# NON-PROPRIETARY CALCULATIONS

## Book 5 of 8

**Attachments to PG&E Letter DIL-01-004**
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Rev. 0

# Non-Linear Seismic Sliding analysis of the ISFSI Pad

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## 1.0 INTRODUCTION

This calculation documents the results of a series of non-linear time history analyses of a finite element representation of the cask/mat set-up at Diablo Canyon ISFSI. The purpose of the analyses is twofold:

a. To determine the extend of sliding that occurs at the mat/rock interface subject to ISFSI control motion.
b. To determine whether as a result of mat sliding, the cask design shears and moments, are altered and if so by how much.

Static analyses of the sliding stability of the mat/cask configuration at DCPP ISFSI mat have shown that for certain seismic load cases, the factor of safety of 1.1 against sliding (as required by NUREG-1536, Ref. 7) cannot be achieved.

The purpose of the analyses described in this calculation is to determine the extent of sliding (if any) by performing a non-linear time history analysis of the cask/mat structure potentially sliding at the rock/mat interface. The only source of non-linear behavior is the friction characteristics at the mat rock interface. Analyses are performed for 5 sets of time histories corresponding to the ISFSI seismic load case.

The seismic analysis of the anchored cask documented in Ref. 1 is performed subject to the Hosgri and LTSP motions. These 2 seismic cases correspond to existing spectra for the plant. The associated time histories for use in the ISFSI project were developed in Ref. 2. The ISFSI case corresponds to the new envelop ISFSI design response spectrum. For this case, 5 sets of associated time histories have been developed (References 3 & 4) that will be used for all non-linear applications such as that performed in this calculation.

The best estimate of max. sliding is predicted assuming two interface sliding friction coefficients of $\mu = 1.19$ corresponding to a friction angle of 50°, and $\mu = 0.73$ corresponding to a friction angle of 36° (Ref. 6). This represents the range of the sliding friction coefficient expected at this interface (Ref. 6).

Section 2.0 of the calculation discusses the methodology. Section 3.0 discusses modeling. Section 4.0 summarizes results of some Validation analyses to ensure that the friction capabilities of the non-linear element utilized for these analyses, work as expected. Section 5.0 summarizes analyses cases and results. Conclusions are summarized in Section 6.0. References are summarized in Section 7.0. Appendix A summarizes all SAP2000N computer analyses input files. Appendix B contains all output files.

## 2.0 METHODOLOGY

A simple non-linear stick model is developed for the purposes of these analyses. The set of 20 casks on a mat are represented by a lollypop stick model representing the cask behavior as performed in Ref. 1. The mat is represented by its mass only. The interface between the rock and the mat surface is modeled using SAP2000N's NLLINK element with friction properties. This element is a biaxial friction element that has coupled friction properties for the two shear deformations, post-slip stiffness in the shear directions, gap behavior in the axial direction, and linear stiffness properties for the three rotational degrees of freedom (not used in these analyses).

The cask superstructure stick is modeled such it represents the dynamic properties of the anchored cask. Ref. 1 models the anchored cask in the absence of sliding of the mat and performs dynamic analyses to predict the design shears, moments, and interface tension and compression forces to be used in design. These reaction forces are reported in Ref. 1 for the Hosgri +/-Z cases and LTSP +/-Z cases.

It is noted that the model used in Ref. 1 has some local non-linearities inside the cask representing the rattling of the canister inside HI-STORM. In addition the anchorage of the cask to the mat is modeled more accurately using a series of tension-only springs modeling the anchors in tension, and compression-only springs modeling the concrete surface under compression. In addition results are filtered at 40 Hz., in order to filter out the high frequency spikes, which might be present as a result of two bodies rattling and impacting against each other.

The fundamental frequencies of the cask superstructure model in these analyses are based on best estimate of the rocking frequency of the anchored cask. In the absence of local non-linearities, it is expected that the fixed base model (superstructure only) of the cask will yield slightly more conservative results than Ref. 1 results. The same model when mounted on the friction element is called the sliding model. The relative ratio of peak response between the sliding model and the fixed base model will yield an adjustment factor, which if found to be greater than unity, will be applied to the design shears and moments predicted by Reference 1. This approach ensures that any potential increases in design peak responses due to sliding are properly carried through the design.

For the vertical direction, the tensile component of base reaction is studied as this component is judged as the important parameter resulting in lower normal resisting force at the interface thus higher sliding displacement under a seismic event.

All analyses are performed based on non-linear time-history analysis option using Fast Non-linear Analysis (FNA) approach of SAP2000N. For all analysis, fault parallel with fling component of the input motion is placed along X direction, fault normal component along Y, and vertical component along Z directions.

## 3.0 MODEL DEVELOPMENT

A 3-D non-linear finite element model is required in order to perform the non-linear sliding analyses. The model comprises of 3 parts:

a. The casks
b. The mat itself
c. The interface between the mat and the underlying rock

The casks are represented using a stick representation. The mat is represented by its mass only. The mat is rigid in plane as such for sliding analyses, there is no need to model the dynamic characteristics of the mat. The interface between the ISFSI mat and the rock is modeled using non-linear friction elements.

The model development is described in more detail below.

### 3.1 CASK FIXED BASE MODEL

Each mat will support 20 casks placed in an array of 4 by 5. Each cask is anchored by a series of 16, 2.5" diameter steel anchors (each 72" long) to the mat. Both the horizontal frequency and the vertical frequency in tension are functions of the stiffness of the supporting anchors. The casks themselves are assumed rigid.

Each cask has the following properties (extracted from Ref. 1):

| | |
|---|---|
| Cask Weight: | W = 360 Kips |
| Cask Mass: | M = 360/386.4 = 0.9317 K-Sec.$^2$/in |
| Cask c.g. Height: | $h_{cg}$ = 118.5" |
| Eff. Height: | H = 2 $h_{cg}$ = 237" |
| Anchor Radius: | $R_A$ = 69.75" |
| Anchor angular interval: | $\theta = 22.5^\circ$ (16 anchors along cask circumference) |
| Cask Radius: | R = $R_A$ = 69.75" |
| Number of anchors: | 16 |
| Anchor diameter: | 2.5" |
| Anchor area: | 4.909 inch$^2$ |
| Anchor Length: | 72.0" |
| Anchor Modulus: | 29,000 Kips/inch$^2$ |

The cask stick is modeled using a reasonable estimation of its horizontal and vertical frequencies. Below is the calculation of the fundamental frequencies:

*Horizontal Fundamental Frequency*

Based on the above anchor properties the axial stiffness $k_A$ of an anchor is:

$$k_A = \frac{A_A E}{L_A} = 1977 \text{ kips/inch}$$

Because the compression stiffness of the concrete is very large relative to the tensile stiffness of an anchor, it will be assumed that the rotational axis is located at the extreme edge of the cask. Thus, the rotational stiffness $k_R$ of the anchorage with 16 anchors is:

$$k_R = k_A R_A^2 \sum_1^{16} (1 + \cos\theta_i)^2$$

$$k_R = 24 k_A R_A^2 = 230.9 \text{x} 10^6 \text{ kip} - \text{inch}$$

The mass moment of inertia $I_C$ about c.g. is:

$$I_C = \frac{W}{g}\left[\frac{R^2}{4} + \frac{H^2}{12}\right]$$

and the mass moment of inertia $I_A$ about extreme edge is:

$$I_A = I_C + \frac{W}{g}\left[R_A^2 + \frac{H^2}{4}\right]$$

Thus:

$$I_A = \frac{W}{g}\left[R_A^2 + \frac{R^2}{4} + \frac{H^2}{12}\right]$$

$I_A$ = 23,130 kip-inch-sec$^2$

Thus the horizontal (rocking) natural frequency $f_h$ is:

$$fh = \frac{1}{2\pi}\left[\frac{k_R}{I_A}\right]^{0.5} = 15.9 Hz$$

*Vertical Fundamental Frequency*

The vertical stiffness of the cask in tension is essentially provided by the anchors. Since there are 16 anchors per cask, the vertical stiffness per cask is calculated as:

$K_v = 16\ K_{Anchor} = 16 \times 1{,}977 = 31{,}632$ Kips/inch

$f_v = 1/2\pi\ [K/M]^{1/2} = 1/2\pi\ [31{,}632/0.9317]^{1/2} = 29.3$ Hz.

It is noted that these are reasonable approximation of the fundamental frequency of a single cask. The actual frequencies maybe slightly different due to the following:

a. There are bodies rattling inside the cask
b. The cask rocking will take place about a neutral axis which maybe slightly away from the edge of the cask
c. The model has different vertical frequency in tension versus compression
d. Actual anchor length in final design is 73.5" versus 72.0" assumed in Ref.1. This change in length will reduce the estimated frequency by 1%, which is considered within tolerance of engineering accuracy.

However for the purposes of this calculation, this approximation is considered reasonable from an engineering accuracy perspective.

*Stick Properties*

The stick section properties are calculated here in order to result in fundamental frequencies calculated above.

$f = 1/2\pi\ [K/M]^{1/2}$

Thus:

$K = (2\pi f)^2 \times M$

For 20 casks on a mat, $M = 20 \times 0.9317 = 18.63354$ K-Sec.$^2$/in

Therefore:

$K_h = (2\pi \times 15.9)^2 \times (18.63354) = 185{,}973$ K/in
$K_v = (2\pi \times 29.3)^2 \times (18.63354) = 631{,}525$ K/in

For Horizontal direction, for a cantilever beam:

$K_h = 3EI/L^3$

$I_{xx} = I_{yy} = K_h L^3/3E = 185{,}973\ (118.5)^3/3(29{,}000) = 3{,}557{,}015\ in^4$

In the vertical direction:

$K_v = EA/L$

$A = K_v L/E = 631{,}525\ (118.5)/29{,}000 = 2{,}580.5\ in^2$

Therefore use the following properties for the stick representing 20 casks:

| | |
|---|---|
| Cross Sectional Area: | $A = 2{,}580.5\ in^2$ |
| Moment of Inertial about XX: | $Ixx = 3{,}557{,}015\ in^4$ |
| Moment of Inertial about YY: | $Iyy = 3{,}557{,}015\ in^4$ |

The shear areas and the torsional constant are set up at high values to make the beam behavior in these modes rigid.

The fixed base stick model of cask set-up with the above properties is analyzed using SAP2000N and the following frequencies are extracted:

Fundamental frequency in X direction = 15.9 Hz. (matches exactly the target frequency)
Fundamental frequency in Y direction = 15.9 Hz. (matches exactly the target frequency)
Fundamental frequency in Z direction = 29.3 Hz. (matches exactly the target frequency)

## 3.2 FIXED BASE ANALYSIS RESULTS

The fixed base model of the cask superstructure is analyzed subject to the following 4 cases for which Ref. 1 has performed similar analyses subject to the identical input motions:

1. Hosgri time histories with vertical component applied in the +Z direction
2. Hosgri time histories with vertical component applied in the -Z direction
3. LTSP time histories with vertical component applied in the +Z direction
4. LTSP time histories with vertical component applied in the -Z direction

The resultant maximum base shears along X & Y directions are extracted. Net resultant vector shear is then computed in the time domain by SRSS of the X & Y shears and the maximum resultant shear is extracted and compared to the results reported from Ref. 1, Page 9.

Table 3.1 provides the summary of maximum fixed base shear response versus those reported in Ref. 1:

| Analysis Case | Fixed Base Results | | | Ref. 1 Results | | | Ratio |
|---|---|---|---|---|---|---|---|
| | $S_x$ (Kips) | $S_y$ (Kips) | Resultant Shear | $S_x$ (Kips) | $S_y$ (Kips) | Resultant Shear | FB/Ref.1 |
| HE (+Z) | 520.0 | 516.0 | 578.7 | 509.4 | 460.5 | 515.0 | 1.12 |
| HE (-Z) | 520.0 | 516.0 | 578.7 | 379.9 | 426.1 | 428.0 | 1.35 |
| LTSP (+Z) | 439.0 | 456.0 | 521.0 | 432.0 | 355.5 | 440.0 | 1.18 |
| LTSP (-Z) | 439.0 | 456.0 | 521.0 | 325.8 | 364.6 | 390.0 | 1.34 |

Table 3.1: Summary of base Shears for fixed base model vs. Ref. 1 results

Also maximum tension force is extracted and compared to those reported in Ref. 1. It should be noted that in computing the maximum interface tension as reported in Ref.1, the reported Minimum interface tension should be subtracted from 360 Kips (Cask weight) in order to arrive at maximum tension due to seismic loading.

Table 3.2 provides the summary of maximum fixed base seismic tension response versus those reported in Ref. 1:

| Analysis Case | SAP2000N Reactions (Kips) | Ref. 1 Reactions (Kips) | Ratio FB/Ref. 1 |
|---|---|---|---|
| HE (+Z) | 211.0 | 232.4 | 0.91 |
| HE (-Z) | 185.3 | 229.4 | 0.81 |
| LTSP (+Z) | 315.6 | 254.2 | 1.24 |
| LTSP (-Z) | 326.2 | 304.4 | 1.07 |

Table 3.2: Summary of base Tension for fixed base model vs. Ref. 1 results

Note: Subsequent to the Cask Anchored Analysis performed and documented in Ref. 1 and the fixed base analysis performed here, it was determined in a Revision to Ref. 2 that the Hosgri event requires scaling up by 1.07 at 7% damping and 1.00 at 4% & 5% damping, and that the LTSP event requires to be scaled up by 1.05 at 5% damping, in order to meet the requirements of spectral matching as defined in SRP 3.7.1. The effects of these scale factors on results of Ref. 1 are reported in Rev. 4 of Ref. 1, Page 52, and are judged to have negligible effects on the reported results. For the fixed base analysis performed here, 4% damping is used for Hosgri and 5% for LTSP. Thus Hosgri results will be unaffected, and LTSP results will need to be scaled up by 5%. However, since the same scale factor applies to the results of Ref. 1 for LTSP, the ratios of FB/Ref. 1 results as discussed in Tables 3.1 and 3.2 above, and further discussed below remain unchanged. Thus these scale factors have no effect on the conclusions arrived below.

Comparing the net shears for the fixed base analysis versus those reported in Ref. 1 (See Table 3.1), it is observed that the fixed base model produces a net shear which is higher than design shear of 515 Kips by 12% for the governing case of HE (+Z) case. For other non-governing cases, the fixed base model produces shears, which are higher by as much as 35%. The reason for this discrepancy is attributed to one or combination of the following:

1. The Holtec model has the MPC rattling inside the HI-STORM. This means that whilst the two bodies are not in contact, the mass of the MPC will not contribute towards the base shear.
2. There is additional energy dissipation between the MPC and the HI-STORM, which is modeled in the Holtec model, but not in the fixed base model.
3. Holtec results are filtered above 40 Hz.
4. The true frequency of the anchored cask may be slightly higher than 15.9 Hz. due to reasons stated in Section 3.1.

Comparing the axial tension with those reported in Ref. 1 (See Table 3.2), the fixed base model predicts max. tension, which is about 7% higher than the governing case of LTSP (-Z). Again, the reasons for this discrepancy are attributed to the items stated above and the fact that Holtec model has different stiffness in vertical direction for axial tension and compression. However, it is also noted the average of the 4 cases matches very close when compared with the average of those reported by Ref. 1.

Since the fixed base model produces more conservative shear results than those of Ref. 1, it is concluded that it's use to benchmark net shears and axial tensions versus those which will be predicted from the non-linear sliding model, is adequate for the stated objectives.

## 3.3 COMBINED CASK & MAT MODEL

The fixed base cask model developed in Section 3.1 and analyzed subject to Hosgri and LTSP events as described in Section 3.2, is mounted on a friction element representing the frictional characteristics at the rock/mat interface. The SAP2000N NLLINK element with friction properties is utilized for modeling the friction.

This non-linear element is a biaxial friction-pendulum isolator element that has coupled friction properties for the two shear deformations, post-slip stiffness in the shear directions, gap behavior in the axial direction, and linear stiffness properties for the three rotational degrees of freedom (not used in these analyses).

By setting the radius of the surface to infinity, a flat surface is depicted; thus post slip stiffness is set to zero. The pre-slip stiffness in the shear deformation directions ($U_2$ and $U_3$) and the contact stiffness in the down axial direction (-Z) need to be set to some value, which is relatively rigid. At the same time these values should be set not too high so that problems with solution convergence due to iteration of non-linear equations of motion are avoided.

The following stiffness properties are selected for the non-linear friction elements (elements 1 & 2):

| | |
|---|---|
| Contact stiffness K in axial ($U_1$) direction: | 1E8 K/in |
| Pre-slip stiffness in the shear ($U_2$ & $U_3$) directions: | 1E7 K/in |
| Friction Coefficient: | Varies |

The vertical contact stiffness is approximately 150 times the cask vertical stiffness, whereas the contact pre-slip stiffness in the horizontal direction is approximately 50 times the cask horizontal stiffness. The linear effective stiffness ($K_e$) was arbitrarily set to 1E7 K/in, and the effective damping was set to zero. The friction coefficient varies for various analysis cases.

The modal damping for the modes, which correspond to the superstructure, are set to respective values for Hosgri (4%) and LTSP (5%). The modal damping associated with sliding is set to zero, since the energy dissipation due to sliding is modeled explicitly in the friction element.

The weight of the mat is calculated as follows:

Mat width = 68'
Mat length = 105'
Mat thickness = 7.5'

Mat weight = 68 x 105 x 7.5 x 0.15 = 8,032.5 Kips
Mat mass = 8,032.5/386.4 = 20.788 K-Sec.$^2$/in

This mass and weight is input as follows:

At Joint 4: W=8,000 Kips
At NLLINK element = W=32.5 Kips

Small portion of weight and mass is assigned to NLLINK element to ensure stability of solution.

The boundary conditions are as follows:

a. Joint 1 (cask c.g.) is free in all 6 DOF
b. Joint 4 (top of mat) is restraint against all 3 rotations, free for all 3 translations
c. Ground (bottom of NLLINK element) is fixed in all 6 DOF

Figure 3.1 below shows the model.

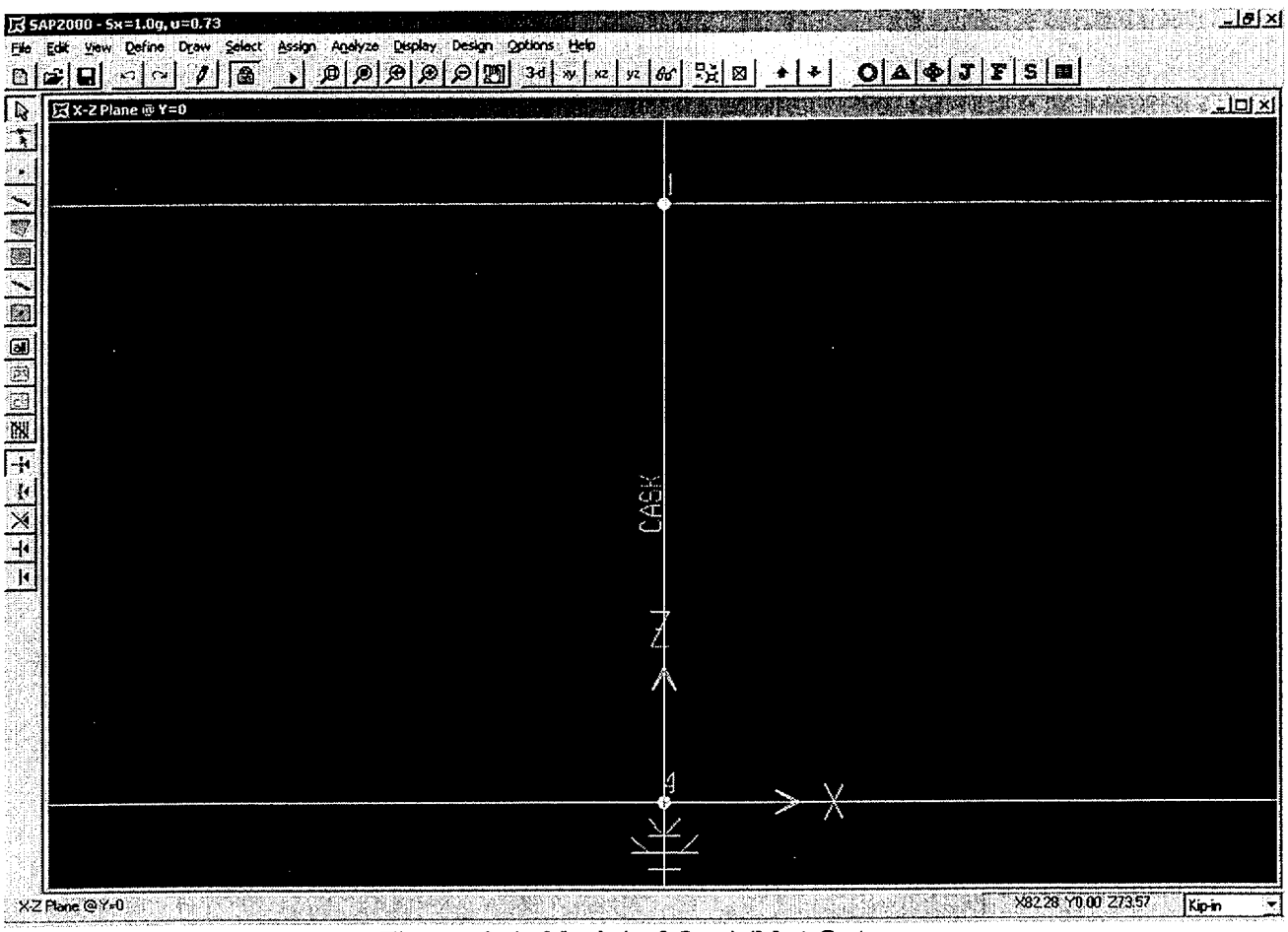


Figure 3.1: Model of Cask/Mat Set-up

Gravity load is input as a gravity force in the –Z direction. The gravity load is applied as follows:

1. $F_z$ = 7,200 Kips at joint 1 representing 20 casks
2. $F_z$ = 8,000 Kips at joint 4 representing the mat
3. $F_z$ = 32.5 Kips at NLLINK element representing the remainder of the mat

For time history seismic analyses, gravity loading is depicted also by a time history called "Gravity", where it uses a ramp function to ramp up the full gravity load. The gravity Time History load case is always a present prior to start of seismic, so that the effects of normal weight downward is present for sliding calculation purposes.

To ensure that the gravity reactions are checked, Figures 3.2 and 3.3 show the axial force under gravity loading in the frame stick element and the NLLINK element. As seen from Figure 3.2. max. axial load in the frame element is 7,200 Kips which is as expected. Also from Figure 3.3, Max. axial load in the NLLINK element is reported as 15,230 Kips, which is summation of applied loads for the mat.

