Dynamic Analysis of Concrete Coupled Wall Structures - A Parametric Study

by

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ABSTRACT

Concrete coupled wall structure is a system that can efficiently dissipate energy under the effect of lateral loads. It has been widely used in medium height buildings for several decades. While researchers have conducted both experimental and analytical investigations in order to improve the performance of concrete shear wall, there is a lack of systematic comparison of coupled wall behavior due to variation of parameters. Therefore, this report will carry out a parametric study by varying the height of the building, the degree of coupling (DC), and the shape of the wall piers.

A computer-simulated study was carried out on the performance of coupled wall structures. The research process was divided into two phases with the first focusing on only on the shear wall system and the second on the interaction between the building and the core shear wall structure. Static pushover analysis was applied in Phase I, and acceleration response spectrum was employed in Phase II. The comparison of the results from both phases provided valuable insight on the structural behaviors of shear walls.

The Phase I results showed that C-shaped coupled wall were more efficient than rectangular wall piers. From further investigation in Phase II, it was found that C-shaped wall with 15 degree opening could achieve the greatest stiffness. Same-size coupling beams could create DC in shorter buildings in Phase I, but the result was contradicted in Phase II testing. However, both Phases displayed the fact that shear stiffness played a more important role in affecting DC than flexural stiffness.

Pushover analysis and response spectrum analysis both suggested that the DC of coupled wall structure decreased after concrete cracked and the horizontal force was then withstood by base moment. While concrete shear wall reduced lateral deflection of buildings, Phase II displayed the fact that floor frames could bend and form a sagging shape when interacting with coupled walls in an earthquake. Further study can be focused on more detailed modeling to investigate the behavior of concrete shear walls for efficient and economic design.

Thesis Supervisor: Oral Buyukozturk
Title: Professor of Civil and Environmental Engineering

TABLE OF CONTENTS

LIST OF TABLES

Table Page

LIST OF FIGURES

Figure Page

LIST OF FIGURES (CONTINUED)

Figure Page

I INTRODUCTION

A coupled wall structure is a combined system of frames and shear walls. It was first seriously studied by Khan (1964) and was a milestone in the development of taller concrete buildings. The system is usually situated at the core of a medium height building and often provides spaces for elevator shafts, stairwells, and storage areas (Figure 1). In the coupled wall system, two or more individual wall piers are coupled together by reinforced concrete beams to form a structure that has large lateral stiffness and strength. By coupling individual flexural walls, the lateral loads, such as wind loads and earthquake motions, are resisted by an axial compression-tension couple across the wall system, rather than by the individual flexural action of the walls (Harris et. Al. 2000). The beams that connect wall piers are called coupled beams. Coupling beams serve the same purpose as the link beams in frame structures. When resisting large lateral loads, coupling beams develop plastic hinges and rotate in similar manner over the height of the building (Aktan and Bertero 1981). As a result, the energy can be dissipated by being distributed over the height of the structure in the coupling beams instead of concentrating it predominantly in the first-story piers (Aktan and Bertero 1984). The design of coupling beam is essential for the coupled wall structure to be effective since the stiffness of the beam to the wall controls the structure's ductility and the hierarchy at yielding. Guidelines and suggestions regarding designing coupled wall system were discussed by Moazzami (1995) and Harries (2001). The *Prestandard and Commentary for the Seismic Rehabilitation of Building* published by American Society of Civil Engineers (ASCE 2000) and *Building Code Requirements for Structural Concrete and Commentary* published by American Concrete Institute (ACI 2002) also contain restrictions that can serve as principles when designing coupled shear walls.

In this research, coupled shear wall structures were modeled and tested by computer simulation, SAP2000. While majority researchers focus only on the core structures, this report is going to present two phases of studying. In the first phase, the conventional method of modeling only the coupled wall system was performed. Parametric studies were conducted by alternating the height, the degree of coupling (DC), and the shape of the wall piers. Both linear-elastic and non-linear pushover tests were completed. Results from the study demonstrated how the parameters influenced the performance and behavior of coupled walls. The results were compared to current literature to prove the validity of the computer modeling. In the second phase, entire building was modeled with coupled wall located in the center of the building. More elaborate computer testing was completed in the parametric studies. A response spectrum was input into the computer program to simulate real earthquake situation. The results from the two phases were compared. Based on the simulation results, properties regarding the performance of coupled wall structures were able to be observed and possible future studies related to the topic were suggested as well.

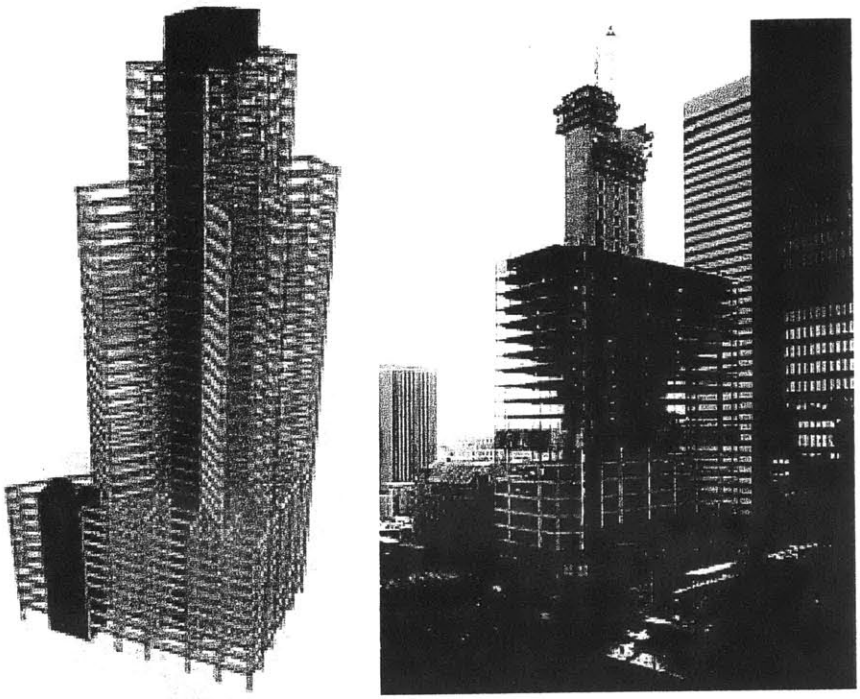

Figure 1 Coupled Wall Structures (www.cs.co.kr/cma/ data/sabo/200001/05.htm)

II LITERATURE REVIEW

Numerous researches have been carried out analytically and experimentally on coupled shear structures. The studies of coupled walls can be divided into two categories: static analysis and dynamic analysis. Each category has been utilizing two approaches, which are continuum method and finite element method. There are few literatures that examine the coupled wall structure by employing computer software or pushover analysis. However, the literature reviewed built a rich background as the preparation for this study. The suggestions and results from existing literature provide resources as comparisons for the results generated by this research and also serve as potential explanations for the structural behaviors shown by computer simulation.

While the topics of the literature relating to this topic were relatively broad, there are a number of them that offers valuable information and are described in this section. The concept of degree of coupling (DC) was discussed in detail in the paper published by Harries (2001). DC represents the ratio of the total overturning moment resisted by the coupling action to the total overturning moment. The mathematical formula that represents DC is as follows:

$$DC = PL / (\sum M_o + PL)$$

Where P = axial load in walls due to shears in coupling beams

L = lever arm between centroids of wall piers

M_o = overturning moments in individual wall piers

In additional to the traditional definition of DC, the paper also presented empirical formulas of degree of coupling from other researches using different approaches. The report also noted the limitation of degree of coupling and proposed that the DC should not exceed 50% for conventionally reinforced concrete coupling beams and 55% for diagonally reinforced breams.

Other studies that concerned the degree of coupling can be seen in the report by Munshi and Ghosh (2000). Two coupled wall structures with weak coupling and adequate coupling were inspected under earthquake motion simulated by the program DRAIN-2DX. The analysis indicated that weakly coupled walls tend to develop excessive ductility demand and biased response under some critical ground motions, whereas walls that are adequately coupled produce displacement and ductility consistent with the design. The adequately coupled wall in this report was also cost-effective, for it saved about 25% in concrete and 30% in steel when comparing to the weekly-coupled system. Chaallal et. Al. (1996) developed methods to classify coupled wall system based on the magnitude of axial force or degree of coupling. The report concluded a boundary of 0.33 as the minimum for DC. Buildings were considered inadequately coupled if DC was below the minimum value. For buildings above 30 stories, the DC should be greater than 0.66, which was not difficult to satisfy. Many literature referred that increasing DC would also in term raise the ductility demand. Researchers ought to be cautious to take the fact in to consideration when optimizing the coupled wall design.

Besides the degree of coupling, other research articles were reviewed for the purpose of this study. Kwan and Chan (1999) performed an analysis on the circumstances when coupling beams were out of plan relative to the wall piers. The report found that the effective stiffness of a coupling was dependent on the angles between the beam and the walls. The beams would exhibit greater stiffness when the angles between the beams and walls were small, and vice versa.

Literatures involving better modeling methods were the most common. Coull and Choudhury (1967) offered curves derived from hand calculation to quickly evaluate important properties of coupled walls. Another calculation method was presented by Tso and Rutenberg (1977) based on the response spectrum technique. Other studies such as the reinforcement in the coupling beam, comparison between concrete coupling beams and steel coupling beams, and the methods to upgrade existing coupled wall system were reviewed for the benefit of this research.

The previously mentioned researches all performed laboratory testing or analytical analysis on the coupled wall systems. There is yet no study which investigates the entire building structure to observe the interaction between coupled wall and the rest of the elements. In comparison to current research papers relating to coupled wall structures, this study is innovative and very useful for its contribution in precise empirical observation utilizing computer-modeled analysis. It is hoped that the results of this study will serve as valuable resource for future researchers and as one of the references for analytical studies.

III METHODOLOGY AND PROCEDURES

3.1 Phase I – Investigation of Coupled Wall Structure Only With Linear and Pushover Analysis

To establish a parametric study, nine coupled wall structures were modeled using the computer software SAP 2000. SAP is an integrated software for structural analysis and design. It has very versatile functions and allows users to not only perform a linear analysis of structures but also numerous options in dynamic analysis in order to investigate the effect of earthquake motions on structures. The models that were developed in this study were: 10-story with C-shaped wall piers, 10-story with rectangular-shape wall piers, and 20-story with C-shaped wall piers, each with regular, high, and low degree of coupling. Three dimensions of coupling beams were used to very the degree of coupling and will be explained later in this section. The design of models were inspired by the analysis examples performed by Paul Brienen (2002), a structural engineer in Cary Kopczynski and Company, Inc. In the analysis, Brienen modeled a ten-story coupled wall structure with C-shaped wall piers, which was applied in this study. Besides using the same dimensions for the coupled wall and entire structure, the parametric study was perform by altering the existing shape of the wall piers and the building height in order to satisfy the objective of the research. The detailed plan view of the coupled wall core structure from Brienen's model is shown in Figure 2 and 3. The side view of the building can be seen in Figure 4.

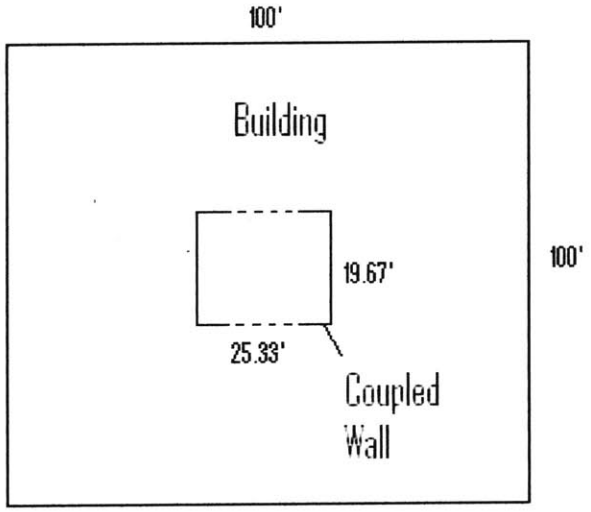

Figure 2 Floor Plan

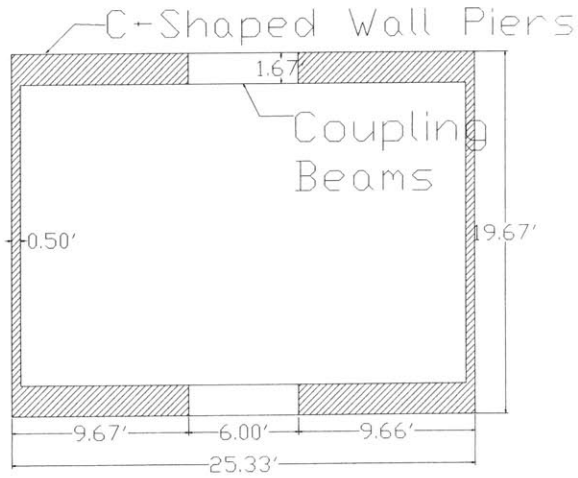

Figure 3 C-Shaped Coupled Wall Dimensions

The total floor area in Brienen's example was 10,000 square feet with 100 feet on each side. The floor height in the example was indicated as 12' 2'' for the first floor and 9' 2'' for the second floor and up, which was considered too short in this project to accommodate for human comfort. Therefore, the floor height was increased to 15 feet throughout the building. As shown in Figure 3, the coupled wall system was simplified to a plane frame. Due to the fact that the frame is a side view of the building, the beams represent the two coupling beams and the piers in Figure 3 stand for the centroids of the C-shaped wall, which was conventionally done in numerous researches. The magnitude of the loads from Brienen's report was adopted for this analysis. The loads included in this example were tabulated in Table 1. The loads from cladding, columns and core wall were decided not important for the loading onto the core structure. Therefore, the weight from these facilities was eliminated in this study. The detail of Brienen's analysis is not included in the project since it is not the focus of the subhect. Further information can be obtained by request to Cary Kopczynski and Company, Inc.

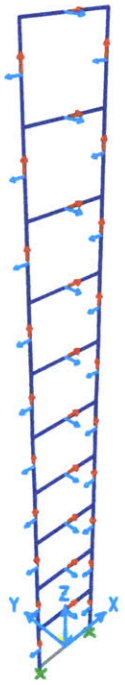

Figure 4 Side View of Simplified Coupled Wall Structure

Table 1 Loads Applied on the Building

Loads	Magnitude
Floor Plate, 8'' @ 150 pcf	100 psf
Mechanical/Electric/Pluming	5 psf
Partitions	10 psf
Cladding/Columns/Core wall and beams	35 psf
Live Loads	50 psf

All the dead loads were checked with Massachusetts Building Code and were found reasonable. A live load of 50 psf was added for office use. The load combination used was calculated as follows:

1.2 DL + 0.5 LL + 1.0 E (Massachusetts Building Code, 1997)

Where DL = Dead loads
LL = Live loads
E = Earthquake loads

The above formula was adopted because it was the load combination that could generate the largest load on the building when earthquake motion was present. The combined loads were then placed to the coupling beams as distributed loads and to the joints as concentrated loads. The core structure was calculated to afford half of the loads assigned to the building using two-way loading method. The calculation is attached in Appendix B. The horizontal loads which acted as earthquake loads were specified by Brienen as well. Table 2 shows the horizontal loads applied on each floor.

The material properties of concrete were defined by the default of SAP 2000, in which included density, Young's modulus, Poisson's ratio, Coefficient of thermal expansion, shear modulii, and yield stresses of concrete and steel reinforcement. The default values were acceptable and there was no need to re-define the properties. The moment of inertia of the beam was adjusted to be 0.35 of the original value in the bending direction, and the moment of inertia of the wall piers was reduced to 0.7 in the upper stories and 0.35 for the first story. The purpose of using a smaller moment of inertia in the bending direction was to acknowledge the fact of reduced stiffness in structures. The reduced stiffness was due to the cracks generated in earthquakes. All the coefficients for reduction of stiffness were adopted from ACI code (2002). For the coupling beams, it was assumed to be rigid at the two ends as shown in Figure 5 where the wall piers situated.

Table 2 Horizontal Loads Applied on 10-Story Buildings

Floor	Horizontal Load (K)
10	318.2
9	279.3
8	241.6
7	205.1
6	170.0
5	136.4
4	104.5
3	74.7
2	47.2
1	23.0

For the models with rectangular wall piers, the dimension of the piers were designed so that it had the same distance from the centroid to the coupling beams as the C-shaped walls. The rectangular pier then had a cross section of 13 feet long by 1.67 feet wide. All the other parameters remained the same.

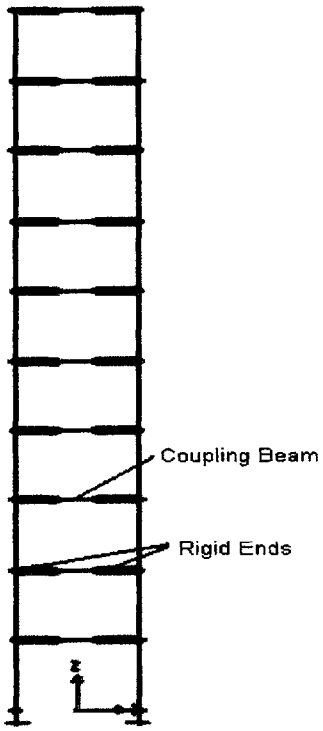

Figure 5 Coupling Beams with Rigid Ends

For the 20-story models, the horizontal loads needed to be re-calculated. The International Building Code (2000) was followed when calculating the horizontal earthquake load and the magnitudes of the loads are presented in Table 3. The calculation for the horizontal loads were included in Appendix D.

There were 3 different degree of coupling for each of the three cases: 10-story C-shaped wall piers, 10-story rectangular shaped wall piers, and 20-story C-shaped wall piers. Since the width of the C-shaped walls that were connected to the coupling beams were 20 inches, the depth of the coupling beams were modeled to be 24 inches to be conventional. It was recognized that increasing the beam depth would in term increase the degree of coupling, for deeper beams increase the stiffness of the walls and in term generate larger axial forces. The higher degree of coupling for the research was defined as altering the depth of the beam to 48 inches. On the other hand, the lower degree of coupling was defined to have a beam depth of 12 inches.

After all the preparation for computer modeling was completed, the nine models were analyzed linearly in SAP 2000. The results were not accurately representing the building's behavior due to the fact that the live loads and dead loads were extremely large on the core structure. In real situation, the core wall structure should not withstand half of the loads that acted on the building. The loads would more likely to be distributed uniformly on the columns placed on each floor, which reduced the forces that the coupled wall system had to afford. It was also found that the important properties that this research concern, such as the axial force, the overturning moments at the base, and the

base shear did not alter a great deal when the gravity forces were absent. Therefore, it was decided that the gravity loads could be eliminated in order to observe the behavior of coupled wall system under merely earthquake loads.

Table 3 Horizontal Loads Applied on 20-Story Models

Floor	Horizontal Load (K)
20	270.55
19	257.03
18	243.50
17	229.97
16	216.44
15	202.92
14	189.39
13	175.86
12	162.33
11	148.80
10	135.28
9	121.75
8	108.22
7	94.69
6	81.17
5	67.64
4	54.11
3	40.58
2	27.06
1	13.53

After the linear analysis was completed, reinforcement was designed for the coupling beams in each model. Conventional reinforcement was used for this research. Reinforcement was designed according to the largest moment in the beams in each model and all the coupling beams were assigned the same steel reinforcement. Detailed calculations were included in Appendix D. For some cases, the widths of the coupling beams were widened to accommodate the large moment. Reinforcement could not be designed for all the low degree of coupling cases because the beams would be too wide to be practical. The purpose of designing the reinforcement was to define the beam capacities and thus characterize the pushover behavior of the hinges. A typical pushover curve for the hinges is shown in Figure 6, which shows the key parameters that were used to outline the shape of the curve. The curve remained a linear-elastic relationship until the beams yielded. The moment capacity of the beams reduced slightly until the beams reached the ultimate rotation angle. The capacity of the beams then dropped to 20% of the yielding moment and remained at the same level until the beams disengaged with the wall piers.

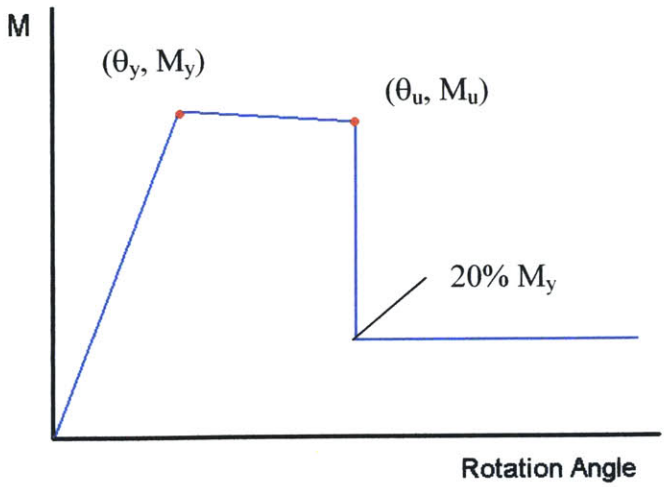

Figure 6 Moment-Rotation Relationships For Hinges

Hinges were assigned to the two ends of the coupling beams. The length of the hinges was assumed to be the same as the height of the beam. The hinges would form when the moment on the beams were greater than the yielding capacity. Once certain beams in the system failed, that was, beyond the ultimate point, the moment would be re-distributed to other beams on upper stories until the moment could not be re-distributed. In this approach, the capacity of the core wall structure could be observed although not all the hinges would form. SAP 2000 also classified the stages of hinges by different colors. With the aid of the computer simulation, the linear and non-linear analyses were successful performed. The results of the analyses are presented in section IV.

3.2 Phase II – Investigation of Entire Structure With Earthquake Response Spectrum

In Phase II of the project, building structures with shear wall at core were modeled by SAP2000. The objective of this phase was very similar to Phase I, and the parameters focused were identical. There were 50 computer models that were made for Phase II. The computer testing was more thorough and extensive in this part because of the lack of previous literature for guidance and reference. To vary the floor height of the building, models of 10 stories to 50 stories were created with a 10-story increment. For the parameter of wall pier shape, phase II placed an emphasis on C-shaped pier with openings of different degrees, since the testing results from Phase I had shown that C-shaped wall was more efficient than rectangular wall. The opening of the side wall piers were 0°, 15°, 30°, 45°, and 60° with respect to a horizontal line. The geometry of the wall piers was carefully modeled so that the distance between the left centroid to the right centroid were identical in each case. Figure 7 shows the plan view of different wall piers. The heights of the buildings were fixed at 30 stories while the shape of the piers varied. Each previously mentioned structure was tested with five different degrees of couplings.

The width of the coupling beams remained the same as Phase I while the depth of the beams ranged from 12 inches to 36 inches with a 6-inch increment. It was hoped that

the detailed setting would result in accurate prediction of coupled wall behavior and the interaction between the core and the rest of the structure.

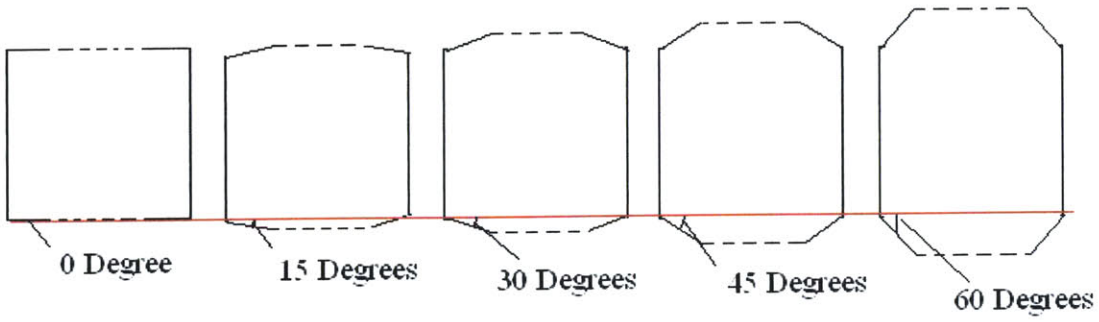

Figure 7 Plan View of Different Wall Piers Applied

An example of SAP2000 model in Phase II is displayed in Figure 8. It features a 30-story and 0-degree C-shaped wall pier building. The building was assumed to have a composite design, with steel frames and concrete floor slabs (not shown in the picture). The loads and load combinations used remained the same as the ones used in Phase I. Steel frame members were designed the designated load with a safety factor of at least 2. For simplicity, both the steel beams and columns were wide flange members W14x68. Steel reinforcements in the coupling beams were designed to withstand the moment and shear under the effect of gravity loads. The dimension of the building was modified to have 175 feet on each side with coupled wall structure of 25 feet by 25 feet at the core. The representation of earthquake loads was completed by inputting a response spectrum rather than calculating the corresponding pushover forces. It was anticipated that the dynamic analysis using acceleration response spectrum would simulate a more realistic earthquake situation than static pushover method.

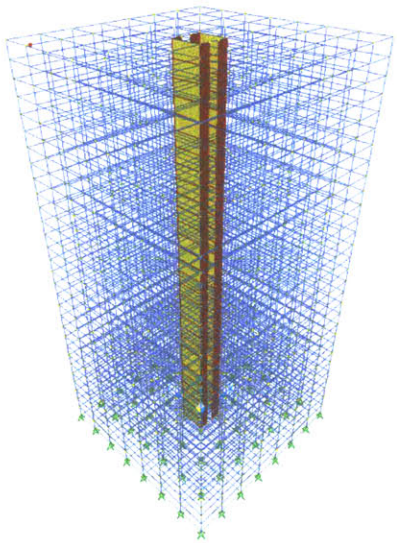

Figure 8 A 30-Story, 0-Degree C-Shaped Wall Pier Building

To select an appropriate earthquake, the data of a number of earthquakes were reviewed. Earthquake information was provided by Spectra Version 2001, a software developed by J.J. Connor, a structural engineering professor in MIT. In the program, response spectra and time histories could be generated by selecting the desired earthquake and specifying the damping coefficient of the structure. For this project, the buildings were not equipped with any form of dampers. However, the natural damping ratio of a building was approximately 2%, which was what it was assumed when obtaining the response spectrum. After observing the characteristics of earthquakes in Spectra, an earthquake occurred in San Fernando, CA in Feb. 9th, 1971 was selected. It was a very strong earthquake with maximum acceleration of 10.55 m/sec^2 (34.82 ft/sec^2), more than ground acceleration. The response spectrum generated is presented in Figure 9. The lateral earthquake force acted on the base of the building in the x-axis direction.

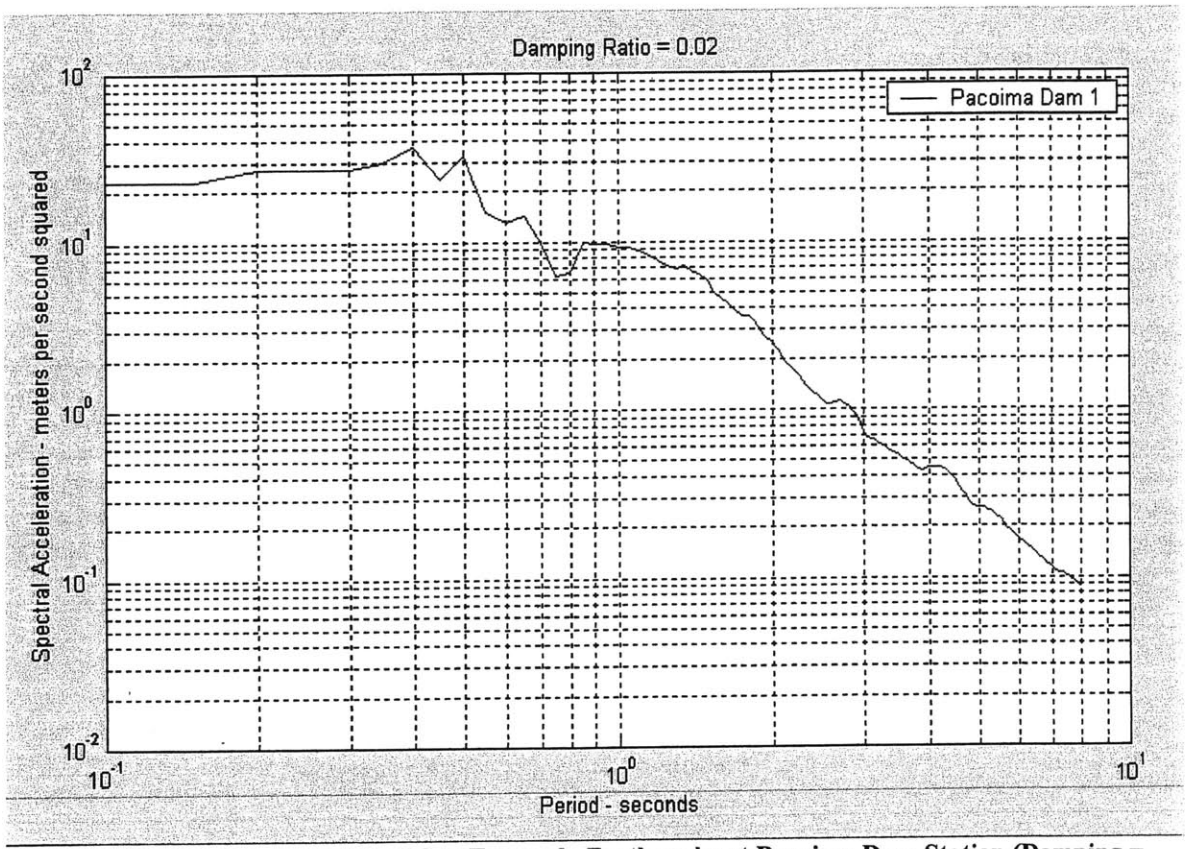

Figure 9 Acceleration Spectrum of San Fernando Earthquake at Pacoima Dam Station (Damping = 2%)

Besides the previously mentioned aspects, all other assumptions remained the same as Phase I. The following section displays the results and discusses the comparison of the outcome from computer outputs.

IV RESULTS AND DISCUSSION

4.1 Phase I Testing

4.1.1 Linear Analysis

Coupled Wall Structure with Different Shapes of Wall Piers

The linear-elastic analysis was carried out by using SAP 2000. The software provided outputs such as displacement, joint reactions, axial force, shear, and moments of every member. Appendix A shows the data and summary tables. From the results obtained, plots can be generated to further examine the linear performance of coupled walls. Figure 10 illustrates the comparison between C-shaped wall piers and rectangular-shaped walls in flexural behavior. The Y-axis offers a scale to measure the strength provided by coupling beams, and the X-axis represents the size of the coupling beams. While having the same coupling beams, the beams supplied the greatest percentage of strength for 10-story, rectangular wall models and the least in 10-story, C-shaped wall models. This fact explains that the 10-story, C-shaped wall piers could afford the most overturning moment than other models. It could also be observed that the wall stiffness in flexure decreased when the height of the building increased. The wall stiffness can be compared quantitatively as well. For example, the EI for the 10-story, rectangular wall building was 0.1E8 in^4 when the coupling was 82%, whereas the EI of the 10-story, C-wall model was 4.8E8 in^4 for the same percentage of coupling. Therefore, the C-wall piers were about 48 times more stiffness than rectangular walls. By applying the same approach, the stiffness of the piers for the 10-story, C-wall building was approximately 7 times greater than the 20-story, C-wall model.

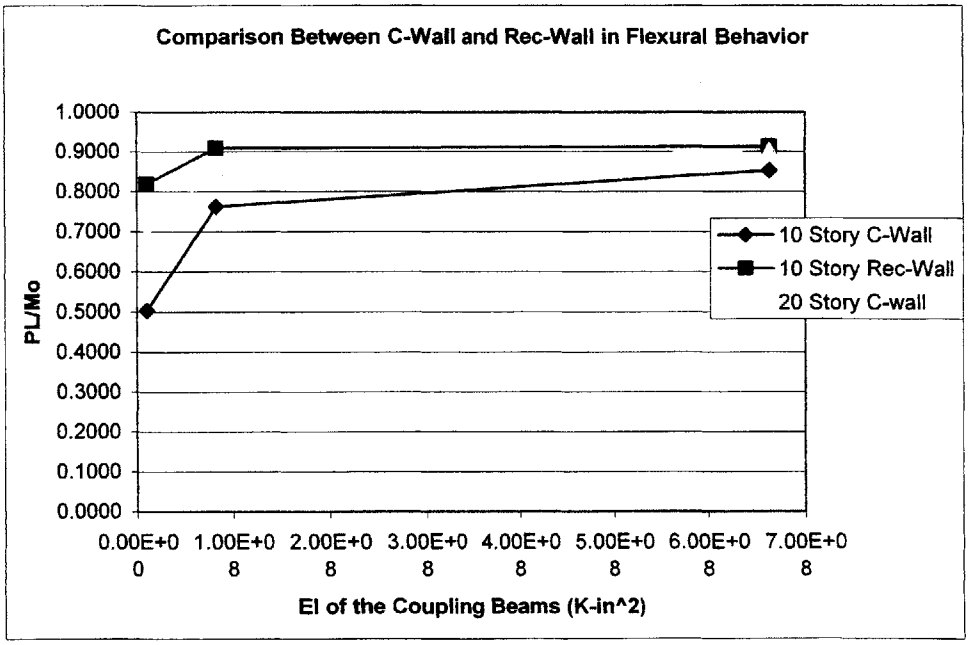

Figure 10 Flexural Behaviors of Models for Linear Analysis

Figure 10 also shows that the degree of coupling stopped increasing for the rectangular wall pier models after 90% of coupling. The degree of coupling grew slowly for the C-shaped wall models for bigger coupling beam sized and seemed to reach an asymptote. It was uncertain when the degree of coupling would end growing for each of the model since there were limited data points. However, it was clear that the degree of coupling would arrive at a certain point where the degree of coupling started growing in a slower rate. Another point that could be drawn from the graph was that while increasing the beam size, the degree of coupling increased the most significantly in 10-story, C-wall models, which shows that the models were most sensitive when responding to the variation of beam sizes.

A similar comparison was made between C-shaped walls and rectangular wall in shear behavior and was shown in Figure 11. The examination of shear behavior is relevant for short beam members such as those appeared in coupled wall structures. The graph exhibits the same hierarchy of wall stiffness in shear as in flexure. The wall stiffness of the 10-story, C-shaped wall was approximately 3.3 times larger than the 10-story, rectangular shaped wall models and 1.7 times greater than the 20-story, C-wall models. While most of the aspects of shear behavior and flexural behavior were alike, it was interesting to compare the magnitude of the shear area increased to the moment of inertia increased while the degree of coupling in the two graphs were identical. From Figure 10, the moment of inertia of the beams was amplified to 8 times larger from the small beam to medium beam while the shear area was only enlarged to twice as much from Figure 11. Due to the fact that the degree of coupling was increased by the same amount, it clearly showed that the degree of coupling corresponded to the shear area more strongly than to the moment of inertia.

