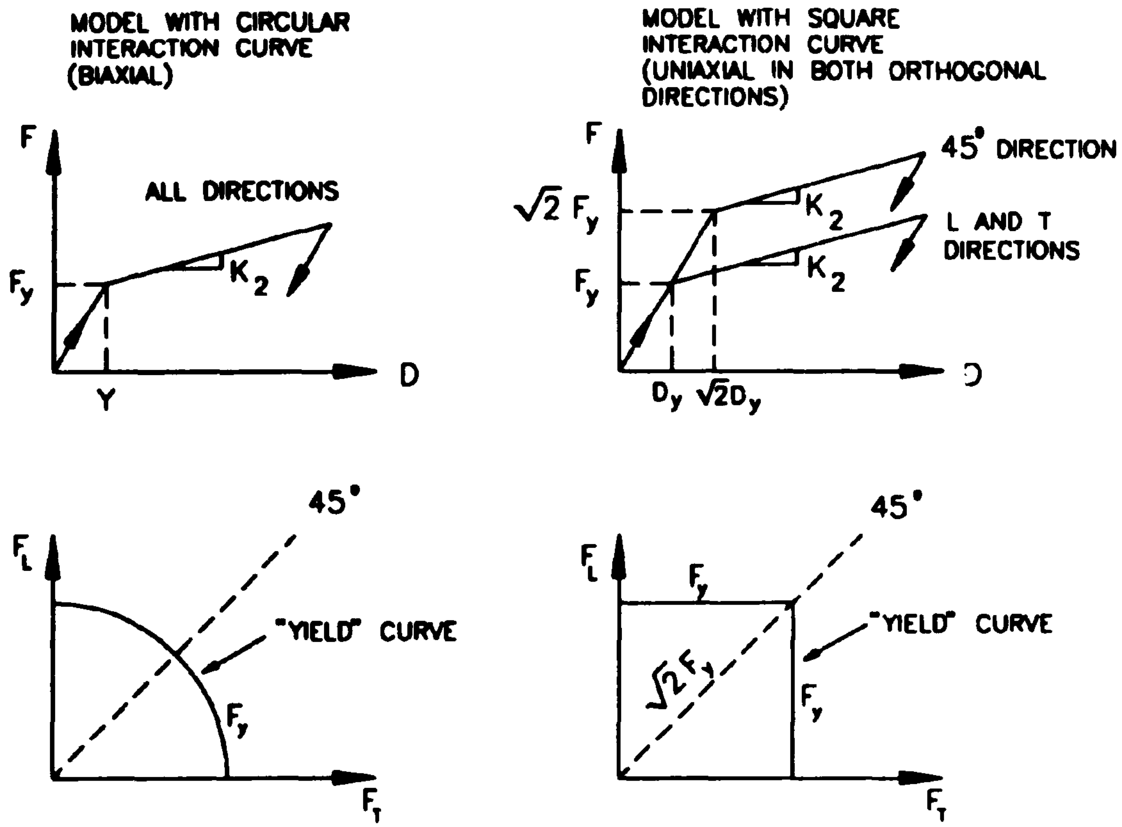


FIGURE 3-7 Comparison of Circular and Square Interaction Models of Isolation Bearings

TABLE 3-VII Comparison of Results of Time History Analyses with and without due Regard for Bidirectional Interaction Effects.

SOIL TYPE	ISOLATION TYPE No.	BASE CENTER DISPL. (in)				CORNER BEARING DISPL. (in)				STRUCTURAL SHEAR / WEIGHT			
		MEAN		MEAN + 1 σ		MEAN		MEAN + 1 σ		MEAN		MEAN + 1 σ	
		WITH	W/OUT	WITH	W/OUT	WITH	W/OUT	WITH	W/OUT	WITH	W/OUT	WITH	W/OUT
S_1	6	8.97	8.34	10.73	9.50	10.71	9.89	13.00	11.47	0.108	0.104	0.129	0.117
	8	5.75	5.21	7.62	6.98	6.92	5.80	9.57	7.89	0.062	0.068	0.072	0.077
	12	9.63	8.74	13.92	12.34	11.21	9.70	16.85	13.93	0.042	0.044	0.048	0.049
S_2	5	12.86	12.07	18.20	17.18	14.74	13.85	20.76	19.88	0.156	0.155	0.214	0.210
	7	7.03	6.97	9.49	9.27	7.76	7.71	10.24	9.95	0.095	0.102	0.102	0.115
	9	13.27	12.47	20.29	18.37	14.87	13.90	22.16	20.27	0.096	0.099	0.137	0.134
	13	9.12	9.31	12.89	13.02	10.13	10.17	14.24	14.25	0.059	0.064	0.066	0.070

Differences as high as 18% demonstrate the significance of accounting for the bidirectional interaction effects.

3.5 Response Spectrum Analysis

Response spectrum analyses were performed with computer code ETABS (Wilson et al, 1975). The excitation was specified by the design spectrum with proper modification in order to account for the difference between the actual modal damping ratios in the isolated structure and the 5% damping ratio in the SEAOC/UBC design spectra. Details of this modification are presented in section 5.

The response spectrum analysis was performed with simultaneous excitation of 100 percent of the ground motion in the most critical direction and 30 percent of the ground motion in the orthogonal axis as described in the SEAOC/UBC regulations. The effective stiffness of the isolation system was modeled in ETABS by four short columns with identical properties and spaced appropriately as to match the rotational properties of the 45 isolators. Each column had one quarter the effective stiffness of the entire isolation system in the transverse and longitudinal directions.

SECTION 4

STATISTICAL EVALUATION OF DYNAMIC RESPONSE FOR A SET OF RECORDED PAIRS OF HORIZONTAL EARTHQUAKE COMPONENTS

4.1 Basis for Statistical Approach

The SEAOC/UBC guidelines require the use of a minimum of three appropriate pairs of horizontal earthquake time histories for nonlinear analysis and that the maximum response of the parameter of interest shall be used for design. Instead of using the maximum response, this report uses statistical quantities such as mean values and standard deviations to compare with the results of the static and response spectrum analysis methods. Also, this report uses more than the required number (three) of appropriate time histories for analysis.

The statistical approach is based on the work done by Kircher and Lashkari (1989), where statistical quantities (mean values and mean plus one standard deviation) were used in order to quantify the variation in response results and to manage the large volume of data produced. These statistical quantities were used for judging the validity and applicability of SEAOC design requirements. Since nine to ten pairs of appropriate time histories were used for analysis, it is expected that this method of reporting results will better represent the level and variation of response parameters due to the variations in the ground motions. All the major assumptions and principles used in the Kircher and Lashkari (1989) report are adopted for this study.

4.2 Ground Motions

The ground motions used in this study are the same earthquake time history accelerograms used by Kircher and Lashkari (1989). According to them, appropriate earthquake time histories should be consistent in amplitude and frequency content with the design spectra currently required by seismic codes. The time histories were selected from the records used by Seed et al (1974) to develop site-dependent spectra. The results of the Seed study have been used as the primary basis for the ATC-3 design spectra (Applied Technology Council, 1978), the seismic criteria of the Blue Book (SEAOC, 1990b) and the Uniform Building Code (ICBO, 1991).

The Seed study developed site-dependent spectra for soil types S_1, S_2 and S_3 by calculating mean and mean-plus-one-standard deviation spectra of normalized acceleration time history records. The Seed study selected horizontal earthquake records with peak ground acceleration (PGA) values of 0.05g or greater from available data up to and including the San Fernando earthquake of 1971. From these many records, only records with both horizontal components exceeding 0.10g PGA were considered appropriate for nonlinear analysis in this study. After neglecting the less significant records and considering only stiff and medium soil types, the following number of records remained in each group:

1. Stiff soil sites - 10 pairs (20 records), representative of soil type S_1
2. Medium soil sites - 9 pairs (18 records), representative of soil type S_2

No records greater than 0.10g PGA for soft soil sites were available, so this site condition was not evaluated. Rock sites were not evaluated since they are classified with stiff soil sites as S_1 type soils, and the records for rock sites may be considered too weak for dynamic analysis use. The information involving each pair of horizontal earthquake time history is provided in Table 4-I for stiff soil sites and in Table 4-II for medium soil sites.

The PGA and peak ground velocity (PGV) values given in Tables 4-I and 4-II were taken directly from the California Institute of Technology data (CIT, 1975). In certain cases the PGA values reported in the Seed study differed from the CIT data. No explanation could be found for these discrepancies, except that some values reported in the Seed study may have been for "uncorrected" records.

The sets of earthquake records for stiff and medium soil types had a large proportion of records obtained from the San Fernando earthquake of 1971. The Seed study investigated the potential biasing of results that can occur if the spectra are dominated by one specific earthquake (San

TABLE 4-I Horizontal Earthquake Components Recorded at Stiff Soil Sites

No.	COMPO NENT	EARTHQUAKE STATION No.	DATE	MAGNITUDE	DISTANCE FROM SOURCE (Km)	LOCAL MMI	DIRECTION	PGA (g)	PGV (in/sec)	PGD (in)
11	T L	LOWER CALIFORNIA (117)	12/30/34	6.5	58	-	S90W S00W	-0.183 -0.160	4.55 -8.21	-1.44 -1.65
12	T L	IMPERIAL VALLEY EL CENTRO (117)	05/18/40	6.6	8	VIII	S00E S90W	0.348 0.214	13.17 -14.53	4.28 -7.79
13	T L	PARKFIELD (014)	06/27/66	5.6	5	VIII	N85E N05W	-0.434 -0.355	-10.02 -9.12	-2.80 -2.09
14	T L	SAN FERNANDO (110)	02/09/71	6.6	21	VIII	N21E N69W	-0.315 -0.270	-6.76 -10.94	1.67 3.73
15	T L	SAN FERNANDO (135)	02/09/71	6.6	35	VII	N90E S00W	-0.211 0.170	-8.32 -6.50	-5.79 3.17
16	T L	SAN FERNANDO (208)	02/09/71	6.6	39	VII	N00E S90W	-0.136 0.144	8.79 7.30	4.50 -4.57
17	T L	SAN FERNANDO (211)	02/09/71	6.6	39	VII	NORTH WEST	0.157 -0.132	-6.90 8.45	3.17 -4.57
18	T L	SAN FERNANDO (466)	02/09/71	6.6	28	VII	N11E N79W	0.225 -0.149	-11.12 -9.23	-5.30 -4.06
19	T L	SAN FERNANDO (253)	02/09/71	6.6	28	VII	S12W N78W	-0.248 0.201	12.43 -7.01	7.21 3.73
20	T L	SAN FERNANDO (199)	02/09/71	6.6	39	VII	N90E S00W	-0.165 -0.161	-6.54 7.24	-4.08 3.56

TABLE 4-II Horizontal Earthquake Components Recorded at Medium Soil Sites

No.	COMPO NENT	EARTHQUAKE STATION No.	DATE	MAGNITUDE	DISTANCE FROM SOURCE (Km)	LOCAL MMI	DIRECTION	PGA (g)	PGV (in/sec)	PGD (in)
21	T L	WESTERN WASHINGTON (325)	04/13/49	7.1	20	VIII	N86E N04W	-0.280 0.165	-6.72 8.43	4.08 -3.38
22	T L	EUREKA (022)	12/21/54	6.5	25	VIII	N79E N11W	-0.258 0.168	11.56 -12.44	5.53 4.88
23	T L	EUREKA (023)	12/21/54	6.5	30	VII	N46W N44E	0.201 0.159	-10.24 14.03	-3.79 -5.58
24	T L	FERNDALE (023)	12/10/67	5.6	25	VII	S44W N46W	-0.237 0.105	4.70 4.65	0.65 -0.67
25	T L	SAN FERNANDO (241)	02/09/71	6.6	16	VII	N00W S90W	-0.255 -0.134	-11.81 9.42	-5.87 5.45
26	T L	SAN FERNANDO (458)	02/09/71	6.6	19	VII	S00W S90W	0.116 0.105	12.46 -11.33	-6.93 6.02
27	T L	SAN FERNANDO (264)	02/09/71	6.6	30	VII	N00E N90E	-0.201 -0.185	-3.87 -6.47	-1.07 2.72
28	T L	SAN FERNANDO (267)	02/09/71	6.6	30	VII	S82E S08W	0.212 0.142	5.48 3.62	-1.95 -1.14
29	T L	PUGET SOUND (325)	04/29/65	6.5	58	VII	S86W S04E	-0.198 0.137	5.14 3.21	-1.51 -1.07

Fernando) and concluded that the results were not unduly influenced. On this basis, Kircher and Lashkari (1989) treated those earthquake records as representative of the SEAOC/UBC design spectra for soil types S_1 and S_2.

4.3 Scaling by Peak Ground Velocity

For this study, Seismic Zone 4 was the only zone considered since it contains the highest seismicity and is the most likely zone for isolation applications. The effective PGA for Seismic Zone 4 is 0.4g. This is the acceleration value specified for scaling of the normalized response spectra of Figure 2-1. The unscaled records used in this study had a variety of PGA values, most of them less than 0.4g. As a result, scaling the records was necessary to insure that the response spectra be consistent with Seismic Zone 4 design spectra.

In this study, scaling in accordance with the PGV was the only method used to scale earthquake time histories. Scaling in accordance with the PGA has been examined by Kircher and Lashkari (1989) and by Theodossiou and Constantinou (1991). In these reports, it was found that the response of an isolated structure is primarily influenced by the amplitude and frequency content of the velocity domain of the design spectrum. As a result, scaling by PGV is considered a more appropriate method than scaling by PGA for an accurate representation of the amplitude and frequency content of ground motion at periods greater than 1.0 second.

Each pair of earthquake components (applied simultaneously in orthogonal directions) was scaled by a common factor such that the average PGV of the two components was equal to either 18 in/sec for stiff soil sites or 22.5 in/sec for medium soil sites. These values were adopted from the Kircher and Lashkari (1989) report. This scaling method differs from the Seed (1974) study where each component was scaled (normalized) individually, rather than together. Since the parameters of interest are the mean of the maximum values between transverse and longitudinal components, this common scaling factor is justified.

The scaling factors for the ground motions used in this report are listed in Table 4-III. For the scaling method used in this study, the report by Theodossiou and Constantinou (1991) shows the following:

1. The mean spectral acceleration values of either the L or the T components of the scaled motions approximate well, the Seismic Zone 4 design spectra at periods larger than 1 second.
2. The mean of the square root of the sum of squares of the spectral values of the L and T components of the scaled motions are larger than or equal to 1.3 times the Seismic Zone 4 design spectrum at periods larger than 1 second.

In this respect, the scaled motions are representative of the Seismic Zone 4 design spectra.

4.4 Dynamic Nonlinear Time History Results

Analyses were performed for 44 structure/isolation system models (1-story and 8-story superstructures with ten types of isolation systems for soil type S_1 and twelve types of isolation systems for soil type S_2) under the excitation of the 19 pairs of PGV scaled motions. The response quantities calculated for each pair of ground motion were peak displacement in the longitudinal (L) and transverse (T) directions at the center of mass and at the corner bearing, peak base shear and story shears (normalized by the total weight of the structure) and the peak story drift ratios (for a story height of 12 feet). It should be noted that the time history analysis results on the base shear force and story shear forces were not reduced by factors 1.5 and R_{WI}, respectively, to obtain the design level forces. The results of the analyses are presented in Tables A-I through A-XXIIa in Appendix A and Tables B-I through B-XXII in Appendix B. The tables also present values of the ratio of peak corner displacement to peak center of mass displacement as well as means and standard deviations (σ) of the calculated response quantities.

TABLE 4-III PGV Scaling Factors of the Earthquake Components

SOIL PROFILE TYPE	EXCITATION NUMBER	EARTHQUAKE STATION NUMBER	SCALING FACTOR
S_1	11	LOWER CALIFORNIA (117)	2.821
	12	IMPERIAL VALLEY EL CENTRO (117)	1.300
	13	PARKFIELD (014)	1.881
	14	SAN FERNANDO (110)	2.034
	15	SAN FERNANDO (135)	2.429
	16	SAN FERNANDO (208)	2.237
	17	SAN FERNANDO (211)	2.345
	18	SAN FERNANDO (466)	1.769
	19	SAN FERNANDO (253)	1.852
	20	SAN FERNANDO (199)	2.612
S_2	21	WESTERN WASHINGTON (325)	2.970
	22	EUREKA (022)	1.875
	23	EUREKA (023)	1.854
	24	FERNDALE (023)	4.813
	25	SAN FERNANDO (241)	2.120
	26	SAN FERNANDO (458)	1.892
	27	SAN FERNANDO (264)	4.352
	28	SAN FERNANDO (267)	4.945
	29	PUGET SOUND (325)	5.389

SECTION 5

RESULTS OF RESPONSE SPECTRUM ANALYSIS PROCEDURE

5.1 Introduction

The response spectrum analysis procedure of SEAOC/UBC is examined in this section. The computer program ETABS (Wilson et al, 1975) is implemented for response spectrum analysis.

Of the 22 isolation systems analyzed in this report, six do not pass all the SEAOC/UBC criteria for response spectrum analysis. These criteria specify that response spectrum analysis may not be performed if the effective stiffness of the isolation system at the design displacement is less than one third of the effective stiffness at 20 percent of the design displacement. These isolation systems that do not pass the requirements for response spectrum analysis are listed in Table 5-I. All the isolation systems that fail SEAOC/UBC criteria have an effective damping of the isolation system greater than or equal to 30 percent of critical. All isolation systems with effective damping values less than 30 percent of critical passed this effective stiffness criteria. In an effort to thoroughly evaluate the SEAOC/UBC response spectrum procedure, these isolation system types were included in all analyses.

It may be easily shown that for the bilinear hysteretic system shown in Figure 3-2, the condition for the effective stiffness at the design displacement to be less than one third of the effective stiffness at 20 percent of the design displacement is equivalent to

$$F_{max} < \frac{2D}{D_y + D} F_y \qquad (5.1)$$

Furthermore, the condition for the effective damping, β, to be larger than 30 percent of critical is equivalent to

$$F_{max} < \frac{2D}{2D_y + 0.3\pi D} F_y \tag{5.2}$$

It may be recognized that equations (5.1) and (5.2) produce nearly the same result when $D/D_y > 10$ and $D > 5$ inches. Accordingly, the stiffness-based criterion of SEAOC/UBC for allowing response spectrum analysis is equivalent to the condition that the effective damping of the isolation system be less than 30 percent of critical.

TABLE 5-I Isolation Systems that Fail Criteria Allowing Response Spectrum Analysis (W = weight)

Soil Type	Isolation System Type	Effective Damping (% of Critical)	Effective Stiffness at Design Displacement (W/inch)	½ Effective Stiffness at 20% of Design Displacement (W/inch)
S_1	5	31	0.0457	0.0495
	8	30	0.0255	0.0267
	12	39	0.0114	0.0138
S_2	4	37	0.0449	0.0536
	7	31	0.0257	0.0264
	13	37	0.0112	0.0130

5.2 Calculation of Modal Damping Ratios for Isolated Structures

For the response spectrum analysis it is required that response spectra consistent with the modal damping ratios of the isolated structure be used. This requires modification of the 5%-damped design spectra of the SEAOC/UBC regulations.

The isolated structure consists of the superstructure, which is assumed to have classically damped mod..., and the isolation system with usually high equivalent viscous damping. The entire system has non-classically damped modes. In general, it is possible to determine the exact modal damping ratios of the non-classically damped structure (Constantinou and Symans, 1992). Herein, a simplified procedure which allows for hand calculations, is employed. In this procedure, the eccentricities in the superstructure and isolation system are neglected so that the translational and torsional motions are decoupled. Subsequently, the isolated structure is reduced to a two-degree of freedom system for determining the modal damping ratios in the first two translational modes of vibration. Finally, the modal damping ratio in the torsional mode is determined by assuming that the structure is rigid so that only the isolation system contributes to the stiffness and energy dissipation capability of the structure.

5.2.1 Modal Damping Ratios in the First Two Translational Modes

The multistory superstructure is replaced by a single degree of freedom (SDOF) representation so that the entire system is represented by two degrees of freedom (one for the superstructure and one for the isolation system), as shown in Figure 5-1.

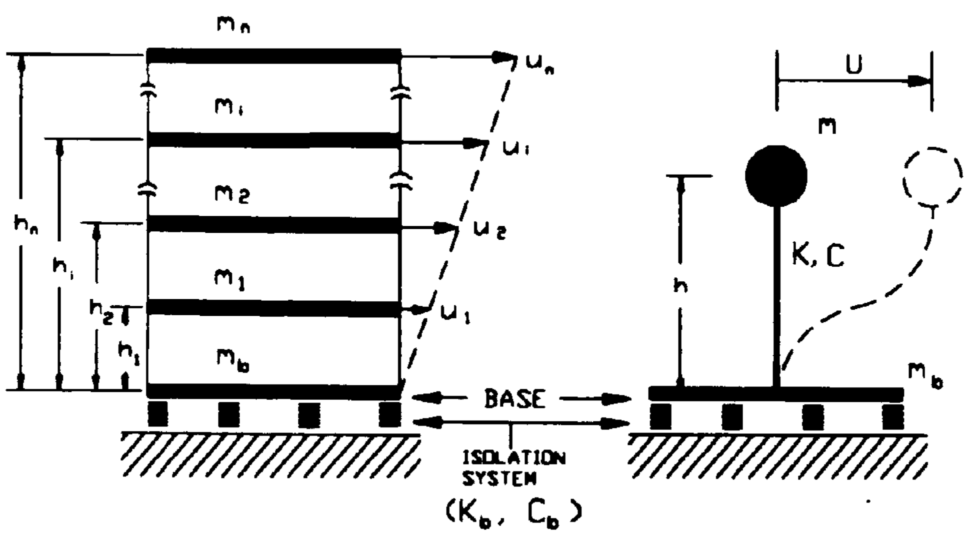


FIGURE 5-1 Two-degree-of-freedom Representation of Multistory Isolated Structure

The superstructure is described by mass, m, height, h, frequency ω_s, and damping ratio, ξ_s:

$$\omega_s = \sqrt{\frac{K}{m}} \tag{5.3}$$

$$\xi_s = \frac{C}{2m\omega_s} \tag{5.4}$$

The isolation system is described by its total horizontal stiffness, K_b, and viscous damping constant, C_b, or in more convenient terms, the isolation system frequency, ω_b, and damping ratio, ξ_b:

$$\omega_b = \sqrt{\frac{K_b}{m + m_b}} \tag{5.5}$$

$$\xi_b = \frac{C_b}{2(m + m_b)\omega_b} \tag{5.6}$$

It should be noted that the damping ratio, ξ_b, is exactly the effective damping of the isolation system, β, as given by equation (3.1) (per SEAOC/UBC) and frequency ω_b is related to the isolated-structure period, T_I, equation (2.2), by

$$\omega_b = \frac{2\pi}{T_I} \tag{5.7}$$

The analysis of this simple two-degree-of-freedom system has been presented by Kelly (1990). The two frequencies of the system are:

$$\omega_1^2,\ \omega_2^2 = \frac{1}{2(1-\gamma)}\left\{(\omega_s^2+\omega_b^2) \pm \left[(\omega_s^2+\omega_b^2)^2 - 4(1-\gamma)\omega_s^2\omega_b^2\right]^{\frac{1}{2}}\right\} \tag{5.8}$$

where,

$$\gamma = \frac{m}{m+m_b} \tag{5.9}$$

Expansion of equation (5.7) by using binomial series, results in the following simple asymptotic expansions:

$$\omega_1 \approx \omega_b \sqrt{1-\gamma\varepsilon} \tag{5.10}$$

$$\omega_2 \approx \omega_s \sqrt{\frac{1+\gamma\varepsilon}{1-\gamma}} \tag{5.11}$$

where,

$$\varepsilon = \left(\frac{\omega_b}{\omega_s}\right)^2 \tag{5.12}$$

These expansions are valid for small ε and they are correct to order ε.

The shapes in the two free-vibrational modes of the system were obtained by Kelly (1990) to be (correct to order ε):

$$\{\phi_1\} = \begin{Bmatrix} \phi_{b,1} \\ \phi_{s,1} \end{Bmatrix} \approx \begin{Bmatrix} 1 \\ \varepsilon \end{Bmatrix} \tag{5.13}$$

$$\{\phi_2\} = \begin{Bmatrix} \phi_{b,2} \\ \phi_{s,2} \end{Bmatrix} \approx \begin{Bmatrix} 1 \\ -\frac{1}{\gamma}[1-(1-\gamma)\varepsilon] \end{Bmatrix} \tag{5.14}$$

Furthermore, the corresponding modal damping ratios were determined by an approximate procedure involving energy considerations to be:

$$\xi_n = \frac{\gamma \xi_s \omega_s \omega_n (\phi_{s,n})^2 + \xi_b \omega_b \omega_n (\phi_{b,n})^2}{\gamma \omega_s^2 (\phi_{s,n})^2 + \omega_b^2 (\phi_{b,n})^2}, \quad n=1,2 \tag{5.15}$$

Expanded in asymptotic expansions correct to order ε, equation (5.15) yields:

$$\xi_1 \approx \xi_b \frac{\sqrt{1-\gamma\varepsilon}}{1+\gamma\varepsilon} \tag{5.16}$$

$$\xi_2 \approx \left[\xi_s \frac{1}{\sqrt{1-\gamma}} + \xi_b \frac{\gamma\sqrt{\varepsilon}}{\sqrt{1-\gamma}} \right] \left(1 - \frac{\gamma\varepsilon}{2} \right) \tag{5.17}$$

In the above equations, ξ_1 represents the modification of the isolation system damping, ξ_b, and ξ_2 represents the modification of the structural damping, ξ_s, as a result of the flexibility of the superstructure. The effect of the superstructure's flexibility is to reduce the isolation system damping while the effect of the isolation system is to significantly increase the structural damping.

5.2.2 Modal Damping Ratio in the Torsional Mode

The isolated structure is assumed rigid and undergoing torsional free vibration. In the absence of eccentricities, motion occurs about a vertical axis passing through the geometric center of the base (see Figure 3-1). The equation of motion is

$$M r^2 \theta + \left(\sum_i C_x y_i^2 + \sum_i C_y x_i^2 \right) \theta + \left(\sum_i K_x y_i^2 + \sum_i K_y x_i^2 \right) \theta = 0 \tag{5.18}$$

where

M = total mass of the structure (including the basemat)

r	=	radius of gyration of structure (= 51.64 ft. for the plan dimensions of Figure 3-1)
C_x, C_y	=	viscous damping constants of individual bearings in the orthogonal x and y directions
K_x, K_y	=	elastic stiffness of individual bearings in the orthogonal x and y directions
x_i, y_i	=	coordinates of bearing i

Equation (5.18) may be written as

$$M r^2 \ddot{\theta} + C_\theta \dot{\theta} + K_\theta \theta = 0 \tag{5.19}$$

from where the rotational frequency, ω_θ, and corresponding damping ratio, ξ_θ, are determined to be:

$$\omega_\theta = \sqrt{\frac{K_\theta}{M r^2}} \tag{5.20}$$

$$\xi_\theta = \frac{C_\theta}{2\sqrt{M r^2 K_\theta}} \tag{5.21}$$

Considering that all bearings have identical properties in all directions, $C_x = C_y = C_i$ and $K_x = K_y = K_i$, so that

$$\omega_\theta = A\sqrt{\frac{\sum_i K_i}{M}} \tag{5.22}$$

$$\xi_\theta = \left(\frac{\sum_i C_i}{2\sqrt{M\sum_i K_i}}\right)A \tag{5.23}$$

where

$$A = \frac{1}{r}\sqrt{\frac{\sum_i \left(x_i^2 + y_i^2\right)}{N}} \tag{5.24}$$

with N = number of bearings (= 45). It may be recognized that the expressions next to constant A on the right side of equations (5.22) and (5.23) are, respectively, the frequency $\omega_b = 2\pi/T_I$ and damping ratio $\xi_b = \beta$. Accordingly, the torsional period of the isolated structure, T_θ, and the corresponding damping ratio are:

$$T_\theta = \frac{T_I}{A} \tag{5.25}$$

$$\xi_\theta = A\,\beta \tag{5.26}$$

For the configuration of isolation bearings shown in Figure 3-1, constant A equals to 1.14. We thus conclude, that in the analyzed configuration, the torsional period is less but the corresponding damping ratio is more than those of the translational mode.

5.3 Modification of Response Spectra for Response Spectrum Analysis

The 5% damped response spectra required for the response spectrum analysis has to be modified to incorporate the damping ratio values of the various modes of the isolated structure that are different from 5%. The SEAOC/UBC guidelines do not describe a procedure for modification of the response spectrum. Herein, two procedures are employed for the modification of the response spectra.

5.3.1 Modification of Response Spectra Based on Modal Damping Ratios in the First Three Modes

The first three modes of the isolated structure are the first translational mode with period $T_1 = 2\pi/\omega_1$ and damping ξ_1 (eqs. 5.10 and 5.16), the torsional mode with period T_θ and damping ξ_θ

(eqs. 5.25 and 5.26) and the second translational mode with period $T_2 = 2\pi/\omega_2$ and damping ξ_2 (eqs. 5.11 and 5.17). For example, Table 5-II lists the characteristics of some of the isolated structures analyzed on soil type S_1. For the range of periods of the spectrum above 0.85 seconds, the 5%-damped response spectrum **was reduced (divided) by factor B (see Table 2-IV) in relation to the damping ratio in the first and second (torsional) modes.** This modification is consistent with the static analysis procedure of SEAOC/UBC which, in essence, is a single mode spectral analysis. Since the first two modes have different periods, the 5%-damped spectrum was modified by different factors in the neighborhoods of periods T_1 and T_θ.

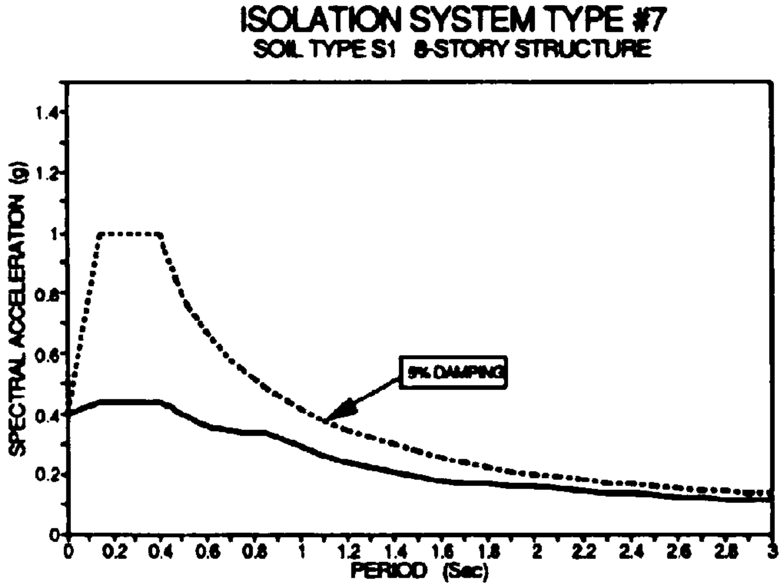
For periods less than 0.85 seconds, modification of the spectrum by the factor B is inappropriate since this region of the spectrum is primarily controlled by the peak ground acceleration and not the peak ground velocity (Newmark and Rosenblueth, 1971). It should be noted that factor B is an appropriate modification factor in the velocity- controlled region of the response spectrum, the region in which the fundamental period of isolated structures typically falls.

The region of periods less than 0.85 seconds contains the period of third mode (second translational mode) $T_2 = 2\pi/\omega_2$ (eq. 5.11) which is considerably less than the fundamental period of the superstructure (see Table 5-II). The modification of the response spectrum in this region of the spectrum was based on the modification factor, B^*, proposed by Newmark and Rosenblueth (1971) for the acceleration-controlled region of the spectrum. These modification factors are listed in Table 5-III.

Of particular interest is to note in Table 5-II that the first damping ratio of the 8-story structure is considerably less than the effective damping of the isolation system. The modification (division) of the response spectrum by factor B was based on the first mode damping ratio, ξ_1, and not the effective damping of the isolation system, β. As an example, Figure 5-2 shows the modified response spectra used in the response spectrum analysis of two of the 8-story isolated structures.

TABLE 5-II Characteristics of Some of the Analyzed 8-story and 1-story Structures on Soil Type S_1

Isolation System Type	Period T_I (seconds)	Effective Damping β (%)	Height of Super-structure	First Mode		Second Mode (Torsional)		Third Mode	
				Period (secs)	Damping Ratio (%)	Period (secs)	Damping Ratio (%)	Period (secs)	Damping Ratio (%)
4	1.50	15	8-STORY	1.86	8.5	1.32	17.3	0.34	30.4
			1-STORY	1.51	15.0	1.32	17.3	0.14	5.7
5	1.50	31	8-STORY	1.86	16.6	1.32	35.0	0.34	54.9
			1-STORY	1.51	30.3	1.32	35.0	0.14	7.1
7	2.00	16	8-STORY	2.27	10.9	1.75	17.9	0.37	26.8
			1-STORY	2.00	15.6	1.75	17.9	0.14	5.3
9	2.50	10	8-STORY	2.72	7.8	2.19	11.1	0.39	17.5
			1-STORY	2.50	9.8	2.19	11.1	0.14	4.8
10	2.50	27	8-STORY	2.72	20.7	2.19	30.3	0.39	34.8
			1-STORY	2.50	26.5	2.19	30.3	0.14	5.7
12	3.00	39	8-STORY	3.19	32.4	2.63	44.1	0.40	41.3
			1-STORY	3.00	3.86	2.63	44.1	0.14	6.1



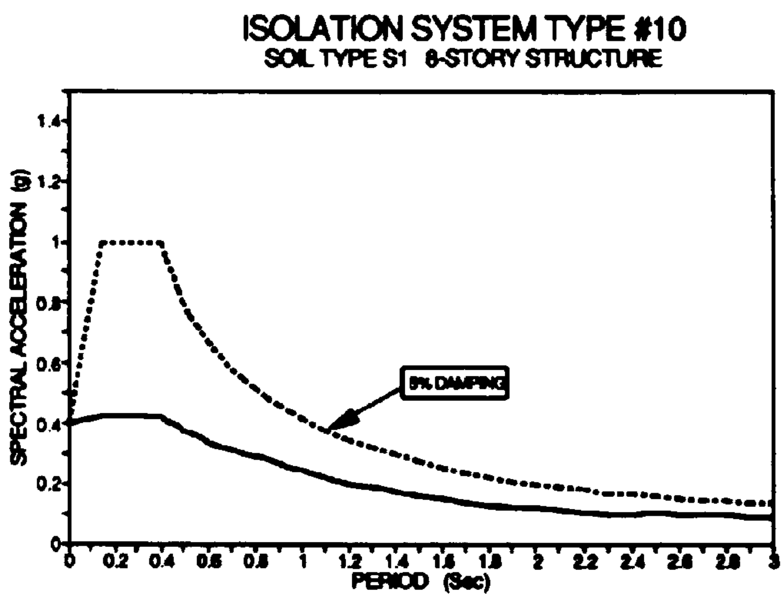


FIGURE 5-2 Modified Response Spectra Based on Modal Damping Ratios in the First Three Modes

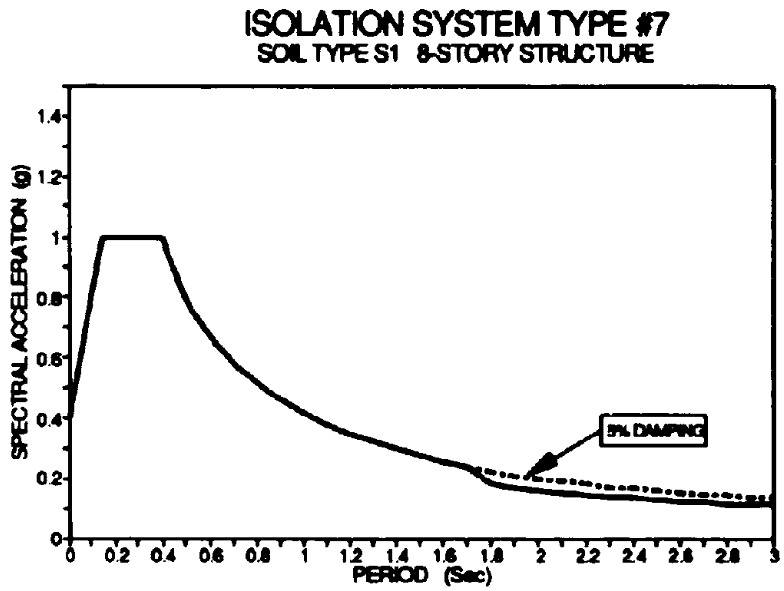
TABLE 5-III Modification Factor B* Used in Acceleration-Controlled Region of Response Spectrum

Damping Ratio (%)	Factor B*
0	0.406
1	0.500
2	0.605
5	1.000
7	1.368
10	1.733
20	2.167
30	2.400
> 30	2.400

5.3.2 Modification of Response Spectra Based on Modal Damping Ratio of the First Mode Only

In this approach, the response spectra are modified by factor B (Table 2-IV) only in the period range greater than $0.8T_1$, where T_1 is the period of the isolated structure in accordance to the SEAOC/UBC guidelines. This is consistent with the recommendations in the 1991 AASHTO Specifications (AASHTO, 1991). However, the reduction employed to the 5%-damped spectrum was based on the first mode damping ratio, ξ_1, and not the effective damping of the isolation system, β.

Figure 5-3 shows the modified response spectra in accordance with this method for the same systems as those of Figure 5-2 (No. 7 and 10, soil type S_1). Modification of the response spectra by this approach gave nearly identical peak responses of isolated structures as the approach described in section 5.3.1. For example, Table 5-IV compares the response of the 8-story



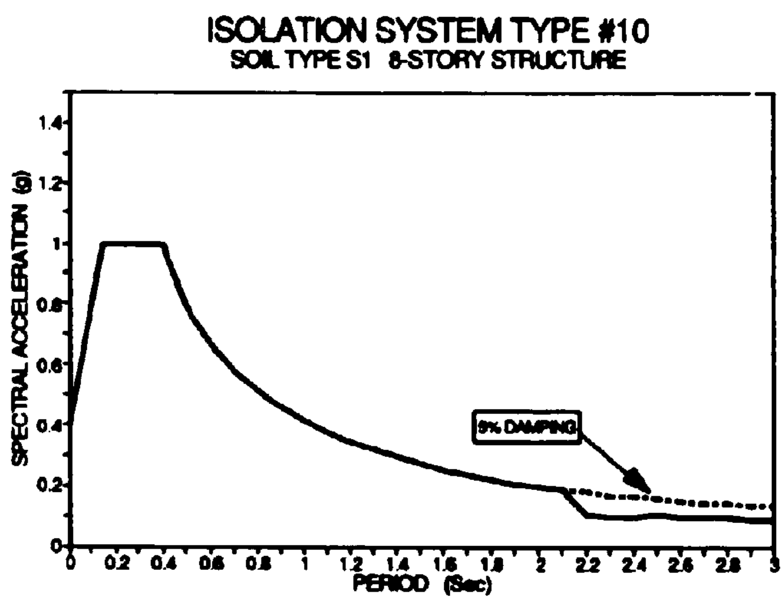


FIGURE 5-3 Modified Response Spectra Based on Modal Damping Ratio of the First Mode Only

structure, isolation system type 7 on soil type S_1 and isolation systems types 5 and 7 on soil type S_2 as calculated by the two procedures of modification of the response spectrum. The results of the two procedures are indeed nearly identical. Apparently, the reason for this good agreement is the fact that the response of the linearized model of the isolated structure is primarily controlled by the first mode of vibration of the isolated structure. It should be noted that the domination of response by the first mode of vibration is not always realistic. For example, isolation system type No. 7 on soil type S_2 is highly nonlinear and the time history analysis clearly demonstrates the strong participation of the higher modes of vibration. This behavior cannot be captured in the response spectrum analysis.

TABLE 5-IV Comparison of Response Spectrum Analysis Results for the 8-story Structure Computed by two Different Methods of Modification of Response Spectrum. Weight = 11520 kips, Height = 12 ft.

RESPONSE SPECTRUM MODIFICATION METHOD	SOIL TYPE	ISOLATION SYSTEM TYPE	BASE CENTER DISPL (inches)	CORNER BEARING DISPL (inches)	BASE SHEAR / WEIGHT	1st STORY SHEAR / WEIGHT	1st STORY DRIFT / HEIGHT (%)
BASED ON FIRST MODE ONLY	S_1	7	5.52	7.70	0.143	0.130	0.306
		10	5.91	8.28	0.097	0.088	0.206
	S_2	5	9.68	13.55	0.251	0.229	0.538
		7	6.73	9.43	0.173	0.157	0.370
BASED ON FIRST THREE MODES	S_1	7	5.51	7.65	0.142	0.130	0.305
		10	5.91	8.26	0.097	0.088	0.206
	S_2	5	9.67	13.49	0.251	0.229	0.538
		7	6.71	9.36	0.173	0.157	0.370

5.4 Results of Response Spectrum Analysis Procedure

The results of the response spectrum analysis procedure are summarized in Tables 5-V to 5-VIII. The results were obtained with the response spectrum modification procedure which is based on the first three modes of vibration of the isolated structure as described in section 5.3.1. It should be recalled that nearly identical results were obtained with the response spectrum modification procedure which is based on just the first mode of vibration. Regardless of the modification procedure employed, it is important to reiterate that the modification of the 5%-damped spectrum for higher damping was done by dividing the 5%-damped spectrum ordinates, in the neighborhood of the isolation system period, by the coefficient B (see Table 2-IV) of the SEAOC/UBC regulations. Coefficient B was related to the damping ratio of the first mode of the isolated structure, ξ_1 (see eq. 5.16, note that $\xi_b = \beta$), and not the effective damping of the isolation system, β. As it is evident in equation (5.16), damping ratio ξ_1 is, in general, less than β. The difference between factors ξ_1 and β is significant in flexible superstructures.