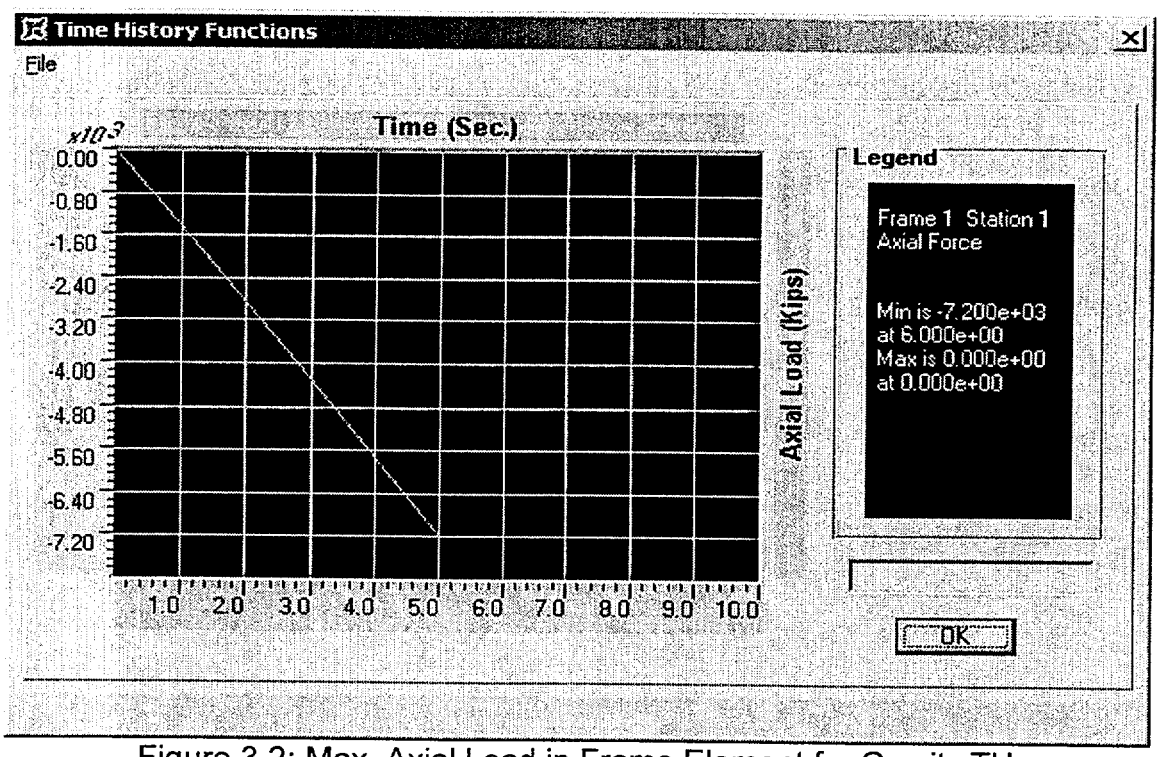


Figure 3.2: Max. Axial Load in Frame Element for Gravity TH

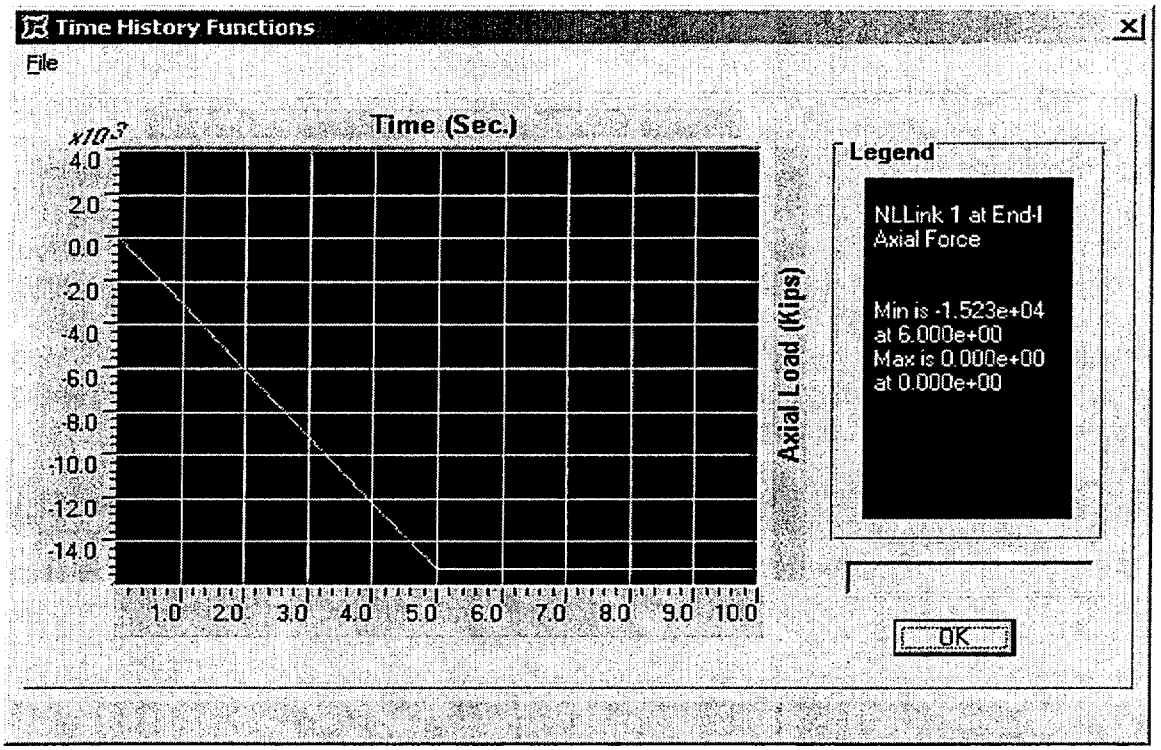


Figure 3.3: Max. Axial Load in NLLINK Element for Gravity TH

## 4. MODEL VALIDATION

To ensure that the friction element does work as intended a series of sine wave tests were performed on the LTSP tuned model. The input is a 5Hz sine wave and is input independently along the X & Y directions. The duration of the sine wave is 5 seconds. The friction coefficient was set at 1.19 corresponding to a friction angle of 50°. Two sets of analyses cases were run, one for an amplitude of the sine wave set at 0.5g and the other at 1.5g. The first run should result in no sliding, whereas the second run should result in some sliding.

Figures 4.1 through 4.4 below show the sliding displacement for all 4 runs. Table 4.1 below summarizes the max. sliding for each case:

| Direction of Input Motion | Sine Amplitude (g) | Max. sliding (inch) |
|---|---|---|
| X | 0.5g | 0.001 |
| Y | 0.5g | 0.001 |
| X | 1.5g | 0.186 |
| Y | 1.5g | 0.186 |

Table 4.1: Summary of Max. Sliding

As seen from Table 4.1 above, the model behaves as expected, i.e. for cases where peak amplitude of input motion is less than coefficient of friction (0.5g<1.19), there is no sliding. However, for the cases where peak amplitude of input motion is greater than coefficient of friction (1.5g>1.19), there is some sliding at the base.

Figures 4.5 and 4.6 show the acceleration time history plot at the base of the model superimposed with the input motion for the two cases of 0.5g and 1.5g for the X direction. As seen from these Figures, as sliding begins some high frequency spikes are introduced. This is a characteristic of this kind of non-linear analyses as high frequency spikes are often introduced when c.g. of the superstructure is above the sliding surface, which subject to sliding causes slight rocking and high frequency impact at the base surface. To demonstrate that the NLLINK element works properly, a "Pure Slide" case is run, where the superstructure stick is completely removed and the model is run subject to the 1.5g Sine wave applied in the X direction. Figures 4.7 and 4.8 show the sliding displacement and acceleration at the base. From Figure 4.8, it is evident that the peak acceleration is limited to 1.19g, which is the threshold that the coefficient of friction can pass.

Comparing, max. sliding from Figure 4.7 to that of Figure 4.3, it is seen that the sliding shapes are very similar and max. sliding for the case with the superstructure is slightly higher (0.186" vs. 0.132"). This is because the superstructure having a natural frequency of 15.9 Hz. in the X direction is subject to slightly higher motion than the ZPA. Also from Figure 4.8, it is noted that max. acceleration at base is limited to 1.19gs, which is what the friction coefficient will pass.

Therefore, the friction behavior of the model is considered validated.

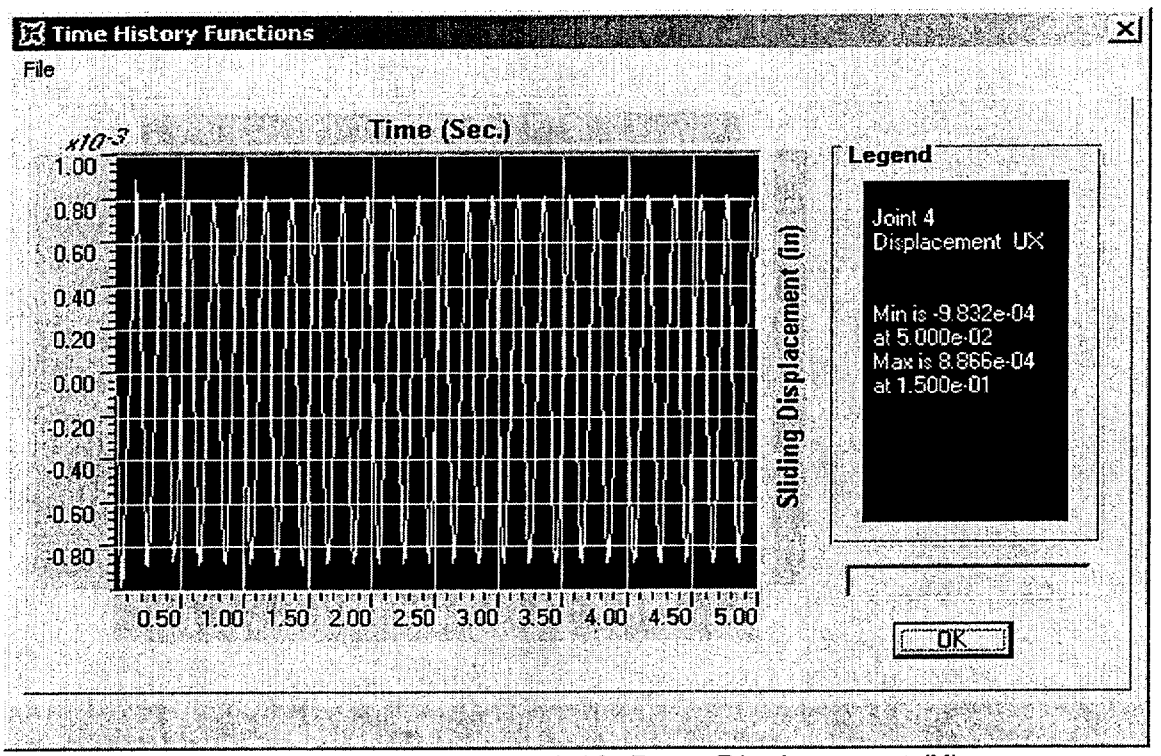


Figure 4.1: Sx = 0.5g, u=1.19, Base Displacement (X)

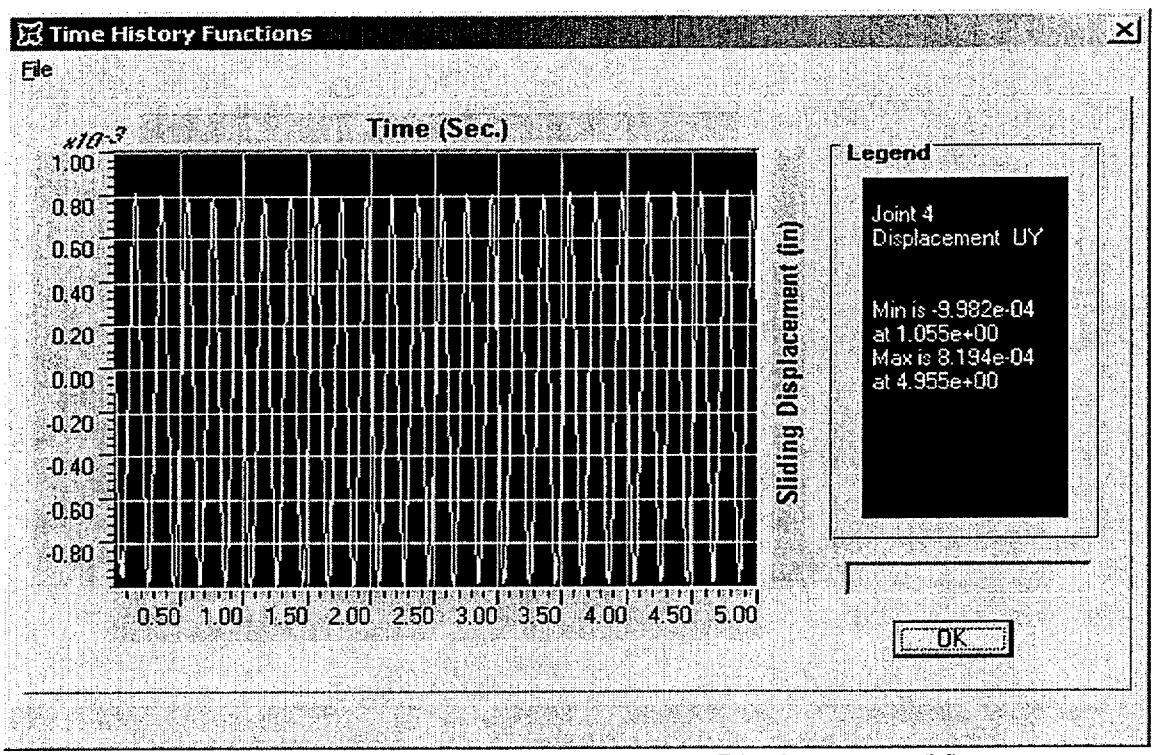


Figure 4.2: Sy = 0.5g, u=1.19, Base Displacement (Y)

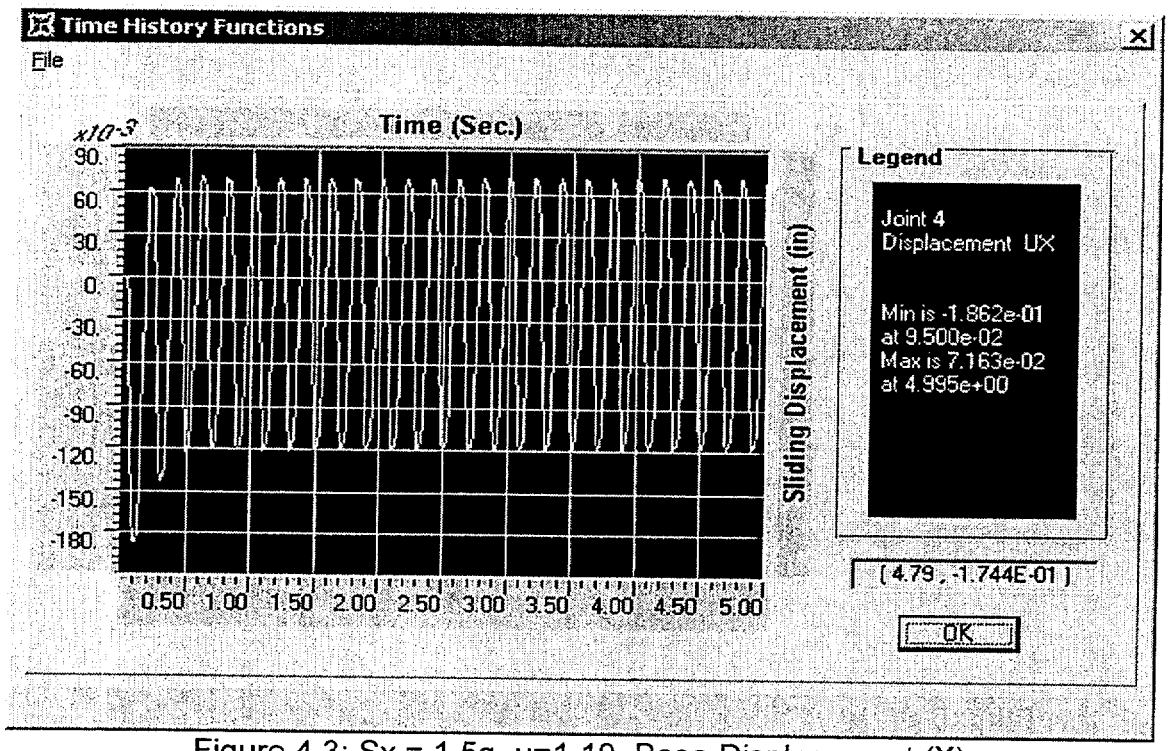


Figure 4.3: Sx = 1.5g, u=1.19, Base Displacement (X)

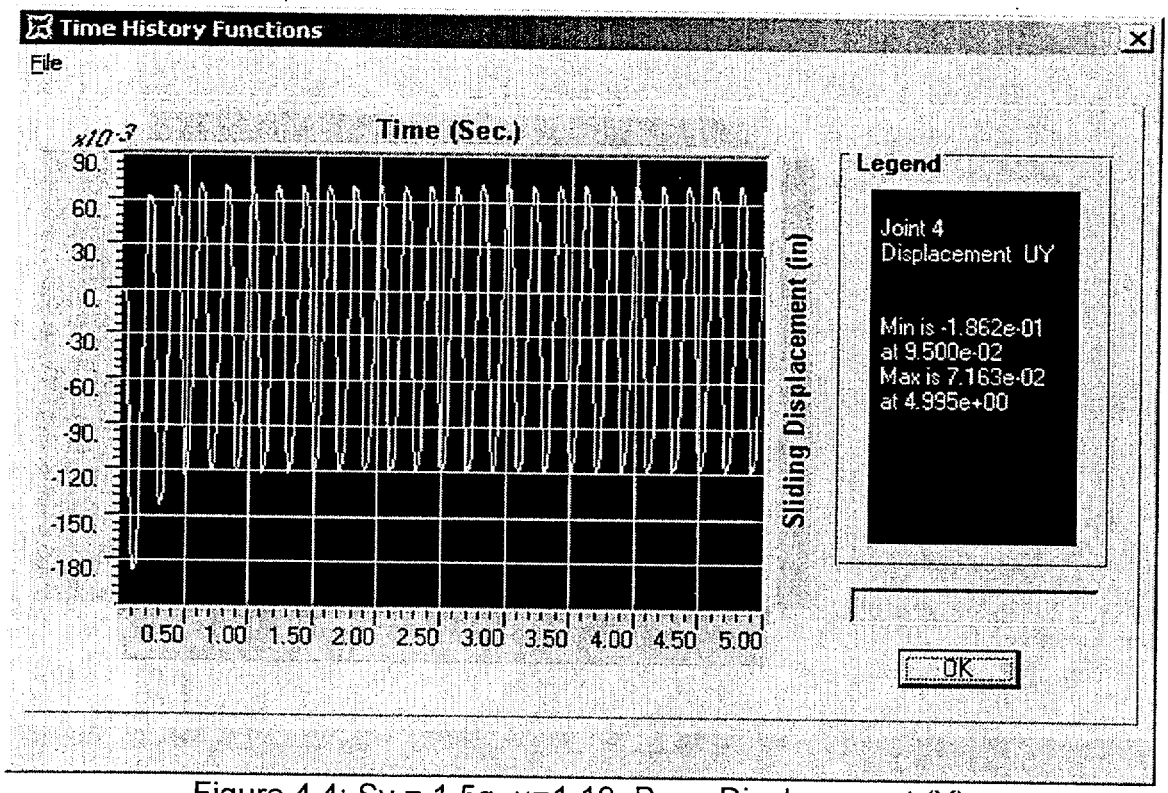


Figure 4.4: Sy = 1.5g, u=1.19, Base Displacement (Y)

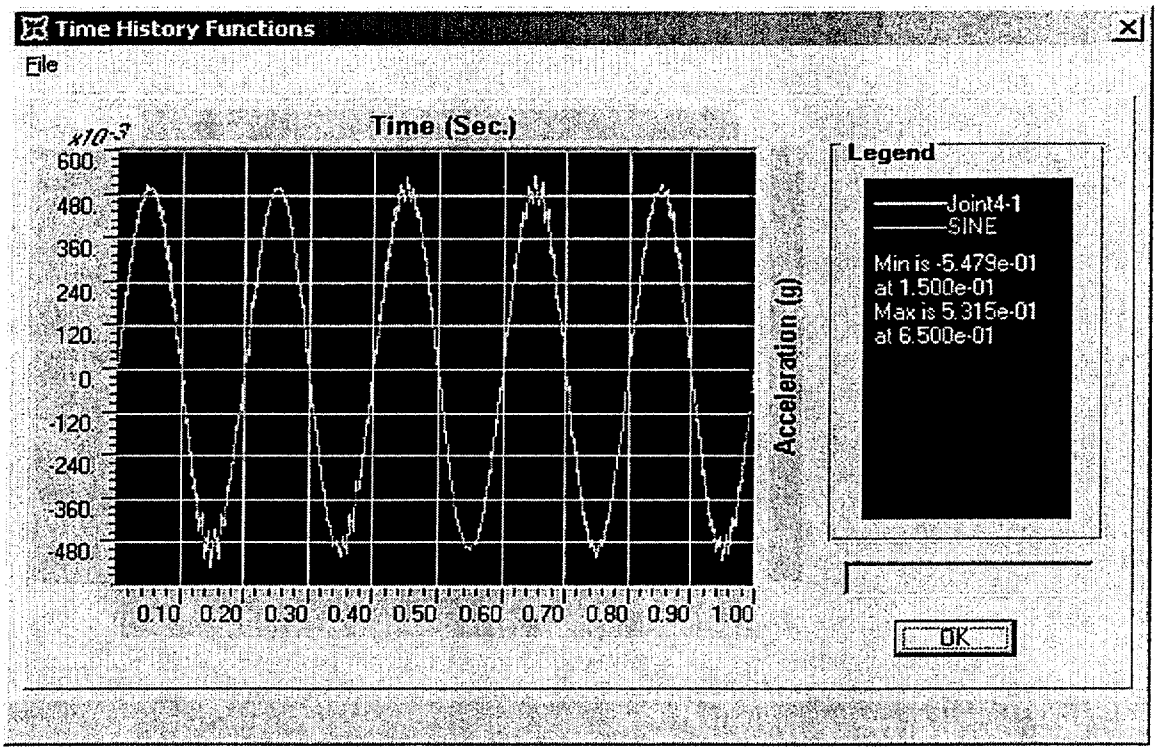


Figure 4.5: Sx = 0.5g, u=1.19, Comparison of Base Acceleration (X)

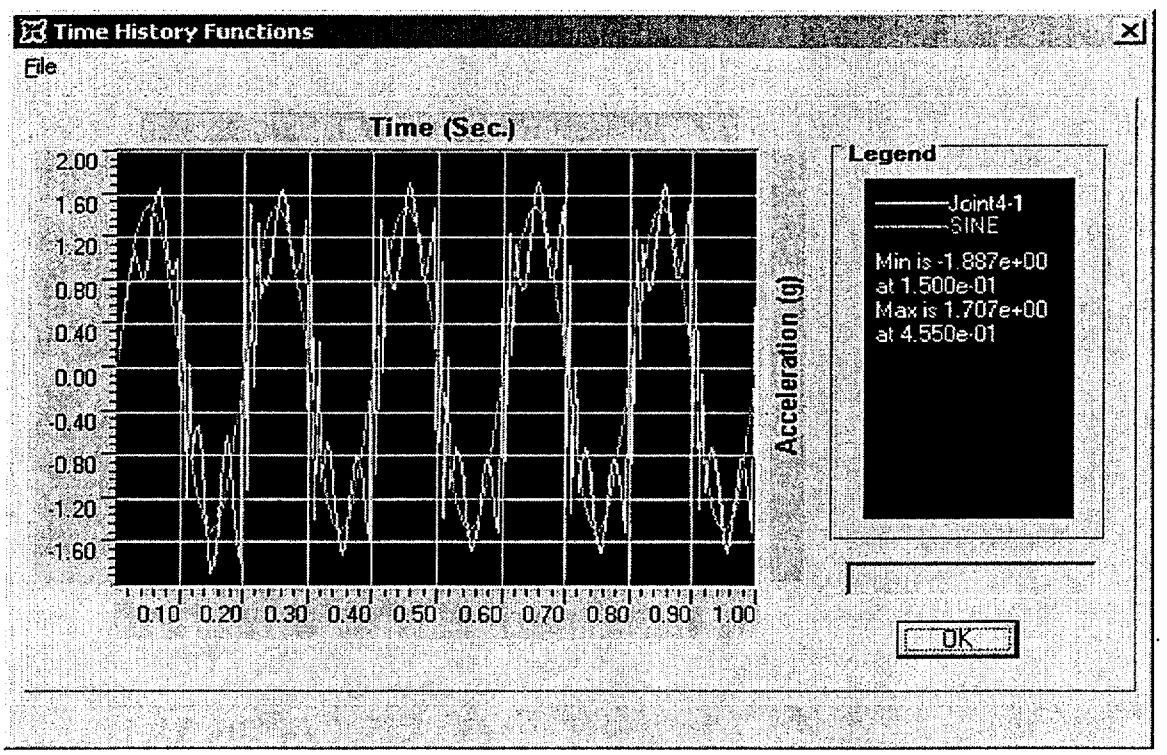


Figure 4.6: Sx = 1.5g, u=1.19, Comparison of Base Acceleration (X)

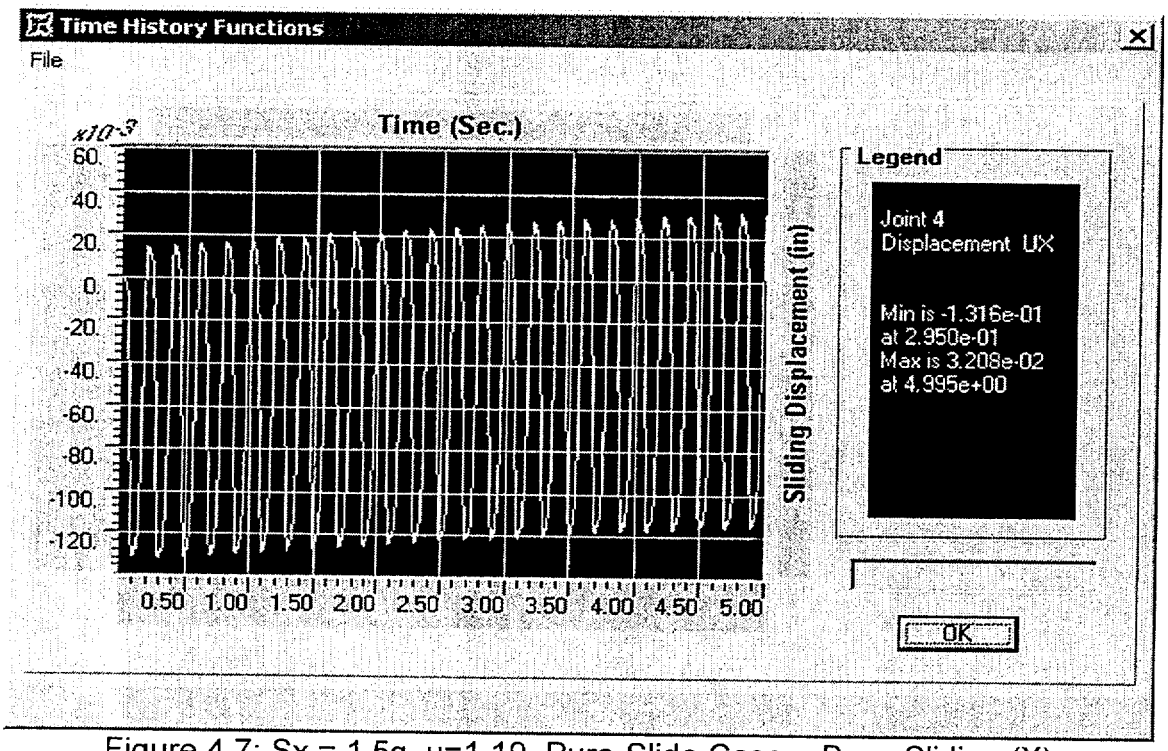


Figure 4.7: Sx = 1.5g, u=1.19, Pure-Slide Case - Base Sliding (X)