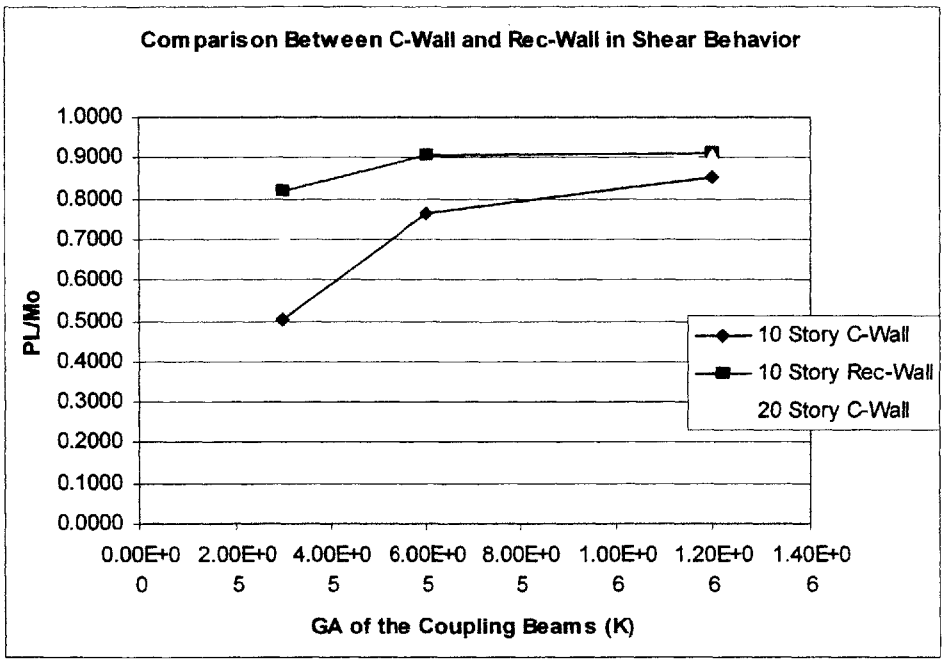

Figure 11 Shear Behaviors of Models for Linear Analysis

Coupled Wall Structures with Different Heights

Similar plots were generated to compare the difference between 10 and 20-story buildings in flexure and shear behavior. The X-axis in these plots were normalized by dividing the EI of the beams by EI of the wall piers to present a fair evaluation since in most real life cases, the size of the walls vary when changing the size of the coupling beams. However, a parametric study was performed in this research and the size of the coupling beams and the wall piers were the same for both 10-story, C-shaped wall models and 20-story, C-shaped coupled walls. The normalized plots essentially provided similar observations as the previous plots. Figure 12 shows the comparison between the two heights of buildings in flexural behavior, and Figure 13 presents the shear behavior.

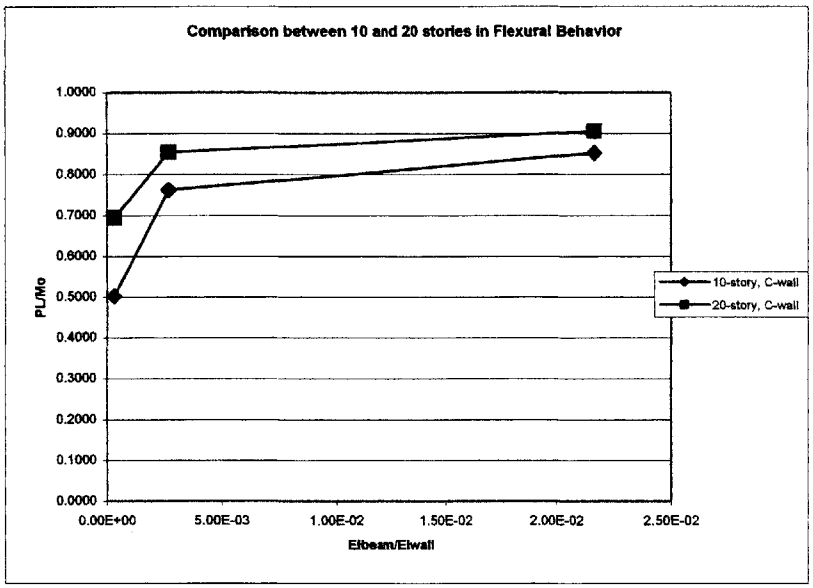

Figure 12 Comparison between 10 and 20-story Models in Flexural Behavior

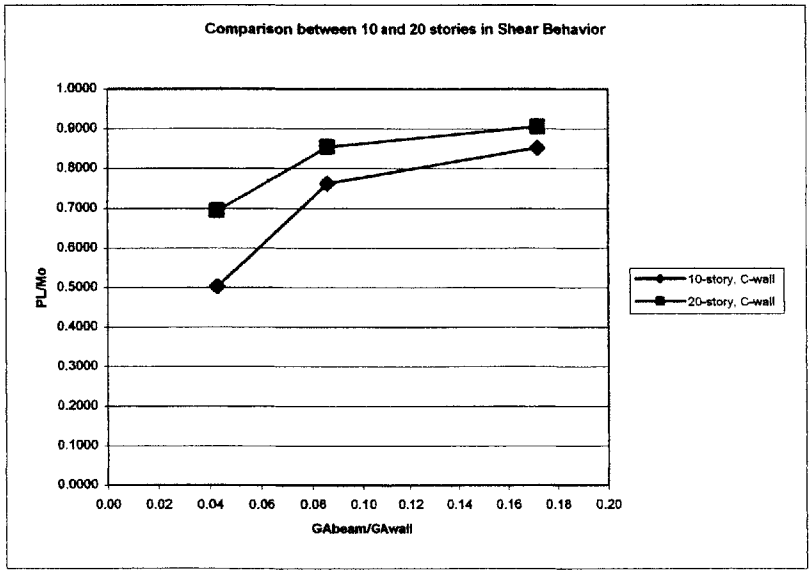

Figure 13 Comparison between 10 and 20-story Models in Shear Behavior

4.1.2 Pushover Analysis

10-Story Models

The summary table of the pushover analysis was enclosed in Appendix A. The table shows axial force, base shear, base moments, displacements at the top story for each step of the pushover procedures. Plots were generated to examine the pushover behavior of models. Figure 14 displays the relationship between the moment strength provided by coupling beams versus the displacement of the 10-story buildings, and Figure 15 presents the relationship between the base shear versus the displacement of the 10-story models. Both plots show similar trends. The curves exhibit a linear-plastic behavior for all the 10-story models but the high DC, C-shaped coupled system. The reason that the C-wall, high DC model never yielded was that the moment in the coupling beams were averagely large throughout the floors so that the moment from the hinged beams could not be re-distributed to other beams. The software then stopped analyzing once the moment could not be re-distributed. From Figure 14 and 15, the high degree of coupling models deflected less than the regular degree of coupling models. The rectangular wall models yielded at approximately the same moment or shear, whereas the high degree of coupling model of C-shaped wall yields at a much higher magnitude of both moment and shear.

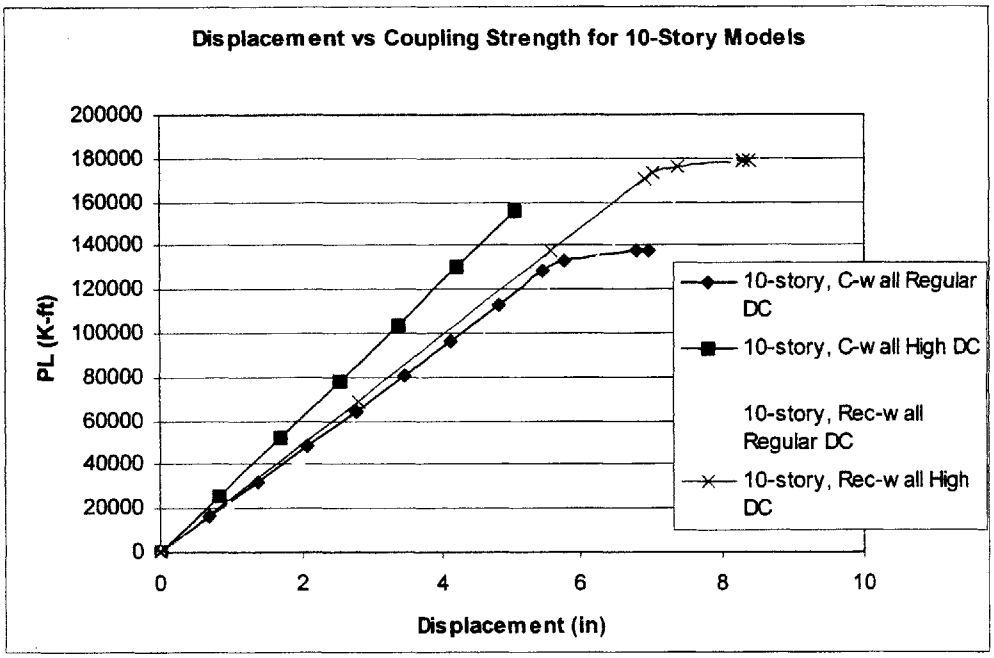

Figure 14 Displacement vs. Coupling Strength for 10-story Models

By comparing the C-shaped wall models and the rectangular shaped models, the C-shaped buildings deformed less quantitatively than rectangular-shaped structures. As expected, the moment provided by coupling (PL) started to level off once the beams started to yield and form hinges. The base shear then in term stabilized and behaved as free, individual cantilevers. At this stage, the wall piers would require much less base shear for the same amount of displacements.

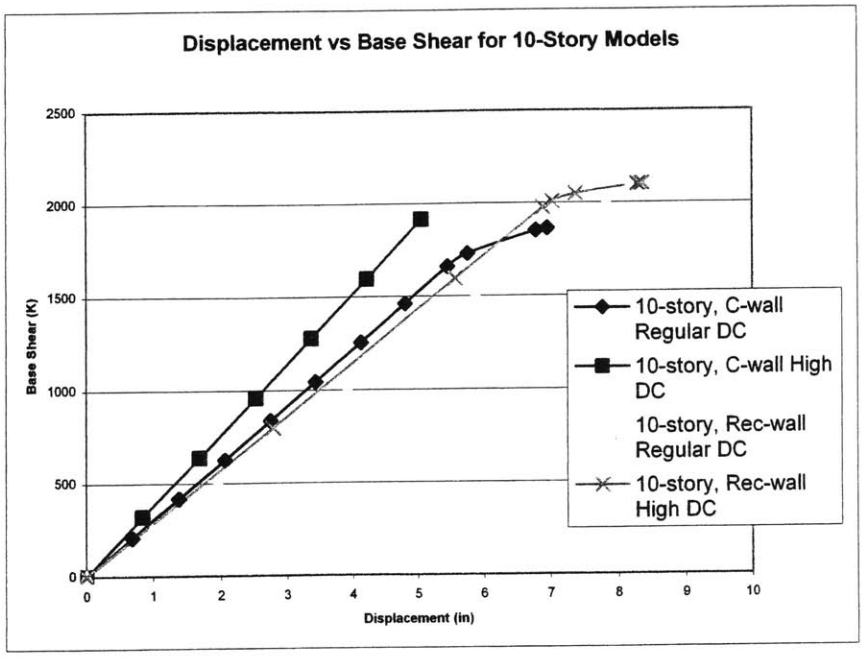

Figure 15 Displacement vs. Base Shear for 10-story Models

20-Story Models

Figure 16 and 17 show the same parameters for 20-story models. The slopes of the curves were almost identical to each other. The yielding step for each model was marked as a red dot on the graphs. These figures illustrated that the 20-story models also presented linear-elastic behavior. The curves were leveled off very slightly after yielding and it was more difficult to observe the behaviors after yielding. The deformation for 20-story models were approximately 5 times more than the 10-story models when measured empirically. The higher DC model also showed slightly less deflection than the regular DC model.

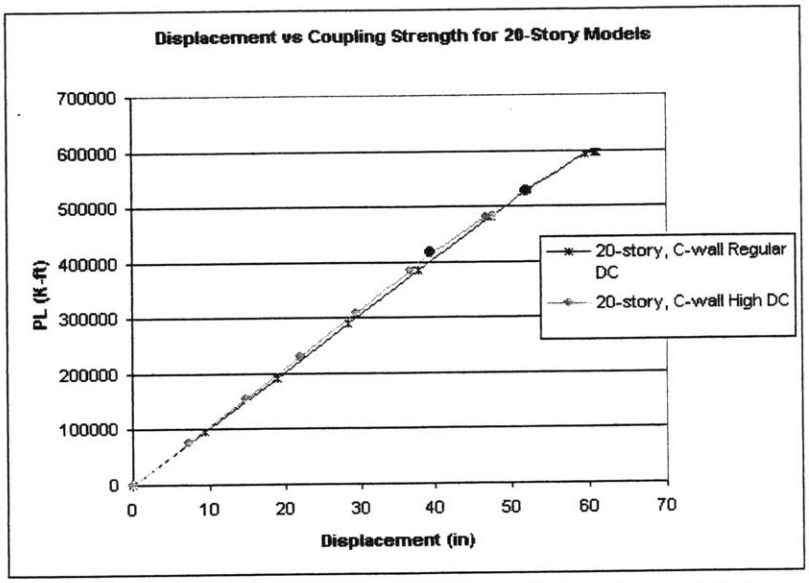

Figure 16 Displacement vs. Coupling Strength for 20-story Models

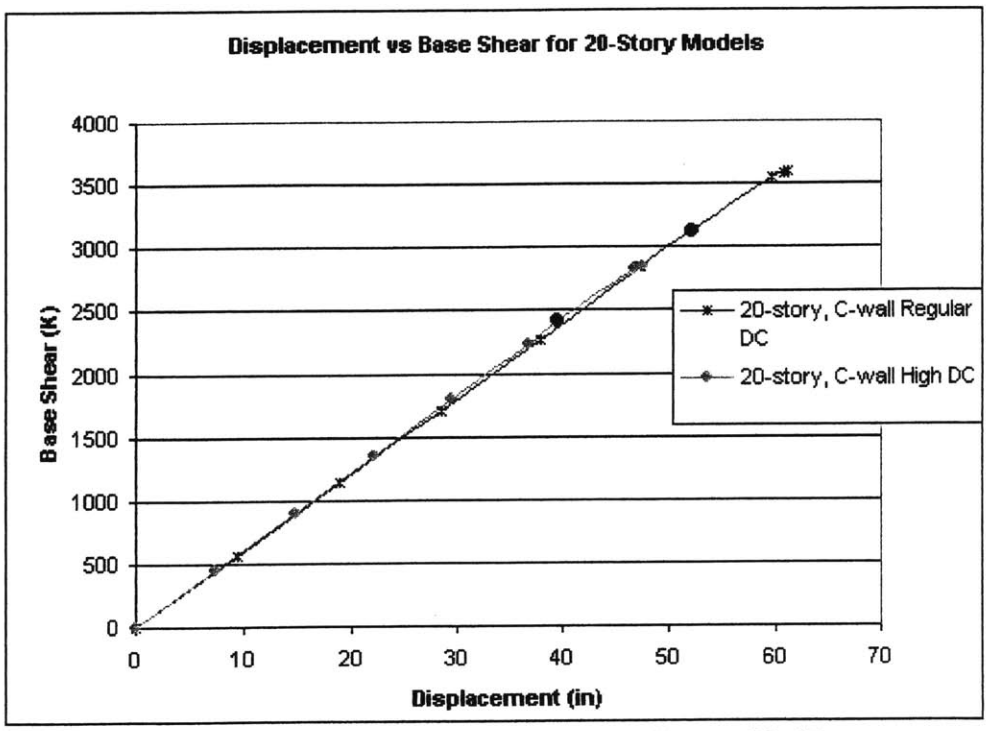

Figure 17 Displacement vs. Base Shear for 20-story Models

Displacement vs. Base Turning Moment

The relationship between the base overturning moment and the displacement was shown in Figure 18 for 10-story models and Figure 19 for 20-story models. It was obvious that C-shaped walls piers could withstand a much larger overturning moment than rectangular piers. By calculating the ratio of moments of C-wall and rectangular wall at the same displacement, the C-shaped wall has approximately 2.3 times more base moments than rectangular walls. The curves from Figure 18 and 19 showed that the base moments increased exponentially after yielding for some of the models. It was due to the disassociation of the coupling beams and the wall piers that the earthquake loads were mostly transformed to overturning moment. The rectangular wall models did not exhibit this behavior because there was not enough hinges forming to allow the walls move as free cantilevers. The 10-story, C-wall high DC model once again failed to re-distribute the coupling beam moments and never yielded in the process.

Finally, Figure 20 shows the strength provided by coupling beams during pushover analysis. The graph shows the same hierarchy in terms of the wall stiffness. The coupling remained constant and the dropped significantly after yielding, which was reasonable intuitively and theoretically.

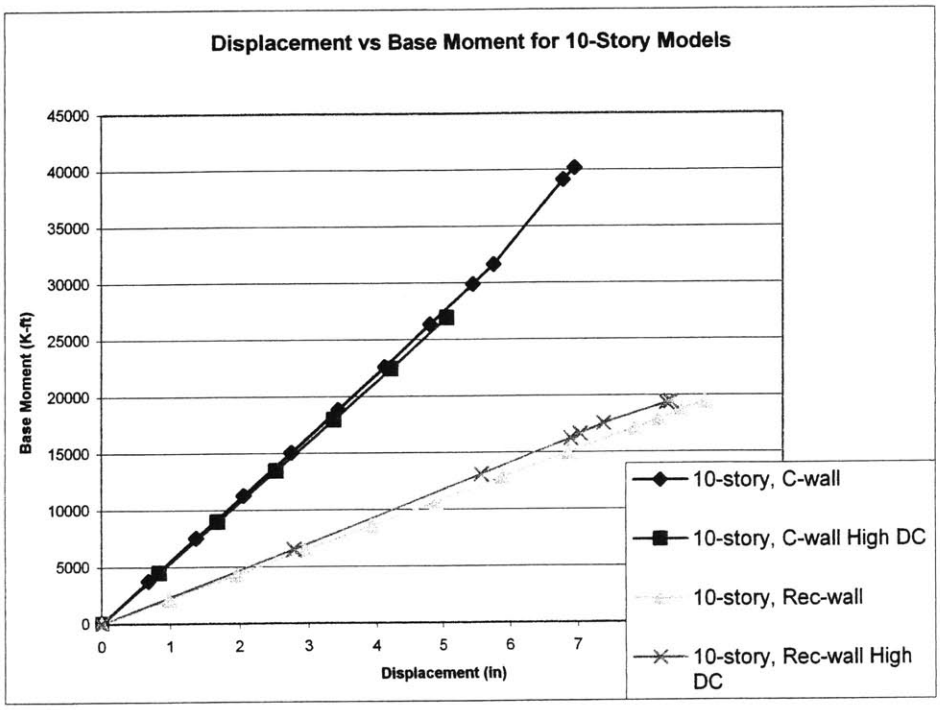

Figure 18 Displacement vs. Base Moment for 10-story Models

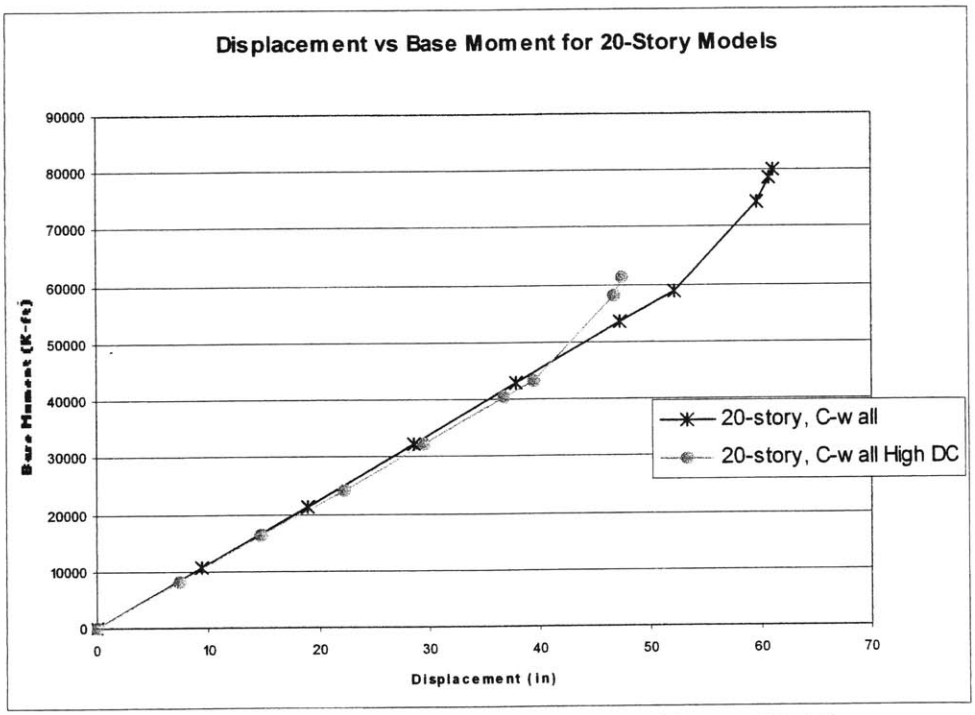

Figure 19 Displacement vs. Base Moment for 20-story Models

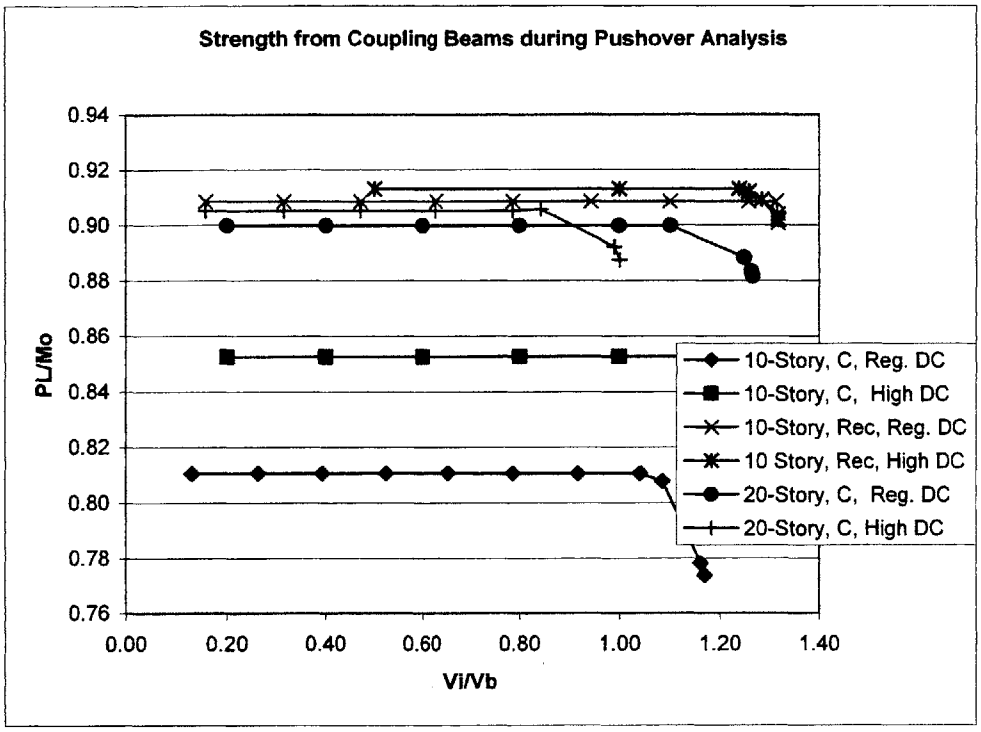

Figure 20 Degree of Coupling during Pushover Analysis

4.2 Phase II Testing

Phase II contains dynamic analysis by applying acceleration response spectrum of San Fernando earthquake. The details of element output for the building were very lengthy and were not the focus of this study. Therefore, the computer output for Phase II was not included. However, the summary table of results was enclosed in Appendix B for reference.

Coupled Wall Structures with Different Shapes of Wall Piers

Figure 21 displays the flexural behavior of the coupled wall structure when the shape of wall piers varied. All the curves in Figure 21 had the general outline. The degree of coupling (PL/Mo) initially increased with increasing beam depth until it reached the peak value. After the maximum DC that it achieved, degree of couplings dropped and eventually leveled off. The most ideal beam depth for this special case was 18 inches with the beam width of 24 inches. The degrees of coupling that these models achieved were in a narrow range, from 0.90 to 0.98. The most efficient angle opening of shear wall, according to empirical observation, was 15 degree with respect to horizontal. Figure 18 presents the shear behavior of concrete coupled walls with varying wall piers. The increase in shear area resulted in the change of degree of coupling in the pattern similar to what it shows in Figure 21. It was interesting to compare the magnitude of the shear area increased to the moment of inertia increased while the degree of coupling in the two graphs were identical. From Figure 21, the moment of inertia of the beams was

amplified to 3.35 times from 12-inch in depth to 18-inch in depth while the shear area only enlarged 1.5 times in magnitude. Due to the fact that the degree of coupling was increased by the same amount, it clearly showed that shear stiffness has a greater control over the behavior of degree of coupling.

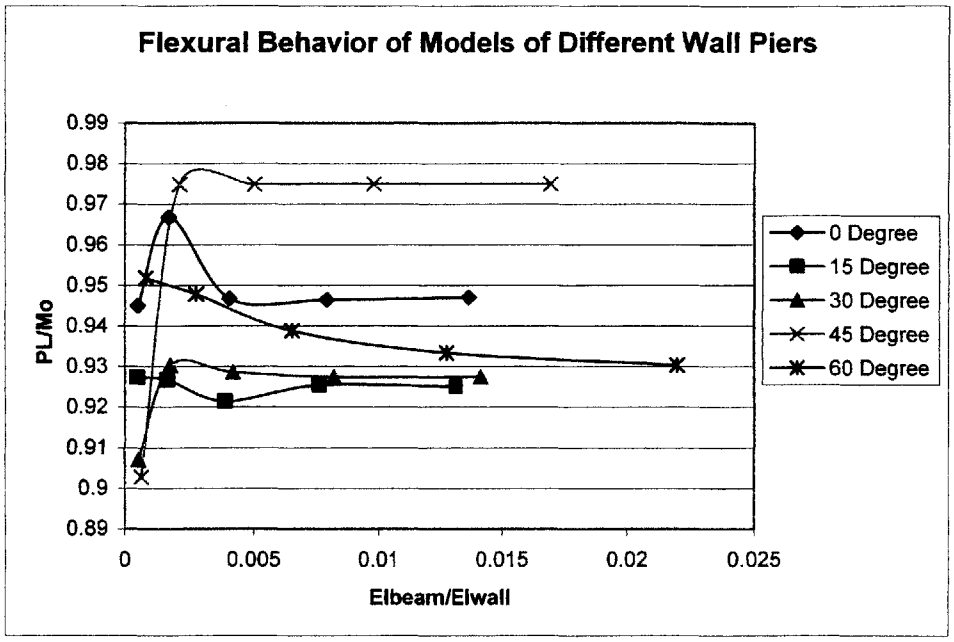

Figure 21 Flexural Behaviors of Models of Different Wall Piers

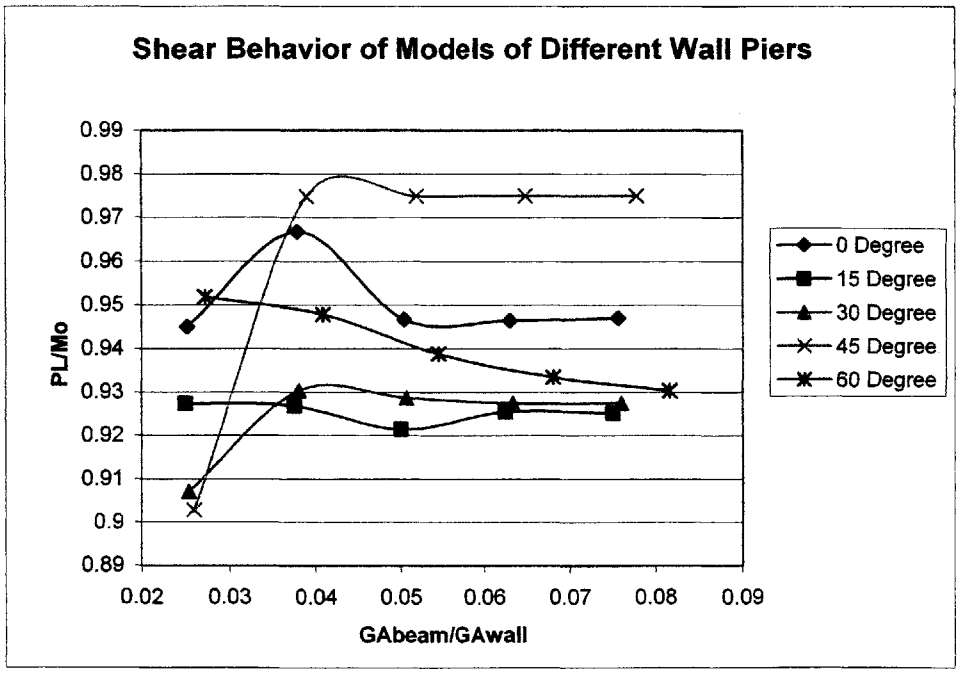

Figure 22 Shear Behaviors of Models of Different Wall Piers

Coupled Wall Structures with Different Heights

Similar plots were generated to observe how building height impacted on the building's flexural and shear behavior. The normalized plots showed that in general it was more difficult for taller buildings to achieve higher degree of coupling. Although the range of degree of coupling was very narrow in this situation, the DC increased in shorter buildings when the depth of coupling beams increased. On the other hand, the degree of coupling dropped with increasing depth in coupling beam for the case of 50 stories. The ideal beam depth for these building models was again 18 inches with the width of the beams being 12 inches. Comparing Figure 23 with Figure 24, the shear stiffness effectively controlled the degree of coupling than the flexural stiffness.

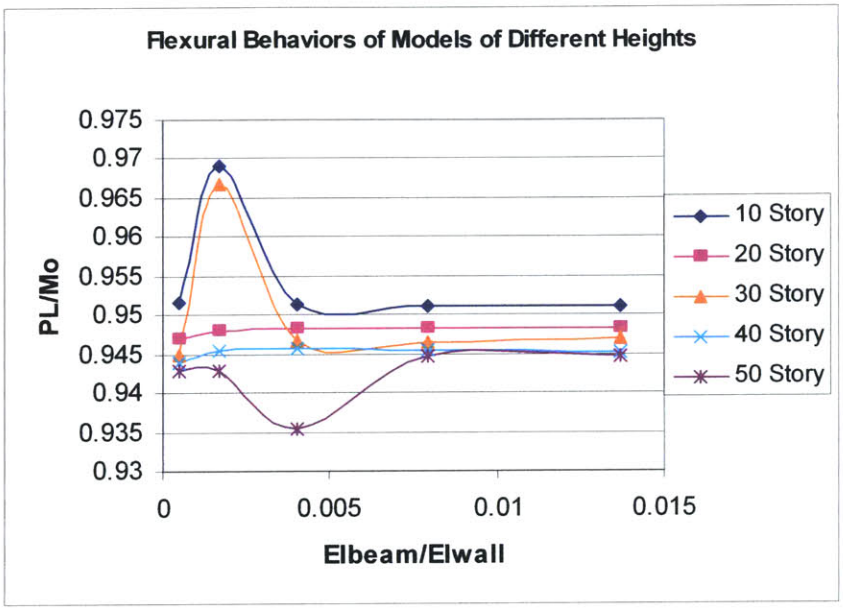

Figure 23 Flexural Behaviors of Models of Different Heights

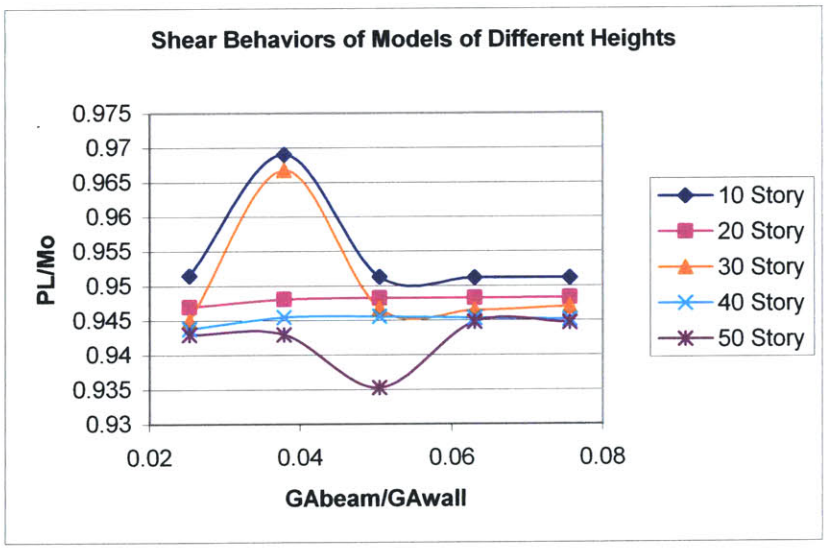

Figure 24 Shear Behaviors of Models of Different Heights

Displacement vs. Degree of Coupling for Buildings of Different Heights

Graphs of maximum lateral displacement versus PL/Mo were generated for different building heights. The figures are attached in Appendix C. The results regarding the relationship of these two variables were not conclusive from the outputs. For 10- and 30-story buildings, the degree of coupling increased with displacement to a peak value and dropped thereafter. For 20- and 40-story buildings, the displacement and the degree of coupling displayed linear relationship. The degree of coupling of these two models finally dropped at a very high displacement. For the 50-story model, the degree of coupling decreased with displacement to a minimum value and concaved back up. The graphs did not provide a clear trend from which scientific observations can be based upon.

Displacements vs. Degree of Coupling for Buildings with Different Shapes of Wall Piers

The graphs created were attached in Appendix C. The figures show that the degree of coupling decreased when maximum lateral displacements increased. It can be explained that when displacements were large, cracks started to be created in concrete beams to cause the drop of degree of coupling. Among the different shapes of wall piers, wall opening of 30 and 45 degrees seemed to be the most effective since the degree of coupling decreased in the slowest fashion in these two models.

Horizontal Displacements at the Top of Buildings with Shear wall and Plain Steel Frame Buildings

A comparison (Figure 25) of buildings with coupled wall structure at the core and buildings with only steel frame was completed. The coupled wall structures used were 10, 20, 30, 40, 50-story model with 0 degree C-shaped wall. Plain steel frame models of corresponding heights were created for the comparison. The buildings with shear walls demonstrated a steady trend that the lateral displacements increased with increasing height. Although the plain models did not display this feature, the overall lateral displacements were much larger than buildings with concrete coupled walls by the magnitude of 60 in average.