TABLE 5-V Maximum Response Spectrum Analysis Results for 1-story Isolated Structure with Excitation Represented by Scaled UBC Design Spectra in Seismic Zone 4, for Stiff Soil Sites (representative of soil type S_1). Weight = 2560 kips, Height = 12 ft

ISOLATION SYSTEM TYPE	BASE CENTER DISPL (inches)	CORNER BEARING DISPL (inches)	BASE SHEAR / WEIGHT	1st STORY SHEAR / WEIGHT	1st STORY DRIFT / HEIGHT (%)
3	5.64	7.90	0.252	0.127	0.0691
4	4.52	6.33	0.200	0.101	0.0551
5	3.53	4.94	0.161	0.082	0.0443
6	7.69	10.80	0.195	0.098	0.0532
7	5.67	7.97	0.147	0.074	0.0401
8	4.59	6.44	0.117	0.059	0.0320
9	8.03	11.29	0.135	0.068	0.0369
10	5.98	8.33	0.098	0.049	0.0269
11	8.89	12.84	0.100	0.050	0.0272
12	6.37	9.21	0.073	0.036	0.0198

TABLE 5-VI Maximum Response Spectrum Analysis Results for 1-story Isolated Structure with Excitation Represented by Scaled UBC Design Spectra in Seismic Zone 4, for Medium Soil Sites (representative of soil type S_2). Weight = 2560 kips, Height = 12 ft

ISOLATION SYSTEM TYPE	BASE CENTER DISPL (inches)	CORNER BEARING DISPL (inches)	BASE SHEAR / WEIGHT	1st STORY SHEAR / WEIGHT	1st STORY DRIFT / HEIGHT (%)
2	7.69	10.85	0.351	0.177	0.0961
3	6.23	8.77	0.282	0.142	0.0773
4	4.81	6.78	0.216	0.109	0.0592
5	10.15	14.22	0.263	0.132	0.0720
6	8.39	11.75	0.215	0.108	0.0586
7	6.82	9.55	0.175	0.088	0.0479
8	14.06	19.89	0.233	0.117	0.0634
9	10.99	15.52	0.177	0.089	0.0482
10	9.08	12.83	0.146	0.073	0.0399
11	15.32	22.05	0.176	0.088	0.0478
12	11.83	17.09	0.130	0.065	0.0355
13	9.66	13.94	0.108	0.054	0.0295

TABLE 5-VII Maximum Response Spectrum Analysis Results for 8-story Isolated Structure with Excitation Represented by Scaled UBC Design Spectra in Seismic Zone 4, for Stiff Soil Sites (representative of soil type S_1). Weight = 11520 kips, Height = 12 ft

ISOLATION SYSTEM TYPE	BASE CENTER DISPL (inches)	CORNER BEARING DISPL (inches)	BASE SHEAR / WEIGHT	1st STORY SHEAR / WEIGHT	1st STORY DRIFT / HEIGHT (%)
3	4.94	6.75	0.220	0.203	0.478
4	4.15	5.67	0.184	0.170	0.400
5	3.33	4.55	0.152	0.140	0.330
6	7.32	10.18	0.185	0.169	0.397
7	5.51	7.65	0.142	0.130	0.305
8	4.49	6.25	0.115	0.105	0.246
9	7.91	11.07	0.133	0.121	0.284
10	5.91	8.26	0.097	0.088	0.206
11	9.29	13.26	0.104	0.094	0.221
12	6.76	9.66	0.077	0.069	0.163

TABLE 5-VII Continued

ISOLATION SYSTEM TYPE	2nd STORY SHEAR / WEIGHT	3rd STORY SHEAR / WEIGHT	4th STORY SHEAR / WEIGHT	5th STORY SHEAR / WEIGHT	6th STORY SHEAR / WEIGHT	7th STORY SHEAR / WEIGHT	8th STORY SHEAR / WEIGHT
3	0.185	0.164	0.142	0.118	0.092	0.064	0.033
4	0.154	0.137	0.119	0.099	0.077	0.054	0.028
5	0.128	0.114	0.099	0.082	0.065	0.045	0.024
6	0.151	0.133	0.114	0.094	0.072	0.050	0.026
7	0.117	0.102	0.088	0.072	0.056	0.038	0.020
8	0.094	0.083	0.071	0.059	0.045	0.031	0.016
9	0.108	0.094	0.080	0.065	0.050	0.034	0.017
10	0.078	0.068	0.058	0.047	0.036	0.025	0.013
11	0.083	0.072	0.061	0.050	0.038	0.026	0.013
12	0.062	0.054	0.045	0.037	0.028	0.019	0.010

TABLE 5-VII Continued

ISOLATION SYSTEM TYPE	2nd STORY $\frac{DRIFT}{HEIGHT}$ (%)	3rd STORY $\frac{DRIFT}{HEIGHT}$ (%)	4th STORY $\frac{DRIFT}{HEIGHT}$ (%)	5th STORY $\frac{DRIFT}{HEIGHT}$ (%)	6th STORY $\frac{DRIFT}{HEIGHT}$ (%)	7th STORY $\frac{DRIFT}{HEIGHT}$ (%)	8th STORY $\frac{DRIFT}{HEIGHT}$ (%)
3	0.434	0.386	0.446	0.371	0.289	0.302	0.156
4	0.363	0.323	0.373	0.311	0.242	0.253	0.131
5	0.300	0.267	0.310	0.259	0.203	0.213	0.111
6	0.356	0.313	0.358	0.294	0.227	0.235	0.120
7	0.274	0.241	0.275	0.227	0.175	0.181	0.092
8	0.221	0.194	0.223	0.184	0.142	0.148	0.076
9	0.253	0.221	0.251	0.205	0.157	0.161	0.082
10	0.184	0.160	0.182	0.149	0.114	0.117	0.060
11	0.196	0.170	0.192	0.155	0.118	0.120	0.061
12	0.145	0.126	0.142	0.116	0.088	0.090	0.046

TABLE 5-VIII Maximum Response Spectrum Analysis Results for 8-story Isolated Structure with Excitation Represented by Scaled UBC Design Spectra in Seismic Zone 4, for Medium Soil Sites (representative of soil type S_2). Weight = 11520 kips, Height = 12 ft

ISOLATION SYSTEM TYPE	BASE CENTER DISPL (inches)	CORNER BEARING DISPL (inches)	BASE SHEAR / WEIGHT	1st STORY SHEAR / WEIGHT	1st STORY DRIFT / HEIGHT (%)
2	7.01	9.61	0.319	0.295	0.694
3	5.97	8.20	0.271	0.250	0.588
4	4.74	6.51	0.213	0.197	0.462
5	9.67	13.49	0.251	0.229	0.538
6	8.22	11.46	0.210	0.192	0.451
7	6.71	9.36	0.173	0.157	0.370
8	13.74	19.26	0.227	0.206	0.484
9	10.93	15.35	0.176	0.159	0.374
10	9.04	12.69	0.146	0.132	0.310
11	15.90	22.74	0.182	0.164	0.386
12	12.40	17.73	0.137	0.123	0.289
13	9.87	14.45	0.111	0.100	0.234

TABLE 5-VIII Continued

ISOLATION SYSTEM TYPE	2nd STORY SHEAR / WEIGHT	3rd STORY SHEAR / WEIGHT	4th STORY SHEAR / WEIGHT	5th STORY SHEAR / WEIGHT	6th STORY SHEAR / WEIGHT	7th STORY SHEAR / WEIGHT	8th STORY SHEAR / WEIGHT
2	0.268	0.238	0.205	0.170	0.131	0.091	0.046
3	0.227	0.201	0.174	0.144	0.112	0.077	0.039
4	0.178	0.159	0.138	0.114	0.089	0.062	0.032
5	0.205	0.180	0.154	0.126	0.097	0.066	0.034
6	0.172	0.151	0.129	0.106	0.081	0.056	0.028
7	0.141	0.124	0.106	0.087	0.067	0.046	0.024
8	0.183	0.160	0.135	0.110	0.084	0.057	0.029
9	0.141	0.123	0.105	0.085	0.065	0.044	0.022
10	0.117	0.102	0.087	0.071	0.054	0.037	0.019
11	0.145	0.126	0.106	0.086	0.066	0.044	0.022
12	0.109	0.094	0.080	0.065	0.049	0.033	0.017
13	0.088	0.077	0.065	0.053	0.040	0.027	0.014

TABLE 5-VIII Continued

ISOLATION SYSTEM TYPE	2nd STORY DRIFT / HEIGHT (%)	3rd STORY DRIFT / HEIGHT (%)	4th STORY DRIFT / HEIGHT (%)	5th STORY DRIFT / HEIGHT (%)	6th STORY DRIFT / HEIGHT (%)	7th STORY DRIFT / HEIGHT (%)	8th STORY DRIFT / HEIGHT (%)
2	0.629	0.559	0.644	0.532	0.412	0.426	0.218
3	0.533	0.474	0.546	0.452	0.350	0.362	0.186
4	0.420	0.373	0.431	0.359	0.280	0.292	0.150
5	0.483	0.424	0.483	0.396	0.304	0.311	0.158
6	0.404	0.355	0.404	0.332	0.255	0.261	0.133
7	0.332	0.292	0.333	0.274	0.211	0.217	0.111
8	0.431	0.375	0.425	0.346	0.264	0.268	0.136
9	0.332	0.290	0.328	0.267	0.204	0.207	0.105
10	0.276	0.241	0.272	0.222	0.170	0.173	0.088
11	0.342	0.297	0.334	0.271	0.205	0.208	0.105
12	0.256	0.222	0.250	0.203	0.154	0.156	0.079
13	0.208	0.180	0.203	0.165	0.126	0.128	0.065

SECTION 6

COMPARISON OF RESULTS

All of the isolated structures in this report were analyzed by a linear response spectrum analysis and a rigorous dynamic nonlinear time history analysis. Furthermore, results were obtained by the static analysis procedure of SEAOC/UBC.

In order to quantify the results and make comparisons between the analyses, plots of the response quantities have been created. In section 6.1, comparisons are made between story shear forces from the analyses and in section 6.2, comparisons are made between center bearing displacements and corner bearing displacements from the analyses.

6.1 Comparison of Results on Story Shear Forces

Plots have been constructed to show the variation of story shear force vs. story as determined by the three analysis procedures. The results are presented as follows. The results of the SEAOC/UBC static analysis procedure are referred to as "SEAOC STATIC". The results of the response spectrum analysis procedure are referred to as "RESPONSE SPECTRUM". The results of the nonlinear dynamic time history analysis are presented in terms of the mean of the maximum longitudinal and transverse direction results. This quantity has been used for comparisons since it represents the absolute maximum result of the nonlinear analyses regardless of the direction of input excitation. This value is called "MEAN OF MAX L,T". Furthermore, the mean of maximum L,T plus one standard deviation of the results is presented in order to provide an upper bound to both the response spectrum results and the static analysis results. This quantity is referred to as "MEAN + 1 σ". It should be noted that all results on story shear forces and base shear force were not reduced by factors R_{WI} and 1.5, respectively, to obtain the design level forces.

Figures 6-1 to 6-6 compare the distribution of shear force over story level in the analyzed 8-story isolated structure. The isolation systems which do not meet the criteria of SEAOC/UBC allowing the response spectrum analysis procedure (see Table 5-I) have been appropriately labeled in the figures. The results of Figures 6-1 to 6-6 demonstrate that:

1. The results of the static and response spectrum analysis procedures are, in general, in close agreement.
2. The results of the static and response spectrum analysis procedures either predict well or underestimate the mean of story shear forces as predicted by the time history analysis. The degree of underestimation is significant in all isolation systems which do not meet the SEAOC/UBC criteria allowing response spectrum analysis. In these systems, with typical effective damping of the isolation system β larger than 30%, the time history analysis predicted significantly more shear force in the upper stories. This is the result of significant contribution from the higher modes of the isolated structure. This behavior is typical of highly nonlinear isolation systems.
3. The underestimation of the story shear force by the static and response spectrum analysis procedures is also significant in isolation systems No. 4, 7 and 10 on soil type S_1 and No. 3, 10 and 12 on soil type S_2. These isolation systems meet the criteria of SEAOC/UBC for allowing response spectrum analysis and have effective damping in the isolation system in the range of 15% to 27% of critical. In these systems, the shear force in the upper stories of the isolated building is underestimated by the static and response spectrum procedures by a factor which is in the range of 2 to 3.

Table 6-I presents a comparison of the base and story shear forces of the 1-story isolated structure as computed by the three analysis procedures. Again, it is observed that the static and response spectrum procedures produce nearly identical base shear forces. The difference in the first story shear force (by a factor of 2) is just a result of equations (2.5) and (2.6) which, without the reduction factors 1.5 and R_{WI}, give identical base and first story shear forces. The response spectrum analysis procedure underpredicts the mean of time history analyses on the story shear force in all but four of the 22 analyzed isolation systems. The degree of underestimation was,

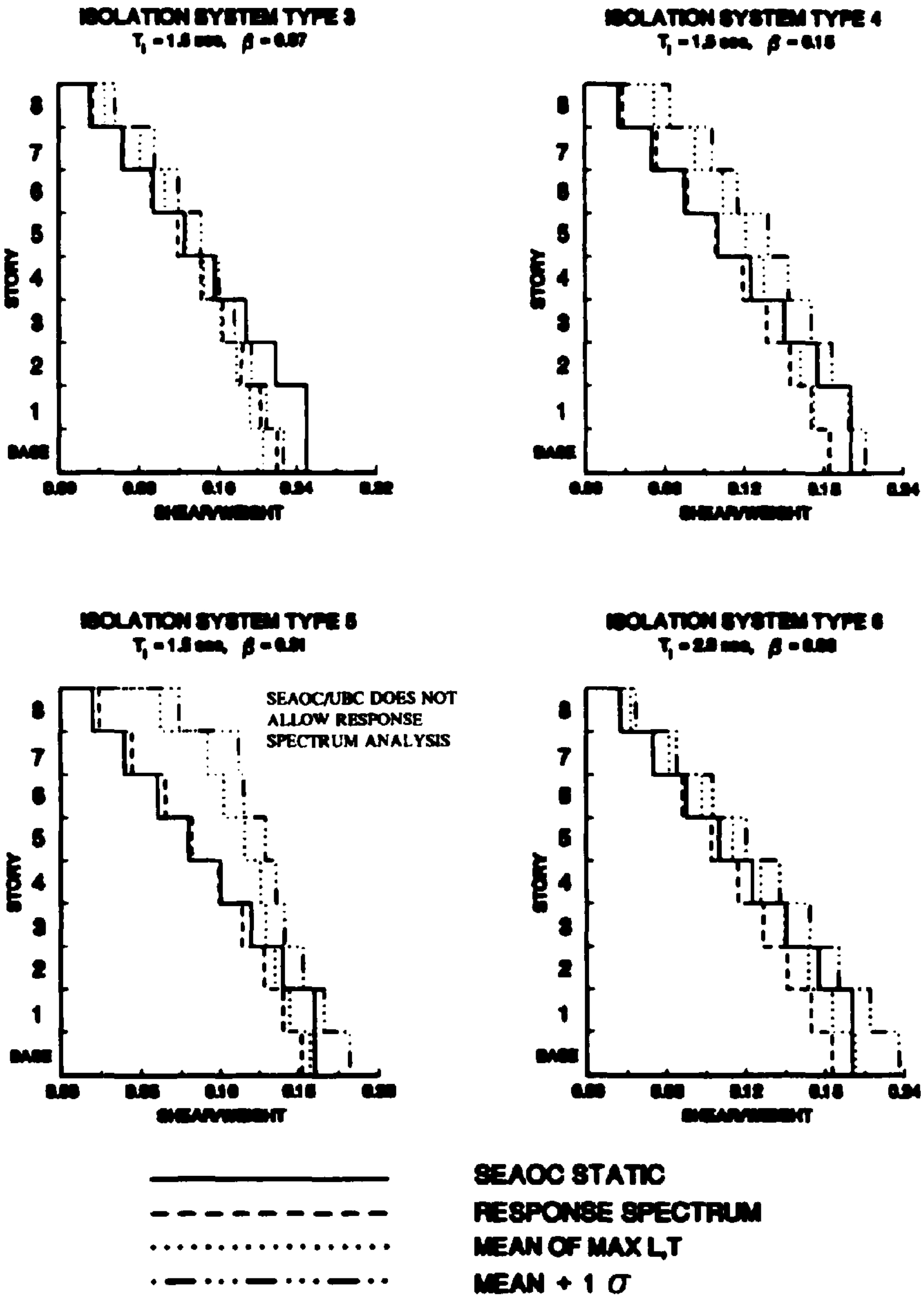


FIGURE 6-1 Distribution of Story Shear Forces for Isolation System Types 3, 4, 5 and 6 on S_1 Soils

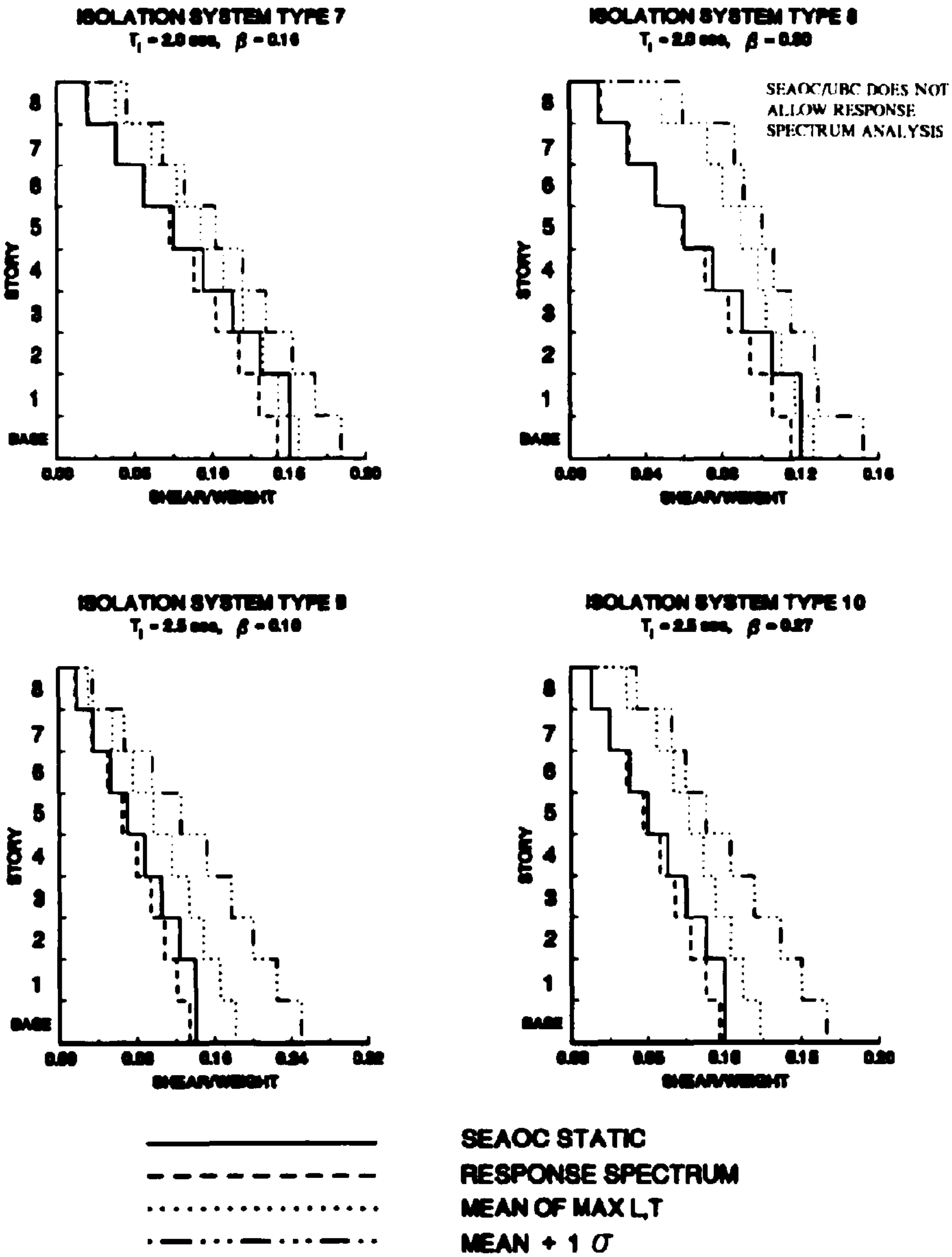


FIGURE 6-2 Distribution of Story Shear Forces for Isolation System Types 7, 8, 9 and 10 on S_1 Soils

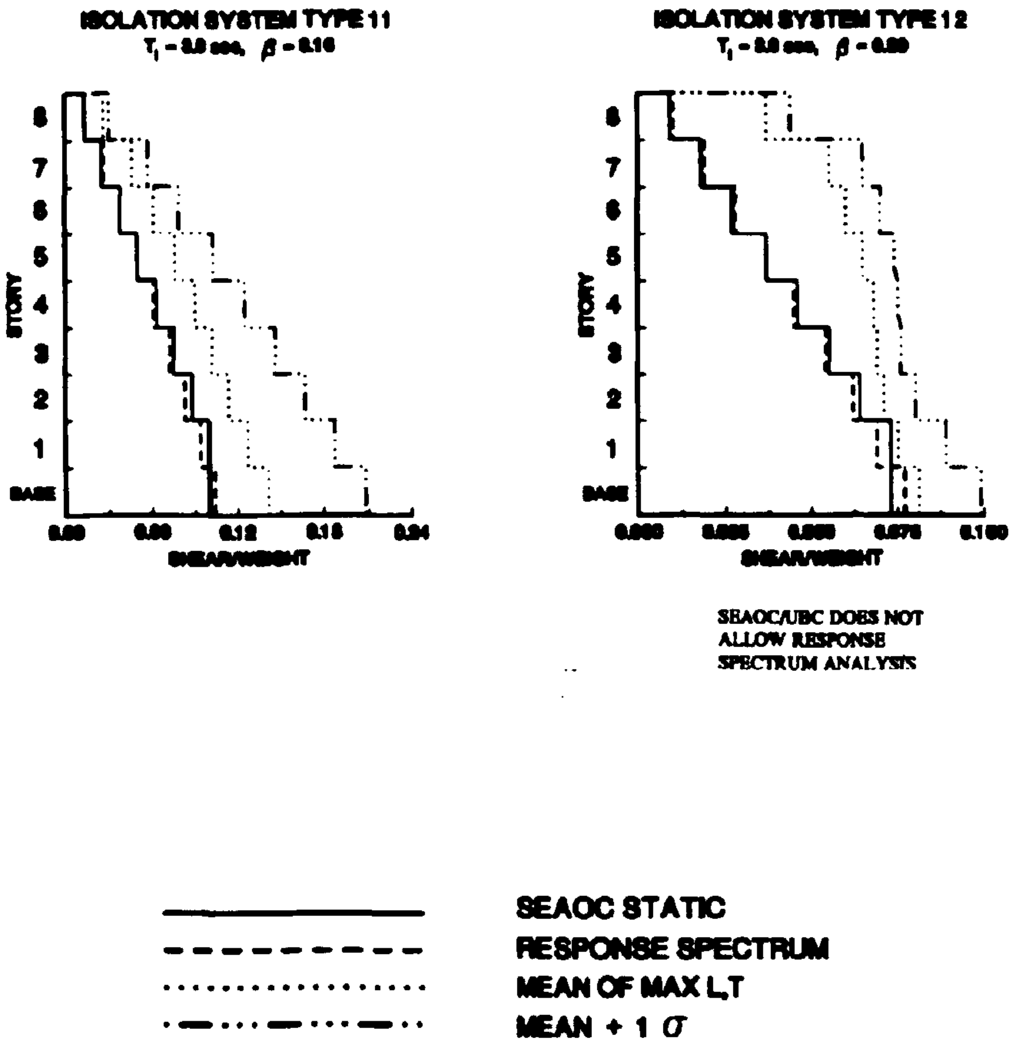


FIGURE 6-3 Distribution of Story Shear Forces for Isolation System Types 11 and 12 on S_1 Soils

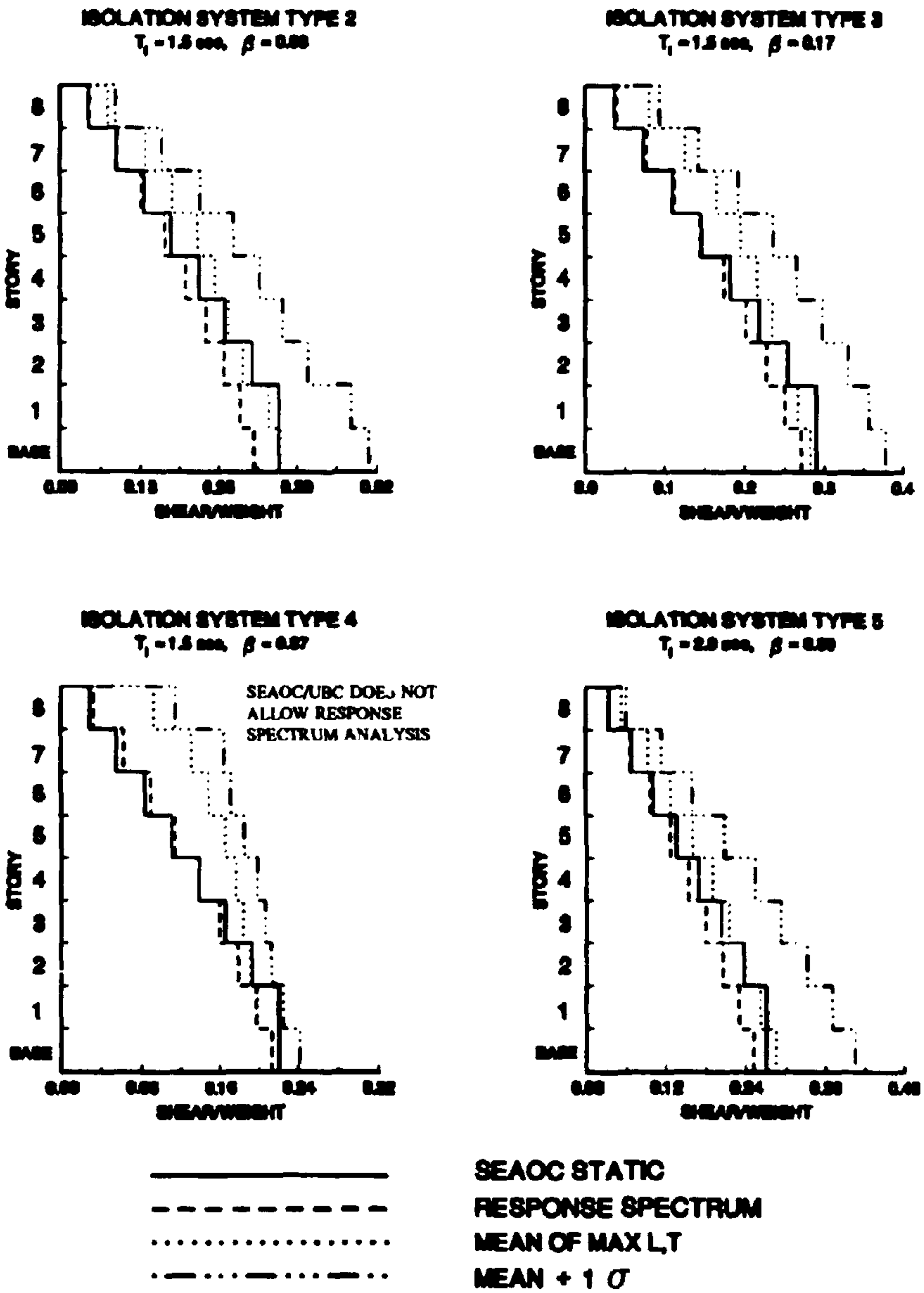


FIGURE 6-4 Distribution of Story Shear Forces for Isolation System Types 2, 3, 4 and 5 on S_2 Soils

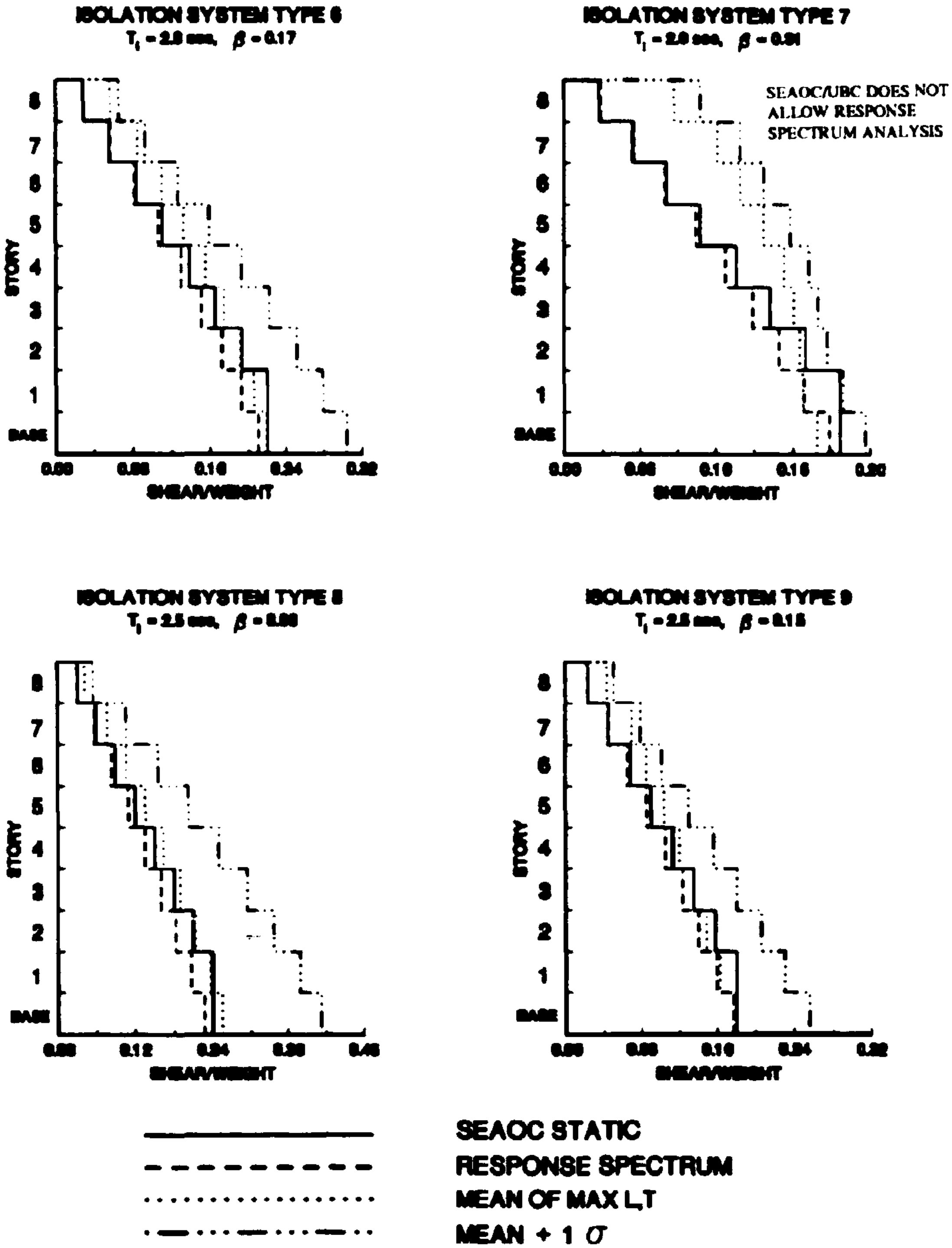


FIGURE 6-5 Distribution of Story Shear Forces for Isolation System Types 6, 7, 8 and 9 on S_2 Soils

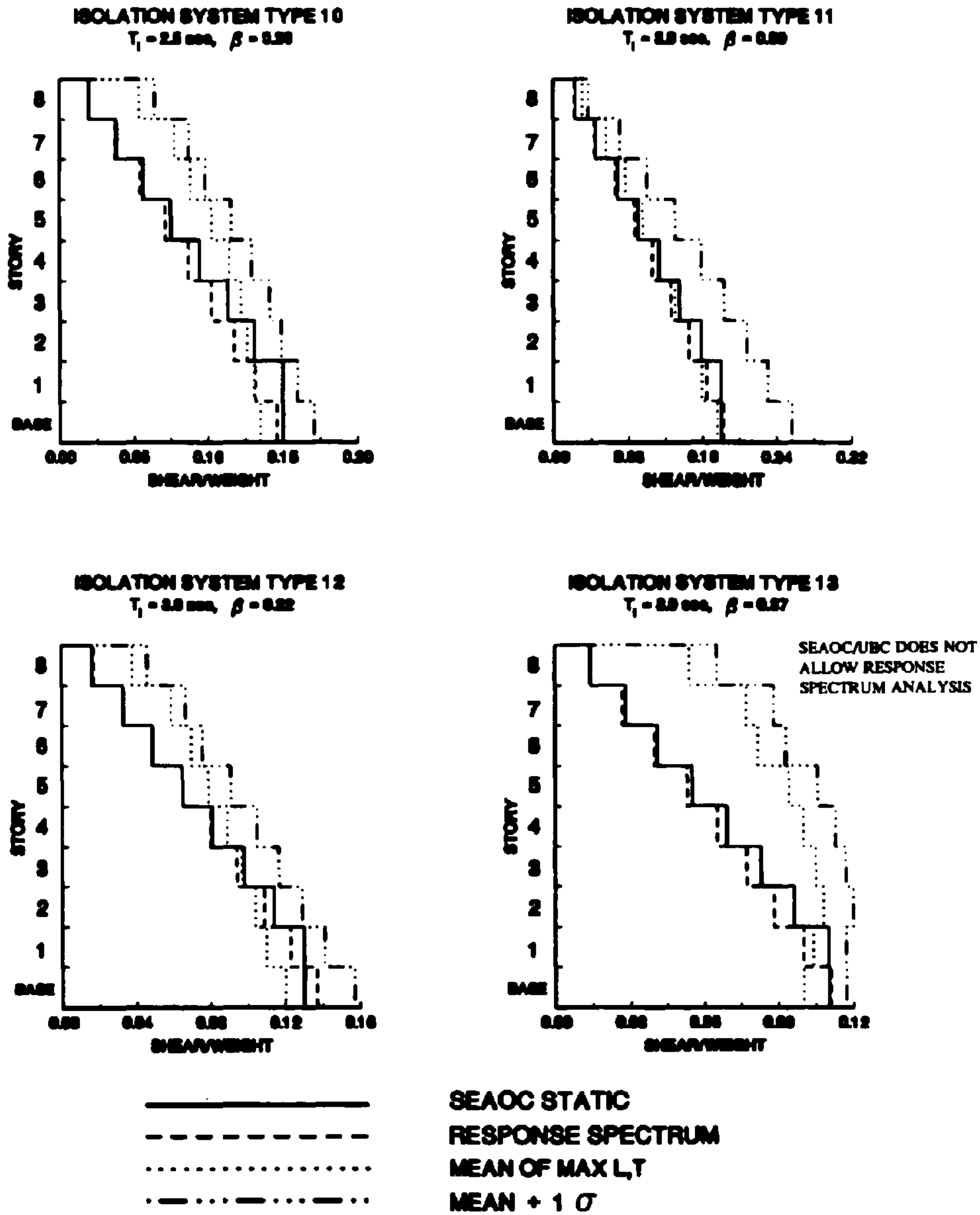


FIGURE 6-6 Distribution of Story Shear Forces for Isolation System Types 10, 11, 12 and 13 on S_2 Soils

TABLE 6-I Comparison of Base Shear (BS) and Story Shear (SS) Force Results for 1-story Isolated Structure. Weight = 2560 kips.

SOIL TYPE	ISOLATION SYSTEM TYPE	SEAOC STATIC		RESPONSE SPECTRUM		MEAN OF MAX L, T		MEAN + 1 σ	
		BS/WEIGHT	SS/WEIGHT	BS/WEIGHT	SS/WEIGHT	BS/WEIGHT	SS/WEIGHT	BS/WEIGHT	SS/WEIGHT
S_1	3	0.250	0.250	0.252	0.127	0.232	0.118	0.281	0.142
	4	0.200	0.200	0.200	0.101	0.179	0.092	0.212	0.108
	5	0.160	0.160	0.161	0.082	0.150	0.080	0.170	0.090
	6	0.200	0.200	0.195	0.098	0.214	0.108	0.256	0.129
	7	0.150	0.150	0.147	0.074	0.158	0.081	0.183	0.093
	8	0.120	0.120	0.117	0.059	0.120	0.062	0.142	0.072
	9	0.140	0.140	0.135	0.068	0.187	0.094	0.253	0.127
	10	0.100	0.100	0.098	0.049	0.121	0.061	0.161	0.081
	11	0.100	0.100	0.100	0.050	0.143	0.072	0.208	0.104
	12	0.073	0.073	0.073	0.036	0.080	0.042	0.096	0.048
S_2	2	0.360	0.360	0.351	0.177	0.377	0.205	0.513	0.283
	3	0.290	0.290	0.282	0.142	0.298	0.158	0.399	0.203
	4	0.220	0.220	0.216	0.109	0.207	0.127	0.222	0.143
	5	0.270	0.270	0.263	0.132	0.306	0.156	0.424	0.214
	6	0.220	0.220	0.215	0.108	0.224	0.116	0.301	0.153
	7	0.180	0.180	0.175	0.088	0.166	0.095	0.192	0.102
	8	0.240	0.240	0.233	0.177	0.283	0.142	0.430	0.215
	9	0.180	0.180	0.177	0.089	0.187	0.096	0.273	0.137
	10	0.150	0.150	0.146	0.073	0.135	0.073	0.167	0.086
	11	0.180	0.180	0.176	0.088	0.184	0.093	0.269	0.135
	12	0.130	0.130	0.130	0.065	0.120	0.063	0.157	0.080
	13	0.110	0.110	0.108	0.054	0.099	0.059	0.115	0.066

generally, less than 30% of the mean of time history analysis. Interestingly, the largest difference was observed in isolation system No. 9 on S_1 soils, which has an effective damping, $\beta = 10\%$.

6.2 Comparison of Results on Bearing Displacements

Figures 6-7 to 6-10 compare the results on the center bearing and corner bearing displacements as determined by the static and response spectrum analysis procedures of SEAOC/UBC and the mean of time history analysis results. The latter is the mean of the maximum response in either the longitudinal or the transverse direction of the structure. The calculated displacements are presented as a function of the isolation system period, T_I, and grouped according to the effective damping of the isolation system, β.

The results demonstrate:

1. The static and response spectrum procedures of SEAOC/UBC predict almost identical center bearing displacement.
2. The response spectrum procedure predicts corner bearing displacements which are typically larger than those predicted by the static procedure. Differences of the order of 15% of the value predicted by the static procedure are observed at an isolation system period of 3 seconds.
3. The center bearing displacement, as predicted by the static and response spectrum procedures, is in good agreement with the mean displacement of the nonlinear time history analyses for Soil Type S_2. However, they are substantially less than the mean of the time history analyses for Soil Type S_1 and for isolation system periods larger than or equal to 2.5 seconds. The source of this discrepancy is the existence of two records with strong long-period components in the set of earthquake motions used in the time history analysis. These records were identified by Theodossiou and Constantinou (1991).
4. The corner bearing displacement as predicted by the static and response spectrum procedures, is in good agreement with the mean of results of time history analysis for isolation system periods of 2 seconds or less. At higher values of effective period, the

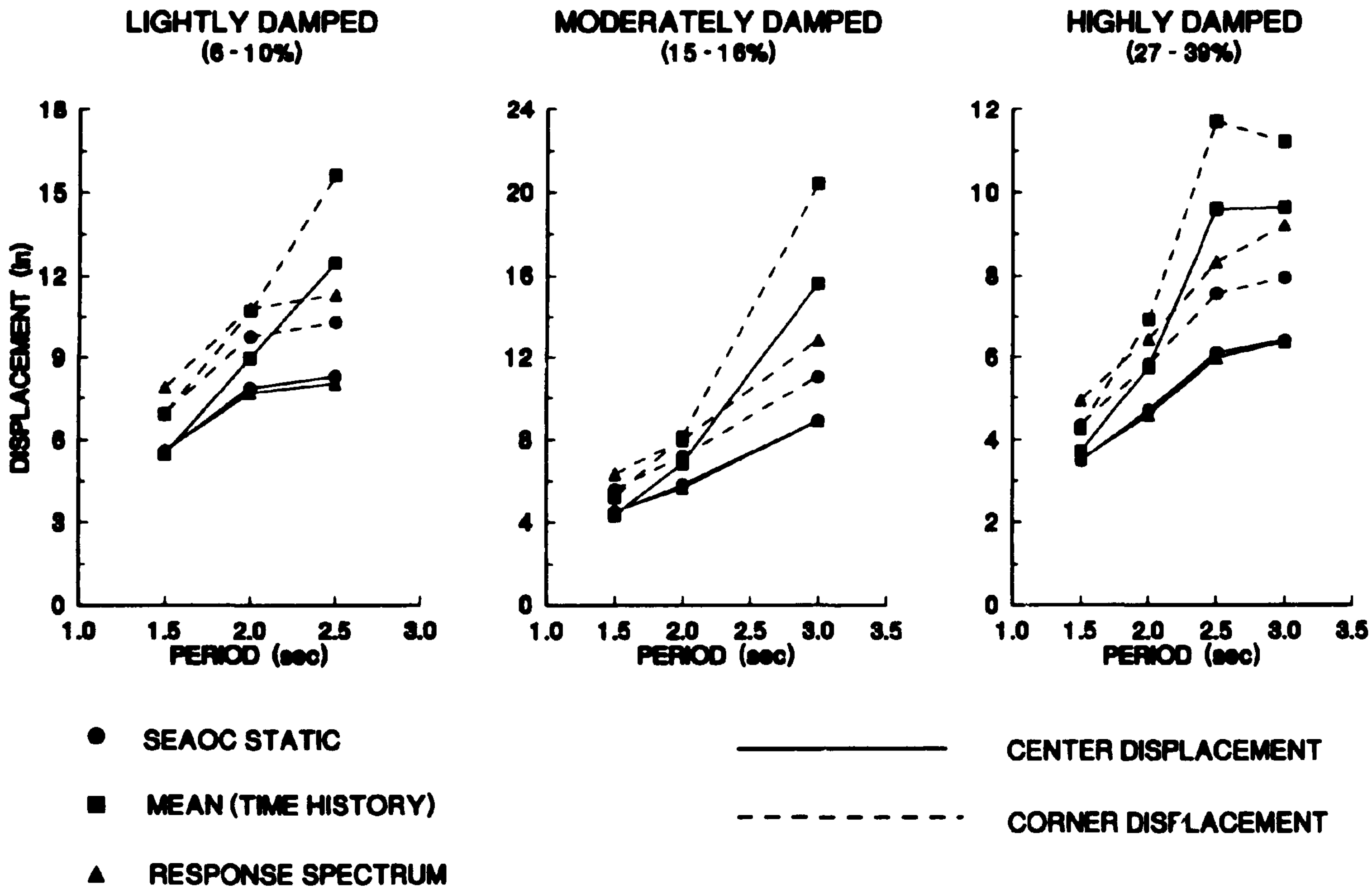


FIGURE 6-7 Results of Center and Corner Bearing Displacements for 1-story Isolated Structures on S_1 Soils