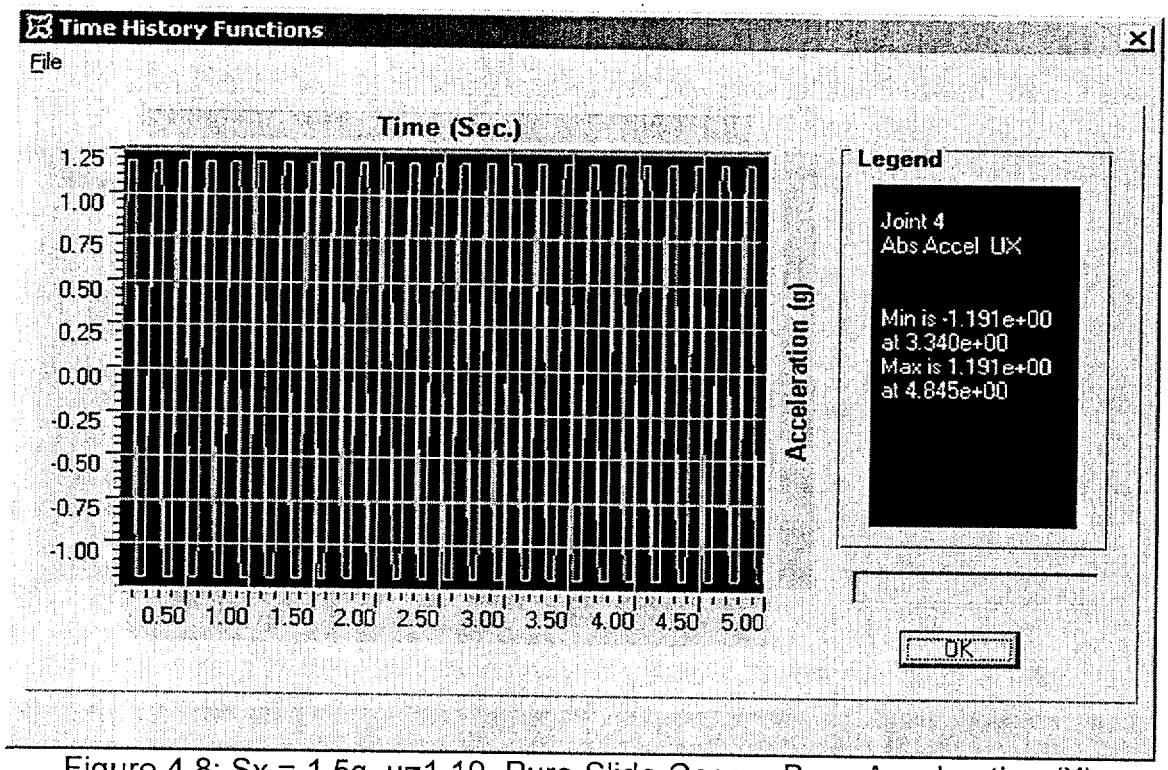


Figure 4.8: Sx = 1.5g, u=1.19, Pure-Slide Case - Base Acceleration (X)

## 5. ANALYSES CASES & RESULTS

Table 5.1 below shows the various sliding analyses cases performed:

| Case No. | SAP2000N Model Name | Seismic Event | Direction of Vertical EQ | Coefficient of Friction (μ) |
|---|---|---|---|---|
| 1 | ISFSI,Set1,u=1.19 | ISFSI Set 1 | +Z | 1.19 = tan 50° |
| 2 | ISFSI,Set2a,u=1.19 | ISFSI Set 2a | +Z | 1.19 = tan 50° |
| 3 | ISFSI,Set3,u=1.19 | ISFSI Set 3 | +Z | 1.19 = tan 50° |
| 4 | ISFSI,Set5,u=1.19 | ISFSI Set 5 | +Z | 1.19 = tan 50° |
| 5 | ISFSI,Set6,u=1.19 | ISFSI Set6 | +Z | 1.19 = tan 50° |
| 6 | ISFSI,Set1,u=0.73 | ISFSI Set 1 | +Z | 0.73 = tan 36° |
| 7 | ISFSI,Set2a,u=0.73 | ISFSI Set 2a | +Z | 0.73 = tan 36° |
| 8 | ISFSI,Set3,u=0.73 | ISFSI Set 3 | +Z | 0.73 = tan 36° |
| 9 | ISFSI,Set5,u=0.73 | ISFSI Set 5 | +Z | 0.73 = tan 36° |
| 10 | ISFSI,Set6,u=0.73 | ISFSI Set6 | +Z | 0.73 = tan 36° |

Table 5.1: Summary of Analyses Cases

Table 5.2 summarizes the sliding displacement at the base of the model. These numbers represent the sliding of the mat under the postulated seismic events. The net vector horizontal sliding is obtained using the SRSS of the maximum of the 2 individual sliding components along X or Y directions. This combination assumes that the 2 sliding displacements along X & Y directions reach their peak at the same time. This is conservative, however judging from the time-history plot of the sliding displacements, it is seen that peak sliding generally occurs at (or very close to) the same time for X & Y directions. This is expected since sliding is often as a result of vector driving forces (shears) exceeding the sliding resistance.

The approach used to arrive at the best estimate of the mat sliding is as follows. The average of response due to the 5 ISFSI cases is obtained as per SRP guidelines, since the average of these 5 sets is used to match the target spectrum. From table 5.2, the average of the 5 ISFSI cases indicating a best estimate of max. sliding of 0.41" for a friction coefficient of 1.19. Corresponding best estimate of mat sliding for a friction coefficient of 0.73 is 1.21". The best estimate of the max. sliding for each of the 2 friction coefficients is shown in bold in Table 5.2 below.

Note that the highest absolute max. mat sliding for any one of the 5 analyses cases is 1.58" (for a friction coefficient of 1.19) and 3.07" (for a friction coefficient of 0.73), both of which correspond to the ISFSI Set 1 Time History. These numbers are also reported here, however per SRP guidelines, the best estimate of max. sliding of the mat subject to multiple time histories whose average envelope the same design spectrum can be taken as the average of all the individual cases. This averaging is allowed for different time histories whose average match a target spectrum.

| Case No. | Seismic Event | μ | Vertical EQ | Max. mat Sliding X (inch) | Max. mat sliding Y (inch) | Net Horizontal Sliding (inch) |
|---|---|---|---|---|---|---|
| 1 | ISFSI Set1 | 1.19 | +Z | +1.12 | -1.11 | 1.58 |
| 2 | ISFSI Set2a | 1.19 | +Z | -0.02 | +0.01 | 0.02 |
| 3 | ISFSI Set3 | 1.19 | +Z | +0.11 | +0.07 | 0.13 |
| 4 | ISFSI Set5 | 1.19 | +Z | -0.07 | +0.14 | 0.16 |
| 5 | ISFSI Set6 | 1.19 | +Z | -0.12 | +0.13 | 0.18 |
| | Avg. 5 ISFSI cases | 1.19 | | | | **0.41** |
| | | | | | | |
| 6 | ISFSI Set1 | 0.73 | +Z | +2.34 | -2.00 | 3.08 |
| 7 | ISFSI Set2a | 0.73 | +Z | -0.27 | +0.25 | 0.37 |
| 8 | ISFSI Set3 | 0.73 | +Z | +0.83 | +0.45 | 0.94 |
| 9 | ISFSI Set5 | 0.73 | +Z | +0.37 | +0.98 | 1.05 |
| 10 | ISFSI Set6 | 0.73 | +Z | +0.26 | +0.55 | 0.61 |
| | Avg. 5 ISFSI cases | 0.73 | | | | **1.21** |

Table 5.2: Summary of Max. Mat Sliding Displacements

Table 5.3 below summarizes maximum base shear per cask from these non-linear analyses after allowing for mat to slide compared to maximum base shears obtained from fixed base analysis which is not subject to sliding. Net shear are computed based on SRSS of X & Y shears in the time domain and extracting the highest value. Same approach as sliding displacement is used here to come up with the best estimate of net shear, i.e. the average of the 5 ISFSI cases is used as the best estimate of sliding shear when compared to fixed based shear. The governing ratios are shown in bold in Table 5.3 next page:

| Analysis Case | Sliding Shears | | | Fixed Base Shears | | | Ratio |
|---|---|---|---|---|---|---|---|
| | $S_x$ (Kips) | $S_y$ (Kips) | Net Shear | $S_x$ (Kips) | $S_y$ (Kips) | Net Shear | Sliding/ FB |
| Set 1, u=1.19 | 571.5 | 463.6 | 601.7 | 485.4 | 487.0 | 617.9 | 0.97 |
| Set 2a, u=1.19 | 472.7 | 485.5 | 485.9 | 484.2 | 488.2 | 496.7 | 0.98 |
| Set 3, u=1.19 | 483.7 | 442.7 | 505.8 | 468.1 | 491.1 | 619.4 | 0.82 |
| Set 5, u=1.19 | 527.0 | 494.8 | 602.4 | 516.0 | 486.4 | 600.5 | 1.00 |
| Set 6, u=1.19 | 511.0 | 503.0 | 545.9 | 475.4 | 501.5 | 538.1 | 1.01 |
| Avg. 5 ISFSI cases, u=1.19 | | | 547.9 | | | 574.5 | **0.95** |
| | | | | | | | |
| Set 1, u=0.73 | 524.0 | 466.5 | 545.1 | 485.4 | 487.0 | 617.9 | 0.88 |
| Set 2a, u=0.73 | 502.5 | 432.6 | 510.7 | 484.2 | 488.2 | 496.7 | 1.03 |
| Set 3, u=0.73 | 442.0 | 399.0 | 471.7 | 468.1 | 491.1 | 619.4 | 0.76 |
| Set 5, u=0.73 | 400.6 | 523.5 | 526.7 | 516.0 | 486.4 | 600.5 | 0.88 |
| Set 6, u=0.73 | 465.6 | 512.0 | 530.4 | 475.4 | 501.5 | 538.1 | 0.99 |
| | | | | | | | |
| Avg. 5 ISFSI cases, u=0.73 | | | 516.7 | | | 574.5 | **0.90** |

Table 5.3: Summary of Base Shears (Sliding Vs. Fixed Base)

Reference 1 reports the net resultant shear of 515.0 Kips for design basis corresponding to HE (+Z) case. The relative ratios of Sliding/Fixed Base reported in Table 5.3 for net shear are used here to predict the effect of mat sliding on the design shear. For this purpose, the average shear response of the 5 ISFSI cases is calculated for both the sliding and the fixed base results. This ratio of the average shear for sliding (for each friction coefficient) versus the fixed base average shear indicates the ratio that should be applied to the design bases shear to account for the effect of mat sliding. If this ratio is less than unity, a ratio of unity will be applied.

As seen from Table 5.3 above, the average ratio of sliding shear to fixed base shear is calculated as 0.95 for u=1.19 and 0.90 for u=0.73. This trend is expected, as the lower the friction coefficient, the more the mat slides, thus resulting in more earthquake energy dissipation and therefore lower shear forces at the cask/mat interface. Since both factors are less than 1, a factor of unity is applied to design shear to allow for the effect of mat sliding.

Therefore the peak net shear after allowing for effects of mat sliding remains the same as design shear. Said otherwise, mat sliding does not increase the design shear of 515 Kips as reported in Ref. 1.

Table 5.4 below summarizes maximum base tension per cask from these non-linear analyses after allowing for mat to slide compared to maximum base tension obtained from fixed base analysis, which is not subject to sliding:

| Analysis Case | u | Sliding Tension (Kips) | Fixed Base Tension (Kips) | Ratio Sliding/ Fixed Base |
|---|---|---|---|---|
| Set 1 | 1.19 | 310.1 | 307.8 | 1.01 |
| Set 2a | 1.19 | 304.9 | 306.1 | 1.00 |
| Set 3 | 1.19 | 359.0 | 357.2 | 1.01 |
| Set 5 | 1.19 | 380.1 | 379.3 | 1.00 |
| Set 6 | 1.19 | 379.4 | 375.1 | 1.01 |
| | | | | |
| Avg. 5 ISFSI Cases | 1.19 | 346.7 | 345.1 | **1.005** |
| | | | | |
| Set 1 | 0.73 | 310.1 | 307.8 | 1.01 |
| Set 2a | 0.73 | 304.9 | 306.1 | 1.00 |
| Set 3 | 0.73 | 359.0 | 357.2 | 1.01 |
| Set 5 | 0.73 | 380.1 | 379.3 | 1.00 |
| Set 6 | 0.73 | 379.4 | 375.1 | 1.01 |
| | | | | |
| Avg. 5 ISFSI Cases | 0.73 | 346.7 | 345.1 | **1.005** |

Table 5.4: Summary of Base Tensions (Sliding Vs. Fixed Base)

Table 5.4 shows that the peak tension load essentially does not change as a result of mat sliding.

Therefore it is concluded that the design shear and net tension forces as reported in Ref. 1 will not change as a result of mat sliding.

Figures 5.1 and 5.2 show the base sliding plots at the mat/rock interface for X & Y directions for case 1 (ISFSI Set 1 TH, $\mu$=1.19). Figures 5.3 and 5.4 show the comparison of response spectra at rock versus mat after sliding for both horizontal directions. These spectra serve to determine if the input motion is significantly altered as a result of mat sliding. Spectra comparisons vertically are not provided as no separation takes place vertically, therefore vertical motion does not change. Similarly Figures 5.5 through 5.20 show similar sets of plots for the remaining 4 cases for $\mu$=1.19. Figures 5.21 through 5.40 shows corresponding plots for $\mu$=0.73 case.

As seen from the spectra comparison plots, the motion at the cask/mat interface does get somewhat altered, but typically at frequencies of approximately 16 to 20 Hz. or higher. These high frequency spikes are considered real and as a result of the sliding.

However, the cask dominant frequency is shown to be around 15.9 Hz. in Section 3.0 of this Calc. Since the base shear after sliding is not effected versus the design shear as a result of mat sliding, it is judged that the discrepancies in the cask/mat interface motion after sliding takes place are of no engineering consequence for the design of the cask embedment, the mat, and the sector lugs. It is further concluded that the cask design basis analyses, when subject to the rock/mat interface motion need not be analyzed subject to these altered motions. However, if inside the cask, there are components that are sensitive to changes in higher frequency motions, the qualification of these components should address the potential change in high frequency motion as a result of mat sliding. The peak spectral ordinate of these high frequency spikes is no higher than 4.1 g's at 5% damping (See Figure 5.36).