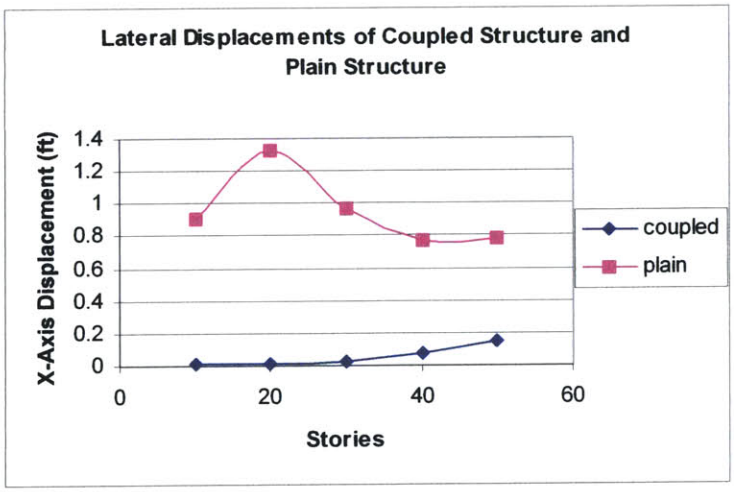

Figure 25 Lateral Displacements of Coupled Structures and Plain Steel Structures

Vertical Bending of Steel Floor Frames in Buildings with Shear Wall

Despite of the advantages that concrete coupled wall significantly reduced the lateral deflection of buildings, the stiffness of the concrete wall had a negative effect on the surrounding elements. The impact caused floors to bend to some extend, with the floors around the core structure suffering the most intensely. Figure 26 presents the vertical deflection of the top floor for models with the shear wall and models with plain steel frames. From the graph, it was clear that the vertical displacement of buildings with concrete coupled wall deflected much more severely than plain steel frame structure, with an average magnitude of 5.4. The phenomenon can be illustrated by Figure 27, which displays a 3-dimensional view of the building and a cross-sectional view of the building. This issue has brought to the attention of the consideration of different connections that can be used in a building. In the modeling process, all the connections in the buildings were assumed to be rigid. Therefore, the situation of vertical deflection could be improved by using different connections which allowed more flexibility in movements.

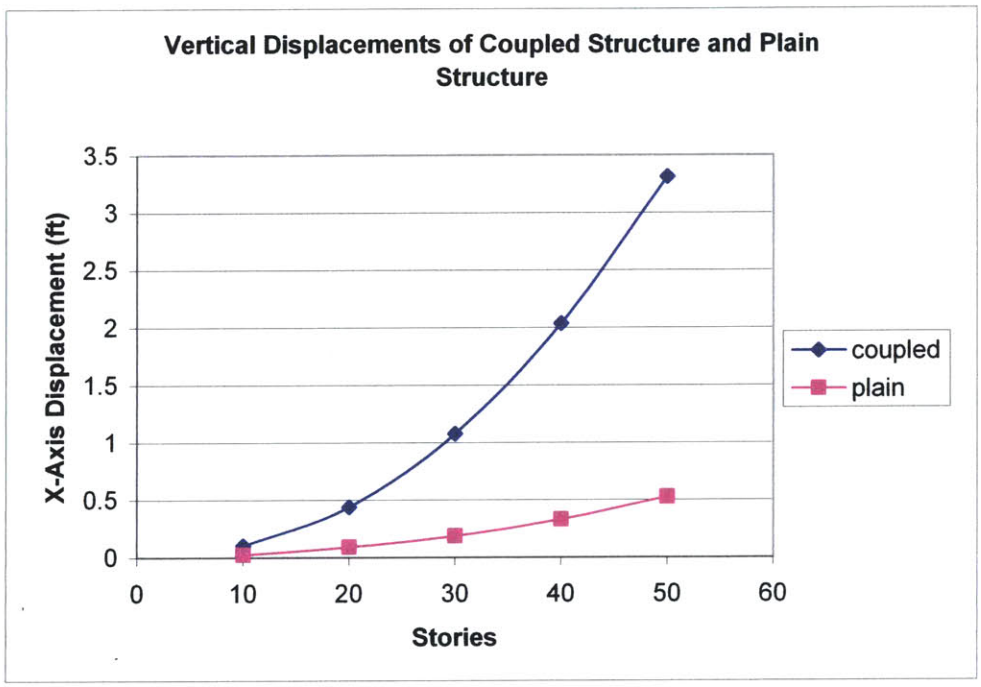

Figure 26 Vertical Displacements of Coupled Structure and Plain Steel Structure

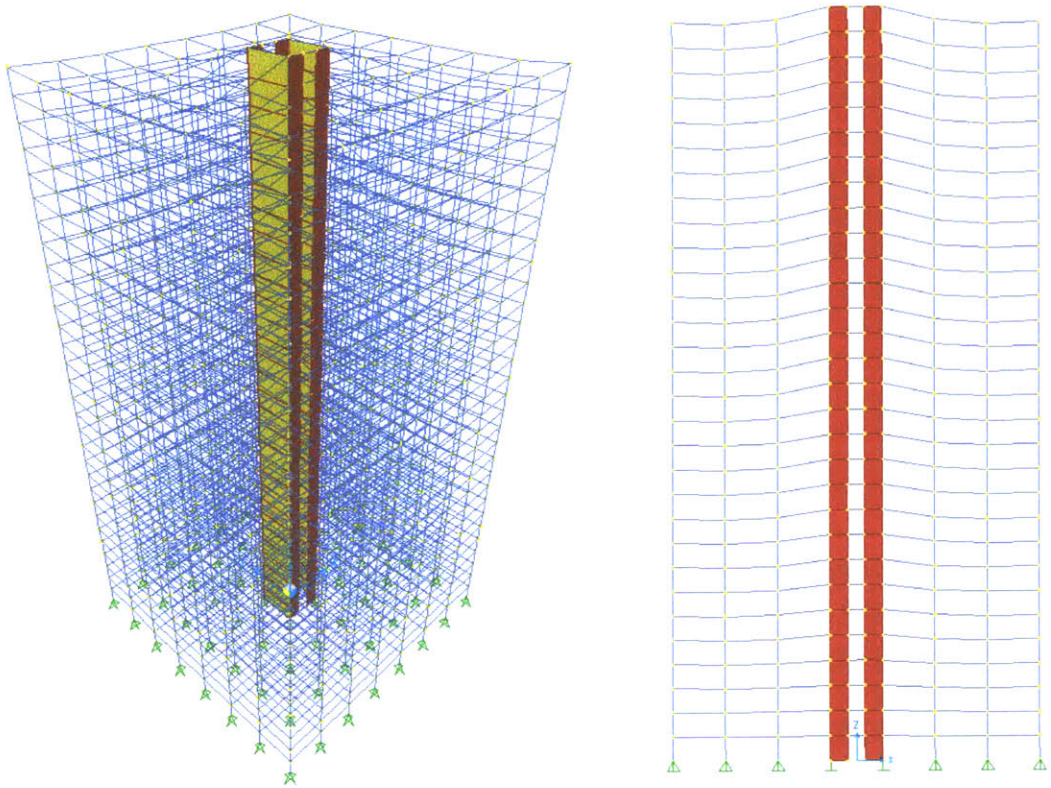

Figure 27 Bending of Floors

4.3 Comparison of Phase I and Phase II

The flexural and shear behaviors of the coupled wall were similar in both phases. However, the degree of coupling instead of leveling off at the end in Phase I, it reached a peak and dropped from that value. In Phase I, shorter buildings had more difficulty achieving higher degree of coupling due to the fact that coupling beams in higher buildings usually withstand much larger moment. In a more realistic setting generated in Phase II, shorter building accomplished higher degree of coupling, which coincided with other literature. The range of degree of coupling in Phase II was narrower and the values were higher, which represented that coupled walls worked very effectively in buildings when situated at the core.

In pushover analysis, the beam coupling strength increased with increasing displacement until it yields. In the response spectrum analysis, the concrete coupled wall was cracked during the test and therefore the degree of coupling dropped with increasing displacements. From this fact, it could be deducted that the base shear would decrease with increasing deflection in Phase II and the base moment at the piers would significantly increase as a result.

It was an interesting fact to note that the concrete coupled wall did not provide advantage for vertical deflection but worsen the effect of earthquake on floor deformation. Different connection methods should be employed to observe the optimum results at this respect.

V SUMMARY/CONCLUSIONS

This research formed a two-phase parametric study relating to the coupled wall structures. The parameters that this study emphasized were: the shaped of wall piers, the heights of structure, and the degree of coupling. In Phase I, the shapes of the wall piers applied were C-shaped walls and rectangular shaped walls. Story heights of 10 and 20 floors were studied. Computer models were built using the software SAP 2000 to simulate linear and non-linear behavior of coupled shear walls. In linear analysis, it was found that C-wall models had the greater stiffness in both flexure and shear than rectangular models and the stiffness decreased with the increase of the height of building. The degree of coupling for linear analysis leveled off ultimately and could not grow effectively when increasing the beam size. While comparing flexure and shear stiffness, it was recognized that shear stiffness corresponded to the shear area more closely than the flexural stiffness to the moment of inertia.

For the pushover analysis, the models were loaded horizontally to the extent that the moment of the beams could not be re-distributed. Hinges were formed at the end of coupling beams and the wall piers acted similar to vertical cantilevers. The strength provided by coupling and base shear increased very slowly after the coupling beams yielded. On the other hand, the overturning moment increased significantly during this period since the wall piers withstood the horizontal loads without the aid of coupling beams. The degree of coupling of the beams remained constant and dropped considerably after the yielding of the beams.

In Phase II, dynamic analyses of buildings with core shear wall structures were carried out. The flexural and the shear behaviors of coupled wall were similar to Phase I. It was found that piers with 45-degree opening could achieve the highest degree of coupling, and piers with 15-degree opening contained the most stiffness. Contrary to Phase I, taller buildings had more difficulty to acquire higher degree of coupling.

Due to the fact of the strong magnitude of San Fernando earthquake, the concrete core wall started to crack and dropped its coupling strength while displacements increased. The stiffness of the shear wall was much more significant than the steel frames of the building, which caused the floor frames to bend when in contact with the coupled wall.

The results from this study agreed with other researches regarding this subject and thus proved to be valid. Further investigation can be achieved by modeling more structures in order to obtain plots with more data. With detailed data, the performance of coupled wall system can be thoroughly observed and optimum design can be made based on the modeled results.

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APPENDIX A COMPUTER OUTPUTS AND SUMMARY TABLES FOR PHASE I

LINEAR ANALYSIS

	P (K)	L (ft)	M1 (K-ft)	M2 (K-ft)	Mo (K-ft)	PL/Mo	Eib (K-in^2)	Eiw (K-in^2)	Eib/Eiw	GAb (K)	GAw (K)	GAb/GAw
10 Story, C-Wall High DC	6818	19	11196	11200	151938	0.8526	663552000	3.06E+10	2.17E-02	1200000	6979200	0.17
10 Story, C-Wall Reg. DC	6172	19	18245	18217	153730	0.7628	82944000	3.06E+10	2.71E-03	600000	6979200	0.09
10 Story, C-Wall Low DC	4090	19	38504	38432	154646	0.5025	10368000	3.06E+10	3.39E-04	300000	6979200	0.04
10 Story, Rec-Wall High DC	7245	19	6535	6554	150744	0.9132	663552000	4.56E+10	1.46E-02	1200000	7800000	0.15
10 Story, Rec-Wall Reg DC	7123	19	6784	6819	148940	0.9087	82944000	4.56E+10	1.82E-03	600000	7800000	0.08
10 Story, Rec-Wall Low DC	6617	19	13867	13863	153453	0.8193	10368000	4.56E+10	2.27E-04	300000	7800000	0.04
20 Story, C-Wall High DC	25959	19	25640	25653	544514	0.9058	663552000	3.06E+10	2.17E-02	1200000	6979200	0.17
20 Story, C-Wall High DC	24656	19	39838	39828	548130	0.8547	82944000	3.06E+10	2.71E-03	600000	6979200	0.09
20 Story, C-Wall High DC	20082	19	84203	84164	549925	0.6938	10368000	3.06E+10	3.39E-04	300000	6979200	0.04

NON-LINEAR ANALYSIS

10 Story, C-Wall Regular DC

Steps	P (K)	L (ft)	M1 (K-ft)	M2 (K-ft)	Mo (K-ft)	PL/Mo	Vb (K)	Vi (K)	Vi/Vb	Displacement (in)	PL (K-ft)	2Vi (K)	M1+M2 (K-ft)
0	0	19	0	0	0	0.0000	797	0	0.0000	0	0	0	0
1	848	19	1882	1883	19877	0.8106	797	104	0.1305	0.6863	16112	208	3765
2	1696	19	3764	3766	39754	0.8106	797	209	0.2622	1.3725	32224	418	7530
3	2544	19	5646	5649	59631	0.8106	797	313	0.3927	2.0588	48336	626	11295
4	3393	19	7528	7531	79526	0.8106	797	418	0.5245	2.745	64467	836	15059
5	4241	19	9410	9414	99403	0.8106	797	522	0.6550	3.4313	80579	1044	18824
6	5089	19	11292	11297	119280	0.8106	797	627	0.7867	4.1175	96691	1254	22589
7	5937	19	13174	13180	139157	0.8106	797	731	0.9172	4.8038	112803	1462	26354
8	6736	19	14946	14953	157883	0.8106	797	830	1.0414	5.4501	127984	1660	29899
9	6997	19	15808	15815	164566	0.8078	797	865	1.0853	5.7552	132943	1730	31623
10	7220	19	19555	19562	176297	0.7781	797	926	1.1619	6.788	137180	1852	39117
11	7226	19	20076	20084	177454	0.7737	797	932	1.1694	6.9566	137294	1864	40160

10 Story, C-Wall High DC

Steps	P (K)	L (ft)	M1 (K-ft)	M2 (K-ft)	Mo (K-ft)	PL/Mo	Vb (K)	Vi (K)	Vi/Vb	Displacement (in)	PL (K-ft)	2Vi (K)	M1+M2 (K-ft)
0	0	19	0	0	0	0.0000	798	0	0.0000	0	0	0	0
1	1364	19	2239	2240	30395	0.8526	798	160	0.2005	0.8404	25916	320	4479
2	2729	19	4480	4482	60813	0.8526	798	319	0.3997	1.6816	51851	638	8962
3	4095	19	6722	6725	91252	0.8526	798	479	0.6003	2.5237	77805	958	13447
4	5463	19	8965	8969	121731	0.8527	798	639	0.8008	3.3666	103797	1278	17934
5	6833	19	11211	11215	152253	0.8527	798	798	1.0000	4.2104	129827	1596	22426
6	8204	19	13458	13462	182796	0.8527	798	958	1.2005	5.055	155876	1916	26920

10 Story, Rectangular Wall Regular DC

Steps	P (K)	L (ft)	M1 (K-ft)	M2 (K-ft)	Mo (K-ft)	PL/Mo	Vb (K)	Vi (K)	Vi/Vb	Displacement (in)	PL (K-ft)	2Vi (K)	M1+M2 (K-ft)
0	0	19	0	0	0	0.0000	796	0	0.0000	0	0	0	0
1	1120	19	1067	1072	23419	0.9087	796	125	0.1570	0.9789	21280	250	2139
2	2240	19	2133	2144	46837	0.9087	796	250	0.3141	1.9578	42560	500	4277
3	3359	19	3200	3216	70237	0.9087	796	376	0.4724	2.9367	63821	752	6416
4	4479	19	4266	4288	93655	0.9087	796	501	0.6294	3.9156	85101	1002	8554
5	5599	19	5333	5360	117074	0.9087	796	626	0.7864	4.8946	106381	1252	10693
6	6719	19	6399	6432	140492	0.9087	796	751	0.9435	5.8735	127661	1502	12831
7	7838	19	7466	7504	163892	0.9087	796	876	1.1005	6.8524	148922	1752	14970
8	8958	19	8532	8576	187310	0.9087	796	1001	1.2575	7.8313	170202	2002	17108
9	9351	19	8906	8952	195527	0.9087	796	1045	1.3128	8.175	177669	2090	17858
10	9331	19	9368	9414	196071	0.9042	796	1048	1.3166	8.5068	177289	2096	18782
11	9296	19	9695	9741	196060	0.9009	796	1048	1.3166	8.8579	176624	2096	19436

10 Story, Rectangular Wall High DC

Steps	P (K)	L (ft)	M1 (K-ft)	M2 (K-ft)	Mo (K-ft)	PL/Mo	Vb (K)	Vi (K)	Vi/Vb	Displacement (in)	PL (K-ft)	2Vi (K)	M1+M2 (K-ft)
0	0	19	0	0	0	0.0000	798	0	0.0000	0	0	0	0
1	3623	19	3267	3277	75381	0.9132	798	399	0.5000	2.7826	68837	798	6544
2	7245	19	6535	6554	150744	0.9132	798	798	1.0000	5.5653	137655	1596	13089
3	8976	19	8095	8120	186759	0.9132	798	988	1.2381	6.8947	170544	1976	16215
4	9104	19	8304	8328	189608	0.9123	798	1004	1.2581	7.0337	172976	2008	16632
5	9259	19	8755	8780	193456	0.9094	798	1024	1.2832	7.3757	175921	2048	17535
6	9427	19	9660	9686	198459	0.9025	798	1050	1.3158	8.2939	179113	2100	19346
7	9431	19	9704	9730	198623	0.9022	798	1051	1.3170	8.3557	179189	2102	19434

20 Story, C-Wall Regular DC													
Steps	**P (K)**	**L (ft)**	**M1 (K-ft)**	**M2 (K-ft)**	**Mo (K-ft)**	**PL/Mo**	**Vb (K)**	**Vi (K)**	**Vi/Vb**	**Displacement (in)**	**PL (K-ft)**	**2Vi (K)**	**M1+M2 (K-ft)**
0	0	19	0	0	0	0.0000	1420	0	0.0000	0	0	0	0
1	5063	19	5340	5351	106888	0.9000	1420	284	0.2000	9.4692	96197	568	10691
2	10125	19	10681	10702	213758	0.9000	1420	568	0.4000	18.9383	192375	1136	21383
3	15188	19	16021	16052	320645	0.9000	1420	852	0.6000	28.4075	288572	1704	32073
4	20251	19	21362	21403	427534	0.9000	1420	1136	0.8000	37.8767	384769	2272	42765
5	25313	19	26702	26754	534403	0.9000	1420	1420	1.0000	47.3458	480947	2840	53456
6	27884	19	29414	29471	588681	0.9000	1420	1564	1.1014	52.1543	529796	3128	58885
7	31197	19	37202	37266	667211	0.8884	1420	1773	1.2486	59.6472	592743	3546	74468
8	31374	19	39303	39368	674777	0.8834	1420	1793	1.2627	60.7371	596106	3586	78671
9	31368	19	39997	40062	676051	0.8816	1420	1797	1.2655	61.0435	595992	3594	80059

20 Floors, C-Wall High DC													
Steps	**P (K)**	**L (ft)**	**M1 (K-ft)**	**M2 (K-ft)**	**Mo (K-ft)**	**PL/Mo**	**Vb (K)**	**Vi (K)**	**Vi/Vb**	**Displacement (in)**	PL (K-ft)	**2Vi (K)**	**M1+M2 (K-ft)**
0	0	19	0	0	0	0.0000	1424	0	0.0000	0	0	0	0
1	4055	19	4031	4033	85109	0.9053	1424	224	0.1573	7.3523	77045	448	8064
2	8109	19	8061	8065	170197	0.9053	1424	448	0.3146	14.7046	154071	896	16126
3	12164	19	12092	12098	255306	0.9053	1424	672	0.4719	22.0569	231116	1344	24190
4	16219	19	16122	16131	340414	0.9053	1424	896	0.6292	29.4092	308161	1792	32253
5	20274	19	20153	20164	425523	0.9053	1424	1120	0.7865	36.7614	385206	2240	40317
6	21918	19	21648	21660	459750	0.9058	1424	1203	0.8448	39.489	416442	2406	43308
7	25304	19	29051	29064	538891	0.8922	1424	1410	0.9902	46.7741	480776	2820	58115
8	25438	19	30623	30637	544582	0.8875	1424	1425	1.0007	47.5756	483322	2850	61260

Top Displacements (in)		
	Linear	**Pushover**
10 Story, C-Wall High DC	4.202	5.51
10 Story, C-Wall Reg. DC	6.806	6.957
10 Story, C-Wall Low DC	19.57	N/A
10 Story, Rec-Wall High DC	5.565	8.356
10 Story, Rec-Wall Reg DC	6.227	8.858
10 Story, Rec-Wall Low DC	30.851	N/A
20 Story, C-Wall High DC	46.77	47.58
20 Story, C-Wall High DC	56.74	61.04
20 Story, C-Wall High DC	116.41	N/A

 10-story. C-wall. reg DC

J O I N T D I S P L A C E M E N T S

JOINT	LOAD	U1	U2	U3	R1	R2	R3
1	LOAD1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	LOAD1	0.0243	0.0000	4.435E-03	0.0000	2.593E-03	0.0000
3	LOAD1	0.0726	0.0000	8.382E-03	0.0000	3.415E-03	0.0000
4	LOAD1	0.1309	0.0000	0.0117	0.0000	3.925E-03	0.0000
5	LOAD1	0.1949	0.0000	0.0145	0.0000	4.209E-03	0.0000
6	LOAD1	0.2616	0.0000	0.0167	0.0000	4.316E-03	0.0000
7	LOAD1	0.3286	0.0000	0.0183	0.0000	4.280E-03	0.0000
8	LOAD1	0.3938	0.0000	0.0194	0.0000	4.129E-03	0.0000
9	LOAD1	0.4557	0.0000	0.0202	0.0000	3.898E-03	0.0000
10	LOAD1	0.5134	0.0000	0.0206	0.0000	3.638E-03	0.0000
11	LOAD1	0.5671	0.0000	0.0208	0.0000	3.435E-03	0.0000
12	LOAD1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
13	LOAD1	0.0243	0.0000	-5.808E-03	0.0000	2.586E-03	0.0000
14	LOAD1	0.0725	0.0000	-0.0110	0.0000	3.408E-03	0.0000
15	LOAD1	0.1306	0.0000	-0.0154	0.0000	3.918E-03	0.0000
16	LOAD1	0.1946	0.0000	-0.0191	0.0000	4.202E-03	0.0000
17	LOAD1	0.2612	0.0000	-0.0221	0.0000	4.309E-03	0.0000
18	LOAD1	0.3281	0.0000	-0.0244	0.0000	4.272E-03	0.0000
19	LOAD1	0.3932	0.0000	-0.0260	0.0000	4.121E-03	0.0000
20	LOAD1	0.4550	0.0000	-0.0271	0.0000	3.890E-03	0.0000
21	LOAD1	0.5127	0.0000	-0.0278	0.0000	3.629E-03	0.0000
22	LOAD1	0.5662	0.0000	-0.0280	0.0000	3.422E-03	0.0000

J O I N T R E A C T I O N S

JOINT	LOAD	F1	F2	F3	M1	M2	M3
1	LOAD1	-799.6398	0.0000	-6172.4126	0.0000	-18245.2168	0.0000
12	LOAD1	-800.3602	0.0000	8187.9380	0.0000	-18216.9512	0.0000

F R A M E E L E M E N T F O R C E S

FRAME	LOAD	LOC	P	V2	V3	T	M2	M3
1	LOAD1	0.00	6172.41	0.00	-799.64	0.00	-18245.22	0.00
							-12247.92	0.00

	15.00	5579.88	0.00	-785.56	0.00	-1877.67	0.00
3	LOAD1						
	0.00	4673.78	0.00	-761.85	0.00	-10532.65	0.00
	7.50	4719.42	0.00	-761.85	0.00	-4818.80	0.00
	15.00	4765.06	0.00	-761.85	0.00	895.05	0.00
4	LOAD1						
	0.00	3821.24	0.00	-724.65	0.00	-8118.27	0.00
	7.50	3866.88	0.00	-724.65	0.00	-2683.43	0.00
	15.00	3912.52	0.00	-724.65	0.00	2751.42	0.00
5	LOAD1						
	0.00	2990.15	0.00	-672.45	0.00	-6058.19	0.00
	7.50	3035.79	0.00	-672.45	0.00	-1014.81	0.00
	15.00	3081.43	0.00	-672.45	0.00	4028.56	0.00
6	LOAD1						
	0.00	2221.32	0.00	-604.25	0.00	-4189.58	0.00
	7.50	2266.96	0.00	-604.25	0.00	342.32	0.00
	15.00	2312.60	0.00	-604.25	0.00	4874.22	0.00
7	LOAD1						
	0.00	1544.72	0.00	-519.26	0.00	-2467.74	0.00
	7.50	1590.36	0.00	-519.26	0.00	1426.72	0.00
	15.00	1636.00	0.00	-519.26	0.00	5321.19	0.00
8	LOAD1						
	0.00	981.93	0.00	-416.65	0.00	-939.66	0.00
	7.50	1027.57	0.00	-416.65	0.00	2185.20	0.00
	15.00	1073.21	0.00	-416.65	0.00	5310.05	0.00
9	LOAD1						
	0.00	544.59	0.00	-295.43	0.00	241.04	0.00
	7.50	590.23	0.00	-295.43	0.00	2456.78	0.00
	15.00	635.87	0.00	-295.43	0.00	4672.52	0.00
10	LOAD1						
	0.00	228.40	0.00	-155.34	0.00	754.29	0.00
	7.50	274.04	0.00	-155.34	0.00	1919.32	0.00
	15.00	319.67	0.00	-155.34	0.00	3084.35	0.00
11	LOAD1						
	0.00	-8187.94	0.00	-800.36	0.00	-18216.95	0.00
	7.50	-8142.30	0.00	-800.36	0.00	-12214.25	0.00
	15.00	-8096.66	0.00	-800.36	0.00	-6211.55	0.00
12	LOAD1						
	0.00	-7302.57	0.00	-791.44	0.00	-13708.29	0.00
	7.50	-7256.93	0.00	-791.44	0.00	-7772.49	0.00
	15.00	-7211.30	0.00	-791.44	0.00	-1836.69	0.00
13	LOAD1						
	0.00	-6286.20	0.00	-767.95	0.00	-10578.00	0.00
	7.50	-6240.56	0.00	-767.95	0.00	-4818.35	0.00
	15.00	-6194.93	0.00	-767.95	0.00	941.30	0.00
14	LOAD1						
	0.00	-5232.11	0.00	-730.45	0.00	-8158.35	0.00
	7.50	-5186.47	0.00	-730.45	0.00	-2679.94	0.00
	15.00	-5140.84	0.00	-730.45	0.00	2798.46	0.00
15	LOAD1						
	0.00	-4199.47	0.00	-678.15	0.00	-6097.42	0.00
	7.50	-4153.83	0.00	-678.15	0.00	-1011.30	0.00
	15.00	-4108.19	0.00	-678.15	0.00	4074.83	0.00
16	LOAD1						
	0.00	-3229.09	0.00	-609.95	0.00	-4229.55	0.00
	7.50	-3183.45	0.00	-609.95	0.00	345.05	0.00
	15.00	-3137.81	0.00	-609.95	0.00	4919.66	0.00
17	LOAD1						
	0.00	-2350.94	0.00	-524.94	0.00	-2508.49	0.00
	7.50	-2305.30	0.00	-524.94	0.00	1428.55	0.00
	15.00	-2259.66	0.00	-524.94	0.00	5365.58	0.00
18	LOAD1						
	0.00	-1586.59	0.00	-422.45	0.00	-981.43	0.00
	7.50	-1540.95	0.00	-422.45	0.00	2186.97	0.00
	15.00	-1495.31	0.00	-422.45	0.00	5355.37	0.00
19	LOAD1						
	0.00	-947.70	0.00	-302.07	0.00	200.22	0.00
	7.50	-902.06	0.00	-302.07	0.00	2465.73	0.00

	15.00	-338.67	0.00	-162.86	0.00	3169.95	0.00
21	LOAD1						
	6.50	-8.92	781.59	0.00	0.00	0.00	2351.25
	8.00	-8.92	783.09	0.00	0.00	0.00	1177.74
	9.50	-8.92	784.59	0.00	0.00	0.00	1.98
	11.00	-8.92	786.09	0.00	0.00	0.00	-1176.03
	12.50	-8.92	787.59	0.00	0.00	0.00	-2356.29
22	LOAD1						
	6.50	-23.49	912.59	0.00	0.00	0.00	2744.24
	8.00	-23.49	914.09	0.00	0.00	0.00	1374.22
	9.50	-23.49	915.59	0.00	0.00	0.00	1.96
	11.00	-23.49	917.09	0.00	0.00	0.00	-1372.56
	12.50	-23.49	918.59	0.00	0.00	0.00	-2749.32
23	LOAD1						
	6.50	-37.50	950.31	0.00	0.00	0.00	2857.40
	8.00	-37.50	951.81	0.00	0.00	0.00	1430.81
	9.50	-37.50	953.31	0.00	0.00	0.00	1.96
	11.00	-37.50	954.81	0.00	0.00	0.00	-1429.14
	12.50	-37.50	956.31	0.00	0.00	0.00	-2862.48 ← max
24	LOAD1						
	6.50	-52.30	928.87	0.00	0.00	0.00	2793.09
	8.00	-52.30	930.37	0.00	0.00	0.00	1398.66
	9.50	-52.30	931.87	0.00	0.00	0.00	1.98
	11.00	-52.30	933.37	0.00	0.00	0.00	-1396.94
	12.50	-52.30	934.87	0.00	0.00	0.00	-2798.12
25	LOAD1						
	6.50	-68.20	866.61	0.00	0.00	0.00	2606.33
	8.00	-68.20	868.11	0.00	0.00	0.00	1305.29
	9.50	-68.20	869.61	0.00	0.00	0.00	2.01
	11.00	-68.20	871.11	0.00	0.00	0.00	-1303.52
	12.50	-68.20	872.61	0.00	0.00	0.00	-2611.31
26	LOAD1						
	6.50	-85.01	774.37	0.00	0.00	0.00	2329.65
	8.00	-85.01	775.87	0.00	0.00	0.00	1166.96
	9.50	-85.01	777.37	0.00	0.00	0.00	2.03
	11.00	-85.01	778.87	0.00	0.00	0.00	-1165.16
	12.50	-85.01	780.37	0.00	0.00	0.00	-2334.59
27	LOAD1						
	6.50	-102.49	660.57	0.00	0.00	0.00	1988.26
	8.00	-102.49	662.07	0.00	0.00	0.00	996.27
	9.50	-102.49	663.57	0.00	0.00	0.00	2.04
	11.00	-102.49	665.07	0.00	0.00	0.00	-994.44
	12.50	-102.49	666.57	0.00	0.00	0.00	-1993.17
28	LOAD1						
	6.50	-120.38	535.11	0.00	0.00	0.00	1611.89
	8.00	-120.38	536.61	0.00	0.00	0.00	808.10
	9.50	-120.38	538.11	0.00	0.00	0.00	2.05
	11.00	-120.38	539.61	0.00	0.00	0.00	-806.24
	12.50	-120.38	541.11	0.00	0.00	0.00	-1616.79
29	LOAD1						
	6.50	-139.21	413.97	0.00	0.00	0.00	1248.53
	8.00	-139.21	415.47	0.00	0.00	0.00	626.45
	9.50	-139.21	416.97	0.00	0.00	0.00	2.12
	11.00	-139.21	418.47	0.00	0.00	0.00	-624.46
	12.50	-139.21	419.97	0.00	0.00	0.00	-1253.30
30	LOAD1						
	6.50	-162.86	326.17	0.00	0.00	0.00	985.35
	8.00	-162.86	327.67	0.00	0.00	0.00	494.96
	9.50	-162.86	329.17	0.00	0.00	0.00	2.33
	11.00	-162.86	330.67	0.00	0.00	0.00	-492.56
	12.50	-162.86	332.17	0.00	0.00	0.00	-989.70

J O I N T D I S P L A C E M E N T S

JOINT	LOAD	U1	U2	U3	R1	R2	R3
1	LOAD1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	LOAD1	0.0132	0.0000	4.895E-03	0.0000	1.104E-03	0.0000
3	LOAD1	0.0366	0.0000	9.021E-03	0.0000	1.588E-03	0.0000
4	LOAD1	0.0665	0.0000	0.0124	0.0000	1.986E-03	0.0000
5	LOAD1	0.1016	0.0000	0.0151	0.0000	2.295E-03	0.0000
6	LOAD1	0.1405	0.0000	0.0171	0.0000	2.519E-03	0.0000
7	LOAD1	0.1819	0.0000	0.0186	0.0000	2.662E-03	0.0000
8	LOAD1	0.2245	0.0000	0.0196	0.0000	2.733E-03	0.0000
9	LOAD1	0.2672	0.0000	0.0201	0.0000	2.743E-03	0.0000
10	LOAD1	0.3093	0.0000	0.0203	0.0000	2.707E-03	0.0000
11	LOAD1	0.3502	0.0000	0.0204	0.0000	2.654E-03	0.0000
12	LOAD1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
13	LOAD1	0.0131	0.0000	-6.403E-03	0.0000	1.097E-03	0.0000
14	LOAD1	0.0365	0.0000	-0.0119	0.0000	1.582E-03	0.0000
15	LOAD1	0.0664	0.0000	-0.0165	0.0000	1.980E-03	0.0000
16	LOAD1	0.1015	0.0000	-0.0202	0.0000	2.290E-03	0.0000
17	LOAD1	0.1403	0.0000	-0.0231	0.0000	2.513E-03	0.0000
18	LOAD1	0.1816	0.0000	-0.0253	0.0000	2.656E-03	0.0000
19	LOAD1	0.2242	0.0000	-0.0268	0.0000	2.727E-03	0.0000
20	LOAD1	0.2669	0.0000	-0.0278	0.0000	2.737E-03	0.0000
21	LOAD1	0.3090	0.0000	-0.0283	0.0000	2.700E-03	0.0000
22	LOAD1	0.3497	0.0000	-0.0284	0.0000	2.642E-03	0.0000

J O I N T R E A C T I O N S

JOINT	LOAD	F1	F2	F3	M1	M2	M3
1	LOAD1	-797.6286	0.0000	-6817.7261	0.0000	-11196.2725	0.0000
12	LOAD1	-802.3714	0.0000	9023.2500	0.0000	-11199.9531	0.0000

F R A M E E L E M E N T F O R C E S

FRAME	LOAD	LOC	P	V2	V3	T	M2	M3
1	LOAD1							
		0.00	6817.73	0.00	-797.63	0.00	-11196.27	0.00
		7.50	6863.36	0.00	-797.63	0.00	-5214.06	0.00