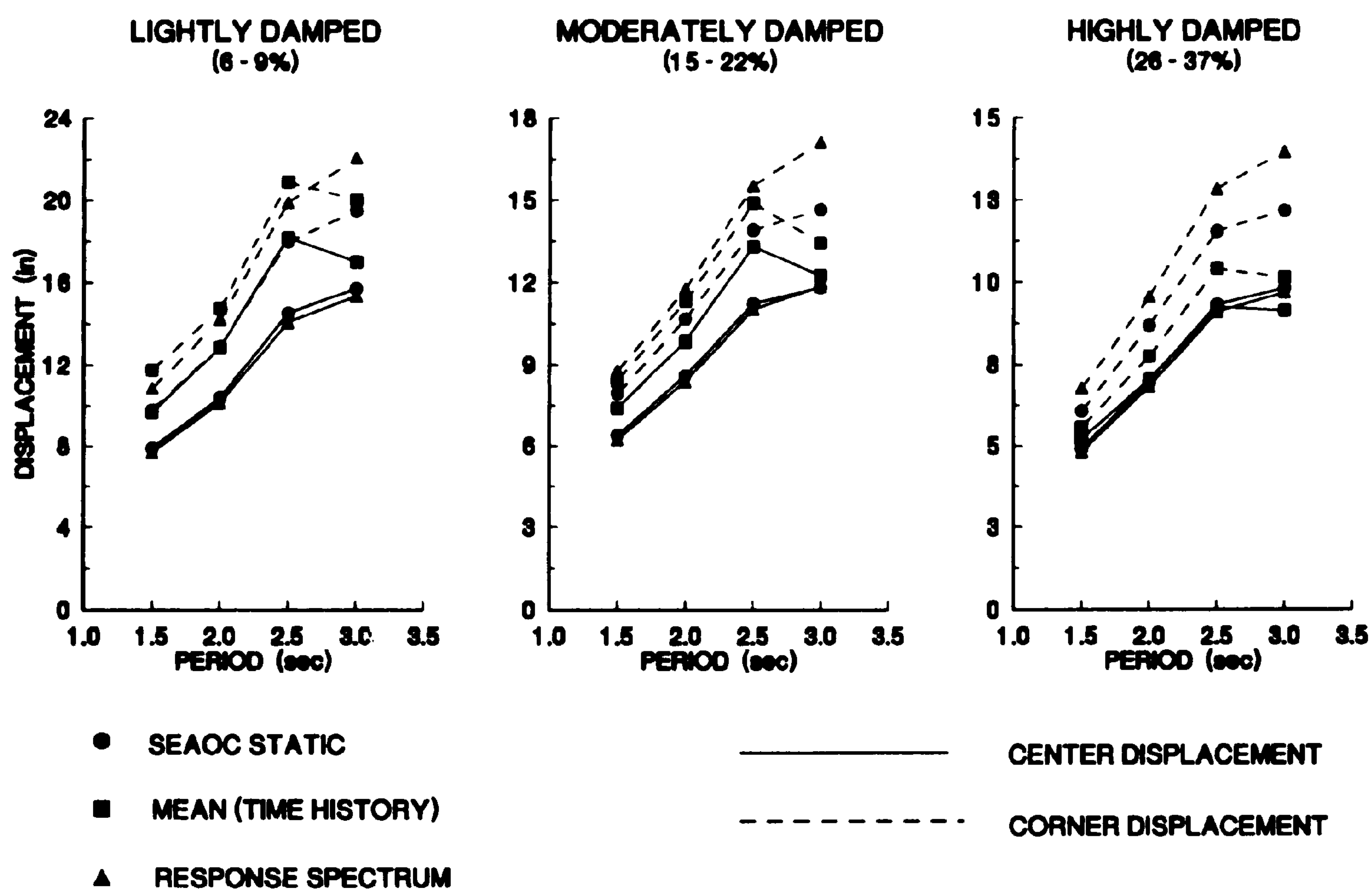


FIGURE 6-8 Results of Center and Corner Bearing Displacements for 1-story Isolated Structures on S_2 Soils

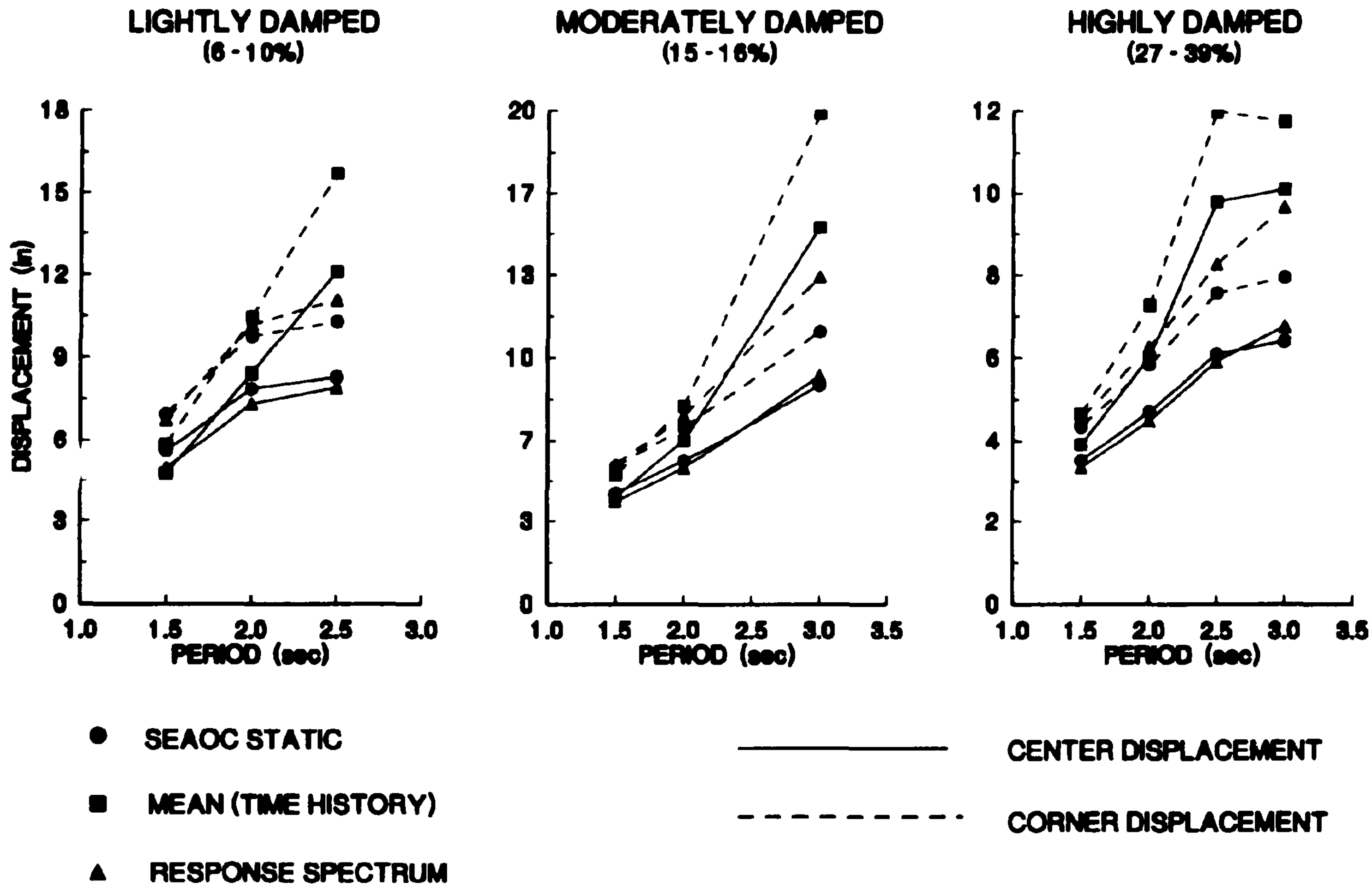


FIGURE 6-9 Results of Center and Corner Bearing Displacements for 8-story Isolated Structures on S_1 Soils

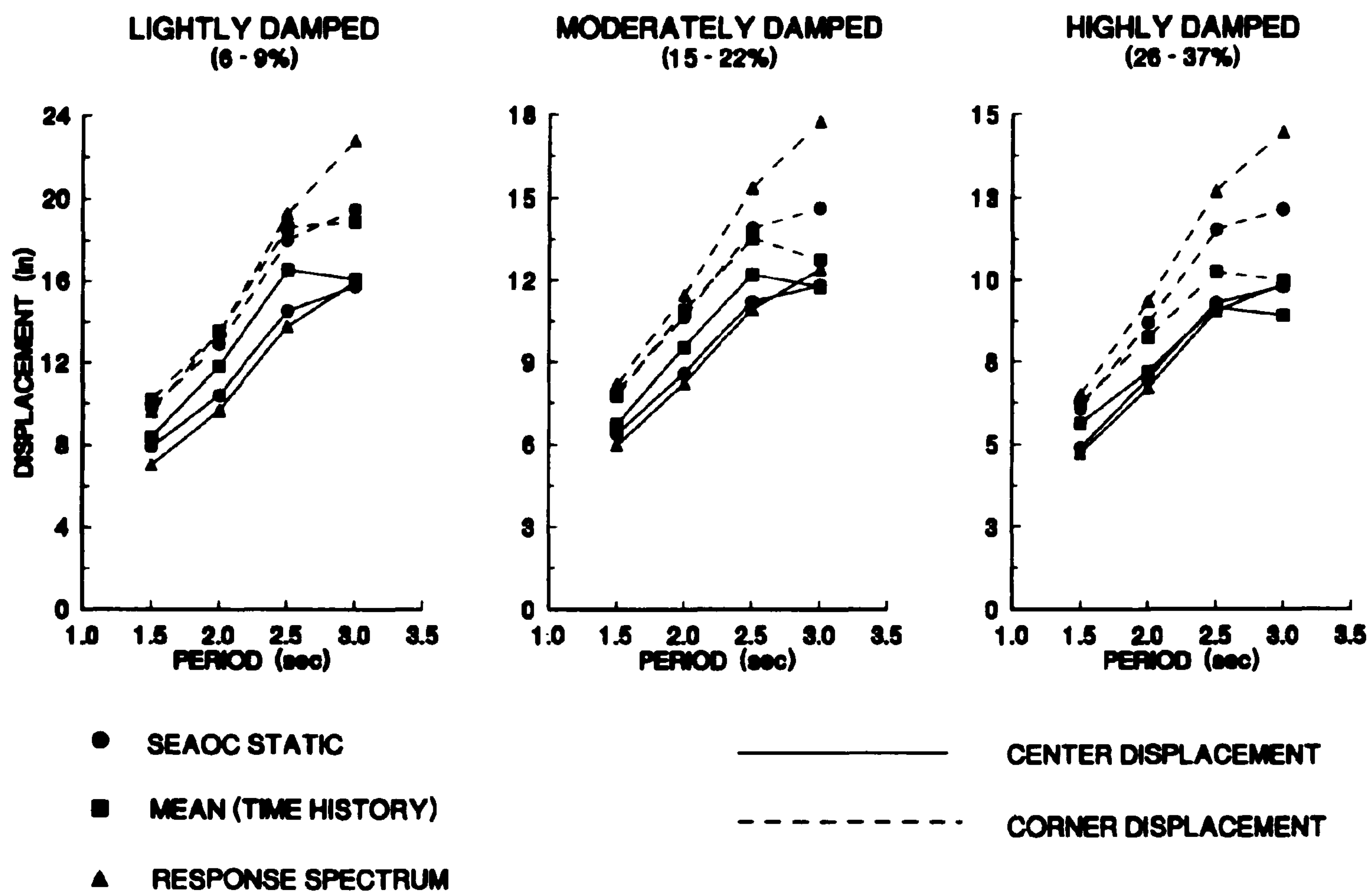


FIGURE 6-10 Results of Center and Corner Bearing Displacements for 8-story Isolated Structures on S_2 Soils

predictions of the static and response spectrum procedures are conservative for Soil Type S_2 and unconservative for Soil Type S_1.

An interesting observation is made with regard to the bearing displacements of the 8-story and 1-story isolated structures. Concentrating on the mean of the time history results (see Appendices A and B), we observe that the center bearing displacement of the 8-story structure is less than the corresponding displacement of the 1-story structure. The difference is rather small and it is observed in most, but not all, analyzed isolation systems. This phenomenon is recognized in the proposed changes for the 1994 Uniform Building Code (Seismology Committee, 1992). It is proposed in the 1994 UBC that the displacement of the isolation system, D', is determined as

$$D' = \frac{D}{\sqrt{1 + \left(\frac{T}{T_I}\right)^2}} \qquad (6.1)$$

where D is given by equation (2.1), T_I is the period of the isolated structure (eq. 2.2) and T is the period of the fixed-based superstructure. The derivation of equation (6.1) is based on the theory presented in section 5.2.

Figure 6-11 compares the predictions of equation (6.1) to the mean (calculated in time history analysis) of the ratio of center bearing displacement of the 8-story isolated structure to the center bearing displacement of the 1-story isolated structure. The comparison demonstrates the validity of equation (6.1). However, it may be seen in Figure 6-11 that equation (6.1) is sufficiently accurate for all damping levels provided that $T_I / T \geq 2.0$. Equation (6.1) is actually valid over a wider range of ratio of T_I / T when the effective damping in the isolation system is within certain limits. For example, the equation is valid for $T_I / T \geq 1.3$ when $\beta \leq 0.10$ (lightly damped isolation systems) and for $T_I / T \geq 1.75$ when $0.15 \leq \beta \leq 0.22$ (moderately damped isolation systems).

The dependency of the accuracy of equation (6.1) on the effective damping of the isolation system is apparently, a result of the nonlinearity of the isolation system and the associated excitation of higher mode response. It should be noted that equation (6.1) is based on the linear theory of section 5.2 and consideration of only the effects of the first mode of vibration of the isolated structure.

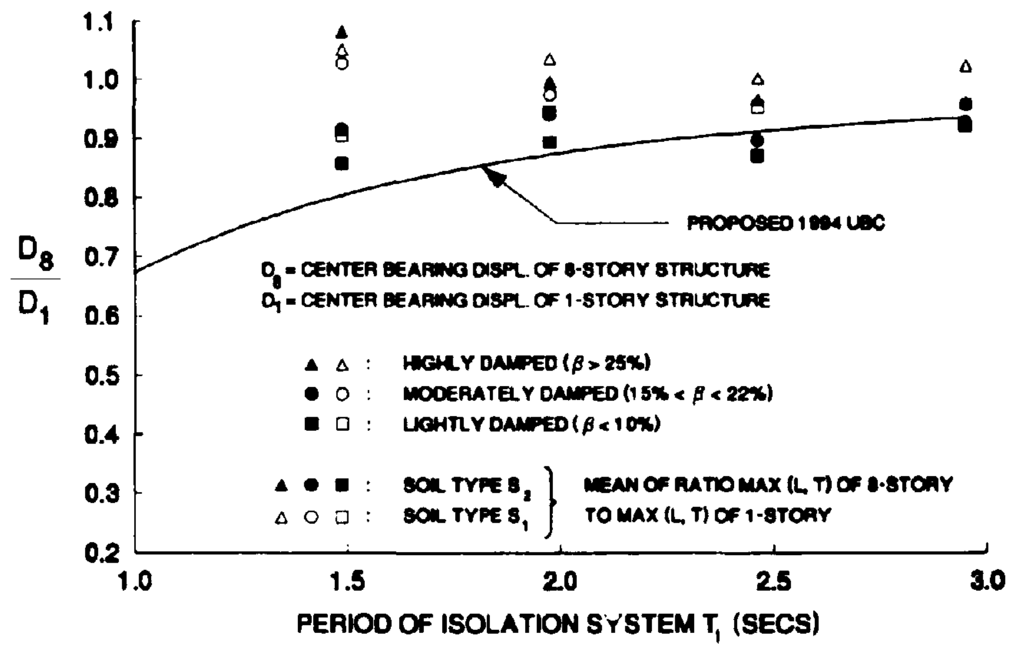


FIGURE 6-11 Ratio of the Center Bearing Displacement of the 8-story and 1-story Isolated Structures

SECTION 7

SUMMARY AND CONCLUSIONS

In this study, comparisons have been made between dynamic nonlinear time history analysis and the SEAOC/UBC static and response spectrum analysis procedures for seismic isolated structures. The response of isolated structures with stiff and flexible superstructures founded on soil types S_1 and S_2 in Seismic Zone 4 has been examined.

The isolation systems varied in properties to account for a wide range of conceivable isolation schemes. The isolation systems had period, T_I (per SEAOC/UBC), in the range of 1.5 to 3 seconds and effective damping, β (per SEAOC/UBC), in the range of 6% to 39% of critical.

The time history analysis results were obtained by the use of 29 pairs of earthquake orthogonal components which were scaled so that they represented Seismic Zone 4 and soil types S_1 and S_2 excitations. The response spectrum analysis results were obtained by the procedures of SEAOC/UBC and using modified response spectra to account for the damping ratios other than 5% of critical in the various modes of the isolated structure.

Two methods of modifying the 5%-damped response spectra were used. The two methods gave nearly identical response results even though the modified spectra were very different at short periods. In the first method, only the long period spectral ordinates were modified for damping different than 5% of critical. In the second method, the entire spectrum was modified in accordance with analytically calculated estimates of the first three periods and corresponding damping ratios of the isolated structure. In both methods, **the 5%-damped response spectrum was reduced (divided) by the factor B (see Table 2-IV) in the neighborhood of the first mode period of the isolated structure, T_1, and in accordance with the damping ratio of the first mode of the isolated structure, ξ_1.** In general, period T_1 is larger than period T_I of the isolation system and damping ratio ξ_1 is less than the effective damping β of the isolation system. The relation between T_1 and T_I and ξ_1 and β has been explored in section 5.2 based on the theory of Kelly (1990). Simplified code type relations, valid for T/T_I less than 0.6 are easily obtained from the results of section 5.2 to be

$$T_1 = T_I\left[1 + \frac{1}{2}\left(\frac{T}{T_I}\right)^2\right] \tag{7.1}$$

$$\xi_1 = \beta\left[1 - \frac{3}{2}\left(\frac{T}{T_I}\right)^2 + \frac{1}{2}\left(\frac{T}{T_I}\right)^4\right] \tag{7.2}$$

where T = period of the fixed based superstructure.

The comparison of results of the time history analysis and the SEAOC/UBC static and response spectrum procedures revealed that:

1. The static and response spectrum analysis procedures predict almost identical center bearing displacement and distribution of shear force with height. However, the response spectrum analysis procedure predicts corner bearing displacements which are larger by no more than 15% of the displacements predicted by the static analysis procedure.
2. The static and response spectrum analysis procedures predict center bearing displacements which are in good agreement with the mean of time history results for soil type S_2 but they are substantially less than the mean of time history results for soil type S_1 and isolation system period $T_I \geq 2.5$ secs. This discrepancy was primarily caused by two records with strong long-period components in the set of earthquake motions representative of soil type S_1.
3. The static and response spectrum analysis procedures predict corner bearing displacements which are in good agreement with the mean of time history analysis results for periods of isolation system less than or equal to 2 seconds. For periods larger than 2 seconds,

the static and response spectrum procedures are conservative for soil type S_2 and unconservative for soil type S_1.

4. The flexibility of the superstructure tends to reduce the isolation system displacement in accordance with equation (6.1) of the proposed 1994 UBC, provided that $T_1 / T \geq 2.0$.
5. The results of the response spectrum analysis procedure on the distribution of shear force over the height of the isolated structure agree with the mean of time history analyses for all lightly damped isolation systems (that is, systems with effective damping $\beta < 10\%$). For higher values of effective damping of the isolation system, the shear force in the upper stories of the structure is underpredicted by the response spectrum procedure by factors exceeding two. In particular, systems which meet the current SEAOC/UBC criteria allowing response spectrum analysis (that is, systems with $\beta < 0.30$), the degree of underprediction of shear force in the upper ⅓ of the structure ranged from 2 to 3. Considering that the top of a building is not, usually, the most critical failure point of the building, underpredicting the response by a factor of 2 might be acceptable for design. However, underprediction of the shear force by a factor of 3 is unconservative.

It is clear from the results of this study that the current SEAOC/UBC criteria for allowing response spectrum analysis (effectively allowing use of the procedure when $\beta < 0.30$) should be modified to prevent the prediction of unconservative shear forces at the top of an isolated building.

SECTION 8

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APPENDIX A

NONLINEAR ANALYSIS RESULTS OF MAXIMUM CENTER DISPLACEMENT, MAXIMUM CORNER DISPLACEMENT, MAXIMUM STORY SHEAR AND INTERSTORY DRIFT RATIO FOR 1-STORY ISOLATED STRUCTURE

TABLE A-I Nonlinear Dynamic Analysis Results for 1-Story Isolated Structure with Isolation System Type # 3 (T = 1.5 sec, β = 7%). Excitation is Represented by Pairs of Scaled Earthquake Motions Recorded on Stiff Soil Sites (Representative of Soil Type S_1). Weight = 2560 kips, Height = 12 ft

	EXCITATION	BASE CENTER DISPL (INCH)		CORNER BEARING DISPL (INCH)		CORNER TO CENTER DISPL RATIO	BASE SHEAR / WEIGHT		1st STORY SHEAR / WEIGHT		1st STORY DRIFT / HEIGHT (%)	
		L	T	L	T		L	T	L	T	L	T
11	LOWER CALIF. (117)	5.73	3.05	5.76	3.58	1.17	0.240	0.138	0.121	0.073	0.0656	0.0396
12	EL CENTRO (117)	4.53	5.14	5.07	6.20	1.21	0.206	0.224	0.105	0.114	0.0568	0.0624
13	PARKFIELD (014)	2.11	3.22	2.18	4.40	1.37	0.100	0.152	0.055	0.077	0.0298	0.0422
14	SAN FERNANDO (110)	5.67	3.35	5.84	3.56	1.06	0.239	0.157	0.126	0.082	0.0686	0.0452
15	SAN FERNANDO (135)	2.84	7.48	4.83	10.47	1.70	0.129	0.297	0.065	0.150	0.0351	0.0821
16	SAN FERNANDO (208)	4.53	4.55	5.48	6.26	1.38	0.187	0.188	0.096	0.094	0.0520	0.0512
17	SAN FERNANDO (211)	4.70	4.83	5.69	6.61	1.37	0.197	0.190	0.102	0.097	0.0554	0.0523
18	SAN FERNANDO (466)	2.37	8.12	3.45	11.27	1.46	0.113	0.331	0.057	0.167	0.0311	0.0903
19	SAN FERNANDO (253)	2.75	5.34	2.94	7.01	1.31	0.133	0.229	0.061	0.116	0.0362	0.0630
20	SAN FERNANDO (199)	4.89	4.52	5.36	5.05	1.12	0.218	0.195	0.111	0.100	0.0604	0.0547
	MEAN	4.01	4.96	4.66	6.44	1.32	0.176	0.210	0.091	0.107	0.0491	0.0583
	σ	1.29	1.62	1.25	2.50	0.18	0.050	0.059	0.026	0.029	0.0140	0.0158
	MEAN OF MAX (L,T)	5.50		6.92			0.232		0.118		0.0642	
	σ OF MAX (L,T)	1.34		2.09			0.049		0.024		0.0132	

TABLE A-II Nonlinear Dynamic Analysis Results for 1-Story Isolated Structure with Isolation System Type # 4 (T = 1.5 sec, β = 15%). Excitation is Represented by Pairs of Scaled Earthquake Motions Recorded on Stiff Soil Sites (Representative of Soil Type S_1). Weight = 2560 kips, Height = 12 ft

	EXCITATION	BASE CENTER DISPL (INCH)		CORNER BEARING DISPL (INCH)		CORNER TO CENTER DISPL RATIO	BASE SHEAR / WEIGHT		1st STORY SHEAR / WEIGHT		1st STORY DRIFT / HEIGHT (%)	
		L	T	L	T		L	T	L	T	L	T
11	LOWER CALIF. (117)	4.83	2.33	4.89	2.60	1.12	0.182	0.118	0.097	0.064	0.0525	0.0353
12	EL CENTRO (117)	3.92	3.70	4.09	4.57	1.24	0.168	0.165	0.087	0.087	0.0470	0.0475
13	PARKFIELD (014)	1.81	2.92	1.96	3.79	1.30	0.103	0.138	0.052	0.071	0.0282	0.0387
14	SAN FERNANDO (110)	5.16	3.32	5.23	3.25	1.08	0.205	0.146	0.103	0.084	0.0562	0.0458
15	SAN FERNANDO (135)	2.60	6.63	3.16	7.91	1.22	0.132	0.259	0.067	0.132	0.0365	0.0722
16	SAN FERNANDO (208)	3.27	3.48	3.70	4.26	1.22	0.144	0.147	0.074	0.077	0.0401	0.0426
17	SAN FERNANDO (211)	3.55	3.65	3.75	4.87	1.33	0.152	0.148	0.078	0.075	0.0421	0.0408
18	SAN FERNANDO (466)	2.20	4.58	2.42	6.10	1.33	0.104	0.188	0.053	0.095	0.0288	0.0517
19	SAN FERNANDO (253)	1.98	4.23	2.00	5.72	1.35	0.117	0.182	0.059	0.093	0.0322	0.0504
20	SAN FERNANDO (199)	3.36	3.99	3.80	4.91	1.23	0.152	0.166	0.080	0.084	0.0436	0.0457

	BASE CENTER DISPL L	BASE CENTER DISPL T	CORNER BEARING DISPL L	CORNER BEARING DISPL T	CORNER TO CENTER DISPL RATIO	BASE SHEAR / WEIGHT L	BASE SHEAR / WEIGHT T	1st STORY SHEAR / WEIGHT L	1st STORY SHEAR / WEIGHT T	1st STORY DRIFT / HEIGHT L	1st STORY DRIFT / HEIGHT T
MEAN	3.27	3.85	3.50	4.80	1.24	0.146	0.166	0.075	0.086	0.0407	0.0471
σ	1.09	1.12	1.07	1.44	0.09	0.032	0.037	0.017	0.018	0.0090	0.0097
MEAN OF MAX (L,T)	4.34		5.23			0.179		0.092		0.0500	
σ OF MAX (L,T)	0.99		1.09			0.033		0.016		0.0090	

TABLE A-III Nonlinear Dynamic Analysis Results for 1-Story Isolated Structure with Isolation System Type # 5 (T = 1.5 sec, β = 31%). Excitation is Represented by Pairs of Scaled Earthquake Motions Recorded on Stiff Soil Sites (Representative of Soil Type S_1). Weight = 2560 kips, Height = 12 ft

	EXCITATION	BASE CENTER DISPL (INCH)		CORNER BEARING DISPL (INCH)		CORNER TO CENTER DISPL RATIO	BASE SHEAR / WEIGHT		1st STORY SHEAR / WEIGHT		1st STORY DRIFT / HEIGHT (%)	
		L	T	L	T		L	T	L	T	L	T
11	LOWER CALIF. (117)	3.49	2.01	3.65	2.31	1.15	0.142	0.126	0.076	0.073	0.0411	0.0398
12	EL CENTRO (117)	3.26	3.75	3.68	4.33	1.15	0.144	0.152	0.080	0.079	0.0435	0.0434
13	PARKFIELD (014)	1.72	2.19	1.96	2.60	1.19	0.114	0.128	0.071	0.067	0.0383	0.0370
14	SAN FERNANDO (110)	4.91	3.03	5.05	3.39	1.12	0.168	0.140	0.095	0.085	0.0515	0.0464
15	SAN FERNANDO (135)	2.37	6.13	3.07	7.05	1.30	0.125	0.200	0.063	0.104	0.0344	0.0568
16	SAN FERNANDO (208)	2.74	3.65	3.20	4.31	1.18	0.136	0.137	0.069	0.071	0.0374	0.0389
17	SAN FERNANDO (211)	2.33	2.79	2.64	3.13	1.13	0.128	0.129	0.066	0.072	0.0358	0.0395
18	SAN FERNANDO (466)	1.66	3.32	1.87	4.40	1.33	0.100	0.147	0.060	0.074	0.0326	0.0404
19	SAN FERNANDO (253)	2.19	3.36	2.46	4.41	1.31	0.108	0.149	0.063	0.076	0.0342	0.0417
20	SAN FERNANDO (199)	3.66	2.70	3.69	3.55	1.31	0.146	0.133	0.077	0.074	0.0420	0.0408
	MEAN	2.83	3.29	3.13	3.95	1.23	0.131	0.144	0.072	0.078	0.0391	0.0425
	σ	0.95	1.09	0.91	1.26	0.08	0.019	0.010	0.010	0.010	0.0054	0.0054
	MEAN OF MAX (L,T)	3.73		4.26			0.150		0.080		0.0434	
	σ OF MAX (L,T)	1.04		1.15			0.020		0.010		0.0057	

TABLE A-IV Nonlinear Dynamic Analysis Results for 1-Story Isolated Structure with Isolation System Type # 6 (T = 2.0 sec, β = 6%). Excitation is Represented by Pairs of Scaled Earthquake Motions Recorded on Stiff Soil Sites (Representative of Soil Type S_1). Weight = 2560 kips, Height = 12 ft

	EXCITATION	BASE CENTER DISPL (INCH)		CORNER BEARING DISPL (INCH)		CORNER TO CENTER DISPL RATIO	BASE SHEAR / WEIGHT		1st STORY SHEAR / WEIGHT		1st STORY DRIFT / HEIGHT (%)	
		L	T	L	T		L	T	L	T	L	T
11	LOWER CALIF. (117)	7.27	4.58	7.71	5.87	1.28	0.182	0.112	0.091	0.056	0.0497	0.0307
12	EL CENTRO (117)	13.07	9.70	15.33	13.00	1.34	0.316	0.228	0.160	0.117	0.0867	0.0634
13	PARKFIELD (014)	2.36	7.49	4.33	11.45	1.83	0.065	0.173	0.033	0.087	0.0179	0.0467
14	SAN FERNANDO (110)	6.58	3.59	6.67	3.80	1.06	0.161	0.098	0.082	0.052	0.0447	0.0287
15	SAN FERNANDO (135)	10.69	8.51	10.90	9.81	1.15	0.251	0.206	0.126	0.104	0.0686	0.0572
16	SAN FERNANDO (208)	6.60	9.12	6.77	12.34	1.35	0.159	0.212	0.080	0.108	0.0433	0.0590
17	SAN FERNANDO (211)	8.11	9.04	8.19	10.88	1.20	0.194	0.212	0.098	0.107	0.0533	0.0585
18	SAN FERNANDO (466)	4054	9.14	5.21	10.54	1.15	0.112	0.218	0.057	0.110	0.0309	0.0605
19	SAN FERNANDO (253)	5054	8.85	6.10	11.71	1.32	0.134	0.205	0.069	0.104	0.0373	0.0565
20	SAN FERNANDO (199)	8.40	7.01	9.52	9.06	1.29	0.208	0.165	0.105	0.083	0.0571	0.0453
	MEAN	7.32	7.70	8.07	9.85	1.30	0.178	0.183	0.090	0.093	0.0490	0.0507
	σ	2.88	1.98	3.04	2.77	0.20	0.067	0.043	0.034	0.022	0.0184	0.0118
	MEAN OF MAX (L,T)	8.97		10.71			0.214		0.108		0.0588	
	σ OF MAX (L,T)	1.76		2.29			0.042		0.021		0.0115	

TABLE A-IVa Nonlinear Dynamic Analysis Results for 1-Story Isolated Structure with Isolation System Type # 6 (T = 2.0 sec, β = 6%). Excitation is Represented by Pairs of Scaled Earthquake Motions Recorded on Stiff Soil Sites (Representative of Soil Type S_1). Bidirectional Interaction Neglected. Weight = 2560 kips, Height = 12 ft

	EXCITATION	BASE CENTER DISPL (INCH)		CORNER BEARING DISPL (INCH)		CORNER TO CENTER DISPL RATIO	BASE SHEAR / WEIGHT		1st STORY SHEAR / WEIGHT		1st STORY DRIFT / HEIGHT (%)	
		L	T	L	T		L	T	L	T	L	T
11	LOWER CALIF. (117)	7.61	4.13	8.11	5.48	1.33	0.193	0.110	0.098	0.056	0.0547	0.0312
12	EL CENTRO (117)	10.89	7.93	11.98	11.08	1.40	0.268	0.191	0.135	0.097	0.0751	0.0538
13	PARKFIELD (014)	2.35	7.43	3.51	10.39	1.49	0.071	0.179	0.036	0.090	0.0205	0.0503
14	SAN FERNANDO (110)	6.57	3.40	6.68	3.66	1.08	0.169	0.096	0.087	0.051	0.0491	0.0321
15	SAN FERNANDO (135)	8.77	8.80	8.92	9.57	1.09	0.220	0.219	0.111	0.109	0.0612	0.0689
16	SAN FERNANDO (208)	5.80	8.44	5.89	11.25	1.33	0.152	0.206	0.076	0.104	0.0433	0.0605
17	SAN FERNANDO (211)	7.64	8.46	7.75	10.51	1.24	0.194	0.206	0.097	0.104	0.0550	0.0623
18	SAN FERNANDO (466)	4.48	9.13	4.80	10.29	1.13	0.120	0.223	0.061	0.113	0.0349	0.0718
19	SAN FERNANDO (253)	5.26	8.86	5.90	11.53	1.30	0.139	0.213	0.071	0.106	0.0413	0.0640
20	SAN FERNANDO (199)	7.23	6.62	8.30	8.54	1.29	0.185	0.166	0.093	0.083	0.0532	0.0470
	MEAN	6.66	7.32	7.18	9.23	1.27	0.171	0.181	0.87	0.091	0.0488	0.0542
	σ	2.25	1.92	2.26	2.50	0.13	0.052	0.043	0.026	0.021	0.0142	0.0135
	MEAN OF MAX (L,T)	8.34		9.89			0.206		0.104		0.0610	
	σ OF MAX (L,T)	1.16		1.58			0.027		0.013		0.0086	

TABLE A-V Nonlinear Dynamic Analysis Results for 1-Story Isolated Structure with Isolation System Type # 7 (T = 2.0 sec, β = 16%). Excitation is Represented by Pairs of Scaled Earthquake Motions Recorded on Stiff Soil Sites (Representative of Soil Type S_1). Weight = 2560 kips, Height = 12 ft

	EXCITATION	BASE CENTER DISPL (INCH)		CORNER BEARING DISPL (INCH)		CORNER TO CENTER DISPL RATIO	BASE SHEAR / WEIGHT		1st STORY SHEAR / WEIGHT		1st STORY DRIFT / HEIGHT (%)	
		L	T	L	T		L	T	L	T	L	T
11	LOWER CALIF. (117)	5.18	2.87	5.47	3.30	1.15	0.133	0.083	0.076	0.046	0.0383	0.0251
12	EL CENTRO (117)	5.94	7.71	6.42	9.47	1.23	0.133	0.175	0.069	0.090	0.0375	0.0493
13	PARKFIELD (014)	1.69	3.60	2.18	4.57	1.29	0.066	0.101	0.037	0.052	0.0201	0.0282
14	SAN FERNANDO (110)	6.24	3.48	6.30	3.65	1.05	0.143	0.101	0.072	0.056	0.0389	0.0309
15	SAN FERNANDO (135)	3.96	8.71	5.02	9.84	1.27	0.101	0.192	0.051	0.097	0.0276	0.0534
16	SAN FERNANDO (208)	5.02	7.68	5.42	9.60	1.25	0.122	0.175	0.062	0.088	0.0335	0.0481
17	SAN FERNANDO (211)	5.61	7.50	5.91	9.46	1.26	0.124	0.172	0.062	0.087	0.0337	0.0473
18	SAN FERNANDO (466)	3.64	7.72	3.99	9.22	1.19	0.100	0.168	0.051	0.085	0.0275	0.0463
19	SAN FERNANDO (253)	4.04	7.82	4.30	10.46	1.34	0.110	0.163	0.056	0.082	0.0303	0.0444
20	SAN FERNANDO (199)	6.28	5.05	6.82	6.66	1.32	0.155	0.115	0.078	0.058	0.0426	[illegible]
	MEAN	4.76	6.21	5.18	7.62	1.24	0.119	0.145	0.061	0.074	0.0330	0.0405
	σ	1.37	2.10	1.32	2.66	0.08	0.024	0.038	0.012	0.018	0.0064	0.0098
	MEAN OF MAX (L,T)	6.84		8.12			0.158		0.081		0.0437	
	σ OF MAX (L,T)	1.45		2.00			0.025		0.012		0.0068	

TABLE A-VI Nonlinear Dynamic Analysis Results for 1-Story Isolated Structure with Isolation System Type # 8 (T = 2.0 sec, β = 30%). Excitation is Represented by Pairs of Scaled Earthquake Motions Recorded on Stiff Soil Sites (Representative of Soil Type S_1). Weight = 2560 kips, Height = 12 ft

	EXCITATION	BASE CENTER DISPL (INCH)		CORNER BEARING DISPL (INCH)		CORNER TO CENTER DISPL RATIO	BASE SHEAR / WEIGHT		1st STORY SHEAR / WEIGHT		1st STORY DRIFT / HEIGHT (%)	
		L	T	L	T		L	T	L	T	L	T
11	LOWER CALIF. (117)	4.38	2.47	4.59	2.81	1.14	0.101	0.083	0.055	0.050	0.0297	0.0274
12	EL CENTRO (117)	6.11	5.04	6.61	5.71	1.13	0.116	0.119	0.061	0.060	0.0332	0.0326
13	PARKFIELD (014)	1.95	2.60	2.01	2.96	1.14	0.081	0.088	0.046	0.046	0.0250	0.0253
14	SAN FERNANDO (110)	5.88	3.49	5.96	3.68	1.05	0.116	0.099	0.063	0.057	0.0342	0.0311
15	SAN FERNANDO (135)	4.15	8.95	5.17	11.35	1.27	0.104	0.164	0.054	0.083	0.0291	0.0452
16	SAN FERNANDO (208)	4.02	5.13	4.37	6.78	1.32	0.109	0.116	0.057	0.058	0.0309	0.0319
17	SAN FERNANDO (211)	3.85	4.36	4.26	5.93	1.36	0.104	0.110	0.053	0.055	0.0287	0.0300
18	SAN FERNANDO (466)	2.73	8.01	4.18	10.41	1.53	0.073	0.146	0.039	0.074	0.0214	0.0402
19	SAN FERNANDO (253)	3.07	7.64	4.10	10.08	1.34	0.089	0.139	0.045	0.070	0.0244	0.0383
20	SAN FERNANDO (199)	4.43	3.86	4.56	4.50	1.17	0.103	0.097	0.056	0.056	0.0306	0.0309
	MEAN	4.06	5.16	4.58	6.42	1.25	0.100	0.116	0.053	0.061	0.0287	0.0333
	σ	1.23	2.18	1.16	3.01	0.14	0.014	0.025	0.007	0.011	0.0038	0.0058
	MEAN OF MAX (L,T)	5.75		6.92			0.120		0.062		0.0339	
	σ OF MAX (L,T)	1.87		2.65			0.022		0.010		0.0055	

TABLE A-VIa Nonlinear Dynamic Analysis Results for 1-Story Isolated Structure with Isolation System Type # 8 (T = 2.0 sec, β = 30%). Excitation is Represented by Pairs of Scaled Earthquake Motions Recorded on Stiff Soil Sites (Representative of Soil Type S_1). Bidirectional Interaction Neglected. Weight = 2560 kips, Height = 12 ft

	EXCITATION	BASE CENTER DISPL (INCH)		CORNER BEARING DISPL (INCH)		CORNER TO CENTER DISPL RATIO	BASE SHEAR / WEIGHT		1st STORY SHEAR / WEIGHT		1st STORY DRIFT / HEIGHT (%)	
		L	T	L	T		L	T	L	T	L	T
11	LOWER CALIF. (117)	4.82	2.58	4.89	2.86	1.11	0.121	0.094	0.064	0.061	0.0344	0.0332
12	EL CENTRO (117)	4.33	4.35	4.88	5.02	1.15	0.116	0.114	0.060	0.065	0.0326	0.0354
13	PARKFIELD (014)	1.81	2.24	1.87	2.66	1.19	0.085	0.089	0.069	0.063	0.0375	0.0343
14	SAN FERNANDO (110)	5.74	2.83	5.88	3.14	1.11	0.132	0.097	0.071	0.053	0.0383	0.0294
15	SAN FERNANDO (135)	3.18	8.74	3.77	9.77	1.19	0.102	0.166	0.053	0.088	0.0284	0.0484
16	SAN FERNANDO (208)	3.65	4.24	4.05	4.91	1.16	0.107	0.113	0.055	0.059	0.0297	0.0324
17	SAN FERNANDO (211)	3.70	2.96	4.00	3.81	1.29	0.108	0.098	0.057	0.052	0.0310	0.0286
18	SAN FERNANDO (466)	2.29	7.40	3.24	8.89	1.41	0.091	0.150	0.046	0.076	0.0249	0.0412
19	SAN FERNANDO (253)	2.42	6.07	3.11	7.22	1.42	0.093	0.135	0.047	0.068	0.0254	0.0371
20	SAN FERNANDO (199)	4.76	3.65	4.80	4.41	1.21	0.121	0.105	0.062	0.058	0.0336	0.0313
	MEAN	3.67	4.51	4.05	5.27	1.22	0.108	0.116	0.058	0.064	0.0316	0.0351
	σ	1.20	2.09	1.08	2.40	0.11	0.014	0.025	0.008	0.011	0.0044	0.0057
	MEAN OF MAX (L,T)	5.21		5.80			0.125		0.068		0.0369	
	σ OF MAX (L,T)	1.77		2.09			0.021		0.009		0.0048	

TABLE A-VII Nonlinear Dynamic Analysis Results for 1-Story Isolated Structure with Isolation System Type # 9 (T = 2.5 sec, β = 10%). Excitation is Represented by Pairs of Scaled Earthquake Motions Recorded on Stiff Soil Sites (Representative of Soil Type S_1). Weight = 2560 kips, Height = 12 ft

	EXCITATION	BASE CENTER DISPL (INCH)		CORNER BEARING DISPL (INCH)		CORNER TO CENTER DISPL RATIO	*BASE SHEAR / WEIGHT*		*1st STORY SHEAR / WEIGHT*		*1st STORY DRIFT / HEIGHT* (%)	
		L	T	L	T		L	T	L	T	L	T
11	LOWER CALIF. (117)	6.47	3.73	6.86	4.43	1.19	0.113	0.073	0.057	0.037	0.0312	0.0201
12	EL CENTRO (117)	10.79	10.93	11.89	14.02	1.28	0.165	0.157	0.083	0.079	0.0453	0.0435
13	PARKFIELD (014)	2.82	6.48	3.86	8.33	1.37	0.058	0.107	0.030	0.054	0.0161	0.0295
14	SAN FERNANDO (110)	7.05	3.84	7.12	4.01	1.04	0.113	0.073	0.058	0.039	0.0315	0.0213
15	SAN FERNANDO (135)	7.33	13.80	7.79	19.54	1.42	0.118	0.204	0.060	0.103	0.0323	0.0557
16	SAN FERNANDO (208)	11.23	14.22	11.87	20.93	1.47	0.175	0.203	0.088	0.102	0.0478	0.0549
17	SAN FERNANDO (211)	11.95	12.80	12.52	18.87	1.47	0.183	0.183	0.092	0.092	0.0500	0.0495
18	SAN FERNANDO (466)	22.84	17.96	25.42	25.21	1.40	0.329	0.251	0.166	0.126	0.0903	0.0688
19	SAN FERNANDO (253)	17.89	15.57	19.46	21.34	1.37	0.262	0.232	0.132	0.117	0.0718	0.0631
20	SAN FERNANDO (199)	12.20	10.21	13.89	13.61	1.33	0.193	0.149	0.097	0.075	0.0526	0.0407

	BASE CENTER DISPL L	BASE CENTER DISPL T	CORNER BEARING DISPL L	CORNER BEARING DISPL T	CORNER TO CENTER DISPL RATIO	BASE SHEAR/WEIGHT L	BASE SHEAR/WEIGHT T	1st STORY SHEAR/WEIGHT L	1st STORY SHEAR/WEIGHT T	1st STORY DRIFT/HEIGHT L	1st STORY DRIFT/HEIGHT T
MEAN	11.06	10.95	12.05	15.03	1.33	0.171	0.163	0.086	0.082	0.0469	0.0447
σ	5.54	4.65	6.13	7.04	0.13	0.075	0.060	0.038	0.030	0.0205	0.0160
MEAN OF MAX (L,T)	12.47		15.63			0.187		0.094		0.0513	
σ OF MAX (L,T)	4.96		6.25			0.066		0.033		0.0181	

TABLE A-VIII Nonlinear Dynamic Analysis Results for 1-Story Isolated Structure with Isolation System Type # 10 (T = 2.5 sec, β = 27%). Excitation is Represented by Pairs of Scaled Earthquake Motions Recorded on Stiff Soil Sites (Representative of Soil Type S_1). Weight = 2560 kips, Height = 12 ft