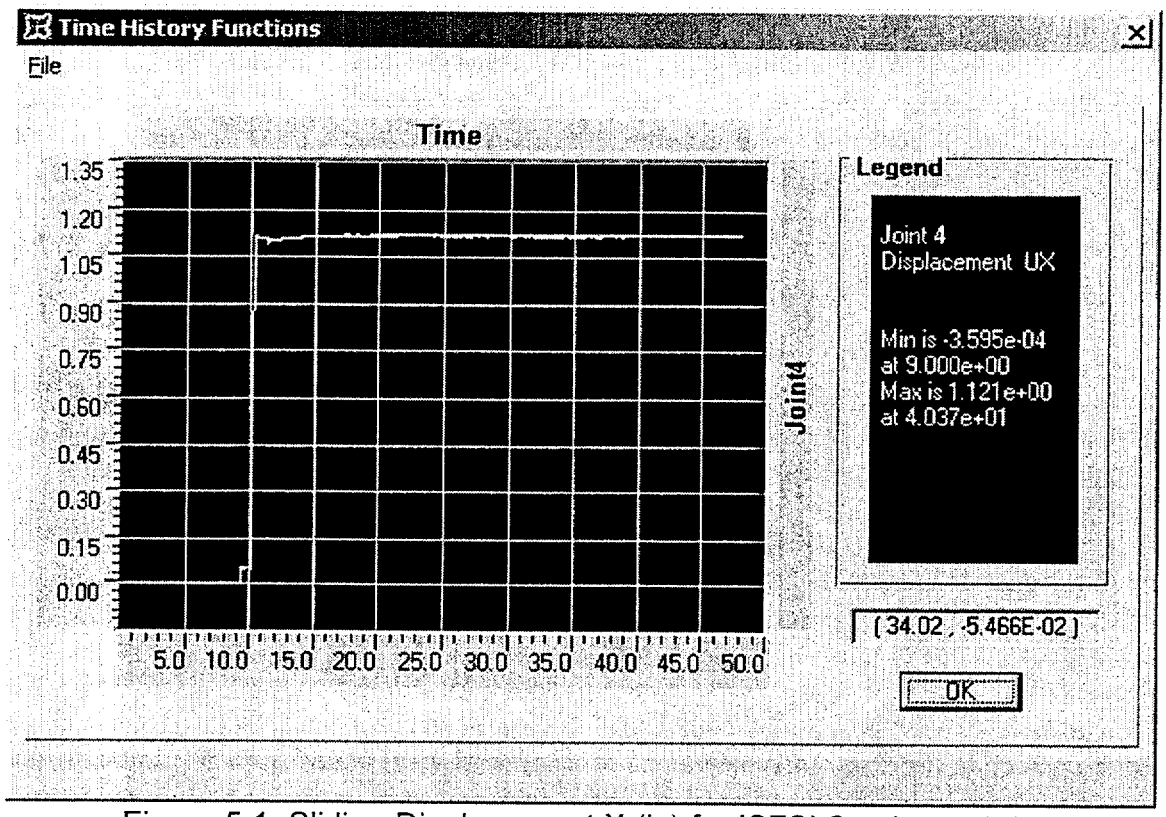


Figure 5.1: Sliding Displacement X (in) for ISFSI Set 1, $\mu$ = 1.19

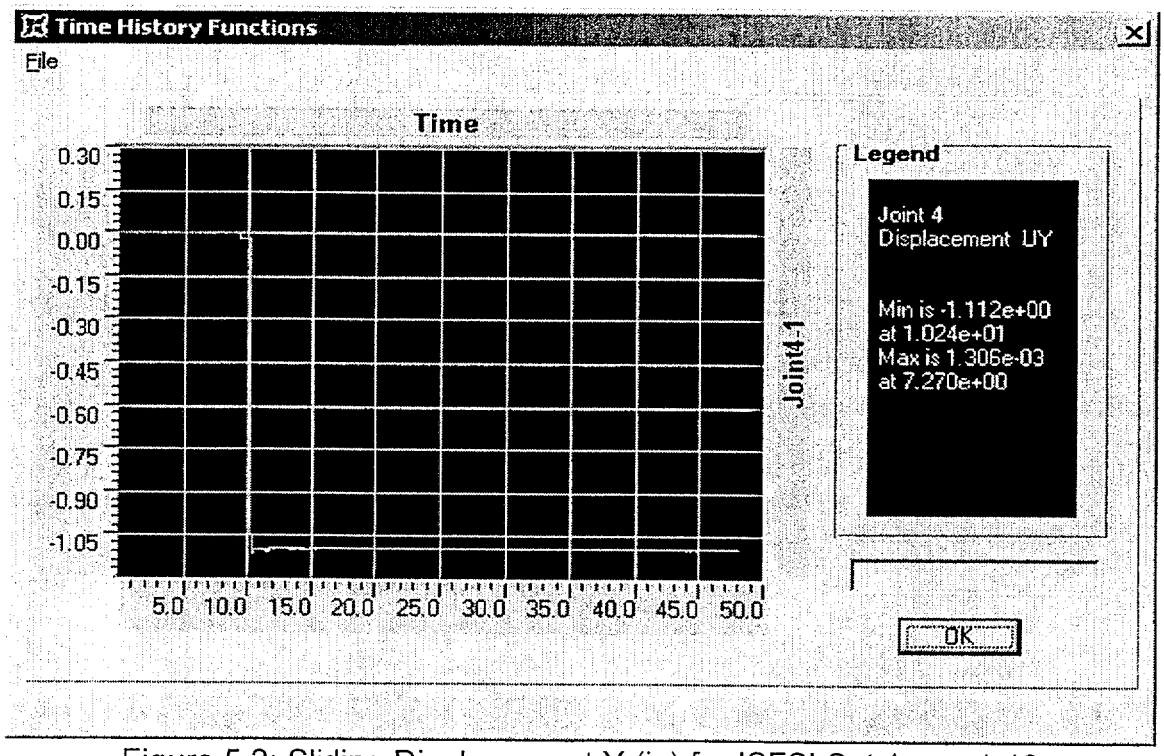


Figure 5.2: Sliding Displacement Y (in) for ISFSI Set 1, $\mu$ = 1.19

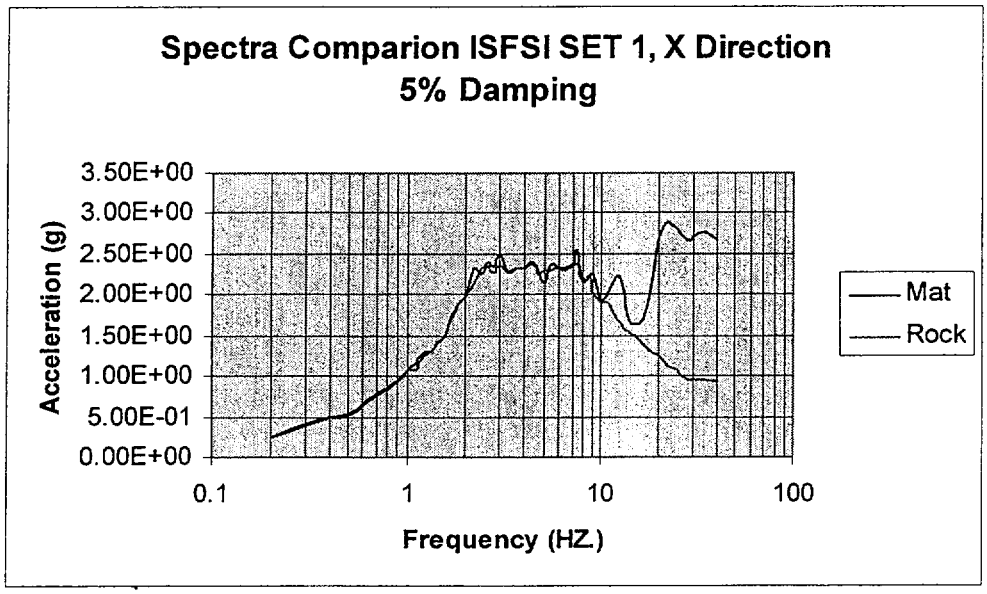


Figure 5.3: Spectra Comparison, X, ISFSI Set 1, 5% Damped, $\mu$ = 1.19

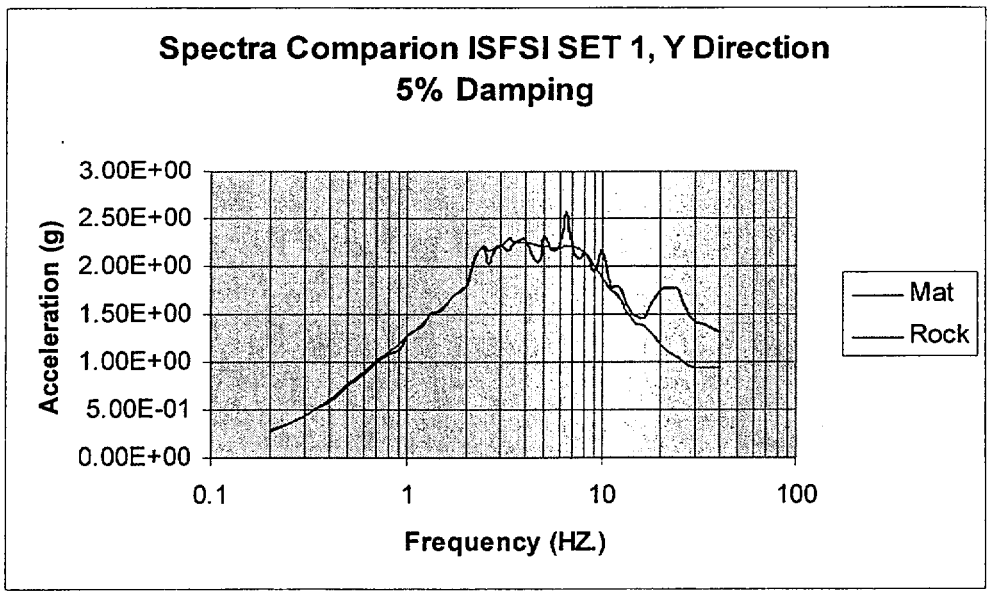


Figure 5.4: Spectra Comparison, Y, ISFSI Set 1, 5% Damped, $\mu$ = 1.19

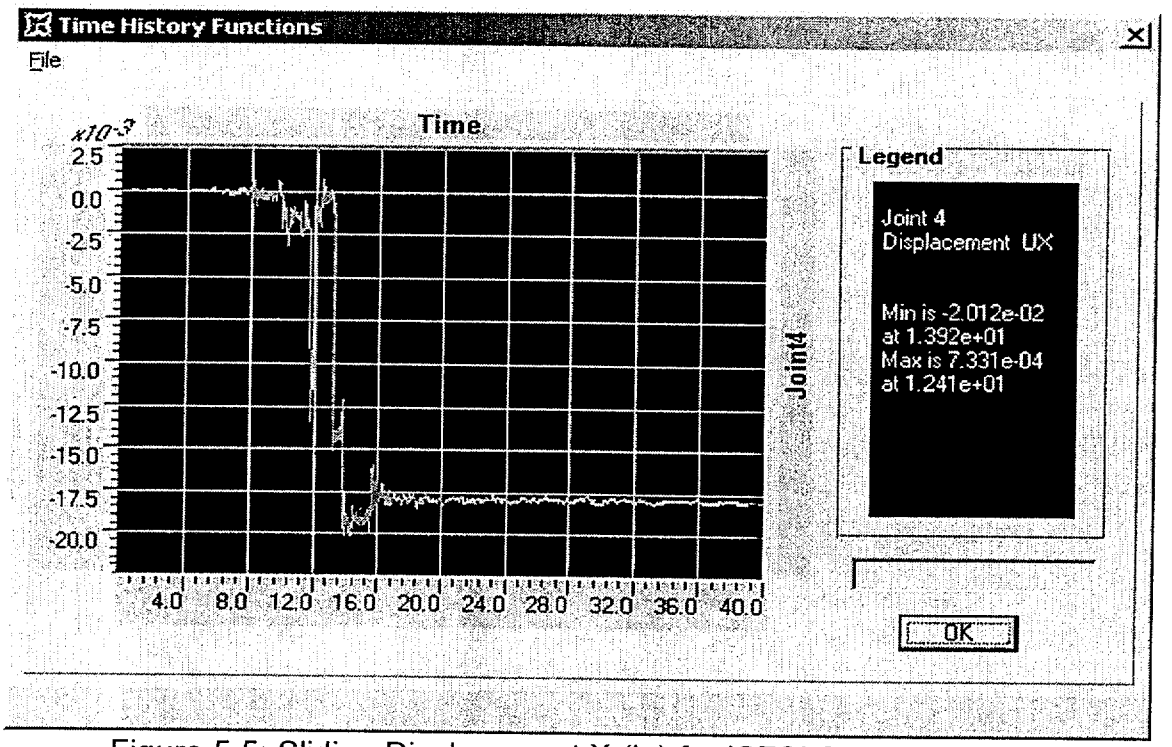


Figure 5.5: Sliding Displacement X (in) for ISFSI Set 2a, $\mu$ = 1.19

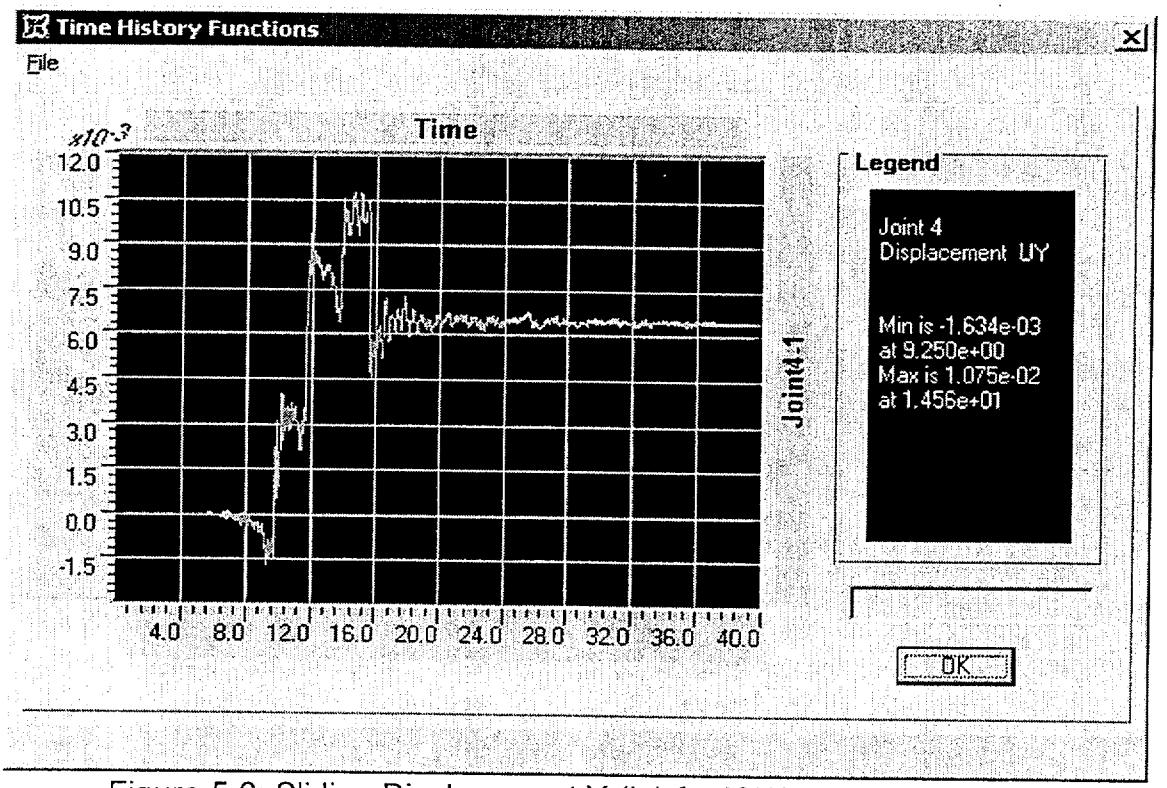


Figure 5.6: Sliding Displacement Y (in) for ISFSI Set 2a, $\mu$ = 1.19

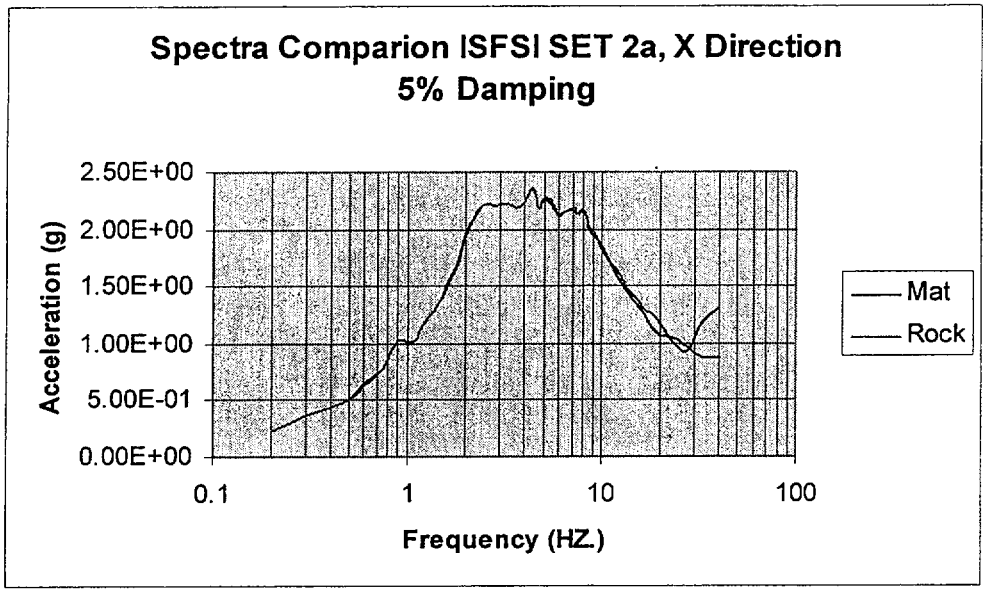


Figure 5.7: Spectra Comparison, X, ISFSI Set 2a, 5% Damped, $\mu$ = 1.19

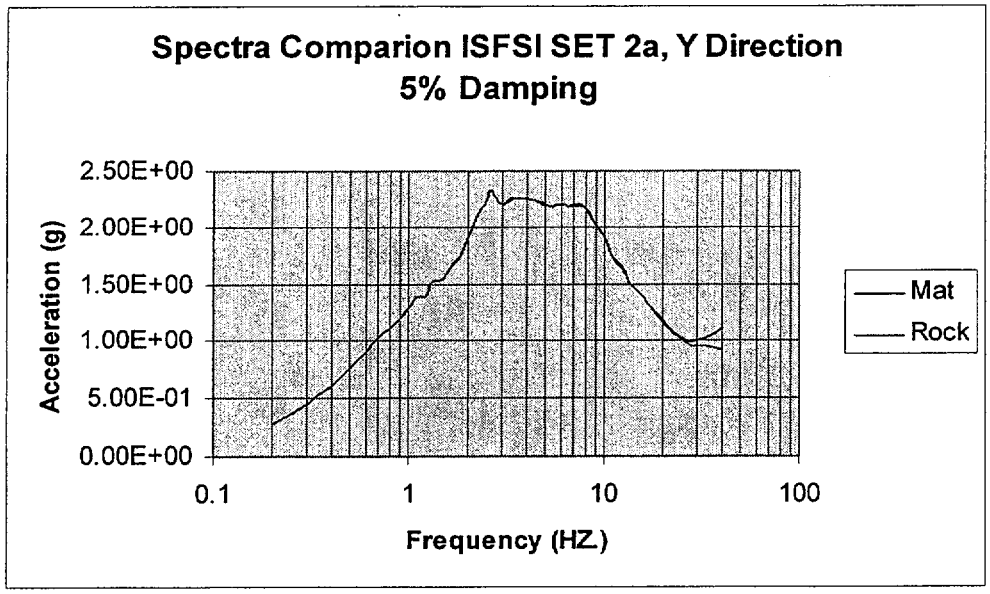


Figure 5.8: Spectra Comparison, Y, ISFSI Set 2a, 5% Damped, $\mu$ = 1.19

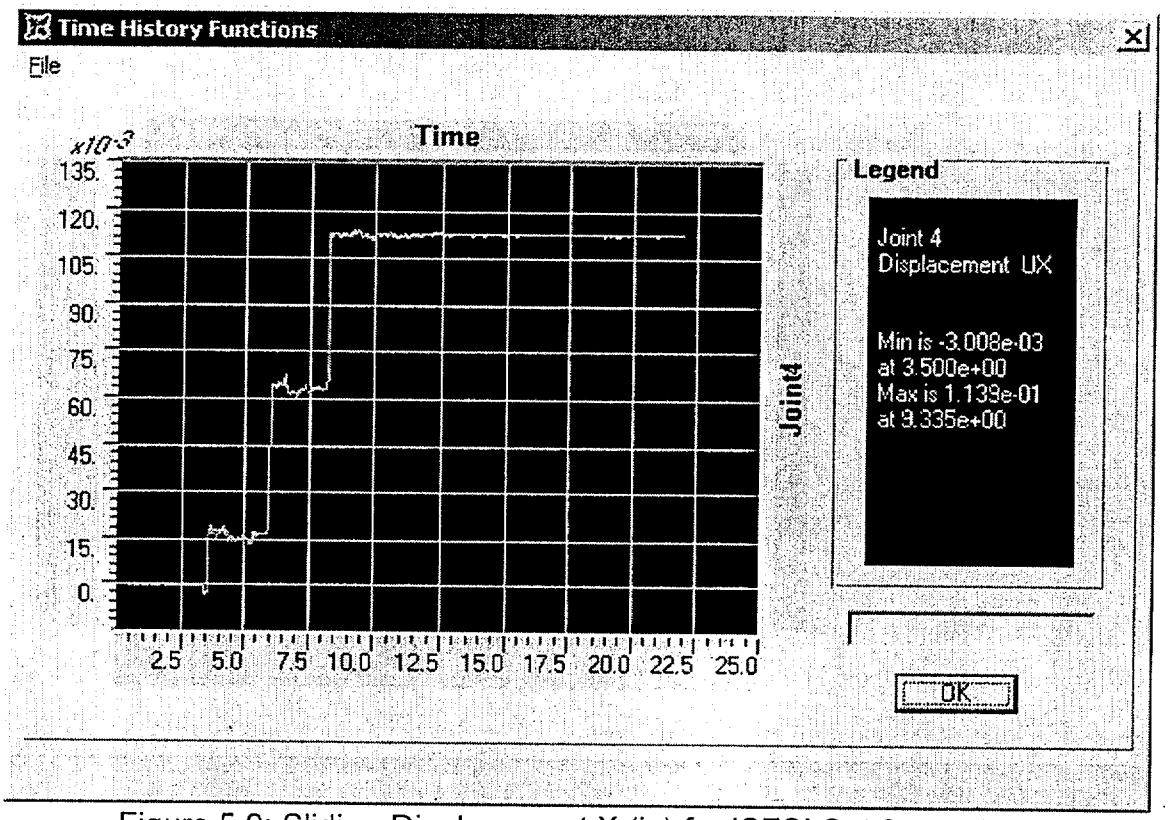


Figure 5.9: Sliding Displacement X (in) for ISFSI Set 3, $\mu$ = 1.19

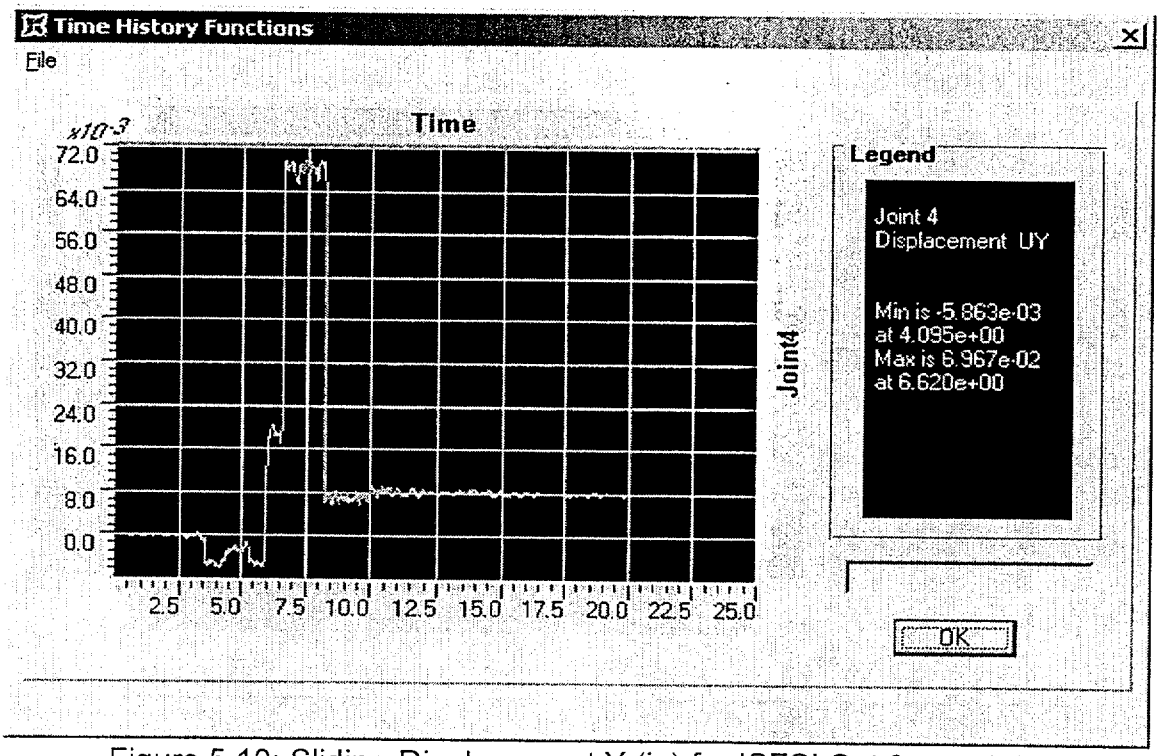


Figure 5.10: Sliding Displacement Y (in) for ISFSI Set 3, $\mu$ = 1.19

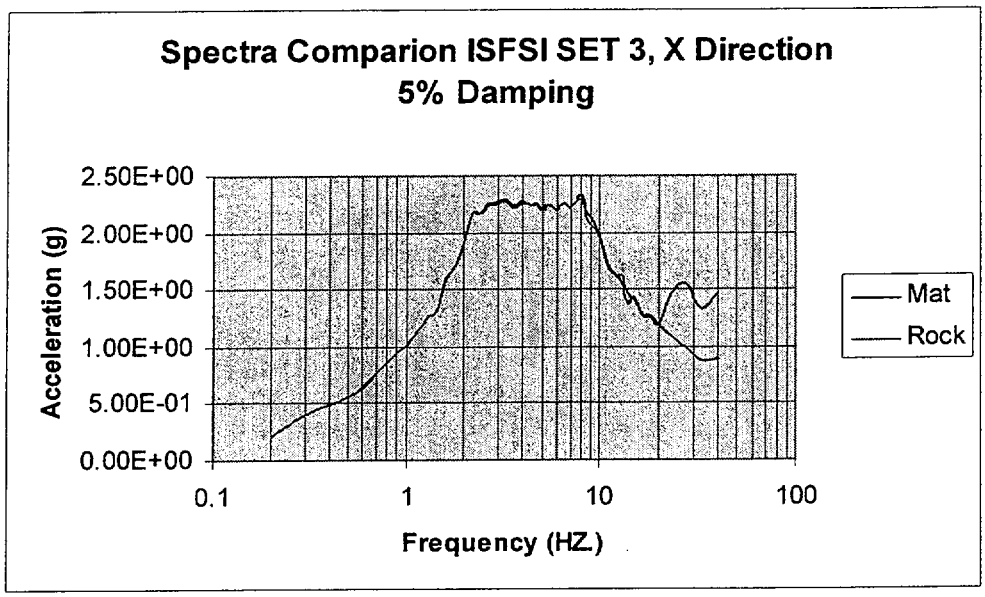


Figure 5.11: Spectra Comparison, X, ISFSI Set 3, 5% Damped, $\mu$ = 1.19

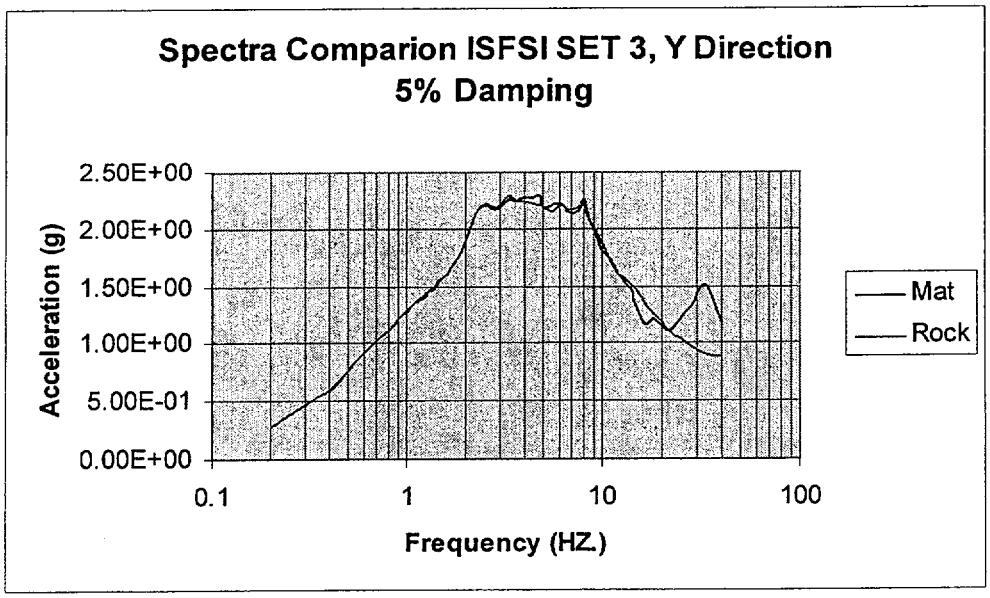


Figure 5.12: Spectra Comparison, Y, ISFSI Set 3, 5% Damped, $\mu$ = 1.19

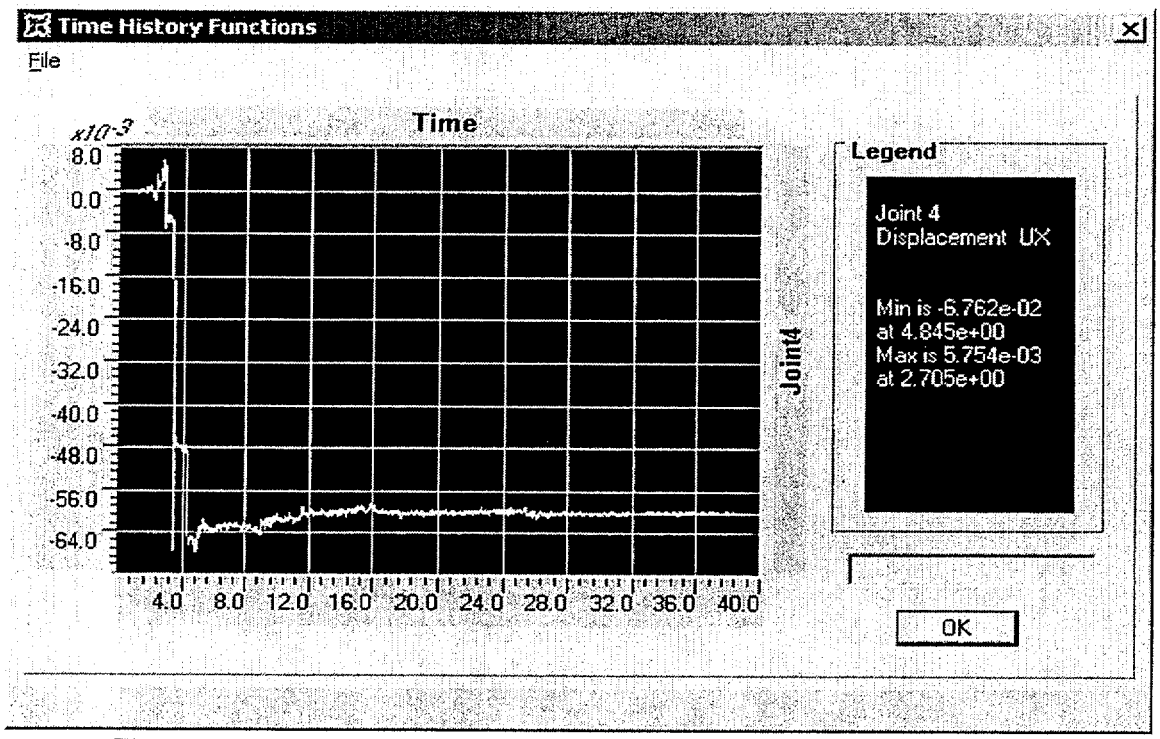


Figure 5.13: Sliding Displacement X (in) for ISFSI Set 5, $\mu$ = 1.19

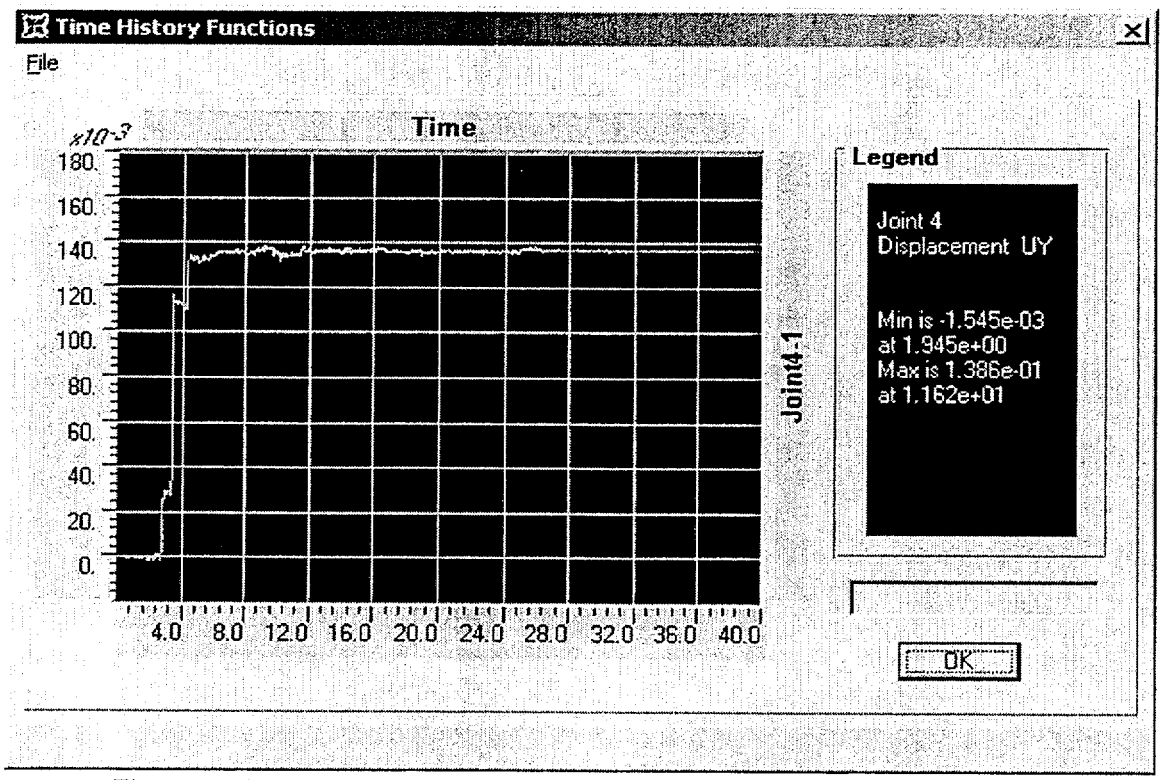


Figure 5.14: Sliding Displacement Y (in) for ISFSI Set 5, $\mu$ = 1.19

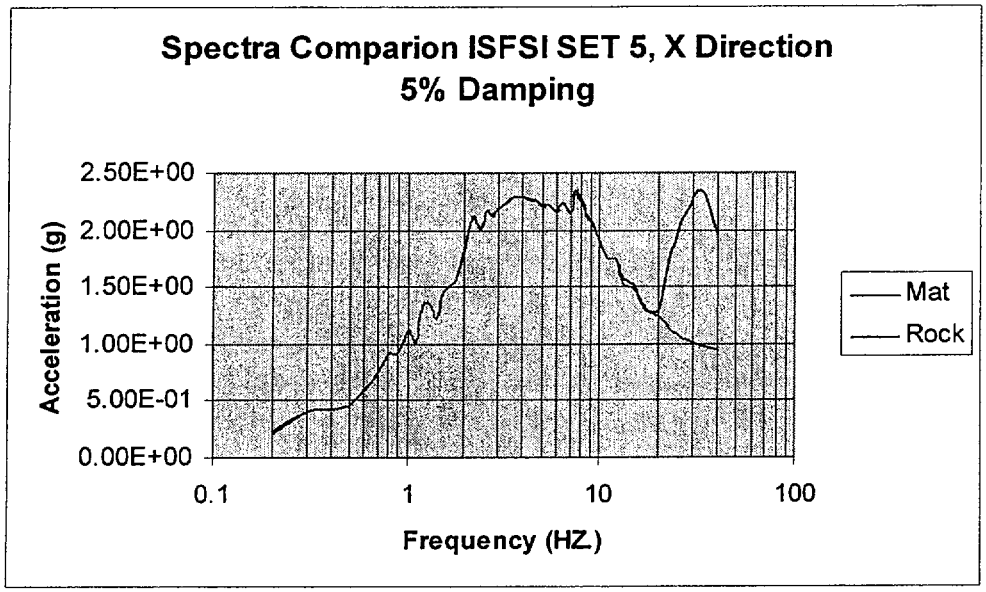


Figure 5.15: Spectra Comparison, X, ISFSI Set 5, 5% Damped, $\mu$ = 1.19

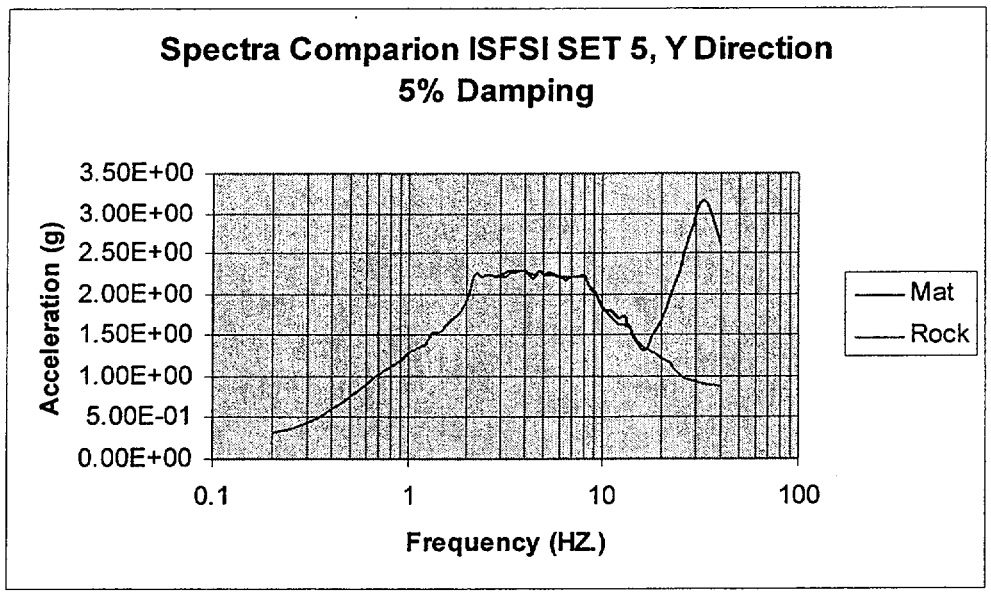


Figure 5.16: Spectra Comparison, Y, ISFSI Set 5, 5% Damped, $\mu$ = 1.19

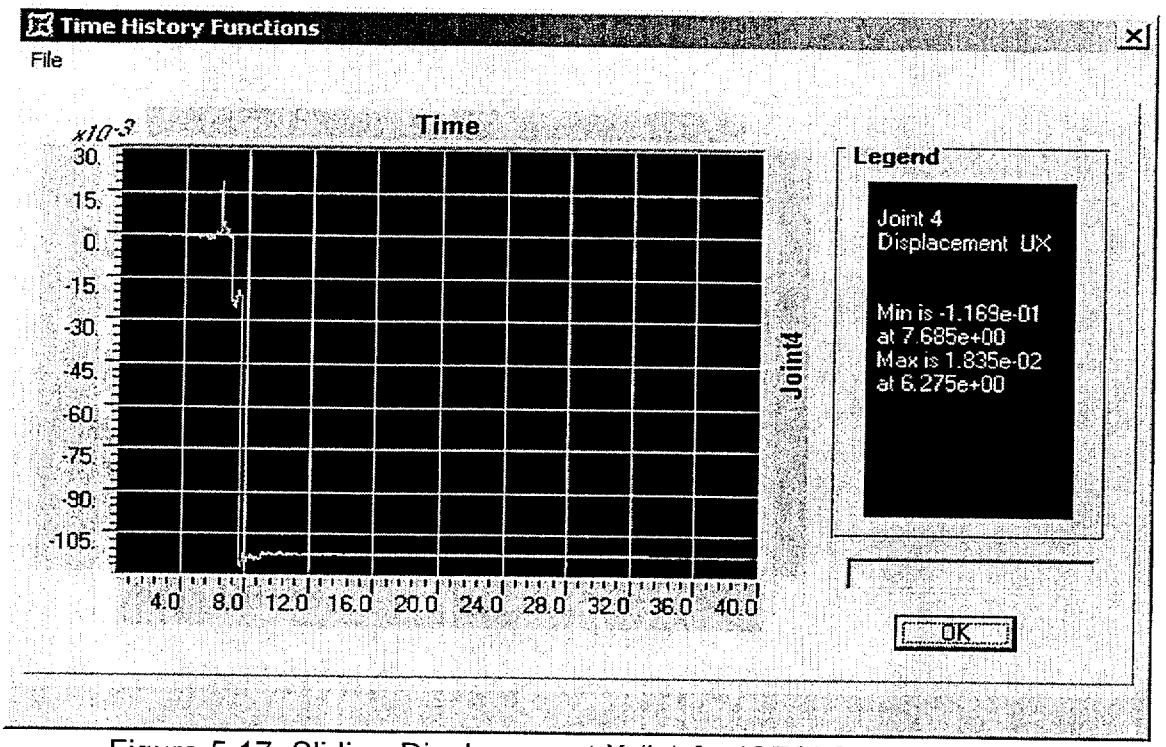


Figure 5.17: Sliding Displacement X (in) for ISFSI Set 6, $\mu$ = 1.19

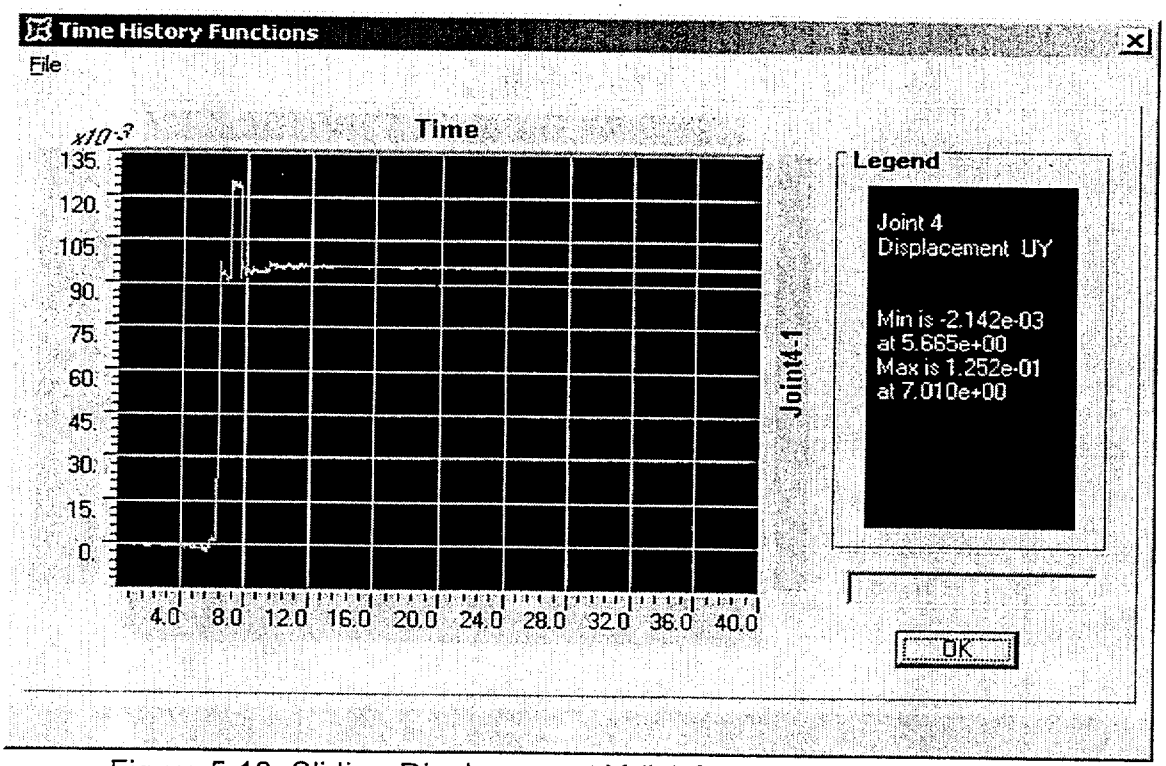


Figure 5.18: Sliding Displacement Y (in) for ISFSI Set 6, $\mu$ = 1.19

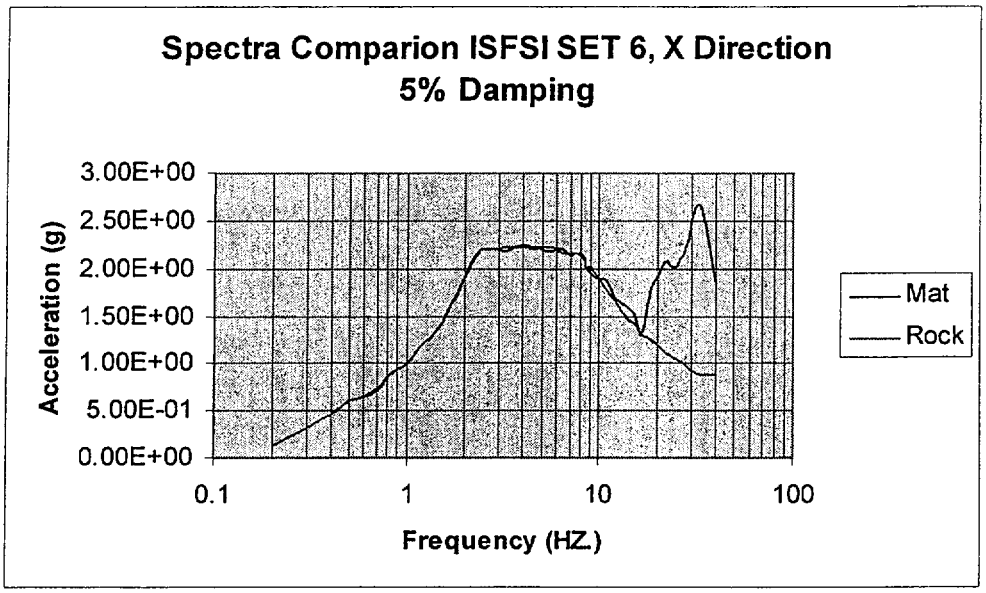


Figure 5.19: Spectra Comparison, X, ISFSI Set 6, 5% Damped, $\mu$ = 1.19

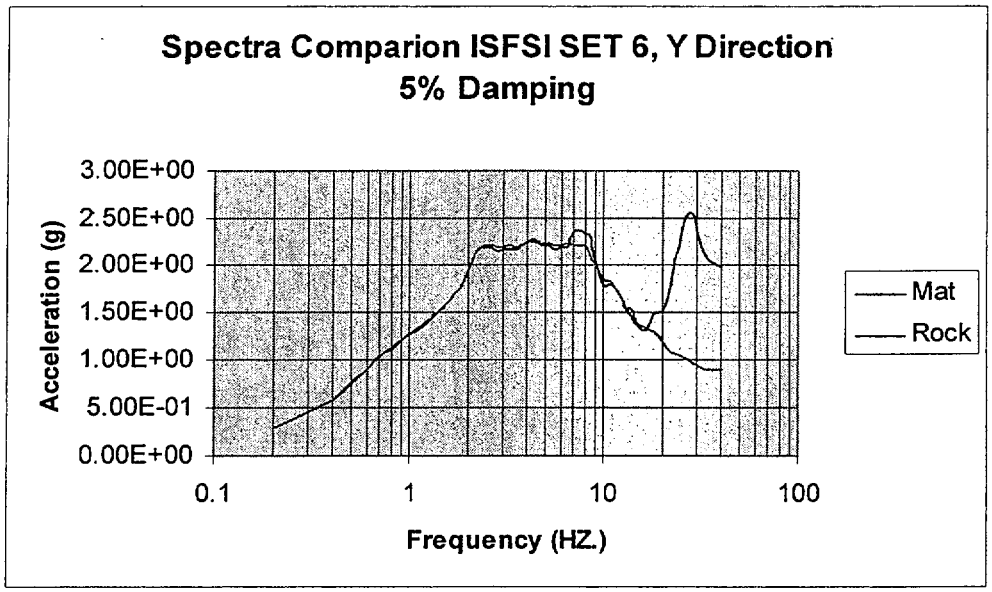


Figure 5.20: Spectra Comparison, Y, ISFSI Set 6, 5% Damped, $\mu$ = 1.19

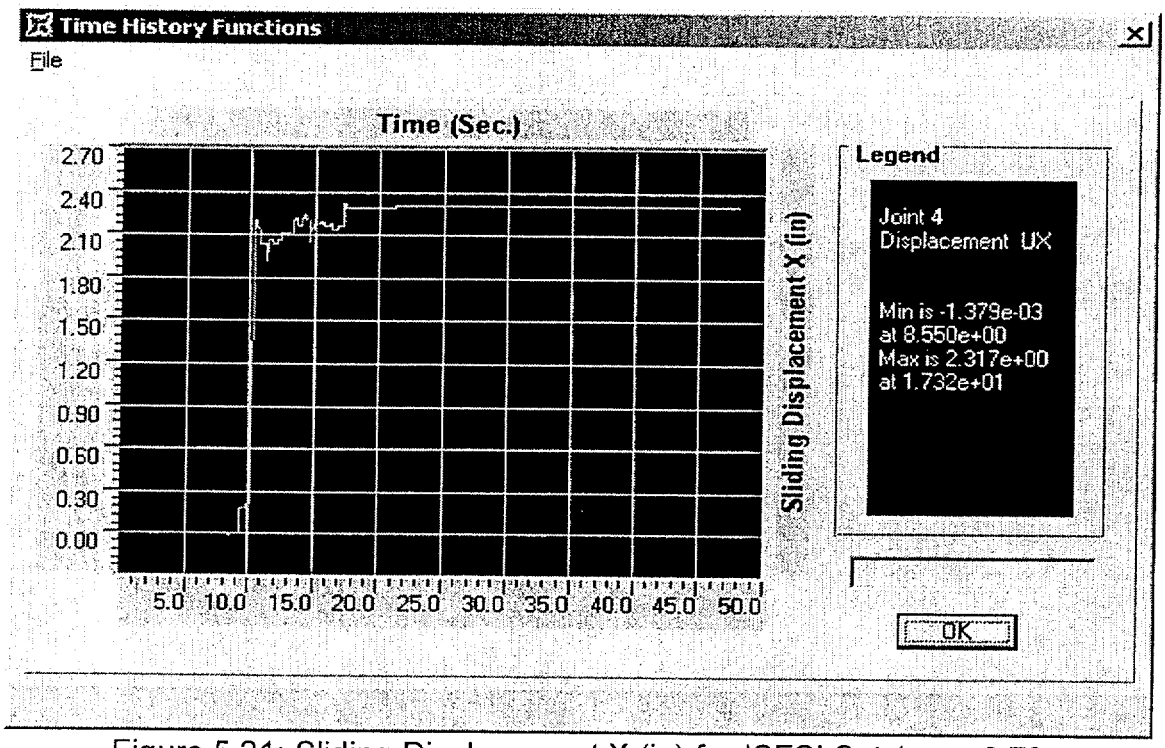


Figure 5.21: Sliding Displacement X (in) for ISFSI Set 1, $\mu$ = 0.73

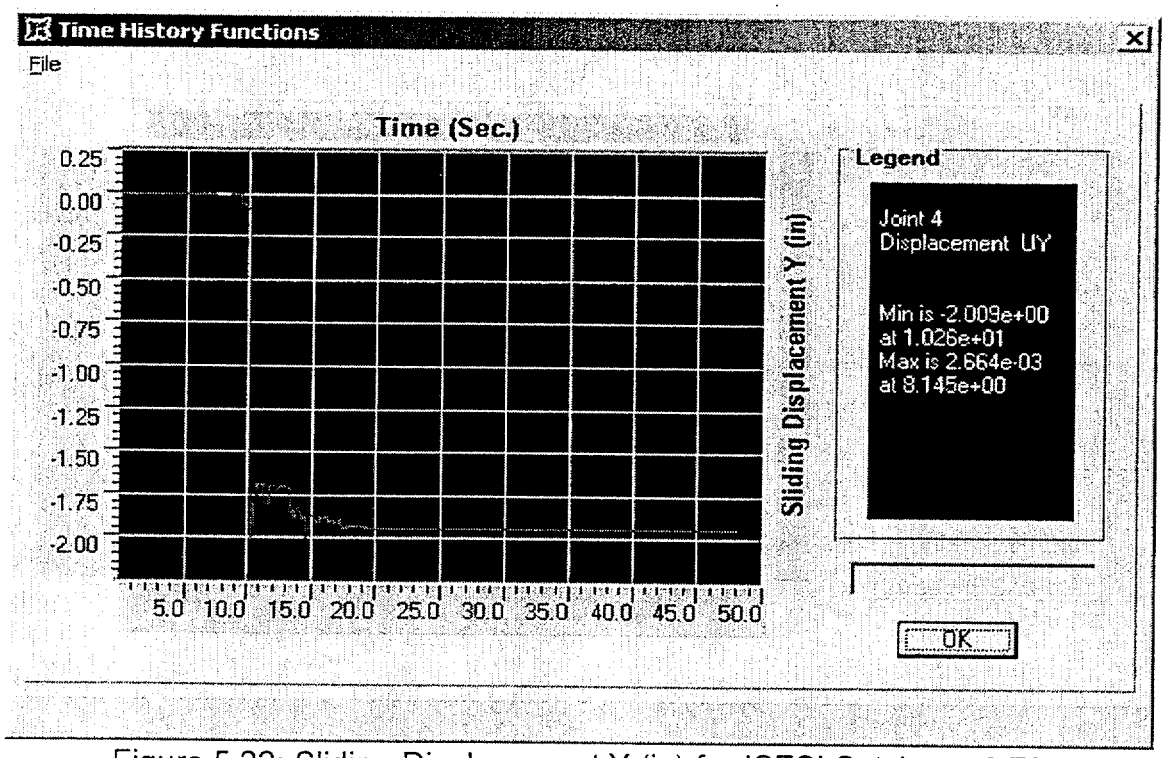


Figure 5.22: Sliding Displacement Y (in) for ISFSI Set 1, $\mu$ = 0.73

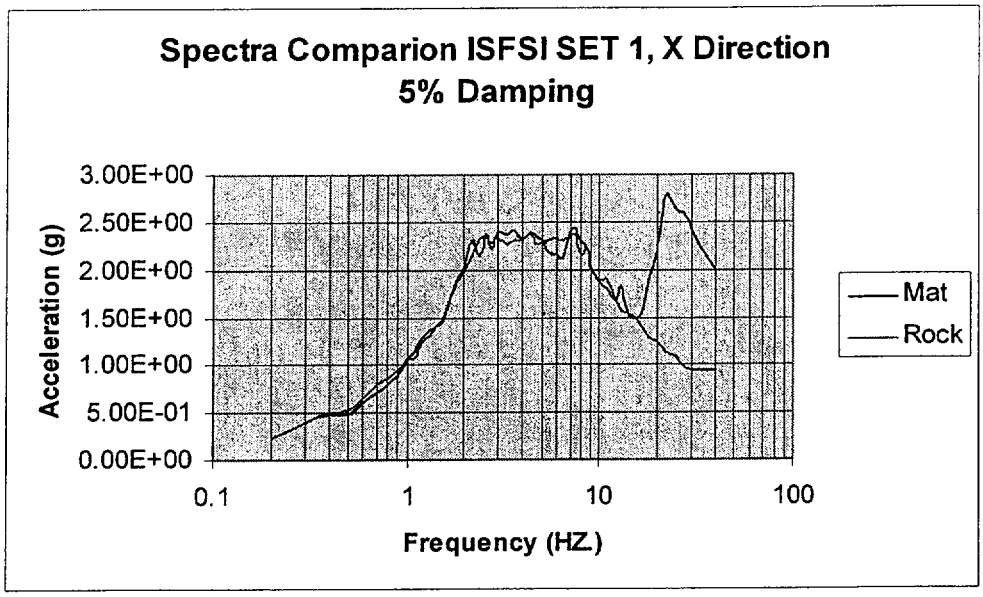


Figure 5.23: Spectra Comparison, X, ISFSI Set 1, 5% Damped, $\mu = 0.73$

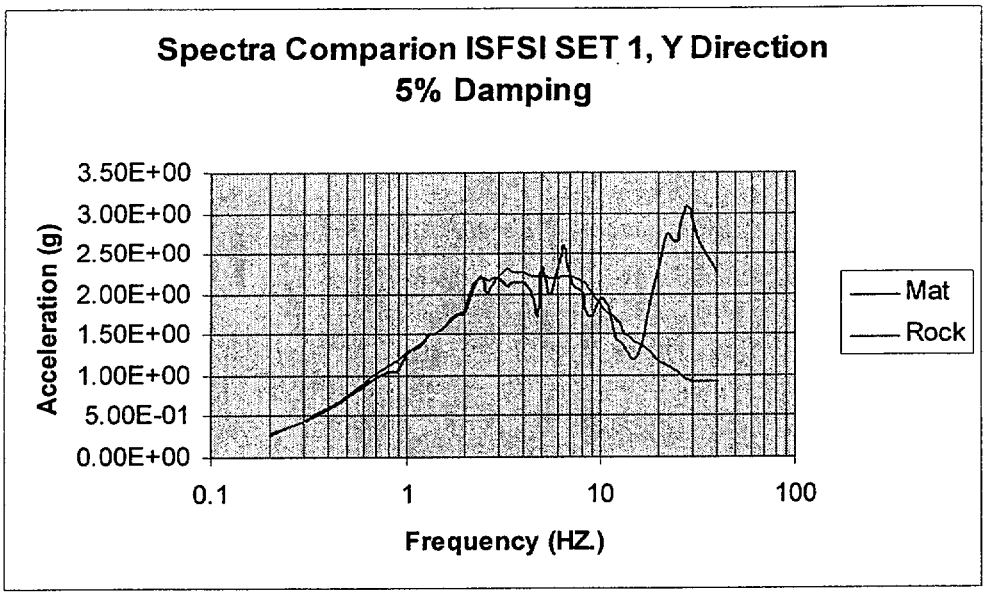


Figure 5.24: Spectra Comparison, Y, ISFSI Set 1, 5% Damped, $\mu = 0.73$

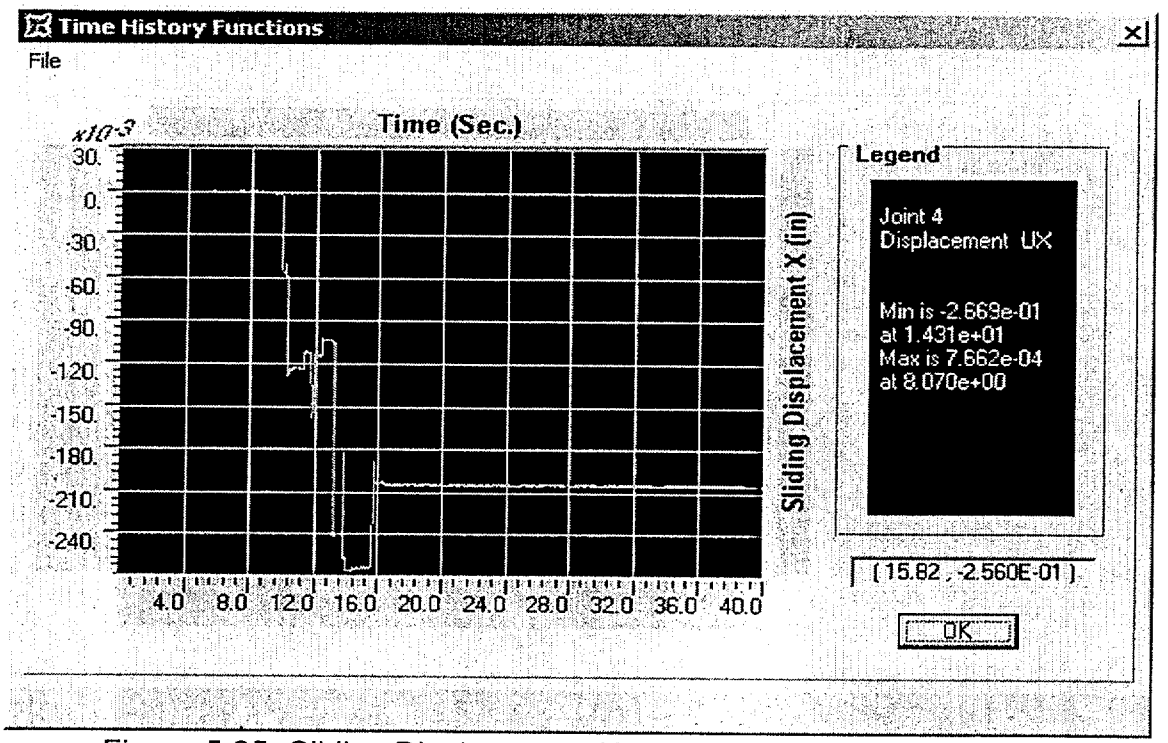