	15.00	5830.29	0.00	-782.48	0.00	1293.60	0.00
3	LOAD1						
	0.00	4708.93	0.00	-759.10	0.00	-9455.64	0.00
	7.50	4754.57	0.00	-759.10	0.00	-3762.37	0.00
	15.00	4800.21	0.00	-759.10	0.00	1930.90	0.00
4	LOAD1						
	0.00	3729.51	0.00	-721.94	0.00	-8337.02	0.00
	7.50	3775.15	0.00	-721.94	0.00	-2922.45	0.00
	15.00	3820.79	0.00	-721.94	0.00	2492.13	0.00
5	LOAD1						
	0.00	2817.74	0.00	-669.72	0.00	-7133.25	0.00
	7.50	2863.38	0.00	-669.72	0.00	-2110.37	0.00
	15.00	2909.02	0.00	-669.72	0.00	2912.50	0.00
6	LOAD1						
	0.00	1995.24	0.00	-601.51	0.00	-5864.85	0.00
	7.50	2040.88	0.00	-601.51	0.00	-1353.50	0.00
	15.00	2086.52	0.00	-601.51	0.00	3157.86	0.00
7	LOAD1						
	0.00	1285.66	0.00	-516.54	0.00	-4546.89	0.00
	7.50	1331.30	0.00	-516.54	0.00	-672.83	0.00
	15.00	1376.94	0.00	-516.54	0.00	3201.24	0.00
8	LOAD1						
	0.00	713.58	0.00	-414.00	0.00	-3197.37	0.00
	7.50	759.21	0.00	-414.00	0.00	-92.37	0.00
	15.00	804.85	0.00	-414.00	0.00	3012.64	0.00
9	LOAD1						
	0.00	302.84	0.00	-292.63	0.00	-1853.11	0.00
	7.50	348.48	0.00	-292.63	0.00	341.65	0.00
	15.00	394.12	0.00	-292.63	0.00	2536.41	0.00
10	LOAD1						
	0.00	70.39	0.00	-151.43	0.00	-636.04	0.00
	7.50	116.03	0.00	-151.43	0.00	499.72	0.00
	15.00	161.66	0.00	-151.43	0.00	1635.48	0.00
11	LOAD1						
	0.00	-9023.25	0.00	-802.37	0.00	-11199.95	0.00
	7.50	-8977.61	0.00	-802.37	0.00	-5182.17	0.00
	15.00	-8931.97	0.00	-802.37	0.00	835.62	0.00
12	LOAD1						
	0.00	-7723.98	0.00	-794.52	0.00	-10543.40	0.00
	7.50	-7678.35	0.00	-794.52	0.00	-4584.51	0.00
	15.00	-7632.71	0.00	-794.52	0.00	1374.37	0.00
13	LOAD1						
	0.00	-6473.35	0.00	-770.70	0.00	-9543.19	0.00
	7.50	-6427.71	0.00	-770.70	0.00	-3762.95	0.00
	15.00	-6382.07	0.00	-770.70	0.00	2017.28	0.00
14	LOAD1						
	0.00	-5273.38	0.00	-733.16	0.00	-8419.03	0.00
	7.50	-5227.74	0.00	-733.16	0.00	-2920.35	0.00
	15.00	-5182.10	0.00	-733.16	0.00	2578.32	0.00
15	LOAD1						
	0.00	-4141.05	0.00	-680.88	0.00	-7215.21	0.00
	7.50	-4095.42	0.00	-680.88	0.00	-2108.58	0.00
	15.00	-4049.78	0.00	-680.88	0.00	2998.04	0.00
16	LOAD1						
	0.00	-3098.01	0.00	-612.69	0.00	-5947.26	0.00
	7.50	-3052.37	0.00	-612.69	0.00	-1352.12	0.00
	15.00	-3006.73	0.00	-612.69	0.00	3243.03	0.00
17	LOAD1						
	0.00	-2167.87	0.00	-527.66	0.00	-4629.51	0.00
	7.50	-2122.23	0.00	-527.66	0.00	-672.08	0.00
	15.00	-2076.60	0.00	-527.66	0.00	3285.36	0.00
18	LOAD1						
	0.00	-1375.23	0.00	-425.10	0.00	-3280.95	0.00
	7.50	-1329.59	0.00	-425.10	0.00	-92.70	0.00
	15.00	-1283.96	0.00	-425.10	0.00	3095.54	0.00
19	LOAD1						
	0.00	-743.94	0.00	-304.87	0.00	-1937.94	0.00
	7.50	-698.31	0.00	-304.87	0.00	348.55	0.00

	15.00	-199.66	0.00	-166.77	0.00	1797.13	0.00
21	LOAD1						
	6.50	-7.85	1182.99	0.00	0.00	0.00	3564.60
	8.00	-7.85	1185.99	0.00	0.00	0.00	1787.86
	9.50	-7.85	1188.99	0.00	0.00	0.00	6.63
	11.00	-7.85	1191.99	0.00	0.00	0.00	-1779.11
	12.50	-7.85	1194.99	0.00	0.00	0.00	-3569.34 ← max
22	LOAD1						
	6.50	-23.82	1134.36	0.00	0.00	0.00	3418.16
	8.00	-23.82	1137.36	0.00	0.00	0.00	1714.37
	9.50	-23.82	1140.36	0.00	0.00	0.00	6.09
	11.00	-23.82	1143.36	0.00	0.00	0.00	-1706.70
	12.50	-23.82	1146.36	0.00	0.00	0.00	-3423.98
23	LOAD1						
	6.50	-37.54	1083.70	0.00	0.00	0.00	3266.14
	8.00	-37.54	1086.70	0.00	0.00	0.00	1638.35
	9.50	-37.54	1089.70	0.00	0.00	0.00	6.06
	11.00	-37.54	1092.70	0.00	0.00	0.00	-1630.74
	12.50	-37.54	1095.70	0.00	0.00	0.00	-3272.03
24	LOAD1						
	6.50	-52.27	1016.05	0.00	0.00	0.00	3063.32
	8.00	-52.27	1019.05	0.00	0.00	0.00	1537.00
	9.50	-52.27	1022.05	0.00	0.00	0.00	6.17
	11.00	-52.27	1025.05	0.00	0.00	0.00	-1529.15
	12.50	-52.27	1028.05	0.00	0.00	0.00	-3068.97
25	LOAD1						
	6.50	-68.20	926.77	0.00	0.00	0.00	2795.59
	8.00	-68.20	929.77	0.00	0.00	0.00	1403.18
	9.50	-68.20	932.77	0.00	0.00	0.00	6.28
	11.00	-68.20	935.77	0.00	0.00	0.00	-1395.13
	12.50	-68.20	938.77	0.00	0.00	0.00	-2801.04
26	LOAD1						
	6.50	-85.03	813.86	0.00	0.00	0.00	2456.93
	8.00	-85.03	816.86	0.00	0.00	0.00	1233.89
	9.50	-85.03	819.86	0.00	0.00	0.00	6.35
	11.00	-85.03	822.86	0.00	0.00	0.00	-1225.68
	12.50	-85.03	825.86	0.00	0.00	0.00	-2462.22
27	LOAD1						
	6.50	-102.56	676.36	0.00	0.00	0.00	2044.49
	8.00	-102.56	679.36	0.00	0.00	0.00	1027.69
	9.50	-102.56	682.36	0.00	0.00	0.00	6.40
	11.00	-102.56	685.36	0.00	0.00	0.00	-1019.40
	12.50	-102.56	688.36	0.00	0.00	0.00	-2049.69
28	LOAD1						
	6.50	-120.23	515.01	0.00	0.00	0.00	1560.42
	8.00	-120.23	518.01	0.00	0.00	0.00	785.65
	9.50	-120.23	521.01	0.00	0.00	0.00	6.38
	11.00	-120.23	524.01	0.00	0.00	0.00	-777.39
	12.50	-120.23	527.01	0.00	0.00	0.00	-1565.66
29	LOAD1						
	6.50	-138.10	336.73	0.00	0.00	0.00	1025.96
	8.00	-138.10	339.73	0.00	0.00	0.00	518.61
	9.50	-138.10	342.73	0.00	0.00	0.00	6.77
	11.00	-138.10	345.73	0.00	0.00	0.00	-509.57
	12.50	-138.10	348.73	0.00	0.00	0.00	-1030.41
30	LOAD1						
	6.50	-166.77	174.66	0.00	0.00	0.00	542.42
	8.00	-166.77	177.66	0.00	0.00	0.00	278.17
	9.50	-166.77	180.66	0.00	0.00	0.00	9.43
	11.00	-166.77	183.66	0.00	0.00	0.00	-263.82
	12.50	-166.77	186.66	0.00	0.00	0.00	-541.56

J O I N T D I S P L A C E M E N T S

JOINT	LOAD	U1	U2	U3	R1	R2	R3
1	LOAD1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	LOAD1	0.0565	0.0000	2.950E-03	0.0000	6.878E-03	0.0000
3	LOAD1	0.1818	0.0000	5.728E-03	0.0000	9.392E-03	0.0000
4	LOAD1	0.3388	0.0000	8.255E-03	0.0000	0.0111	0.0000
5	LOAD1	0.5167	0.0000	0.0105	0.0000	0.0122	0.0000
6	LOAD1	0.7062	0.0000	0.0124	0.0000	0.0127	0.0000
7	LOAD1	0.9001	0.0000	0.0139	0.0000	0.0128	0.0000
8	LOAD1	1.0924	0.0000	0.0151	0.0000	0.0126	0.0000
9	LOAD1	1.2791	0.0000	0.0160	0.0000	0.0121	0.0000
10	LOAD1	1.4586	0.0000	0.0166	0.0000	0.0116	0.0000
11	LOAD1	1.6312	0.0000	0.0169	0.0000	0.0113	0.0000
12	LOAD1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
13	LOAD1	0.0564	0.0000	-4.254E-03	0.0000	6.867E-03	0.0000
14	LOAD1	0.1815	0.0000	-8.200E-03	0.0000	9.381E-03	0.0000
15	LOAD1	0.3384	0.0000	-0.0118	0.0000	0.0111	0.0000
16	LOAD1	0.5161	0.0000	-0.0149	0.0000	0.0122	0.0000
17	LOAD1	0.7055	0.0000	-0.0175	0.0000	0.0127	0.0000
18	LOAD1	0.8991	0.0000	-0.0197	0.0000	0.0128	0.0000
19	LOAD1	1.0912	0.0000	-0.0214	0.0000	0.0125	0.0000
20	LOAD1	1.2778	0.0000	-0.0226	0.0000	0.0121	0.0000
21	LOAD1	1.4570	0.0000	-0.0234	0.0000	0.0116	0.0000
22	LOAD1	1.6294	0.0000	-0.0238	0.0000	0.0113	0.0000

J O I N T R E A C T I O N S

JOINT	LOAD	F1	F2	F3	M1	M2	M3
1	LOAD1	-801.3999	0.0000	-4089.6719	0.0000	-38504.4453	0.0000
12	LOAD1	-798.6001	0.0000	6010.1987	0.0000	-38432.2852	0.0000

F R A M E E L E M E N T F O R C E S

FRAME	LOAD	LOC	P	V2	V3	T	M2	M3
1	LOAD1							
		0.00	4089.67	0.00	-801.40	0.00	-38504.45	0.00
		7.50	4135.31	0.00	-801.40	0.00	-32493.95	0.00

		15.00	3940.92	0.00	-787.35	0.00	-17844.04	0.00
3	LOAD1							
		0.00	3497.86	0.00	-763.29	0.00	-22076.50	0.00
		7.50	3543.50	0.00	-763.29	0.00	-16351.83	0.00
		15.00	3589.14	0.00	-763.29	0.00	-10627.16	0.00
4	LOAD1							
		0.00	3073.10	0.00	-726.02	0.00	-15552.95	0.00
		7.50	3118.74	0.00	-726.02	0.00	-10107.77	0.00
		15.00	3164.38	0.00	-726.02	0.00	-4662.58	0.00
5	LOAD1							
		0.00	2607.54	0.00	-673.87	0.00	-9975.93	0.00
		7.50	2653.18	0.00	-673.87	0.00	-4921.87	0.00
		15.00	2698.82	0.00	-673.87	0.00	132.18	0.00
6	LOAD1							
		0.00	2127.41	0.00	-605.69	0.00	-5319.59	0.00
		7.50	2173.05	0.00	-605.69	0.00	-776.88	0.00
		15.00	2218.69	0.00	-605.69	0.00	3765.84	0.00
7	LOAD1							
		0.00	1653.17	0.00	-520.68	0.00	-1629.97	0.00
		7.50	1698.81	0.00	-520.68	0.00	2275.11	0.00
		15.00	1744.45	0.00	-520.68	0.00	6180.18	0.00
8	LOAD1							
		0.00	1199.33	0.00	-418.04	0.00	978.08	0.00
		7.50	1244.97	0.00	-418.04	0.00	4113.39	0.00
		15.00	1290.60	0.00	-418.04	0.00	7248.71	0.00
9	LOAD1							
		0.00	773.80	0.00	-297.03	0.00	2315.67	0.00
		7.50	819.44	0.00	-297.03	0.00	4543.43	0.00
		15.00	865.08	0.00	-297.03	0.00	6771.19	0.00
10	LOAD1							
		0.00	376.95	0.00	-157.41	0.00	2110.47	0.00
		7.50	422.58	0.00	-157.41	0.00	3291.02	0.00
		15.00	468.22	0.00	-157.41	0.00	4471.56	0.00
11	LOAD1							
		0.00	-6010.20	0.00	-798.60	0.00	-38432.29	0.00
		7.50	-5964.56	0.00	-798.60	0.00	-32442.78	0.00
		15.00	-5918.92	0.00	-798.60	0.00	-26453.28	0.00
12	LOAD1							
		0.00	-5578.12	0.00	-789.65	0.00	-29667.52	0.00
		7.50	-5532.48	0.00	-789.65	0.00	-23745.11	0.00
		15.00	-5486.84	0.00	-789.65	0.00	-17822.71	0.00
13	LOAD1							
		0.00	-5034.28	0.00	-766.51	0.00	-22098.60	0.00
		7.50	-4988.65	0.00	-766.51	0.00	-16349.77	0.00
		15.00	-4943.01	0.00	-766.51	0.00	-10600.94	0.00
14	LOAD1							
		0.00	-4417.47	0.00	-729.08	0.00	-15570.16	0.00
		7.50	-4371.83	0.00	-729.08	0.00	-10102.09	0.00
		15.00	-4326.19	0.00	-729.08	0.00	-4634.02	0.00
15	LOAD1							
		0.00	-3759.86	0.00	-676.73	0.00	-9990.79	0.00
		7.50	-3714.22	0.00	-676.73	0.00	-4915.34	0.00
		15.00	-3668.58	0.00	-676.73	0.00	160.10	0.00
16	LOAD1							
		0.00	-3087.68	0.00	-608.51	0.00	-5335.08	0.00
		7.50	-3042.04	0.00	-608.51	0.00	-771.29	0.00
		15.00	-2996.40	0.00	-608.51	0.00	3792.50	0.00
17	LOAD1							
		0.00	-2421.39	0.00	-523.52	0.00	-1646.71	0.00
		7.50	-2375.75	0.00	-523.52	0.00	2279.72	0.00
		15.00	-2330.11	0.00	-523.52	0.00	6206.14	0.00
18	LOAD1							
		0.00	-1775.49	0.00	-421.06	0.00	960.64	0.00
		7.50	-1729.85	0.00	-421.06	0.00	4118.58	0.00
		15.00	-1684.21	0.00	-421.06	0.00	7276.51	0.00
19	LOAD1							
		0.00	-1157.91	0.00	-300.47	0.00	2300.09	0.00

		15.00	-477.72	0.00	-160.79	0.00	4514.90	0.00
21	LOAD1							
		6.50	-8.95	334.55	0.00	0.00	0.00	1006.75
		8.00	-8.95	335.30	0.00	0.00	0.00	504.36
		9.50	-8.95	336.05	0.00	0.00	0.00	8.410E-01
		11.00	-8.95	336.80	0.00	0.00	0.00	-503.80
		12.50	-8.95	337.55	0.00	0.00	0.00	-1009.57
22	LOAD1							
		6.50	-23.14	446.31	0.00	0.00	0.00	1342.02
		8.00	-23.14	447.06	0.00	0.00	0.00	671.99
		9.50	-23.14	447.81	0.00	0.00	0.00	8.445E-01
		11.00	-23.14	448.56	0.00	0.00	0.00	-671.43
		12.50	-23.14	449.31	0.00	0.00	0.00	-1344.83
23	LOAD1							
		6.50	-37.44	519.29	0.00	0.00	0.00	1560.97
		8.00	-37.44	520.04	0.00	0.00	0.00	781.47
		9.50	-37.44	520.79	0.00	0.00	0.00	8.464E-01
		11.00	-37.44	521.54	0.00	0.00	0.00	-780.90
		12.50	-37.44	522.29	0.00	0.00	0.00	-1563.77
24	LOAD1							
		6.50	-52.35	560.08	0.00	0.00	0.00	1683.36
		8.00	-52.35	560.83	0.00	0.00	0.00	842.67
		9.50	-52.35	561.58	0.00	0.00	0.00	8.514E-01
		11.00	-52.35	562.33	0.00	0.00	0.00	-842.09
		12.50	-52.35	563.08	0.00	0.00	0.00	-1686.15
25	LOAD1							
		6.50	-68.22	574.66	0.00	0.00	0.00	1727.07
		8.00	-68.22	575.41	0.00	0.00	0.00	864.53
		9.50	-68.22	576.16	0.00	0.00	0.00	8.572E-01
		11.00	-68.22	576.91	0.00	0.00	0.00	-863.94
		12.50	-68.22	577.66	0.00	0.00	0.00	-1729.86 ← max
26	LOAD1							
		6.50	-84.98	568.76	0.00	0.00	0.00	1709.40
		8.00	-84.98	569.51	0.00	0.00	0.00	855.70
		9.50	-84.98	570.26	0.00	0.00	0.00	8.622E-01
		11.00	-84.98	571.01	0.00	0.00	0.00	-855.10
		12.50	-84.98	571.76	0.00	0.00	0.00	-1712.18
27	LOAD1							
		6.50	-102.47	548.37	0.00	0.00	0.00	1648.24
		8.00	-102.47	549.12	0.00	0.00	0.00	825.11
		9.50	-102.47	549.87	0.00	0.00	0.00	8.663E-01
		11.00	-102.47	550.62	0.00	0.00	0.00	-824.51
		12.50	-102.47	551.37	0.00	0.00	0.00	-1651.01
28	LOAD1							
		6.50	-120.59	520.05	0.00	0.00	0.00	1563.27
		8.00	-120.59	520.80	0.00	0.00	0.00	782.63
		9.50	-120.59	521.55	0.00	0.00	0.00	8.709E-01
		11.00	-120.59	522.30	0.00	0.00	0.00	-782.02
		12.50	-120.59	523.05	0.00	0.00	0.00	-1566.03
29	LOAD1							
		6.50	-139.67	491.38	0.00	0.00	0.00	1477.28
		8.00	-139.67	492.13	0.00	0.00	0.00	739.64
		9.50	-139.67	492.88	0.00	0.00	0.00	8.799E-01
		11.00	-139.67	493.63	0.00	0.00	0.00	-739.01
		12.50	-139.67	494.38	0.00	0.00	0.00	-1480.02
30	LOAD1							
		6.50	-160.79	471.47	0.00	0.00	0.00	1417.56
		8.00	-160.79	472.22	0.00	0.00	0.00	709.79
		9.50	-160.79	472.97	0.00	0.00	0.00	8.959E-01
		11.00	-160.79	473.72	0.00	0.00	0.00	-709.12
		12.50	-160.79	474.47	0.00	0.00	0.00	-1420.27

10-Story, Rec-Wall Reg DC

J O I N T D I S P L A C E M E N T S

JOINT	LOAD	U1	U2	U3	R1	R2	R3
1	LOAD1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	LOAD1	0.0448	0.0000	4.789E-03	0.0000	1.673E-03	0.0000
3	LOAD1	0.0901	0.0000	8.847E-03	0.0000	2.161E-03	0.0000
4	LOAD1	0.1415	0.0000	0.0122	0.0000	2.541E-03	0.0000
5	LOAD1	0.1969	0.0000	0.0148	0.0000	2.815E-03	0.0000
6	LOAD1	0.2546	0.0000	0.0168	0.0000	2.992E-03	0.0000
7	LOAD1	0.3129	0.0000	0.0182	0.0000	3.076E-03	0.0000
8	LOAD1	0.3699	0.0000	0.0191	0.0000	3.074E-03	0.0000
9	LOAD1	0.4242	0.0000	0.0196	0.0000	2.997E-03	0.0000
10	LOAD1	0.4742	0.0000	0.0198	0.0000	2.851E-03	0.0000
11	LOAD1	0.5189	0.0000	0.0198	0.0000	2.697E-03	0.0000
12	LOAD1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
13	LOAD1	0.0448	0.0000	-6.407E-03	0.0000	1.632E-03	0.0000
14	LOAD1	0.0901	0.0000	-0.0119	0.0000	2.139E-03	0.0000
15	LOAD1	0.1414	0.0000	-0.0165	0.0000	2.515E-03	0.0000
16	LOAD1	0.1968	0.0000	-0.0203	0.0000	2.790E-03	0.0000
17	LOAD1	0.2545	0.0000	-0.0232	0.0000	2.966E-03	0.0000
18	LOAD1	0.3127	0.0000	-0.0254	0.0000	3.050E-03	0.0000
19	LOAD1	0.3697	0.0000	-0.0269	0.0000	3.048E-03	0.0000
20	LOAD1	0.4239	0.0000	-0.0278	0.0000	2.970E-03	0.0000
21	LOAD1	0.4740	0.0000	-0.0283	0.0000	2.833E-03	0.0000
22	LOAD1	0.5186	0.0000	-0.0284	0.0000	2.634E-03	0.0000

J O I N T R E A C T I O N S

JOINT	LOAD	F1	F2	F3	M1	M2	M3
1	LOAD1	-796.3557	0.0000	-7123.2490	0.0000	-6784.4111	0.0000
12	LOAD1	-803.6443	0.0000	9643.2490	0.0000	-6819.3633	0.0000

F R A M E E L E M E N T F O R C E S

FRAME	LOAD	LOC	P	V2	V3	T	M2	M3
1	LOAD1							

		15.00	6126.21	778.28	0.00	0.00	0.00	-5362.75
3	LOAD1							
		0.00	4940.61	756.85	0.00	0.00	0.00	6044.80
		7.50	4989.36	756.85	0.00	0.00	0.00	368.43
		15.00	5038.11	756.85	0.00	0.00	0.00	-5307.94
4	LOAD1							
		0.00	3898.88	719.11	0.00	0.00	0.00	5659.92
		7.50	3947.63	719.11	0.00	0.00	0.00	266.56
		15.00	3996.38	719.11	0.00	0.00	0.00	-5126.79
5	LOAD1							
		0.00	2927.41	666.93	0.00	0.00	0.00	5173.46
		7.50	2976.16	666.93	0.00	0.00	0.00	171.48
		15.00	3024.91	666.93	0.00	0.00	0.00	-4830.50
6	LOAD1							
		0.00	2050.47	598.72	0.00	0.00	0.00	4571.70
		7.50	2099.22	598.72	0.00	0.00	0.00	81.32
		15.00	2147.97	598.72	0.00	0.00	0.00	-4409.05
7	LOAD1							
		0.00	1293.73	513.74	0.00	0.00	0.00	3851.31
		7.50	1342.48	513.74	0.00	0.00	0.00	-1.77
		15.00	1391.23	513.74	0.00	0.00	0.00	-3854.86
8	LOAD1							
		0.00	684.09	411.04	0.00	0.00	0.00	3008.01
		7.50	732.84	411.04	0.00	0.00	0.00	-74.78
		15.00	781.59	411.04	0.00	0.00	0.00	-3157.57
9	LOAD1							
		0.00	249.50	291.20	0.00	0.00	0.00	2042.65
		7.50	298.25	291.20	0.00	0.00	0.00	-141.34
		15.00	347.00	291.20	0.00	0.00	0.00	-2325.33
10	LOAD1							
		0.00	17.64	146.25	0.00	0.00	0.00	947.28
		7.50	66.39	146.25	0.00	0.00	0.00	-149.59
		15.00	115.14	146.25	0.00	0.00	0.00	-1246.45
11	LOAD1							
		0.00	-9643.25	803.64	0.00	0.00	0.00	6819.36
		7.50	-9594.50	803.64	0.00	0.00	0.00	792.03
		15.00	-9545.75	803.64	0.00	0.00	0.00	-5235.30
12	LOAD1							
		0.00	-8296.71	798.72	0.00	0.00	0.00	6482.49
		7.50	-8247.96	798.72	0.00	0.00	0.00	492.11
		15.00	-8199.21	798.72	0.00	0.00	0.00	-5498.27
13	LOAD1							
		0.00	-6956.61	772.95	0.00	0.00	0.00	6162.02
		7.50	-6907.86	772.95	0.00	0.00	0.00	364.89
		15.00	-6859.11	772.95	0.00	0.00	0.00	-5432.24
14	LOAD1							
		0.00	-5662.88	735.99	0.00	0.00	0.00	5786.89
		7.50	-5614.13	735.99	0.00	0.00	0.00	267.00
		15.00	-5565.38	735.99	0.00	0.00	0.00	-5252.90
15	LOAD1							
		0.00	-4439.41	683.67	0.00	0.00	0.00	5298.81
		7.50	-4390.66	683.67	0.00	0.00	0.00	171.29
		15.00	-4341.91	683.67	0.00	0.00	0.00	-4956.23
16	LOAD1							
		0.00	-3310.47	615.48	0.00	0.00	0.00	4697.33
		7.50	-3261.72	615.48	0.00	0.00	0.00	81.21
		15.00	-3212.97	615.48	0.00	0.00	0.00	-4534.91
17	LOAD1							
		0.00	-2301.73	530.46	0.00	0.00	0.00	3976.78
		7.50	-2252.98	530.46	0.00	0.00	0.00	-1.63
		15.00	-2204.23	530.46	0.00	0.00	0.00	-3980.05
18	LOAD1							
		0.00	-1440.09	428.06	0.00	0.00	0.00	3134.20
		7.50	-1391.34	428.06	0.00	0.00	0.00	-76.26
		15.00	-1342.59	428.06	0.00	0.00	0.00	-3286.72

	15.00	-172.14	171.95	0.00	0.00	0.00	-1482.66
21	LOAD1						
	6.50	-4.93	1211.54	0.00	0.00	0.00	3660.80
	8.00	-4.93	1216.04	0.00	0.00	0.00	1840.12
	9.50	-4.93	1220.54	0.00	0.00	0.00	12.69
	11.00	-4.93	1225.04	0.00	0.00	0.00	-1821.49
	12.50	-4.93	1229.54	0.00	0.00	0.00	-3662.42 ← max
22	LOAD1						
	6.50	-25.77	1205.10	0.00	0.00	0.00	3637.79
	8.00	-25.77	1209.60	0.00	0.00	0.00	1826.77
	9.50	-25.77	1214.10	0.00	0.00	0.00	9.00
	11.00	-25.77	1218.60	0.00	0.00	0.00	-1815.52
	12.50	-25.77	1223.10	0.00	0.00	0.00	-3646.79
23	LOAD1						
	6.50	-36.96	1158.74	0.00	0.00	0.00	3499.45
	8.00	-36.96	1163.24	0.00	0.00	0.00	1757.97
	9.50	-36.96	1167.74	0.00	0.00	0.00	9.74
	11.00	-36.96	1172.24	0.00	0.00	0.00	-1745.24
	12.50	-36.96	1176.74	0.00	0.00	0.00	-3506.97
24	LOAD1						
	6.50	-52.32	1088.47	0.00	0.00	0.00	3288.56
	8.00	-52.32	1092.97	0.00	0.00	0.00	1652.48
	9.50	-52.32	1097.47	0.00	0.00	0.00	9.65
	11.00	-52.32	1101.97	0.00	0.00	0.00	-1639.93
	12.50	-52.32	1106.47	0.00	0.00	0.00	-3296.27
25	LOAD1						
	6.50	-68.19	993.93	0.00	0.00	0.00	3004.99
	8.00	-68.19	998.43	0.00	0.00	0.00	1510.72
	9.50	-68.19	1002.93	0.00	0.00	0.00	9.69
	11.00	-68.19	1007.43	0.00	0.00	0.00	-1498.09
	12.50	-68.19	1011.93	0.00	0.00	0.00	-3012.62
26	LOAD1						
	6.50	-85.03	873.74	0.00	0.00	0.00	2644.43
	8.00	-85.03	878.24	0.00	0.00	0.00	1330.45
	9.50	-85.03	882.74	0.00	0.00	0.00	9.71
	11.00	-85.03	887.24	0.00	0.00	0.00	-1317.77
	12.50	-85.03	891.74	0.00	0.00	0.00	-2652.01
27	LOAD1						
	6.50	-102.39	726.64	0.00	0.00	0.00	2203.10
	8.00	-102.39	731.14	0.00	0.00	0.00	1109.77
	9.50	-102.39	735.64	0.00	0.00	0.00	9.68
	11.00	-102.39	740.14	0.00	0.00	0.00	-1097.15
	12.50	-102.39	744.64	0.00	0.00	0.00	-2210.73
28	LOAD1						
	6.50	-121.76	551.59	0.00	0.00	0.00	1678.26
	8.00	-121.76	556.09	0.00	0.00	0.00	847.50
	9.50	-121.76	560.59	0.00	0.00	0.00	9.99
	11.00	-121.76	565.09	0.00	0.00	0.00	-834.27
	12.50	-121.76	569.59	0.00	0.00	0.00	-1685.28
29	LOAD1						
	6.50	-134.35	348.87	0.00	0.00	0.00	1068.35
	8.00	-134.35	353.37	0.00	0.00	0.00	541.68
	9.50	-134.35	357.87	0.00	0.00	0.00	8.25
	11.00	-134.35	362.37	0.00	0.00	0.00	-531.92
	12.50	-134.35	366.87	0.00	0.00	0.00	-1078.85
30	LOAD1						
	6.50	-171.95	134.64	0.00	0.00	0.00	434.69
	8.00	-171.95	139.14	0.00	0.00	0.00	229.35
	9.50	-171.95	143.64	0.00	0.00	0.00	17.27
	11.00	-171.95	148.14	0.00	0.00	0.00	-201.56
	12.50	-171.95	152.64	0.00	0.00	0.00	-427.14

J O I N T D I S P L A C E M E N T S

JOINT	LOAD	U1	U2	U3	R1	R2	R3
1	LOAD1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	LOAD1	0.0409	0.0000	4.871E-03	0.0000	1.134E-03	0.0000
3	LOAD1	0.0781	0.0000	8.986E-03	0.0000	1.620E-03	0.0000
4	LOAD1	0.1216	0.0000	0.0124	0.0000	2.018E-03	0.0000
5	LOAD1	0.1695	0.0000	0.0150	0.0000	2.324E-03	0.0000
6	LOAD1	0.2202	0.0000	0.0171	0.0000	2.543E-03	0.0000
7	LOAD1	0.2722	0.0000	0.0185	0.0000	2.680E-03	0.0000
8	LOAD1	0.3238	0.0000	0.0194	0.0000	2.743E-03	0.0000
9	LOAD1	0.3738	0.0000	0.0199	0.0000	2.743E-03	0.0000
10	LOAD1	0.4208	0.0000	0.0201	0.0000	2.689E-03	0.0000
11	LOAD1	0.4638	0.0000	0.0202	0.0000	2.615E-03	0.0000
12	LOAD1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
13	LOAD1	0.0408	0.0000	-6.361E-03	0.0000	1.109E-03	0.0000
14	LOAD1	0.0781	0.0000	-0.0118	0.0000	1.604E-03	0.0000
15	LOAD1	0.1215	0.0000	-0.0164	0.0000	2.001E-03	0.0000
16	LOAD1	0.1693	0.0000	-0.0201	0.0000	2.307E-03	0.0000
17	LOAD1	0.2200	0.0000	-0.0230	0.0000	2.525E-03	0.0000
18	LOAD1	0.2719	0.0000	-0.0251	0.0000	2.662E-03	0.0000
19	LOAD1	0.3235	0.0000	-0.0266	0.0000	2.725E-03	0.0000
20	LOAD1	0.3734	0.0000	-0.0275	0.0000	2.725E-03	0.0000
21	LOAD1	0.4204	0.0000	-0.0279	0.0000	2.674E-03	0.0000
22	LOAD1	0.4633	0.0000	-0.0281	0.0000	2.577E-03	0.0000

J O I N T R E A C T I O N S

JOINT	LOAD	F1	F2	F3	M1	M2	M3
1	LOAD1	-797.8770	0.0000	-7245.3765	0.0000	-6534.5840	0.0000
12	LOAD1	-802.1230	0.0000	9575.3555	0.0000	-6553.9644	0.0000

F R A M E E L E M E N T F O R C E S

FRAME	LOAD	LOC	P	V2	V3	T	M2	M3

	15.00	6212.45	782.30	0.00	0.00	0.00	-5395.79
3	LOAD1						
	0.00	5014.60	759.84	0.00	0.00	0.00	6085.53
	7.50	5063.35	759.84	0.00	0.00	0.00	386.75
	15.00	5112.10	759.84	0.00	0.00	0.00	-5312.03
4	LOAD1						
	0.00	3962.21	722.34	0.00	0.00	0.00	5714.53
	7.50	4010.96	722.34	0.00	0.00	0.00	296.94
	15.00	4059.71	722.34	0.00	0.00	0.00	-5120.64
5	LOAD1						
	0.00	2980.14	670.12	0.00	0.00	0.00	5237.97
	7.50	3028.89	670.12	0.00	0.00	0.00	212.09
	15.00	3077.64	670.12	0.00	0.00	0.00	-4813.79
6	LOAD1						
	0.00	2092.54	601.92	0.00	0.00	0.00	4647.37
	7.50	2141.29	601.92	0.00	0.00	0.00	132.97
	15.00	2190.04	601.92	0.00	0.00	0.00	-4381.42
7	LOAD1						
	0.00	1325.08	516.93	0.00	0.00	0.00	3938.48
	7.50	1373.83	516.93	0.00	0.00	0.00	61.53
	15.00	1422.58	516.93	0.00	0.00	0.00	-3815.42
8	LOAD1						
	0.00	704.69	414.35	0.00	0.00	0.00	3107.48
	7.50	753.44	414.35	0.00	0.00	0.00	-1.166E-01
	15.00	802.19	414.35	0.00	0.00	0.00	-3107.71
9	LOAD1						
	0.00	259.39	293.90	0.00	0.00	0.00	2152.02
	7.50	308.14	293.90	0.00	0.00	0.00	-52.21
	15.00	356.89	293.90	0.00	0.00	0.00	-2256.44
10	LOAD1						
	0.00	17.86	151.67	0.00	0.00	0.00	1065.56
	7.50	66.61	151.67	0.00	0.00	0.00	-72.00
	15.00	115.36	151.67	0.00	0.00	0.00	-1209.55
11	LOAD1						
	0.00	-9575.36	802.12	0.00	0.00	0.00	6553.96
	7.50	-9526.61	802.12	0.00	0.00	0.00	538.04
	15.00	-9477.86	802.12	0.00	0.00	0.00	-5477.88
12	LOAD1						
	0.00	-8211.93	794.70	0.00	0.00	0.00	6441.35
	7.50	-8163.18	794.70	0.00	0.00	0.00	481.13
	15.00	-8114.43	794.70	0.00	0.00	0.00	-5479.09
13	LOAD1						
	0.00	-6878.58	769.96	0.00	0.00	0.00	6159.78
	7.50	-6829.83	769.96	0.00	0.00	0.00	385.06
	15.00	-6781.08	769.96	0.00	0.00	0.00	-5389.66
14	LOAD1						
	0.00	-5593.20	732.76	0.00	0.00	0.00	5792.59
	7.50	-5544.45	732.76	0.00	0.00	0.00	296.92
	15.00	-5495.70	732.76	0.00	0.00	0.00	-5198.74
15	LOAD1						
	0.00	-4378.12	680.48	0.00	0.00	0.00	5315.54
	7.50	-4329.37	680.48	0.00	0.00	0.00	211.92
	15.00	-4280.63	680.48	0.00	0.00	0.00	-4891.70
16	LOAD1						
	0.00	-3257.53	612.28	0.00	0.00	0.00	4724.95
	7.50	-3208.78	612.28	0.00	0.00	0.00	132.85
	15.00	-3160.03	612.28	0.00	0.00	0.00	-4459.26
17	LOAD1						
	0.00	-2257.08	527.27	0.00	0.00	0.00	4016.00
	7.50	-2208.33	527.27	0.00	0.00	0.00	61.45
	15.00	-2159.58	527.27	0.00	0.00	0.00	-3893.10
18	LOAD1						
	0.00	-1403.68	424.75	0.00	0.00	0.00	3185.05
	7.50	-1354.93	424.75	0.00	0.00	0.00	-6.020E-01
	15.00	-1306.18	424.75	0.00	0.00	0.00	-3186.26
19	LOAD1						