	EXCITATION	BASE CENTER DISPL (INCH)		CORNER BEARING DISPL (INCH)		CORNER TO CENTER DISPL RATIO	BASE SHEAR / WEIGHT		1st STORY SHEAR / WEIGHT		1st STORY DRIFT / HEIGHT (%)	
		L	T	L	T		L	T	L	T	L	T
11	LOWER CALIF. (117)	4.51	2.96	4.83	3.25	1.10	0.079	0.065	0.041	0.036	0.0224	0.0197
12	EL CENTRO (117)	9.73	7.04	10.51	8.74	1.24	0.131	0.090	0.067	0.049	0.0366	0.0267
13	PARKFIELD (014)	1.96	3.11	2.03	3.78	1.22	0.059	0.070	0.033	0.036	0.0177	0.0198
14	SAN FERNANDO (110)	6.79	3.77	6.84	3.90	1.03	0.091	0.072	0.047	0.040	0.0256	0.0222
15	SAN FERNANDO (135)	5.70	15.81	7.08	19.81	1.25	0.089	0.178	0.045	0.090	0.0247	0.0489
16	SAN FERNANDO (208)	6.81	7.74	7.40	9.62	1.24	0.092	0.099	0.046	0.050	0.0253	0.0276
17	SAN FERNANDO (211)	8.10	6.64	8.60	8.08	1.22	0.108	0.083	0.055	0.042	0.0296	0.0229
18	SAN FERNANDO (466)	8.43	15.58	8.89	21.32	1.37	0.120	0.165	0.060	0.083	0.0328	0.0452
19	SAN FERNANDO (253)	7.22	17.21	9.44	22.41	1.31	0.089	0.186	0.045	0.093	0.0245	0.0507
20	SAN FERNANDO (199)	7.31	7.39	8.39	9.30	1.26	0.093	0.103	0.047	0.0052	0.0257	0.0282
	MEAN	6.66	8.73	7.40	11.02	1.22	0.095	0.111	0.049	0.057	0.0265	0.0312
	σ	2.07	5.18	2.33	7.04	0.09	0.019	0.044	0.009	0.021	0.0051	0.0116
	MEAN OF MAX (L,T)	9.60		11.70			0.121		0.061		0.0335	
	σ OF MAX (L,T)	4.68		6.54			0.040		0.020		0.0106	

TABLE A-IX Nonlinear Dynamic Analysis Results for 1-Story Isolated Structure with Isolation System Type # 11 (T = 3.0 sec, β = 16%). Excitation is Represented by Pairs of Scaled Earthquake Motions Recorded on Stiff Soil Sites (Representative of Soil Type S_1). Weight = 2560 kips, Height = 12 ft

	EXCITATION	BASE CENTER DISPL (INCH)		CORNER BEARING DISPL (INCH)		CORNER TO CENTER DISPL RATIO	BASE SHEAR / WEIGHT		1st STORY SHEAR / WEIGHT		1st STORY DRIFT / HEIGHT (%)	
		L	T	L	T		L	T	L	T	L	T
11	LOWER CALIF. (117)	5.65	3.74	5.91	4.26	1.14	0.070	0.054	0.036	0.028	0.0193	0.0153
12	EL CENTRO (117)	14.37	10.47	15.40	12.21	1.17	0.143	0.096	0.072	0.048	0.0390	0.0264
13	PARKFIELD (014)	2.11	4.84	2.30	5.92	1.22	0.041	0.059	0.023	0.030	0.0126	0.0166
14	SAN FERNANDO (110)	7.41	4.03	7.47	4.17	1.03	0.078	0.054	0.040	0.029	0.0218	0.0160
15	SAN FERNANDO (135)	8.51	24.86	15.39	37.28	1.81	0.085	0.207	0.043	0.103	0.0232	0.0555
16	SAN FERNANDO (208)	12.83	10.91	14.25	14.56	1.33	0.127	0.100	0.064	0.051	0.0349	0.0276
17	SAN FERNANDO (211)	13.99	9.63	15.28	11.74	1.22	0.139	0.090	0.070	0.046	0.0378	0.0248
18	SAN FERNANDO (466)	13.41	30.61	16.64	43.80	1.43	0.116	0.252	0.058	0.126	0.0315	0.0682
19	SAN FERNANDO (253)	11.47	28.70	16.35	41.57	1.45	0.110	0.237	0.055	0.119	0.0299	0.0648
20	SAN FERNANDO (199)	12.42	12.98	13.46	16.88	1.30	0.117	0.120	0.059	0.061	0.0322	0.0331

	L	T	L	T		L	T	L	T	L	T
MEAN	10.22	14.08	12.25	19.24	1.31	0.103	0.127	0.052	0.064	0.0282	0.0348
σ	3.90	9.70	4.82	14.80	0.21	0.031	0.072	0.015	0.036	0.0082	0.0193
MEAN OF MAX (L,T)	15.62		20.41			0.143		0.072		0.0391	
σ OF MAX (L,T)	8.85		14.02			0.065		0.032		0.0174	

TABLE A-X Nonlinear Dynamic Analysis Results for 1-Story Isolated Structure with Isolation System Type # 12 (T = 3.0 sec, β = 39%). Excitation is Represented by Pairs of Scaled Earthquake Motions Recorded on Stiff Soil Sites (Representative of Soil Type S_1). Weight = 2560 kips, Height = 12 ft

	EXCITATION	BASE CENTER DISPL (INCH)		CORNER BEARING DISPL (INCH)		CORNER TO CENTER DISPL RATIO	BASE SHEAR / WEIGHT		1st STORY SHEAR / WEIGHT		1st STORY DRIFT / HEIGHT (%)	
		L	T	L	T		L	T	L	T	L	T
11	LOWER CALIF. (117)	4.42	3.34	4.76	3.50	1.08	0.057	0.056	0.033	0.033	0.0177	0.0180
12	EL CENTRO (117)	9.25	5.83	9.75	6.82	1.17	0.076	0.061	0.040	0.036	0.0215	0.0200
13	PARKFIELD (014)	2.27	3.39	2.28	4.01	1.18	0.054	0.059	0.036	0.030	0.0195	0.0167
14	SAN FERNANDO (110)	7.12	3.94	7.16	4.05	1.03	0.074	0.055	0.037	0.038	0.0203	0.0206
15	SAN FERNANDO (135)	5.98	15.79	6.96	19.52	1.24	0.068	0.104	0.035	0.052	0.0188	0.0287
16	SAN FERNANDO (208)	7.97	6.38	8.31	7.35	1.15	0.075	0.059	0.037	0.030	0.0203	0.0168
17	SAN FERNANDO (211)	9.92	6.13	10.29	6.84	1.12	0.081	0.055	0.041	0.030	0.0220	0.0168
18	SAN FERNANDO (466)	6.84	14.74	8.09	18.04	1.24	0.073	0.098	0.037	0.049	0.0199	0.0269
19	SAN FERNANDO (253)	6.57	16.02	8.12	20.17	1.26	0.064	0.102	0.032	0.051	0.0175	0.0279
20	SAN FERNANDO (199)	6.15	7.70	6.20	10.12	1.32	0.066	0.075	0.034	0.038	0.0187	0.0205
	MEAN	6.65	8.33	7.19	10.04	1.18	0.069	0.072	0.036	0.039	0.0196	0.0213
	σ	2.11	4.90	2.24	6.32	0.08	0.008	0.020	0.003	0.008	0.0014	0.0045
	MEAN OF MAX (L,T)	9.63		11.21			0.080		0.042		0.0226	
	σ OF MAX (L,T)	4.29		5.64			0.016		0.006		0.0036	

TABLE A-Xa Nonlinear Dynamic Analysis Results for 1-Story Isolated Structure with Isolation System Type # 12 (T = 3.0 sec, β = 39%). Excitation is Represented by Pairs of Scaled Earthquake Motions Recorded on Stiff Soil Sites (Representative of Soil Type S_1). Bidirectional Interaction Neglected. Weight = 2560 kips, Height = 12 ft

	EXCITATION	BASE CENTER DISPL (INCH)		CORNER BEARING DISPL (INCH)		CORNER TO CENTER DISPL RATIO	BASE SHEAR / WEIGHT		1st STORY SHEAR / WEIGHT		1st STORY DRIFT / HEIGHT (%)	
		L	T	L	T		L	T	L	T	L	T
11	LOWER CALIF. (117)	5.78	3.57	6.01	3.84	1.08	0.071	0.062	0.036	0.040	0.0210	0.0255
12	EL CENTRO (117)	7.62	4.93	8.04	5.34	1.08	0.078	0.067	0.039	0.042	0.0220	0.0264
13	PARKFIELD (014)	1.89	3.66	2.11	4.37	1.19	0.055	0.062	0.046	0.044	0.0257	0.0274
14	SAN FERNANDO (110)	6.99	3.32	7.11	3.55	1.07	0.075	0.061	0.043	0.041	0.0239	0.0261
15	SAN FERNANDO (135)	4.10	14.24	5.35	15.08	1.30	0.064	0.103	0.033	0.052	0.0190	0.0325
16	SAN FERNANDO (208)	5.70	6.08	5.78	7.22	1.19	0.070	0.070	0.035	0.035	0.0206	0.0216
17	SAN FERNANDO (211)	9.37	4.86	9.43	5.89	1.21	0.085	0.066	0.042	0.034	0.0241	0.0217
18	SAN FERNANDO (466)	8.39	12.67	8.68	14.60	1.15	0.081	0.096	0.041	0.048	0.0237	0.0274
19	SAN FERNANDO (253)	5.32	14.48	6.36	17.64	1.22	0.069	0.102	0.036	0.052	0.0202	0.0314
20	SAN FERNANDO (199)	6.55	6.10	6.68	7.50	1.23	0.074	0.071	0.038	0.036	0.0213	0.0224
	MEAN	6.17	7.39	6.56	8.50	1.17	0.072	0.076	0.039	0.042	0.0222	0.0262
	σ	2.04	4.31	1.94	4.97	0.07	0.008	0.016	0.004	0.006	0.0020	0.0035
	MEAN OF MAX (L,T)	8.74		9.70			0.082		0.044		0.0265	
	σ OF MAX (L,T)	3.60		4.23			0.014		0.005		0.0033	

TABLE A-XI Nonlinear Dynamic Analysis Results for 1-Story Isolated Structure with Isolation System Type # 2 (T = 1.5 sec, β = 8%). Excitation is Represented by Pairs of Scaled Earthquake Motions Recorded on Medium Soil Sites (Representative of Soil Type S_2). Weight = 2560 kips, Height = 12 ft

	EXCITATION	BASE CENTER DISPL (INCH)		CORNER BEARING DISPL (INCH)		CORNER TO CENTER DISPL RATIO	BASE SHEAR / WEIGHT		1st STORY SHEAR / WEIGHT		1st STORY DRIFT / HEIGHT (%)	
		L	T	L	T		L	T	L	T	L	T
21	WESTERN WASH. (325)	4.70	5.80	4.86	7.89	1.36	0.226	0.256	0.121	0.129	0.0659	0.0701
22	EUREKA (022)	4.71	4.84	4.77	6.36	1.31	0.216	0.232	0.113	0.119	0.0616	0.0650
23	EUREKA (023)	15.35	10.26	17.03	15.67	1.53	0.620	0.399	0.317	0.201	0.1723	0.1097
24	FERNDALE (023)	4.87	3.61	5.14	3.79	1.06	0.211	0.171	0.110	0.107	0.0599	0.0589
25	SAN FERNANDO (241)	9.30	15.59	12.26	22.95	1.47	0.369	0.604	0.187	0.305	0.1017	0.1663
26	SAN FERNANDO (458)	11.96	7.22	13.59	10.61	1.47	0.509	0.286	0.256	0.144	0.1391	0.0774
27	SAN FERNANDO (264)	8.99	5.30	9.51	6.89	1.30	0.381	0.219	0.194	0.113	0.1054	0.0613
28	SAN FERNANDO (267)	6.52	5.68	7.56	6.92	1.22	0.295	0.248	0.147	0.131	0.0801	0.0714
29	PUGET SOUND (325)	4.68	13.20	8.03	18.80	1.72	0.204	0.517	0.104	0.270	0.0564	0.1462
	MEAN	7.90	7.94	9.19	11.10	1.38	0.337	0.326	0.172	0.169	0.0936	0.0918
	σ	3.61	3.90	4.07	6.17	0.18	0.139	0.140	0.070	0.069	0.0380	0.0375
	MEAN OF MAX (L,T)	9.68		11.76			0.377		0.205		0.1116	
	σ OF MAX (L,T)	4.17		5.91			0.136		0.078		0.0425	

TABLE A-XII Nonlinear Dynamic Analysis Results for 1-Story Isolated Structure with Isolation System Type # 3 (T = 1.5 sec, β = 17%). Excitation is Represented by Pairs of Scaled Earthquake Motions Recorded on Medium Soil Sites (Representative of Soil Type S_2). Weight = 2560 kips, Height = 12 ft

	EXCITATION	BASE CENTER DISPL (INCH)		CORNER BEARING DISPL (INCH)		CORNER TO CENTER DISPL RATIO	BASE SHEAR / WEIGHT		1st STORY SHEAR / WEIGHT		1st STORY DRIFT / HEIGHT (%)	
		L	T	L	T		L	T	L	T	L	T
21	WESTERN WASH. (325)	3.63	4.05	3.76	5.00	1.23	0.194	0.200	0.107	0.116	0.0581	0.0639
22	EUREKA (022)	3.43	3.27	3.48	4.05	1.24	0.156	0.182	0.092	0.102	0.0501	0.0559
23	EUREKA (023)	13.55	7.62	14.00	9.68	1.27	0.492	0.286	0.249	0.146	0.1352	0.0794
24	FERNDALE (023)	4.50	3.58	4.95	3.92	1.10	0.185	0.181	0.110	0.122	0.0600	0.0676
25	SAN FERNANDO (241)	5.83	8.13	7.70	10.40	1.32	0.250	0.314	0.128	0.160	0.0696	0.0872
26	SAN FERNANDO (458)	8.65	5.13	9.44	6.29	1.23	0.357	0.203	0.180	0.103	0.0978	0.0560
27	SAN FERNANDO (264)	7.82	4.52	8.09	5.25	1.16	0.306	0.178	0.153	0.100	0.0832	0.0546
28	SAN FERNANDO (267)	5.50	4.86	5.78	5.52	1.14	0.245	0.227	0.132	0.123	0.0716	0.0672
29	PUGET SOUND (325)	3.07	10.93	4.80	14.07	1.56	0.172	0.404	0.093	0.207	0.0504	0.1124
	MEAN	6.22	5.79	6.89	7.13	1.25	0.262	0.242	0.138	0.131	0.0751	0.0716
	σ	3.17	2.41	3.16	3.27	0.13	0.102	0.073	0.048	0.033	0.0258	0.0178
	MEAN OF MAX (L,T)	7.40		8.42			0.298		0.158		0.0861	
	σ OF MAX (L,T)	3.19		3.62			0.101		0.045		0.0241	

TABLE A-XIII Nonlinear Dynamic Analysis Results for 1-Story Isolated Structure with Isolation System Type # 4 (T = 1.5 sec, β = 37%). Excitation is Represented by Pairs of Scaled Earthquake Motions Recorded on Medium Soil Sites (Representative of Soil Type S_2). Weight = 2560 kips, Height = 12 ft

	EXCITATION	BASE CENTER DISPL (INCH)		CORNER BEARING DISPL (INCH)		CORNER TO CENTER DISPL RATIO	BASE SHEAR / WEIGHT		1st STORY SHEAR / WEIGHT		1st STORY DRIFT / HEIGHT (%)	
		L	T	L	T		L	T	L	T	L	T
21	WESTERN WASH. (325)	3.63	3.05	3.67	3.91	1.28	0.194	0.182	0.141	0.130	0.0766	0.0715
22	EUREKA (022)	3.33	2.74	3.52	3.01	1.10	0.185	0.162	0.096	0.107	0.0523	0.0588
23	EUREKA (023)	8.65	5.20	8.79	5.81	1.12	0.232	0.211	0.119	0.110	0.0648	0.0602
24	FERNDALE (023)	4.79	4.14	4.95	4.36	1.05	0.170	0.201	0.120	0.147	0.0653	0.0807
25	SAN FERNANDO (241)	3.15	4.86	3.56	5.56	1.14	0.181	0.200	0.094	0.107	0.0511	0.0580
26	SAN FERNANDO (458)	4.75	3.09	5.25	3.89	1.26	0.210	0.174	0.109	0.090	0.0590	0.0490
27	SAN FERNANDO (264)	6.03	3.55	6.10	3.93	1.11	0.225	0.174	0.131	0.124	0.0711	0.0679
28	SAN FERNANDO (267)	4.57	3.81	4.94	4.42	1.16	0.196	0.179	0.126	0.136	0.0685	0.0746
29	PUGET SOUND (325)	2.58	6.27	2.94	7.31	1.17	0.178	0.219	0.113	0.150	0.0614	0.0819
	MEAN	4.61	4.08	4.86	4.69	1.15	0.197	0.189	0.117	0.122	0.0633	0.0670
	σ	1.74	1.10	1.69	11.23	0.07	0.020	0.018	0.020	0.019	0.0079	0.0106
	MEAN OF MAX (L,T)	5.21		5.59			0.207		0.127		0.0695	
	σ OF MAX (L,T)	1.51		1.55			0.015		0.016		0.0091	

TABLE A-XIV Nonlinear Dynamic Analysis Results for 1-Story Isolated Structure with Isolation System Type # 5 ($T = 2.0$ sec, $\beta = 9\%$). Excitation is Represented by Pairs of Scaled Earthquake Motions Recorded on Medium Soil Sites (Representative of Soil Type S_2). Weight = 2560 kips, Height = 12 ft

	EXCITATION	BASE CENTER DISPL (INCH)		CORNER BEARING DISPL (INCH)		CORNER TO CENTER DISPL RATIO	BASE SHEAR / WEIGHT		1st STORY SHEAR / WEIGHT		1st STORY DRIFT / HEIGHT (%)	
		L	T	L	T		L	T	L	T	L	T
21	WESTERN WASH. (325)	8.10	10.83	8.76	14.92	1.38	0.203	0.256	0.105	0.134	0.0573	0.0721
22	EUREKA (022)	6.26	7.49	6.51	9.74	1.30	0.155	0.184	0.080	0.094	0.0435	0.0513
23	EUREKA (023)	20.11	8.89	20.96	9.64	1.08	0.466	0.225	0.236	0.115	0.1282	0.0637
24	FERNDALE (023)	4.29	3.27	4.44	3.44	1.05	0.111	0.101	0.058	0.062	0.0315	0.0341
25	SAN FERNANDO (241)	20.55	17.59	24.94	24.83	1.41	0.472	0.399	0.237	0.202	0.1286	0.1088
26	SAN FERNANDO (458)	16.45	10.68	17.02	14.86	1.39	0.385	0.249	0.194	0.127	0.1055	0.0682
27	SAN FERNANDO (264)	12.26	8.98	13.00	11.61	1.29	0.293	0.210	0.148	0.107	0.0803	0.0582
28	SAN FERNANDO (267)	8.49	6.56	9.23	8.48	1.29	0.226	0.159	0.116	0.081	0.0633	0.0448
29	PUGET SOUND (325)	3.34	15.31	5.68	18.42	1.70	0.094	0.359	0.051	0.183	0.0278	0.1002
	MEAN	11.09	9.96	12.28	12.88	1.32	0.267	0.238	0.136	0.123	0.0740	0.0668
	σ	6.20	4.12	6.82	5.89	0.18	0.137	0.088	0.068	0.043	0.0368	0.0231
	MEAN OF MAX (L,T)	12.86		14.74			0.306		0.156		0.0848	
	σ OF MAX (L,T)	5.34		6.02			0.118		0.058		0.0313	

TABLE A-XIVa Nonlinear Dynamic Analysis Results for 1-Story Isolated Structure with Isolation System Type # 5 (T = 2.0 sec, β = 9%). Excitation is Represented by Pairs of Scaled Earthquake Motions Recorded on Medium Soil Sites (Representative of Soil Type S_2). Bidirectional Interaction Neglected. Weight = 2560 kips, Height = 12 ft

	EXCITATION	BASE CENTER DISPL (INCH)		CORNER BEARING DISPL (INCH)		CORNER TO CENTER DISPL RATIO	BASE SHEAR / WEIGHT		1st STORY SHEAR / WEIGHT		1st STORY DRIFT / HEIGHT (%)	
		L	T	L	T		L	T	L	T	L	T
21	WESTERN WASH. (325)	7.55	10.13	7.77	13.12	1.30	0.207	0.248	0.108	0.126	0.0597	0.0707
22	EUREKA (022)	6.22	6.00	6.48	7.48	1.25	0.177	0.167	0.090	0.086	0.0511	0.0503
23	EUREKA (023)	20.28	8.23	21.04	9.43	1.15	0.489	0.213	0.245	0.111	0.1391	0.0710
24	FERNDALE (023)	4.80	2.82	4.97	2.92	1.04	0.146	0.102	0.082	0.057	0.0464	0.0371
25	SAN FERNANDO (241)	16.41	15.63	20.76	22.88	1.46	0.403	0.367	0.201	0.184	0.1161	0.1049
26	SAN FERNANDO (458)	16.55	10.87	17.27	15.07	1.39	0.407	0.264	0.204	0.133	0.1129	0.0762
27	SAN FERNANDO (264)	11.37	8.63	12.02	11.66	1.35	0.291	0.220	0.149	0.113	0.0827	0.0634
28	SAN FERNANDO (267)	7.18	5.86	7.57	7.00	1.19	0.198	0.167	0.101	0.090	0.0553	0.0565
29	PUGET SOUND (325)	3.36	15.73	5.80	18.32	1.73	0.111	0.376	0.061	0.193	0.0348	0.1166
	MEAN	10.41	9.32	11.52	11.99	1.32	0.270	0.236	0.138	0.121	0.0776	0.0719
	σ	5.67	4.09	6.15	5.81	0.19	0.126	0.086	0.061	0.042	0.0347	0.0238
	MEAN OF MAX (L,T)	12.07		13.85			0.304		0.155		0.0880	
	σ OF MAX (L,T)	5.11		6.03			0.113		0.055		0.0321	

TABLE A-XV Nonlinear Dynamic Analysis Results for 1-Story Isolated Structure with Isolation System Type # 6 (T = 2.0 sec, β = 17%). Excitation is Represented by Pairs of Scaled Earthquake Motions Recorded on Medium Soil Sites (Representative of Soil Type S_2). Weight = 2560 kips, Height = 12 ft

	EXCITATION	BASE CENTER DISPL (INCH)		CORNER BEARING DISPL (INCH)		CORNER TO CENTER DISPL RATIO	BASE SHEAR / WEIGHT		1st STORY SHEAR / WEIGHT		1st STORY DRIFT / HEIGHT (%)	
		L	T	L	T		L	T	L	T	L	T
21	WESTERN WASH. (325)	5.89	8.31	6.00	10.86	1.31	0.159	0.193	0.089	0.101	0.0484	0.0550
22	EUREKA (022)	5.02	5.53	5.49	7.44	1.35	0.135	0.137	0.068	0.070	0.0379	0.0384
23	EUREKA (023)	16.56	7.83	17.09	8.42	1.08	0.340	0.195	0.171	0.100	0.0929	0.0548
24	FERNDALE (023)	4.78	2.89	5.03	3.25	1.12	0.120	0.109	0.069	0.070	0.0374	0.0388
25	SAN FERNANDO (241)	17.01	12.16	19.06	15.71	1.29	0.349	0.262	0.176	0.133	0.0956	0.0720
26	SAN FERNANDO (458)	10.70	9.24	11.34	12.87	1.39	0.249	0.219	0.128	0.111	0.0696	0.0603
27	SAN FERNANDO (264)	8.81	6.08	9.46	7.95	1.31	0.210	0.137	0.111	0.070	0.0602	0.0384
28	SAN FERNANDO (267)	5.92	5.16	6.25	5.99	1.16	0.167	0.145	0.089	0.075	0.0485	0.0409
29	PUGET SOUND (325)	3.01	11.13	3.83	13.55	1.27	0.104	0.253	0.060	0.132	0.0328	0.0722
	MEAN	8.63	7.59	9.28	9.56	1.25	0.204	0.183	0.107	0.096	0.0581	0.0523
	σ	4.85	2.81	5.20	3.76	0.10	0.086	0.051	0.041	0.024	0.0222	0.0132
	MEAN OF MAX (L,T)	9.86		11.29			0.224		0.116		0.0635	
	σ OF MAX (L,T)	4.24		4.53			0.077		0.037		0.0199	

TABLE A-XVI Nonlinear Dynamic Analysis Results for 1-Story Isolated Structure with Isolation System Type # 7 (T = 2.0 sec, β = 31%). Excitation is Represented by Pairs of Scaled Earthquake Motions Recorded on Medium Soil Sites (Representative of Soil Type S_2). Weight = 2560 kips, Height = 12 ft

	EXCITATION	BASE CENTER DISPL (INCH)		CORNER BEARING DISPL (INCH)		CORNER TO CENTER DISPL RATIO	BASE SHEAR / WEIGHT		1st STORY SHEAR / WEIGHT		1st STORY DRIFT / HEIGHT (%)	
		L	T	L	T		L	T	L	T	L	T
21	WESTERN WASH. (325)	4.75	5.00	4.85	6.15	1.23	0.143	0.145	0.091	0.088	0.0496	0.0481
22	EUREKA (022)	5.05	4.46	5.24	5.08	1.14	0.140	0.123	0.084	0.067	0.0457	0.0369
23	EUREKA (023)	13.05	5.94	13.25	6.25	1.05	0.217	0.146	0.110	0.077	0.0597	0.0422
24	FERNDALE (023)	4.54	2.77	5.08	3.63	1.31	0.117	0.125	0.076	0.091	0.0413	0.0503
25	SAN FERNANDO (241)	7.57	7.51	8.05	9.43	1.26	0.153	0.174	0.079	0.088	0.0430	0.0479
26	SAN FERNANDO (458)	7.66	6.24	7.98	8.01	1.28	0.183	0.164	0.094	0.082	0.0511	0.0450
27	SAN FERNANDO (264)	7.67	4.43	7.76	4.69	1.06	0.178	0.112	0.100	0.076	0.0545	0.0420
28	SAN FERNANDO (267)	5.35	4.74	5.71	5.47	1.15	0.158	0.133	0.090	0.097	0.0488	0.0527
29	PUGET SOUND (325)	3.21	7.42	3.67	9.24	1.25	0.126	0.173	0.079	0.101	0.0431	0.0556
	MEAN	6.54	5.39	6.84	6.44	1.19	0.157	0.144	0.089	0.085	0.0485	0.0467
	σ	2.75	1.45	2.70	1.92	0.09	0.029	0.021	0.010	0.010	0.0057	0.0055
	MEAN OF MAX (L,T)	7.03		7.76			0.166		0.095		0.0519	
	σ OF MAX (L,T)	2.46		2.48			0.026		0.007		0.0040	

TABLE A-XVIa Nonlinear Dynamic Analysis Results for 1-Story Isolated Structure with Isolation System Type # 7 (T = 2.0 sec, β = 31%). Excitation is Represented by Pairs of Scaled Earthquake Motions Recorded on Medium Soil Sites (Representative of Soil Type S_2). Bidirectional Interaction Neglected. Weight = 2560 kips, Height = 12 ft

	EXCITATION	BASE CENTER DISPL (INCH)		CORNER BEARING DISPL (INCH)		CORNER TO CENTER DISPL RATIO	BASE SHEAR / WEIGHT		1st STORY SHEAR / WEIGHT		1st STORY DRIFT / HEIGHT (%)	
		L	T	L	T		L	T	L	T	L	T
21	WESTERN WASH. (325)	4.45	4.75	4.52	6.20	1.31	0.149	0.142	0.091	0.097	0.0493	0.0532
22	EUREKA (022)	4.52	2.94	4.92	3.92	1.33	0.149	0.125	0.080	0.089	0.0436	0.0488
23	EUREKA (023)	12.39	5.57	12.87	5.98	1.07	0.246	0.156	0.125	0.086	0.0678	0.0471
24	FERNDALE (023)	5.23	2.70	5.85	3.35	1.24	0.158	0.126	0.095	0.083	0.0516	0.0458
25	SAN FERNANDO (241)	4.52	7.20	4.56	8.50	1.18	0.149	0.182	0.075	0.099	0.0408	0.0544
26	SAN FERNANDO (458)	6.93	4.05	7.57	5.77	1.42	0.179	0.141	0.090	0.071	0.0489	0.0384
27	SAN FERNANDO (264)	8.29	4.28	8.49	4.90	1.14	0.196	0.145	0.115	0.105	0.0624	0.0575
28	SAN FERNANDO (267)	5.61	4.93	6.11	5.41	1.10	0.163	0.154	0.089	0.089	0.0482	0.0489
29	PUGET SOUND (325)	3.13	7.82	3.13	8.87	1.13	0.132	0.189	0.089	0.117	0.0480	0.0641
	MEAN	6.12	4.92	6.45	5.88	1.21	0.169	0.151	0.095	0.093	0.0512	0.0509
	σ	2.64	1.64	2.74	1.74	0.11	0.032	0.021	0.015	0.013	0.0081	0.0070
	MEAN OF MAX (L,T)	6.97		7.71			0.179		0.102		0.0556	
	σ OF MAX (L,T)	2.30		2.24			0.029		0.013		0.0069	

TABLE A-XVII Nonlinear Dynamic Analysis Results for 1-Story Isolated Structure with Isolation System Type # 8 (T = 2.5 sec, β = 6%). Excitation is Represented by Pairs of Scaled Earthquake Motions Recorded on Medium Soil Sites (Representative of Soil Type S_2). Weight = 2560 kips, Height = 12 ft

	EXCITATION	BASE CENTER DISPL (INCH)		CORNER BEARING DISPL (INCH)		CORNER TO CENTER DISPL RATIO	BASE SHEAR / WEIGHT		1st STORY SHEAR / WEIGHT		1st STORY DRIFT / HEIGHT (%)	
		L	T	L	T		L	T	L	T	L	T
21	WESTERN WASH. (325)	11.74	18.80	13.55	28.47	1.51	0.184	0.277	0.093	0.139	0.0507	0.0750
22	EUREKA (022)	11.12	12.07	14.02	14.90	1.26	0.173	0.184	0.088	0.094	0.0477	0.0512
23	EUREKA (023)	18.77	8.38	19.24	10.50	1.25	0.297	0.143	0.149	0.072	0.0809	0.0394
24	FERNDALE (023)	3.54	2.97	3.69	3.12	1.05	0.061	0.067	0.031	0.037	0.0169	0.0204
25	SAN FERNANDO (241)	39.77	15.05	43.18	28.24	1.88	0.602	0.215	0.301	0.108	0.0164	0.0593
26	SAN FERNANDO (458)	26.51	18.11	30.76	29.89	1.65	0.412	0.258	0.207	0.129	0.1123	0.0689
27	SAN FERNANDO (264)	20.19	9.48	21.20	10.58	1.12	0.321	0.164	0.161	0.084	0.0873	0.0463
28	SAN FERNANDO (267)	9.54	7.08	9.65	8.02	1.13	0.158	0.112	0.081	0.058	0.0438	0.0319
29	PUGET SOUND (325)	3.56	14.54	5.55	16.72	1.56	0.064	0.225	0.035	0.113	0.0191	0.0618
	MEAN	16.08	11.83	17.87	16.72	1.38	0.252	0.183	0.127	0.093	0.0528	0.0505
	σ	11.03	4.99	11.89	9.34	0.27	0.165	0.065	0.082	0.031	0.0323	0.0168
	MEAN OF MAX (L,T)	18.19		20.87			0.283		0.142		0.0658	
	σ OF MAX (L,T)	9.89		11.21			0.147		0.073		0.0253	

TABLE A-XVIII Nonlinear Dynamic Analysis Results for 1-Story Isolated Structure with Isolation System Type # 9 (T = 2.5 sec, β = 15%). Excitation is Represented by Pairs of Scaled Earthquake Motions Recorded on Medium Soil Sites (Representative of Soil Type S_3). Weight = 2560 kips, Height = 12 ft

	EXCITATION	BASE CENTER DISPL (INCH)		CORNER BEARING DISPL (INCH)		CORNER TO CENTER DISPL RATIO	BASE SHEAR / WEIGHT		1st STORY SHEAR / WEIGHT		1st STORY DRIFT / HEIGHT (%)	
		L	T	L	T		L	T	L	T	L	T
21	WESTERN WASH. (325)	8.30	13.53	10.86	18.95	1.40	0.128	0.180	0.065	0.091	0.0351	0.0495
22	EUREKA (022)	8.24	8.86	10.01	10.81	1.22	0.136	0.131	0.068	0.066	0.0369	0.0363
23	EUREKA (023)	17.44	6.49	17.80	7.21	1.11	0.240	0.117	0.121	0.060	0.0656	0.0331
24	FERNDALE (023)	4.12	2.81	4.24	2.85	1.03	0.073	0.077	0.047	0.041	0.0223	0.0259
25	SAN FERNANDO (241)	29.33	13.34	30.06	16.19	1.21	0.384	0.182	0.193	0.093	0.1047	0.0508
26	SAN FERNANDO (458)	16.97	16.06	17.17	20.02	1.25	0.236	0.226	0.118	0.114	0.0644	0.0624
27	SAN FERNANDO (264)	10.47	7.17	10.83	8.11	1.13	0.153	0.118	0.080	0.060	0.0434	0.0327
28	SAN FERNANDO (267)	5.61	6.77	5.95	8.08	1.19	0.105	0.110	0.057	0.060	0.0309	0.0331
29	PUGET SOUND (325)	3.55	11.92	3.83	13.03	1.09	0.073	0.165	0.048	0.085	0.0260	0.0464

MEAN	11.56	9.66	12.31	11.69	1.18	0.170	0.145	0.089	0.374	0.0477	0.0411
σ	7.87	4.04	7.86	5.47	0.10	0.095	0.044	0.045	0.021	0.0248	0.0111
MEAN OF MAX (L,T)	13.27		14.87			0.187		0.096		0.0522	
σ OF MAX (L,T)	7.02		7.29			0.086		0.0041		0.0223	

TABLE A-XVIIIa Nonlinear Dynamic Analysis Results for 1-Story Isolated Structure with Isolation System Type # 9 (T = 2.5 sec, β = 15%). Excitation is Represented by Pairs of Scaled Earthquake Motions Recorded on Medium Soil Sites (Representative of Soil Type S_2). Bidirectional Interaction Neglected. Weight = 2560 kips, Height = 12 ft

	EXCITATION	BASE CENTER DISPL (INCH)		CORNER BEARING DISPL (INCH)		CORNER TO CENTER DISPL RATIO	BASE SHEAR / WEIGHT		1st STORY SHEAR / WEIGHT		1st STORY DRIFT / HEIGHT (%)	
		L	T	L	T		L	T	L	T	L	T
21	WESTERN WASH. (325)	7.26	12.60	9.07	15.51	1.25	0.132	0.186	0.071	0.094	0.0382	0.0514
22	EUREKA (022)	6.21	7.26	7.01	9.30	1.28	0.119	0.128	0.062	0.065	0.0333	0.0354
23	EUREKA (023)	17.48	6.32	18.00	7.13	1.13	0.256	0.120	0.131	0.064	0.0710	0.0352
24	FERNDALE (023)	4.69	3.01	4.81	3.05	1.03	0.101	0.080	0.060	0.044	0.0325	0.0244
25	SAN FERNANDO (241)	24.47	11.79	26.94	13.43	1.14	0.341	0.184	0.171	0.093	0.0928	0.0509
26	SAN FERNANDO (458)	16.54	15.05	16.89	18.60	1.24	0.245	0.220	0.123	0.111	0.0666	0.0603
27	SAN FERNANDO (264)	10.08	7.02	10.28	9.13	1.30	0.166	0.125	0.084	0.065	0.0454	0.0355
28	SAN FERNANDO (267)	5.41	6.61	5.83	7.84	1.19	0.110	0.122	0.057	0.067	0.0307	0.0363
29	PUGET SOUND (325)	3.49	12.54	3.99	13.80	1.14	0.086	0.192	0.048	0.098	0.0257	0.0536
	MEAN	10.63	9.13	11.42	10.87	1.19	0.173	0.151	0.090	0.078	0.0485	0.0426
	σ	6.82	3.73	7.23	4.55	0.08	0.083	0.043	0.040	0.021	0.0217	0.0111
	MEAN OF MAX (L,T)	12.47		13.90			0.193		0.099		0.0539	
	σ OF MAX (L,T)	5.90		6.37			0.072		0.035		0.0187	

TABLE A-XIX Nonlinear Dynamic Analysis Results for 1-Story Isolated Structure with Isolation System Type # 10 ($T = 2.5$ sec, $\beta = 26\%$). Excitation is Represented by Pairs of Scaled Earthquake Motions Recorded on Medium Soil Sites (Representative of Soil Type S_2). Weight = 2560 kips, Height = 12 ft

	EXCITATION	BASE CENTER DISPL (INCH)		CORNER BEARING DISPL (INCH)		CORNER TO CENTER DISPL RATIO	BASE SHEAR / WEIGHT		1st STORY SHEAR / WEIGHT		1st STORY DRIFT / HEIGHT (%)	
		L	T	L	T		L	T	L	T	L	T
21	WESTERN WASH (325)	5.92	6.63	6.13	9.01	1.36	0.101	0.117	0.059	0.060	0.0322	0.0328
22	EUREKA (022)	6.43	6.79	7.21	8.11	1.19	0.109	0.112	0.062	0.059	0.0334	0.0324
23	EUREKA (023)	16.39	6.07	16.59	6.37	1.05	0.194	0.109	0.098	0.056	0.0531	0.0304
24	FERNDALE (023)	4.75	2.80	4.97	2.81	1.05	0.086	0.089	0.053	0.059	0.0290	0.0325
25	SAN FERNANDO (241)	13.16	12.32	13.87	13.94	1.13	0.174	0.153	0.087	0.078	0.0474	0.0424
26	SAN FERNANDO (458)	11.30	11.50	11.60	15.26	1.33	0.142	0.161	0.071	0.082	0.0388	0.0445
27	SAN FERNANDO (264)	8.98	4.53	9.14	5.22	1.15	0.132	0.091	0.071	0.050	0.0385	0.0275
28	SAN FERNANDO (267)	4.94	5.83	5.33	6.63	1.14	0.105	0.111	0.060	0.063	0.0328	0.0346
29	PUGET SOUND (325)	3.31	8.92	3.71	9.93	1.12	0.089	0.126	0.058	0.073	0.0312	0.0404
	MEAN	8.35	7.27	8.73	8.59	1.17	0.126	0.119	0.069	0.064	0.0374	0.0353
	σ	4.17	2.94	4.17	3.78	0.10	0.036	0.023	0.014	0.010	0.0076	0.0055
	MEAN OF MAX (L,T)	9.22		10.40			0.135		0.073		0.0397	
	σ OF MAX (L,T)	3.60		3.76			0.032		0.013		0.0069	

TABLE A-XX Nonlinear Dynamic Analysis Results for 1-Story Isolated Structure with Isolation System Type # 11 (T = 3.0 sec, β = 9%). Excitation is Represented by Pairs of Scaled Earthquake Motions Recorded on Medium Soil Sites (Representative of Soil Type S_2). Weight = 2560 kips, Height = 12 ft

	EXCITATION	BASE CENTER DISPL (INCH)		CORNER BEARING DISPL (INCH)		CORNER TO CENTER DISPL RATIO	BASE SHEAR / WEIGHT		1st STORY SHEAR / WEIGHT		1st STORY DRIFT / HEIGHT (%)	
		L	T	L	T		L	T	L	T	L	T
21	WESTERN WASH. (325)	9.73	21.66	14.07	33.32	1.54	0.114	0.214	0.058	0.108	0.0314	0.0579
22	EUREKA (022)	14.06	12.17	16.52	13.74	1.17	0.154	0.130	0.077	0.067	0.0420	0.0365
23	EUREKA (023)	18.89	6.06	19.19	6.70	1.11	0.206	0.077	0.104	0.040	0.0564	0.0218
24	FERNDALE (023)	3.39	3.07	3.52	3.12	1.04	0.045	0.055	0.024	0.030	0.0128	0.0164
25	SAN FERNANDO (241)	34.76	14.78	35.80	16.30	1.10	0.367	0.161	0.185	0.081	0.1007	0.0444
26	SAN FERNANDO (458)	24.01	21.90	24.76	31.57	1.44	0.247	0.224	0.124	0.112	0.0675	0.0614
27	SAN FERNANDO (264)	14.64	9.68	15.26	11.06	1.14	0.168	0.109	0.085	0.055	0.0464	0.0301
28	SAN FERNANDO (267)	7.06	10.16	7.34	12.49	1.23	0.081	0.111	0.042	0.056	0.0229	0.0305
29	PUGET SOUND (325)	3.37	11.28	4.71	12.62	1.40	0.049	0.131	0.031	0.067	0.0169	0.0372
	MEAN	14.43	12.31	15.69	15.66	1.24	0.159	0.135	0.081	0.068	0.0441	0.0374
	σ	9.69	5.99	9.67	9.70	0.17	0.098	0.054	0.048	0.026	0.0263	0.0143
	MEAN OF MAX (L,T)	16.98		20.03			0.184		0.093		0.0506	
	σ OF MAX (L,T)	8.62		10.43			0.085		0.042		0.0229	

TABLE A-XXI Nonlinear Dynamic Analysis Results for 1-Story Isolated Structure with Isolation System Type # 12 (T = 3.0 sec, β = 22%). Excitation is Represented by Pairs of Scaled Earthquake Motions Recorded on Medium Soil Sites (Representative of Soil Type S_2). Weight = 2560 kips, Height = 12 ft

	EXCITATION	BASE CENTER DISPL (INCH)		CORNER BEARING DISPL (INCH)		CORNER TO CENTER DISPL RATIO	BASE SHEAR / WEIGHT		1st STORY SHEAR / WEIGHT		1st STORY DRIFT / HEIGHT (%)	
		L	T	L	T		L	T	L	T	L	T
21	WESTERN WASH. (325)	7.70	11.56	8.38	15.13	1.31	0.077	0.112	0.039	0.060	0.0213	0.0326
22	EUREKA (022)	9.97	10.12	11.45	11.70	1.16	0.095	0.095	0.051	0.050	0.0276	0.0275
23	EUREKA (023)	17.34	5.88	17.60	6.42	1.09	0.160	0.070	0.081	0.036	0.0441	0.0197
24	FERNDALE (023)	4.00	2.85	4.08	2.90	1.02	0.058	0.066	0.035	0.042	0.0188	0.0229
25	SAN FERNANDO (241)	20.38	15.22	20.64	17.45	1.15	0.189	0.146	0.095	0.073	0.0516	0.0401
26	SAN FERNANDO (458)	18.29	16.34	18.75	20.34	1.24	0.152	0.154	0.077	0.078	0.0417	0.0425
27	SAN FERNANDO (264)	11.74	6.28	12.06	7.23	1.15	0.118	0.075	0.060	0.038	0.0327	0.0209
28	SAN FERNANDO (267)	4.59	8.23	4.94	10.17	1.24	0.074	0.092	0.044	0.048	0.0240	0.0266
29	PUGET SOUND (325)	3.34	8.46	4.08	9.03	1.22	0.064	0.095	0.041	0.053	0.0222	0.0290
	MEAN	10.82	8.33	11.33	11.15	1.18	0.110	0.101	0.058	0.053	0.0316	0.0291
	σ	6.17	4.73	6.11	5.29	0.08	0.045	0.030	0.020	0.014	0.0110	0.0076
	MEAN OF MAX (L,T)	12.24		13.42			0.120		0.063		0.0344	
	σ OF MAX (L,T)	5.08		5.19			0.037		0.017		0.0090	