Figure 5.25: Sliding Displacement X (in) for ISFSI Set 2a, $\mu$ = 0.73

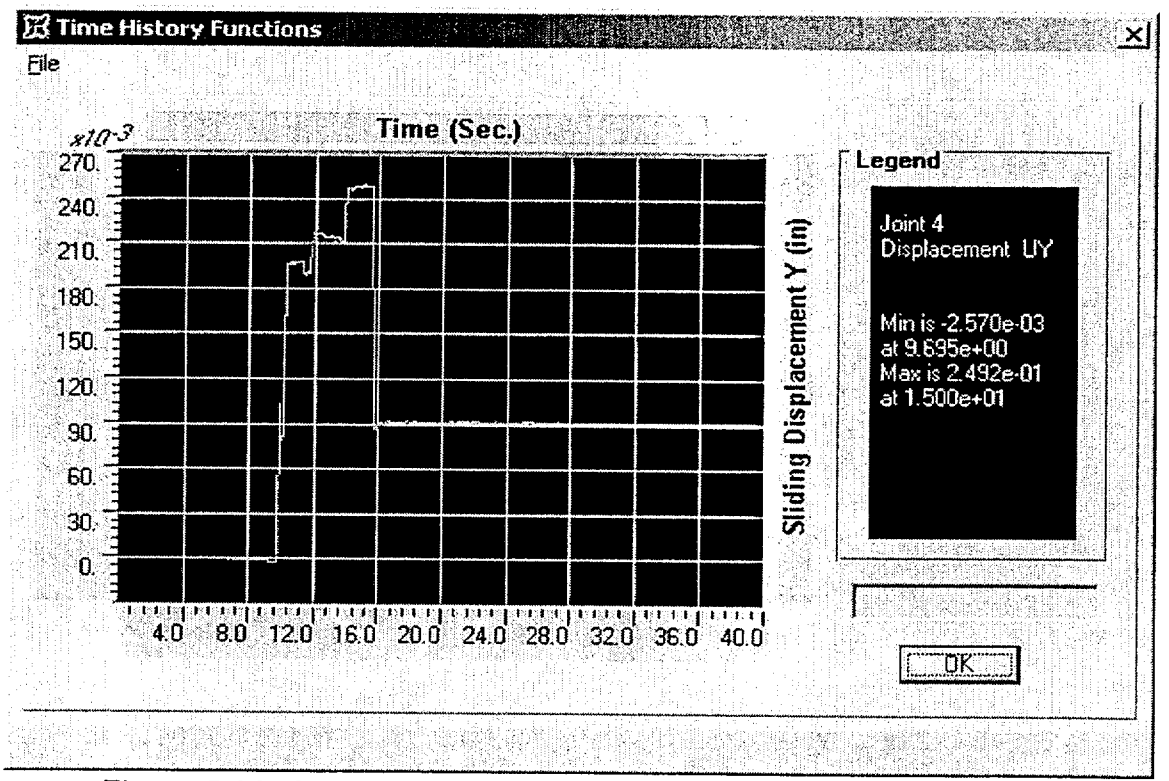


Figure 5.26: Sliding Displacement Y (in) for ISFSI Set 2a, $\mu$ = 0.73

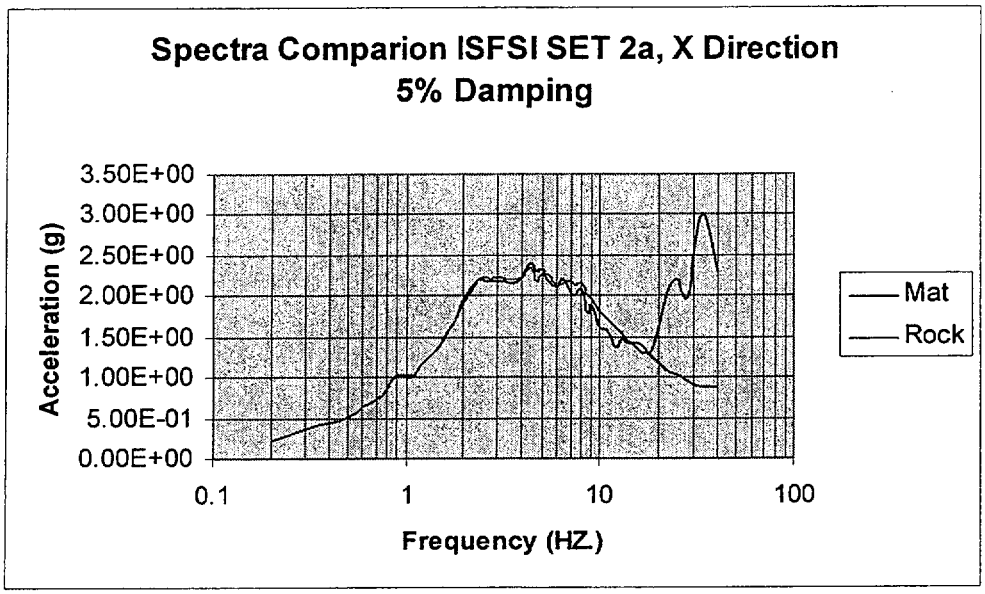


Figure 5.27: Spectra Comparison, X, ISFSI Set 2a, 5% Damped, $\mu = 0.73$

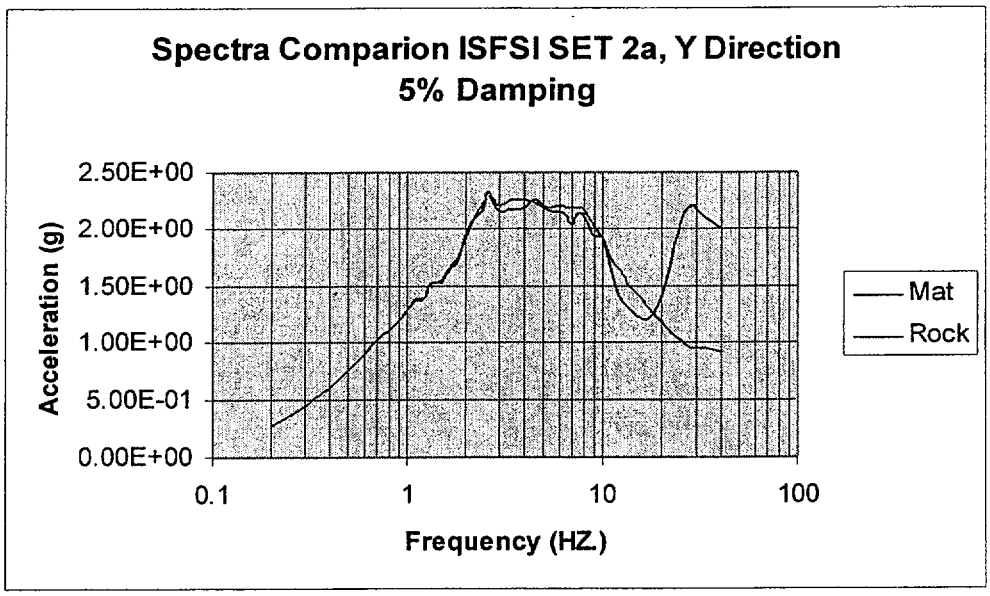


Figure 5.28: Spectra Comparison, Y, ISFSI Set 2a, 5% Damped, $\mu = 0.73$

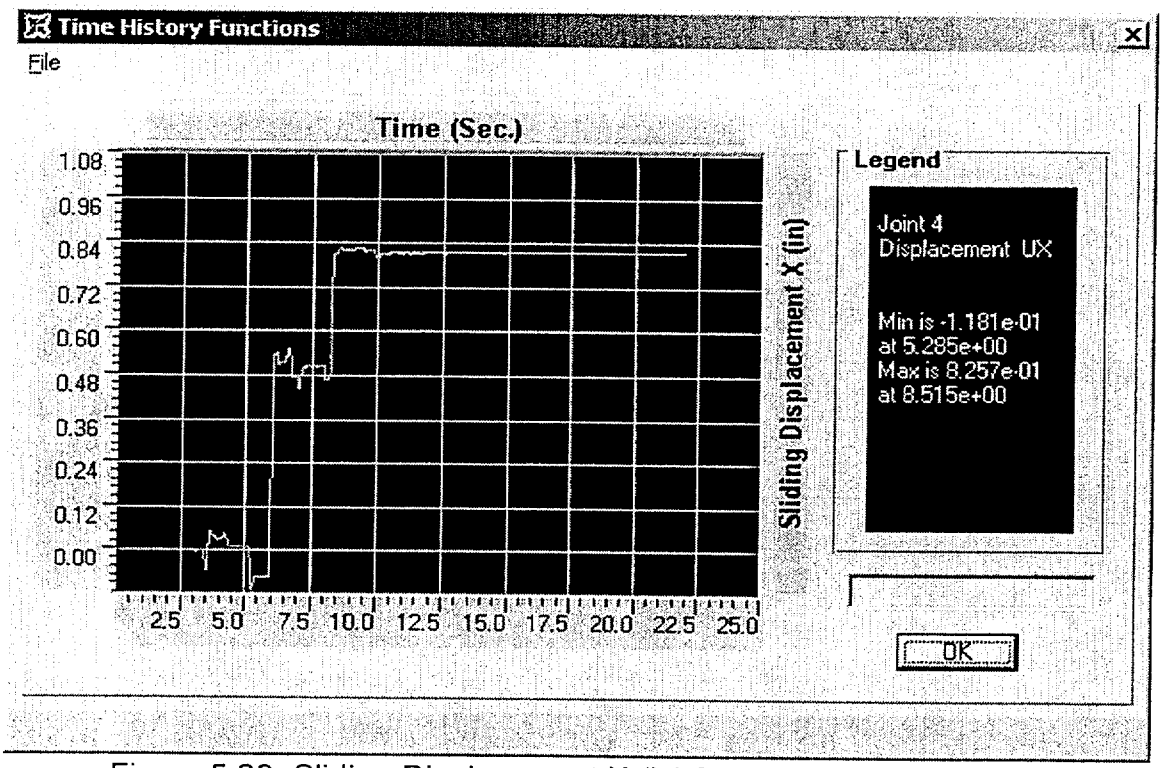


Figure 5.29: Sliding Displacement X (in) for ISFSI Set 3, $\mu$ = 0.73

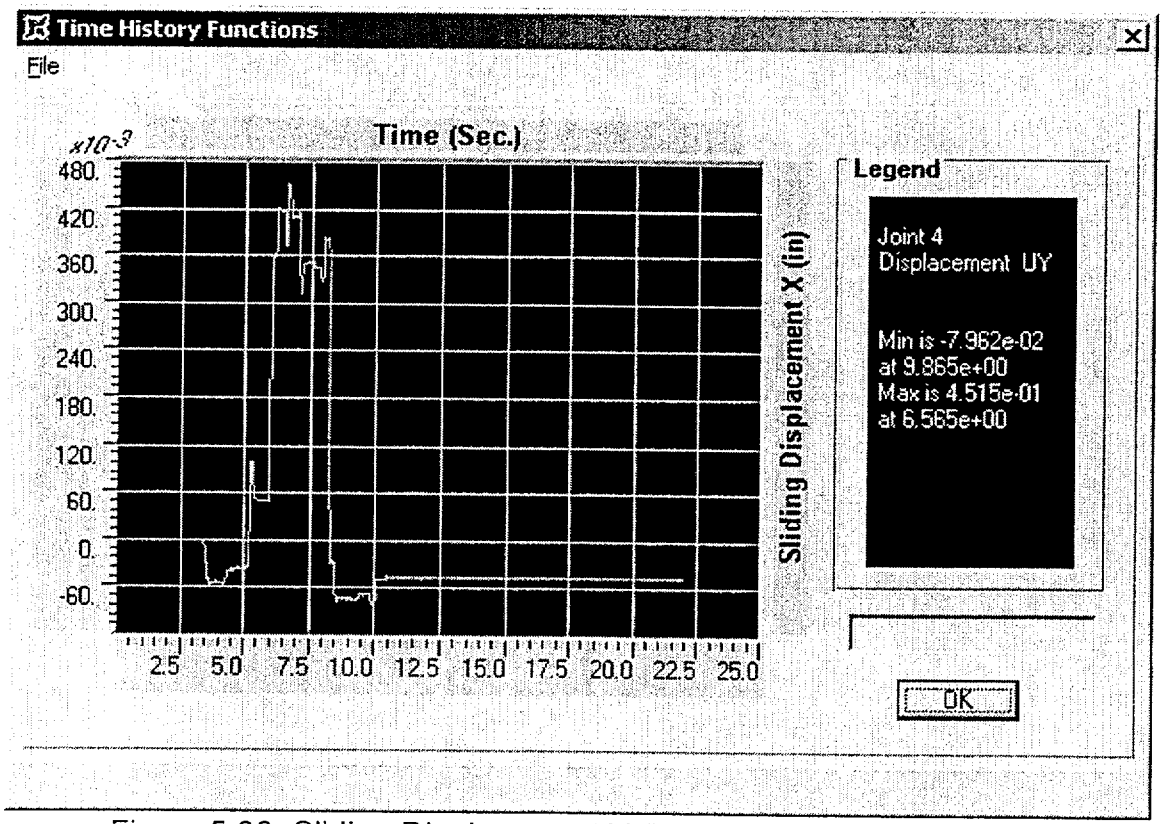


Figure 5.30: Sliding Displacement Y (in) for ISFSI Set 3, $\mu$ = 0.73

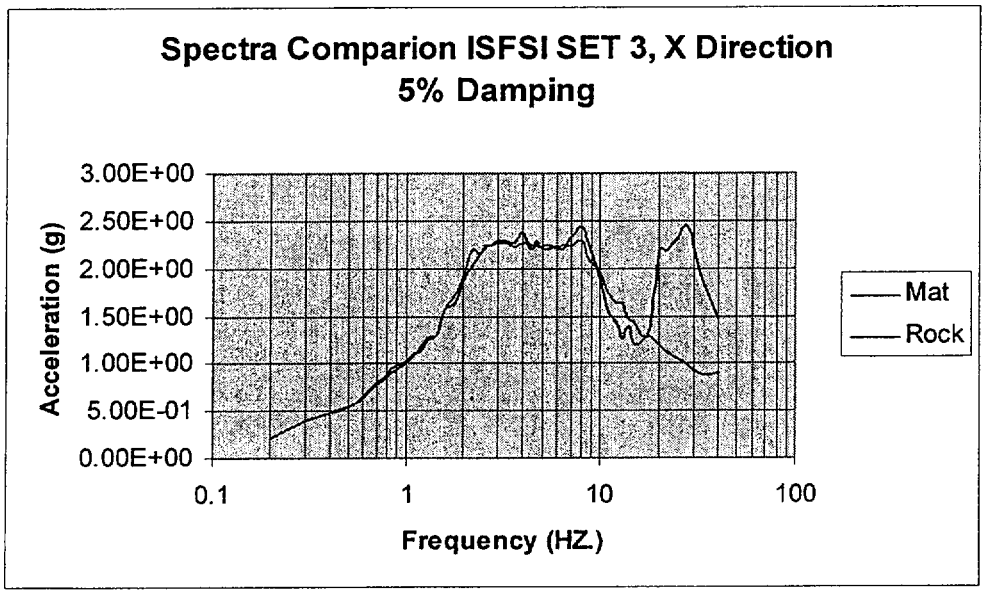


Figure 5.31: Spectra Comparison, X, ISFSI Set 3, 5% Damped, $\mu = 0.73$

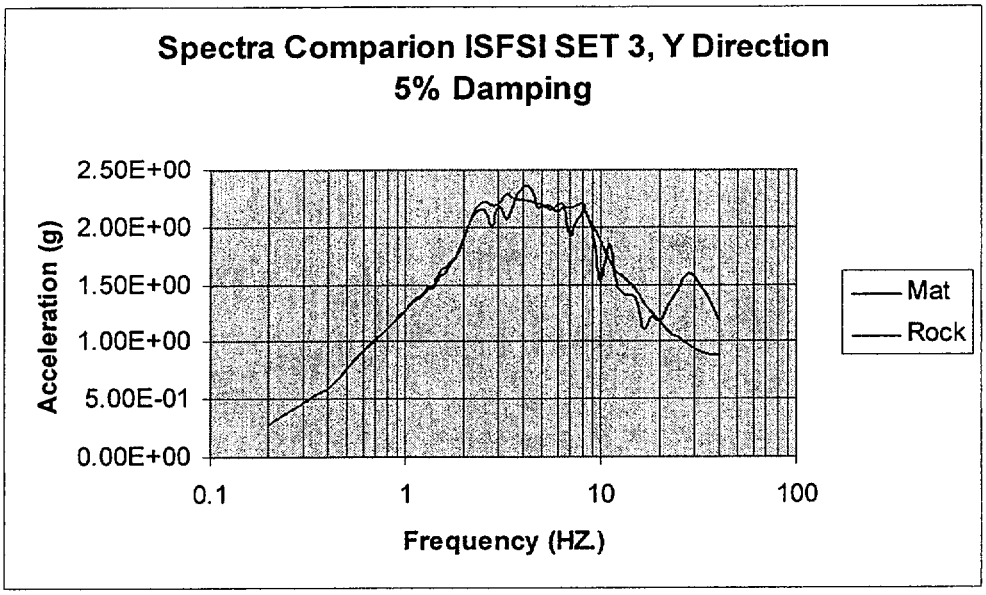


Figure 5.32: Spectra Comparison, Y, ISFSI Set 3, 5% Damped, $\mu = 0.73$

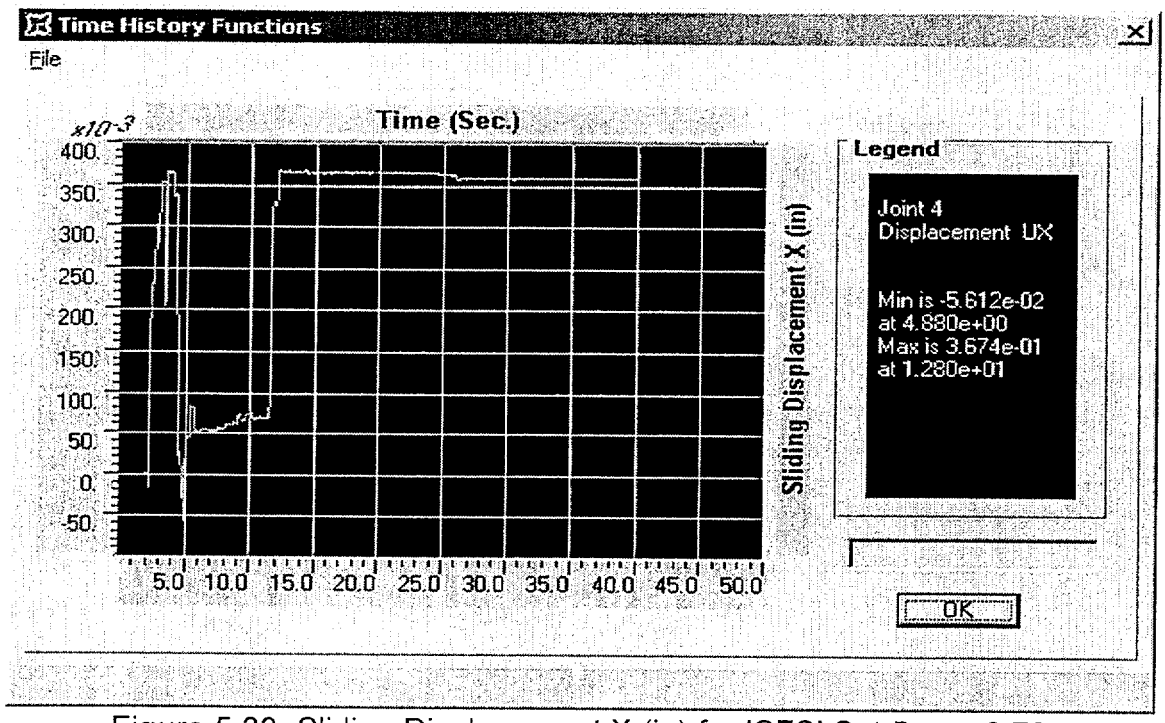


Figure 5.33: Sliding Displacement X (in) for ISFSI Set 5, $\mu$ = 0.73

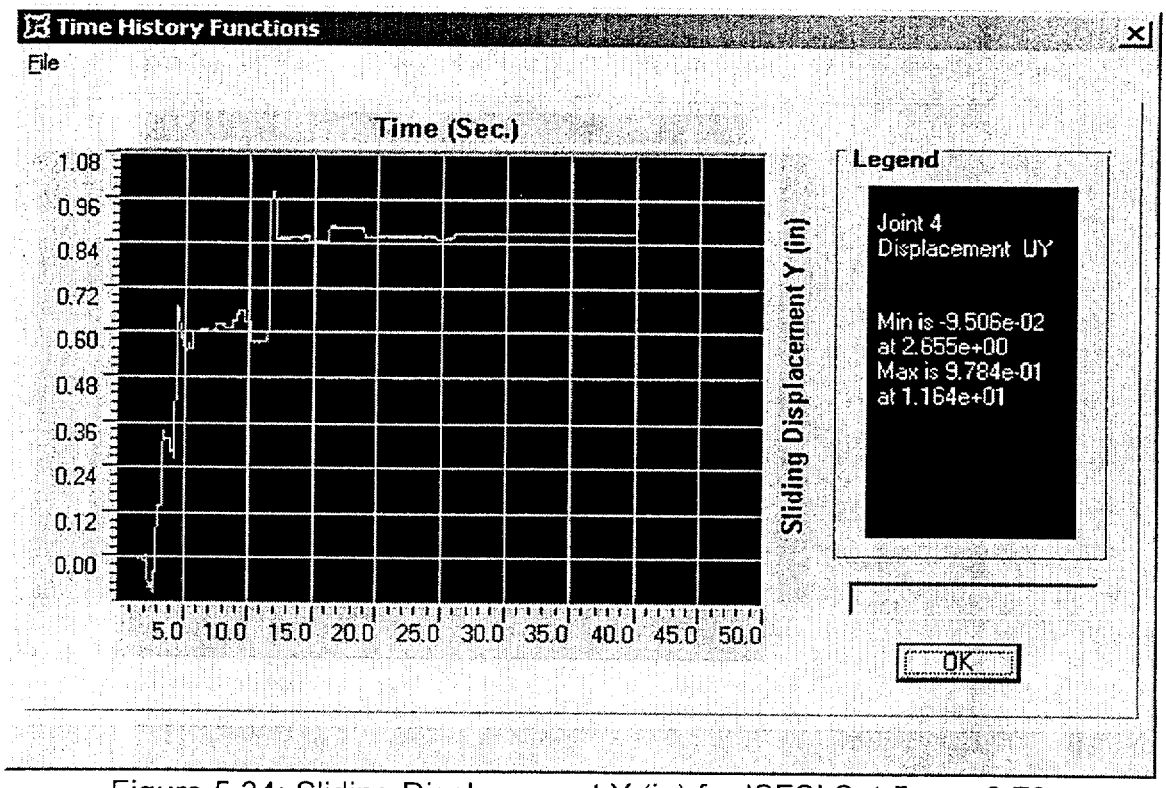


Figure 5.34: Sliding Displacement Y (in) for ISFSI Set 5, $\mu$ = 0.73

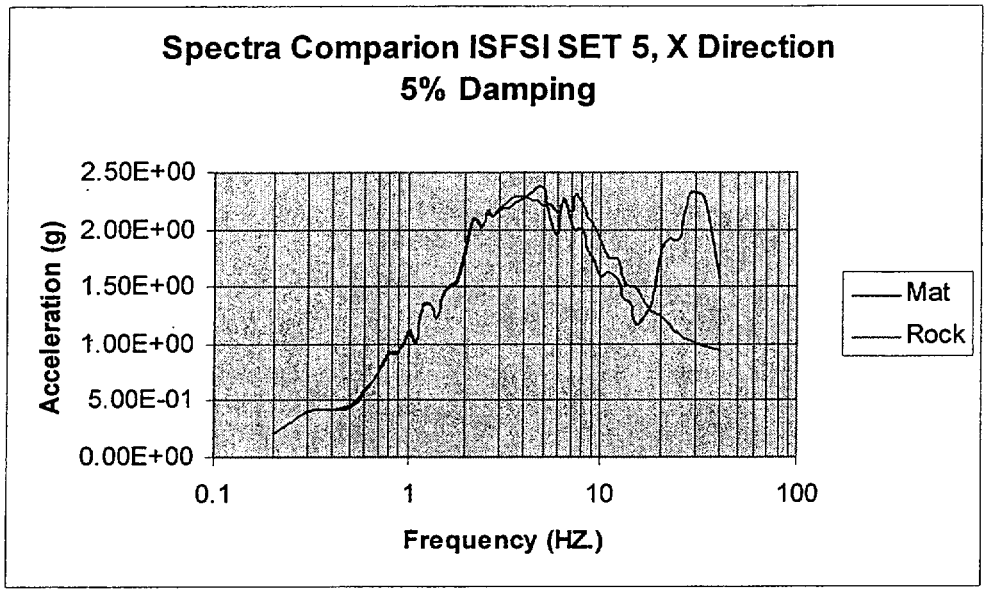


Figure 5.35: Spectra Comparison, X, ISFSI Set 5, 5% Damped, $\mu$ = 0.73

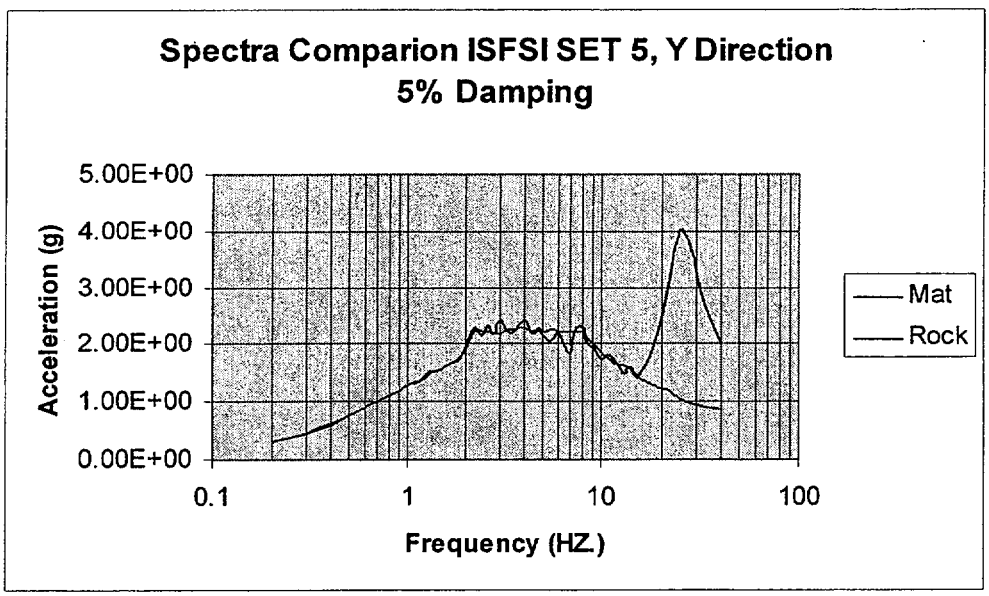


Figure 5.36: Spectra Comparison, Y, ISFSI Set 5, 5% Damped, $\mu$ = 0.73

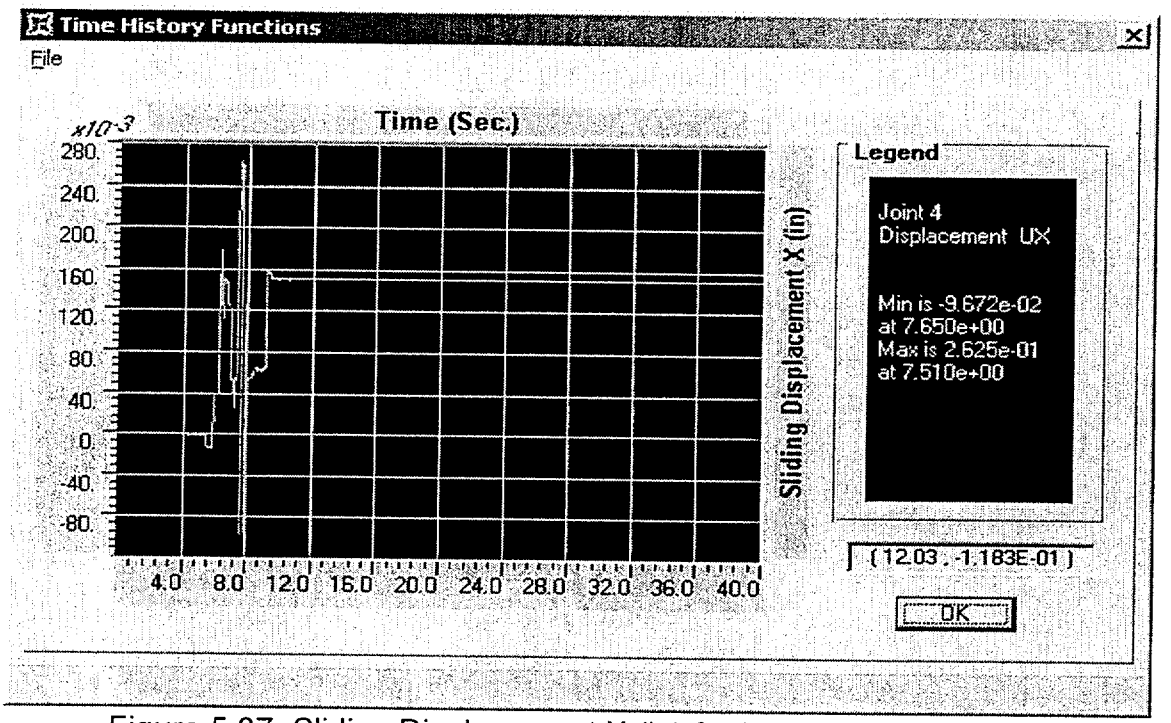


Figure 5.37: Sliding Displacement X (in) for ISFSI Set 6, $\mu$ = 0.73

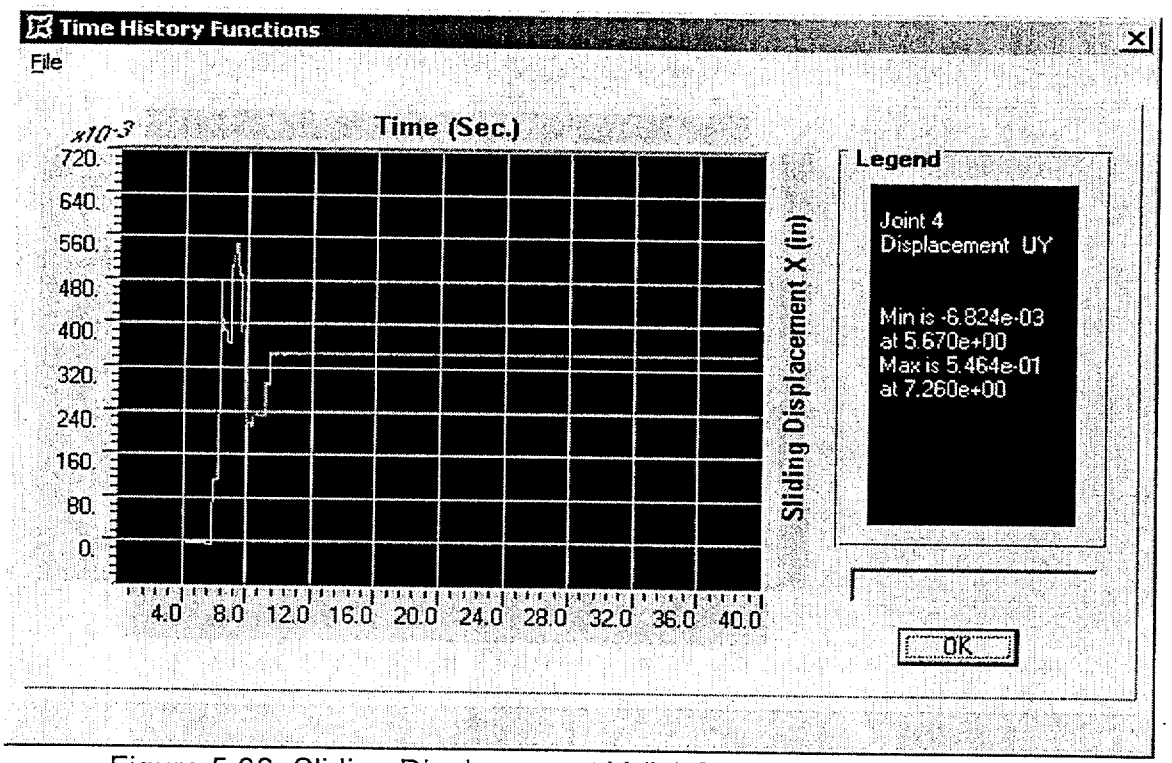


Figure 5.38: Sliding Displacement Y (in) for ISFSI Set 6, $\mu$ = 0.73

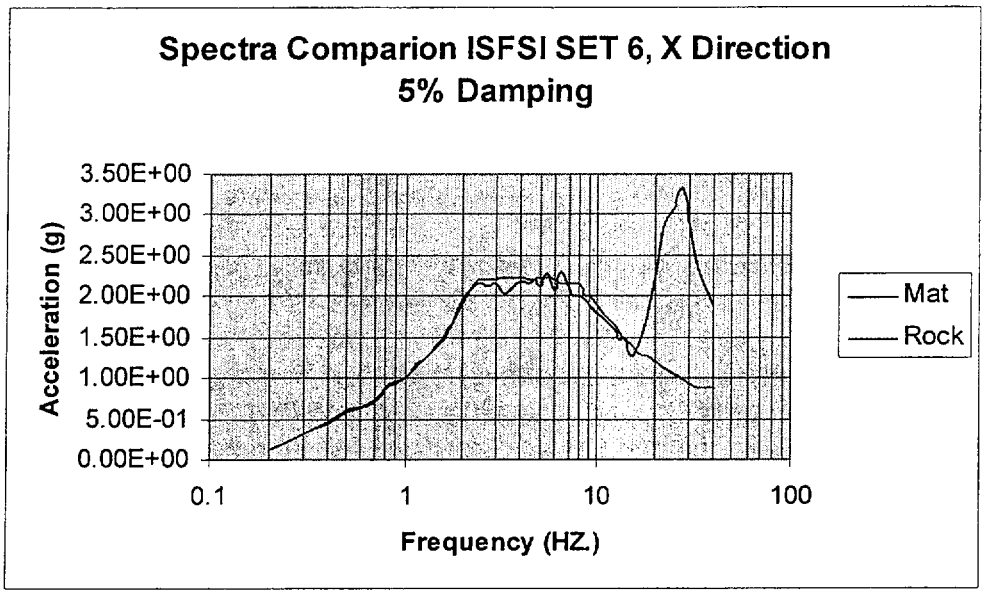


Figure 5.39: Spectra Comparison, X, ISFSI Set 6, 5% Damped, $\mu$ = 0.73

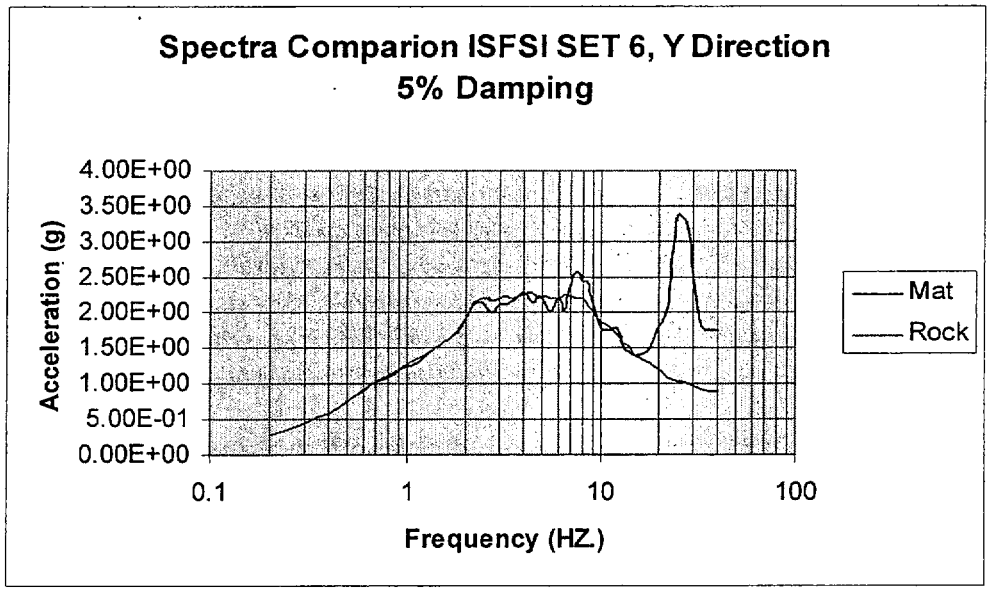


Figure 5.40: Spectra Comparison, Y, ISFSI Set 6, 5% Damped, $\mu$ = 0.73

## 6. CONCLUSIONS

Based on the results of these analyses, the following is concluded:

1. The best estimate of max. sliding for a lower bound friction coefficient of 0.73 corresponding to a rock friction angle of 36 degrees is estimated as 1.21".

2. The best estimate of max. sliding for an upper bound friction coefficient of 1.19 corresponding to a rock friction angle of 50 degrees is estimated as 0.41".

3. The above sliding displacements are considered small and not large enough to cause any damage to the mat or the casks. The acceptance criteria for mat sliding is defined as whether mat sliding results in increased design shears and moments for the casks and the mat, which is discussed further below.

4. After mat sliding is considered, it is concluded that design shear of 515 Kips remains valid for design. The best estimate of the adjustment factor to account for the effects of mat sliding is calculated as 0.95 for a friction coefficient of 1.19, and 0.90 for a friction coefficient of 0.73. Both of these ratios are below unity, as such the design shear of 515 Kips (and associated moments) remains valid for design.