	15.00	-153.36	166.53	0.00	0.00	0.00	-1343.27
21	LOAD1						
	6.50	-7.43	1240.92	0.00	0.00	0.00	3748.58 ← max
	8.00	-7.43	1243.92	0.00	0.00	0.00	1884.94
	9.50	-7.43	1246.92	0.00	0.00	0.00	16.81
	11.00	-7.43	1249.92	0.00	0.00	0.00	-1855.83
	12.50	-7.43	1252.92	0.00	0.00	0.00	-3732.97
22	LOAD1						
	6.50	-24.73	1210.85	0.00	0.00	0.00	3653.03
	8.00	-24.73	1213.85	0.00	0.00	0.00	1834.50
	9.50	-24.73	1216.85	0.00	0.00	0.00	11.47
	11.00	-24.73	1219.85	0.00	0.00	0.00	-1816.06
	12.50	-24.73	1222.85	0.00	0.00	0.00	-3648.09
23	LOAD1						
	6.50	-37.21	1162.88	0.00	0.00	0.00	3510.06
	8.00	-37.21	1165.88	0.00	0.00	0.00	1763.48
	9.50	-37.21	1168.88	0.00	0.00	0.00	12.40
	11.00	-37.21	1171.88	0.00	0.00	0.00	-1743.17
	12.50	-37.21	1174.88	0.00	0.00	0.00	-3503.25
24	LOAD1						
	6.50	-52.27	1092.57	0.00	0.00	0.00	3299.13
	8.00	-52.27	1095.57	0.00	0.00	0.00	1658.02
	9.50	-52.27	1098.57	0.00	0.00	0.00	12.41
	11.00	-52.27	1101.57	0.00	0.00	0.00	-1637.70
	12.50	-52.27	1104.57	0.00	0.00	0.00	-3292.31
25	LOAD1						
	6.50	-68.20	998.10	0.00	0.00	0.00	3015.79
	8.00	-68.20	1001.10	0.00	0.00	0.00	1516.40
	9.50	-68.20	1004.10	0.00	0.00	0.00	12.51
	11.00	-68.20	1007.10	0.00	0.00	0.00	-1495.89
	12.50	-68.20	1010.10	0.00	0.00	0.00	-3008.78
26	LOAD1						
	6.50	-85.01	877.96	0.00	0.00	0.00	2655.45
	8.00	-85.01	880.96	0.00	0.00	0.00	1336.26
	9.50	-85.01	883.96	0.00	0.00	0.00	12.58
	11.00	-85.01	886.96	0.00	0.00	0.00	-1315.61
	12.50	-85.01	889.96	0.00	0.00	0.00	-2648.29
27	LOAD1						
	6.50	-102.52	730.90	0.00	0.00	0.00	2214.32
	8.00	-102.52	733.90	0.00	0.00	0.00	1115.72
	9.50	-102.52	736.90	0.00	0.00	0.00	12.62
	11.00	-102.52	739.90	0.00	0.00	0.00	-1094.97
	12.50	-102.52	742.90	0.00	0.00	0.00	-2207.07
28	LOAD1						
	6.50	-121.15	555.80	0.00	0.00	0.00	1689.29
	8.00	-121.15	558.80	0.00	0.00	0.00	853.34
	9.50	-121.15	561.80	0.00	0.00	0.00	12.89
	11.00	-121.15	564.80	0.00	0.00	0.00	-832.05
	12.50	-121.15	567.80	0.00	0.00	0.00	-1681.50
29	LOAD1						
	6.50	-137.08	352.03	0.00	0.00	0.00	1076.10
	8.00	-137.08	355.02	0.00	0.00	0.00	545.81
	9.50	-137.08	358.02	0.00	0.00	0.00	11.02
	11.00	-137.08	361.02	0.00	0.00	0.00	-528.27
	12.50	-137.08	364.02	0.00	0.00	0.00	-1072.05
30	LOAD1						
	6.50	-166.53	128.36	0.00	0.00	0.00	417.47
	8.00	-166.53	131.36	0.00	0.00	0.00	222.68
	9.50	-166.53	134.36	0.00	0.00	0.00	23.39
	11.00	-166.53	137.36	0.00	0.00	0.00	-180.40
	12.50	-166.53	140.36	0.00	0.00	0.00	-388.69

J O I N T D I S P L A C E M E N T S

JOINT	LOAD	U1	U2	U3	R1	R2	R3
1	LOAD1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	LOAD1	0.1540	0.0000	4.451E-03	0.0000	0.0162	0.0000
3	LOAD1	0.4422	0.0000	8.429E-03	0.0000	0.0200	0.0000
4	LOAD1	0.7683	0.0000	0.0118	0.0000	0.0213	0.0000
5	LOAD1	1.1032	0.0000	0.0146	0.0000	0.0213	0.0000
6	LOAD1	1.4283	0.0000	0.0168	0.0000	0.0202	0.0000
7	LOAD1	1.7307	0.0000	0.0184	0.0000	0.0184	0.0000
8	LOAD1	2.0007	0.0000	0.0195	0.0000	0.0161	0.0000
9	LOAD1	2.2313	0.0000	0.0202	0.0000	0.0135	0.0000
10	LOAD1	2.4198	0.0000	0.0206	0.0000	0.0108	0.0000
11	LOAD1	2.5709	0.0000	0.0208	0.0000	8.871E-03	0.0000
12	LOAD1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
13	LOAD1	0.1539	0.0000	-5.752E-03	0.0000	0.0162	0.0000
14	LOAD1	0.4419	0.0000	-0.0109	0.0000	0.0200	0.0000
15	LOAD1	0.7679	0.0000	-0.0153	0.0000	0.0213	0.0000
16	LOAD1	1.1026	0.0000	-0.0190	0.0000	0.0212	0.0000
17	LOAD1	1.4276	0.0000	-0.0219	0.0000	0.0202	0.0000
18	LOAD1	1.7298	0.0000	-0.0241	0.0000	0.0184	0.0000
19	LOAD1	1.9995	0.0000	-0.0257	0.0000	0.0161	0.0000
20	LOAD1	2.2300	0.0000	-0.0268	0.0000	0.0134	0.0000
21	LOAD1	2.4183	0.0000	-0.0274	0.0000	0.0108	0.0000
22	LOAD1	2.5691	0.0000	-0.0276	0.0000	8.843E-03	0.0000

J O I N T R E A C T I O N S

JOINT	LOAD	F1	F2	F3	M1	M2	M3
1	LOAD1	-799.7401	0.0000	-6617.2480	0.0000	-13867.4258	0.0000
12	LOAD1	-800.2599	0.0000	8662.2471	0.0000	-13862.8721	0.0000

F R A M E E L E M E N T F O R C E S

FRAME	LOAD	LOC	P	V2	V3	T	M2	M3

	15.00	6006.13	786.70	0.00	0.00	0.00	-2247.66
3	LOAD1						
	0.00	5030.02	763.46	0.00	0.00	0.00	7048.88
	7.50	5078.77	763.46	0.00	0.00	0.00	1322.93
	15.00	5127.52	763.46	0.00	0.00	0.00	-4403.02
4	LOAD1						
	0.00	4102.17	726.12	0.00	0.00	0.00	5361.20
	7.50	4150.92	726.12	0.00	0.00	0.00	-84.67
	15.00	4199.67	726.12	0.00	0.00	0.00	-5530.55
5	LOAD1						
	0.00	3196.39	673.86	0.00	0.00	0.00	4024.07
	7.50	3245.14	673.86	0.00	0.00	0.00	-1029.87
	15.00	3293.89	673.86	0.00	0.00	0.00	-6083.82
6	LOAD1						
	0.00	2359.39	605.66	0.00	0.00	0.00	2817.38
	7.50	2408.14	605.66	0.00	0.00	0.00	-1725.05
	15.00	2456.89	605.66	0.00	0.00	0.00	-6267.47
7	LOAD1						
	0.00	1624.82	520.65	0.00	0.00	0.00	1660.67
	7.50	1673.57	520.65	0.00	0.00	0.00	-2244.24
	15.00	1722.32	520.65	0.00	0.00	0.00	-6149.15
8	LOAD1						
	0.00	1017.31	418.13	0.00	0.00	0.00	571.91
	7.50	1066.06	418.13	0.00	0.00	0.00	-2564.06
	15.00	1114.81	418.13	0.00	0.00	0.00	-5700.02
9	LOAD1						
	0.00	551.32	297.32	0.00	0.00	0.00	-323.43
	7.50	600.07	297.32	0.00	0.00	0.00	-2553.33
	15.00	648.82	297.32	0.00	0.00	0.00	-4783.22
10	LOAD1						
	0.00	224.20	156.92	0.00	0.00	0.00	-725.90
	7.50	272.95	156.92	0.00	0.00	0.00	-1902.81
	15.00	321.70	156.92	0.00	0.00	0.00	-3079.73
11	LOAD1						
	0.00	-8662.25	800.26	0.00	0.00	0.00	13862.87
	7.50	-8613.50	800.26	0.00	0.00	0.00	7860.92
	15.00	-8564.75	800.26	0.00	0.00	0.00	1858.97
12	LOAD1						
	0.00	-7749.13	790.30	0.00	0.00	0.00	9583.85
	7.50	-7700.38	790.30	0.00	0.00	0.00	3656.61
	15.00	-7651.63	790.30	0.00	0.00	0.00	-2270.63
13	LOAD1						
	0.00	-6666.02	766.34	0.00	0.00	0.00	7069.31
	7.50	-6617.27	766.34	0.00	0.00	0.00	1321.75
	15.00	-6568.52	766.34	0.00	0.00	0.00	-4425.80
14	LOAD1						
	0.00	-5533.67	728.98	0.00	0.00	0.00	5381.80
	7.50	-5484.92	728.98	0.00	0.00	0.00	-85.58
	15.00	-5436.17	728.98	0.00	0.00	0.00	-5552.96
15	LOAD1						
	0.00	-4423.39	676.74	0.00	0.00	0.00	4045.03
	7.50	-4374.64	676.74	0.00	0.00	0.00	-1030.53
	15.00	-4325.89	676.74	0.00	0.00	0.00	-6106.08
16	LOAD1						
	0.00	-3381.89	608.54	0.00	0.00	0.00	2838.46
	7.50	-3333.14	608.54	0.00	0.00	0.00	-1725.61
	15.00	-3284.39	608.54	0.00	0.00	0.00	-6289.69
17	LOAD1						
	0.00	-2442.82	523.55	0.00	0.00	0.00	1681.80
	7.50	-2394.07	523.55	0.00	0.00	0.00	-2244.79
	15.00	-2345.32	523.55	0.00	0.00	0.00	-6171.38
18	LOAD1						
	0.00	-1630.81	420.97	0.00	0.00	0.00	593.01
	7.50	-1582.06	420.97	0.00	0.00	0.00	-2564.28
	15.00	-1533.31	420.97	0.00	0.00	0.00	-5721.57

	15.00	-331.20	161.28	0.00	0.00	0.00	-3122.88
21	LOAD1						
	6.50	-9.96	809.36	0.00	0.00	0.00	2431.24
	8.00	-9.96	810.11	0.00	0.00	0.00	1216.63
	9.50	-9.96	810.86	0.00	0.00	0.00	8.963E-01
	11.00	-9.96	811.61	0.00	0.00	0.00	-1215.96
	12.50	-9.96	812.36	0.00	0.00	0.00	-2433.95
22	LOAD1						
	6.50	-23.96	979.37	0.00	0.00	0.00	2941.21
	8.00	-23.96	980.12	0.00	0.00	0.00	1471.60
	9.50	-23.96	980.87	0.00	0.00	0.00	8.616E-01
	11.00	-23.96	981.62	0.00	0.00	0.00	-1471.00
	12.50	-23.96	982.37	0.00	0.00	0.00	-2943.99
23	LOAD1						
	6.50	-37.36	1028.60	0.00	0.00	0.00	3088.91
	8.00	-37.36	1029.35	0.00	0.00	0.00	1545.45
	9.50	-37.36	1030.10	0.00	0.00	0.00	8.718E-01
	11.00	-37.36	1030.85	0.00	0.00	0.00	-1544.83
	12.50	-37.36	1031.60	0.00	0.00	0.00	-3091.66 ← max
24	LOAD1						
	6.50	-52.24	1006.53	0.00	0.00	0.00	3022.73
	8.00	-52.24	1007.28	0.00	0.00	0.00	1512.37
	9.50	-52.24	1008.03	0.00	0.00	0.00	8.797E-01
	11.00	-52.24	1008.78	0.00	0.00	0.00	-1511.73
	12.50	-52.24	1009.53	0.00	0.00	0.00	-3025.47
25	LOAD1						
	6.50	-68.20	937.75	0.00	0.00	0.00	2816.38
	8.00	-68.20	938.50	0.00	0.00	0.00	1409.20
	9.50	-68.20	939.25	0.00	0.00	0.00	8.853E-01
	11.00	-68.20	940.00	0.00	0.00	0.00	-1408.55
	12.50	-68.20	940.75	0.00	0.00	0.00	-2819.11
26	LOAD1						
	6.50	-85.00	835.32	0.00	0.00	0.00	2509.11
	8.00	-85.00	836.07	0.00	0.00	0.00	1255.56
	9.50	-85.00	836.82	0.00	0.00	0.00	8.902E-01
	11.00	-85.00	837.57	0.00	0.00	0.00	-1254.91
	12.50	-85.00	838.32	0.00	0.00	0.00	-2511.83
27	LOAD1						
	6.50	-102.57	708.26	0.00	0.00	0.00	2127.93
	8.00	-102.57	709.01	0.00	0.00	0.00	1064.97
	9.50	-102.57	709.76	0.00	0.00	0.00	8.950E-01
	11.00	-102.57	710.51	0.00	0.00	0.00	-1064.31
	12.50	-102.57	711.26	0.00	0.00	0.00	-2130.64
28	LOAD1						
	6.50	-120.79	566.74	0.00	0.00	0.00	1703.36
	8.00	-120.79	567.49	0.00	0.00	0.00	852.69
	9.50	-120.79	568.24	0.00	0.00	0.00	8.969E-01
	11.00	-120.79	568.99	0.00	0.00	0.00	-852.02
	12.50	-120.79	569.74	0.00	0.00	0.00	-1706.06
29	LOAD1						
	6.50	-138.90	427.87	0.00	0.00	0.00	1286.75
	8.00	-138.90	428.62	0.00	0.00	0.00	644.38
	9.50	-138.90	429.37	0.00	0.00	0.00	8.942E-01
	11.00	-138.90	430.12	0.00	0.00	0.00	-643.72
	12.50	-138.90	430.87	0.00	0.00	0.00	-1289.46
30	LOAD1						
	6.50	-161.28	324.95	0.00	0.00	0.00	978.09
	8.00	-161.28	325.70	0.00	0.00	0.00	490.10
	9.50	-161.28	326.45	0.00	0.00	0.00	9.849E-01
	11.00	-161.28	327.20	0.00	0.00	0.00	-489.26
	12.50	-161.28	327.95	0.00	0.00	0.00	-980.62

J O I N T D I S P L A C E M E N T S

JOINT	LOAD	U1	U2	U3	R1	R2	R3
1	LOAD1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	LOAD1	0.0550	0.0000	0.0176	0.0000	6.169E-03	0.0000
3	LOAD1	0.1716	0.0000	0.0342	0.0000	8.593E-03	0.0000
4	LOAD1	0.3212	0.0000	0.0495	0.0000	0.0106	0.0000
5	LOAD1	0.4983	0.0000	0.0636	0.0000	0.0123	0.0000
6	LOAD1	0.6986	0.0000	0.0763	0.0000	0.0137	0.0000
7	LOAD1	0.9186	0.0000	0.0878	0.0000	0.0149	0.0000
8	LOAD1	1.1554	0.0000	0.0980	0.0000	0.0159	0.0000
9	LOAD1	1.4062	0.0000	0.1070	0.0000	0.0168	0.0000
10	LOAD1	1.6684	0.0000	0.1148	0.0000	0.0175	0.0000
11	LOAD1	1.9396	0.0000	0.1215	0.0000	0.0180	0.0000
12	LOAD1	2.2176	0.0000	0.1271	0.0000	0.0184	0.0000
13	LOAD1	2.5002	0.0000	0.1318	0.0000	0.0187	0.0000
14	LOAD1	2.7854	0.0000	0.1356	0.0000	0.0188	0.0000
15	LOAD1	3.0713	0.0000	0.1385	0.0000	0.0188	0.0000
16	LOAD1	3.3564	0.0000	0.1407	0.0000	0.0188	0.0000
17	LOAD1	3.6390	0.0000	0.1424	0.0000	0.0186	0.0000
18	LOAD1	3.9181	0.0000	0.1435	0.0000	0.0183	0.0000
19	LOAD1	4.1927	0.0000	0.1442	0.0000	0.0181	0.0000
20	LOAD1	4.4626	0.0000	0.1446	0.0000	0.0178	0.0000
21	LOAD1	4.7285	0.0000	0.1448	0.0000	0.0176	0.0000
22	LOAD1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
23	LOAD1	0.0550	0.0000	-0.0204	0.0000	6.163E-03	0.0000
24	LOAD1	0.1715	0.0000	-0.0396	0.0000	8.589E-03	0.0000
25	LOAD1	0.3211	0.0000	-0.0575	0.0000	0.0106	0.0000
26	LOAD1	0.4981	0.0000	-0.0740	0.0000	0.0123	0.0000
27	LOAD1	0.6984	0.0000	-0.0890	0.0000	0.0137	0.0000
28	LOAD1	0.9184	0.0000	-0.1025	0.0000	0.0149	0.0000
29	LOAD1	1.1551	0.0000	-0.1147	0.0000	0.0159	0.0000
30	LOAD1	1.4059	0.0000	-0.1255	0.0000	0.0168	0.0000
31	LOAD1	1.6681	0.0000	-0.1349	0.0000	0.0175	0.0000
32	LOAD1	1.9393	0.0000	-0.1431	0.0000	0.0180	0.0000
33	LOAD1	2.2172	0.0000	-0.1501	0.0000	0.0184	0.0000
34	LOAD1	2.4997	0.0000	-0.1560	0.0000	0.0187	0.0000
35	LOAD1	2.7849	0.0000	-0.1609	0.0000	0.0188	0.0000
36	LOAD1	3.0708	0.0000	-0.1648	0.0000	0.0188	0.0000

41	LOAD1	4.4619	0.0000	-0.1734	0.0000	0.0178	0.0000
42	LOAD1	4.7277	0.0000	-0.1736	0.0000	0.0176	0.0000

J O I N T R E A C T I O N S

JOINT	LOAD	F1	F2	F3	M1	M2	M3
1	LOAD1	-1426.2504	0.0000	-24655.7188	0.0000	-39837.7656	0.0000
22	LOAD1	-1428.1096	0.0000	28686.7695	0.0000	-39827.9023	0.0000

F R A M E E L E M E N T F O R C E S

FRAME	LOAD	LOC	P	V2	V3	T	M2	M3
1	LOAD1							
		0.00	24655.72	0.00	-1426.25	0.00	-39837.77	0.00
		7.50	24701.36	0.00	-1426.25	0.00	-29140.89	0.00
		15.00	24746.99	0.00	-1426.25	0.00	-18444.01	0.00
2	LOAD1							
		0.00	23162.99	0.00	-1417.55	0.00	-33539.03	0.00
		7.50	23208.63	0.00	-1417.55	0.00	-22907.37	0.00
		15.00	23254.27	0.00	-1417.55	0.00	-12275.71	0.00
3	LOAD1							
		0.00	21462.83	0.00	-1403.80	0.00	-29341.24	0.00
		7.50	21508.47	0.00	-1403.80	0.00	-18812.77	0.00
		15.00	21554.11	0.00	-1403.80	0.00	-8284.30	0.00
4	LOAD1							
		0.00	19669.41	0.00	-1383.62	0.00	-26235.83	0.00
		7.50	19715.05	0.00	-1383.62	0.00	-15858.68	0.00
		15.00	19760.69	0.00	-1383.62	0.00	-5481.54	0.00
5	LOAD1							
		0.00	17848.02	0.00	-1356.61	0.00	-23698.79	0.00
		7.50	17893.66	0.00	-1356.61	0.00	-13524.21	0.00
		15.00	17939.29	0.00	-1356.61	0.00	-3349.63	0.00
6	LOAD1							
		0.00	16038.00	0.00	-1322.82	0.00	-21458.86	0.00
		7.50	16083.63	0.00	-1322.82	0.00	-11537.70	0.00
		15.00	16129.27	0.00	-1322.82	0.00	-1616.55	0.00
7	LOAD1							
		0.00	14264.90	0.00	-1282.21	0.00	-19374.95	0.00
		7.50	14310.54	0.00	-1282.21	0.00	-9758.39	0.00
		15.00	14356.18	0.00	-1282.21	0.00	-141.82	0.00
8	LOAD1							
		0.00	12546.97	0.00	-1234.86	0.00	-17376.23	0.00
		7.50	12592.61	0.00	-1234.86	0.00	-8114.80	0.00
		15.00	12638.25	0.00	-1234.86	0.00	1146.63	0.00
9	LOAD1							
		0.00	10898.51	0.00	-1180.76	0.00	-15427.77	0.00
		7.50	10944.15	0.00	-1180.76	0.00	-6572.08	0.00
		15.00	10989.78	0.00	-1180.76	0.00	2283.60	0.00
10	LOAD1							
		0.00	9331.75	0.00	-1119.92	0.00	-13514.62	0.00
		7.50	9377.39	0.00	-1119.92	0.00	-5115.24	0.00
		15.00	9423.03	0.00	-1119.92	0.00	3284.13	0.00

	15.00	6578.34	0.00	-977.86	0.00	4883.27	0.00
13	LOAD1						
	0.00	5229.54	0.00	-896.72	0.00	-7977.23	0.00
	7.50	5275.18	0.00	-896.72	0.00	-1251.86	0.00
	15.00	5320.82	0.00	-896.72	0.00	5473.51	0.00
14	LOAD1						
	0.00	4094.75	0.00	-808.76	0.00	-6221.07	0.00
	7.50	4140.38	0.00	-808.76	0.00	-155.39	0.00
	15.00	4186.02	0.00	-808.76	0.00	5910.29	0.00
15	LOAD1						
	0.00	3091.59	0.00	-714.06	0.00	-4533.70	0.00
	7.50	3137.23	0.00	-714.06	0.00	821.75	0.00
	15.00	3182.87	0.00	-714.06	0.00	6177.21	0.00
16	LOAD1						
	0.00	2227.94	0.00	-612.63	0.00	-2941.52	0.00
	7.50	2273.58	0.00	-612.63	0.00	1653.20	0.00
	15.00	2319.22	0.00	-612.63	0.00	6247.91	0.00
17	LOAD1						
	0.00	1509.75	0.00	-504.44	0.00	-1488.93	0.00
	7.50	1555.39	0.00	-504.44	0.00	2294.38	0.00
	15.00	1601.02	0.00	-504.44	0.00	6077.68	0.00
18	LOAD1						
	0.00	939.44	0.00	-389.22	0.00	-254.22	0.00
	7.50	985.08	0.00	-389.22	0.00	2664.96	0.00
	15.00	1030.72	0.00	-389.22	0.00	5584.13	0.00
19	LOAD1						
	0.00	512.80	0.00	-266.79	0.00	617.00	0.00
	7.50	558.44	0.00	-266.79	0.00	2617.90	0.00
	15.00	604.08	0.00	-266.79	0.00	4618.80	0.00
20	LOAD1						
	0.00	213.08	0.00	-138.76	0.00	857.30	0.00
	7.50	258.72	0.00	-138.76	0.00	1897.98	0.00
	15.00	304.36	0.00	-138.76	0.00	2938.66	0.00
21	LOAD1						
	0.00	-28686.77	0.00	-1428.11	0.00	-39827.90	0.00
	7.50	-28641.13	0.00	-1428.11	0.00	-29117.08	0.00
	15.00	-28595.49	0.00	-1428.11	0.00	-18406.26	0.00
22	LOAD1						
	0.00	-26992.49	0.00	-1423.31	0.00	-33587.85	0.00
	7.50	-26946.85	0.00	-1423.31	0.00	-22913.05	0.00
	15.00	-26901.21	0.00	-1423.31	0.00	-12238.26	0.00
23	LOAD1						
	0.00	-25090.78	0.00	-1409.90	0.00	-29390.44	0.00
	7.50	-25045.14	0.00	-1409.90	0.00	-18816.16	0.00
	15.00	-24999.50	0.00	-1409.90	0.00	-8241.88	0.00
24	LOAD1						
	0.00	-23095.80	0.00	-1389.48	0.00	-26280.12	0.00
	7.50	-23050.17	0.00	-1389.48	0.00	-15859.02	0.00
	15.00	-23004.53	0.00	-1389.48	0.00	-5437.92	0.00
25	LOAD1						
	0.00	-21072.86	0.00	-1362.39	0.00	-23741.88	0.00
	7.50	-21027.22	0.00	-1362.39	0.00	-13523.96	0.00
	15.00	-20981.58	0.00	-1362.39	0.00	-3306.04	0.00
26	LOAD1						
	0.00	-19061.29	0.00	-1328.58	0.00	-21501.98	0.00
	7.50	-19015.65	0.00	-1328.58	0.00	-11537.63	0.00
	15.00	-18970.01	0.00	-1328.58	0.00	-1573.28	0.00
27	LOAD1						
	0.00	-17086.64	0.00	-1287.99	0.00	-19418.39	0.00
	7.50	-17041.00	0.00	-1287.99	0.00	-9758.45	0.00
	15.00	-16995.36	0.00	-1287.99	0.00	-98.51	0.00
28	LOAD1						
	0.00	-15167.15	0.00	-1240.64	0.00	-17419.62	0.00
	7.50	-15121.51	0.00	-1240.64	0.00	-8114.81	0.00
	15.00	-15075.88	0.00	-1240.64	0.00	1190.01	0.00

		15.00	-11457.55	0.00	-1125.68	0.00	3327.38	0.00
31	LOAD1							
		0.00	-9873.32	0.00	-1058.04	0.00	-11675.95	0.00
		7.50	-9827.68	0.00	-1058.04	0.00	-3740.62	0.00
		15.00	-9782.04	0.00	-1058.04	0.00	4194.70	0.00
32	LOAD1							
		0.00	-8301.04	0.00	-983.64	0.00	-9827.93	0.00
		7.50	-8255.40	0.00	-983.64	0.00	-2450.60	0.00
		15.00	-8209.76	0.00	-983.64	0.00	4926.72	0.00
33	LOAD1							
		0.00	-6841.96	0.00	-902.48	0.00	-8020.49	0.00
		7.50	-6796.32	0.00	-902.48	0.00	-1251.86	0.00
		15.00	-6750.69	0.00	-902.48	0.00	5516.77	0.00
34	LOAD1							
		0.00	-5505.61	0.00	-814.54	0.00	-6264.50	0.00
		7.50	-5459.98	0.00	-814.54	0.00	-155.43	0.00
		15.00	-5414.34	0.00	-814.54	0.00	5953.65	0.00
35	LOAD1							
		0.00	-4300.91	0.00	-719.84	0.00	-4577.05	0.00
		7.50	-4255.27	0.00	-719.84	0.00	821.75	0.00
		15.00	-4209.63	0.00	-719.84	0.00	6220.54	0.00
36	LOAD1							
		0.00	-3235.70	0.00	-618.37	0.00	-2984.89	0.00
		7.50	-3190.06	0.00	-618.37	0.00	1652.90	0.00
		15.00	-3144.43	0.00	-618.37	0.00	6290.69	0.00
37	LOAD1							
		0.00	-2315.96	0.00	-510.16	0.00	-1532.85	0.00
		7.50	-2270.32	0.00	-510.16	0.00	2293.34	0.00
		15.00	-2224.68	0.00	-510.16	0.00	6119.54	0.00
38	LOAD1							
		0.00	-1544.10	0.00	-395.38	0.00	-299.09	0.00
		7.50	-1498.46	0.00	-395.38	0.00	2666.23	0.00
		15.00	-1452.83	0.00	-395.38	0.00	5631.55	0.00
39	LOAD1							
		0.00	-915.91	0.00	-274.31	0.00	577.72	0.00
		7.50	-870.27	0.00	-274.31	0.00	2635.07	0.00
		15.00	-824.63	0.00	-274.31	0.00	4692.42	0.00
40	LOAD1							
		0.00	-414.63	0.00	-145.34	0.00	844.46	0.00
		7.50	-368.99	0.00	-145.34	0.00	1934.53	0.00
		15.00	-323.36	0.00	-145.34	0.00	3024.60	0.00
41	LOAD1							
		6.50	-4.80	1590.51	0.00	0.00	0.00	4777.85
		8.00	-4.80	1592.01	0.00	0.00	0.00	2390.97
		9.50	-4.80	1593.51	0.00	0.00	0.00	1.84
		11.00	-4.80	1595.01	0.00	0.00	0.00	-2389.54
		12.50	-4.80	1596.51	0.00	0.00	0.00	-4783.18
42	LOAD1							
		6.50	-13.40	1797.93	0.00	0.00	0.00	5400.09
		8.00	-13.40	1799.43	0.00	0.00	0.00	2702.07
		9.50	-13.40	1800.93	0.00	0.00	0.00	1.80
		11.00	-13.40	1802.43	0.00	0.00	0.00	-2700.72
		12.50	-13.40	1803.93	0.00	0.00	0.00	-5405.50
43	LOAD1							
		6.50	-20.42	1891.20	0.00	0.00	0.00	5679.87
		8.00	-20.42	1892.70	0.00	0.00	0.00	2841.95
		9.50	-20.42	1894.20	0.00	0.00	0.00	1.77
		11.00	-20.42	1895.70	0.00	0.00	0.00	-2840.65
		12.50	-20.42	1897.20	0.00	0.00	0.00	-5685.32 ← max
44	LOAD1							
		6.50	-27.09	1919.17	0.00	0.00	0.00	5763.78
		8.00	-27.09	1920.67	0.00	0.00	0.00	2883.90
		9.50	-27.09	1922.17	0.00	0.00	0.00	1.77
		11.00	-27.09	1923.67	0.00	0.00	0.00	-2882.61
		12.50	-27.09	1925.17	0.00	0.00	0.00	-5769.24
45	LOAD1							
		6.50	-33.81	1907.80	0.00	0.00	0.00	5729.67
		8.00	-33.81	1909.30	0.00	0.00	0.00	2866.85

	9.50	-40.59	1873.87	0.00	0.00	0.00	1.77
	11.00	-40.59	1875.37	0.00	0.00	0.00	-2810.15
	12.50	-40.59	1876.87	0.00	0.00	0.00	-5624.33
47	LOAD1						
	6.50	-47.35	1815.71	0.00	0.00	0.00	5453.41
	8.00	-47.35	1817.21	0.00	0.00	0.00	2728.72
	9.50	-47.35	1818.71	0.00	0.00	0.00	1.77
	11.00	-47.35	1820.21	0.00	0.00	0.00	-2727.42
	12.50	-47.35	1821.71	0.00	0.00	0.00	-5458.86
48	LOAD1						
	6.50	-54.10	1746.24	0.00	0.00	0.00	5244.98
	8.00	-54.10	1747.74	0.00	0.00	0.00	2624.50
	9.50	-54.10	1749.24	0.00	0.00	0.00	1.77
	11.00	-54.10	1750.74	0.00	0.00	0.00	-2623.21
	12.50	-54.10	1752.24	0.00	0.00	0.00	-5250.44
49	LOAD1						
	6.50	-60.86	1664.53	0.00	0.00	0.00	4999.87
	8.00	-60.86	1666.03	0.00	0.00	0.00	2501.95
	9.50	-60.86	1667.53	0.00	0.00	0.00	1.77
	11.00	-60.86	1669.03	0.00	0.00	0.00	-2500.65
	12.50	-60.86	1670.53	0.00	0.00	0.00	-5005.33
50	LOAD1						
	6.50	-67.64	1571.73	0.00	0.00	0.00	4721.48
	8.00	-67.64	1573.23	0.00	0.00	0.00	2362.75
	9.50	-67.64	1574.73	0.00	0.00	0.00	1.77
	11.00	-67.64	1576.23	0.00	0.00	0.00	-2361.45
	12.50	-67.64	1577.73	0.00	0.00	0.00	-4726.93
51	LOAD1						
	6.50	-74.40	1468.50	0.00	0.00	0.00	4411.78
	8.00	-74.40	1470.00	0.00	0.00	0.00	2207.90
	9.50	-74.40	1471.50	0.00	0.00	0.00	1.77
	11.00	-74.40	1473.00	0.00	0.00	0.00	-2206.61
	12.50	-74.40	1474.50	0.00	0.00	0.00	-4417.23
52	LOAD1						
	6.50	-81.16	1355.30	0.00	0.00	0.00	4072.18
	8.00	-81.16	1356.80	0.00	0.00	0.00	2038.10
	9.50	-81.16	1358.30	0.00	0.00	0.00	1.77
	11.00	-81.16	1359.80	0.00	0.00	0.00	-2036.80
	12.50	-81.16	1361.30	0.00	0.00	0.00	-4077.63
53	LOAD1						
	6.50	-87.94	1232.57	0.00	0.00	0.00	3703.99
	8.00	-87.94	1234.07	0.00	0.00	0.00	1854.01
	9.50	-87.94	1235.57	0.00	0.00	0.00	1.77
	11.00	-87.94	1237.07	0.00	0.00	0.00	-1852.71
	12.50	-87.94	1238.57	0.00	0.00	0.00	-3709.44
54	LOAD1						
	6.50	-94.70	1100.93	0.00	0.00	0.00	3309.07
	8.00	-94.70	1102.43	0.00	0.00	0.00	1656.54
	9.50	-94.70	1103.93	0.00	0.00	0.00	1.77
	11.00	-94.70	1105.43	0.00	0.00	0.00	-1655.25
	12.50	-94.70	1106.93	0.00	0.00	0.00	-3314.52
55	LOAD1						
	6.50	-101.47	961.43	0.00	0.00	0.00	2890.56
	8.00	-101.47	962.93	0.00	0.00	0.00	1447.29
	9.50	-101.47	964.43	0.00	0.00	0.00	1.77
	11.00	-101.47	965.93	0.00	0.00	0.00	-1446.00
	12.50	-101.47	967.43	0.00	0.00	0.00	-2896.01
56	LOAD1						
	6.50	-108.21	815.97	0.00	0.00	0.00	2454.17
	8.00	-108.21	817.47	0.00	0.00	0.00	1229.10
	9.50	-108.21	818.97	0.00	0.00	0.00	1.77
	11.00	-108.21	820.47	0.00	0.00	0.00	-1227.80
	12.50	-108.21	821.97	0.00	0.00	0.00	-2459.63
57	LOAD1						
	6.50	-114.78	668.08	0.00	0.00	0.00	2010.51
	8.00	-114.78	669.58	0.00	0.00	0.00	1007.26
	9.50	-114.78	671.08	0.00	0.00	0.00	1.76
	11.00	-114.78	672.58	0.00	0.00	0.00	-1005.98
	12.50	-114.78	674.08	0.00	0.00	0.00	-2015.98