TABLE A-XXII Nonlinear Dynamic Analysis Results for 1-Story Isolated Structure with Isolation System Type # 13 (T = 3.0 sec, β = 37%). Excitation is Represented by Pairs of Scaled Earthquake Motions Recorded on Medium Soil Sites (Representative of Soil Type S_2). Weight = 2560 kips, Height = 12 ft

	EXCITATION	BASE CENTER DISPL (INCH)		CORNER BEARING DISPL (INCH)		CORNER TO CENTER DISPL RATIO	BASE SHEAR / WEIGHT		1st STORY SHEAR / WEIGHT		1st STORY DRIFT / HEIGHT (%)	
		L	T	L	T		L	T	L	T	L	T
21	WESTERN WASH. (325)	5.46	5.80	5.51	7.26	1.25	0.081	0.089	0.057	0.053	0.0309	0.0289
22	EUREKA (022)	7.36	7.28	8.35	8.64	1.19	0.087	0.087	0.047	0.047	0.0257	0.0259
23	EUREKA (023)	16.61	5.35	16.83	5.84	1.09	0.127	0.077	0.064	0.040	0.0346	0.0218
24	FERNDALE (023)	4.71	2.74	4.90	2.75	1.04	0.074	0.078	0.046	0.055	0.0249	0.0303
25	SAN FERNANDO (241)	11.36	11.74	12.20	13.35	1.14	0.103	0.110	0.052	0.057	0.0281	0.0310
26	SAN FERNANDO (458)	10.30	13.63	10.78	16.62	1.22	0.097	0.120	0.049	0.060	0.0269	0.0329
27	SAN FERNANDO (264)	8.54	4.32	8.78	5.21	1.21	0.101	0.081	0.063	0.050	0.0342	0.0277
28	SAN FERNANDO (267)	4.05	6.55	4.48	7.46	1.14	0.084	0.092	0.053	0.073	0.0289	0.0398
29	PUGET SOUND (325)	3.56	7.13	3.84	7.29	1.08	0.077	0.089	0.056	0.058	0.0303	0.0319

	BASE CENTER DISPL L	BASE CENTER DISPL T	CORNER BEARING DISPL L	CORNER BEARING DISPL T	CORNER TO CENTER DISPL RATIO	BASE SHEAR L	BASE SHEAR T	1st STORY SHEAR L	1st STORY SHEAR T	1st STORY DRIFT L	1st STORY DRIFT T
MEAN	7.99	7.17	8.41	8.27	1.15	0.092	0.091	0.054	0.055	0.0294	0.0300
σ	4.00	3.27	4.06	4.00	0.07	0.016	0.014	0.006	0.009	0.0033	0.0047
MEAN OF MAX (L,T)	9.12		10.13			0.099		0.059		0.0324	
σ OF MAX (L,T)	3.77		4.11			0.016		0.007		0.0036	

TABLE A-XXIIa Nonlinear Dynamic Analysis Results for 1-Story Isolated Structure with Isolation System Type # 13 (T = 3.0 sec, β = 37%). Excitation is Represented by Pairs of Scaled Earthquake Motions Recorded on Medium Soil Sites (Representative of Soil Type S_2). Bidirectional Interaction Neglected. Weight = 2560 kips, Height = 12 ft

	EXCITATION	BASE CENTER DISPL (INCH)		CORNER BEARING DISPL (INCH)		CORNER TO CENTER DISPL RATIO	BASE SHEAR / WEIGHT		1st STORY SHEAR / WEIGHT		1st STORY DRIFT / HEIGHT (%)	
		L	T	L	T		L	T	L	T	L	T
21	WESTERN WASH. (325)	6.10	6.51	6.15	7.15	1.10	0.094	0.095	0.059	0.058	0.0340	0.0374
22	EUREKA (022)	6.30	5.64	6.90	7.00	1.24	0.095	0.091	0.050	0.053	0.0292	0.0340
23	EUREKA (023)	17.42	6.07	17.57	6.50	1.07	0.143	0.094	0.074	0.048	0.0421	0.0313
24	FERNDALE (023)	6.25	3.13	6.42	3.18	1.03	0.095	0.081	0.061	0.048	0.0344	0.0310
25	SAN FERNANDO (241)	9.10	11.94	10.25	13.62	1.14	0.107	0.118	0.054	0.061	0.0304	0.0377
26	SAN FERNANDO (458)	9.46	12.80	10.02	15.94	1.25	0.108	0.121	0.055	0.061	0.0309	0.0349
27	SAN FERNANDO (264)	8.73	5.09	8.91	5.28	1.04	0.105	0.090	0.066	0.073	0.0373	0.0466
28	SAN FERNANDO (267)	4.23	6.27	4.38	7.07	1.13	0.086	0.093	0.054	0.067	0.0296	0.0417
29	PUGET SOUND (325)	3.86	7.56	4.01	7.87	1.04	0.084	0.099	0.063	0.064	0.0358	0.0413
	MEAN	7.94	7.22	8.29	8.18	1.12	0.102	0.098	0.060	0.059	0.0337	0.0373
	σ	3.85	2.98	3.90	3.80	0.08	0.017	0.012	0.007	0.008	0.0040	0.0049
	MEAN OF MAX (L,T)	9.31		10.17			0.107		0.064		0.0389	
	σ OF MAX (L,T)	3.71		4.08			0.016		0.006		0.0040	

APPENDIX B

NONLINEAR ANALYSIS RESULTS OF MAXIMUM CENTER DISPLACEMENT, MAXIMUM CORNER DISPLACEMENT, MAXIMUM STORY SHEAR AND INTERSTORY DRIFT RATIO FOR 8-STORY ISOLATED STRUCTURE

TABLE B-I Nonlinear Dynamic Analysis Results for 8-Story Isolated Structure with Isolation System Type # 3 (T = 1.5 sec, β = 7%). Excitation is Represented by Pairs of Scaled Earthquake Motions Recorded on Stiff Soil Sites (Representative of Soil Type S_1). Weight = 11520 kips, Height = 12 ft

	EXCITATION	BASE CENTER DISPL (INCH)		CORNER BEARING DISPL (INCH)		CORNER TO CENTER DISPL RATIO	BASE SHEAR / WEIGHT		1st STORY SHEAR / WEIGHT		1st STORY DRIFT / HEIGHT (%)	
		L	T	L	T		L	T	L	T	L	T
11	LOWER CALIF. (117)	4.40	2.35	4.60	2.82	1.20	0.203	0.108	0.179	0.097	0.413	0.238
12	EL CENTRO (117)	5.03	5.19	5.87	6.60	1.27	0.227	0.222	0.209	0.208	0.490	0.499
13	PARKFIELD (014)	1.72	4.40	2.11	5.86	1.33	0.093	0.195	0.079	0.185	0.200	0.453
14	SAN FERNANDO (110)	3.94	2.18	4.04	2.43	1.11	0.177	0.111	0.175	0.108	0.424	0.278
15	SAN FERNANDO (135)	3.28	4.92	3.48	5.74	1.17	0.153	0.211	0.140	0.203	0.323	0.532
16	SAN FERNANDO (208)	2.77	5.02	2.88	6.40	1.27	0.131	0.205	0.124	0.190	0.299	0.460
17	SAN FERNANDO (211)	3.37	4.87	3.57	6.23	1.30	0.159	0.202	0.141	0.189	0.335	0.458
18	SAN FERNANDO (466)	2.32	5.88	3.23	8.24	1.40	0.106	0.241	0.098	0.220	0.243	0.516
19	SAN FERNANDO (253)	2.84	5.22	2.97	6.47	1.24	0.132	0.225	0.124	0.207	0.300	0.506
20	SAN FERNANDO (199)	3.64	3.40	4.43	3.79	1.22	0.170	0.157	0.160	0.142	0.379	0.338

	BASE CENTER DISPL L	BASE CENTER DISPL T	CORNER BEARING DISPL L	CORNER BEARING DISPL T	CORNER TO CENTER DISPL RATIO	BASE SHEAR / WEIGHT L	BASE SHEAR / WEIGHT T	1st STORY SHEAR / WEIGHT L	1st STORY SHEAR / WEIGHT T	1st STORY DRIFT / HEIGHT L	1st STORY DRIFT / HEIGHT T
MEAN	3.33	4.34	3.72	5.46	1.25	0.155	0.188	0.143	0.175	0.341	0.428
σ	0.93	1.20	1.01	1.75	0.08	0.039	0.044	0.037	0.041	0.083	0.099
MEAN OF MAX (L,T)	4.75		5.86			0.206		0.192		0.464	
σ OF MAX (L,T)	0.63		1.18			0.021		0.017		0.047	

TABLE B-I Continued

	EXCITATION	2nd STORY SHEAR / WEIGHT		3rd STORY SHEAR / WEIGHT		4th STORY SHEAR / WEIGHT		5th STORY SHEAR / WEIGHT		6th STORY SHEAR / WEIGHT		7th STORY SHEAR / WEIGHT		8th STORY SHEAR / WEIGHT	
		L	T	L	T	L	T	L	T	L	T	L	T	L	T
11	LOWER CALIF. (117)	0.162	0.093	0.152	0.089	0.136	0.095	0.122	0.097	0.111	0.087	0.096	0.065	0.058	0.037
12	EL CENTRO (117)	0.192	0.191	0.172	0.181	0.147	0.168	0.120	0.148	0.097	0.122	0.070	0.091	0.037	0.054
13	PARKFIELD (014)	0.076	0.174	0.072	0.161	0.065	0.144	0.079	0.123	0.095	0.096	0.098	0.067	0.063	0.041
14	SAN FERNANDO (110)	0.171	0.104	0.161	0.099	0.153	0.095	0.143	0.080	0.121	0.076	0.090	0.072	0.047	0.050
15	SAN FERNANDO (135)	0.124	0.192	0.107	0.175	0.101	0.151	0.092	0.135	0.072	0.118	0.054	0.087	0.029	0.047
16	SAN FERNANDO (208)	0.119	0.173	0.109	0.154	0.098	0.133	0.083	0.110	0.068	0.086	0.054	0.060	0.031	0.035
17	SAN FERNANDO (211)	0.126	0.174	0.115	0.156	0.104	0.137	0.091	0.115	0.076	0.091	0.055	0.063	0.031	0.032
18	SAN FERNANDO (466)	0.095	0.200	0.091	0.176	0.083	0.154	0.070	0.129	0.054	0.101	0.038	0.071	0.026	0.036
19	SAN FERNANDO (253)	0.118	0.191	0.111	0.173	0.103	0.159	0.092	0.143	0.077	0.120	0.057	0.090	0.031	0.049
20	SAN FERNANDO (199)	0.146	0.124	0.130	0.108	0.112	0.098	0.099	0.087	0.088	0.072	0.068	0.054	0.038	0.034
	MEAN	0.133	0.162	0.122	0.147	0.110	0.133	0.099	0.117	0.086	0.097	0.068	0.072	0.039	0.042
	σ	0.033	0.037	0.030	0.033	0.026	0.026	0.021	0.022	0.019	0.017	0.019	0.012	0.012	0.007
	MEAN OF MAX (L,T)	0.178		0.162		0.145		0.127		0.105		0.081		0.046	
	σ OF MAX (L,T)	0.016		0.014		0.015		0.015		0.014		0.014		0.010	

TABLE B-I Continued

	EXCITATION	2nd STORY DRIFT/HEIGHT (%)		3rd STORY DRIFT/HEIGHT (%)		4th STORY DRIFT/HEIGHT (%)		5th STORY DRIFT/HEIGHT (%)		6th STORY DRIFT/HEIGHT (%)		7th STORY DRIFT/HEIGHT (%)		8th STORY DRIFT/HEIGHT (%)	
		L	T	L	T	L	T	L	T	L	T	L	T	L	T
11	LOWER CALIF. (117)	0.380	0.221	0.360	0.210	0.436	0.315	0.377	0.320	0.350	0.285	0.457	0.329	0.273	0.197
12	EL CENTRO (117)	0.455	0.473	0.410	0.438	0.468	0.567	0.381	0.497	0.313	0.416	0.337	0.465	0.177	0.285
13	PARKFIELD (014)	0.190	0.445	0.181	0.394	0.221	0.481	0.250	0.405	0.305	0.320	0.468	0.334	0.299	0.215
14	SAN FERNANDO (110)	0.400	0.266	0.381	0.248	0.496	0.336	0.464	0.283	0.396	0.246	0.438	0.358	0.225	0.258
15	SAN FERNANDO (135)	0.296	0.525	0.260	0.465	0.325	0.550	0.298	0.493	0.233	0.438	0.254	0.483	0.138	0.252
16	SAN FERNANDO (208)	0.283	0.440	0.265	0.373	0.321	0.435	0.271	0.359	0.213	0.289	0.259	0.320	0.146	0.199
17	SAN FERNANDO (211)	0.309	0.441	0.276	0.378	0.336	0.447	0.299	0.374	0.250	0.302	0.276	0.315	0.155	0.166
18	SAN FERNANDO (466)	0.233	0.494	0.223	0.419	0.271	0.494	0.226	0.409	0.173	0.321	0.182	0.344	0.120	0.170
19	SAN FERNANDO (253)	0.284	0.486	0.270	0.416	0.335	0.512	0.294	0.456	0.244	0.389	0.278	0.443	0.153	0.241
20	SAN FERNANDO (199)	0.353	0.313	0.318	0.264	0.360	0.339	0.317	0.300	0.282	0.251	0.323	0.281	0.177	0.179
	MEAN	0.318	0.410	0.294	0.361	0.357	0.448	0.318	0.390	0.276	0.326	0.327	0.367	0.186	0.216
	σ	0.076	0.099	0.068	0.083	0.082	0.086	0.067	0.073	0.063	0.064	0.092	0.067	0.057	0.039
	MEAN OF MAX (L,T)	0.444		0.394		0.478		0.415		0.350		0.406		0.232	
	σ OF MAX (L,T)	0.051		0.040		0.058		0.057		0.053		0.067		0.047	

TABLE B-II Nonlinear Dynamic Analysis Results for 8-Story Isolated Structure with Isolation System Type # 4 ($T = 1.5$ sec, $\beta = 15\%$). Excitation is Represented by Pairs of Scaled Earthquake Motions Recorded on Stiff Soil Sites (Representative of Soil Type S_1). Weight = 11520 kips, Height = 12 ft

	EXCITATION	BASE CENTER DISPL (INCH)		CORNER BEARING DISPL (INCH)		CORNER TO CENTER DISPL RATIO	BASE SHEAR / WEIGHT		1st STORY SHEAR / WEIGHT		1st STORY DRIFT / HEIGHT (%)	
		L	T	L	T		L	T	L	T	L	T
11	LOWER CALIF. (117)	3.86	1.95	4.01	2.40	1.23	0.179	0.098	0.152	0.088	0.350	0.233
12	EL CENTRO (117)	3.57	4.46	3.85	5.65	1.27	0.161	0.187	0.142	0.182	0.340	0.449
13	PARKFIELD (014)	1.52	2.70	1.63	3.68	1.36	0.099	0.134	0.067	0.122	0.151	0.320
14	SAN FERNANDO (110)	3.87	2.11	3.97	2.36	1.12	0.167	0.114	0.166	0.110	0.409	0.284
15	SAN FERNANDO (135)	2.31	5.71	3.04	6.75	1.32	0.126	0.226	0.108	0.216	0.246	0.556
16	SAN FERNANDO (208)	2.77	4.99	2.99	6.32	1.27	0.120	0.199	0.123	0.186	0.300	0.453
17	SAN FERNANDO (211)	3.07	4.79	3.26	6.13	1.28	0.128	0.197	0.134	0.186	0.323	0.449
18	SAN FERNANDO (466)	2.03	5.50	2.15	7.20	1.31	0.102	0.220	0.091	0.202	0.222	0.477
19	SAN FERNANDO (253)	2.26	4.17	2.40	5.22	1.25	0.125	0.178	0.113	0.158	0.263	0.383
20	SAN FERNANDO (199)	3.43	3.08	3.51	3.50	1.14	0.165	0.139	0.150	0.130	0.351	0.341
	MEAN	2.87	3.95	3.08	4.92	1.26	0.137	0.169	0.125	0.158	0.296	0.395
	σ	0.78	1.32	0.77	1.70	0.07	0.027	0.043	0.029	0.041	0.072	0.094
	MEAN OF MAX (L,T)	4.35		5.24			0.185		0.172		0.420	
	σ OF MAX (L,T)	0.89		1.30			0.026		0.026		0.068	

TABLE B-II Continued

	EXCITATION	2nd STORY SHEAR / WEIGHT		3rd STORY SHEAR / WEIGHT		4th STORY SHEAR / WEIGHT		5th STORY SHEAR / WEIGHT		6th STORY SHEAR / WEIGHT		7th STORY SHEAR / WEIGHT		8th STORY SHEAR / WEIGHT	
		L	T	L	T	L	T	L	T	L	T	L	T	L	T
11	LOWER CALIF. (117)	0.133	0.091	0.122	0.089	0.111	0.097	0.108	0.098	0.096	0.087	0.085	0.068	0.054	0.045
12	EL CENTRO (117)	0.134	0.179	0.123	0.168	0.108	0.155	0.118	0.141	0.110	0.118	0.085	0.093	0.045	0.064
13	PARKFIELD (014)	0.063	0.123	0.066	0.121	0.077	0.108	0.083	0.087	0.101	0.069	0.109	0.073	0.072	0.051
14	SAN FERNANDO (110)	0.164	0.106	0.152	0.101	0.143	0.098	0.134	0.081	0.113	0.087	0.082	0.088	0.044	0.067
15	SAN FERNANDO (135)	0.095	0.201	0.089	0.181	0.096	0.154	0.090	0.142	0.069	0.123	0.054	0.089	0.032	0.054
16	SAN FERNANDO (208)	0.117	0.171	0.105	0.153	0.094	0.134	0.080	0.112	0.073	0.088	0.058	0.063	0.036	0.040
17	SAN FERNANDO (211)	0.128	0.174	0.113	0.160	0.099	0.145	0.085	0.126	0.067	0.102	0.057	0.073	0.035	0.038
18	SAN FERNANDO (466)	0.088	0.188	0.084	0.174	0.075	0.155	0.061	0.130	0.046	0.099	0.051	0.067	0.035	0.035
19	SAN FERNANDO (253)	0.105	0.147	0.099	0.140	0.093	0.136	0.084	0.125	0.071	0.107	0.057	0.081	0.034	0.053
20	SAN FERNANDO (199)	0.136	0.119	0.120	0.108	0.111	0.096	0.100	0.092	0.091	0.084	0.077	0.063	0.047	0.043
	MEAN	0.116	0.150	0.107	0.140	0.101	0.128	0.094	0.113	0.084	0.096	0.072	0.076	0.043	0.049
	σ	0.028	0.036	0.023	0.031	0.018	0.024	0.020	0.0021	0.021	0.016	0.018	0.011	0.012	0.010
	MEAN OF MAX (L,T)	0.162		0.149		0.135		0.121		0.104		0.083		0.052	
	σ OF MAX (L,T)	0.024		0.021		0.018		0.017		0.011		0.013		0.012	

TABLE B-II Continued

	EXCITATION	2nd STORY DRIFT/HEIGHT (%)		3rd STORY DRIFT/HEIGHT (%)		4th STORY DRIFT/HEIGHT (%)		5th STORY DRIFT/HEIGHT (%)		6th STORY DRIFT/HEIGHT (%)		7th STORY DRIFT/HEIGHT (%)		8th STORY DRIFT/HEIGHT (%)	
		L	T	L	T	L	T	L	T	L	T	L	T	L	T
11	LOWER CALIF. (117)	0.311	0.234	0.293	0.223	0.360	0.340	0.334	0.347	0.303	0.302	0.408	0.344	0.252	0.239
12	EL CENTRO (117)	0.319	0.451	0.294	0.410	0.347	0.521	0.378	0.470	0.353	0.398	0.409	0.475	0.210	0.334
13	PARKFIELD (014)	0.145	0.305	0.149	0.294	0.243	0.364	0.274	0.280	0.322	0.241	0.518	0.389	0.340	0.276
14	SAN FERNANDO (110)	0.383	0.269	0.359	0.251	0.466	0.345	0.437	0.285	0.369	0.284	0.398	0.451	0.205	0.343
15	SAN FERNANDO (135)	0.221	0.542	0.217	0.472	0.311	0.549	0.289	0.508	0.221	0.448	0.263	0.487	0.155	0.288
16	SAN FERNANDO (208)	0.279	0.438	0.256	0.377	0.304	0.446	0.259	0.370	0.230	0.299	0.276	0.348	0.171	0.223
17	SAN FERNANDO (211)	0.297	0.438	0.267	0.387	0.322	0.475	0.276	0.409	0.221	0.339	0.277	0.367	0.164	0.192
18	SAN FERNANDO (466)	0.213	0.459	0.204	0.404	0.247	0.493	0.201	0.411	0.150	0.323	0.244	0.335	0.163	0.177
19	SAN FERNANDO (253)	0.246	0.363	0.234	0.320	0.298	0.428	0.267	0.393	0.227	0.338	0.278	0.391	0.167	0.276
20	SAN FERNANDO (199)	0.325	0.328	0.289	0.285	0.367	0.340	0.330	0.321	0.291	0.288	0.371	0.327	0.226	0.225
	MEAN	0.274	0.383	0.256	0.342	0.327	0.430	0.305	0.379	0.269	0.326	0.344	0.391	0.205	0.257
	σ	0.065	0.093	0.055	0.076	0.061	0.075	0.064	0.071	0.066	0.057	0.085	0.056	0.054	0.053
	MEAN OF MAX (L,T)	0.402		0.361		0.447		0.396		0.343		0.415		0.265	
	σ OF MAX (L,T)	0.073		0.058		0.064		0.064		0.047		0.060		0.058	

TABLE B-III Nonlinear Dynamic Analysis Results for 8-Story Isolated Structure with Isolation System Type # 5 (T = 1.5 sec, β = 31%). Excitation is Represented by Pairs of Scaled Earthquake Motions Recorded on Stiff Soil Sites (Representative of Soil Type S_1). Weight = 11520 kips, Height = 12 ft

	EXCITATION	BASE CENTER DISPL (INCH)		CORNER BEARING DISPL (INCH)		CORNER TO CENTER DISPL RATIO	BASE SHEAR / WEIGHT		1st STORY SHEAR / WEIGHT		1st STORY DRIFT / HEIGHT (%)	
		L	T	L	T		L	T	L	T	L	T
11	LOWER CALIF. (117)	2.90	1.71	2.94	2.00	1.17	0.147	0.114	0.131	0.094	0.319	0.256
12	EL CENTRO (117)	3.66	3.56	3.82	4.54	1.27	0.154	0.153	0.139	0.139	0.331	0.353
13	PARKFIELD (014)	1.33	2.01	1.40	2.24	1.11	0.112	0.122	0.080	0.121	0.191	0.316
14	SAN FERNANDO (110)	3.82	2.04	3.97	2.30	1.13	0.149	0.114	0.149	0.109	0.372	0.283
15	SAN FERNANDO (135)	2.53	7.15	3.11	8.45	1.23	0.113	0.223	0.099	0.203	0.242	0.525
16	SAN FERNANDO (208)	2.49	4.00	2.74	5.22	1.31	0.118	0.157	0.120	0.140	0.297	0.349
17	SAN FERNANDO (211)	3.04	3.57	3.22	4.82	1.35	0.124	0.152	0.133	0.139	0.327	0.339
18	SAN FERNANDO (466)	1.63	5.06	2.43	6.14	1.49	0.109	0.174	0.093	0.154	0.214	0.394
19	SAN FERNANDO (253)	1.65	3.31	1.77	4.18	1.26	0.120	0.145	0.104	0.130	0.247	0.331
20	SAN FERNANDO (199)	2.24	3.50	2.47	3.97	1.13	0.129	0.145	0.116	0.132	0.286	0.352
	MEAN	2.53	3.59	2.79	4.39	1.25	0.128	0.150	0.116	0.136	0.283	0.350
	σ	0.80	1.53	0.77	1.88	0.11	0.016	0.031	0.021	0.028	0.055	0.069
	MEAN OF MAX (L,T)	3.90		4.65			0.157		0.144		0.363	
	σ OF MAX (L,T)	1.31		1.64			0.025		0.022		0.059	

TABLE B-III Continued

	EXCITATION	2nd STORY SHEAR/WEIGHT		3rd STORY SHEAR/WEIGHT		4th STORY SHEAR/WEIGHT		5th STORY SHEAR/WEIGHT		6th STORY SHEAR/WEIGHT		7th STORY SHEAR/WEIGHT		8th STORY SHEAR/WEIGHT	
		L	T	L	T	L	T	L	T	L	T	L	T	L	T
11	LOWER CALIF. (117)	0.125	0.096	0.116	0.095	0.112	0.122	0.113	0.126	0.101	0.114	0.081	0.097	0.046	0.066
12	EL CENTRO (117)	0.124	0.133	0.129	0.131	0.137	0.132	0.135	0.129	0.122	0.117	0.098	0.114	0.056	0.073
13	PARKFIELD (014)	0.072	0.120	0.078	0.118	0.088	0.113	0.102	0.103	0.108	0.086	0.123	0.092	0.083	0.070
14	SAN FERNANDO (110)	0.149	0.107	0.138	0.102	0.125	0.098	0.118	0.091	0.103	0.108	0.085	0.114	0.052	0.082
15	SAN FERNANDO (135)	0.094	0.182	0.087	0.159	0.088	0.150	0.082	0.139	0.071	0.117	0.062	0.098	0.036	0.057
16	SAN FERNANDO (208)	0.116	0.128	0.114	0.121	0.108	0.123	0.091	0.114	0.073	0.091	0.068	0.071	0.043	0.045
17	SAN FERNANDO (211)	0.127	0.130	0.127	0.121	0.122	0.116	0.107	0.094	0.084	0.078	0.059	0.061	0.035	0.041
18	SAN FERNANDO (466)	0.084	0.141	0.080	0.136	0.076	0.127	0.066	0.112	0.060	0.092	0.069	0.068	0.046	0.051
19	SAN FERNANDO (253)	0.093	0.120	0.086	0.120	0.082	0.116	0.072	0.096	0.066	0.082	0.057	0.090	0.035	0.067
20	SAN FERNANDO (199)	0.122	0.126	0.125	0.119	0.126	0.112	0.114	0.099	0.098	0.094	0.087	0.072	0.058	0.053
	MEAN	0.111	0.128	0.108	0.122	0.106	0.121	0.100	C.110	0.087	0.098	0.079	0.088	0.049	0.061
	σ	0.023	0.022	0.022	0.017	0.020	0.013	0.021	0.016	0.020	0.014	0.019	0.018	0.014	0.012
	MEAN OF MAX (L,T)	0.135		0.129		0.126		0.116		0.102		0.092		0.062	
	σ OF MAX (L,T)	0.018		0.012		0.010		0.013		0.013		0.020		0.014	

TABLE B-III Continued

	EXCITATION	2nd STORY DRIFT/HEIGHT (%)		3rd STORY DRIFT/HEIGHT (%)		4th STORY DRIFT/HEIGHT (%)		5th STORY DRIFT/HEIGHT (%)		6th STORY DRIFT/HEIGHT (%)		7th STORY DRIFT/HEIGHT (%)		8th STORY DRIFT/HEIGHT (%)	
		L	T	L	T	L	T	L	T	L	T	L	T	L	T
11	LOWER CALIF. (117)	0.302	0.354	0.284	0.237	0.366	0.417	0.363	0.436	0.327	0.387	0.389	0.491	0.218	0.352
12	EL CENTRO (117)	0.302	0.346	0.303	0.329	0.435	0.450	0.429	0.465	0.386	0.404	0.465	0.581	0.259	0.389
13	PARKFIELD (014)	0.165	0.324	0.173	0.307	0.278	0.403	0.326	0.365	0.341	0.309	0.589	0.492	0.396	0.376
14	SAN FERNANDO (110)	0.348	0.268	0.323	0.250	0.411	0.346	0.386	0.311	0.335	0.362	0.413	0.584	0.248	0.427
15	SAN FERNANDO (135)	0.226	0.498	0.210	0.419	0.283	0.541	0.258	0.497	0.233	0.422	0.299	0.524	0.174	0.313
16	SAN FERNANDO (208)	0.275	0.327	0.271	0.321	0.348	0.451	0.297	0.421	0.235	0.339	0.329	0.381	0.210	0.237
17	SAN FERNANDO (211)	0.299	0.323	0.294	0.322	0.384	0.425	0.338	0.346	0.262	0.266	0.282	0.320	0.173	0.222
18	SAN FERNANDO (466)	0.195	0.365	0.187	0.319	0.244	0.409	0.209	0.357	0.204	0.309	0.336	0.349	0.217	0.261
19	SAN FERNANDO (253)	0.226	0.317	0.199	0.288	0.265	0.407	0.232	0.350	0.204	0.296	0.273	0.463	0.171	0.350
20	SAN FERNANDO (199)	0.278	0.346	0.292	0.311	0.399	0.403	0.364	0.354	0.315	0.318	0.422	0.366	0.278	0.271
	MEAN	0.262	0.347	0.254	0.310	0.341	0.425	0.320	0.390	0.284	0.341	0.380	0.455	0.234	0.320
	σ	0.054	0.056	0.052	0.047	0.065	0.048	0.067	0.057	0.061	0.048	0.093	0.091	0.064	0.066
	MEAN OF MAX (L,T)	0.355		0.322		0.432		0.399		0.344		0.470		0.322	
	σ OF MAX (L,T)	0.050		0.035		0.040		0.050		0.047		0.095		0.068	

TABLE B-IV Nonlinear Dynamic Analysis Results for 8-Story Isolated Structure with Isolation System Type # 6 (T = 2.0 sec, β = 6%). Excitation is Represented by Pairs of Scaled Earthquake Motions Recorded on Stiff Soil Sites (Representative of Soil Type S_1). Weight = 11520 kips, Height = 12 ft

	EXCITATION	BASE CENTER DISPL (INCH)		CORNER BEARING DISPL (INCH)		CORNER TO CENTER DISPL RATIO	BASE SHEAR / WEIGHT		1st STORY SHEAR / WEIGHT		1st STORY DRIFT / HEIGHT (%)	
		L	T	L	T		L	T	L	T	L	T
11	LOWER CALIF. (117)	6.09	4.42	6.43	5.57	1.26	0.158	0.106	0.145	0.099	0.344	0.240
12	EL CENTRO (117)	8.38	9.98	10.18	13.14	1.32	0.204	0.236	0.185	0.220	0.437	0.535
13	PARKFIELD (014)	2.86	7.67	4.69	10.63	1.64	0.077	0.184	0.073	0.163	0.191	0.377
14	SAN FERNANDO (110)	5.02	2.84	5.13	3.06	1.08	0.125	0.081	0.126	0.080	0.306	0.208
15	SAN FERNANDO (135)	9.72	8.17	10.19	10.55	1.29	0.228	0.193	0.209	0.176	0.496	0.431
16	SAN FERNANDO (208)	7.78	9.58	8.08	13.36	1.39	0.190	0.219	0.172	0.200	0.409	0.475
17	SAN FERNANDO (211)	9.24	8.32	9.55	10.05	1.21	0.221	0.203	0.202	0.188	0.479	0.474
18	SAN FERNANDO (466)	5.21	9.15	6.48	11.95	1.31	0.136	0.216	0.125	0.198	0.303	0.469
19	SAN FERNANDO (253)	6.41	9.24	6.45	11.94	1.29	0.165	0.221	0.145	0.193	0.335	0.455
20	SAN FERNANDO (199)	8.60	8.48	10.11	11.23	1.32	0.215	0.199	0.194	0.183	0.458	0.428
	MEAN	6.93	7.79	7.73	10.15	1.31	0.172	0.186	0.158	0.170	0.376	0.409
	σ	2.07	2.21	2.05	3.14	0.13	0.046	0.049	0.041	0.043	0.091	0.101
	MEAN OF MAX (L,T)	8.43		10.44			0.202		0.185		0.439	
	σ OF MAX (L,T)	1.58		2.56			0.034		0.029		0.069	

TABLE B-IV Continued

	EXCITATION	2nd STORY SHEAR / WEIGHT		3rd STORY SHEAR / WEIGHT		4th STORY SHEAR / WEIGHT		5th STORY SHEAR / WEIGHT		6th STORY SHEAR / WEIGHT		7th STORY SHEAR / WEIGHT		8th STORY SHEAR / WEIGHT	
		L	T	L	T	L	T	L	T	L	T	L	T	L	T
11	LOWER CALIF. (117)	0.140	0.087	0.133	0.071	0.122	0.074	0.106	0.069	0.087	0.057	0.069	0.044	0.039	0.026
12	EL CENTRO (117)	0.166	0.201	0.146	0.181	0.127	0.158	0.110	0.133	0.087	0.106	0.062	0.076	0.033	0.041
13	PARKFIELD (014)	0.067	0.143	0.059	0.125	0.050	0.109	0.045	0.092	0.055	0.072	0.054	0.050	0.033	0.030
14	SAN FERNANDO (110)	0.122	0.077	0.116	0.074	0.112	0.069	0.102	0.058	0.085	0.044	0.062	0.050	0.033	0.033
15	SAN FERNANDO (135)	0.189	0.156	0.168	0.136	0.145	0.115	0.119	0.091	0.091	0.073	0.062	0.051	0.032	0.027
16	SAN FERNANDO (208)	0.154	0.181	0.134	0.160	0.113	0.137	0.092	0.112	0.071	0.086	0.049	0.059	0.025	0.030
17	SAN FERNANDO (211)	0.180	0.172	0.158	0.153	0.1366	0.133	0.112	0.110	0.086	0.087	0.058	0.061	0.029	0.032
18	SAN FERNANDO (466)	0.113	0.178	0.099	0.155	0.084	0.132	0.069	0.111	0.053	0.089	0.037	0.064	0.019	0.034
19	SAN FERNANDO (253)	0.127	0.165	0.109	0.146	0.096	0.126	0.080	0.107	0.063	0.085	0.043	0.060	0.022	0.031
20	SAN FERNANDO (199)	0.172	0.166	0.150	0.146	0.129	0.124	0.106	0.102	0.082	0.080	0.057	0.056	0.029	0.029
	MEAN	0.143	0.153	0.127	0.135	0.111	0.118	0.094	0.099	0.076	0.078	0.055	0.057	0.029	0.031
	σ	0.035	0.038	0.031	0.034	0.027	0.026	0.022	0.021	0.014	0.017	0.009	0.009	0.006	0.004
	MEAN OF MAX (L,T)	0.167		0.149		0.131		0.110		0.087		0.062		0.033	
	σ OF MAX (L,T)	0.023		0.019		0.014		0.010		0.008		0.006		0.004	

TABLE B-IV Continued

	EXCITATION	2nd STORY DRIFT/HEIGHT (%)		3rd STORY DRIFT/HEIGHT (%)		4th STORY DRIFT/HEIGHT (%)		5th STORY DRIFT/HEIGHT (%)		6th STORY DRIFT/HEIGHT (%)		7th STORY DRIFT/HEIGHT (%)		8th STORY DRIFT/HEIGHT (%)	
		L	T	L	T	L	T	L	T	L	T	L	T	L	T
11	LOWER CALIF. (117)	0.323	0.218	0.312	0.174	0.384	0.243	0.332	0.223	0.275	0.189	0.324	0.214	0.182	0.132
12	EL CENTRO (117)	0.405	0.516	0.362	0.444	0.407	0.526	0.346	0.439	0.276	0.358	0.302	0.389	0.160	0.210
13	PARKFIELD (014)	0.178	0.352	0.159	0.297	0.179	0.354	0.146	0.299	0.170	0.240	0.252	0.248	0.156	0.161
14	SAN FERNANDO (110)	[illegible]	0.203	0.281	0.189	0.363	0.248	0.331	0.207	0.277	0.154	0.302	0.247	0.155	0.174
15	SAN FERNANDO (135)	0.461	0.414	0.414	0.356	0.469	0.410	0.374	0.319	0.286	0.260	0.305	0.273	0.161	0.147
16	SAN FERNANDO (208)	0.376	0.454	0.331	0.386	0.366	0.448	0.285	0.367	0.220	0.292	0.238	0.307	0.129	0.158
17	SAN FERNANDO (211)	0.439	0.455	0.388	0.390	0.435	0.457	0.347	0.377	0.266	0.303	0.281	0.322	0.149	0.167
18	SAN FERNANDO (466)	0.281	0.445	0.250	0.372	0.280	0.431	0.221	0.355	0.171	0.294	0.187	0.319	0.102	0.166
19	SAN FERNANDO (253)	0.304	0.425	0.272	0.361	0.316	0.426	0.259	0.361	0.203	0.295	0.214	0.314	0.113	0.159
20	SAN FERNANDO (199)	0.421	0.408	0.372	0.342	0.416	0.394	0.332	0.321	0.255	0.259	0.280	0.272	0.149	0.141

	2nd L	2nd T	3rd L	3rd T	4th L	4th T	5th L	5th T	6th L	6th T	7th L	7th T	8th L	8th T
MEAN	0.348	0.389	0.314	0.331	0.362	0.394	0.297	0.327	0.240	0.264	0.269	0.291	0.146	0.162
σ	0.084	0.098	0.072	0.083	0.080	0.085	0.067	0.067	0.043	0.056	0.342	0.047	0.023	0.020
MEAN OF MAX (L,T)	0.414		0.363		0.427		0.357		0.288		0.311		0.169	
σ OF MAX (L,T)	0.067		0.049		0.049		0.036		0.029		0.033		0.016	

TABLE B-V Nonlinear Dynamic Analysis Results for 8-Story Isolated Structure with Isolation System Type # 7 (T = 2.0 sec, β = 16%). Excitation is Represented by Pairs of Scaled Earthquake Motions Recorded on Stiff Soil Sites (Representative of Soil Type S_1). Weight = 11520 kips, Height = 12 ft

	EXCITATION	BASE CENTER DISPL (INCH)		CORNER BEARING DISPL (INCH)		CORNER TO CENTER DISPL RATIO	BASE SHEAR / WEIGHT		1st STORY SHEAR / WEIGHT		1st STORY DRIFT / HEIGHT (%)	
		L	T	L	T		L	T	L	T	i.	T
11	LOWER CALIF. (117)	4.04	2.77	4.26	3.34	1.21	0.108	0.077	0.103	0.068	0.253	0.181
12	EL CENTRO (117)	6.47	7.34	6.86	9.11	1.24	0.160	0.166	0.134	0.157	0.307	0.392
13	PARKFIELD (014)	1.30	4.12	1.96	5.40	1.51	0.061	0.114	0.055	0.099	0.142	0.251
14	SAN FERNANDO (110)	5.02	2.74	5.15	2.98	1.09	0.120	0.085	0.123	0.083	0.302	0.217
15	SAN FERNANDO (135)	5.14	7.73	5.17	10.13	1.31	0.122	0.180	0.113	0.163	0.266	0.430
16	SAN FERNANDO (208)	5.65	7.56	5.98	9.34	1.24	0.132	0.174	0.120	0.161	0.289	0.401
17	SAN FERNANDO (211)	6.79	7.30	7.06	9.00	1.23	0.145	0.165	0.133	0.155	0.322	0.388
18	SAN FERNANDO (466)	4.74	7.74	5.37	9.46	1.22	0.114	0.170	0.104	0.154	0.244	0.387
19	SAN FERNANDO (253)	5.65	8.42	5.92	10.78	1.28	0.139	0.193	0.128	0.166	0.300	0.414
20	SAN FERNANDO (199)	7.12	6.01	7.85	7.86	1.31	0.165	0.130	0.151	0.124	0.355	0.296
	MEAN	5.19	6.17	5.56	7.74	1.26	0.127	0.135	0.116	0.133	0.278	0.336
	σ	1.58	2.05	1.57	2.67	0.10	0.028	0.055	0.025	0.035	0.055	0.086
	MEAN OF MAX (L,T)	6.64		8.05			0.156		0.143		0.357	
	σ OF MAX (L,T)	1.53		2.17			0.028		0.024		0.062	

TABLE B-V Continued

	EXCITATION	2nd STORY SHEAR / WEIGHT		3rd STORY SHEAR / WEIGHT		4th STORY SHEAR / WEIGHT		5th STORY SHEAR / WEIGHT		6th STORY SHEAR / WEIGHT		7th STORY SHEAR / WEIGHT		8th STORY SHEAR / WEIGHT	
		L	T	L	T	L	T	L	T	L	T	L	T	L	T
11	LOWER CALIF. (117)	0.105	0.068	0.100	0.074	0.093	0.082	0.086	0.078	0.076	0.068	0.064	0.052	0.038	0.038
12	EL CENTRO (117)	0.126	0.146	0.123	0.134	0.117	0.121	0.103	0.104	0.083	0.085	0.058	0.072	0.029	0.050
13	PARKFIELD (014)	0.052	0.094	0.049	0.087	0.058	0.077	0.064	0.066	0.071	0.053	0.073	0.054	0.047	0.036
14	SAN FERNANDO (110)	0.120	0.081	0.110	0.077	0.106	0.073	0.097	0.059	0.080	0.059	0.060	0.066	0.037	0.044
15	SAN FERNANDO (135)	0.103	0.146	0.091	0.128	0.083	0.109	0.073	0.094	0.059	0.080	0.044	0.057	0.025	0.036
16	SAN FERNANDO (208)	0.108	0.147	0.096	0.132	0.083	0.115	0.059	0.097	0.054	0.076	0.043	0.054	0.028	0.030
17	SAN FERNANDO (211)	0.121	0.143	0.110	0.129	0.097	0.114	0.081	0.097	0.063	0.077	0.044	0.056	0.027	0.029
18	SAN FERNANDO (466)	0.092	0.140	0.086	0.126	0.078	0.110	0.067	0.092	0.053	0.072	0.038	0.055	0.025	0.031
19	SAN FERNANDO (253)	0.117	0.152	0.105	0.136	0.091	0.120	0.076	0.101	0.059	0.083	0.042	0.060	0.026	0.042
20	SAN FERNANDO (199)	0.136	0.115	0.121	0.104	0.105	0.093	0.087	0.079	0.070	0.067	0.056	0.051	0.035	0.032
	MEAN	0.108	0.123	0.099	0.113	0.091	0.101	0.080	0.087	0.067	0.072	0.052	0.058	0.032	0.037
	σ	0.022	0.030	0.020	0.024	0.016	0.017	0.012	0.015	0.010	0.010	0.011	0.006	0.007	0.006
	MEAN OF MAX (L,T)	0.133		0.120		0.107		0.092		0.077		0.061		0.038	
	σ OF MAX (L,T)	0.019		0.015		0.013		0.010		0.005		0.007		0.007	