5. The best estimate of max. axial tension load after sliding remains unchanged. Thus the design axial tensions as reported in Ref. 1 remain valid.

6. The response spectra comparison plots indicate that the motions generally do not vary up to about 16 Hz, however above this frequency some differences in the motion is seen as a result of sliding. The highest peak spectral ordinate associated with change in motion as a result of mat sliding is 4.1 g's at 5% critical damping. The cask designer, Holtec, has determined that these motions are well within the lateral design limit of the cask which is 45g's. This determination has been documented in Reference 8.

7. Given that the base shear (and therefore base moments) and axial tension do not change as a result of mat sliding, it is concluded that there is no need to repeat the analyses of Ref. 1, subject to these slightly altered motions.

## 7. REFERENCES

1. Analyses of Anchored HI-STORM Casks at the Diablo Canyon ISFSI, Holtec Report No. HI-2012618, Revision 4, dated 11/6/01.
2. Spectrum Compatible Acceleration Time Histories, PG&E Calculation 52.27.100.747, Rev. 0 (Geosciences' Calculation Package GEO.DCPP.01.37, Rev. 1).
3. Spectral Compatible Time Histories for ISFSI Sets 1, 2a, 3, 5, and 6, for Fault Parallel, Fault Normal, and Vertical, PG&E Calculation No. 52.27.100.723, Rev. 0 (Geosciences' Calculation Package GEO.DCPP.01.13, Rev. 1).
4. Spectral Compatible Time Histories for ISFSI Sets 1, 2a, 3, 5, and 6, for Fault Parallel Ground Motions with Fling, PG&E Calculation No. 52.27.100.724, Rev. 0 (Geosciences' Calculation Package GEO.DCPP.01.14, Rev. 1).
5. Standard Review Plan, Section 3.7.2, Rev. 2.
6. PG&E Calculation No. 52.27.100.714, Rev. 0.
7. NUREG 1536 – Standard Review Plan for Dry Cask Storage Systems, January 1997.
8. Holtec Document Transmittal Form (DTF), from Eric Lewis to Bruce Patton of PG&E, dated 11/6/2001.

# APPENDIX A
# COMPUTER INPUT FILES

Table A.1 below summarizes the SAP2000 input file names for each analysis case:

| Analysis Case Description | SAP2000N Model Name | Seismic Event | Direction of Vertical EQ | Coeff. of Friction (μ) | Page Numbers |
|---|---|---|---|---|---|
| Hosgri Fixed Base | HEFB | Hosgri | NA | NA | A1-1 to A1-2 |
| LTSP Fixed Base | LTSPFB | LTSP | NA | NA | A2-1 to A2-2 |
| Validation | Sx=0.5g,u=1.19 | Sine | NA | 1.19 | A3-1 to A3-36 |
| Validation | Sx=1.5g,u=1.19 | Sine | NA | 1.19 | A4-1 to A4-35 |
| Validation | Sy=0.5g,u=1.19 | Sine | NA | 1.19 | A5-1 to A5-35 |
| Validation | Sy=1.5g,u=1.19 | Sine | NA | 1.19 | A6-1 to A6-35 |
| Validation | Pure Slide,u=1.19 | Sine | NA | 1.19 | A7-1 to A7-35 |
| Seismic Case 1 | ISFSI Set 1,u=1.19 | ISFSI | +Z | 1.19 | A8-1 to A8-2 |