58 LOAD1

		8.00	-128.97	399.00	0.00	0.00	0.00	601.52
		9.50	-128.97	400.50	0.00	0.00	0.00	1.90
		11.00	-128.97	402.00	0.00	0.00	0.00	-599.98
		12.50	-128.97	403.50	0.00	0.00	0.00	-1204.10
60	LOAD1							
		6.50	-145.34	310.86	0.00	0.00	0.00	939.22
		8.00	-145.34	312.36	0.00	0.00	0.00	471.81
		9.50	-145.34	313.86	0.00	0.00	0.00	2.16
		11.00	-145.34	315.36	0.00	0.00	0.00	-469.75
		12.50	-145.34	316.86	0.00	0.00	0.00	-943.91

J O I N T D I S P L A C E M E N T S

JOINT	LOAD	U1	U2	U3	R1	R2	R3
1	LOAD1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	LOAD1	0.0325	0.0000	0.0185	0.0000	3.166E-03	0.0000
3	LOAD1	0.0993	0.0000	0.0354	0.0000	4.965E-03	0.0000
4	LOAD1	0.1925	0.0000	0.0508	0.0000	6.693E-03	0.0000
5	LOAD1	0.3106	0.0000	0.0648	0.0000	8.284E-03	0.0000
6	LOAD1	0.4512	0.0000	0.0775	0.0000	9.724E-03	0.0000
7	LOAD1	0.6122	0.0000	0.0888	0.0000	0.0110	0.0000
8	LOAD1	0.7913	0.0000	0.0988	0.0000	0.0122	0.0000
9	LOAD1	0.9862	0.0000	0.1076	0.0000	0.0132	0.0000
10	LOAD1	1.1948	0.0000	0.1152	0.0000	0.0140	0.0000
11	LOAD1	1.4151	0.0000	0.1217	0.0000	0.0147	0.0000
12	LOAD1	1.6451	0.0000	0.1271	0.0000	0.0153	0.0000
13	LOAD1	1.8830	0.0000	0.1316	0.0000	0.0158	0.0000
14	LOAD1	2.1272	0.0000	0.1351	0.0000	0.0162	0.0000
15	LOAD1	2.3759	0.0000	0.1378	0.0000	0.0165	0.0000
16	LOAD1	2.6279	0.0000	0.1398	0.0000	0.0167	0.0000
17	LOAD1	2.8818	0.0000	0.1412	0.0000	0.0168	0.0000
18	LOAD1	3.1365	0.0000	0.1421	0.0000	0.0169	0.0000
19	LOAD1	3.3911	0.0000	0.1426	0.0000	0.0169	0.0000
20	LOAD1	3.6449	0.0000	0.1428	0.0000	0.0168	0.0000
21	LOAD1	3.8975	0.0000	0.1428	0.0000	0.0168	0.0000
22	LOAD1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
23	LOAD1	0.0325	0.0000	-0.0216	0.0000	3.160E-03	0.0000
24	LOAD1	0.0993	0.0000	-0.0414	0.0000	4.961E-03	0.0000
25	LOAD1	0.1925	0.0000	-0.0596	0.0000	6.689E-03	0.0000
26	LOAD1	0.3105	0.0000	-0.0762	0.0000	8.279E-03	0.0000
27	LOAD1	0.4512	0.0000	-0.0913	0.0000	9.719E-03	0.0000
28	LOAD1	0.6121	0.0000	-0.1049	0.0000	0.0110	0.0000
29	LOAD1	0.7911	0.0000	-0.1171	0.0000	0.0121	0.0000
30	LOAD1	0.9860	0.0000	-0.1279	0.0000	0.0131	0.0000
31	LOAD1	1.1946	0.0000	-0.1373	0.0000	0.0140	0.0000
32	LOAD1	1.4149	0.0000	-0.1455	0.0000	0.0147	0.0000
33	LOAD1	1.6449	0.0000	-0.1524	0.0000	0.0153	0.0000
34	LOAD1	1.8828	0.0000	-0.1582	0.0000	0.0158	0.0000
35	LOAD1	2.1269	0.0000	-0.1629	0.0000	0.0162	0.0000
36	LOAD1	2.3757	0.0000	-0.1666	0.0000	0.0165	0.0000

41	LOAD1	3.6445	0.0000	-0.1744	0.0000	0.0168	0.0000
42	LOAD1	3.8971	0.0000	-0.1746	0.0000	0.0168	0.0000

J O I N T R E A C T I O N S

JOINT	LOAD	F1	F2	F3	M1	M2	M3
1	LOAD1	-1424.4528	0.0000	-25959.0098	0.0000	-25639.6680	0.0000
22	LOAD1	-1429.9072	0.0000	30370.0586	0.0000	-25653.4863	0.0000

F R A M E E L E M E N T F O R C E S

FRAME	LOAD	LOC	P	V2	V3	T	M2	M3
1	LOAD1							
		0.00	25959.01	0.00	-1424.45	0.00	-25639.67	0.00
		7.50	26004.65	0.00	-1424.45	0.00	-14956.27	0.00
		15.00	26050.29	0.00	-1424.45	0.00	-4272.88	0.00
2	LOAD1							
		0.00	23603.97	0.00	-1414.45	0.00	-27609.22	0.00
		7.50	23649.61	0.00	-1414.45	0.00	-17000.86	0.00
		15.00	23695.25	0.00	-1414.45	0.00	-6392.49	0.00
3	LOAD1							
		0.00	21553.61	0.00	-1401.00	0.00	-26833.73	0.00
		7.50	21599.25	0.00	-1401.00	0.00	-16326.22	0.00
		15.00	21644.89	0.00	-1401.00	0.00	-5818.71	0.00
4	LOAD1							
		0.00	19595.38	0.00	-1380.88	0.00	-25384.60	0.00
		7.50	19641.02	0.00	-1380.88	0.00	-15027.99	0.00
		15.00	19686.66	0.00	-1380.88	0.00	-4671.37	0.00
5	LOAD1							
		0.00	17687.55	0.00	-1353.85	0.00	-23758.52	0.00
		7.50	17733.18	0.00	-1353.85	0.00	-13604.68	0.00
		15.00	17778.82	0.00	-1353.85	0.00	-3450.83	0.00
6	LOAD1							
		0.00	15828.04	0.00	-1320.05	0.00	-22078.83	0.00
		7.50	15873.68	0.00	-1320.05	0.00	-12178.48	0.00
		15.00	15919.32	0.00	-1320.05	0.00	-2278.14	0.00
7	LOAD1							
		0.00	14024.04	0.00	-1279.44	0.00	-20378.92	0.00
		7.50	14069.68	0.00	-1279.44	0.00	-10783.14	0.00
		15.00	14115.31	0.00	-1279.44	0.00	-1187.35	0.00
8	LOAD1							
		0.00	12284.83	0.00	-1232.09	0.00	-18672.56	0.00
		7.50	12330.47	0.00	-1232.09	0.00	-9431.89	0.00
		15.00	12376.10	0.00	-1232.09	0.00	-191.23	0.00
9	LOAD1							
		0.00	10620.19	0.00	-1177.99	0.00	-16968.00	0.00
		7.50	10665.83	0.00	-1177.99	0.00	-8133.09	0.00
		15.00	10711.47	0.00	-1177.99	0.00	701.82	0.00
10	LOAD1							
		0.00	9040.02	0.00	-1117.14	0.00	-15272.55	0.00
		7.50	9085.66	0.00	-1117.14	0.00	-6893.97	0.00
		15.00	9131.29	0.00	-1117.14	0.00	1484.62	0.00

	15.00	6264.10	0.00	-975.09	0.00	2689.42	0.00
13	LOAD1						
	0.00	4905.67	0.00	-893.94	0.00	-10311.23	0.00
	7.50	4951.31	0.00	-893.94	0.00	-3606.64	0.00
	15.00	4996.95	0.00	-893.94	0.00	3097.94	0.00
14	LOAD1						
	0.00	3762.74	0.00	-805.99	0.00	-8722.59	0.00
	7.50	3808.38	0.00	-805.99	0.00	-2677.69	0.00
	15.00	3854.02	0.00	-805.99	0.00	3367.22	0.00
15	LOAD1						
	0.00	2753.98	0.00	-711.29	0.00	-7178.76	0.00
	7.50	2799.62	0.00	-711.29	0.00	-1844.10	0.00
	15.00	2845.25	0.00	-711.29	0.00	3490.55	0.00
16	LOAD1						
	0.00	1889.28	0.00	-609.84	0.00	-5686.81	0.00
	7.50	1934.92	0.00	-609.84	0.00	-1112.98	0.00
	15.00	1980.56	0.00	-609.84	0.00	3460.85	0.00
17	LOAD1						
	0.00	1178.47	0.00	-501.68	0.00	-4254.54	0.00
	7.50	1224.11	0.00	-501.68	0.00	-491.93	0.00
	15.00	1269.75	0.00	-501.68	0.00	3270.68	0.00
18	LOAD1						
	0.00	631.08	0.00	-386.62	0.00	-2892.25	0.00
	7.50	676.72	0.00	-386.62	0.00	7.39	0.00
	15.00	722.35	0.00	-386.62	0.00	2907.02	0.00
19	LOAD1						
	0.00	255.21	0.00	-264.07	0.00	-1626.36	0.00
	7.50	300.85	0.00	-264.07	0.00	354.13	0.00
	15.00	346.49	0.00	-264.07	0.00	2334.63	0.00
20	LOAD1						
	0.00	52.89	0.00	-134.62	0.00	-550.68	0.00
	7.50	98.53	0.00	-134.62	0.00	458.98	0.00
	15.00	144.17	0.00	-134.62	0.00	1468.65	0.00
21	LOAD1						
	0.00	-30370.06	0.00	-1429.91	0.00	-25653.49	0.00
	7.50	-30324.42	0.00	-1429.91	0.00	-14929.18	0.00
	15.00	-30278.78	0.00	-1429.91	0.00	-4204.88	0.00
22	LOAD1						
	0.00	-27794.46	0.00	-1426.41	0.00	-27709.56	0.00
	7.50	-27748.83	0.00	-1426.41	0.00	-17011.47	0.00
	15.00	-27703.19	0.00	-1426.41	0.00	-6313.39	0.00
23	LOAD1						
	0.00	-25523.56	0.00	-1412.70	0.00	-26924.17	0.00
	7.50	-25477.92	0.00	-1412.70	0.00	-16328.93	0.00
	15.00	-25432.28	0.00	-1412.70	0.00	-5733.69	0.00
24	LOAD1						
	0.00	-23344.77	0.00	-1392.22	0.00	-25469.44	0.00
	7.50	-23299.13	0.00	-1392.22	0.00	-15027.80	0.00
	15.00	-23253.50	0.00	-1392.22	0.00	-4586.16	0.00
25	LOAD1						
	0.00	-21216.38	0.00	-1365.15	0.00	-23843.14	0.00
	7.50	-21170.75	0.00	-1365.15	0.00	-13604.48	0.00
	15.00	-21125.11	0.00	-1365.15	0.00	-3365.83	0.00
26	LOAD1						
	0.00	-19136.33	0.00	-1331.35	0.00	-22163.63	0.00
	7.50	-19090.69	0.00	-1331.35	0.00	-12178.47	0.00
	15.00	-19045.05	0.00	-1331.35	0.00	-2193.31	0.00
27	LOAD1						
	0.00	-17111.77	0.00	-1290.76	0.00	-20463.90	0.00
	7.50	-17066.13	0.00	-1290.76	0.00	-10783.18	0.00
	15.00	-17020.49	0.00	-1290.76	0.00	-1102.46	0.00
28	LOAD1						
	0.00	-15152.01	0.00	-1243.41	0.00	-18757.48	0.00
	7.50	-15106.37	0.00	-1243.41	0.00	-9431.89	0.00
	15.00	-15060.73	0.00	-1243.41	0.00	-106.31	0.00

		15.00	-11374.82	0.00	-1128.46	0.00	1569.45	0.00
31	LOAD1							
		0.00	-9759.77	0.00	-1060.81	0.00	-13677.91	0.00
		7.50	-9714.13	0.00	-1060.81	0.00	-5721.82	0.00
		15.00	-9668.49	0.00	-1060.81	0.00	2234.27	0.00
32	LOAD1							
		0.00	-8157.79	0.00	-986.41	0.00	-12021.80	0.00
		7.50	-8112.15	0.00	-986.41	0.00	-4623.71	0.00
		15.00	-8066.51	0.00	-986.41	0.00	2774.39	0.00
33	LOAD1							
		0.00	-6670.09	0.00	-905.26	0.00	-10396.06	0.00
		7.50	-6624.45	0.00	-905.26	0.00	-3606.64	0.00
		15.00	-6578.81	0.00	-905.26	0.00	3182.77	0.00
34	LOAD1							
		0.00	-5306.61	0.00	-817.31	0.00	-8807.56	0.00
		7.50	-5260.97	0.00	-817.31	0.00	-2677.72	0.00
		15.00	-5215.33	0.00	-817.31	0.00	3452.12	0.00
35	LOAD1							
		0.00	-4077.29	0.00	-722.61	0.00	-7263.67	0.00
		7.50	-4031.65	0.00	-722.61	0.00	-1844.08	0.00
		15.00	-3986.02	0.00	-722.61	0.00	3575.51	0.00
36	LOAD1							
		0.00	-2992.04	0.00	-621.16	0.00	-5771.65	0.00
		7.50	-2946.40	0.00	-621.16	0.00	-1112.98	0.00
		15.00	-2900.76	0.00	-621.16	0.00	3545.69	0.00
37	LOAD1							
		0.00	-2060.68	0.00	-512.92	0.00	-4339.50	0.00
		7.50	-2015.04	0.00	-512.92	0.00	-492.60	0.00
		15.00	-1969.41	0.00	-512.92	0.00	3354.29	0.00
38	LOAD1							
		0.00	-1292.74	0.00	-397.98	0.00	-2978.52	0.00
		7.50	-1247.10	0.00	-397.98	0.00	6.35	0.00
		15.00	-1201.46	0.00	-397.98	0.00	2991.22	0.00
39	LOAD1							
		0.00	-696.31	0.00	-277.03	0.00	-1712.17	0.00
		7.50	-650.68	0.00	-277.03	0.00	365.59	0.00
		15.00	-605.04	0.00	-277.03	0.00	2443.34	0.00
40	LOAD1							
		0.00	-273.44	0.00	-149.48	0.00	-610.67	0.00
		7.50	-227.80	0.00	-149.48	0.00	510.41	0.00
		15.00	-182.17	0.00	-149.48	0.00	1631.49	0.00
41	LOAD1							
		6.50	-3.50	2459.32	0.00	0.00	0.00	7393.03
		8.00	-3.50	2462.32	0.00	0.00	0.00	3701.81
		9.50	-3.50	2465.32	0.00	0.00	0.00	6.08
		11.00	-3.50	2468.32	0.00	0.00	0.00	-3694.14
		12.50	-3.50	2471.32	0.00	0.00	0.00	-7398.87 ← max
42	LOAD1							
		6.50	-13.71	2154.63	0.00	0.00	0.00	6478.38
		8.00	-13.71	2157.63	0.00	0.00	0.00	3244.18
		9.50	-13.71	2160.63	0.00	0.00	0.00	5.48
		11.00	-13.71	2163.63	0.00	0.00	0.00	-3237.72
		12.50	-13.71	2166.63	0.00	0.00	0.00	-6485.42
43	LOAD1							
		6.50	-20.48	2062.51	0.00	0.00	0.00	6201.85
		8.00	-20.48	2065.51	0.00	0.00	0.00	3105.84
		9.50	-20.48	2068.51	0.00	0.00	0.00	5.32
		11.00	-20.48	2071.51	0.00	0.00	0.00	-3099.69
		12.50	-20.48	2074.51	0.00	0.00	0.00	-6209.20
44	LOAD1							
		6.50	-27.06	2012.11	0.00	0.00	0.00	6050.67
		8.00	-27.06	2015.11	0.00	0.00	0.00	3030.25
		9.50	-27.06	2018.11	0.00	0.00	0.00	5.34
		11.00	-27.06	2021.11	0.00	0.00	0.00	-3024.08
		12.50	-27.06	2024.11	0.00	0.00	0.00	-6058.00
45	LOAD1							
		6.50	-33.80	1963.78	0.00	0.00	0.00	5905.68

	9.50	-40.59	1914.28	0.00	0.00	0.00	5.35
	11.00	-40.59	1917.28	0.00	0.00	0.00	-2868.33
	12.50	-40.59	1920.28	0.00	0.00	0.00	-5746.50
47	LOAD1						
	6.50	-47.35	1843.49	0.00	0.00	0.00	5544.80
	8.00	-47.35	1846.49	0.00	0.00	0.00	2777.32
	9.50	-47.35	1849.49	0.00	0.00	0.00	5.34
	11.00	-47.35	1852.49	0.00	0.00	0.00	-2771.13
	12.50	-47.35	1855.49	0.00	0.00	0.00	-5552.11
48	LOAD1						
	6.50	-54.10	1768.91	0.00	0.00	0.00	5321.08
	8.00	-54.10	1771.91	0.00	0.00	0.00	2665.46
	9.50	-54.10	1774.91	0.00	0.00	0.00	5.34
	11.00	-54.10	1777.91	0.00	0.00	0.00	-2659.28
	12.50	-54.10	1780.91	0.00	0.00	0.00	-5328.39
49	LOAD1						
	6.50	-60.86	1684.45	0.00	0.00	0.00	5067.70
	8.00	-60.86	1687.45	0.00	0.00	0.00	2538.77
	9.50	-60.86	1690.45	0.00	0.00	0.00	5.35
	11.00	-60.86	1693.45	0.00	0.00	0.00	-2532.58
	12.50	-60.86	1696.45	0.00	0.00	0.00	-5075.00
50	LOAD1						
	6.50	-67.64	1590.05	0.00	0.00	0.00	4784.49
	8.00	-67.64	1593.05	0.00	0.00	0.00	2397.17
	9.50	-67.64	1596.05	0.00	0.00	0.00	5.35
	11.00	-67.64	1599.05	0.00	0.00	0.00	-2390.98
	12.50	-67.64	1602.05	0.00	0.00	0.00	-4791.80
51	LOAD1						
	6.50	-74.40	1485.70	0.00	0.00	0.00	4471.45
	8.00	-74.40	1488.70	0.00	0.00	0.00	2240.65
	9.50	-74.40	1491.70	0.00	0.00	0.00	5.34
	11.00	-74.40	1494.70	0.00	0.00	0.00	-2234.46
	12.50	-74.40	1497.70	0.00	0.00	0.00	-4478.76
52	LOAD1						
	6.50	-81.16	1371.43	0.00	0.00	0.00	4128.62
	8.00	-81.16	1374.43	0.00	0.00	0.00	2069.24
	9.50	-81.16	1377.43	0.00	0.00	0.00	5.35
	11.00	-81.16	1380.43	0.00	0.00	0.00	-2063.04
	12.50	-81.16	1383.43	0.00	0.00	0.00	-4135.93
53	LOAD1						
	6.50	-87.94	1247.20	0.00	0.00	0.00	3755.96
	8.00	-87.94	1250.20	0.00	0.00	0.00	1882.90
	9.50	-87.94	1253.20	0.00	0.00	0.00	5.35
	11.00	-87.94	1256.20	0.00	0.00	0.00	-1876.71
	12.50	-87.94	1259.20	0.00	0.00	0.00	-3763.26
54	LOAD1						
	6.50	-94.70	1113.04	0.00	0.00	0.00	3353.47
	8.00	-94.70	1116.04	0.00	0.00	0.00	1681.66
	9.50	-94.70	1119.04	0.00	0.00	0.00	5.34
	11.00	-94.70	1122.04	0.00	0.00	0.00	-1675.47
	12.50	-94.70	1125.04	0.00	0.00	0.00	-3360.78
55	LOAD1						
	6.50	-101.46	968.98	0.00	0.00	0.00	2921.27
	8.00	-101.46	971.98	0.00	0.00	0.00	1465.56
	9.50	-101.46	974.98	0.00	0.00	0.00	5.35
	11.00	-101.46	977.98	0.00	0.00	0.00	-1459.37
	12.50	-101.46	980.98	0.00	0.00	0.00	-2928.58
56	LOAD1						
	6.50	-108.24	815.08	0.00	0.00	0.00	2459.59
	8.00	-108.24	818.08	0.00	0.00	0.00	1234.72
	9.50	-108.24	821.08	0.00	0.00	0.00	5.35
	11.00	-108.24	824.08	0.00	0.00	0.00	-1228.53
	12.50	-108.24	827.08	0.00	0.00	0.00	-2466.90
57	LOAD1						
	6.50	-114.94	651.67	0.00	0.00	0.00	1969.32
	8.00	-114.94	654.67	0.00	0.00	0.00	989.56
	9.50	-114.94	657.67	0.00	0.00	0.00	5.31
	11.00	-114.94	660.67	0.00	0.00	0.00	-983.45
	12.50	-114.94	663.67	0.00	0.00	0.00	-1976.70
58	LOAD1						

	8.00	-127.56	309.60	0.00	0.00	0.00	472.54
	9.50	-127.56	312.60	0.00	0.00	0.00	5.90
	11.00	-127.56	315.60	0.00	0.00	0.00	-465.24
	12.50	-127.56	318.60	0.00	0.00	0.00	-940.89
60	LOAD1						
	6.50	-149.48	157.17	0.00	0.00	0.00	489.32
	8.00	-149.48	160.17	0.00	0.00	0.00	251.32
	9.50	-149.48	163.17	0.00	0.00	0.00	8.83
	11.00	-149.48	166.17	0.00	0.00	0.00	-238.17
	12.50	-149.48	169.17	0.00	0.00	0.00	-489.67

 20 floor. C-wall. Low DC

J O I N T D I S P L A C E M E N T S

JOINT	LOAD	U1	U2	U3	R1	R2	R3
1	LOAD1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	LOAD1	0.1254	0.0000	0.0144	0.0000	0.0156	0.0000
3	LOAD1	0.4115	0.0000	0.0283	0.0000	0.0218	0.0000
4	LOAD1	0.7814	0.0000	0.0416	0.0000	0.0268	0.0000
5	LOAD1	1.2177	0.0000	0.0541	0.0000	0.0306	0.0000
6	LOAD1	1.7053	0.0000	0.0658	0.0000	0.0336	0.0000
7	LOAD1	2.2317	0.0000	0.0767	0.0000	0.0358	0.0000
8	LOAD1	2.7859	0.0000	0.0866	0.0000	0.0374	0.0000
9	LOAD1	3.3586	0.0000	0.0955	0.0000	0.0383	0.0000
10	LOAD1	3.9417	0.0000	0.1035	0.0000	0.0388	0.0000
11	LOAD1	4.5283	0.0000	0.1106	0.0000	0.0388	0.0000
12	LOAD1	5.1122	0.0000	0.1168	0.0000	0.0385	0.0000
13	LOAD1	5.6883	0.0000	0.1222	0.0000	0.0378	0.0000
14	LOAD1	6.2522	0.0000	0.1267	0.0000	0.0369	0.0000
15	LOAD1	6.8004	0.0000	0.1305	0.0000	0.0358	0.0000
16	LOAD1	7.3306	0.0000	0.1336	0.0000	0.0345	0.0000
17	LOAD1	7.8411	0.0000	0.1360	0.0000	0.0332	0.0000
18	LOAD1	8.3315	0.0000	0.1379	0.0000	0.0319	0.0000
19	LOAD1	8.8029	0.0000	0.1392	0.0000	0.0307	0.0000
20	LOAD1	9.2579	0.0000	0.1401	0.0000	0.0298	0.0000
21	LOAD1	9.7011	0.0000	0.1405	0.0000	0.0292	0.0000
22	LOAD1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
23	LOAD1	0.1254	0.0000	-0.0170	0.0000	0.0156	0.0000
24	LOAD1	0.4113	0.0000	-0.0335	0.0000	0.0218	0.0000
25	LOAD1	0.7812	0.0000	-0.0492	0.0000	0.0268	0.0000
26	LOAD1	1.2174	0.0000	-0.0640	0.0000	0.0306	0.0000
27	LOAD1	1.7049	0.0000	-0.0778	0.0000	0.0336	0.0000
28	LOAD1	2.2312	0.0000	-0.0907	0.0000	0.0358	0.0000
29	LOAD1	2.7853	0.0000	-0.1024	0.0000	0.0374	0.0000
30	LOAD1	3.3580	0.0000	-0.1131	0.0000	0.0383	0.0000
31	LOAD1	3.9411	0.0000	-0.1227	0.0000	0.0388	0.0000
32	LOAD1	4.5276	0.0000	-0.1312	0.0000	0.0388	0.0000
33	LOAD1	5.1114	0.0000	-0.1387	0.0000	0.0385	0.0000
34	LOAD1	5.6874	0.0000	-0.1452	0.0000	0.0378	0.0000
35	LOAD1	6.2512	0.0000	-0.1508	0.0000	0.0369	0.0000

41	LOAD1	9.2565	0.0000	-0.1675	0.0000	0.0298	0.0000
42	LOAD1	9.6996	0.0000	-0.1680	0.0000	0.0292	0.0000

J O I N T R E A C T I O N S

JOINT	LOAD	F1	F2	F3	M1	M2	M3
1	LOAD1	-1427.6814	0.0000	-20082.2188	0.0000	-84203.0547	0.0000
22	LOAD1	-1426.6786	0.0000	23923.2715	0.0000	-84164.0859	0.0000

F R A M E E L E M E N T F O R C E S

FRAME	LOAD	LOC	P	V2	V3	T	M2	M3
1	LOAD1							
		0.00	20082.22	0.00	-1427.68	0.00	-84203.05	0.00
		7.50	20127.86	0.00	-1427.68	0.00	-73495.45	0.00
		15.00	20173.49	0.00	-1427.68	0.00	-62787.84	0.00
2	LOAD1							
		0.00	19458.80	0.00	-1419.28	0.00	-69600.80	0.00
		7.50	19504.44	0.00	-1419.28	0.00	-58956.20	0.00
		15.00	19550.08	0.00	-1419.28	0.00	-48311.59	0.00
3	LOAD1							
		0.00	18595.15	0.00	-1405.27	0.00	-57406.74	0.00
		7.50	18640.79	0.00	-1405.27	0.00	-46867.24	0.00
		15.00	18686.43	0.00	-1405.27	0.00	-36327.75	0.00
4	LOAD1							
		0.00	17553.75	0.00	-1385.01	0.00	-47111.52	0.00
		7.50	17599.39	0.00	-1385.01	0.00	-36723.93	0.00
		15.00	17645.03	0.00	-1385.01	0.00	-26336.35	0.00
5	LOAD1							
		0.00	16385.75	0.00	-1358.03	0.00	-38322.86	0.00
		7.50	16431.39	0.00	-1358.03	0.00	-28137.64	0.00
		15.00	16477.03	0.00	-1358.03	0.00	-17952.42	0.00
6	LOAD1							
		0.00	15133.27	0.00	-1324.26	0.00	-30741.50	0.00
		7.50	15178.91	0.00	-1324.26	0.00	-20809.54	0.00
		15.00	15224.54	0.00	-1324.26	0.00	-10877.58	0.00
7	LOAD1							
		0.00	13831.20	0.00	-1283.65	0.00	-24137.70	0.00
		7.50	13876.84	0.00	-1283.65	0.00	-14510.33	0.00
		15.00	13922.48	0.00	-1283.65	0.00	-4882.95	0.00
8	LOAD1							
		0.00	12508.62	0.00	-1236.30	0.00	-18337.95	0.00
		7.50	12554.26	0.00	-1236.30	0.00	-9065.72	0.00
		15.00	12599.90	0.00	-1236.30	0.00	206.50	0.00
9	LOAD1							
		0.00	11189.84	0.00	-1182.20	0.00	-13212.43	0.00
		7.50	11235.48	0.00	-1182.20	0.00	-4345.96	0.00
		15.00	11281.11	0.00	-1182.20	0.00	4520.52	0.00
10	LOAD1							
		0.00	9895.21	0.00	-1121.36	0.00	-8668.97	0.00
		7.50	9940.84	0.00	-1121.36	0.00	-258.79	0.00

	15.00	7534.63	0.00	-979.29	0.00	13572.61	0.00
13	LOAD1						
	0.00	6311.38	0.00	-898.16	0.00	1928.42	0.00
	7.50	6357.02	0.00	-898.16	0.00	8664.59	0.00
	15.00	6402.66	0.00	-898.16	0.00	15400.77	0.00
14	LOAD1						
	0.00	5254.38	0.00	-810.20	0.00	4468.76	0.00
	7.50	5300.01	0.00	-810.20	0.00	10545.25	0.00
	15.00	5345.65	0.00	-810.20	0.00	16621.75	0.00
15	LOAD1						
	0.00	4278.16	0.00	-715.51	0.00	6457.21	0.00
	7.50	4323.80	0.00	-715.51	0.00	11823.54	0.00
	15.00	4369.44	0.00	-715.51	0.00	17189.88	0.00
16	LOAD1						
	0.00	3385.56	0.00	-614.07	0.00	7819.73	0.00
	7.50	3431.20	0.00	-614.07	0.00	12425.27	0.00
	15.00	3476.84	0.00	-614.07	0.00	17030.80	0.00
17	LOAD1						
	0.00	2576.04	0.00	-505.81	0.00	8449.86	0.00
	7.50	2621.68	0.00	-505.81	0.00	12243.40	0.00
	15.00	2667.32	0.00	-505.81	0.00	16036.95	0.00
18	LOAD1						
	0.00	1845.08	0.00	-390.47	0.00	8202.33	0.00
	7.50	1890.72	0.00	-390.47	0.00	11130.84	0.00
	15.00	1936.36	0.00	-390.47	0.00	14059.35	0.00
19	LOAD1						
	0.00	1183.39	0.00	-268.29	0.00	6882.79	0.00
	7.50	1229.03	0.00	-268.29	0.00	8894.95	0.00
	15.00	1274.67	0.00	-268.29	0.00	10907.10	0.00
20	LOAD1						
	0.00	575.83	0.00	-141.08	0.00	4244.75	0.00
	7.50	621.47	0.00	-141.08	0.00	5302.83	0.00
	15.00	667.10	0.00	-141.08	0.00	6360.90	0.00
21	LOAD1						
	0.00	-23923.27	0.00	-1426.68	0.00	-84164.09	0.00
	7.50	-23877.63	0.00	-1426.68	0.00	-73464.00	0.00
	15.00	-23832.00	0.00	-1426.68	0.00	-62763.91	0.00
22	LOAD1						
	0.00	-23107.80	0.00	-1421.58	0.00	-69620.38	0.00
	7.50	-23062.16	0.00	-1421.58	0.00	-58958.54	0.00
	15.00	-23016.53	0.00	-1421.58	0.00	-48296.69	0.00
23	LOAD1						
	0.00	-22052.10	0.00	-1408.43	0.00	-57435.36	0.00
	7.50	-22006.46	0.00	-1408.43	0.00	-46872.10	0.00
	15.00	-21960.82	0.00	-1408.43	0.00	-36308.84	0.00
24	LOAD1						
	0.00	-20818.65	0.00	-1388.09	0.00	-47136.14	0.00
	7.50	-20773.01	0.00	-1388.09	0.00	-36725.48	0.00
	15.00	-20727.37	0.00	-1388.09	0.00	-26314.82	0.00
25	LOAD1						
	0.00	-19458.59	0.00	-1360.97	0.00	-38344.86	0.00
	7.50	-19412.96	0.00	-1360.97	0.00	-28137.58	0.00
	15.00	-19367.32	0.00	-1360.97	0.00	-17930.30	0.00
26	LOAD1						
	0.00	-18014.06	0.00	-1327.14	0.00	-30762.91	0.00
	7.50	-17968.42	0.00	-1327.14	0.00	-20809.37	0.00
	15.00	-17922.78	0.00	-1327.14	0.00	-10855.83	0.00
27	LOAD1						
	0.00	-16519.94	0.00	-1286.55	0.00	-24159.48	0.00
	7.50	-16474.30	0.00	-1286.55	0.00	-14510.35	0.00
	15.00	-16428.66	0.00	-1286.55	0.00	-4861.23	0.00
28	LOAD1						
	0.00	-15005.31	0.00	-1239.20	0.00	-18359.75	0.00
	7.50	-14959.67	0.00	-1239.20	0.00	-9065.72	0.00
	[illegible]	[illegible]	[illegible]	-1239.20	0.00	228.31	0.00