TABLE B-V Continued

	EXCITATION	2nd STORY DRIFT/HEIGHT (%)		3rd STORY DRIFT/HEIGHT (%)		4th STORY DRIFT/HEIGHT (%)		5th STORY DRIFT/HEIGHT (%)		6th STORY DRIFT/HEIGHT (%)		7th STORY DRIFT/HEIGHT (%)		8th STORY DRIFT/HEIGHT (%)	
		L	T	L	T	L	T	L	T	L	T	L	T	L	T
11	LOWER CALIF. (117)	0.240	0.173	0.232	0.185	0.299	0.289	0.275	0.272	0.243	0.233	0.300	0.268	0.174	0.197
12	EL CENTRO (117)	0.294	0.384	0.290	0.339	0.368	0.415	0.325	0.256	0.263	0.295	0.281	0.369	0.144	0.271
13	PARKFIELD (014)	0.134	0.252	0.126	0.227	0.182	0.261	0.209	0.214	0.222	0.180	0.347	0.286	0.221	0.188
14	SAN FERNANDO (110)	0.283	0.209	0.268	0.195	0.347	0.260	0.315	0.210	0.260	0.193	0.288	0.338	0.167	0.233
15	SAN FERNANDO (135)	0.247	0.407	0.221	0.346	0.258	0.388	0.230	0.340	0.188	0.291	0.215	0.307	0.124	0.190
16	SAN FERNANDO (208)	0.267	0.384	0.239	0.328	0.271	0.385	0.219	0.320	0.171	0.260	0.205	0.277	0.131	0.158
17	SAN FERNANDO (211)	0.299	0.376	0.272	0.326	0.314	0.391	0.255	0.328	0.199	0.266	0.214	0.287	0.129	0.151
18	SAN FERNANDO (466)	0.224	0.374	0.209	0.323	0.251	0.382	0.212	0.316	0.170	0.247	0.185	0.278	0.117	0.155
19	SAN FERNANDO (253)	0.280	0.399	0.254	0.344	0.291	0.406	0.235	0.339	0.191	0.279	0.208	0.308	0.119	0.217
20	SAN FERNANDO (199)	0.329	0.288	0.296	0.251	0.338	0.303	0.272	0.268	0.216	0.236	0.265	0.265	0.168	0.170

	2nd L	2nd T	3rd L	3rd T	4th L	4th T	5th L	5th T	6th L	6th T	7th L	7th T	8th L	8th T
MEAN	0.260	0.325	0.241	0.286	0.292	0.348	0.255	0.286	0.212	0.248	0.251	0.298	0.149	0.193
σ	0.051	0.082	0.047	0.061	0.052	0.059	0.039	0.047	0.033	0.037	0.050	0.031	0.031	0.036
MEAN OF MAX (L,T)	0.343		0.303		0.361		0.304		0.260		0.308		0.196	
σ OF MAX (L,T)	0.059		0.043		0.047		0.037		0.022		0.032		0.037	

TABLE B-VI Nonlinear Dynamic Analysis Results for 8-Story Isolated Structure with Isolation System Type # 8 (T = 2.0 sec, β = 30%). Excitation is Represented by Pairs of Scaled Earthquake Motions Recorded on Stiff Soil Sites (Representative of Soil Type S_1). Weight = 11520 kips, Height = 12 ft

	EXCITATION	BASE CENTER DISPL (INCH)		CORNER BEARING DISPL (INCH)		CORNER TO CENTER DISPL RATIO	BASE SHEAR / WEIGHT		1st STORY SHEAR / WEIGHT		1st STORY DRIFT / HEIGHT (%)	
		L	T	L	T		L	T	L	T	L	T
11	LOWER CALIF. (117)	3.53	1.86	3.68	2.07	1.11	0.095	0.080	0.093	0.073	0.226	0.200
12	EL CENTRO (117)	6.64	5.37	6.97	6.08	1.13	0.142	0.119	0.121	0.105	0.286	0.282
13	PARKFIELD (014)	1.24	2.34	1.30	2.74	1.17	0.076	0.088	0.054	0.087	0.136	0.238
14	SAN FERNANDO (110)	5.08	2.70	5.24	2.95	1.09	0.107	0.081	0.110	0.079	0.276	0.207
15	SAN FERNANDO (135)	3.74	9.92	4.71	12.77	1.29	0.086	0.174	0.089	0.160	0.225	0.394
16	SAN FERNANDO (208)	4.13	6.15	4.51	7.71	1.25	0.092	0.128	0.084	0.120	0.209	0.291
17	SAN FERNANDO (211)	5.05	5.60	5.41	7.12	1.27	0.105	0.123	0.094	0.116	0.224	0.287
18	SAN FERNANDO (466)	3.43	7.56	3.98	9.27	1.23	0.075	0.143	0.068	0.132	0.168	0.324
19	SAN FERNANDO (253)	4.90	8.65	5.63	11.27	1.30	0.096	0.154	0.088	0.139	0.206	0.333
20	SAN FERNANDO (199)	4.60	4.38	5.29	5.72	1.31	0.107	0.102	0.094	0.093	0.224	0.251

	L	T	L	T		L	T	L	T	L	T
MEAN	4.23	5.45	4.67	6.77	1.22	0.098	0.119	0.090	0.110	0.218	0.281
σ	1.35	2.58	1.43	3.44	0.08	0.018	0.030	0.018	0.027	0.042	0.057
MEAN OF MAX (L,T)	6.01		7.25			0.126		0.117		0.291	
σ OF MAX (L,T)	2.18		3.01			0.026		0.022		0.047	

TABLE B-VI Continued

	EXCITATION	2nd STORY SHEAR/WEIGHT		3rd STORY SHEAR/WEIGHT		4th STORY SHEAR/WEIGHT		5th STORY SHEAR/WEIGHT		6th STORY SHEAR/WEIGHT		7th STORY SHEAR/WEIGHT		8th STORY SHEAR/WEIGHT	
		L	T	L	T	L	T	L	T	L	T	L	T	L	T
11	LOWER CALIF. (117)	0.087	0.073	0.079	0.080	0.076	0.099	0.077	0.097	0.070	0.088	0.056	0.075	0.033	0.053
12	EL CENTRO (117)	0.110	0.099	0.097	0.091	0.111	0.084	0.115	0.096	0.102	0.096	0.080	0.092	0.046	0.062
13	PARKFIELD (014)	0.053	0.086	0.058	0.084	0.072	0.086	0.079	0.072	0.085	0.063	0.092	0.073	0.061	0.051
14	SAN FERNANDO (110)	0.109	0.077	0.100	0.075	0.093	0.070	0.090	0.064	0.081	0.077	0.065	0.083	0.042	0.055
15	SAN FERNANDO (135)	0.089	0.145	0.085	0.129	0.080	0.112	0.071	0.095	0.064	0.083	0.053	0.075	0.045	0.032
16	SAN FERNANDO (208)	0.087	0.112	0.087	0.103	0.086	0.092	0.076	0.086	0.063	0.077	0.051	0.057	0.033	0.037
17	SAN FERNANDO (211)	0.095	0.109	0.093	0.100	0.087	0.092	0.077	0.080	0.061	0.060	0.052	0.046	0.031	0.031
18	SAN FERNANDO (466)	0.065	0.124	0.059	0.114	0.054	0.102	0.046	0.087	0.045	0.070	0.049	0.053	0.033	0.032
19	SAN FERNANDO (253)	0.083	0.123	0.076	0.107	0.069	0.093	0.060	0.076	0.056	0.066	0.047	0.070	0.030	0.053
20	SAN FERNANDO (199)	0.099	0.086	0.106	0.084	0.104	0.086	0.088	0.089	0.077	0.082	0.074	0.062	0.047	0.042
	MEAN	0.088	0.103	0.084	0.097	0.083	0.092	0.078	0.084	0.070	0.076	0.062	0.069	0.040	0.045
	σ	0.017	0.022	0.015	0.016	0.016	0.011	0.017	0.010	0.016	0.011	0.015	0.013	0.009	0.011
	MEAN OF MAX (L,T)	0.110		0.102		0.098		0.089		0.080		0.072		0.048	
	σ OF MAX (L,T)	0.017		0.013		0.008		0.011		0.011		0.014		0.011	

TABLE B-VI Continued

	EXCITATION	2nd STORY DRIFT/HEIGHT (%)		3rd STORY DRIFT/HEIGHT (%)		4th STORY DRIFT/HEIGHT (%)		5th STORY DRIFT/HEIGHT (%)		6th STORY DRIFT/HEIGHT (%)		7th STORY DRIFT/HEIGHT (%)		8th STORY DRIFT/HEIGHT (%)	
		L	T	L	T	L	T	L	T	L	T	L	T	L	T
11	LOWER CALIF. (117)	0.212	0.183	0.196	0.192	0.244	0.349	0.247	0.344	0.227	0.303	0.275	0.384	0.163	0.280
12	EL CENTRO (117)	0.263	0.273	0.234	0.245	0.352	0.310	0.366	0.329	0.324	0.324	0.375	0.478	0.207	0.335
13	PARKFIELD (014)	0.129	0.242	0.134	0.229	0.228	0.297	0.257	0.261	0.266	0.221	0.441	0.382	0.288	0.270
14	SAN FERNANDO (110)	0.257	0.200	0.238	0.189	0.306	0.252	0.282	0.219	0.255	0.259	0.314	0.432	0.196	0.291
15	SAN FERNANDO (135)	0.210	0.377	0.197	0.322	0.251	0.378	0.229	0.347	0.205	0.299	0.254	0.399	0.152	0.243
16	SAN FERNANDO (208)	0.203	0.281	0.207	0.244	0.274	0.313	0.241	0.316	0.199	0.280	0.247	0.316	0.160	0.199
17	SAN FERNANDO (211)	0.217	0.278	0.215	0.244	0.274	0.337	0.240	0.295	0.190	0.224	0.247	0.258	0.151	0.167
18	SAN FERNANDO (466)	0.159	0.317	0.148	0.280	0.176	0.340	0.149	0.288	0.145	0.239	0.234	0.275	0.156	0.168
19	SAN FERNANDO (253)	0.194	0.311	0.181	0.262	0.222	0.309	0.203	0.270	0.180	0.230	0.226	0.356	0.135	0.269
20	SAN FERNANDO (199)	0.228	0.241	0.247	0.224	0.333	0.302	0.287	0.315	0.248	0.281	0.361	0.319	0.227	0.220
	MEAN	0.207	0.270	0.200	0.243	0.266	0.319	0.250	0.298	0.224	0.266	0.297	0.360	0.184	0.244
	σ	0.038	0.054	0.035	0.037	0.051	0.033	0.054	0.038	0.049	0.035	0.069	0.066	0.044	0.052
	MEAN OF MAX (L,T)	0.279		0.251		0.331		0.308		0.271		0.370		0.247	
	σ OF MAX (L,T)	0.045		0.031		0.024		0.033		0.031		0.068		0.053	

TABLE B-VII Nonlinear Dynamic Analysis Results for 8-Story Isolated Structure with Isolation System Type # 9 (T = 2.5 sec, β = 10%). Excitation is Represented by Pairs of Scaled Earthquake Motions Recorded on Stiff Soil Sites (Representative of Soil Type S_1). Weight = 11520 kips, Height = 12 ft

	EXCITATION	BASE CENTER DISPL (INCH)		CORNER BEARING DISPL (INCH)		CORNER TO CENTER DISPL RATIO	BASE SHEAR / WEIGHT		1st STORY SHEAR / WEIGHT		1st STORY DRIFT / HEIGHT (%)	
		L	T	L	T		L	T	L	T	L	T
11	LOWER CALIF. (117)	5.57	3.24	5.92	3.94	1.22	0.092	0.062	0.093	0.058	0.225	0.144
12	EL CENTRO (117)	11.05	9.40	11.96	12.23	1.30	0.178	0.135	0.156	0.123	0.359	0.312
13	PARKFIELD (014)	2.78	5.98	3.28	7.80	1.30	0.054	0.101	0.050	0.086	0.124	0.211
14	SAN FERNANDO (110)	5.72	3.19	5.82	3.39	1.06	0.094	0.063	0.094	0.062	0.230	0.164
15	SAN FERNANDO (135)	6.86	14.78	7.83	20.60	1.39	0.111	0.215	0.102	0.197	0.249	0.473
16	SAN FERNANDO (208)	10.88	14.18	11.61	20.37	1.44	0.173	0.204	0.157	0.184	0.372	0.439
17	SAN FERNANDO (211)	11.08	12.15	11.80	17.52	1.44	0.175	0.176	0.159	0.159	0.375	0.379
18	SAN FERNANDO (466)	16.93	22.34	18.50	29.91	1.34	0.244	0.308	0.222	0.279	0.539	0.643
19	SAN FERNANDO (253)	15.27	17.11	15.99	23.61	1.38	0.219	0.251	0.200	0.232	0.475	0.542
20	SAN FERNANDO (199)	11.97	9.94	13.29	12.94	1.30	0.189	0.148	0.169	0.133	0.405	0.316
	MEAN	9.81	11.23	10.60	15.23	1.32	0.153	0.166	0.140	0.151	0.335	0.362
	σ	4.27	5.84	4.57	8.27	0.11	0.058	0.076	0.051	0.069	0.120	0.156
	MEAN OF MAX (L,T)	12.09		15.71			0.181		0.165		0.391	
	σ OF MAX (L,T)	5.13		7.66			0.069		0.060		0.135	

TABLE B-VII Continued

	EXCITATION	2nd STORY SHEAR / WEIGHT		3rd STORY SHEAR / WEIGHT		4th STORY SHEAR / WEIGHT		5th STORY SHEAR / WEIGHT		6th STORY SHEAR / WEIGHT		7th STORY SHEAR / WEIGHT		8th STORY SHEAR / WEIGHT	
		L	T	L	T	L	T	L	T	L	T	L	T	L	T
11	LOWER CALIF. (117)	0.092	0.061	0.091	0.062	0.087	0.059	0.077	0.050	0.063	0.043	0.047	0.032	0.027	0.024
12	EL CENTRO (117)	0.135	0.109	0.124	0.097	0.113	0.087	0.097	0.075	0.076	0.060	0.052	0.055	0.027	0.036
13	PARKFIELD (014)	0.046	0.075	0.041	0.068	0.039	0.061	0.039	0.054	0.039	0.046	0.041	0.042	0.026	0.029
14	SAN FERNANDO (110)	0.091	0.060	0.087	0.058	0.083	0.054	0.075	0.043	0.062	0.033	0.047	0.038	0.027	0.025
15	SAN FERNANDO (135)	0.093	0.178	0.157	0.083	0.134	0.071	0.110	0.061	0.085	0.050	0.059	0.037	0.031	0.020
16	SAN FERNANDO (208)	0.140	0.163	0.122	0.142	0.104	0.119	0.085	0.095	0.066	0.073	0.047	0.050	0.024	0.026
17	SAN FERNANDO (211)	0.141	0.141	0.122	0.123	0.103	0.103	0.084	0.083	0.066	0.064	0.048	0.044	0.025	0.023
18	SAN FERNANDO (466)	0.198	0.249	0.173	0.218	0.147	0.186	0.119	0.152	0.091	0.116	0.062	0.079	0.031	0.040
19	SAN FERNANDO (253)	0.179	0.211	0.156	0.189	0.132	0.164	0.109	0.136	0.085	0.106	0.059	0.073	0.030	0.038
20	SAN FERNANDO (199)	0.149	0.117	0.128	0.100	0.109	0.082	0.089	0.068	0.070	0.055	0.049	0.040	0.025	0.021
	MEAN	0.126	0.136	0.120	0.114	0.105	0.099	0.088	0.082	0.070	0.065	0.051	0.049	0.027	0.028
	σ	0.043	0.061	0.037	0.052	0.029	0.043	0.022	0.035	0.014	0.026	0.006	0.015	0.002	0.007
	MEAN OF MAX (L,T)	0.148		0.133		0.116		0.097		0.076		0.055		0.030	
	σ OF MAX (L,T)	0.052		0.044		0.036		0.028		0.020		0.012		0.005	

TABLE B-VII Continued

	EXCITATION	2nd STORY DRIFT/HEIGHT (%)		3rd STORY DRIFT/HEIGHT (%)		4th STORY DRIFT/HEIGHT (%)		5th STORY DRIFT/HEIGHT (%)		6th STORY DRIFT/HEIGHT (%)		7th STORY DRIFT/HEIGHT (%)		8th STORY DRIFT/HEIGHT (%)	
		L	T	L	T	L	T	L	T	L	T	L	T	L	T
11	LOWER CALIF. (117)	0.216	0.149	0.215	0.151	0.276	0.204	0.244	0.178	0.197	0.152	0.222	0.166	0.124	0.128
12	EL CENTRO (117)	0.323	0.298	0.298	0.254	0.361	0.292	0.306	0.236	0.241	0.200	0.254	0.284	0.134	0.198
13	PARKFIELD (014)	0.115	0.195	0.103	0.169	0.122	0.205	0.126	0.182	0.125	0.158	0.194	0.220	0.123	0.150
14	SAN FERNANDO (110)	0.217	0.160	0.212	0.150	0.273	0.194	0.243	0.157	0.199	0.113	0.223	0.191	0.128	0.131
15	SAN FERNANDO (135)	0.231	0.450	0.208	0.378	0.237	0.434	0.195	0.354	0.162	0.283	0.180	0.296	0.096	0.153
16	SAN FERNANDO (208)	0.341	0.416	0.300	0.347	0.334	0.391	0.265	0.312	0.207	0.238	0.226	0.255	0.124	0.134
17	SAN FERNANDO (211)	0.344	0.359	0.302	0.300	0.333	0.339	0.263	0.269	0.208	0.212	0.232	0.224	0.129	0.117
18	SAN FERNANDO (466)	0.497	0.608	0.441	0.510	0.492	0.586	0.387	0.474	0.294	0.371	0.314	0.385	0.166	0.189
19	SAN FERNANDO (253)	0.438	0.521	0.387	0.444	0.430	0.522	0.335	0.432	0.261	0.349	0.281	0.363	0.150	0.188
20	SAN FERNANDO (199)	0.371	0.296	0.323	0.242	0.355	0.271	0.280	0.226	0.217	0.186	0.237	0.205	0.127	0.107

MEAN	0.309	0.345	0.279	0.295	0.321	0.344	0.264	0.282	0.211	0.226	0.236	0.259	0.130	0.150
σ	0.109	0.147	0.093	0.118	0.098	0.130	0.068	0.104	0.045	0.081	0.037	0.069	0.017	0.031
MEAN OF MAX (L,T)	0.368		0.320		0.374		0.310		0.247		0.272		0.153	
σ OF MAX (L,T)	0.130		0.101		0.110		0.085		0.065		0.057		0.027	

TABLE B-VIII Nonlinear Dynamic Analysis Results for 8-Story Isolated Structure with Isolation System Type # 10 (T = 2.5 sec, β = 27%). Excitation is Represented by Pairs of Scaled Earthquake Motions Recorded on Stiff Soil Sites (Representative of Soil Type S_1). Weight = 11520 kips, Height = 12 ft

	EXCITATION	BASE CENTER DISPL (INCH)		CORNER BEARING DISPL (INCH)		CORNER TO CENTER DISPL RATIO	BASE SHEAR / WEIGHT		1st STORY SHEAR / WEIGHT		1st STORY DRIFT / HEIGHT (%)	
		L	T	L	T		L	T	L	T	L	T
11	LOWER CALIF. (117)	3.92	2.84	4.16	3.34	1.18	0.073	0.061	0.070	0.056	0.172	0.156
12	EL CENTRO (117)	9.77	6.52	10.29	7.76	1.19	0.129	0.083	0.110	0.080	0.253	0.205
13	PARKFIELD (014)	1.32	3.05	1.45	3.56	1.17	0.052	0.070	0.045	0.066	0.117	0.181
14	SAN FERNANDO (110)	5.89	3.16	6.01	3.39	1.07	0.084	0.061	0.086	0.060	0.215	0.159
15	SAN FERNANDO (135)	4.89	15.77	7.58	20.23	1.55	0.081	0.179	0.077	0.163	0.191	0.408
16	SAN FERNANDO (208)	7.79	7.59	8.39	9.45	1.25	0.105	0.090	0.091	0.084	0.222	0.218
17	SAN FERNANDO (211)	9.07	6.44	9.62	7.90	1.23	0.121	0.078	0.105	0.071	0.253	0.184
18	SAN FERNANDO (466)	8.44	17.15	9.43	23.44	1.37	0.116	0.176	0.110	0.161	0.258	0.386
19	SAN FERNANDO (253)	7.67	17.76	9.96	23.15	1.30	0.091	0.193	0.079	0.175	0.197	0.425
20	SAN FERNANDO (199)	7.76	7.68	8.84	9.95	1.30	0.095	0.103	0.084	0.094	0.201	0.225
	MEAN	6.65	8.80	7.57	11.22	1.26	0.095	0.109	0.086	0.101	0.208	0.255
	σ	2.49	5.59	2.73	7.63	0.12	0.022	0.050	0.019	0.044	0.041	0.102
	MEAN OF MAX (L,T)	9.79		11.99			0.123		0.112		0.272	
	σ OF MAX (L,T)	5.07		7.15			0.043		0.038		0.092	

TABLE B-VIII Continued

	EXCITATION	2nd STORY SHEAR / WEIGHT		3rd STORY SHEAR / WEIGHT		4th STORY SHEAR / WEIGHT		5th STORY SHEAR / WEIGHT		6th STORY SHEAR / WEIGHT		7th STORY SHEAR / WEIGHT		8th STORY SHEAR / WEIGHT	
		L	T	L	T	L	T	L	T	L	T	L	T	L	T
11	LOWER CALIF. (117)	0.070	0.055	0.067	0.063	0.068	0.068	0.066	0.072	0.056	0.061	0.051	0.051	0.033	0.037
12	EL CENTRO (117)	0.099	0.070	0.094	0.073	0.089	0.073	0.080	0.084	0.065	0.082	0.053	0.076	0.031	0.050
13	PARKFIELD (014)	0.047	0.067	0.051	0.068	0.054	0.067	0.060	0.063	0.062	0.057	0.067	0.055	0.044	0.038
14	SAN FERNANDO (110)	0.085	0.059	0.077	0.058	0.073	0.053	0.075	0.044	0.070	0.051	0.061	0.059	0.037	0.041
15	SAN FERNANDO (135)	0.077	0.148	0.073	0.131	0.068	0.111	0.059	0.090	0.051	0.069	0.041	0.054	0.023	0.036
16	SAN FERNANDO (208)	0.084	0.079	0.078	0.074	0.073	0.069	0.065	0.061	0.053	0.051	0.040	0.044	0.026	0.030
17	SAN FERNANDO (211)	0.095	0.066	0.085	0.062	0.076	0.063	0.068	0.057	0.058	0.047	0.044	0.039	0.026	0.024
18	SAN FERNANDO (466)	0.103	0.145	0.095	0.127	0.084	0.109	0.071	0.091	0.054	0.072	0.037	0.051	0.024	0.027
19	SAN FERNANDO (253)	0.073	0.156	0.066	0.136	0.058	0.115	0.050	0.093	0.046	0.073	0.038	0.058	0.025	0.041
20	SAN FERNANDO (199)	0.078	0.086	0.079	0.077	0.074	0.071	0.059	0.073	0.058	0.066	0.051	0.049	0.034	0.032
	MEAN	0.081	0.093	0.077	0.087	0.072	0.080	0.065	0.073	0.057	0.063	0.048	0.054	0.030	0.036
	σ	0.015	0.038	0.013	0.030	0.010	0.021	[illegible]08	0.016	0.007	0.011	0.010	0.009	0.006	0.007
	MEAN OF MAX (L,T)	0.104		0.094		0.086		0.077		0.067		0.056		0.036	
	σ OF MAX (L,T)	0.032		0.025		0.018		0.011		0.008		0.010		0.007	

TABLE B-VIIi Continued

	EXCITATION	2nd STORY DRIFT/HEIGHT (%)		3rd STORY DRIFT/HEIGHT (%)		4th STORY DRIFT/HEIGHT (%)		5th STORY DRIFT/HEIGHT (%)		6th STORY DRIFT/HEIGHT (%)		7th STORY DRIFT/HEIGHT (%)		8th STORY DRIFT/HEIGHT (%)	
		L	T	L	T	L	T	L	T	L	T	L	T	L	T
11	LOWER CALIF. (117)	0.163	0.145	0.159	0.156	0.217	0.241	0.211	0.250	0.179	0.210	0.242	0.262	0.156	0.199
12	EL CENTRO (117)	0.237	0.186	0.225	0.191	0.285	0.248	0.253	0.287	0.206	0.283	0.250	0.398	0.144	0.269
13	PARKFIELD (014)	0.111	0.183	0.117	0.180	0.171	0.249	0.196	0.227	0.198	0.202	0.318	0.283	0.205	0.196
14	SAN FERNANDO (110)	0.200	0.156	0.188	0.148	0.243	0.191	0.241	0.161	0.225	0.172	0.286	0.308	0.167	0.218
15	SAN FERNANDO (135)	0.182	0.391	0.176	0.331	0.219	0.381	0.192	0.307	0.166	0.242	0.202	0.284	0.114	0.193
16	SAN FERNANDO (208)	0.206	0.213	0.193	0.192	0.237	0.237	0.207	0.204	0.171	0.183	0.190	0.231	0.124	0.160
17	SAN FERNANDO (211)	0.234	0.177	0.212	0.165	0.250	0.234	0.218	0.211	0.185	0.175	0.216	0.215	0.125	0.135
18	SAN FERNANDO (466)	0.243	0.368	0.226	0.313	0.267	0.367	0.219	0.305	0.168	0.248	0.175	0.267	0.114	0.142
19	SAN FERNANDO (253)	0.184	0.401	0.167	0.333	0.192	0.376	0.164	0.302	0.151	0.240	0.186	0.297	0.114	0.212
20	SAN FERNANDO (199)	0.184	0.215	0.187	0.183	0.236	0.258	0.189	0.261	0.179	0.230	0.243	0.259	0.165	0.166

	L	T	L	T	L	T	L	T	L	T	L	T	L	T
MEAN	0.194	0.244	0.185	0.219	0.232	0.278	0.209	0.252	0.183	0.219	0.231	0.280	0.143	0.189
σ	0.038	0.096	0.031	0.071	0.032	0.065	0.025	0.047	0.021	0.034	0.044	0.048	0.029	0.038
MEAN OF MAX (L,T)	0.261		0.232		0.289		0.261		0.225		0.284		0.190	
σ OF MAX (L,T)	0.085		0.064		0.058		0.036		0.029		0.049		0.038	

TABLE B-IX Nonlinear Dynamic Analysis Results for 8-Story Isolated Structure with Isolation System Type # 11 (T = 3.0 sec, β = 16%). Excitation is Represented by Pairs of Scaled Earthquake Motions Recorded on Stiff Soil Sites (Representative of Soil Type S_1). Weight = 11520 kips, Height = 12 ft

	EXCITATION	BASE CENTER DISPL (INCH)		CORNER BEARING DISPL (INCH)		CORNER TO CENTER DISPL RATIO	BASE SHEAR / WEIGHT		1st STORY SHEAR / WEIGHT		1st STORY DRIFT / HEIGHT (%)	
		L	T	L	T		L	T	L	T	L	T
11	LOWER CALIF. (117)	5.17	3.46	5.46	4.10	1.18	0.065	0.050	0.060	0.042	0.146	0.113
12	EL CENTRO (117)	13.70	8.83	14.56	10.17	1.15	0.136	0.083	0.118	0.077	0.274	0.201
13	PARKFIELD (014)	2.11	4.54	2.14	5.62	1.24	0.043	0.059	0.036	0.050	0.089	0.129
14	SAN FERNANDO (110)	6.29	3.48	6.38	3.69	1.06	0.070	0.048	0.070	0.047	0.172	0.125
15	SAN FERNANDO (135)	8.20	26.09	14.75	38.04	1.80	0.084	0.221	0.073	0.199	0.182	0.483
16	SAN FERNANDO (208)	12.28	10.30	13.80	12.82	1.24	0.124	0.096	0.109	0.088	0.255	0.216
17	SAN FERNANDO (211)	13.34	9.36	14.83	11.38	1.22	0.133	0.085	0.118	0.078	0.277	0.194
18	SAN FERNANDO (466)	12.74	29.14	17.49	41.56	1.43	0.110	0.241	0.099	0.218	0.250	0.511
19	SAN FERNANDO (253)	10.88	28.87	14.26	41.46	1.44	0.102	0.239	0.093	0.217	0.219	0.515
20	SAN FERNANDO (199)	12.02	13.21	12.98	17.08	1.29	0.113	0.120	0.101	0.108	0.242	0.258
	MEAN	9.67	13.73	11.67	18.59	1.31	0.098	0.124	0.088	0.112	0.211	0.275
	σ	3.79	9.84	4.82	14.79	0.20	0.030	0.075	0.026	0.068	0.059	0.156
	MEAN OF MAX (L,T)	15.26		19.88			0.141		0.127		0.302	
	σ OF MAX (L,T)	9.01		13.99			0.067		0.060		0.141	

TABLE B-IX Continued

	EXCITATION	2nd STORY SHEAR/WEIGHT		3rd STORY SHEAR/WEIGHT		4th STORY SHEAR/WEIGHT		5th STORY SHEAR/WEIGHT		6th STORY SHEAR/WEIGHT		7th STORY SHEAR/WEIGHT		8th STORY SHEAR/WEIGHT	
		L	T	L	T	L	T	L	T	L	T	L	T	L	T
11	LOWER CALIF. (117)	0.060	0.043	0.061	0.046	0.060	0.050	0.055	0.050	0.044	0.042	0.033	0.031	0.019	0.023
12	EL CENTRO (117)	0.100	0.071	0.089	0.065	0.082	0.062	0.073	0.063	0.058	0.060	0.044	0.053	0.024	0.032
13	PARKFIELD (014)	0.038	0.045	0.039	0.045	0.038	0.044	0.035	0.040	0.034	0.042	0.038	0.040	0.026	0.025
14	SAN FERNANDO (110)	0.067	0.046	0.063	0.045	0.061	0.041	0.056	0.032	0.048	0.030	0.041	0.035	0.024	0.024
15	SAN FERNANDO (135)	0.067	0.176	0.063	0.153	0.058	0.129	0.051	0.104	0.042	0.079	0.031	0.053	0.017	0.027
16	SAN FERNANDO (208)	0.097	0.078	0.086	0.067	0.076	0.057	0.064	0.047	0.050	0.037	0.036	0.031	0.019	0.021
17	SAN FERNANDO (211)	0.106	0.070	0.095	0.061	0.083	0.052	0.069	0.042	0.054	0.033	0.038	0.025	0.020	0.017
18	SAN FERNANDO (466)	0.088	0.195	0.077	0.170	0.065	0.144	0.053	0.117	0.040	0.089	0.028	0.060	0.016	0.030
19	SAN FERNANDO (253)	0.085	0.195	0.076	0.172	0.065	0.148	0.054	0.122	0.042	0.094	0.029	0.065	0.018	0.033
20	SAN FERNANDO (199)	0.088	0.097	0.077	0.087	0.067	0.076	0.058	0.064	0.048	0.050	0.038	0.035	0.024	0.020
	MEAN	0.080	0.102	0.073	0.091	0.066	0.080	0.057	0.068	0.046	0.056	0.036	0.043	0.021	0.025
	σ	0.020	0.059	0.016	0.050	0.012	0.041	0.010	0.032	0.007	0.0233	0.005	0.013	0.003	0.005
	MEAN OF MAX (L,T)	0.114		0.102		0.090		0.076		0.061		0.046		0.026	
	σ OF MAX (L,T)	0.053		0.044		0.035		0.027		0.018		0.011		0.004	

TABLE B-IX Continued

	EXCITATION	2nd STORY DRIFT/HEIGHT (%)		3rd STORY DRIFT/HEIGHT (%)		4th STORY DRIFT/HEIGHT (%)		5th STORY DRIFT/HEIGHT (%)		6th STORY DRIFT/HEIGHT (%)		7th STORY DRIFT/HEIGHT (%)		8th STORY DRIFT/HEIGHT (%)	
		L	T	L	T	L	T	L	T	L	T	L	T	L	T
11	LOWER CALIF. (117)	0.142	0.118	0.145	0.122	0.191	0.175	0.173	0.171	0.139	0.149	0.155	0.168	0.088	0.127
12	EL CENTRO (117)	0.244	0.193	0.215	0.169	0.264	0.213	0.231	0.212	0.184	0.204	0.214	0.270	0.119	0.171
13	PARKFIELD (014)	0.084	0.126	0.088	0.122	0.119	0.161	0.115	0.149	0.112	0.149	0.184	0.212	0.120	0.136
14	SAN FERNANDO (110)	0.161	0.124	0.157	0.117	0.202	0.148	0.180	0.118	0.164	0.107	0.194	0.180	0.111	0.129
15	SAN FERNANDO (135)	0.171	0.459	0.157	0.385	0.191	0.436	0.166	0.346	0.138	0.262	0.155	0.275	0.083	0.144
16	SAN FERNANDO (208)	0.235	0.203	0.212	0.174	0.249	0.205	0.205	0.170	0.161	0.135	0.176	0.163	0.096	0.113
17	SAN FERNANDO (211)	0.256	0.184	0.231	0.154	0.267	0.177	0.219	0.144	0.170	0.118	0.185	0.131	0.104	0.092
18	SAN FERNANDO (466)	0.231	0.487	0.204	0.409	0.227	0.467	0.178	0.375	0.133	0.290	0.146	0.300	0.078	0.151
19	SAN FERNANDO (253)	0.204	0.486	0.184	0.408	0.209	0.471	0.168	0.382	0.130	0.304	0.139	0.313	0.083	0.160
20	SAN FERNANDO (199)	0.220	0.241	0.190	0.204	0.214	0.242	0.186	0.202	0.155	0.164	0.182	0.175	0.114	0.104
	MEAN	0.195	0.262	0.178	0.226	0.213	0.270	0.182	0.227	0.149	0.188	0.173	0.219	0.100	0.133
	σ	0.052	0.146	0.040	0.117	0.041	0.126	0.031	0.096	0.021	0.069	0.022	0.062	0.015	0.024
	MEAN OF MAX (L,T)	0.284		0.249		0.295		0.246		0.202		0.228		0.135	
	σ OF MAX (L,T)	0.134		0.105		0.112		0.083		0.057		0.053		0.021	

TABLE B-X Nonlinear Dynamic Analysis Results for 8-Story Isolated Structure with Isolation System Type # 12 (T = 3.0 sec, β = 39%). Excitation is Represented by Pairs of Scaled Earthquake Motions Recorded on Stiff Soil Sites (Representative of Soil Type S_1). Weight = 11520 kips, Height = 12 ft

	EXCITATION	BASE CENTER DISPL (INCH)		CORNER BEARING DISPL (INCH)		CORNER TO CENTER DISPL RATIO	BASE SHEAR / WEIGHT		1st STORY SHEAR / WEIGHT		1st STORY DRIFT / HEIGHT (%)	
		L	T	L	T		L	T	L	T	L	T
11	LOWER CALIF. (117)	4.10	2.85	4.37	3.30	1.16	0.058	0.054	0.056	0.052	0.138	0.146
12	EL CENTRO (117)	10.67	6.35	11.10	7.20	1.13	0.081	0.059	0.073	0.063	0.177	0.173
13	PARKFIELD (014)	1.27	2.94	1.31	3.35	1.14	0.050	0.058	0.043	0.061	0.108	0.170
14	SAN FERNANDO (110)	6.46	3.44	6.57	3.73	1.08	0.061	0.049	0.064	0.046	0.163	0.128
15	SAN FERNANDO (135)	5.71	16.06	6.43	20.11	1.25	0.066	0.105	0.062	0.093	0.156	0.228
16	SAN FERNANDO (208)	8.75	6.56	9.14	7.44	1.13	0.078	0.055	0.070	0.057	0.168	0.160
17	SAN FERNANDO (211)	10.24	6.04	10.66	6.77	1.12	0.084	0.054	0.073	0.054	0.172	0.148
18	SAN FERNANDO (466)	7.58	15.98	9.11	19.46	1.22	0.070	0.104	0.070	0.094	0.167	0.237
19	SAN FERNANDO (253)	6.93	17.58	8.05	22.14	1.26	0.066	0.104	0.061	0.097	0.151	0.242
20	SAN FERNANDO (199)	5.65	8.14	6.71	10.46	1.29	0.059	0.076	0.060	0.069	0.151	0.170
	MEAN	6.74	7.68	7.35	10.40	1.18	0.067	0.072	0.063	0.069	0.155	0.180
	σ	2.68	6.31	2.81	7.01	0.07	0.010	0.022	0.009	0.018	0.019	0.039
	MEAN OF MAX (L,T)	10.09		11.74			0.081		0.075		0.187	
	σ OF MAX (L,T)	4.82		6.32			0.018		0.014		0.033	

TABLE B-X Continued

	EXCITATION	2nd STORY SHEAR / WEIGHT		3rd STORY SHEAR / WEIGHT		4th STORY SHEAR / WEIGHT		5th STORY SHEAR / WEIGHT		6th STORY SHEAR / WEIGHT		7th STORY SHEAR / WEIGHT		8th STORY SHEAR / WEIGHT	
		L	T	L	T	L	T	L	T	L	T	L	T	L	T
11	LOWER CALIF. (117)	0.059	0.053	0.063	0.062	0.066	0.069	0.065	0.070	0.054	0.058	0.047	0.054	0.030	0.039
12	EL CENTRO (117)	0.071	0.073	0.081	0.073	0.086	0.079	0.082	0.084	0.072	0.081	0.061	0.070	0.036	0.043
13	PARKFIELD (014)	0.047	0.064	0.051	0.067	0.052	0.067	0.059	0.064	0.059	0.058	0.065	0.054	0.043	0.039
14	SAN FERNANDO (110)	0.064	0.049	0.059	0.056	0.064	0.062	0.071	0.053	0.070	0.063	0.062	0.069	0.037	0.047
15	SAN FERNANDO (135)	0.062	0.083	0.061	0.074	0.058	0.066	0.060	0.066	0.054	0.063	0.040	0.053	0.024	0.037
16	SAN FERNANDO (208)	0.067	0.062	0.063	0.064	0.059	0.062	0.054	0.055	0.045	0.047	0.038	0.045	0.025	0.032
17	SAN FERNANDO (211)	0.067	0.059	0.062	0.061	0.059	0.061	0.057	0.055	0.051	0.045	0.042	0.038	0.026	0.025
18	SAN FERNANDO (466)	0.070	0.082	0.067	0.073	0.062	0.067	0.053	0.055	0.043	0.052	0.036	0.043	0.024	0.026
19	SAN FERNANDO (253)	0.060	0.088	0.057	0.079	0.054	0.070	0.049	0.060	0.045	0.055	0.038	0.055	0.025	0.040
20	SAN FERNANDO (199)	0.065	0.064	0.065	0.066	0.060	0.070	0.058	0.072	0.060	0.065	0.055	0.049	0.034	0.031

	2nd L	2nd T	3rd L	3rd T	4th L	4th T	5th L	5th T	6th L	6th T	7th L	7th T	8th L	8th T
MEAN	0.063	0.068	0.069	0.068	0.062	0.067	0.061	0.063	0.055	0.059	0.048	0.053	0.030	0.036
σ	0.007	0.013	0.007	0.007	0.009	0.005	0.009	0.009	0.010	0.010	0.011	0.010	0.006	0.007
MEAN OF MAX (L,T)	0.071		0.069		0.068		0.065		0.060		0.055		0.037	
σ OF MAX (L,T)	0.009		0.007		0.007		0.009		0.010		0.010		0.007	

TABLE B-X Continued

	EXCITATION	2nd STORY DRIFT/HEIGHT (%)		3rd STORY DRIFT/HEIGHT (%)		4th STORY DRIFT/HEIGHT (%)		5th STORY DRIFT/HEIGHT (%)		6th STORY DRIFT/HEIGHT (%)		7th STORY DRIFT/HEIGHT (%)		8th STORY DRIFT/HEIGHT (%)	
		L	T	L	T	L	T	L	T	L	T	L	T	L	T
11	LOWER CALIF. (117)	0.137	0.143	0.146	0.154	0.209	0.248	0.207	0.243	0.178	0.201	0.218	0.279	0.141	0.208
12	EL CENTRO (117)	0.162	0.184	0.188	0.183	0.274	0.270	0.263	0.287	0.228	0.279	0.285	0.368	0.168	0.228
13	PARKFIELD (014)	0.107	0.176	0.117	0.178	0.165	0.246	0.192	0.231	0.190	0.206	0.311	0.282	0.202	0.204
14	SAN FERNANDO (110)	0.151	0.129	0.140	0.138	0.205	0.227	0.228	0.188	0.223	0.215	0.289	0.361	0.168	0.253
15	SAN FERNANDO (135)	0.150	0.213	0.147	0.176	0.187	0.221	0.197	0.228	0.174	0.213	0.197	0.279	0.114	0.198
16	SAN FERNANDO (208)	0.158	0.169	0.148	0.169	0.187	0.226	0.178	0.197	0.150	0.168	0.180	0.239	0.119	0.169
17	SAN FERNANDO (211)	0.160	0.158	0.149	0.161	0.185	0.225	0.180	0.201	0.162	0.165	0.198	0.208	0.123	0.134
18	SAN FERNANDO (466)	0.162	0.220	0.158	0.181	0.194	0.233	0.165	0.193	0.137	0.177	0.170	0.224	0.112	0.143
19	SAN FERNANDO (253)	0.145	0.232	0.141	0.199	0.177	0.239	0.156	0.201	0.150	0.192	0.183	0.286	0.115	0.205
20	SAN FERNANDO (199)	0.151	0.170	0.154	0.170	0.192	0.255	0.181	0.258	0.186	0.227	0.258	0.255	0.162	0.163
	MEAN	0.148	0.179	0.149	0.171	0.198	0.239	0.195	0.223	0.178	0.204	0.229	0.278	0.142	0.191
	σ	0.016	0.032	0.017	0.016	0.028	0.015	0.030	0.031	0.029	0.032	0.049	0.050	0.029	0.036
	MEAN OF MAX (L,T)	0.182		0.172		0.239		0.227		0.205		0.281		0.191	
	σ OF MAX (L,T)	0.029		0.016		0.016		0.029		0.032		0.051		0.036	

TABLE B-XI Nonlinear Dynamic Analysis Results for 8-Story Isolated Structure with Isolation System Type # 2 (T = 1.5 sec, β = 8%). Excitation is Represented by Pairs of Scaled Earthquake Motions Recorded on Medium Soil Sites (Representative of Soil Type S_2). Weight = 11520 kips, Height = 12 ft

	EXCITATION	BASE CENTER DISPL (INCH)		CORNER BEARING DISPL (INCH)		CORNER TO CENTER DISPL RATIO	BASE SHEAR / WEIGHT		1st STORY SHEAR / WEIGHT		1st STORY DRIFT / HEIGHT (%)	
		L	T	L	T		L	T	L	T	L	T
21	WESTERN WASH. (325)	5.15	6.86	5.42	8.78	1.28	0.251	0.304	0.213	0.291	0.487	0.697
22	EUREKA (022)	4.12	4.57	4.28	5.93	1.30	0.205	0.217	0.181	0.211	0.425	0.515
23	EUREKA (023)	13.80	6.77	13.87	8.61	1.27	0.568	0.277	0.539	0.263	1.295	0.665
24	FERNDALE (023)	1.91	1.82	2.03	2.12	1.16	0.105	0.114	0.104	0.125	0.266	0.337
25	SAN FERNANDO (241)	7.73	13.35	8.68	17.47	1.31	0.344	0.540	0.316	0.516	0.737	1.222
26	SAN FERNANDO (458)	9.70	8.29	10.55	11.20	1.35	0.421	0.354	0.392	0.328	0.917	0.763
27	SAN FERNANDO (264)	7.51	7.92	8.00	10.30	1.30	0.340	0.325	0.308	0.305	0.716	0.718
28	SAN FERNANDO (267)	5.58	4.22	6.03	5.14	1.22	0.262	0.197	0.244	0.211	0.575	0.557
29	PUGET SOUND (325)	2.36	11.92	4.33	15.88	1.83	0.130	0.488	0.132	0.462	0.356	1.080
	MEAN	6.43	7.30	7.02	9.49	1.34	0.292	0.313	0.270	0.301	0.642	0.728
	σ	3.54	3.44	3.44	4.66	0.18	0.137	0.128	0.129	0.116	0.301	0.259
	MEAN OF MAX (L,T)	8.40		10.18			0.362		0.343		0.817	
	σ OF MAX (L,T)	3.87		4.74			0.145		0.135		0.312	