| Seismic Case 2 | ISFSI Set 2a,u=1.19 | ISFSI | +Z | 1.19 | A9-1 to A9-2 |
| Seismic Case 3 | ISFSI Set 3,u=1.19 | ISFSI | +Z | 1.19 | A10-1 to A10-2 |
| Seismic Case 4 | ISFSI Set 5,u=1.19 | ISFSI | +Z | 1.19 | A11-1 to A11-2 |
| Seismic Case 5 | ISFSI Set 6,u=1.19 | ISFSI | +Z | 1.19 | A12-1 to A12-2 |
| Seismic Case 6 | ISFSI Set 1,u=0.73 | ISFSI | +Z | 0.73 | A13-1 to A13-2 |
| Seismic Case 7 | ISFSI Set 2a,u=0.73 | ISFSI | +Z | 0.73 | A14-1 to A14-2 |
| Seismic Case 8 | ISFSI Set 3,u=0.73 | ISFSI | +Z | 0.73 | A15-1 to A15-2 |
| Seismic Case 9 | ISFSI Set 5,u=0.73 | ISFSI | +Z | 0.73 | A16-1 to A16-2 |
| Seismic Case 10 | ISFSI Set 6,u=0.73 | ISFSI | +Z | 0.73 | A17-1 to A17-2 |
| | | | | | |
| Total Pages | | | | | 200 |
| Total Pages Including this page | | | | | 201 |

Table A.1: Summary of Analyses Cases and S2K Input File Names

```
DCPP ISFSI PAD SLIDING (FB - Hosgri)

; File C:\DATA\SAP2000N\Pad sliding\FB\HeFB.s2k saved 11/16/01 8:06:14 in Kip-in

SYSTEM
  DOF=UX,UY,UZ,RX,RY,RZ  LENGTH=IN  FORCE=Kip  LINES=56

JOINT
  1  X=0  Y=0  Z=0
  2  X=0  Y=0  Z=118.5

RESTRAINT
  ADD=1  DOF=U1,U2,U3,R1,R2,R3

PATTERN
  NAME=DEFAULT

MASS
  ADD=2  U1=18.63354  U2=18.63354  U3=18.63354

MATERIAL
  NAME=STEEL  IDES=S  M=7.324016E-07  W=.000283
    T=0  E=29000  U=.3  A=.0000065  FY=36
  NAME=CONC  IDES=C  M=2.246377E-07  W=.0000868
    T=0  E=3600  U=.2  A=.0000055
  NAME=CASKSTL  IDES=S
    T=0  E=29000  U=.3  A=.0000065  FY=36

FRAME SECTION
  NAME=FESC1 MAT=STEEL SH=R T=100,100 A=10000 J=1.408333E+07 I=8333334,8333334
AS=8333.333,8333.333
  NAME=CASK MAT=CASKSTL A=2580.5 J=1000000 I=3557015,3557015 AS=1000000,1000000
S=1,1 Z=1,1 R=1,1 T=18,10

FRAME
  1  J=1,2  SEC=CASK  NSEG=2  ANG=0

LOAD
  NAME=GRAVITY  SW=1

MODE
  TYPE=EIGEN  N=6  TOL=.00001

FUNCTION
  NAME=HX DT=.005 NPL=8 PRINT=Y FILE=hehor1.ath
  NAME=HY DT=.005 NPL=8 PRINT=Y FILE=hehor2.ath
  NAME=V DT=.005 NPL=8 PRINT=Y FILE=hevert.ath

HISTORY
  NAME=SEISMIC TYPE=LIN NSTEP=9625 DT=.005 DAMP=.04
    ACC=U1  ANG=0 FUNC=HX SF=386.4 AT=0
    ACC=U2  ANG=0 FUNC=HY SF=386.4 AT=0
    ACC=U3 FUNC=V SF=386.4 AT=0

OUTPUT
; No Output Requested

END
```

```
; The following data is used for graphics, design and pushover analysis.
; If changes are made to the analysis data above, then the following data
; should be checked for consistency.
SAP2000 V7.10 SUPPLEMENTAL DATA
  GRID GLOBAL  X "1"  -50.375
  GRID GLOBAL  X "2"  0
  GRID GLOBAL  X "3"  50.375
  GRID GLOBAL  Y "4"  0
  GRID GLOBAL  Z "5"  -90
  GRID GLOBAL  Z "6"  0
  GRID GLOBAL  Z "7"  118.5
  MATERIAL STEEL FY 36
  MATERIAL CASKSTL FY 36
  MATERIAL CONC FYREBAR 60 FYSHEAR 40 FC 4 FCSHEAR 4
  STATICLOAD GRAVITY TYPE DEAD
END SUPPLEMENTAL DATA
```

Calculation No. 52.27.100.704, Rev. 0 ISFSI Pad Seismic Sliding
Analysis - Input File
Appendix A, Page A1-2