	15.00	-11916.51	0.00	-1124.24	0.00	8173.03	0.00
31	LOAD1						
	0.00	-10562.23	0.00	-1056.61	0.00	-4669.21	0.00
	7.50	-10516.60	0.00	-1056.61	0.00	3255.32	0.00
	15.00	-10470.96	0.00	-1056.61	0.00	11179.86	0.00
32	LOAD1						
	0.00	-9171.82	0.00	-982.21	0.00	-1138.57	0.00
	7.50	-9126.18	0.00	-982.21	0.00	6227.98	0.00
	15.00	-9080.55	0.00	-982.21	0.00	13594.52	0.00
33	LOAD1						
	0.00	-7847.80	0.00	-901.04	0.00	1906.80	0.00
	7.50	-7802.16	0.00	-901.04	0.00	8664.62	0.00
	15.00	-7756.52	0.00	-901.04	0.00	15422.44	0.00
34	LOAD1						
	0.00	-6598.75	0.00	-813.10	0.00	4446.90	0.00
	7.50	-6553.11	0.00	-813.10	0.00	10545.15	0.00
	15.00	-6507.47	0.00	-813.10	0.00	16643.40	0.00
35	LOAD1						
	0.00	-5430.48	0.00	-718.39	0.00	6435.33	0.00
	7.50	-5384.84	0.00	-718.39	0.00	11823.24	0.00
	15.00	-5339.20	0.00	-718.39	0.00	17211.15	0.00
36	LOAD1						
	0.00	-4345.83	0.00	-616.93	0.00	7797.48	0.00
	7.50	-4300.19	0.00	-616.93	0.00	12424.44	0.00
	15.00	-4254.55	0.00	-616.93	0.00	17051.40	0.00
37	LOAD1						
	0.00	-3344.25	0.00	-508.79	0.00	8426.93	0.00
	7.50	-3298.61	0.00	-508.79	0.00	12242.88	0.00
	15.00	-3252.98	0.00	-508.79	0.00	16058.84	0.00
38	LOAD1						
	0.00	-2421.24	0.00	-394.13	0.00	8180.69	0.00
	7.50	-2375.60	0.00	-394.13	0.00	11136.68	0.00
	15.00	-2329.96	0.00	-394.13	0.00	14092.67	0.00
39	LOAD1						
	0.00	-1567.49	0.00	-272.81	0.00	6872.60	0.00
	7.50	-1521.86	0.00	-272.81	0.00	8918.69	0.00
	15.00	-1476.22	0.00	-272.81	0.00	10964.79	0.00
40	LOAD1						
	0.00	-767.88	0.00	-143.02	0.00	4258.97	0.00
	7.50	-722.24	0.00	-143.02	0.00	5331.64	0.00
	15.00	-676.60	0.00	-143.02	0.00	6404.32	0.00
41	LOAD1						
	6.50	-5.10	717.94	0.00	0.00	0.00	2156.89
	8.00	-5.10	718.69	0.00	0.00	0.00	1079.41
	9.50	-5.10	719.44	0.00	0.00	0.00	8.059E-01
	11.00	-5.10	720.19	0.00	0.00	0.00	-1078.92
	12.50	-5.10	720.94	0.00	0.00	0.00	-2159.78
42	LOAD1						
	6.50	-13.15	958.17	0.00	0.00	0.00	2877.58
	8.00	-13.15	958.92	0.00	0.00	0.00	1439.75
	9.50	-13.15	959.67	0.00	0.00	0.00	8.038E-01
	11.00	-13.15	960.42	0.00	0.00	0.00	-1439.27
	12.50	-13.15	961.17	0.00	0.00	0.00	-2880.47
43	LOAD1						
	6.50	-20.35	1135.93	0.00	0.00	0.00	3410.82
	8.00	-20.35	1136.68	0.00	0.00	0.00	1706.37
	9.50	-20.35	1137.43	0.00	0.00	0.00	7.995E-01
	11.00	-20.35	1138.18	0.00	0.00	0.00	-1705.90
	12.50	-20.35	1138.93	0.00	0.00	0.00	-3413.73
44	LOAD1						
	6.50	-27.12	1262.53	0.00	0.00	0.00	3790.63
	8.00	-27.12	1263.28	0.00	0.00	0.00	1896.28
	9.50	-27.12	1264.03	0.00	0.00	0.00	7.981E-01
	11.00	-27.12	1264.78	0.00	0.00	0.00	-1895.81
	12.50	-27.12	1265.53	0.00	0.00	0.00	-3793.54

	9.50	-40.59	1398.09	0.00	0.00	0.00	7.983E-01
	11.00	-40.59	1398.84	0.00	0.00	0.00	-2096.90
	12.50	-40.59	1399.59	0.00	0.00	0.00	-4195.73
47	LOAD1						
	6.50	-47.35	1417.11	0.00	0.00	0.00	4254.37
	8.00	-47.35	1417.86	0.00	0.00	0.00	2128.14
	9.50	-47.35	1418.61	0.00	0.00	0.00	7.983E-01
	11.00	-47.35	1419.36	0.00	0.00	0.00	-2127.67
	12.50	-47.35	1420.11	0.00	0.00	0.00	-4257.27 ← max
48	LOAD1						
	6.50	-54.10	1413.31	0.00	0.00	0.00	4242.98
	8.00	-54.10	1414.06	0.00	0.00	0.00	2122.45
	9.50	-54.10	1414.81	0.00	0.00	0.00	7.983E-01
	11.00	-54.10	1415.56	0.00	0.00	0.00	-2121.98
	12.50	-54.10	1416.31	0.00	0.00	0.00	-4245.88
49	LOAD1						
	6.50	-60.86	1389.16	0.00	0.00	0.00	4170.52
	8.00	-60.86	1389.91	0.00	0.00	0.00	2086.22
	9.50	-60.86	1390.66	0.00	0.00	0.00	7.984E-01
	11.00	-60.86	1391.41	0.00	0.00	0.00	-2085.75
	12.50	-60.86	1392.16	0.00	0.00	0.00	-4173.43
50	LOAD1						
	6.50	-67.64	1348.02	0.00	0.00	0.00	4047.12
	8.00	-67.64	1348.77	0.00	0.00	0.00	2024.52
	9.50	-67.64	1349.52	0.00	0.00	0.00	7.984E-01
	11.00	-67.64	1350.27	0.00	0.00	0.00	-2024.05
	12.50	-67.64	1351.02	0.00	0.00	0.00	-4050.02
51	LOAD1						
	6.50	-74.40	1292.89	0.00	0.00	0.00	3881.71
	8.00	-74.40	1293.64	0.00	0.00	0.00	1941.81
	9.50	-74.40	1294.39	0.00	0.00	0.00	7.984E-01
	11.00	-74.40	1295.14	0.00	0.00	0.00	-1941.34
	12.50	-74.40	1295.89	0.00	0.00	0.00	-3884.61
52	LOAD1						
	6.50	-81.16	1226.50	0.00	0.00	0.00	3682.53
	8.00	-81.16	1227.25	0.00	0.00	0.00	1842.23
	9.50	-81.16	1228.00	0.00	0.00	0.00	7.984E-01
	11.00	-81.16	1228.75	0.00	0.00	0.00	-1841.76
	12.50	-81.16	1229.50	0.00	0.00	0.00	-3685.44
53	LOAD1						
	6.50	-87.94	1151.53	0.00	0.00	0.00	3457.64
	8.00	-87.94	1152.28	0.00	0.00	0.00	1729.78
	9.50	-87.94	1153.03	0.00	0.00	0.00	7.984E-01
	11.00	-87.94	1153.78	0.00	0.00	0.00	-1729.31
	12.50	-87.94	1154.53	0.00	0.00	0.00	-3460.54
54	LOAD1						
	6.50	-94.71	1070.74	0.00	0.00	0.00	3215.28
	8.00	-94.71	1071.49	0.00	0.00	0.00	1608.60
	9.50	-94.71	1072.24	0.00	0.00	0.00	7.983E-01
	11.00	-94.71	1072.99	0.00	0.00	0.00	-1608.13
	12.50	-94.71	1073.74	0.00	0.00	0.00	-3218.18
55	LOAD1						
	6.50	-101.46	987.12	0.00	0.00	0.00	2964.42
	8.00	-101.46	987.87	0.00	0.00	0.00	1483.17
	9.50	-101.46	988.62	0.00	0.00	0.00	7.981E-01
	11.00	-101.46	989.37	0.00	0.00	0.00	-1482.70
	12.50	-101.46	990.12	0.00	0.00	0.00	-2967.32
56	LOAD1						
	6.50	-108.13	904.05	0.00	0.00	0.00	2715.19
	8.00	-108.13	904.80	0.00	0.00	0.00	1358.56
	9.50	-108.13	905.55	0.00	0.00	0.00	7.973E-01
	11.00	-108.13	906.30	0.00	0.00	0.00	-1358.09
	12.50	-108.13	907.05	0.00	0.00	0.00	-2718.10
57	LOAD1						
	6.50	-114.66	825.49	0.00	0.00	0.00	2479.51
	8.00	-114.66	826.24	0.00	0.00	0.00	1240.72
	9.50	-114.66	826.99	0.00	0.00	0.00	7.969E-01
	11.00	-114.66	827.74	0.00	0.00	0.00	-1240.25
	12.50	-114.66	828.49	0.00	0.00	0.00	-2482.42

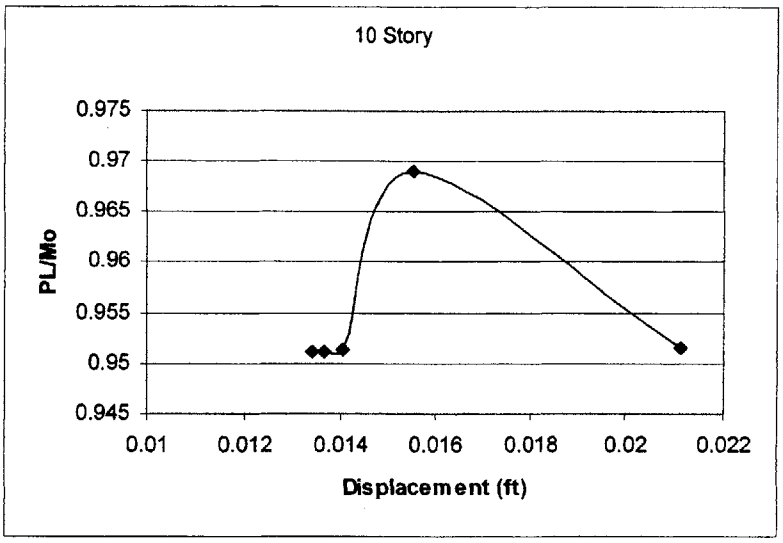
		8.00	-129.79	702.84	0.00	0.00	0.00	1055.64
		9.50	-129.79	703.59	0.00	0.00	0.00	8.232E-01
		11.00	-129.79	704.34	0.00	0.00	0.00	-1055.12
		12.50	-129.79	705.09	0.00	0.00	0.00	-2112.19
60	LOAD1							
		6.50	-143.02	670.35	0.00	0.00	0.00	2014.16
		8.00	-143.02	671.10	0.00	0.00	0.00	1008.07
		9.50	-143.02	671.85	0.00	0.00	0.00	8.488E-01
		11.00	-143.02	672.60	0.00	0.00	0.00	-1007.49
		12.50	-143.02	673.35	0.00	0.00	0.00	-2016.96

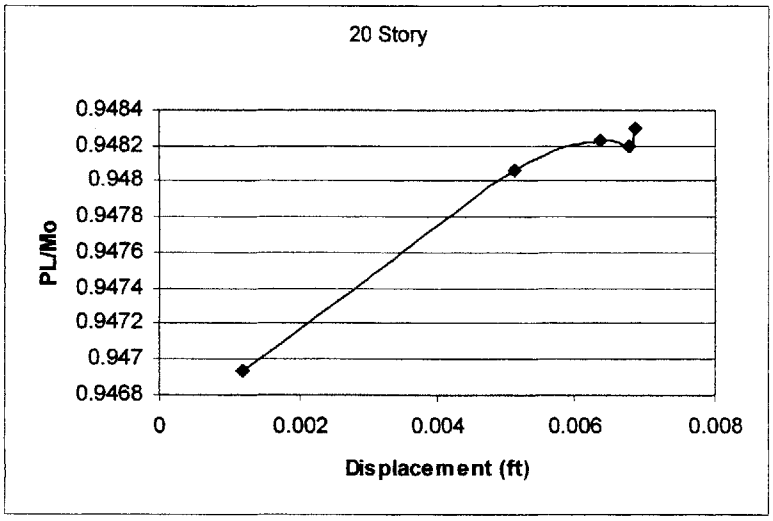
APPENDIX B SUMMARY TABLES FOR PHASE II

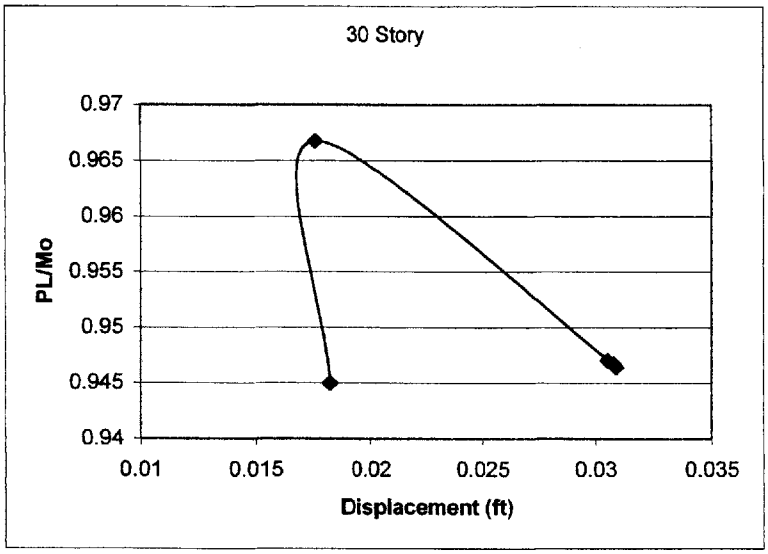
C-Shaped Wall, 10 Stories																
DC	P (K)	Pier M3	Beam M	X (ft)	Y (ft)	Z (ft)	Period	EI beam	EI wall	Eib/Eiw	GA beam	GA wall	Gab/Gaw	PL	Mo	PL/Mo
12"	157.15	33.38	44.41	0.0211	-0.0444	-0.103	1.197	43200	85333629	0.00051	216000	8566560	0.02521	1309.5	1376.2	0.95149
18"	136.81	18.2	72.83	0.0156	-0.0333	-0.103	1.1901	145800	85333629	0.00171	324000	8566560	0.03782	1140	1176.4	0.96906
24"	147.26	31.42	85.17	0.014	-0.032	-0.103	1.1862	345600	85333629	0.00405	432000	8566560	0.05043	1227.1	1289.9	0.95128
30"	146.86	31.43	114.22	0.0136	-0.0314	-0.103	1.1834	675000	85333629	0.00791	540000	8566560	0.06304	1223.7	1286.6	0.95114
36"	146.64	31.37	142.3	0.0134	-0.0311	-0.103	1.1817	1166400	85333629	0.01367	648000	8566560	0.07564	1222	1284.7	0.95116
C-Shaped Wall, 20 Stories																
12"	356.46	83.22	63305	0.0012	-0.0035	-0.44	2.0292	43200	85333629	0.00051	216000	8566560	0.02521	2970.3	3136.8	0.94694
18"	356.04	81.26	116.84	0.0051	-0.0035	-0.441	1.97	145800	85333629	0.00171	324000	8566560	0.03782	2966.9	3129.4	0.94807
24"	356.01	80.99	201.97	0.0064	-0.0035	-0.441	1.9206	345600	85333629	0.00405	432000	8566560	0.05043	2966.6	3128.6	0.94823
30"	355.48	80.91	276.93	0.0068	-0.0035	-0.441	1.887	675000	85333629	0.00791	540000	8566560	0.06304	2962.2	3124	0.9482
36"	355.37	80.72	339.04	0.0069	-0.0035	-0.441	1.8657	1166400	85333629	0.01367	648000	8566560	0.07564	2961.3	3122.7	0.9483
C-Shaped Wall, 30 Stories																
12"	652.89	158.4	93.25	0.0182	-0.005	-1.076	2.9508	43200	85333629	0.00051	216000	8566560	0.02521	5440.5	5757.3	0.94497
18"	604.30	86.61	289.9	0.0176	-0.005	-1.076	2.8277	145800	85333629	0.00171	324000	8566560	0.03782	5035.6	5208.8	0.96674
24"	651.97	152.89	374.75	0.0308	-0.005	-1.077	2.8015	345600	85333629	0.00405	432000	8566560	0.05043	5432.8	5738.6	0.94672
30"	651.67	153.7	508.97	0.0309	-0.005	-1.077	8.8026	675000	85333629	0.00791	540000	8566560	0.06304	5430.3	5737.7	0.94642
36"	651.60	151.87	619.24	0.0305	-0.005	-1.076	2.8046	1166400	85333629	0.01367	648000	8566560	0.07564	5429.8	5733.5	0.94702
C-Shaped Wall, 40 Stories																
12"	1037.24	257.4	130.4	0.0541	-0.0062	-2.036	4.1559	43200	85333629	0.00051	216000	8566560	0.02521	8643.3	9158.1	0.94379
18"	1036.82	249.19	351.85	0.0734	-0.0061	-2.037	4.1541	145800	85333629	0.00171	324000	8566560	0.03782	8639.8	9138.2	0.94546
24"	1036.44	248.58	593.08	0.0753	-0.0061	-2.037	4.1545	345600	85333629	0.00405	432000	8566560	0.05043	8636.7	9133.8	0.94557
30"	1036.15	249.69	804.09	0.074	-0.0061	-2.037	4.1567	675000	85333629	0.00791	540000	8566560	0.06304	8634.2	9133.6	0.94532
36"	1036.01	250.59	976.93	0.0723	-0.0061	-2.037	4.1602	1166400	85333629	0.01367	648000	8566560	0.07564	8633	9134.2	0.94513
C-Shaped Wall, 50 Stories																
12"	1506.03	379.62	190.33	0.1163	-0.0654	-3.309	5.6135	43200	85333629	0.00051	216000	8566560	0.02521	12550	13309	0.94295
18"	1506.03	379.62	190.33	0.1163	-0.0065	-3.309	5.6135	145800	85333629	0.00171	324000	8566560	0.03782	12550	13309	0.94295
24"	1256.18	362.17	855.98	0.1439	-0.0065	-3.311	5.6154	345600	85333629	0.00405	432000	8566560	0.05043	10468	11192	0.93528
30"	1506.30	367	507.4	0.1445	-0.0065	-3.311	5.6135	675000	85333629	0.00791	540000	8566560	0.06304	12552	13286	0.94475
36"	1506.00	367.37	1161	0.1393	-0.0065	-3.311	5.6192	1166400	85333629	0.01367	648000	8566560	0.07564	12549	13284	0.94469

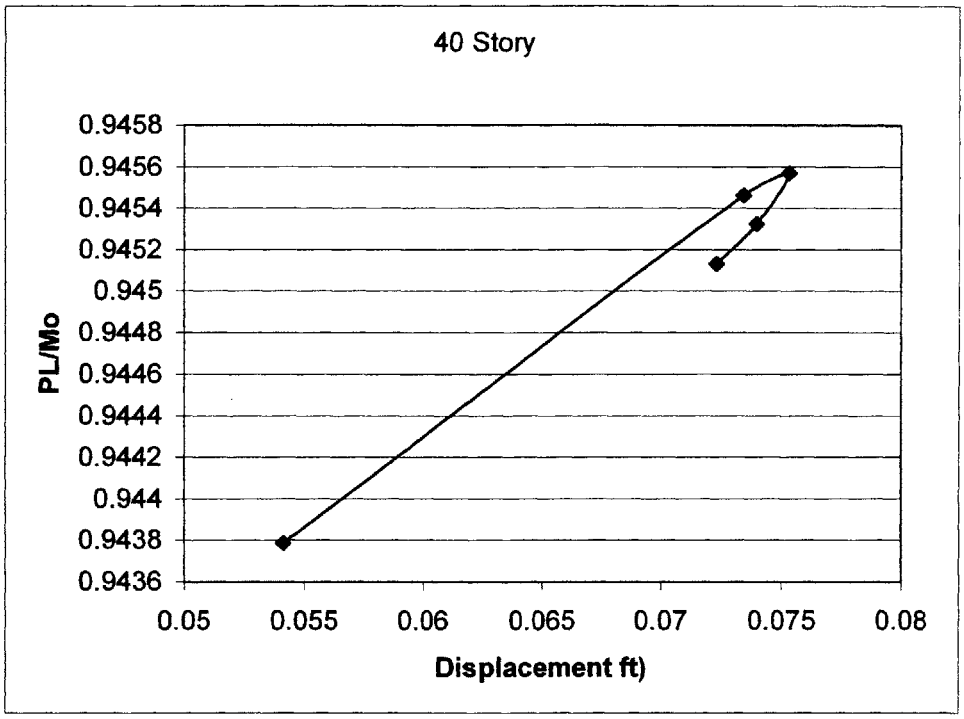
15 Degrees																
12"	648.95	205.82	97.26	0.0263	-0.005	-1.076	2.9267	43200	88905773	0.00049	216000	8639568	0.025	5256.5	5668.1	0.92738
18"	648.21	207.46	228.63	0.037	-0.005	-1.076	2.7919	145800	88905773	0.00164	324000	8639568	0.0375	5250.5	5665.4	0.92676
24"	607.18	209.64	377.33	0.0389	-0.005	-1.077	2.7682	345600	88905773	0.00389	432000	8639568	0.05	4918.1	5337.4	0.92144
30"	647.31	211.21	499.95	0.0389	-0.005	-1.077	2.7686	675000	88905773	0.00759	540000	8639568	0.0625	5243.2	5665.6	0.92544
36"	647.08	212.15	595.65	0.0385	-0.005	-1.077	2.77	1166400	88905773	0.01312	648000	8639568	0.075	5241.3	5665.6	0.92511
30 Degrees																
12"	703.20	307.86	240.38	0.7062	-0.005	-1.093	2.9697	43200	82443110	0.00052	216000	8523360	0.02534	6005.3	6621	0.90701
18"	649.13	207.67	174.84	0.0435	-0.005	-1.077	2.7943	145800	82443110	0.00177	324000	8523360	0.03801	5543.5	5958.9	0.9303
24"	648.86	212.74	281.87	0.0457	-0.005	-1.077	2.7318	345600	82443110	0.00419	432000	8523360	0.05068	5541.2	5966.7	0.92869
30"	648.67	216.61	364.59	0.0459	-0.005	-1.077	2.7322	675000	82443110	0.00819	540000	8523360	0.06336	5539.6	5972.8	0.92747
36"	648.67	216.61	593.41	0.0459	-0.005	-1.077	2.322	1166400	82443110	0.01415	648000	8523360	0.07603	5539.6	5972.8	0.92747
45 Degrees																
12"	3321.56	1689.1	237.33	0.6861	-0.0006	-0.112	3.0747	43200	68818593	0.00063	216000	8328096	0.02594	31356	34734	0.90274
18"	3287.49	400.69	78.63	0.0023	-0.0006	-0.098	3.0464	145800	68818593	0.00212	324000	8328096	0.0389	31034	31835	0.97483
24"	3286.30	398.18	107.91	0.0039	-0.0006	-0.098	3.025	345600	68818593	0.00502	432000	8328096	0.05187	31023	31819	0.97497
30"	3285.72	397.07	151.01	0.0048	-0.0006	-0.098	3.0064	675000	68818593	0.00981	540000	8328096	0.06484	31017	31811	0.97504
36"	3285.44	396.99	187.4	0.0053	-0.0006	-0.098	2.9921	1166400	68818593	0.01695	648000	8328096	0.07781	31015	31808	0.97504
60 Degrees																
12"	694.47	197.91	153.96	0.6919	-0.005	-1.092	3.3376	43200	53060464	0.00081	216000	7935840	0.02722	7819.7	8215.5	0.95182
18"	724.86	224.52	255.07	0.6923	-0.005	-1.092	3.0501	145800	53060464	0.00275	324000	7935840	0.04083	8161.9	8611	0.94785
24"	769.17	282.11	382.63	0.8622	-0.005	-1.097	2.863	345600	53060464	0.00651	432000	7935840	0.05444	8660.8	9225	0.93884
30"	803.70	322.66	470.49	0.9712	-0.005	-1.1	2.7595	675000	53060464	0.01272	540000	7935840	0.06805	9049.6	9694.9	0.93344
36"	824.85	347.49	520.79	1.0233	-0.005	-1.101	2.7028	1166400	53060464	0.02198	648000	7935840	0.08165	9287.8	9982.7	0.93038

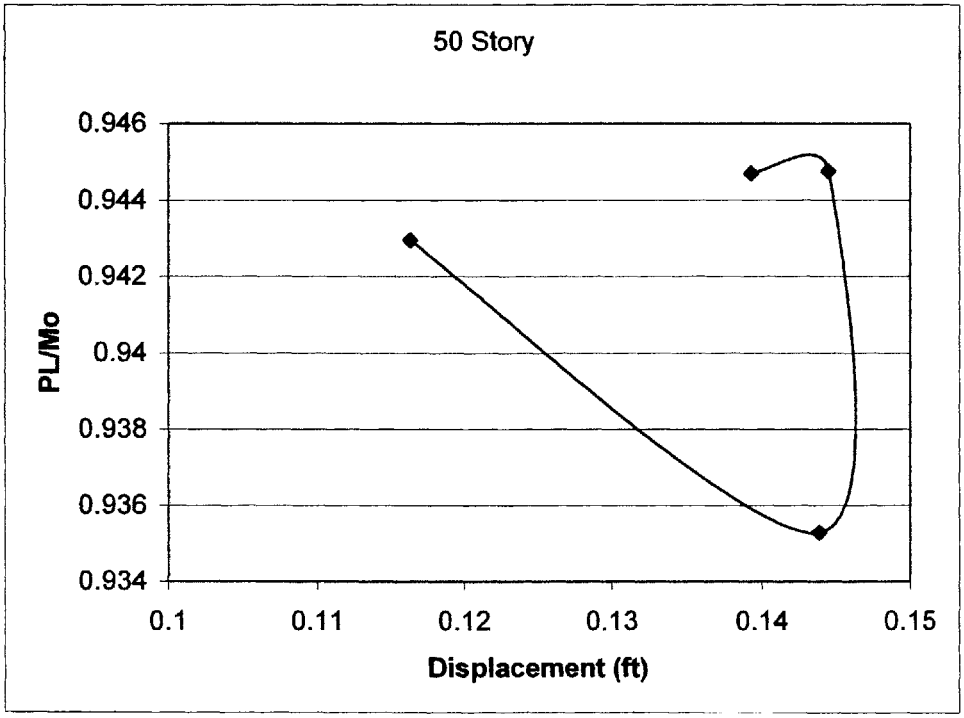
APPENDIX C FIGURES OF PHASE II TESTING

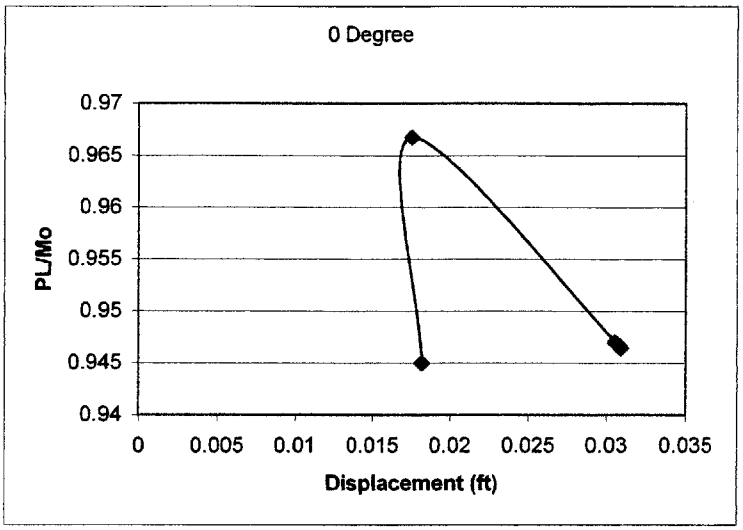

10 Story
0.975
0.97
0.965
0.96
0.955
0.95
0.945
PL/Mo
0.01
0.012
0.014
0.016
0.018
0.02
0.022
Displacement (ft)

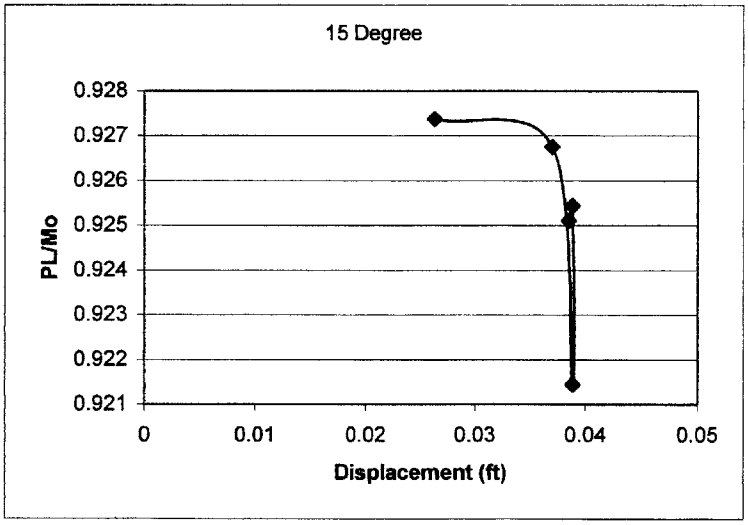

20 Story
0.9484
0.9482
0.948
0.9478
0.9476
0.9474
0.9472
0.947
0.9468
PL/Mo
0
0.002
0.004
0.006
0.008
Displacement (ft)

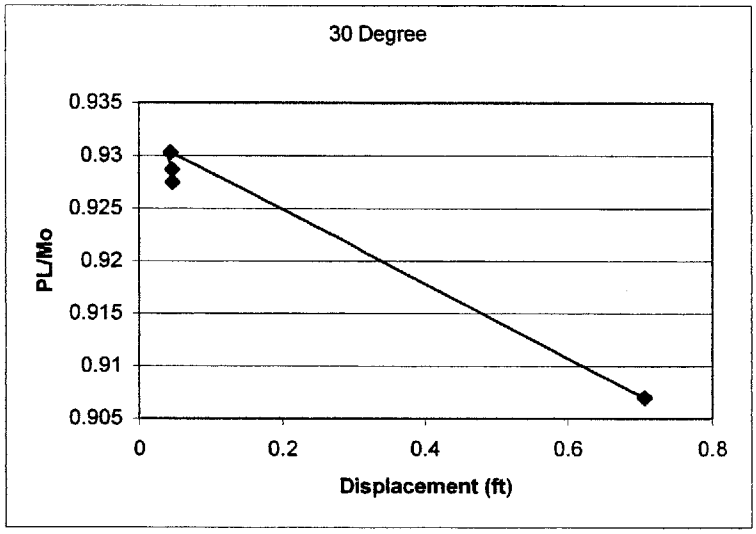

30 Story
0.97
0.965
0.96
0.955
0.95
0.945
0.94
PL/Mo
0.01
0.015
0.02
0.025
0.03
0.035
Displacement (ft)

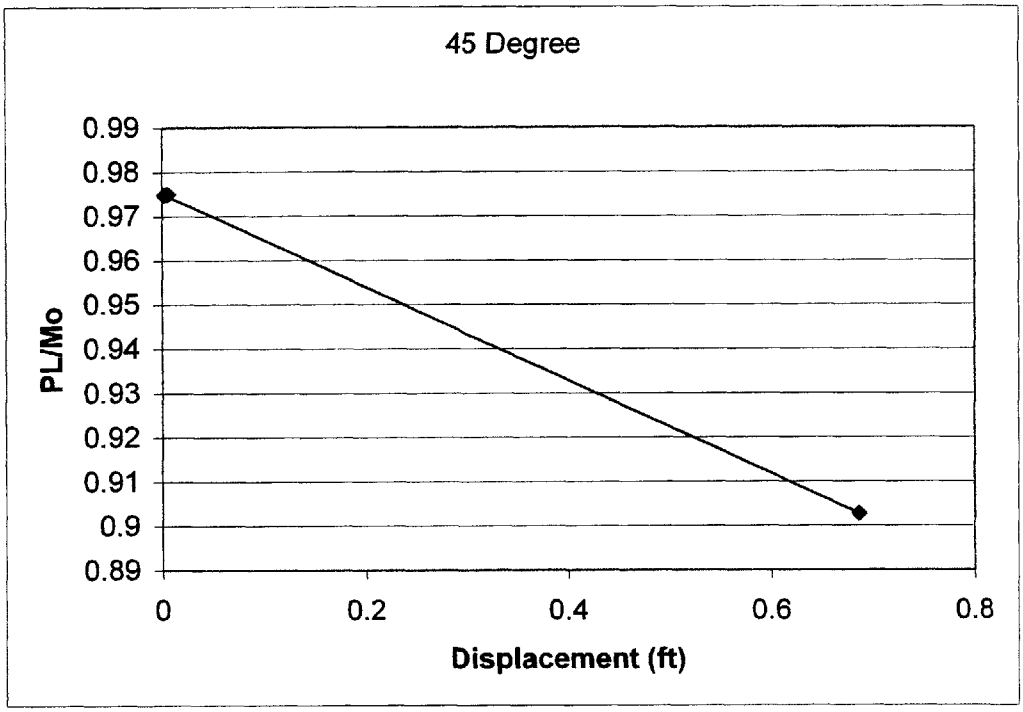

40 Story
0.9458
0.9456
0.9454
0.9452
0.945
0.9448
0.9446
0.9444
0.9442
0.944
0.9438
0.9436
PL/Mo
0.05
0.055
0.06
0.065
0.07
0.075
0.08
Displacement ft)