TABLE B-XI Continued

	EXCITATION	2nd STORY SHEAR/WEIGHT		3rd STORY SHEAR/WEIGHT		4th STORY SHEAR/WEIGHT		5th STORY SHEAR/WEIGHT		6th STORY SHEAR/WEIGHT		7th STORY SHEAR/WEIGHT		8th STORY SHEAR/WEIGHT	
		L	T	L	T	L	T	L	T	L	T	L	T	L	T
21	WESTERN WASH. (325)	0.202	0.277	0.201	0.261	0.195	0.241	0.178	0.210	0.146	0.172	0.116	0.128	0.071	0.074
22	EUREKA (022)	0.161	0.205	0.144	0.206	0.134	0.210	0.117	0.193	0.088	0.162	0.066	0.123	0.036	0.070
23	EUREKA (023)	0.502	0.243	0.456	0.216	0.402	0.184	0.339	0.149	0.268	0.112	0.189	0.075	0.098	0.039
24	FERNDALE (023)	0.116	0.135	0.123	0.146	0.127	0.151	0.127	0.143	0.117	0.120	0.095	0.082	0.054	0.069
25	SAN FERNANDO (241)	0.289	0.049	0.260	0.045	0.227	0.040	0.187	0.034	0.152	0.029	0.114	0.021	0.063	0.011
26	SAN FERNANDO (458)	0.358	0.312	0.321	0.294	0.281	0.269	0.236	0.231	0.183	0.184	0.129	0.135	0.069	0.073
27	SAN FERNANDO (264)	0.281	0.281	0.256	0.253	0.236	0.222	0.221	0.185	0.188	0.151	0.141	0.114	0.079	0.071
28	SAN FERNANDO (267)	0.226	0.204	0.203	0.179	0.182	0.153	0.168	0.145	0.141	0.152	0.106	0.125	0.059	0.063
29	PUGET SOUND (325)	0.142	0.424	0.141	0.379	0.129	0.350	0.117	0.309	0.108	0.252	0.083	0.180	0.048	0.099
	MEAN	0.253	0.237	0.234	0.220	0.213	0.202	0.188	0.178	0.155	0.148	0.115	0.109	0.064	0.063
	σ	0.114	0.101	0.100	0.089	0.084	0.082	0.067	0.071	0.051	0.057	0.034	0.042	0.017	0.023
	MEAN OF MAX (L,T)	0.300		0.276		0.253		0.223		0.183		0.137		0.076	
	σ OF MAX (L,T)	0.107		0.090		0.075		0.060		0.045		0.028		0.013	

TABLE B-XI Continued

	EXCITATION	2nd STORY DRIFT/HEIGHT (%) L	2nd STORY DRIFT/HEIGHT (%) T	3rd STORY DRIFT/HEIGHT (%) L	3rd STORY DRIFT/HEIGHT (%) T	4th STORY DRIFT/HEIGHT (%) L	4th STORY DRIFT/HEIGHT (%) T	5th STORY DRIFT/HEIGHT (%) L	5th STORY DRIFT/HEIGHT (%) T	6th STORY DRIFT/HEIGHT (%) L	6th STORY DRIFT/HEIGHT (%) T	7th STORY DRIFT/HEIGHT (%) L	7th STORY DRIFT/HEIGHT (%) T	8th STORY DRIFT/HEIGHT (%) L	8th STORY DRIFT/HEIGHT (%) T
21	WESTERN WASH. (325)	0.462	0.681	0.461	0.613	0.617	0.777	0.572	0.672	0.467	0.551	0.553	0.629	0.339	0.363
22	EUREKA (022)	0.386	0.522	0.351	0.489	0.439	0.660	0.378	0.614	0.283	0.526	0.317	0.606	0.175	0.356
23	EUREKA (023)	1.213	0.639	1.113	0.546	1.301	0.633	1.078	0.513	0.854	0.394	0.919	0.396	0.483	0.210
24	FERNDALE (023)	0.270	0.358	0.289	0.376	0.415	0.530	0.418	0.507	0.384	0.426	0.465	0.421	0.265	0.365
25	SAN FERNANDO (241)	0.687	1.199	0.626	1.057	0.721	1.280	0.585	1.124	0.487	0.946	0.555	1.036	0.293	0.563
26	SAN FERNANDO (458)	0.850	0.761	0.771	0.693	0.893	0.873	0.738	0.749	0.569	0.614	0.619	0.653	0.338	0.346
27	SAN FERNANDO (264)	0.657	0.691	0.595	0.595	0.748	0.710	0.689	0.586	0.583	0.490	0.677	0.559	0.389	0.378
28	SAN FERNANDO (267)	0.533	0.539	0.486	0.461	0.582	0.513	0.527	0.493	0.445	0.528	0.510	0.656	0.278	0.341
29	PUGET SOUND (325)	0.346	1.040	0.342	0.920	0.435	1.155	0.385	1.019	0.351	0.858	0.406	0.927	0.219	0.509

	2nd L	2nd T	3rd L	3rd T	4th L	4th T	5th L	5th T	6th L	6th T	7th L	7th T	8th L	8th T
MEAN	0.600	0.714	0.559	0.639	0.677	0.792	0.597	0.697	0.491	0.593	0.558	0.654	0.309	0.381
σ	0.277	0.246	0.244	0.208	0.262	0.252	0.208	0.216	0.167	0.178	0.163	0.198	0.087	0.096
MEAN OF MAX (L,T)	0.788		0.713		0.881		0.775		0.649		0.730		0.413	
σ OF MAX (L,T)	0.290		0.250		0.279		0.224		0.174		0.176		0.078	

TABLE B-XII Nonlinear Dynamic Analysis Results for 8-Story Isolated Structure with Isolation System Type # 3 (T = 1.5 sec, β = 17%). Excitation is Represented by Pairs of Scaled Earthquake Motions Recorded on Medium Soil Sites (Representative of Soil Type S_2). Weight = 11520 kips, Height = 12 ft

	EXCITATION	BASE CENTER DISPL (INCH)		CORNER BEARING DISPL (INCH)		CORNER TO CENTER DISPL RATIO	BASE SHEAR / WEIGHT		1st STORY SHEAR / WEIGHT		1st STORY DRIFT / HEIGHT (%)	
		L	T	L	T		L	T	L	T	L	T
21	WESTERN WASH. (325)	4.09	5.15	4.25	6.76	1.31	0.213	0.229	0.188	0.223	0.431	0.529
22	EUREKA (022)	3.43	3.83	3.56	4.49	1.17	0.187	0.179	0.156	0.175	0.360	0.439
23	EUREKA (023)	12.26	6.14	12.33	7.42	1.21	0.444	0.255	0.421	0.241	1.013	0.601
24	FERNDALE (023)	1.88	1.54	1.91	1.82	1.18	0.124	0.128	0.120	0.126	0.304	0.348
25	SAN FERNANDO (241)	7.49	9.28	8.38	11.58	1.25	0.322	0.349	0.288	0.329	0.674	0.817
26	SAN FERNANDO (458)	7.39	6.70	8.13	8.31	1.24	0.314	0.290	0.284	0.247	0.675	0.606
27	SAN FERNANDO (264)	6.45	4.81	6.78	6.15	1.28	0.289	0.202	0.278	0.180	0.672	0.442
28	SAN FERNANDO (267)	4.30	4.00	4.49	4.60	1.15	0.215	0.185	0.196	0.200	0.468	0.535
29	PUGET SOUND (325)	2.52	10.16	3.59	13.30	1.42	0.151	0.384	0.153	0.364	0.405	0.859
	MEAN	5.53	5.73	5.94	7.16	1.25	0.251	0.245	0.232	0.232	0.556	0.575
	σ	3.05	2.55	3.07	3.37	0.08	0.095	0.079	0.089	0.071	0.210	0.161
	MEAN OF MAX (L,T)	6.74		7.78			0.282		0.267		0.654	
	σ OF MAX (L,T)	3.16		3.70			0.096		0.090		0.202	

TABLE B-XII Continued

	EXCITATION	2nd STORY SHEAR / WEIGHT		3rd STORY SHEAR / WEIGHT		4th STORY SHEAR / WEIGHT		5th STORY SHEAR / WEIGHT		6th STORY SHEAR / WEIGHT		7th STORY SHEAR / WEIGHT		8th STORY SHEAR / WEIGHT	
		L	T	L	T	L	T	L	T	L	T	L	T	L	T
21	WESTERN WASH. (325)	0.171	0.218	0.191	0.211	0.203	0.200	0.174	0.178	0.136	0.148	0.115	0.111	0.062	0.080
22	EUREKA (022)	0.134	0.172	0.115	0.175	0.107	0.167	0.094	0.156	0.087	0.131	0.075	0.095	0.047	0.057
23	EUREKA (023)	0.393	0.222	0.358	0.198	0.319	0.172	0.273	0.145	0.218	0.117	0.154	0.082	0.080	0.041
24	FERNDALE (023)	0.137	0.136	0.146	0.144	0.151	0.158	0.151	0.155	0.144	0.130	0.122	0.098	0.072	0.090
25	SAN FERNANDO (241)	0.262	0.298	0.237	0.263	0.208	0.239	0.172	0.216	0.131	0.185	0.091	0.142	0.049	0.078
26	SAN FERNANDO (458)	0.259	0.222	0.233	0.206	0.212	0.189	0.186	0.169	0.150	0.143	0.114	0.109	0.065	0.061
27	SAN FERNANDO (264)	0.266	0.166	0.244	0.150	0.218	0.127	0.210	0.115	0.179	0.097	0.137	0.111	0.083	0.086
28	SAN FERNANDO (267)	0.188	0.194	0.175	0.167	0.158	0.127	0.137	0.133	0.114	0.143	0.088	0.117	0.061	0.077
29	PUGET SOUND (325)	0.135	0.336	0.132	0.298	0.127	0.261	0.124	0.233	0.110	0.191	0.087	0.133	0.053	0.105
	MEAN	0.216	0.218	0.203	0.201	0.189	0.182	0.169	0.167	0.141	0.143	0.109	0.111	0.064	0.075
	σ	0.082	0.060	0.070	0.048	0.059	0.043	0.049	0.036	0.037	0.029	0.025	0.017	0.012	0.018
	MEAN OF MAX (L,T)	0.253		0.234		0.215		0.194		0.165		0.125		0.080	
	σ OF MAX (L,T)	0.077		0.063		0.050		0.041		0.027		0.017		0.013	

TABLE B-XII Continued

	EXCITATION	2nd STORY DRIFT/HEIGHT (%)		3rd STORY DRIFT/HEIGHT (%)		4th STORY DRIFT/HEIGHT (%)		5th STORY DRIFT/HEIGHT (%)		6th STORY DRIFT/HEIGHT (%)		7th STORY DRIFT/HEIGHT (%)		8th STORY DRIFT/HEIGHT (%)	
		L	T	L	T	L	T	L	T	L	T	L	T	L	T
21	WESTERN WASH. (325)	0.396	0.526	0.439	0.491	0.639	0.647	0.558	0.574	0.439	0.482	0.549	0.551	0.376	0.313
22	EUREKA (022)	0.320	0.442	0.272	0.436	0.341	0.562	0.302	0.498	0.290	0.429	0.359	0.471	0.223	0.303
23	EUREKA (023)	0.947	0.572	0.873	0.485	1.034	0.564	0.873	0.464	0.697	0.374	0.746	0.399	0.390	0.205
24	FERNDALE (023)	0.309	0.357	0.338	0.368	0.484	0.540	0.492	0.543	0.469	0.463	0.595	0.500	0.355	0.481
25	SAN FERNANDO (241)	0.626	0.771	0.572	0.646	0.660	0.780	0.533	0.697	0.411	0.616	0.446	0.706	0.248	0.402
26	SAN FERNANDO (458)	0.622	0.541	0.563	0.469	0.686	0.601	0.596	0.526	0.485	0.449	0.558	0.521	0.316	0.291
27	SAN FERNANDO (264)	0.627	0.427	0.575	0.370	0.684	0.426	0.650	0.363	0.549	0.332	0.656	0.581	0.402	0.460
28	SAN FERNANDO (267)	0.433	0.514	0.407	0.433	0.505	0.455	0.430	0.455	0.364	0.502	0.425	0.622	0.291	0.419
29	PUGET SOUND (325)	0.353	0.821	0.295	0.706	0.409	0.878	0.419	0.781	0.369	0.663	0.431	0.692	0.261	0.556
	MEAN	0.515	0.552	0.482	0.489	0.605	0.606	0.539	0.545	0.453	0.479	0.529	0.560	0.318	0.381
	σ	0.197	0.145	0.177	0.109	0.193	0.137	0.154	0.120	0.112	0.100	0.118	0.095	0.062	0.105
	MEAN OF MAX (L,T)	0.625		0.566		0.702		0.630		0.544		0.622		0.411	
	σ OF MAX (L,T)	0.180		0.149		0.162		0.128		0.089		0.082		0.075	

TABLE B-XIII Nonlinear Dynamic Analysis Results for 8-Story Isolated Structure with Isolation System Type # 4 (T = 1.5 sec, β = 37%). Excitation is Represented by Pairs of Scaled Earthquake Motions Recorded on Medium Soil Sites (Representative of Soil Type S_2). Weight = 11520 kips, Height = 12 ft

	EXCITATION	BASE CENTER DISPL (INCH)		CORNER BEARING DISPL (INCH)		CORNER TO CENTER DISPL RATIO	BASE SHEAR / WEIGHT		1st STORY SHEAR / WEIGHT		1st STORY DRIFT / HEIGHT (%)	
		L	T	L	T		L	T	L	T	L	T
21	WESTERN WASH. (325)	2.43	4.34	2.59	5.14	1.18	0.175	0.197	0.169	0.178	0.450	0.482
22	EUREKA (022)	4.39	3.38	4.58	3.96	1.17	0.181	0.172	0.157	0.171	0.389	0.463
23	EUREKA (023)	10.77	5.10	10.91	5.35	1.05	0.250	0.215	0.215	0.187	0.523	0.504
24	FERNDALE (023)	1.98	1.03	2.01	1.11	1.08	0.164	0.136	0.155	0.129	0.381	0.359
25	SAN FERNANDO (241)	3.91	5.62	4.07	6.74	1.20	0.195	0.216	0.171	0.190	0.417	0.506
26	SAN FERNANDO (458)	6.75	6.52	7.17	8.07	1.24	0.245	0.234	0.205	0.196	0.482	0.492
27	SAN FERNANDO (264)	6.54	2.38	6.56	2.96	1.24	0.236	0.152	0.239	0.149	0.583	0.417
28	SAN FERNANDO (267)	4.50	3.84	4.82	4.46	1.16	0.201	0.167	0.195	0.174	0.470	0.490
29	PUGET SOUND (325)	2.99	5.78	3.30	7.13	1.23	0.160	0.223	0.160	0.232	0.378	0.619
	MEAN	4.92	4.22	5.11	4.99	1.17	0.201	0.190	0.185	0.178	0.453	0.481
	σ	2.59	1.66	2.60	2.05	0.06	0.033	0.033	0.028	0.027	0.066	0.066
	MEAN OF MAX (L,T)	5.63		6.22			0.213		0.198		0.504	
	σ OF MAX (L,T)	2.27		2.36			0.028		0.026		0.065	

TABLE B-XIII Continued

	EXCITATION	2nd STORY SHEAR / WEIGHT		3rd STORY SHEAR / WEIGHT		4th STORY SHEAR / WEIGHT		5th STORY SHEAR / WEIGHT		6th STORY SHEAR / WEIGHT		7th STORY SHEAR / WEIGHT		8th STORY SHEAR / WEIGHT	
		L	T	L	T	L	T	L	T	L	T	L	T	L	T
21	WESTERN WASH. (325)	0.201	0.166	0.220	0.163	0.217	0.154	0.182	0.137	0.155	0.131	0.142	0.118	0.096	0.096
22	EUREKA (022)	0.164	0.157	0.160	0.160	0.157	0.154	0.148	0.143	0.131	0.129	0.111	0.106	0.066	0.082
23	EUREKA (023)	0.203	0.160	0.190	0.140	0.174	0.139	0.154	0.134	0.125	0.119	0.096	0.093	0.054	0.055
24	FERNDALE (023)	0.172	0.139	0.184	0.131	0.188	0.156	0.185	0.163	0.177	0.137	0.150	0.111	0.088	0.109
25	SAN FERNANDO (241)	0.160	0.171	0.145	0.154	0.146	0.155	0.136	0.152	0.114	0.134	0.095	0.121	0.061	0.082
26	SAN FERNANDO (458)	0.180	0.164	0.162	0.159	0.153	0.149	0.145	0.136	0.126	0.123	0.104	0.099	0.060	0.060
27	SAN FERNANDO (264)	0.224	0.148	0.199	0.146	0.185	0.148	0.193	0.124	0.185	0.118	0.156	0.137	0.094	0.113
28	SAN FERNANDO (267)	0.181	0.173	0.163	0.144	0.155	0.137	0.144	0.125	0.121	0.127	0.108	0.137	0.077	0.100
29	PUGET SOUND (325)	0.152	0.227	0.152	0.214	0.160	0.198	0.164	0.183	0.142	0.171	0.106	0.164	0.059	0.127

	2nd L	2nd T	3rd L	3rd T	4th L	4th T	5th L	5th T	6th L	6th T	7th L	7th T	8th L	8th T
MEAN	0.182	0.167	0.175	0.157	0.171	0.154	0.161	0.144	0.142	0.132	0.119	0.121	0.073	0.092
σ	0.022	0.023	0.023	0.023	0.021	0.017	0.020	0.018	0.024	0.015	0.022	0.021	0.015	0.023
MEAN OF MAX (L,T)	0.191		0.183		0.176		0.165		0.148		0.131		0.092	
σ OF MAX (L,T)	0.022		0.023		0.022		0.019		0.023		0.023		0.023	

TABLE B-XIII Continued

	EXCITATION	2nd STORY DRIFT/HEIGHT (%)		3rd STORY DRIFT/HEIGHT (%)		4th STORY DRIFT/HEIGHT (%)		5th STORY DRIFT/HEIGHT (%)		6th STORY DRIFT/HEIGHT (%)		7th STORY DRIFT/HEIGHT (%)		8th STORY DRIFT/HEIGHT (%)	
		L	T	L	T	L	T	L	T	L	T	L	T	L	T
21	WESTERN WASH. (325)	0.465	0.465	0.503	0.434	0.679	0.569	0.578	0.502	0.508	0.434	0.665	0.611	0.441	0.514
22	EUREKA (022)	0.375	0.426	0.374	0.404	0.492	0.526	0.469	0.469	0.420	0.426	0.534	0.559	0.324	0.441
23	EUREKA (023)	0.492	0.461	0.459	0.364	0.557	0.470	0.480	0.450	0.390	0.408	0.460	0.463	0.262	0.276
24	FERNDALE (023)	0.387	0.360	0.420	0.351	0.587	0.533	0.594	0.562	0.570	0.480	0.727	0.555	0.437	0.575
25	SAN FERNANDO (241)	0.381	0.477	0.352	0.399	0.462	0.571	0.437	0.562	0.367	0.497	0.453	0.632	0.292	0.440
26	SAN FERNANDO (458)	0.437	0.443	0.391	0.412	0.509	0.528	0.480	0.476	0.405	0.441	0.481	0.541	0.274	0.332
27	SAN FERNANDO (264)	0.532	0.390	0.477	0.374	0.590	0.518	0.609	0.460	0.582	0.400	0.739	0.724	0.455	0.617
28	SAN FERNANDO (267)	0.433	0.453	0.394	0.386	0.503	0.503	0.459	0.453	0.387	0.454	0.521	0.726	0.378	0.535
29	PUGET SOUND (325)	0.346	0.603	0.355	0.572	0.510	0.721	0.515	0.649	0.451	0.579	0.520	0.870	0.283	0.680
	MEAN	0.428	0.453	0.414	0.411	0.543	0.549	0.513	0.509	0.453	0.458	0.567	0.631	0.350	0.490
	σ	0.058	0.064	0.051	0.062	0.063	0.068	0.060	0.064	0.076	0.052	0.106	0.117	0.074	0.124
	MEAN OF MAX (L,T)	0.475		0.449		0.585		0.542		0.496		0.658		0.490	
	σ OF MAX (L,T)	0.059		0.056		0.068		0.067		0.064		0.117		0.124	

TABLE B-XIV Nonlinear Dynamic Analysis Results for 8-Story Isolated Structure with Isolation System Type # 5 (T = 2.0 sec, β = 9%). Excitation is Represented by Pairs of Scaled Earthquake Motions Recorded on Medium Soil Sites (Representative of Soil Type S_2). Weight = 11520 kips, Height = 12 ft

	EXCITATION	BASE CENTER DISPL (INCH)		CORNER BEARING DISPL (INCH)		CORNER TO CENTER DISPL RATIO	BASE SHEAR / WEIGHT		1st STORY SHEAR / WEIGHT		1st STORY DRIFT / HEIGHT (%)	
		L	T	L	T		L	T	L	T	L	T
21	WESTERN WASH. (325)	9.26	12.09	10.31	16.11	1.33	0.242	0.283	0.235	0.259	0.569	0.597
22	EUREKA (022)	5.89	8.29	6.78	10.74	1.30	0.141	0.192	0.124	0.171	0.291	0.413
23	EUREKA (023)	15.32	6.15	15.53	6.71	1.09	0.367	0.161	0.339	0.148	0.816	0.404
24	FERNDALE (023)	2.11	2.01	2.16	2.11	1.05	0.070	0.081	0.072	0.084	0.187	0.242
25	SAN FERNANDO (241)	21.37	16.25	25.02	24.18	1.49	0.483	0.366	0.439	0.337	1.032	0.804
26	SAN FERNANDO (458)	18.75	15.20	19.30	20.11	1.32	0.446	0.355	0.406	0.324	0.947	0.776
27	SAN FERNANDO (264)	10.12	6.87	10.95	8.14	1.18	0.250	0.183	0.242	0.178	0.575	0.450
28	SAN FERNANDO (267)	7.11	5.67	7.44	6.86	1.21	0.194	0.132	0.172	0.132	0.405	0.373
29	PUGET SOUND (325)	2.35	11.10	4.29	13.86	1.83	0.083	0.263	0.089	0.241	0.231	0.620
	MEAN	10.25	9.29	11.31	12.09	1.31	0.233	0.224	0.235	0.208	0.561	0.520
	σ	6.50	4.44	6.99	6.69	0.22	0.160	0.093	0.127	0.082	0.295	0.180
	MEAN OF MAX (L,T)	11.81		13.55			0.284		0.261		0.627	
	σ OF MAX (L,T)	5.62		6.38			0.121		0.109		0.247	

TABLE B-XIV Continued

	EXCITATION	2nd STORY SHEAR / WEIGHT		3rd STORY SHEAR / WEIGHT		4th STORY SHEAR / WEIGHT		5th STORY SHEAR / WEIGHT		6th STORY SHEAR / WEIGHT		7th STORY SHEAR / WEIGHT		8th STORY SHEAR / WEIGHT	
		L	T	L	T	L	T	L	T	L	T	L	T	L	T
21	WESTERN WASH. (325)	0.224	0.233	0.207	0.207	0.189	0.178	0.166	0.153	0.133	0.130	0.105	0.100	0.060	0.055
22	EUREKA (022)	0.118	0.151	0.112	0.137	0.106	0.119	0.095	0.098	0.075	0.087	0.058	0.068	0.035	0.038
23	EUREKA (023)	0.309	0.134	0.278	0.123	0.244	0.110	0.203	0.095	0.157	0.078	0.107	0.060	0.054	0.034
24	FERNDALE (023)	0.081	0.095	0.085	0.101	0.085	0.102	0.084	0.095	0.078	0.080	0.064	0.053	0.037	0.045
25	SAN FERNANDO (241)	0.393	0.303	0.343	0.266	0.291	0.225	0.237	0.182	0.182	0.137	0.125	0.092	0.064	0.048
26	SAN FERNANDO (458)	0.363	0.290	0.317	0.253	0.269	0.213	0.218	0.171	0.165	0.131	0.112	0.093	0.059	0.049
27	SAN FERNANDO (264)	0.230	0.170	0.214	0.157	0.191	0.140	0.156	0.118	0.115	0.096	0.084	0.071	0.047	0.046
28	SAN FERNANDO (267)	0.158	0.136	0.151	0.126	0.144	0.103	0.130	0.085	0.108	0.092	0.080	0.078	0.042	0.048
29	PUGET SOUND (325)	0.086	0.208	0.075	0.180	0.076	0.157	0.083	0.134	0.078	0.115	0.066	0.090	0.041	0.057
	MEAN	0.218	0.191	0.198	0.172	0.177	0.150	0.152	0.126	0.121	0.105	0.089	0.078	0.049	0.047
	σ	0.111	0.068	0.094	0.055	0.075	0.044	0.055	0.034	0.038	0.022	0.023	0.015	0.010	0.007
	MEAN OF MAX (L,T)	0.238		0.214		0.190		0.160		0.127		0.093		0.052	
	σ OF MAX (L,T)	0.094		0.078		0.063		0.048		0.033		0.020		0.008	

TABLE B-XIV Continued

	EXCITATION	2nd STORY DRIFT/HEIGHT (%)		3rd STORY DRIFT/HEIGHT (%)		4th STORY DRIFT/HEIGHT (%)		5th STORY DRIFT/HEIGHT (%)		6th STORY DRIFT/HEIGHT (%)		7th STORY DRIFT/HEIGHT (%)		8th STORY DRIFT/HEIGHT (%)	
		L	T	L	T	L	T	L	T	L	T	L	T	L	T
21	WESTERN WASH. (325)	0.533	0.572	0.500	0.485	0.620	0.568	0.542	0.507	0.432	0.443	0.511	0.514	0.289	0.280
22	EUREKA (022)	0.275	0.400	0.264	0.363	0.339	0.428	0.300	0.321	0.238	0.278	0.279	0.328	0.175	0.200
23	EUREKA (023)	0.760	0.378	0.691	0.323	0.796	0.387	0.644	0.326	0.497	0.264	0.523	0.293	0.275	0.168
24	FERNDALE (023)	0.188	0.259	0.200	0.271	0.281	0.370	0.279	0.342	0.256	0.283	0.313	0.278	0.182	0.238
25	SAN FERNANDO (241)	0.953	0.768	0.846	0.649	0.941	0.744	0.736	0.594	0.558	0.445	0.605	0.475	0.322	0.250
26	SAN FERNANDO (458)	0.872	0.733	0.773	0.610	0.858	0.692	0.671	0.555	0.510	0.444	0.539	0.474	0.289	0.248
27	SAN FERNANDO (264)	0.547	0.439	0.514	0.391	0.607	0.479	0.489	0.396	0.356	0.321	0.396	0.361	0.232	0.247
28	SAN FERNANDO (267)	0.378	0.374	0.360	0.340	0.453	0.386	0.404	0.297	0.338	0.326	0.379	0.416	0.203	0.239
29	PUGET SOUND (325)	0.213	0.577	0.190	0.469	0.263	0.579	0.292	0.480	0.268	0.402	0.311	0.439	0.183	0.298

	2nd L	2nd T	3rd L	3rd T	4th L	4th T	5th L	5th T	6th L	6th T	7th L	7th T	8th L	8th T
MEAN	0.524	0.500	0.482	0.433	0.573	0.515	0.484	0.424	0.384	0.356	0.428	0.398	0.239	0.241
σ	0.270	0.163	0.233	0.123	0.240	0.131	0.166	0.105	0.113	0.073	0.112	0.081	0.053	0.036
MEAN OF MAX (L,T)	0.591		0.532		0.628		0.514		0.407		0.453		0.266	
σ OF MAX (L,T)	0.219		0.187		0.188		0.138		0.096		0.094		0.036	

TABLE B-XV Nonlinear Dynamic Analysis Results for 8-Story Isolated Structure with Isolation System Type # 6 (T = 2.0 sec, β = 17%). Excitation is Represented by Pairs of Scaled Earthquake Motions Recorded on Medium Soil Sites (Representative of Soil Type S_2). Weight = 11520 kips, Height = 12 ft

	EXCITATION	BASE CENTER DISPL (INCH)		CORNER BEARING DISPL (INCH)		CORNER TO CENTER DISPL RATIO	BASE SHEAR / WEIGHT		1st STORY SHEAR / WEIGHT		1st STORY DRIFT / HEIGHT (%)	
		L	T	L	T		L	T	L	T	L	T
21	WESTERN WASH. (325)	5.81	9.56	5.79	12.85	1.34	0.163	0.214	0.186	0.198	0.465	0.486
22	EUREKA (022)	5.11	6.61	5.72	8.51	1.29	0.126	0.153	0.112	0.141	0.261	0.356
23	EUREKA (023)	13.37	5.58	13.56	6.28	1.13	0.292	0.154	0.273	0.136	0.654	0.359
24	FERNDALE (023)	1.87	1.90	1.92	2.10	1.11	0.075	0.093	0.076	0.103	0.201	0.284
25	SAN FERNANDO (241)	19.22	11.28	21.42	15.67	1.39	0.383	0.244	0.348	0.226	0.807	0.543
26	SAN FERNANDO (458)	12.84	10.41	13.22	13.47	1.29	0.291	0.244	0.265	0.212	0.621	0.515
27	SAN FERNANDO (264)	7.83	6.26	8.41	7.69	1.23	0.193	0.149	0.191	0.135	0.458	0.322
28	SAN FERNANDO (267)	4.79	5.00	5.10	5.89	1.18	0.139	0.131	0.129	0.129	0.313	0.367
29	PUGET SOUND (325)	2.80	9.55	3.04	11.90	1.25	0.092	0.210	0.099	0.198	0.250	0.508
	MEAN	8.18	7.35	8.69	9.37	1.25	0.195	0.177	0.187	0.164	0.448	0.416
	σ	5.44	2.88	5.91	4.12	0.09	0.099	0.050	0.087	0.042	0.199	0.091
	MEAN OF MAX (L,T)	9.54		10.90			0.219		0.205		0.505	
	σ OF MAX (L,T)	4.83		5.20			0.085		0.074		0.156	

TABLE B-XV Continued

	EXCITATION	2nd STORY SHEAR / WEIGHT		3rd STORY SHEAR / WEIGHT		4th STORY SHEAR / WEIGHT		5th STORY SHEAR / WEIGHT		6th STORY SHEAR / WEIGHT		7th STORY SHEAR / WEIGHT		8th STORY SHEAR / WEIGHT	
		L	T	L	T	L	T	L	T	L	T	L	T	L	T
21	WESTERN WASH. (325)	0.188	0.186	0.172	0.169	0.146	0.148	0.122	0.128	0.097	0.114	0.069	0.091	0.041	0.052
22	EUREKA (022)	0.110	0.137	0.110	0.124	0.104	0.111	0.092	0.082	0.083	0.074	0.073	0.072	0.045	0.055
23	EUREKA (023)	0.251	0.119	0.227	0.113	0.201	0.108	0.168	0.096	0.130	0.081	0.089	0.065	0.045	0.038
24	FERNDALE (023)	0.089	0.111	0.096	0.119	0.100	0.120	0.099	0.113	0.094	0.096	0.081	0.070	0.048	0.063
25	SAN FERNANDO (241)	0.309	0.205	0.267	0.181	0.224	0.156	0.181	0.129	0.141	0.101	0.100	0.083	0.053	0.055
26	SAN FERNANDO (458)	0.237	0.183	0.208	0.158	0.176	0.139	0.144	0.119	0.110	0.095	0.079	0.065	0.044	0.035
27	SAN FERNANDO (264)	0.182	0.133	0.168	0.127	0.148	0.118	0.132	0.101	0.100	0.081	0.073	0.074	0.047	0.058
28	SAN FERNANDO (267)	0.120	0.135	0.121	0.125	0.117	0.107	0.105	0.094	0.088	0.098	0.071	0.085	0.041	0.055
29	PUGET SOUND (325)	0.100	0.173	0.105	0.160	0.099	0.149	0.094	0.127	0.091	0.105	0.076	0.087	0.044	0.076
	MEAN	0.176	0.154	0.164	0.142	0.130	0.128	0.126	0.110	0.104	0.094	0.079	0.077	0.045	0.054
	σ	0.073	0.032	0.057	0.024	0.063	0.018	0.031	0.016	0.019	0.012	0.009	0.009	0.004	0.012
	MEAN OF MAX (L,T)	0.191		0.174		0.155		0.132		0.0109		0.084		0.056	
	σ OF MAX (L,T)	0.060		0.048		0.037		0.027		0.017		0.008		0.009	

TABLE B-XV Continued

	EXCITATION	2nd STORY DRIFT/HEIGHT (%)		3rd STORY DRIFT/HEIGHT (%)		4th STORY DRIFT/HEIGHT (%)		5th STORY DRIFT/HEIGHT (%)		6th STORY DRIFT/HEIGHT (%)		7th STORY DRIFT/HEIGHT (%)		8th STORY DRIFT/HEIGHT (%)	
		L	T	L	T	L	T	L	T	L	T	L	T	L	T
21	WESTERN WASH. (325)	0.437	0.475	0.401	0.418	0.471	0.500	0.395	0.422	0.310	0.382	0.353	0.471	0.213	0.267
22	EUREKA (022)	0.245	0.345	0.250	0.332	0.327	0.406	0.292	0.300	0.263	0.266	0.353	0.376	0.222	0.285
23	EUREKA (023)	0.612	0.328	0.562	0.293	0.654	0.376	0.535	0.329	0.416	0.272	0.438	0.317	0.230	0.192
24	FERNDALE (023)	0.205	0.302	0.223	0.318	0.317	0.436	0.321	0.410	0.308	0.342	0.396	0.360	0.238	0.334
25	SAN FERNANDO (241)	0.739	0.519	0.648	0.439	0.711	0.511	0.551	0.422	0.429	0.338	0.477	0.456	0.263	0.301
26	SAN FERNANDO (458)	0.572	0.474	0.507	0.391	0.562	0.466	0.440	0.385	0.347	0.307	0.380	0.326	0.210	0.182
27	SAN FERNANDO (264)	0.432	0.318	0.403	0.294	0.475	0.377	0.409	0.325	0.311	0.267	0.351	0.391	0.230	0.313
28	SAN FERNANDO (267)	0.283	0.371	0.279	0.339	0.367	0.385	0.332	0.327	0.280	0.350	0.355	0.453	0.211	0.285
29	PUGET SOUND (325)	0.225	0.461	0.232	0.440	0.316	0.555	0.325	0.473	0.308	0.378	0.371	0.451	0.207	0.403

	L	T	L	T	L	T	L	T	L	T	L	T	L	T
MEAN	0.417	0.399	0.389	0.363	0.467	0.446	0.400	0.377	0.330	0.322	0.386	0.400	0.225	0.285
σ	0.181	0.078	0.147	0.057	0.141	0.062	0.089	0.056	0.054	0.044	0.042	0.056	0.017	0.064
MEAN OF MAX (L,T)	0.479		0.441		0.520		0.430		0.358		0.426		0.292	
σ OF MAX (L,T)	0.132		0.106		0.104		0.078		0.048		0.038		0.054	

TABLE B-XVI Nonlinear Dynamic Analysis Results for 8-Story Isolated Structure with Isolation System Type # 7 (T = 2.0 sec, β = 31%). Excitation is Represented by Pairs of Scaled Earthquake Motions Recorded on Medium Soil Sites (Representative of Soil Type S_2). Weight = 11520 kips, Height = 12 ft

	EXCITATION	BASE CENTER DISPL (INCH)		CORNER BEARING DISPL (INCH)		CORNER TO CENTER DISPL RATIO	BASE SHEAR / WEIGHT		1st STORY SHEAR / WEIGHT		1st STORY DRIFT / HEIGHT (%)	
		L	T	L	T		L	T	L	T	L	T
21	WESTERN WASH. (325)	4.66	5.41	4.77	6.99	1.29	0.132	0.154	0.146	0.144	0.387	0.357
22	EUREKA (022)	5.02	4.97	5.10	5.97	1.20	0.120	0.139	0.121	0.127	0.297	0.351
23	EUREKA (023)	13.23	4.99	13.41	5.24	1.05	0.211	0.148	0.191	0.126	0.459	0.327
24	FERNDALE (023)	1.89	1.70	2.03	1.96	1.15	0.098	0.102	0.106	0.112	0.251	0.323
25	SAN FERNANDO (241)	11.47	9.56	12.33	11.53	1.21	0.197	0.175	0.177	0.163	0.421	0.411
26	SAN FERNANDO (458)	6.55	8.95	6.68	11.97	1.34	0.170	0.196	0.143	0.177	0.341	0.419
27	SAN FERNANDO (264)	6.77	5.04	7.08	6.27	1.24	0.175	0.128	0.176	0.122	0.431	0.303
28	SAN FERNANDO (267)	5.16	4.96	5.50	5.63	1.14	0.144	0.129	0.135	0.133	0.325	0.383
29	PUGET SOUND (325)	3.36	6.86	3.58	8.66	1.26	0.115	0.168	0.117	0.163	0.286	0.464
	MEAN	6.46	5.83	6.72	7.14	1.21	0.151	0.149	0.146	0141.	0.355	0.371
	σ	3.47	2.23	3.59	2.98	0.08	0.037	0.027	0.028	0.021	0.068	0.050
	MEAN OF MAX (L,T)	7.20		8.23			0.165		0.156		0.404	
	σ OF MAX (L,T)	3.30		3.51			0.032		0.026		0.045	

TABLE B-XVI Continued

	EXCITATION	2nd STORY SHEAR / WEIGHT		3rd STORY SHEAR / WEIGHT		4th STORY SHEAR / WEIGHT		5th STORY SHEAR / WEIGHT		6th STORY SHEAR / WEIGHT		7th STORY SHEAR / WEIGHT		8th STORY SHEAR / WEIGHT	
		L	T	L	T	L	T	L	T	L	T	L	T	L	T
21	WESTERN WASH. (325)	0.167	0.139	0.175	0.126	0.170	0.118	0.144	0.118	0.111	0.122	0.108	0.110	0.073	0.067
22	EUREKA (022)	0.132	0.124	0.133	0.126	0.124	0.122	0.112	0.099	0.103	0.096	0.087	0.095	0.051	0.070
23	EUREKA (023)	0.172	0.110	0.160	0.101	0.145	0.101	0.124	0.095	0.097	0.087	0.075	0.070	0.045	0.043
24	FERNDALE (023)	0.114	0.123	0.127	0.131	0.137	0.140	0.138	0.136	0.132	0.116	0.116	0.093	0.069	0.088
25	SAN FERNANDO (241)	0.163	0.152	0.151	0.139	0.137	0.128	0.119	0.120	0.099	0.114	0.075	0.096	0.043	0.065
26	SAN FERNANDO (458)	0.132	0.170	0.124	0.159	0.121	0.146	0.112	0.128	0.095	0.107	0.073	0.080	0.044	0.053
27	SAN FERNANDO (264)	0.171	0.117	0.156	0.118	0.164	0.113	0.164	0.107	0.144	0.102	0.113	0.097	0.072	0.078
28	SAN FERNANDO (267)	0.121	0.134	0.115	0.124	0.111	0.118	0.105	0.096	0.093	0.101	0.080	0.098	0.048	0.077
29	PUGET SOUND (325)	0.121	0.156	0.123	0.160	0.117	0.151	0.117	0.140	0.116	0.121	0.097	0.122	0.055	0.104

	2nd L	2nd T	3rd L	3rd T	4th L	4th T	5th L	5th T	6th L	6th T	7th L	7th T	8th L	8th T
MEAN	0.144	0.136	0.140	0.132	0.136	0.126	0.126	0.115	0.110	0.107	0.092	0.096	0.055	0.072
σ	0.023	0.019	0.019	0.018	0.019	0.015	0.018	0.016	0.017	0.011	0.016	0.014	0.012	0.017
MEAN OF MAX (L,T)	0.154		0.150		0.144		0.131		0.116		0.101		0.073	
σ OF MAX (L,T)	0.018		0.016		0.016		0.017		0.015		0.015		0.017	

TABLE B-XVI Continued

	EXCITATION	2nd STORY DRIFT/HEIGHT (%)		3rd STORY DRIFT/HEIGHT (%)		4th STORY DRIFT/HEIGHT (%)		5th STORY DRIFT/HEIGHT (%)		6th STORY DRIFT/HEIGHT (%)		7th STORY DRIFT/HEIGHT (%)		8th STORY DRIFT/HEIGHT (%)	
		L	T	L	T	L	T	L	T	L	T	L	T	L	T
21	WESTERN WASH. (325)	0.386	0.350	0.400	0.309	0.530	0.419	0.453	0.393	0.349	0.416	0.504	0.572	0.344	0.346
22	EUREKA (022)	0.294	0.342	0.298	0.340	0.387	0.447	0.354	0.365	0.329	0.325	0.423	0.501	0.256	0.375
23	EUREKA (023)	0.423	0.292	0.392	0.251	0.471	0.342	0.398	0.329	0.314	0.310	0.356	0.369	0.214	0.219
24	FERNDALE (023)	0.259	0.331	0.292	0.343	0.429	0.490	0.442	0.488	0.432	0.418	0.564	0.478	0.344	0.468
25	SAN FERNANDO (241)	0.391	0.398	0.367	0.350	0.439	0.457	0.378	0.427	0.316	0.407	0.365	0.513	0.205	0.332
26	SAN FERNANDO (458)	0.315	0.408	0.299	0.369	0.401	0.462	0.375	0.406	0.312	0.352	0.363	0.412	0.212	0.284
27	SAN FERNANDO (264)	0.403	0.295	0.371	0.288	0.528	0.389	0.517	0.357	0.455	0.339	0.533	0.513	0.341	0.421
28	SAN FERNANDO (267)	0.294	0.366	0.276	0.333	0.366	0.427	0.340	0.338	0.294	0.362	0.396	0.524	0.244	0.406
29	PUGET SOUND (325)	0.262	0.452	0.269	0.444	0.371	0.567	0.395	0.526	0.386	0.443	0.474	0.637	0.266	0.554
	MEAN	0.336	0.359	0.329	0.336	0.436	0.444	0.406	0.403	0.354	0.375	0.442	0.502	0.270	0.378
	σ	0.061	0.050	0.049	0.051	0.059	0.060	0.053	0.064	0.054	0.045	0.075	0.075	0.055	0.094
	MEAN OF MAX (L,T)	0.390		0.373		0.487		0.436		0.390		0.514		0.378	
	σ OF MAX (L,T)	0.036		0.033		0.043		0.062		0.049		0.077		0.094	

TABLE B-XVII Nonlinear Dynamic Analysis Results for 8-Story Isolated Structure with Isolation System Type # 8 (T = 2.5 sec, β = 6%). Excitation is Represented by Pairs of Scaled Earthquake Motions Recorded on Medium Soil Sites (Representative of Soil Type S_2). Weight = 11520 kips, Height = 12 ft

	EXCITATION	BASE CENTER DISPL (INCH)		CORNER BEARING DISPL (INCH)		CORNER TO CENTER DISPL RATIO	BASE SHEAR / WEIGHT		1st STORY SHEAR / WEIGHT		1st STORY DRIFT / HEIGHT (%)	
		L	T	L	T		L	T	L	T	L	T
21	WESTERN WASH. (325)	8.65	19.53	11.95	28.63	1.47	0.141	0.295	0.130	0.268	0.314	0.633
22	EUREKA (022)	11.68	10.41	13.93	12.05	1.19	0.191	0.162	0.169	0.146	0.408	0.365
23	EUREKA (023)	15.92	7.73	16.18	10.38	1.34	0.252	0.126	0.233	0.118	0.557	0.283
24	FERNDALE (023)	2.40	2.31	2.54	2.49	1.08	0.047	0.056	0.050	0.055	0.130	0.160
25	SAN FERNANDO (241)	43.00	12.65	47.18	20.56	1.63	0.654	0.185	0.589	0.167	1.389	0.468
26	SAN FERNANDO (458)	19.78	16.97	21.20	20.90	1.24	0.311	0.265	0.281	0.242	0.661	0.596
27	SAN FERNANDO (264)	16.07	8.66	16.54	9.78	1.13	0.259	0.140	0.237	0.126	0.557	0.333
28	SAN FERNANDO (267)	8.26	6.96	8.44	8.24	1.18	0.132	0.109	0.121	0.096	0.280	0.251
29	PUGET SOUND (325)	3.32	11.97	4.09	12.56	1.23	0.056	0.192	0.061	0.175	0.157	0.455
	MEAN	14.34	10.79	15.78	13.95	1.28	0.227	0.170	0.208	0.155	0.495	0.394
	σ	11.53	4.93	12.47	7.51	0.17	0.173	0.071	0.154	0.064	0.360	0.149
	MEAN OF MAX (L,T)	16.51		18.58			0.255		0.236		0.567	
	σ OF MAX (L,T)	10.71		12.26			0.158		0.142		0.329	

TABLE B-XVII Continued

	EXCITATION	2nd STORY SHEAR / WEIGHT		3rd STORY SHEAR / WEIGHT		4th STORY SHEAR / WEIGHT		5th STORY SHEAR / WEIGHT		6th STORY SHEAR / WEIGHT		7th STORY SHEAR / WEIGHT		8th STORY SHEAR / WEIGHT	
		L	T	L	T	L	T	L	T	L	T	L	T	L	T
21	WESTERN WASH. (325)	0.118	0.244	0.112	0.218	0.104	0.188	0.095	0.155	0.081	0.121	0.062	0.084	0.034	0.044
22	EUREKA (022)	0.149	0.134	0.129	0.124	0.111	0.111	0.097	0.093	0.079	0.071	0.058	0.052	0.032	0.030
23	EUREKA (023)	0.212	0.109	0.190	0.099	0.165	0.087	0.137	0.074	0.107	0.059	0.074	0.042	0.038	0.022
24	FERNDALE (023)	0.055	0.062	0.057	0.065	0.056	0.064	0.055	0.059	0.051	0.049	0.042	0.032	0.024	0.025
25	SAN FERNANDO (241)	0.521	0.149	0.451	0.130	0.380	0.110	0.307	0.088	0.232	0.068	0.156	0.055	0.078	0.035
26	SAN FERNANDO (458)	0.251	0.216	0.219	0.189	0.185	0.163	0.150	0.135	0.114	0.104	0.077	0.070	0.039	0.036
27	SAN FERNANDO (264)	0.212	0.117	0.185	0.108	0.157	0.096	0.128	0.082	0.098	0.065	0.069	0.045	0.036	0.029
28	SAN FERNANDO (267)	0.107	0.090	0.094	0.085	0.081	0.073	0.066	0.064	0.055	0.065	0.044	0.060	0.025	0.038
29	PUGET SOUND (325)	0.063	0.161	0.060	0.150	0.064	0.140	0.065	0.123	0.056	0.097	0.044	0.074	0.025	0.043

	2nd L	2nd T	3rd L	3rd T	4th L	4th T	5th L	5th T	6th L	6th T	7th L	7th T	8th L	8th T
MEAN	0.188	0.142	0.166	0.130	0.145	0.115	0.122	0.097	0.097	0.078	0.070	0.057	0.037	0.034
σ	0.134	0.055	0.114	0.046	0.094	0.039	0.073	0.031	0.052	0.023	0.033	0.016	0.016	0.007
MEAN OF MAX (L,T)	0.213		0.189		0.163		0.136		0.107		0.077		0.041	
σ OF MAX (L,T)	0.124		0.105		0.087		0.067		0.049		0.030		0.014	

TABLE B-XVII Continued

	EXCITATION	2nd STORY DRIFT/HEIGHT (%)		3rd STORY DRIFT/HEIGHT (%)		4th STORY DRIFT/HEIGHT (%)		5th STORY DRIFT/HEIGHT (%)		6th STORY DRIFT/HEIGHT (%)		7th STORY DRIFT/HEIGHT (%)		8th STORY DRIFT/HEIGHT (%)	
		L	T	L	T	L	T	L	T	L	T	L	T	L	T
21	WESTERN WASH. (325)	0.294	0.609	0.281	0.522	0.349	0.608	0.308	0.494	0.256	0.383	0.303	0.415	0.166	0.226
22	EUREKA (022)	0.374	0.345	0.329	0.300	0.380	0.366	0.317	0.304	0.254	0.233	0.290	0.270	0.158	0.157
23	EUREKA (023)	0.518	0.274	0.468	0.238	0.536	0.284	0.437	0.239	0.341	0.195	0.362	0.211	0.189	0.113
24	FERNDALE (023)	0.130	0.172	0.135	0.177	0.185	0.239	0.182	0.216	0.166	0.176	0.205	0.167	0.119	0.133
25	SAN FERNANDO (241)	1.277	0.444	1.124	0.377	1.242	0.434	0.969	0.351	0.729	0.267	0.774	0.281	0.409	0.187
26	SAN FERNANDO (458)	0.607	0.561	0.537	0.465	0.601	0.531	0.477	0.435	0.364	0.347	0.382	0.351	0.200	0.177
27	SAN FERNANDO (264)	0.513	0.326	0.454	0.290	0.504	0.351	0.395	0.296	0.303	0.236	0.330	0.248	0.179	0.155
28	SAN FERNANDO (267)	0.256	0.241	0.228	0.221	0.257	0.267	0.216	0.213	0.180	0.210	0.211	0.299	0.124	0.194
29	PUGET SOUND (325)	0.144	0.429	0.151	0.373	0.230	0.482	0.228	0.418	0.195	0.332	0.217	0.386	0.118	0.228

MEAN	0.457	0.378	0.412	0.329	0.476	0.396	0.392	0.330	0.310	0.264	0.342	0.292	0.185	0.174
σ	0.330	0.137	0.285	0.108	0.303	0.120	0.225	0.096	0.162	0.069	0.165	0.076	0.084	0.037
MEAN OF MAX (L,T)	0.528		0.468		0.540		0.438		0.344		0.383		0.213	
σ OF MAX (L,T)	0.300		0.260		0.278		0.211		0.151		0.151		0.075	

TABLE B-XVIII Nonlinear Dynamic Analysis Results for 8-Story Isolated Structure with Isolation System Type # 9 (T = 2.5 sec, β = 15%). Excitation is Represented by Pairs of Scaled Earthquake Motions Recorded on Medium Soil Sites (Representative of Soil Type S_2). Weight = 11520 kips, Height = 12 ft

	EXCITATION	BASE CENTER DISPL (INCH)		CORNER BEARING DISPL (INCH)		CORNER TO CENTER DISPL RATIO	BASE SHEAR / WEIGHT		1st STORY SHEAR / WEIGHT		1st STORY DRIFT / HEIGHT (%)	
		L	T	L	T		L	T	L	T	L	T
21	WESTERN WASH. (325)	7.46	13.94	10.36	19.34	1.39	0.112	0.186	0.109	0.165	0.267	0.396
22	EUREKA (022)	8.14	9.01	9.62	10.65	1.18	0.139	0.133	0.126	0.123	0.305	0.313
23	EUREKA (023)	15.43	5.42	15.61	5.78	1.07	0.217	0.099	0.205	0.087	0.493	0.228
24	FERNDALE (023)	2.11	2.13	2.14	2.22	1.04	0.055	0.068	0.056	0.070	0.148	0.199
25	SAN FERNANDO (241)	25.92	12.63	26.84	14.97	1.19	0.346	0.178	0.308	0.162	0.716	0.411
26	SAN FERNANDO (458)	17.11	15.39	17.50	18.84	1.22	0.239	0.220	0.216	0.200	0.498	0.497
27	SAN FERNANDO (264)	9.95	6.57	10.31	7.59	1.16	0.158	0.119	0.137	0.105	0.320	0.275
28	SAN FERNANDO (267)	5.34	6.65	5.42	7.88	1.18	0.105	0.107	0.095	0.099	0.221	0.282
29	PUGET SOUND (325)	3.02	9.65	3.56	10.18	1.18	0.066	0.146	0.063	0.135	0.163	0.342
	MEAN	10.50	9.04	11.26	10.83	1.18	0.160	0.140	0.146	0.127	0.348	0.327
	σ	7.26	4.09	7.31	5.51	0.09	0.088	0.045	0.078	0.040	0.176	0.089
	MEAN OF MAX (L,T)	12.20		13.54			0.178		0.162		0.395	
	σ OF MAX (L,T)	6.50		6.94			0.077		0.068		0.145	

TABLE B-XVIII Continued

	EXCITATION	2nd STORY SHEAR / WEIGHT		3rd STORY SHEAR / WEIGHT		4th STORY SHEAR / WEIGHT		5th STORY SHEAR / WEIGHT		6th STORY SHEAR / WEIGHT		7th STORY SHEAR / WEIGHT		8th STORY SHEAR / WEIGHT	
		L	T	L	T	L	T	L	T	L	T	L	T	L	T
21	WESTERN WASH. (325)	0.106	0.151	0.099	0.138	0.088	0.122	0.076	0.108	0.067	0.093	0.055	0.074	0.033	0.042
22	EUREKA (022)	0.114	0.114	0.101	0.102	0.089	0.090	0.080	0.073	0.067	0.065	0.052	0.057	0.030	0.035
23	EUREKA (023)	0.191	0.080	0.174	0.075	0.153	0.071	0.129	0.063	0.101	0.052	0.070	0.041	C.036	0.024
24	FERNDALE (023)	0.064	0.076	0.069	0.082	0.072	0.082	0.070	0.078	0.066	0.067	0.057	0.048	0.034	0.041
25	SAN FERNANDO (241)	0.271	0.146	0.233	0.137	0.198	0.125	0.163	0.104	0.124	0.082	0.088	0.063	0.047	0.039
26	SAN FERNANDO (458)	0.191	0.177	0.165	0.151	0.138	0.127	0.111	0.106	0.085	0.084	0.059	0.060	0.030	0.032
27	SAN FERNANDO (264)	0.122	0.094	0.106	0.083	0.099	0.080	0.091	0.073	0.071	0.063	0.073	0.054	0.050	0.039
28	SAN FERNANDO (267)	0.085	0.096	0.084	0.095	0.080	0.086	0.068	0.078	0.059	0.076	0.050	0.074	0.030	0.049
29	PUGET SOUND (325)	0.069	0.127	0.073	0.119	0.072	0.114	0.073	0.098	0.071	0.085	0.059	0.071	0.034	0.051
	MEAN	0.135	0.118	0.123	0.109	0.110	0.100	0.096	0.087	0.079	0.074	0.063	0.060	0.036	0.039
	σ	0.065	0.033	0.052	0.026	0.041	0.021	0.031	0.016	0.020	0.012	0.012	0.011	0.007	0.008
	MEAN OF MAX (L,T)	0.149		0.135		0.120		0.104		0.085		0.069		0.043	
	σ OF MAX (L,T)	0.057		0.045		0.036		0.026		0.017		0.009		0.007	

TABLE B-XVIII Continued

	EXCITATION	2nd STORY DRIFT/HEIGHT (%)		3rd STORY DRIFT/HEIGHT (%)		4th STORY DRIFT/HEIGHT (%)		5th STORY DRIFT/HEIGHT (%)		6th STORY DRIFT/HEIGHT (%)		7th STORY DRIFT/HEIGHT (%)		8th STORY DRIFT/HEIGHT (%)	
		L	T	L	T	L	T	L	T	L	T	L	T	L	T
21	WESTERN WASH. (325)	0.254	0.370	0.240	0.328	0.288	0.408	0.244	0.352	0.212	0.302	0.263	0.358	0.155	0.226
22	EUREKA (022)	0.282	0.299	0.253	0.260	0.298	0.312	0.258	0.247	0.212	0.222	0.256	0.294	0.150	0.183
23	EUREKA (023)	0.462	0.214	0.425	0.188	0.496	0.248	0.408	0.215	0.320	0.170	0.340	0.209	0.178	0.128
24	FERNDALE (023)	0.149	0.212	0.161	0.222	0.227	0.303	0.227	0.284	0.217	0.237	0.278	0.247	0.167	0.221
25	SAN FERNANDO (241)	0.655	0.385	0.580	0.338	0.657	0.432	0.527	0.359	0.400	0.285	0.425	0.334	0.233	0.213
26	SAN FERNANDO (458)	0.457	0.465	0.401	0.379	0.440	0.418	0.342	0.349	0.262	0.286	0.285	0.312	0.154	0.162
27	SAN FERNANDO (264)	0.293	0.250	0.257	0.214	0.314	0.283	0.282	0.254	0.219	0.216	0.350	0.278	0.245	0.212
28	SAN FERNANDO (267)	0.198	0.256	0.193	0.249	0.248	0.311	0.219	0.273	0.195	0.239	0.242	0.356	0.157	0.248
29	PUGET SOUND (325)	0.152	0.325	0.164	0.303	0.233	0.388	0.240	0.336	0.229	0.282	0.280	0.358	0.158	0.272

	L	T	L	T	L	T	L	T	L	T	L	T	L	T
MEAN	0.322	0.308	0.297	0.276	0.356	0.345	0.305	0.297	0.252	0.249	0.302	0.305	0.177	0.207
σ	0.160	0.081	0.134	0.061	0.138	0.063	0.097	0.050	0.063	0.041	0.055	0.050	0.034	0.041
MEAN OF MAX (L,T)	0.371		0.336		0.403		0.341		0.279		0.341		0.219	
σ OF MAX (L,T)	0.129		0.108		0.110		0.080		0.055		0.041		0.035	

TABLE B-XIX Nonlinear Dynamic Analysis Results for 8-Story Isolated Structure with Isolation System Type # 10 (T = 2.5 sec, β = 26%). Excitation is Represented by Pairs of Scaled Earthquake Motions Recorded on Medium Soil Sites (Representative of Soil Type S_2). Weight = 11520 kips, Height = 12 ft

	EXCITATION	BASE CENTER DISPL (INCH)		CORNER BEARING DISPL (INCH)		CORNER TO CENTER DISPL. RATIO	BASE SHEAR / WEIGHT		1st STORY SHEAR / WEIGHT		1st STORY DRIFT / HEIGHT (%)	
		L	T	L	T		L	T	L	T	L	T
21	WESTERN WASH. (325)	6.32	8.12	6.58	10.97	1.35	0.095	0.127	0.109	0.119	0.281	0.293
22	EUREKA (022)	6.73	7.43	7.46	8.76	1.18	0.109	0.114	0.112	0.112	0.269	0.284
23	EUREKA (023)	14.77	5.29	14.93	5.67	1.07	0.183	0.091	0.175	0.078	0.424	0.199
24	FERNDALE (023)	1.90	1.83	1.91	1.98	1.08	0.072	0.080	0.075	0.088	0.173	0.250
25	SAN FERNANDO (241)	14.99	12.19	15.15	13.78	1.13	0.192	0.159	0.169	0.146	0.399	0.358
26	SAN FERNANDO (458)	13.08	13.48	13.25	16.97	1.26	0.164	0.173	0.146	0.164	0.341	0.420
27	SAN FERNANDO (264)	8.73	4.91	8.96	5.95	1.21	0.132	0.105	0.129	0.094	0.308	0.242
28	SAN FERNANDO (267)	5.32	5.76	5.64	6.41	1.11	0.102	0.107	0.096	0.108	0.230	0.319
29	PUGET SOUND (325)	3.35	7.23	3.67	8.03	1.11	0.082	0.110	0.083	0.114	0.215	0.338
	MEAN	8.35	7.36	8.62	8.72	1.17	0.126	0.118	0.122	0.114	0.293	0.300
	σ	4.60	3.41	4.57	4.31	0.09	0.042	0.029	0.034	0.026	0.079	0.063
	MEAN OF MAX (L,T)	9.16		10.24			0.135		0.131		0.337	
	σ OF MAX (L,T)	4.17		4.52			0.036		0.029		0.059	

TABLE B-XIX Continued

	EXCITATION	2nd STORY SHEAR / WEIGHT		3rd STORY SHEAR / WEIGHT		4th STORY SHEAR / WEIGHT		5th STORY SHEAR / WEIGHT		6th STORY SHEAR / WEIGHT		7th STORY SHEAR / WEIGHT		8th STORY SHEAR / WEIGHT	
		L	T	L	T	L	T	L	T	L	T	L	T	L	T
21	WESTERN WASH. (325)	0.119	0.117	0.122	0.111	0.119	0.101	0.101	0.095	0.070	0.098	0.066	0.089	0.042	0.054
22	EUREKA (022)	0.110	0.110	0.100	0.098	0.084	0.087	0.074	0.070	0.065	0.064	0.052	0.064	0.029	0.048
23	EUREKA (023)	0.166	0.074	0.153	0.072	0.136	0.071	0.116	0.064	0.091	0.060	0.066	0.049	0.040	0.033
24	FERNDALE (023)	0.076	0.094	0.086	0.102	0.095	0.103	0.095	0.099	0.088	0.085	0.077	0.066	0.046	0.060
25	SAN FERNANDO (241)	0.145	0.145	0.127	0.141	0.113	0.129	0.100	0.107	0.086	0.089	0.067	0.072	0.038	0.049
26	SAN FERNANDO (458)	0.127	0.156	0.111	0.144	0.096	0.128	0.082	0.110	0.067	0.087	0.054	0.062	0.033	0.035
27	SAN FERNANDO (264)	0.129	0.093	0.119	0.098	0.118	0.091	0.117	0.085	0.100	0.082	0.090	0.072	0.062	0.053
28	SAN FERNANDO (267)	0.087	0.106	0.092	0.104	0.093	0.101	0.083	0.092	0.074	0.082	0.060	0.082	0.038	0.057
29	PUGET SOUND (325)	0.097	0.110	0.101	0.111	0.094	0.107	0.090	0.100	0.090	0.087	0.076	0.087	0.043	0.073
	MEAN	0.117	0.112	0.112	0.109	0.105	0.102	0.095	0.091	0.081	0.082	0.068	0.071	0.041	0.051
	σ	0.027	0.024	0.019	0.021	0.016	0.017	0.014	0.015	0.012	0.011	0.011	0.012	0.009	0.012
	MEAN OF MAX (L,T)	0.126		0.122		0.114		0.102		0.088		0.077		0.053	
	σ OF MAX (L,T)	0.023		0.019		0.015		0.013		0.010		0.010		0.011	

TABLE B-XIX Continued

	EXCITATION	2nd STORY DRIFT/HEIGHT (%)		3rd STORY DRIFT/HEIGHT (%)		4th STORY DRIFT/HEIGHT (%)		5th STORY DRIFT/HEIGHT (%)		6th STORY DRIFT/HEIGHT (%)		7th STORY DRIFT/HEIGHT (%)		8th STORY DRIFT/HEIGHT (%)	
		L	T	L	T	L	T	L	T	L	T	L	T	L	T
21	WESTERN WASH. (325)	0.273	0.292	0.278	0.269	0.373	0.339	0.321	0.335	0.225	0.344	0.320	0.470	0.202	0.284
22	EUREKA (022)	0.253	0.271	0.233	0.234	0.275	0.287	0.242	0.237	0.209	0.210	0.255	0.332	0.144	0.256
23	EUREKA (023)	0.400	0.195	0.371	0.190	0.439	0.250	0.365	0.229	0.290	0.213	0.320	0.256	0.186	0.175
24	FERNDALE (023)	0.176	0.262	0.200	0.276	0.299	0.380	0.303	0.363	0.289	0.304	0.377	0.341	0.230	0.320
25	SAN FERNANDO (241)	0.362	0.358	0.319	0.336	0.372	0.437	0.319	0.368	0.274	0.319	0.328	0.376	0.187	0.261
26	SAN FERNANDO (458)	0.310	0.413	0.271	0.367	0.306	0.443	0.255	0.374	0.217	0.299	0.263	0.325	0.159	0.199
27	SAN FERNANDO (264)	0.291	0.244	0.271	0.251	0.378	0.328	0.366	0.292	0.313	0.283	0.432	0.371	0.304	0.282
28	SAN FERNANDO (267)	0.202	0.289	0.215	0.278	0.293	0.364	0.266	0.324	0.235	0.285	0.297	0.411	0.195	0.303
29	PUGET SOUND (325)	0.214	0.323	0.221	0.312	0.295	0.406	0.295	0.375	0.290	0.334	0.361	0.477	0.202	0.386

	2nd L	2nd T	3rd L	3rd T	4th L	4th T	5th L	5th T	6th L	6th T	7th L	7th T	8th L	8th T
MEAN	0.276	0.294	0.264	0.279	0.337	0.359	0.304	0.322	0.260	0.288	0.328	0.373	0.201	0.274
σ	0.070	0.061	0.052	0.050	0.052	0.062	0.042	0.054	0.036	0.045	0.053	0.067	0.043	0.059
MEAN OF MAX (L,T)	0.323		0.303		0.390		0.346		0.300		0.391		0.278	
σ OF MAX (L,T)	0.053		0.044		0.047		0.040		0.037		0.057		0.058	

TABLE B-XX Nonlinear Dynamic Analysis Results for 8-Story Isolated Structure with Isolation System Type # 11 (T = 3.0 sec, β = 9%). Excitation is Represented by Pairs of Scaled Earthquake Motions Recorded on Medium Soil Sites (Representative of Soil Type S_2). Weight = 11520 kips, Height = 12 ft

	EXCITATION	BASE CENTER DISPL (INCH)		CORNER BEARING DISPL (INCH)		CORNER TO CENTER DISPL RATIO	BASE SHEAR / WEIGHT		1st STORY SHEAR / WEIGHT		1st STORY DRIFT / HEIGHT (%)	
		L	T	L	T		L	T	L	T	L	T
21	WESTERN WASH. (325)	9.97	21.53	14.05	31.81	1.48	0.118	0.210	0.110	0.187	0.277	0.457
22	EUREKA (022)	13.75	11.27	15.82	12.58	1.15	0.151	0.120	0.138	0.114	0.329	0.298
23	EUREKA (023)	16.22	5.30	16.39	5.75	1.08	0.181	0.066	0.169	0.060	0.404	0.160
24	FERNDALE (023)	2.36	2.42	2.49	2.58	1.07	0.037	0.048	0.040	0.046	0.106	0.131
25	SAN FERNANDO (241)	32.07	14.82	33.00	17.19	1.16	0.335	0.166	0.305	0.148	0.722	0.374
26	SAN FERNANDO (458)	25.13	23.48	25.45	32.29	1.38	0.262	0.232	0.234	0.209	0.540	0.494
27	SAN FERNANDO (264)	13.86	9.13	14.36	10.38	1.14	0.159	0.101	0.145	0.091	0.336	0.234
28	SAN FERNANDO (267)	6.26	10.37	6.95	13.11	1.26	0.072	0.116	0.065	0.105	0.159	0.251
29	PUGET SOUND (325)	3.29	9.23	4.26	10.37	1.29	0.045	0.112	0.045	0.103	0.124	0.283
	MEAN	13.66	11.95	14.75	15.12	1.22	0.151	0.130	0.139	0.118	0.333	0.298
	σ	9.31	6.55	9.27	9.88	0.13	0.094	0.058	0.083	0.051	0.191	0.117
	MEAN OF MAX (L,T)	16.06		18.86			0.175		0.159		0.384	
	σ OF MAX (L,T)	8.46		10.29			0.081		0.072		0.164	

TABLE B-XX Continued

	EXCITATION	2nd STORY SHEAR/WEIGHT		3rd STORY SHEAR/WEIGHT		4th STORY SHEAR/WEIGHT		5th STORY SHEAR/WEIGHT		6th STORY SHEAR/WEIGHT		7th STORY SHEAR/WEIGHT		8th STORY SHEAR/WEIGHT	
		L	T	L	T	L	T	L	T	L	T	L	T	L	T
21	WESTERN WASH. (325)	0.101	0.172	0.090	0.155	0.079	0.137	0.065	0.116	0.056	0.091	0.043	0.062	0.024	0.032
22	EUREKA (022)	0.124	0.105	0.109	0.092	0.092	0.077	0.075	0.060	0.057	0.051	0.043	0.042	0.024	0.024
23	EUREKA (023)	0.156	0.056	0.141	0.051	0.123	0.048	0.104	0.043	0.082	0.037	0.058	0.029	0.030	0.015
24	FERNDALE (023)	0.045	0.050	0.047	0.053	0.048	0.052	0.047	0.049	0.044	0.041	0.037	0.028	0.022	0.023
25	SAN FERNANDO (241)	0.273	0.134	0.239	0.119	0.204	0.104	0.167	0.085	0.128	0.064	0.087	0.047	0.044	0.026
26	SAN FERNANDO (458)	0.208	0.185	0.181	0.160	0.153	0.134	0.124	0.108	0.094	0.081	0.064	0.055	0.032	0.029
27	SAN FERNANDO (264)	0.132	0.080	0.117	0.068	0.101	0.057	0.084	0.048	0.067	0.048	0.048	0.037	0.027	0.025
28	SAN FERNANDO (267)	0.057	0.093	0.052	0.082	0.053	0.069	0.049	0.056	0.044	0.057	0.036	0.053	0.020	0.035
29	PUGET SOUND (325)	0.050	0.099	0.058	0.095	0.066	0.094	0.064	0.083	0.052	0.066	0.041	0.052	0.025	0.030

	L	T	L	T	L	T	L	T	L	T	L	T	L	T
MEAN	0.127	0.108	0.115	0.097	0.102	0.086	0.087	0.072	0.069	0.060	0.051	0.045	0.028	0.027
σ	0.072	0.045	0.060	0.038	0.048	0.032	0.037	0.026	0.026	0.017	0.016	0.011	0.007	0.006
MEAN OF MAX (L,T)	0.145		0.130		0.114		0.095		0.076		0.056		0.031	
σ OF MAX (L,T)	0.063		0.053		0.044		0.035		0.024		0.014		0.006	

TABLE B-XX Continued

	EXCITATION	2nd STORY DRIFT/HEIGHT (%)		3rd STORY DRIFT/HEIGHT (%)		4th STORY DRIFT/HEIGHT (%)		5th STORY DRIFT/HEIGHT (%)		6th STORY DRIFT/HEIGHT (%)		7th STORY DRIFT/HEIGHT (%)		8th STORY DRIFT/HEIGHT (%)	
		L	T	L	T	L	T	L	T	L	T	L	T	L	T
21	WESTERN WASH. (325)	0.259	0.440	0.238	0.379	0.274	0.449	0.220	0.372	0.178	0.288	0.207	0.299	0.115	0.155
22	EUREKA (022)	0.303	0.284	0.268	0.240	0.298	0.272	0.231	0.212	0.178	0.183	0.209	0.227	0.117	0.130
23	EUREKA (023)	0.377	0.152	0.344	0.135	0.400	0.174	0.329	0.154	0.260	0.130	0.280	0.154	0.148	0.079
24	FERNDALE (023)	0.105	0.141	0.111	0.145	0.154	0.196	0.152	0.180	0.143	0.149	0.183	0.148	0.109	0.124
25	SAN FERNANDO (241)	0.666	0.353	0.593	0.298	0.664	0.356	0.254	0.288	0.400	0.216	0.423	0.238	0.224	0.137
26	SAN FERNANDO (458)	0.496	0.467	0.438	0.390	0.486	0.441	0.382	0.351	0.290	0.270	0.307	0.279	0.162	0.141
27	SAN FERNANDO (264)	0.311	0.218	0.280	0.180	0.321	0.201	0.263	0.166	0.210	0.166	0.231	0.195	0.135	0.137
28	SAN FERNANDO (267)	0.141	0.237	0.127	0.200	0.169	0.228	0.160	0.182	0.144	0.193	0.175	0.272	0.099	0.185
29	PUGET SOUND (325)	0.121	0.272	0.141	0.248	0.219	0.341	0.214	0.301	0.174	0.236	0.202	0.280	0.115	0.165
	MEAN	0.309	0.285	0.282	0.246	0.332	0.295	0.275	0.245	0.220	0.203	0.246	0.232	0.136	0.139
	σ	0.175	0.109	0.149	0.088	0.154	0.100	0.112	0.079	0.079	0.051	0.075	0.053	0.036	0.028
	MEAN OF MAX (L,T)	0.360		0.322		0.376		0.307		0.245		0.278		0.159	
	σ OF MAX (L,T)	0.147		0.128		0.136		0.104		0.071		0.063		0.029	

TABLE B-XXI Nonlinear Dynamic Analysis Results for 8-Story Isolated Structure with Isolation System Type # 12 (T = 3.0 sec, β = 22%). Excitation is Represented by Pairs of Scaled Earthquake Motions Recorded on Medium Soil Sites (Representative of Soil Type S_2). Weight = 11520 kips, Height = 12 ft

	EXCITATION	BASE CENTER DISPL (INCH)		CORNER BEARING DISPL (INCH)		CORNER TO CENTER DISPL RATIO	BASE SHEAR / WEIGHT		1st STORY SHEAR / WEIGHT		1st STORY DRIFT / HEIGHT (%)	
		L	T	L	T		L	T	L	T	L	T
21	WESTERN WASH. (325)	7.59	12.32	8.38	15.81	1.28	0.074	0.119	0.081	0.107	0.207	0.266
22	EUREKA (022)	10.12	9.93	11.38	11.26	1.13	0.099	0.094	0.095	0.090	0.222	0.238
23	EUREKA (023)	15.01	5.45	15.11	5.72	1.05	0.149	0.070	0.144	0.060	0.345	0.148
24	FERNDALE (023)	2.10	2.20	2.11	2.28	1.04	0.052	0.060	0.056	0.063	0.131	0.175
25	SAN FERNANDO (241)	20.18	14.64	20.42	16.94	1.16	0.188	0.145	0.165	0.139	0.382	0.355
26	SAN FERNANDO (458)	18.32	15.95	18.80	19.82	1.24	0.156	0.147	0.135	0.134	0.314	0.347
27	SAN FERNANDO (264)	12.02	7.15	12.36	8.07	1.13	0.123	0.080	0.113	0.074	0.267	0.198
28	SAN FERNANDO (267)	5.20	8.16	5.49	10.08	1.24	0.075	0.096	0.071	0.085	0.170	0.248
29	PUGET SOUND (325)	3.66	7.40	4.16	7.58	1.14	0.059	0.089	0.066	0.085	0.169	0.249
	MEAN	10.47	9.24	10.91	10.84	1.16	0.108	0.100	0.103	0.093	0.245	0.247
	σ	6.07	4.18	6.07	5.39	0.08	0.045	0.029	0.036	0.027	0.082	0.066
	MEAN OF MAX (L,T)	11.75		12.76			0.120		0.110		0.280	
	σ OF MAX (L,T)	5.28		5.47			0.037		0.031		0.062	

TABLE B-XXI Continued

	EXCITATION	2nd STORY SHEAR/WEIGHT		3rd STORY SHEAR/WEIGHT		4th STORY SHEAR/WEIGHT		5th STORY SHEAR/WEIGHT		6th STORY SHEAR/WEIGHT		7th STORY SHEAR/WEIGHT		8th STORY SHEAR/WEIGHT	
		L	T	L	T	L	T	L	T	L	T	L	T	L	T
21	WESTERN WASH. (325)	0.089	0.100	0.090	0.086	0.084	0.076	0.068	0.071	0.054	0.071	0.052	0.066	0.033	0.041
22	EUREKA (022)	0.085	0.085	0.071	0.076	0.065	0.067	0.056	0.058	0.048	0.057	0.038	0.049	0.021	0.037
23	EUREKA (023)	0.136	0.055	0.125	0.055	0.112	0.057	0.095	0.053	0.076	0.049	0.054	0.042	0.029	0.0258
24	FERNDALE (023)	0.057	0.066	0.063	0.072	0.069	0.073	0.069	0.071	0.063	0.061	0.054	0.045	0.033	0.040
25	SAN FERNANDO (241)	0.147	0.135	0.129	0.126	0.112	0.112	0.095	0.090	0.073	0.070	0.050	0.053	0.030	0.030
26	SAN FERNANDO (458)	0.117	0.126	0.104	0.116	0.091	0.105	0.077	0.091	0.065	0.074	0.049	0.053	0.027	0.027
27	SAN FERNANDO (264)	0.104	0.075	0.094	0.077	0.083	0.071	0.080	0.071	0.068	0.071	0.061	0.055	0.041	0.039
28	SAN FERNANDO (267)	0.067	0.088	0.069	0.085	0.070	0.081	0.066	0.076	0.058	0.074	0.047	0.072	0.028	0.050
29	PUGET SOUND (325)	0.077	0.084	0.082	0.084	0.079	0.083	0.072	0.074	0.070	0.071	0.059	0.068	0.034	0.051
	MEAN	0.098	0.090	0.092	0.086	0.085	0.081	0.075	0.073	0.064	0.066	0.052	0.056	0.031	0.038
	σ	0.029	0.025	0.022	0.021	0.016	0.017	0.012	0.012	0.009	0.008	0.006	0.010	0.005	0.009
	MEAN OF MAX (L,T)	0.104		0.097		0.089		0.079		0.070		0.059		0.038	
	σ OF MAX (L,T)	0.025		0.020		0.016		0.012		0.006		0.008		0.008	

TABLE B-XXI Continued

	EXCITATION	2nd STORY DRIFT/HEIGHT (%)		3rd STORY DRIFT/HEIGHT (%)		4th STORY DRIFT/HEIGHT (%)		5th STORY DRIFT/HEIGHT (%)		6th STORY DRIFT/HEIGHT (%)		7th STORY DRIFT/HEIGHT (%)		8th STORY DRIFT/HEIGHT (%)	
		L	T	L	T	L	T	L	T	L	T	L	T	L	T
21	WESTERN WASH. (325)	0.204	0.252	0.204	0.216	0.261	0.278	0.218	0.256	0.181	0.258	0.252	0.360	0.156	0.225
22	EUREKA (022)	0.199	0.229	0.173	0.199	0.211	0.238	0.179	0.202	0.151	0.200	0.185	0.261	0.105	0.197
23	EUREKA (023)	0.326	0.148	0.303	0.142	0.360	0.204	0.302	0.190	0.240	0.174	0.259	0.224	0.141	0.136
24	FERNDALE (023)	0.132	0.186	0.147	0.197	0.218	0.269	0.220	0.257	0.206	0.217	0.266	0.237	0.162	0.212
25	SAN FERNANDO (241)	0.349	0.351	0.307	0.317	0.357	0.387	0.301	0.312	0.231	0.246	0.243	0.285	0.140	0.160
26	SAN FERNANDO (458)	0.284	0.344	0.256	0.307	0.297	0.375	0.242	0.321	0.200	0.263	0.233	0.284	0.130	0.145
27	SAN FERNANDO (264)	0.248	0.201	0.227	0.202	0.221	0.260	0.253	0.248	0.216	0.247	0.299	0.275	0.197	0.210
28	SAN FERNANDO (267)	0.157	0.239	0.162	0.221	0.222	0.292	0.213	0.266	0.188	0.250	0.226	0.363	0.146	0.265
29	PUGET SOUND (325)	0.170	0.238	0.180	0.229	0.247	0.299	0.231	0.277	0.226	0.267	0.277	0.368	0.162	0.284

	2nd L	2nd T	3rd L	3rd T	4th L	4th T	5th L	5th T	6th L	6th T	7th L	7th T	8th L	8th T
MEAN	0.230	0.243	0.218	0.226	0.272	0.289	0.240	0.259	0.204	0.236	0.249	0.297	0.149	0.204
σ	0.072	0.063	0.056	0.052	0.053	0.056	0.038	0.041	0.026	0.030	0.031	0.052	0.024	0.048
MEAN OF MAX (L,T)	0.268		0.246		0.308		0.272		0.243		0.305		0.204	
σ OF MAX (L,T)	0.054		0.046		0.050		0.034		0.021		0.043		0.047	

TABLE B-XXII Nonlinear Dynamic Analysis Results for 8-Story Isolated Structure with Isolation System Type # 13 (T = 3.0 sec, β = 37%). Excitation is Represented by Pairs of Scaled Earthquake Motions Recorded on Medium Soil Sites (Representative of Soil Type S_2). Weight = 11520 kips, Height = 12 ft

	EXCITATION	BASE CENTER DISPL (INCH)		CORNER BEARING DISPL (INCH)		CORNER TO CENTER DISPL RATIO	BASE SHEAR / WEIGHT		1st STORY SHEAR / WEIGHT		1st STORY DRIFT / HEIGHT (%)	
		L	T	L	T		L	T	L	T	L	T
21	WESTERN WASH. (325)	5.62	7.06	5.66	9.22	1.31	0.080	0.088	0.095	0.086	0.255	0.226
22	EUREKA (022)	7.98	7.97	8.87	9.15	1.15	0.088	0.088	0.091	0.091	0.219	0.231
23	EUREKA (023)	13.94	5.42	14.04	5.72	1.06	0.123	0.074	0.122	0.068	0.294	0.183
24	FERNDALE (023)	1.87	1.85	1.88	2.06	1.11	0.070	0.073	0.077	0.082	0.179	0.230
25	SAN FERNANDO (241)	11.15	11.88	12.05	13.64	1.15	0.109	0.115	0.100	0.116	0.236	0.297
26	SAN FERNANDO (458)	12.11	15.11	12.64	17.47	1.16	0.099	0.123	0.094	0.116	0.223	0.306
27	SAN FERNANDO (264)	10.42	6.57	10.68	8.05	1.23	0.107	0.092	0.115	0.087	0.286	0.247
28	SAN FERNANDO (267)	6.31	6.54	6.51	7.17	1.10	0.092	0.088	0.091	0.102	0.219	0.305
29	PUGET SOUND (325)	4.14	5.52	4.15	6.37	1.15	0.075	0.088	0.087	0.099	0.213	0.277
	MEAN	8.17	7.55	8.50	8.76	1.16	0.094	0.092	0.097	0.094	0.236	0.256
	σ	3.78	3.64	3.95	4.25	0.07	0.016	0.016	0.013	0.015	0.035	0.040
	MEAN OF MAX (L,T)	8.92		9.98			0.100		0.104		0.276	
	σ OF MAX (L,T)	4.02		4.36			0.017		0.013		0.028	

TABLE B-XXII Continued

	EXCITATION	2nd STORY SHEAR/WEIGHT		3rd STORY SHEAR/WEIGHT		4th STORY SHEAR/WEIGHT		5th STORY SHEAR/WEIGHT		6th STORY SHEAR/WEIGHT		7th STORY SHEAR/WEIGHT		8th STORY SHEAR/WEIGHT	
		L	T	L	T	L	T	L	T	L	T	L	T	L	T
21	WESTERN WASH. (325)	0.110	0.085	0.119	0.089	0.122	0.086	0.108	0.092	0.078	0.096	0.067	0.089	0.046	0.056
22	EUREKA (022)	0.086	0.089	0.075	0.079	0.069	0.073	0.062	0.072	0.047	0.063	0.039	0.068	0.023	0.052
23	EUREKA (023)	0.118	0.065	0.110	0.065	0.099	0.063	0.086	0.064	0.074	0.065	0.067	0.061	0.041	0.038
24	FERNDALE (023)	0.077	0.086	0.083	0.094	0.095	0.095	0.095	0.093	0.087	0.081	0.075	0.065	0.046	0.059
25	SAN FERNANDO (241)	0.092	0.121	0.083	0.118	0.076	0.108	0.071	0.089	0.064	0.073	0.053	0.066	0.035	0.046
26	SAN FERNANDO (458)	0.086	0.112	0.078	0.104	0.078	0.096	0.081	0.085	0.077	0.072	0.064	0.054	0.037	0.037
27	SAN FERNANDO (264)	0.120	0.100	0.111	0.103	0.110	0.095	0.105	0.096	0.092	0.094	0.085	0.076	0.057	0.058
28	SAN FERNANDO (267)	0.086	0.108	0.086	0.097	0.089	0.097	0.082	0.091	0.074	0.081	0.061	0.090	0.036	0.066
29	PUGET SOUND (325)	0.098	0.108	0.103	0.112	0.097	0.111	0.091	0.112	0.091	0.096	0.078	0.093	0.045	0.071
	MEAN	0.097	0.097	0.094	0.096	0.093	0.092	0.087	0.088	0.076	0.080	0.065	0.074	0.041	0.054
	σ	0.015	0.016	0.016	0.015	0.016	0.015	0.014	0.013	0.013	0.012	0.013	0.013	0.009	0.011
	MEAN OF MAX (L,T)	0.108		0.105		0.100		0.094		0.082		0.077		0.054	
	σ OF MAX (L,T)	0.012		0.012		0.013		0.012		0.011		0.011		0.011	

TABLE B-XXII Continued

	EXCITATION	2nd STORY DRIFT/HEIGHT (%)		3rd STORY DRIFT/HEIGHT (%)		4th STORY DRIFT/HEIGHT (%)		5th STORY DRIFT/HEIGHT (%)		6th STORY DRIFT/HEIGHT (%)		7th STORY DRIFT/HEIGHT (%)		8th STORY DRIFT/HEIGHT (%)	
		L	T	L	T	L	T	L	T	L	T	L	T	L	T
21	WESTERN WASH. (325)	0.254	0.229	0.272	0.229	0.383	0.312	0.340	0.320	0.244	0.335	0.309	0.469	0.212	0.294
22	EUREKA (022)	0.201	0.218	0.176	0.210	0.217	0.260	0.196	0.250	0.152	0.206	0.192	0.349	0.112	0.272
23	EUREKA (023)	0.279	0.181	0.264	0.175	0.319	0.223	0.272	0.224	0.242	0.218	0.328	0.315	0.197	0.196
24	FERNDALE (023)	0.169	0.240	0.195	0.255	0.298	0.352	0.304	0.341	0.284	0.289	0.370	0.334	0.227	0.313
25	SAN FERNANDO (241)	0.220	0.307	0.201	0.293	0.247	0.377	0.232	0.313	0.215	0.260	0.262	0.343	0.163	0.242
26	SAN FERNANDO (458)	0.208	0.302	0.190	0.273	0.251	0.341	0.258	0.299	0.245	0.253	0.307	0.290	0.175	0.204
27	SAN FERNANDO (264)	0.267	0.267	0.248	0.269	0.352	0.347	0.332	0.334	0.291	0.327	0.409	0.406	0.277	0.325
28	SAN FERNANDO (267)	0.205	0.287	0.205	0.255	0.286	0.352	0.264	0.322	0.236	0.284	0.292	0.482	0.192	0.370
29	PUGET SOUND (325)	0.213	0.286	0.227	0.295	0.309	0.405	0.296	0.389	0.292	0.345	0.367	0.508	0.207	0.397
	MEAN	0.224	0.257	0.220	0.250	0.296	0.330	0.277	0.310	0.245	0.280	0.315	0.388	0.196	0.290
	σ	0.033	0.040	0.033	0.037	0.050	0.054	0.044	0.046	0.041	0.047	0.061	0.076	0.043	0.065
	MEAN OF MAX (L,T)	0.271		0.265		0.349		0.318		0.282		0.396		0.290	
	σ OF MAX (L,T)	0.028		0.024		0.039		0.039		0.044		0.070		0.065	

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