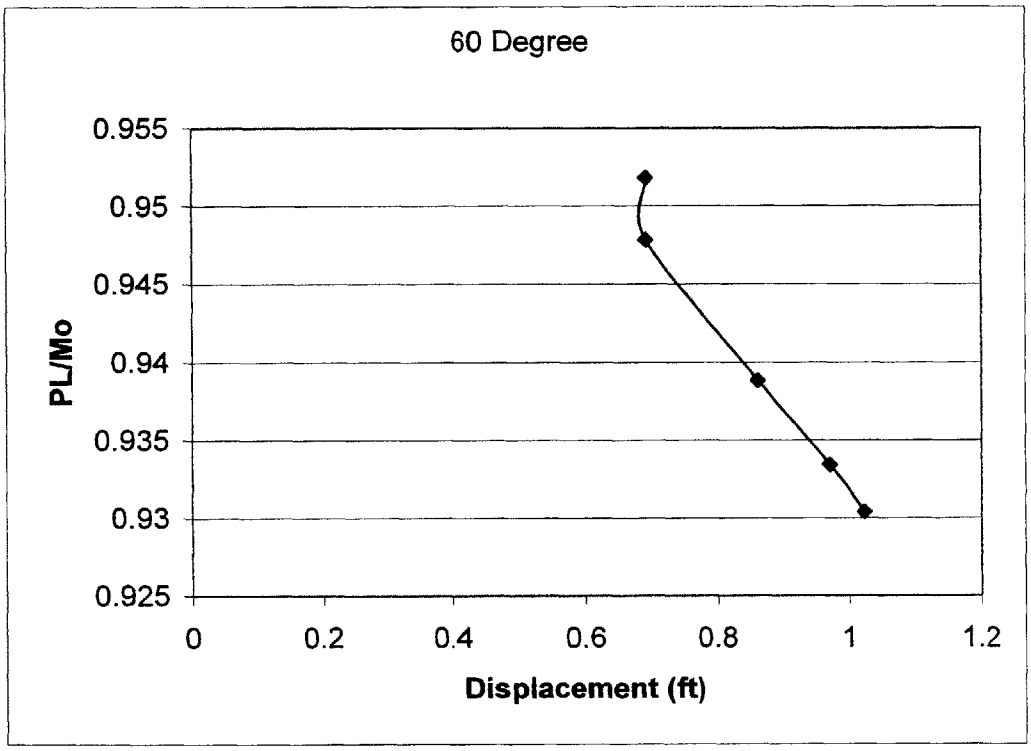

50 Story
0.946
0.944
0.942
0.94
0.938
0.936
0.934
PL/Mo
0.1
0.11
0.12
0.13
0.14
0.15
Displacement (ft)


0 Degree
0.97
0.965
0.96
0.955
0.95
0.945
0.94
PL/Mo
0
0.005
0.01
0.015
0.02
0.025
0.03
0.035
Displacement (ft)


15 Degree
0.928
0.927
0.926
0.925
0.924
0.923
0.922
0.921
PL/Mo
0
0.01
0.02
0.03
0.04
0.05
Displacement (ft)


30 Degree
0.935
0.93
0.925
0.92
0.915
0.91
0.905
PL/Mo
0
0.2
0.4
0.6
0.8
Displacement (ft)


45 Degree
0.99
0.98
0.97
0.96
0.95
0.94
0.93
0.92
0.91
0.9
0.89
PL/Mo
0
0.2
0.4
0.6
0.8
Displacement (ft)


60 Degree
0.955
0.95
0.945
0.94
0.935
0.93
0.925
PL/Mo
0
0.2
0.4
0.6
0.8
1
1.2
Displacement (ft)

APPENDIX D CALCULATIONS

Pushover Force for 20-story Models

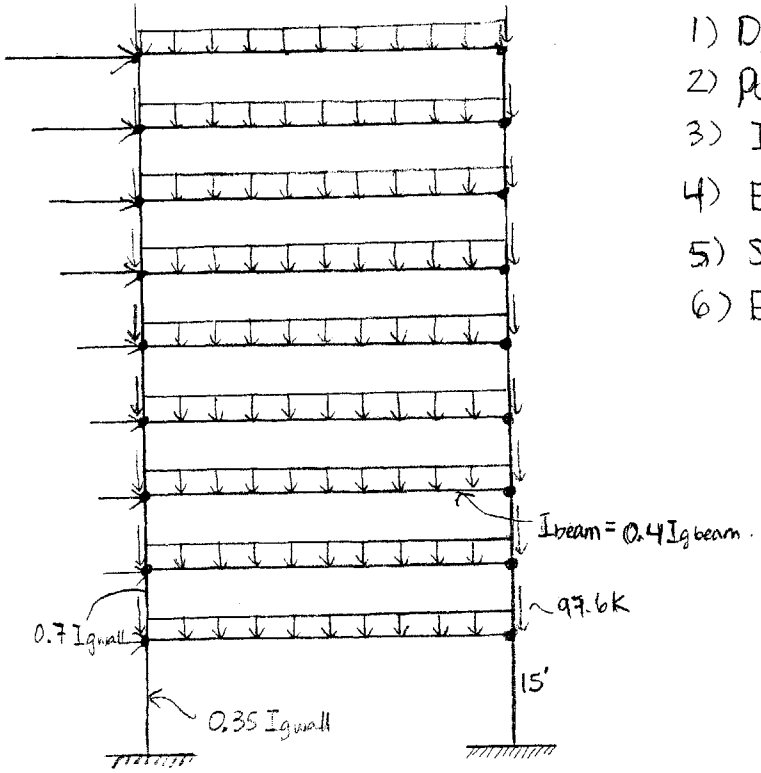
Floor	Height (ft)	Period (sec	Cs	Vb (K)	Wi (K)	WiHi	WiHi/(WiHi)total	Fi (K)
1	15	1.387278	0.067638	2570.26	2000	30000	0.005263158	13.52769
2	30	1.387278	0.067638	2570.26	2000	60000	0.010526316	27.05537
3	45	1.387278	0.067638	2570.26	2000	90000	0.015789474	40.58306
4	60	1.387278	0.067638	2570.26	2000	120000	0.021052632	54.11074
5	75	1.387278	0.067638	2570.26	2000	150000	0.026315789	67.63843
6	90	1.387278	0.067638	2570.26	2000	180000	0.031578947	81.16611
7	105	1.387278	0.067638	2570.26	2000	210000	0.036842105	94.6938
8	120	1.387278	0.067638	2570.26	2000	240000	0.042105263	108.2215
9	135	1.387278	0.067638	2570.26	2000	270000	0.047368421	121.7492
10	150	1.387278	0.067638	2570.26	2000	300000	0.052631579	135.2769
11	165	1.387278	0.067638	2570.26	2000	330000	0.057894737	148.8045
12	180	1.387278	0.067638	2570.26	2000	360000	0.063157895	162.3322
13	195	1.387278	0.067638	2570.26	2000	390000	0.068421053	175.8599
14	210	1.387278	0.067638	2570.26	2000	420000	0.073684211	189.3876
15	225	1.387278	0.067638	2570.26	2000	450000	0.078947368	202.9153
16	240	1.387278	0.067638	2570.26	2000	480000	0.084210526	216.443
17	255	1.387278	0.067638	2570.26	2000	510000	0.089473684	229.9707
18	270	1.387278	0.067638	2570.26	2000	540000	0.094736842	243.4983
19	285	1.387278	0.067638	2570.26	2000	570000	0.1	257.026
20	300	1.387278	0.067638	2570.26	2000	600000	0.105263158	270.5537
					SUM	6300000	1.105263158	2840.814

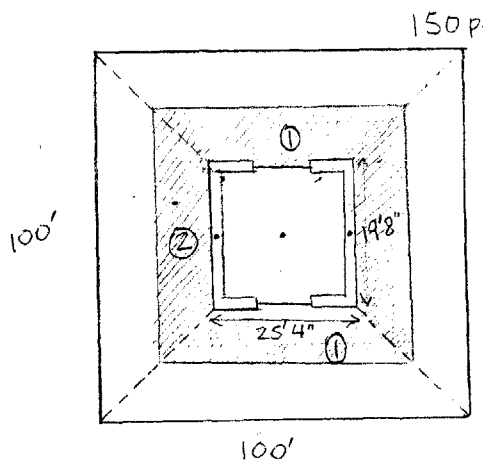
Load calculation | Elaine Huang | Drawings and Calculations

-10-story model:

Determine:

1) Distributed load
2) Point load on joints
3) I's of the pier and beams
4) E's
5) Self weight?
6) Earthquake Loads





(1)

Area ① = loads on coupling beams

$[(25.33+50)\times 20.08/2\times 125\,psf]\times 2$

$= 189\ K/25 = 7.56\ k/ft \rightarrow DL$

$LL = 3\ k/ft$

(2)

Area ② = loads on floor piers

$[(19.67+50)\times 18.67/2\times 125\,psf]$

$= 81.30\ K \leftarrow$ a concentrated load

LL 32.5K $32.5\times 0.5 = 16.26\ K$

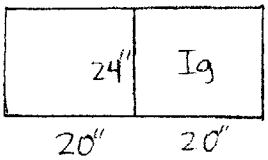
$1.2\times 81.5 = 97.56\ K$

$114\ K \rightarrow$ at joints

$\rightarrow 1.2\times 7.56 + 0.5\times 3 = 10.6 \approx 10.0\ k/ft \leftarrow$ on the beams

(3) Calculate I's

Ig, coupling beams →

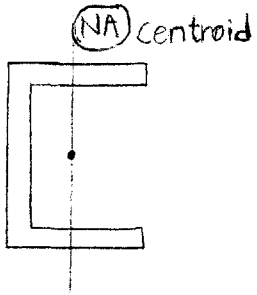


$I_g = \frac{bh^3}{12}$

$2I_g = \frac{2bh^3}{12} = \frac{bh^3}{6}$

$= \frac{20 \times 24^3}{6} = \boxed{46080\ in^4}$

Ig, wall piers →



$I_g = 9.95 \times 10^6\ in^4$

from paper (p40)

(4) Calculate E's

$E_{c\,beam} = 57000\sqrt{f'c} = 57000\sqrt{4000}$ (Assumed) $= 3604996\ psi = 3605\ ksi$

for both beam and prer?

(5) EI's

Coupling beams. $EI = 0.20EI_g \times 2$

Walls: $EI =$

$$\rho = \frac{1}{m}\left(1 - \sqrt{1 - \frac{2mR_n}{f_y}}\right)$$

$$m = \frac{60}{0.85(4)} = \frac{f_y}{0.85 f_c} = 17.65$$

$$R_n = \frac{M_n}{bd^2} = \frac{M_u}{\Phi bd^2} = \frac{2862/2}{0.9 \times 20'' \times 21.5^2} = 2064 \text{ psi}$$

$$d = 24'' - 1.5'' - \tfrac{1}{2}'' - \tfrac{1}{2}'' = 21.5''$$

$$\rho = \frac{1}{17.65}\left(1 - \sqrt{1 - \frac{2 \times 17.65 \times 2085}{60000}}\right) = \sqrt{\ } < 0 \quad \text{(width needs to be widened)}$$

$$\rho_{max} = 0.021 = 0.429\left(\frac{f_c'}{f_y}\right)\beta_1$$

$$R_n = \rho f_y (1 - 0.5\rho m) = 0.988 \text{ ksi} = \frac{M_u}{\Phi bd}$$

$$b = \frac{1446 \times 12}{0.87(21.5)^2(0.988)} = 43.67'' \rightarrow 42''$$

$$\varepsilon_t = (21 - c)\frac{\varepsilon_u}{c} = (21 - c)\frac{0.003}{c} = 0.004$$

$$\frac{21 - c}{c} = 1.333, \quad 1.333c = 21 - c. \quad c = 9.00''$$

$$a = c\beta_1 = 9.00 \times 0.85 = 7.65 = \frac{T}{(0.85)(4)(42)}$$

$$T = 1092 \text{ k} = A_s f_y = A_s(60)$$

$$A_s = 18.2 \text{ in}^2$$

Use 14 #10 bars, $A_s = \underline{17.78}$ in^2. minimum width ✓ when dividing bars into several rows

Calculate M_{cr}, φ_{cr}

$$I = I_g = \frac{1}{12}bh^3 = \frac{1}{12} \times 42 \times 24^3 = 48384 \text{ in}^4$$

$$M_{cr} = f_{cr}\frac{I}{y_t} = [7.5\sqrt{f_c}]\frac{I_g}{y_t} = \underline{159.4 \text{ k-ft}}$$

$$\varphi_{cr} = \frac{M_{cr}}{EI_g} = \frac{159.4(12)}{3600(48384)} = \underline{1.098 \text{ E-5/in}}$$

Calculate M_y, φ_y

$d = 21''$

$$n = \frac{E_s}{E_c} = \frac{29000}{3600} = 8.06$$

$$\rho = \frac{A_s}{b \cdot d} = \frac{17.78}{(42)(21)} = 0.0202$$

$$K = -n\rho + \sqrt{[\rho'(n-1) + n\rho]^2 + 2[n\rho + \rho'(\tfrac{d'}{d})(n-1)]} - \rho'(n-1) = 0.373$$

$$\varphi_y = \frac{\varepsilon_y}{d(1-K)} = \frac{0.0021}{21(1-0.373)} = \underline{1.595 \times 10^{-4}/\text{in}}$$

$$j = 1 - \frac{K}{3} = 1 - \frac{0.373}{3} = 0.876$$

Calculate Mu, φ_u

$\varphi_u = \frac{\varepsilon_{cu}}{c} = \frac{0.003}{9.0} = \underline{3.333 \times 10^{-4}}$ /in

$M_n = A_s f_y (d - \frac{a}{2}) = 17.78 \times 60 \times (21 - \frac{7.65}{2}) = 18322$ K-in $= \underline{1527}$ K-ft

---

Yield moment for 1 beam

$M_y = 1635$ K-ft from above

M_y for input $= 2M_y = 2 \times 1635 = 3270$ K-ft $= 3270$ K-ft $\times \frac{12 \text{ in}}{\text{ft}} = \underline{39240}$ K-in

φ_y stays the same $= 1.595 \times 10^{-4}$/in $\times h^{\wedge 24''} = 0.00383$ rad

Ratio of ultimate to yield $\frac{M_u}{M_y} = \frac{1527}{1635} = 0.934$

$\frac{\varphi_u}{\varphi_y} = \frac{3.333 \times 10^{-4}}{1.595 \times 10^{-4}} = 2.09$

$$\rho = \frac{1}{m}\left(1-\sqrt{1-\frac{2mRn}{fy}}\right) = \frac{1}{17.65}\left(1-\sqrt{1-\frac{2\times17.65\times6.74}{60000}}\right) = 0.0126$$

$$Rn = \frac{Mn}{bd^2} = \frac{Mu}{\Phi bd^2} = \frac{3569/2(12000)}{0.9\times20\times42^2} = 674$$

$$d = 48" - 1.5" - \frac{1}{2}" - \frac{1}{2}" = 45.5"$$

$$As = \rho bd = 0.0126\times20"\times42" = 10.62\ in^2$$

Use 7#11, $As = 10.92\ in^2$

$$T = Asfy = (10.92)(60) = 655.2\ k$$

$$a = \frac{655.2}{(0.85)(4)(20)} = 9.64\ in$$

$$C = 6.72/0.85 = 11.34"$$

$$\varepsilon t = (42-11.34)\frac{0.003}{11.34} = 0.0082 > 0.004\ \checkmark \quad \Phi = 0.9\ \checkmark$$

Calculate Mcr, φcr

$$I = Ig = \frac{1}{12}bh^3 = \frac{1}{12}(20)(48)^3 = 184320\ in^4$$

$$Mcr = fcr\frac{I}{yt} = [7.5\sqrt{4000}]\frac{184320}{24(12000)} = \underline{303.6}\ k\text{-}ft$$

$$\varphi cr = \frac{Mcr}{EIg} = \frac{303.6\times12}{3600\times184320} = \underline{5.49\times10^{-6}/in}$$

Calculate φy, My

$$d = 42"$$

$$n = 8.06$$

$$\rho = \frac{As}{bd} = \frac{10.92}{20\times42} = 0.013$$

$$n\rho = 8.06(0.013) = 0.105$$

$$k = -n\rho + \sqrt{[\rho'(n-1)+n\rho]^2 + 2\left[n\rho+\rho'\left(\frac{d'}{d}\right)(n-1)\right]} - \rho'(n-1) = 0.328$$

$$\varphi y = \frac{\varepsilon y}{d(1-k)} = \underline{6.94\times10^{-5}/in}$$

$$My = Asfy(jd) = 10.92(60)(0.891\times45) = 26270\ k\text{-}in = 2189\ k\text{-}ft$$

$$j = 1-\frac{k}{3} = 1-\frac{0.328}{3} = 0.891$$

Calculate φu, Mu

$$\varphi u = \frac{\varepsilon cu}{C} = \frac{0.003}{11.34} = 2.65\times10^{-4}/in$$

Yield moment for 1 beam

$M_y = 2189$ K-ft

2 beams $M_y = 2 \times 2189 = 4378$ K-ft $= 52536$ K-in

$\phi_y = 6.94 \times 10^{-5}/\text{in} \times 48" = 0.00333$ rad

Ratio of ultimate to yield

$$\frac{M_u}{M_y} = \frac{2194}{2189} = 1.00$$

$$\frac{\phi_u}{\phi_y} = \frac{2.65 \times 10^{-4}}{6.94 \times 10^{-5}} = 3.82$$

$\rho = \frac{1}{m}\left(1-\sqrt{1-\frac{2mR_n}{f_y}}\right) = \frac{1}{17.65}\left(1-\sqrt{1-\frac{2\times17.65\times5867}{60000}}\right)$ = negative value in $\sqrt{\ }$

$R_n = \frac{M_n}{bd^2} = \frac{M_u}{\phi bd^2} = \frac{1730/2(12000)}{0.9(20)(10)^2} = 5767$ psi

Suppose $\varepsilon_t = 0.004 = (10-c)\frac{\varepsilon_{cu}}{c} = (10-c)\frac{0.003}{c}$ $\phi = 0.87$

$\frac{(10-c)}{c} = 1.333$, $2.333c = 10$, $c = 4.29"$

$a = 4.29\beta_1 = 3.64" = \frac{T}{0.87(4)(60)}$

$T = 760.0K = A_s f_y = A_s(60)$

$A_s = 12.67 in^2$

Use 10#10, $A_s = 12.70 in^2$, min. width OK if divide into several beams

$\rho_{max} = 0.429\left(\frac{f_c'}{f_y}\right)\beta_1 = 0.021$

$R_n = \rho f_y(1-0.5\rho m) = 0.988$ KSi $= \frac{M_u}{\phi bd^2}$

$b = \frac{865\times12}{(0.87)(100)(0.988)} = 120.8" = 10.1'$ → too wide not practical

Design reinforcements | 10-story, Rec wall, Reg DC

$\rho = \frac{1}{m}\left(1 - \sqrt{1 - \frac{2mRn}{fy}}\right) = \frac{1}{17.65}\left(1 - \sqrt{1 - \frac{2\times17.65\times2771}{60000}}\right) =$ ... negative $\sqrt{}$

$Rn = \frac{Mn}{bd^2} = \frac{Mu}{\Phi bd^2} = \frac{3666/2\,(12000)}{0.9(20)(21)^2} = 2771$ psi

Suppose $\varepsilon_t = 0.004 = (21-c)\frac{\varepsilon_{cu}}{c}$ $\Phi = 0.87$

$\frac{21-c}{c} = 1.333$, $c = 9.00$"

$a = 9.00\,\beta_1 = 7.65 = \frac{T}{0.87(4)(60)}$

$T = 1597\,K = A_s f_y = A_s(60)$

$A_s = 26.6\ in^2$

Use 12#9, 10#10, $A_s = 26.2\ in^2$ min. width V

$\rho_{max} = 0.429\left(\frac{f_c'}{f_y}\right)\beta_1 = 0.021$

$Rn = \rho f_y (1 - 0.5\rho m) = 0.988$ ksi

$b = \frac{1833\times12}{0.87\times21^2(0.988)} = 58.0 \rightarrow 60$"

Calculate M_{cr}, φ_{cr}

$I = I_g = \frac{1}{12}bh^3 = \frac{1}{12}\times60\times24^3 = 69120\ in^4$

$M_{cr} = f_{cr}\frac{I}{y_t} = [7.5\sqrt{f_c'}]\frac{I_g}{y_t} = \frac{7.5\sqrt{4000}\,(69120)}{12(12000)} = \underline{228\ k\text{-}ft}$

$\varphi_{cr} = \frac{M_{cr}}{EI_g} = \frac{228(12)}{3600\times69120} = \underline{1.098\times10^{-5}/in}$

Calculate M_y, φ_y

$d = 24 - 1.5" - 0.375" - \frac{1.27"}{2} = 21.49 \approx 21"$

$n = \frac{E_s}{E_c} = 8.06"$

$\rho = \frac{A_s}{b\cdot d} = \frac{26.2}{60\times21} = 0.0208$

$n\rho = (8.06)(0.0208) = 0.168$

$K = -n\rho + \sqrt{[\rho'(n-1) + n\rho]^2 + 2[n\rho + \rho'(\frac{d'}{d})(n-1)] - \rho'(n-1)} = 0.376$

$\varphi_y = \frac{\varepsilon_y}{21(1-0.376)} = \frac{0.0021}{21(1-0.376)} = \underline{1.603\times10^{-4}/in}$

$M_y = A_s f_y (jd) = 26.2(60)(0.874)(21) = \underline{28852\ k\text{-}in} = \underline{2404\ k\text{-}ft}$

Calculate Mu, φ_u

$$\varphi_u = \frac{\varepsilon_{cu}}{c} = \frac{0.003}{7.875} = 3.810 \times 10^{-4}/in$$

$$M_u = A_s f_y \left(d - \frac{a}{2}\right) = 26.2 \times 60 \left(21 - \frac{7.65}{2}\right) = 26949\ K\text{-}in = 2250\ k\text{-}ft$$

M_y for input

$$= 2\ beams = 2 \times 2885.2\ K\text{-}in = 5770.4\ K\text{-}in = 480.8\ k\text{-}ft$$

φ_y stays the same $= 1.603 \times 10^{-4}/in = 1.603 \times 10^{-4} \times h = 1.603 \times 10^{-4} \times 24$

$$= 0.00384\ rad$$

Ratio of ultimate to yield

$$\frac{M_u}{M_y} = \frac{2250}{2404} = 0.936$$

$$\frac{\varphi_u}{\varphi_y} = \frac{3.810 \times 10^{-4}}{1.603 \times 10^{-4}} = 2.38$$

$$\rho = \frac{1}{m}\left(1-\sqrt{1-\frac{2mRn}{f_y}}\right) = \frac{1}{17.65}\left(1-\sqrt{1-\frac{2\times 17.65\times 708}{60000}}\right) = 0.0134$$

$$Rn = \frac{Mn}{bd^2} = \frac{Mu}{\Phi bd^2} = \frac{(3749)/2(12000)}{0.9\times 20\times 42^2} = 708 \text{ psi}$$

$$As = \rho bd = 0.0134\times 20\times 42 = 11.24 \text{ in}^2$$

Use 8#11, $As = 12.48 \text{ in}^2$

$$T = Asfy = (12.48)(60) = 748.8 \text{ K}$$

$$a = \frac{748.8}{(0.85)(4)(20)} = 11.0''$$

$$C = \frac{11.0''}{0.85} = 12.96''$$

$$\varepsilon t = (42-12.96)\frac{0.003}{12.96} = 0.0067 > 0.004 \text{ V} \quad \Phi = 0.9 \text{ V}$$

Calculate M_{cr}, φ_{cr}

$$I = Ig = \frac{1}{12}bh^3 = \frac{1}{12}\times 20\times 48^3 = 184320 \text{ in}^4$$

$$M_{cr} = f_{cr}\frac{I}{y_t} = [7.5\sqrt{4000}]\frac{184320}{24(12000)} = 303.6 \text{ K-ft}$$

$$\varphi_{cr} = \frac{M_{cr}}{EIg} = \frac{303.6\times 12}{3600\times 184320} = 5.49\times 10^{-6}/\text{in}$$

Calculate M_y, φ_y

$d = 42''$, $n = 8.06$

$$\rho = \frac{As}{b\cdot d} = \frac{12.48}{(20)(42)} = 0.01486$$

$$n\rho = (8.06)(0.01486) = 0.1197$$

$$K = -n\rho + \sqrt{[\rho'(n-1)+n\rho)^2 + 2[n\rho+\rho'(\tfrac{d'}{d})(n-1)} - \rho'(n-1) = 0.341$$

$$\varphi_y = \frac{\varepsilon_y}{d(1-K)} = 7.59\times 10^{-5}/\text{in}$$

$$M_y = Asfy(jd) = (12.48)(60)(0.886\times 42) = 27864 \text{ K-in} = 2322 \text{ K-ft}$$

$$j = 1-\frac{K}{3} = 1-\frac{0.3411}{3} = 0.886$$

Calculate φ_u, M_u

$$\varphi_u = \frac{\varepsilon_{cu}}{c} = \frac{0.003}{12.96} = 2.315\times 10^{-4}/\text{in}$$

Yield moment for input $M_y = 2 \times 2322\ k\text{-}ft = 4644\ k\text{-}ft$

$\phi_y = 7.59 \times 10^{-5}/in \times 48'' = 0.0036\ rad$

Ultimate/Yield

$$\frac{M_u}{M_y} = \frac{2297.6}{2322} = 0.98$$

$$\frac{\phi_u}{\phi_y} = \frac{2.315 \times 10^{-4}}{7.59 \times 10^{-5}} = 3.05$$

Design for Reinforcement | 10-story, Rei-wall, Low DC

$$\rho = \frac{1}{m}\left(1-\sqrt{1-\frac{2mRn}{fy}}\right) = \frac{1}{17.65}\left(1-\sqrt{1-\frac{2\times 17.65\times 10307}{60000}}\right) = \text{negative } \sqrt{}$$

$$Rn = \frac{Mu}{\phi bd^2} = \frac{3092/2\,(12000)}{0.9\,(20)(10)^2} = 10307$$

Suppose $\varepsilon_t = 0.004 = (10-c)\frac{\varepsilon_{cu}}{c} = (10-c)\frac{0.003}{c}$, $\phi = 0.87$

$\frac{(10-c)}{c} = 1.3333,\ 2.333 = 10,\ c = 4.29"$

$a = 4.29" \times 0.85 = 3.65"$

$\rho_{max} = 0.429\left(\frac{fc'}{fy}\right)\beta_1 = 0.021$

$Rn = \rho fy(1-0.5\rho m) = 0.988 \text{ ksi} = \frac{Mu}{\phi bd^2}$

$b = \frac{1546\times 12}{0.87(100)(0.988)} = 216" \approx 18'$ too wide not practical

Design for Reinforcement | 20-floor, C-wall, Reg DC

$\rho = \frac{1}{m}\left(1-\sqrt{1-\frac{2mRn}{fy}}\right) = \frac{1}{17.65}\left(1-\sqrt{1-\frac{2\times17.65\times4297}{60000}}\right)$ = negative $\sqrt{}$

$Rn = \frac{Mn}{bd^2} = \frac{5685/2\,(12000)}{0.9(20)(21)^2} = 4297$

Suppose $\varepsilon_t = 0.004 = (21-c)\frac{\varepsilon_{cu}}{c} = (21-c)\frac{0.003}{c}$ $\phi = 0.87$

$\frac{21-c}{c} = 1.333$, $2.333c = 21$, $c = 9.00"$

$a = c\beta_1 = 9.00\times0.85 = 7.65" = \frac{T}{0.85(4)(b)} = \frac{T}{0.87(4)(96)}$

$T = 2556\,K$

$\rho_{max} = 0.429\left(\frac{fc'}{fy}\right)\beta_1 = 0.021$

$Rn = \rho fy(1-0.5\rho m) = 0.988\ Ksi = \frac{Mu}{\phi bd^2}$

$b = \frac{2842\times12}{(0.87)(21^2)(0.988)} = 90" \rightarrow b = 96"$

$T = 2556 = Asfy = As(60)$, $As = 42.6\ in^2$

Use 27 #11, $As = 42.12\ in^2$, min. width ✓

Calculate M_{cr}, φ_{cr}

$I = Ig = \frac{1}{12}bh^3 = \frac{1}{12}\times96\times24^3 = 110592\ in^4$

$M_{cr} = f_{cr}\frac{I}{y_t} = [7.5\sqrt{f'c}]\frac{Ig}{ft} = \frac{7.5\sqrt{4000}\,(110592)}{12(12000)} = 364\ K\text{-}ft$

$\varphi_{cr} = \frac{Mcr}{EIg} = \frac{364(12)}{3600(110592)} = 1.098\times10^{-3}/in$

Calculate M_y, φ_y

$d = 24" - 1.5" - 0.375" - \frac{1.27"}{2} = 21.49" \rightarrow 21"$

$n = \frac{Es}{Ec} = 8.06$

$\rho = \frac{As}{b\cdot d} = \frac{42.6}{(96)(21)} = 0.021$

$n\rho = (8.06)(0.021) = 0.168$

$K = -n\rho + \sqrt{[\rho'(n-1)+n\rho]^2 + 2[n\rho + \rho'(\frac{d'}{d})(n-1)} - \rho'(n-1) = 0.376$

$\varphi_y = \frac{\varepsilon_y}{21(1-0.376)} = \frac{0.0021}{21(1-0.376)} = 1.603\times10^{-4}/in$

Calculate Mu, φ_u

$$\varphi_u = \frac{\varepsilon_{cu}}{c} = \frac{0.003}{7.875} = 3.810\times10^{-4}/in$$

$$Mu = A_s f_y \left(d - \frac{a}{2}\right) = 42.6(60)\left(21 - \frac{7.65}{2}\right)$$

$$= 43899\ k\text{-}in = 3658\ k\text{-}ft$$

M_y for input = 2 beams = 2×46913 k-in = 93826 k-in = 7819 k-ft

φ_y stays the same $= 1.603\times10^{-4}/in = 1.603\times10^{-4}\times h$

$$= 1.603\times10^{-4}\times 24$$

$$= 0.00384\ rad$$

Ratio of ultimate to yield

$$\frac{Mu}{My} = \frac{3658}{3909} = 0.936$$

$$\frac{\varphi_u}{\varphi_y} = \frac{3.810\times10^{-4}}{1.603\times10^{-4}} = 2.38$$

Design for reinforcement | 20 floor, C-wall, high DC

$$\rho = \frac{1}{m}\left(1 - \sqrt{1 - \frac{2mR_n}{f_y}}\right) = \frac{1}{17.65}\left(1 - \sqrt{1 - \frac{2 \times 17.65 \times 1398}{60000}}\right) = 0.0328$$

$$R_n = \frac{M_n}{bd^2} = \frac{M_u}{\phi bd^2} = \frac{7399/2\,(12000)}{(20)(42)^2(0.9)} = 1398$$

$A_s = \rho bd = 0.0328 \times 20'' \times 42'' = 27.54\ in^2$

Use 18#11 bars, $A_s = 28.08\ in^2$

$T = A_s f_y = (28.08)(60) = 1685\ k$

$$a = \frac{1685}{(0.85)(4)(20)} = 24.78''$$

$$C = \frac{24.78}{0.85} = 29.15''$$

$$\varepsilon_t = (42 - 29.15)\frac{0.003}{29.15} = 0.0013 < 0.004\ \times$$

If $\varepsilon_t = 0.004$, $\varepsilon_t = (42 - C)\frac{\varepsilon_{cu}}{C}$

$$\frac{42 - C}{C} = 1.333$$

$2.333C = 42$, $C = 18''$

$$a = C\beta = 18.00 \times 0.85 = 15.30'' = \frac{T}{(0.85)(4)(20)}$$

$T = 1040k = A_s f_y = A_s(60)$

$A_s = 17.34\ in^2$

Use 6#10, 6#11 $= 16.98\ in^2$ min. width ✓

Calculate M_{cr}, φ_{cr}

$$I = I_g = \frac{1}{12}bh^3 = \frac{1}{12} \times 20 \times 48^3 = 184320\ in^4$$

$$M_{cr} = f_{cr}\frac{I}{y_t} = [7.5\sqrt{4000}]\frac{184320}{24(12000)} = 303.6\ k\text{-}ft$$

$$\varphi_{cr} = \frac{M_{cr}}{EI_g} = \frac{303.6 \times 12}{3600 \times 184320} = 5.49 \times 10^{-6}/in$$

Calculate M_y, φ_y

$d = 42''$, $n = 8.06$

$$\rho = A_s/b \cdot d = \frac{16.98}{(20)(42)} = 0.0202$$

$n\rho = 8.06 \times 0.0202 = 0.163$

$$My = Asfy(jd) = (16.98)(60)(0.876)(42)$$

$$= 37483 \text{ K-in} = 3123.6 \text{ K-ft}$$

$$j = 1 - \frac{k}{3} = 1 - \frac{0.373}{3} = 0.876$$

Calculate Mu, φ_u

$$\varphi_u = \frac{\varepsilon_{cu}}{c} = \frac{0.003}{18} = 1.667 \times 10^{-4}/\text{in}$$

$$Mu = Asfy\left(d - \frac{a}{2}\right) = (16.98)(60)\left(42 - \frac{15.3}{2}\right) = 34996 \text{ K-in}$$

$$= 2916 \text{ K-ft}$$

My for 1 beam = 3123.6 K-ft

Input for 2 beams $My = 2 \times 3123.6 = 6247.2$ K-ft

$$\varphi_y = 7.97 \times 10^{-5}/\text{in} \times 48 \text{ in} = 0.00383 \text{ rad}$$

Ratio of ultimate to yield

$$\frac{Mu}{My} = \frac{2916}{3123} = 0.934$$

$$\frac{\varphi_u}{\varphi_y} = \frac{1.667 \times 10^{-4}}{7.97 \times 10^{-5}} = 2.09$$

Design for reinforcement | 20-floor, C-wall, Low DC

$$\rho = \frac{1}{m}\left(1 - \sqrt{1 - \frac{2mR_n}{f_y}}\right) = \frac{1}{17.65}\left(1 - \sqrt{1 - \frac{2 \times 17.65 \times 14190}{60000}}\right) = \text{negative} \sqrt{\ }$$

$$R_n = \frac{M_n}{bd^2} = \frac{M_u}{\phi bd^2} = \frac{4257/2(12000)}{(0.9)(20)(10)^2} = 14190 \text{ psi}$$

Suppose $\varepsilon_t = 0.004$

$$\rho_{max} = 0.429\left(\frac{f_c'}{f_y}\right) = 0.021$$

$$R_n = \rho f_y (1 - 0.5\rho m) = 0.988 \text{ ksi} = \frac{M_u}{\phi bd^2}$$

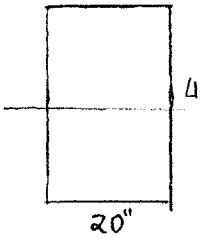
$$b = \frac{2129 \times 12}{(0.87)(100)(0.988)} = 297'' = 25' \quad \text{too wide}$$

not practical

EI values

$E = 3600\ K/in^2$

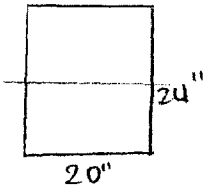
I values of beams



High DC

$I = \frac{1}{12} \times 20 \times 48^3 = 184320\ (in^4)$

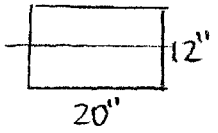
$EI = (184320)(3600) = 663552000\ K\text{-}in^2$



Regular DC

$I = \frac{1}{12} \times 20 \times 24^3 = 23040\ (in^4)$

$EI = (23040)(3600) = 82944000\ K\text{-}in^2$

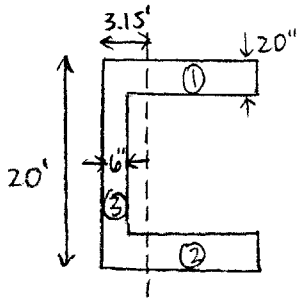


Low DC

$I = \frac{1}{12} \times 20 \times 12^3 = 2880\ (in^4)$

$EI = (2880)(3600) = 10368000\ K\text{-}in^2$

I values of wall piers



$I_1 = \frac{1}{3}bh^3 = I_2 = \frac{1}{3} \times 20 \times (6.5 \times 12)^3 = 3163680\ in^4$

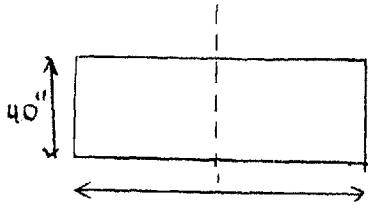
$I_3 = \frac{1}{3}(20 \times 12)(3.15 \times 12)^3 - \frac{1}{3}(16.67 \times 12)(2.65 \times 12)^3$

$= 2176554$

$I_{total} = I_1 + I_2 + I_3 = 3163680 \times 2 + 2176554$

$= 8503915\ in^4$

$EI = (3600)(8503915) = 3.06E10\ K\text{-}in^2$



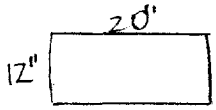
$I = \frac{1}{12} \times 40 \times 156^3 = 12654720\ in^3$

$EI = 12654720 \times 3600 = 4.56E10\ K\text{-}in$

Shear stiffness

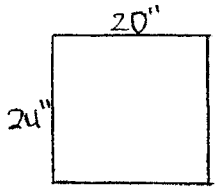
$G = 1500$ k/in

Areas of the beams



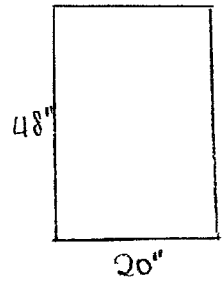
$A = (12)(20) = 240 \text{ in}^2$

$GA = (1500)(240)$



$A = (24)(20) = 480 \text{ in}^2$

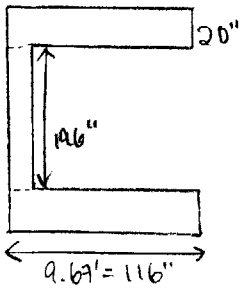
$GA = (1500)(480)$



$A = (48)(20) = 960 \text{ in}^2$

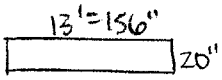
$GA = (1500)(960)$

Areas of wall piers



$A = 20 \times 116 \times 2 + 6 \times 196 = 5816 \text{ in}^2$

$GA = (1500)(5816)$



$20 \times 156 \times 2 = 6240 \text{ in}^2$