Calculation No. 52.27.100.704, Rev. 0 ISFSI Pad Seismic Sliding
Analyses - Input File
Appendix A, Page A1-2

```
DCPP ISFSI Pad Seismic Sliding Analyses (FB - LTSP)

; File C:\DATA\SAP2000N\Pad sliding\FB\LTSPFB.s2k saved 11/16/01 8:37:16 in Kip-
in

SYSTEM
  DOF=UX,UY,UZ,RX,RY,RZ  LENGTH=IN  FORCE=Kip  LINES=56

JOINT
  1  X=0  Y=0  Z=0
  2  X=0  Y=0  Z=118.5

RESTRAINT
  ADD=1  DOF=U1,U2,U3,R1,R2,R3

PATTERN
  NAME=DEFAULT

MASS
  ADD=2  U1=18.63354  U2=18.63354  U3=18.63354

MATERIAL
  NAME=STEEL  IDES=S  M=7.324016E-07  W=.000283
    T=0  E=29000  U=.3  A=.0000065  FY=36
  NAME=CONC  IDES=C  M=2.246377E-07  W=.0000868
    T=0  E=3600  U=.2  A=.0000055
  NAME=CASKSTL  IDES=S
    T=0  E=29000  U=.3  A=.0000065  FY=36

FRAME SECTION
  NAME=FESC1 MAT=STEEL SH=R T=100,100 A=10000 J=1.408333E+07 I=8333334,8333334
AS=8333.333,8333.333
  NAME=CASK MAT=CASKSTL A=2580.5 J=1000000 I=3557015,3557015 AS=1000000,1000000
S=1,1 Z=1,1 R=1,1 T=18,10

FRAME
  1  J=1,2  SEC=CASK  NSEG=2  ANG=0

LOAD
  NAME=GRAVITY  SW=1

MODE
  TYPE=EIGEN  N=6  TOL=.00001

FUNCTION
  NAME=HX DT=.005 NPL=8 PRINT=Y FILE=lthor1.ath
  NAME=HY DT=.005 NPL=8 PRINT=Y FILE=lthor2.ath
  NAME=V DT=.005 NPL=8 PRINT=Y FILE=ltvert.ath

HISTORY
  NAME=SEISMIC TYPE=LIN NSTEP=9625 DT=.005 DAMP=.05
    ACC=U1  ANG=0 FUNC=HX SF=386.4 AT=0
    ACC=U2  ANG=0 FUNC=HY SF=386.4 AT=0
    ACC=U3 FUNC=V SF=386.4 AT=0

OUTPUT
; No Output Requested

END
```

```
; The following data is used for graphics, design and pushover analysis.
; If changes are made to the analysis data above, then the following data
; should be checked for consistency.
SAP2000 V7.10 SUPPLEMENTAL DATA
  GRID GLOBAL  X "1"  -50.375
  GRID GLOBAL  X "2"  0
  GRID GLOBAL  X "3"  50.375
  GRID GLOBAL  Y "4"  0
  GRID GLOBAL  Z "5"  -90
  GRID GLOBAL  Z "6"  0
  GRID GLOBAL  Z "7"  118.5
  MATERIAL STEEL FY 36
  MATERIAL CASKSTL FY 36
  MATERIAL CONC FYREBAR 60 FYSHEAR 40 FC 4 FCSHEAR 4
  STATICLOAD GRAVITY TYPE DEAD
END SUPPLEMENTAL DATA
```

```
ISFSI Pad Seismic Sliding Analysis (V&V - Sx=0.5g, u=1.19)

; File C:\DATA\SAP2000N\Pad sliding\Verif\Sx=0.5g, u=1.19.s2k saved 11/16/01
8:59:22 in Kip-in

SYSTEM
  DOF=UX,UY,UZ,RX,RY,RZ  LENGTH=IN  FORCE=Kip  LINES=56

JOINT
  1  X=0  Y=0  Z=118.5
  4  X=0  Y=0  Z=0

RESTRAINT
  ADD=4  DOF=R1,R2,R3

PATTERN
  NAME=DEFAULT

MASS
  ADD=4  U1=20.704  U2=20.704  U3=20.704
  ADD=1  U1=18.63354  U2=18.63354  U3=18.63354

MATERIAL
  NAME=STEEL  IDES=S
    T=0  E=29000  U=.3  A=.0000065  FY=36
  NAME=CONC  IDES=C  M=2.246377E-07  W=.0000868
    T=0  E=3600  U=.2  A=.0000055
  NAME=RIGID  IDES=N
    T=0  E=16000  U=.2  A=0

FRAME SECTION
  NAME=FSEC1 MAT=STEEL SH=R T=18,10 A=180 J=3916.671 I=4860,1500 AS=150,150
  NAME=CASK MAT=STEEL A=30059.1 J=1E+07 I=3557015,3557015 AS=1E+07,1E+07 S=1,1
Z=1,1 R=1,1 T=18,10

NLPROP
  NAME=CONTACT    TYPE=Isolator2  M=.168  W=65
    DOF=U1  KE=1E+08  CE=0  K=1E+08
    DOF=U2  KE=1E+07  CE=0  K=1E+07  FRICT=1.19,1.19
    DOF=U3  KE=1E+07  CE=0  K=1E+07  FRICT=1.19,1.19

FRAME
  1  J=1,4  SEC=CASK  NSEG=2  ANG=0

NLLINK
  1  J=4  NLP=CONTACT  ANG=0  AXDIR=+Z

LOAD
  NAME=GRAVITY  SW=1
    TYPE=FORCE
      ADD=4  UZ=-8000
      ADD=1  UZ=-7200

MODE
  TYPE=RITZ  N=12
    ACC=UX
    ACC=UZ
    LOAD=GRAVITY
    NLLINK=*
```

```
FUNCTION
  NAME=RAMP5 NPL=1 PRINT=Y
    0 0
    5 1
  NAME=SINE NPL=1 PRINT=Y
    0 0
    .01 .309
    .02 .588
    .03 .809
    .04 .951
    .05 1
    .06 .951
    .07 .809
    .08 .588
    .09 .309
    .1 0
    .11 -.309
    .12 -.588
    .13 -.809
    .14 -.951
    .15 -1
    .16 -.951
    .17 -.809
    .18 -.588
    .19 -.309
    .2 0
    .21 .309
    .22 .588
    .23 .809
    .24 .951
    .25 1
    .26 .951
    .27 .809
    .28 .588
    .29 .309
    .3 0
    .31 -.309
    .32 -.588
    .33 -.809
    .34 -.951
    .35 -1
    .36 -.951
    .37 -.809
    .38 -.588
    .39 -.309
    .4 0
    .41 .309
    .42 .588
    .43 .809
    .44 .951
    .45 1
    .46 .951
    .47 .809
    .48 .588
    .49 .309
    .5 0
    .51 -.309
    .52 -.588
```

```
.53 -.809
.54 -.951
.55 -1
.56 -.951
.57 -.809
.58 -.588
.59 -.309
.6 0
.61 .309
.62 .588
.63 .809
.64 .951
.65 1
.66 .951
.67 .809
.68 .588
.69 .309
.7 0
.71 -.309
.72 -.588
.73 -.809
.74 -.951
.75 -1
.76 -.951
.77 -.809
.78 -.588
.79 -.309
.8 0
.81 .309
.82 .588
.83 .809
.84 .951
.85 1
.86 .951
.87 .809
.88 .588
.89 .309
.9 0
.91 -.309
.92 -.588
.93 -.809
.94 -.951
.95 -1
.96 -.951
.97 -.809
.98 -.588
.99 -.309
1 0
1.01 .309
1.02 .588
1.03 .809
1.04 .951
1.05 1
1.06 .951
1.07 .809
1.08 .588
1.09 .309
1.1 0
1.11 -.309
```

```
1.12 -.588
1.13 -.809
1.14 -.951
1.15 -1
1.16 -.951
1.17 -.809
1.18 -.588
1.19 -.309
1.2 0
1.21 .309
1.22 .588
1.23 .809
1.24 .951
1.25 1
1.26 .951
1.27 .809
1.28 .588
1.29 .309
1.3 0
1.31 -.309
1.32 -.588
1.33 -.809
1.34 -.951
1.35 -1
1.36 -.951
1.37 -.809
1.38 -.588
1.39 -.309
1.4 0
1.41 .309
1.42 .588
1.43 .809
1.44 .951
1.45 1
1.46 .951
1.47 .809
1.48 .588
1.49 .309
1.5 0
1.51 -.309
1.52 -.588
1.53 -.809
1.54 -.951
1.55 -1
1.56 -.951
1.57 -.809
1.58 -.588
1.59 -.309
1.6 0
1.61 .309
1.62 .588
1.63 .809
1.64 .951
1.65 1
1.66 .951
1.67 .809
1.68 .588
1.69 .309
1.7 0
```

```
1.71 -.309
1.72 -.588
1.73 -.809
1.74 -.951
1.75 -1
1.76 -.951
1.77 -.809
1.78 -.588
1.79 -.309
1.8 0
1.81 .309
1.82 .588
1.83 .809
1.84 .951
1.85 1
1.86 .951
1.87 .809
1.88 .588
1.89 .309
1.9 0
1.91 -.309
1.92 -.588
1.93 -.809
1.94 -.951
1.95 -1
1.96 -.951
1.97 -.809
1.98 -.588
1.99 -.309
2 0
2.01 .309
2.02 .588
2.03 .809
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13.05 1
13.06 .951
13.07 .809
13.08 .588
13.09 .309
13.1 -5.37E-08
13.11 -.309
13.12 -.588
13.13 -.809
13.14 -.951
13.15 -1
13.16 -.951
13.17 -.809
13.18 -.588
13.19 -.309
13.2 5.41E-08
13.21 .309
13.22 .588
13.23 .809
13.24 .951
13.25 1
13.26 .951
13.27 .809
13.28 .588
13.29 .309
13.3 -5.46E-08
13.31 -.309
13.32 -.588
13.33 -.809
13.34 -.951
13.35 -1
13.36 -.951
13.37 -.809
13.38 -.588
13.39 -.309
13.4 5.5E-08
13.41 .309
13.42 .588
13.43 .809
13.44 .951
13.45 1
13.46 .951
13.47 .809
13.48 .588
13.49 .309
13.5 -5.54E-08
```

```
13.51 -.309
13.52 -.588
13.53 -.809
13.54 -.951
13.55 -1
13.56 -.951
13.57 -.809
13.58 -.588
13.59 -.309
13.6 5.58E-08
13.61 .309
13.62 .588
13.63 .809
13.64 .951
13.65 1
13.66 .951
13.67 .809
13.68 .588
13.69 .309
13.7 -5.62E-08
13.71 -.309
13.72 -.588
13.73 -.809
13.74 -.951
13.75 -1
13.76 -.951
13.77 -.809
13.78 -.588
13.79 -.309
13.8 5.66E-08
13.81 .309
13.82 .588
13.83 .809
13.84 .951
13.85 1
13.86 .951
13.87 .809
13.88 .588
13.89 .309
13.9 -5.7E-08
13.91 -.309
13.92 -.588
13.93 -.809
13.94 -.951
13.95 -1
13.96 -.951
13.97 -.809
13.98 -.588
13.99 -.309
14 5.74E-08
14.01 .309
14.02 .588
14.03 .809
14.04 .951
14.05 1
14.06 .951
14.07 .809
14.08 .588
14.09 .309
```

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14.1 -5.78E-08
14.11 -.309
14.12 -.588
14.13 -.809
14.14 -.951
14.15 -1
14.16 -.951
14.17 -.809
14.18 -.588
14.19 -.309
14.2 5.82E-08
14.21 .309
14.22 .588
14.23 .809
14.24 .951
14.25 1
14.26 .951
14.27 .809
14.28 .588
14.29 .309
14.3 -5.87E-08
14.31 -.309
14.32 -.588
14.33 -.809
14.34 -.951
14.35 -1
14.36 -.951
14.37 -.809
14.38 -.588
14.39 -.309
14.4 5.91E-08
14.41 .309
14.42 .588
14.43 .809
14.44 .951
14.45 1
14.46 .951
14.47 .809
14.48 .588
14.49 .309
14.5 -5.95E-08
14.51 -.309
14.52 -.588
14.53 -.809
14.54 -.951
14.55 -1
14.56 -.951
14.57 -.809
14.58 -.588
14.59 -.309
14.6 5.99E-08
14.61 .309
14.62 .588
14.63 .809
14.64 .951
14.65 1
14.66 .951
14.67 .809
14.68 .588
```

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14.69 .309
14.7 -6.03E-08
14.71 -.309
14.72 -.588
14.73 -.809
14.74 -.951
14.75 -1
14.76 -.951
14.77 -.809
14.78 -.588
14.79 -.309
14.8 6.07E-08
14.81 .309
14.82 .588
14.83 .809
14.84 .951
14.85 1
14.86 .951
14.87 .809
14.88 .588
14.89 .309
14.9 -6.11E-08
14.91 -.309
14.92 -.588
14.93 -.809
14.94 -.951
14.95 -1
14.96 -.951
14.97 -.809
14.98 -.588
14.99 -.309
15 6.15E-08
15.01 .309
15.02 .588
15.03 .809
15.04 .951
15.05 1
15.06 .951
15.07 .809
15.08 .588
15.09 .309
15.1 -6.19E-08
15.11 -.309
15.12 -.588
15.13 -.809
15.14 -.951
15.15 -1
15.16 -.951
15.17 -.809
15.18 -.588
15.19 -.309
15.2 6.23E-08
15.21 .309
15.22 .588
15.23 .809
15.24 .951
15.25 1
15.26 .951
15.27 .809
```

```
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15.29 .309
15.3 -6.28E-08
15.31 -.309
15.32 -.588
15.33 -.809
15.34 -.951
15.35 -1
15.36 -.951
15.37 -.809
15.38 -.588
15.39 -.309
15.4 6.32E-08
15.41 .309
15.42 .588
15.43 .809
15.44 .951
15.45 1
15.46 .951
15.47 .809
15.48 .588
15.49 .309
15.5 -6.36E-08
15.51 -.309
15.52 -.588
15.53 -.809
15.54 -.951
15.55 -1
15.56 -.951
15.57 -.809
15.58 -.588
15.59 -.309
15.6 6.4E-08
15.61 .309
15.62 .588
15.63 .809
15.64 .951
15.65 1
15.66 .951
15.67 .809
15.68 .588
15.69 .309
15.7 -6.44E-08
15.71 -.309
15.72 -.588
15.73 -.809
15.74 -.951
15.75 -1
15.76 -.951
15.77 -.809
15.78 -.588
15.79 -.309
15.8 6.48E-08
15.81 .309
15.82 .588
15.83 .809
15.84 .951
15.85 1
15.86 .951
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15.88 .588
15.89 .309
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15.92 -.588
15.93 -.809
15.94 -.951
15.95 -1
15.96 -.951
15.97 -.809
15.98 -.588
15.99 -.309
16 6.56E-08
16.01 .309
16.02 .588
16.03 .809
16.04 .951
16.05 1
16.06 .951
16.07 .809
16.08 .588
16.09 .309
16.1 -6.6E-08
16.11 -.309
16.12 -.588
16.13 -.809
16.14 -.951
16.15 -1
16.16 -.951
16.17 -.809
16.18 -.588
16.19 -.309
16.2 6.64E-08
16.21 .309
16.22 .588
16.23 .809
16.24 .951
16.25 1
16.26 .951
16.27 .809
16.28 .588
16.29 .309
16.3 -6.69E-08
16.31 -.309
16.32 -.588
16.33 -.809
16.34 -.951
16.35 -1
16.36 -.951
16.37 -.809
16.38 -.588
16.39 -.309
16.4 6.73E-08
16.41 .309
16.42 .588
16.43 .809
16.44 .951
16.45 1
```

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16.46 .951
16.47 .809
16.48 .588
16.49 .309
16.5 -6.77E-08
16.51 -.309
16.52 -.588
16.53 -.809
16.54 -.951
16.55 -1
16.56 -.951
16.57 -.809
16.58 -.588
16.59 -.309
16.6 6.81E-08
16.61 .309
16.62 .588
16.63 .809
16.64 .951
16.65 1
16.66 .951
16.67 .809
16.68 .588
16.69 .309
16.7 -6.85E-08
16.71 -.309
16.72 -.588
16.73 -.809
16.74 -.951
16.75 -1
16.76 -.951
16.77 -.809
16.78 -.588
16.79 -.309
16.8 6.89E-08
16.81 .309
16.82 .588
16.83 .809
16.84 .951
16.85 1
16.86 .951
16.87 .809
16.88 .588
16.89 .309
16.9 -6.93E-08
16.91 -.309
16.92 -.588
16.93 -.809
16.94 -.951
16.95 -1
16.96 -.951
16.97 -.809
16.98 -.588
16.99 -.309
17 6.97E-08
17.01 .309
17.02 .588
17.03 .809
17.04 .951
```

```
17.05 1
17.06 .951
17.07 .809
17.08 .588
17.09 .309
17.1 -7.01E-08
17.11 -.309
17.12 -.588
17.13 -.809
17.14 -.951
17.15 -1
17.16 -.951
17.17 -.809
17.18 -.588
17.19 -.309
17.2 7.06E-08
17.21 .309
17.22 .588
17.23 .809
17.24 .951
17.25 1
17.26 .951
17.27 .809
17.28 .588
17.29 .309
17.3 -7.1E-08
17.31 -.309
17.32 -.588
17.33 -.809
17.34 -.951
17.35 -1
17.36 -.951
17.37 -.809
17.38 -.588
17.39 -.309
17.4 7.14E-08
17.41 .309
17.42 .588
17.43 .809
17.44 .951
17.45 1
17.46 .951
17.47 .809
17.48 .588
17.49 .309
17.5 -7.18E-08
17.51 -.309
17.52 -.588
17.53 -.809
17.54 -.951
17.55 -1
17.56 -.951
17.57 -.809
17.58 -.588
17.59 -.309
17.6 7.22E-08
17.61 .309
17.62 .588
17.63 .809
```

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17.64 .951
17.65 1
17.66 .951
17.67 .809
17.68 .588
17.69 .309
17.7 -7.26E-08
17.71 -.309
17.72 -.588
17.73 -.809
17.74 -.951
17.75 -1
17.76 -.951
17.77 -.809
17.78 -.588
17.79 -.309
17.8 7.3E-08
17.81 .309
17.82 .588
17.83 .809
17.84 .951
17.85 1
17.86 .951
17.87 .809
17.88 .588
17.89 .309
17.9 -7.34E-08
17.91 -.309
17.92 -.588
17.93 -.809
17.94 -.951
17.95 -1
17.96 -.951
17.97 -.809
17.98 -.588
17.99 -.309
18 7.38E-08
18.01 .309
18.02 .588
18.03 .809
18.04 .951
18.05 1
18.06 .951
18.07 .809
18.08 .588
18.09 .309
18.1 -7.42E-08
18.11 -.309
18.12 -.588
18.13 -.809
18.14 -.951
18.15 -1
18.16 -.951
18.17 -.809
18.18 -.588
18.19 -.309
18.2 7.47E-08
18.21 .309
18.22 .588
```

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18.23 .809
18.24 .951
18.25 1
18.26 .951
18.27 .809
18.28 .588
18.29 .309
18.3 -7.51E-08
18.31 -.309
18.32 -.588
18.33 -.809
18.34 -.951
18.35 -1
18.36 -.951
18.37 -.809
18.38 -.588
18.39 -.309
18.4 7.55E-08
18.41 .309
18.42 .588
18.43 .809
18.44 .951
18.45 1
18.46 .951
18.47 .809
18.48 .588
18.49 .309
18.5 -7.59E-08
18.51 -.309
18.52 -.588
18.53 -.809
18.54 -.951
18.55 -1
18.56 -.951
18.57 -.809
18.58 -.588
18.59 -.309
18.6 7.63E-08
18.61 .309
18.62 .588
18.63 .809
18.64 .951
18.65 1
18.66 .951
18.67 .809
18.68 .588
18.69 .309
18.7 -7.67E-08
18.71 -.309
18.72 -.588
18.73 -.809
18.74 -.951
18.75 -1
18.76 -.951
18.77 -.809
18.78 -.588
18.79 -.309
18.8 7.71E-08
18.81 .309
```

```
18.82 .588
18.83 .809
18.84 .951
18.85 1
18.86 .951
18.87 .809
18.88 .588
18.89 .309
18.9 -7.75E-08
18.91 -.309
18.92 -.588
18.93 -.809
18.94 -.951
18.95 -1
18.96 -.951
18.97 -.809
18.98 -.588
18.99 -.309
19 7.79E-08
19.01 .309
19.02 .588
19.03 .809
19.04 .951
19.05 1
19.06 .951
19.07 .809
19.08 .588
19.09 .309
19.1 -7.84E-08
19.11 -.309
19.12 -.588
19.13 -.809
19.14 -.951
19.15 -1
19.16 -.951
19.17 -.809
19.18 -.588
19.19 -.309
19.2 7.88E-08
19.21 .309
19.22 .588
19.23 .809
19.24 .951
19.25 1
19.26 .951
19.27 .809
19.28 .588
19.29 .309
19.3 -7.92E-08
19.31 -.309
19.32 -.588
19.33 -.809
19.34 -.951
19.35 -1
19.36 -.951
19.37 -.809
19.38 -.588
19.39 -.309
19.4 7.96E-08
```

```
19.41 .309
19.42 .588
19.43 .809
19.44 .951
19.45 1
19.46 .951
19.47 .809
19.48 .588
19.49 .309
19.5 -8E-08
19.51 -.309
19.52 -.588
19.53 -.809
19.54 -.951
19.55 -1
19.56 -.951
19.57 -.809
19.58 -.588
19.59 -.309
19.6 8.04E-08
19.61 .309
19.62 .588
19.63 .809
19.64 .951
19.65 1
19.66 .951
19.67 .809
19.68 .588
19.69 .309
19.7 -8.08E-08
19.71 -.309
19.72 -.588
19.73 -.809
19.74 -.951
19.75 -1
19.76 -.951
19.77 -.809
19.78 -.588
19.79 -.309
19.8 8.12E-08
19.81 .309
19.82 .588
19.83 .809
19.84 .951
19.85 1
19.86 .951
19.87 .809
19.88 .588
19.89 .309
19.9 -8.16E-08
19.91 -.309
19.92 -.588
19.93 -.809
19.94 -.951
19.95 -1
19.96 -.951
19.97 -.809
19.98 -.588
19.99 -.309
```

```
   20 8.21E-08

HISTORY
  NAME=GRAVITY TYPE=NON NSTEP=10 DT=1 DAMP=.99
    LOAD=GRAVITY FUNC=RAMP5 SF=1 AT=0
  NAME=SINE TYPE=NON NSTEP=1000 DT=.005 DAMP=0 PREV=GRAVITY
    MODE=1 DAMP=.05
    MODE=2 DAMP=.05
    MODE=3 DAMP=.05
    ACC=U1  ANG=0 FUNC=SINE SF=193.2 AT=0

OUTPUT
; No Output Requested

END

; The following data is used for graphics, design and pushover analysis.
; If changes are made to the analysis data above, then the following data
; should be checked for consistency.
SAP2000 V7.10 SUPPLEMENTAL DATA
  GRID GLOBAL  X "1"  0
  GRID GLOBAL  Y "2"  0
  GRID GLOBAL  Z "3"  0
  GRID GLOBAL  Z "4"  118.5
  MATERIAL STEEL FY 36
  MATERIAL CONC FYREBAR 60 FYSHEAR 40 FC 4 FCSHEAR 4
  STATICLOAD GRAVITY TYPE DEAD
END SUPPLEMENTAL DATA
```

```
ISFSI Pad Seismic Analysis (V&V - Sx=1.5g, u=1.19)

; File C:\DATA\SAP2000N\Pad sliding\Verif\Sx=1.5g, u=1.19.s2k saved 11/16/01
9:08:15 in Kip-in

SYSTEM
  DOF=UX,UY,UZ,RX,RY,RZ  LENGTH=IN  FORCE=Kip  LINES=56

JOINT
  1  X=0  Y=0  Z=118.5
  4  X=0  Y=0  Z=0

RESTRAINT
  ADD=4  DOF=R1,R2,R3

PATTERN
  NAME=DEFAULT

MASS
  ADD=4  U1=20.704  U2=20.704  U3=20.704
  ADD=1  U1=18.63354  U2=18.63354  U3=18.63354

MATERIAL
  NAME=STEEL  IDES=S
    T=0  E=29000  U=.3  A=.0000065  FY=36
  NAME=CONC  IDES=C  M=2.246377E-07  W=.0000868
    T=0  E=3600  U=.2  A=.0000055
  NAME=RIGID  IDES=N
    T=0  E=16000  U=.2  A=0

FRAME SECTION
  NAME=FSEC1 MAT=STEEL SH=R T=18,10 A=180 J=3916.671 I=4860,1500 AS=150,150
  NAME=CASK MAT=STEEL A=30059.1 J=1E+07 I=3557015,3557015 AS=1E+07,1E+07 S=1,1
Z=1,1 R=1,1 T=18,10

NLPROP
  NAME=CONTACT   TYPE=Isolator2  M=.168  W=65
    DOF=U1  KE=1E+08  CE=0  K=1E+08
    DOF=U2  KE=1E+07  CE=0  K=1E+07  FRICT=1.19,1.19
    DOF=U3  KE=1E+07  CE=0  K=1E+07  FRICT=1.19,1.19

FRAME
  1  J=1,4  SEC=CASK  NSEG=2  ANG=0

NLLINK
  1  J=4  NLP=CONTACT  ANG=0  AXDIR=+Z

LOAD
  NAME=GRAVITY  SW=1
    TYPE=FORCE
      ADD=4  UZ=-8000
      ADD=1  UZ=-7200

MODE
  TYPE=RITZ  N=12
    ACC=UX
    ACC=UZ
    LOAD=GRAVITY
    NLLINK=*
```

```
FUNCTION
  NAME=RAMP5 NPL=1 PRINT=Y
    0 0
    5 1
  NAME=SINE NPL=1 PRINT=Y
    0 0
    .01 .309
    .02 .588
    .03 .809
    .04 .951
    .05 1
    .06 .951
    .07 .809
    .08 .588
    .09 .309
    .1 0
    .11 -.309
    .12 -.588
    .13 -.809
    .14 -.951
    .15 -1
    .16 -.951
    .17 -.809
    .18 -.588
    .19 -.309
    .2 0
    .21 .309
    .22 .588
    .23 .809
    .24 .951
    .25 1
    .26 .951
    .27 .809
    .28 .588
    .29 .309
    .3 0
    .31 -.309
    .32 -.588
    .33 -.809
    .34 -.951
    .35 -1
    .36 -.951
    .37 -.809
    .38 -.588
    .39 -.309
    .4 0
    .41 .309
    .42 .588
    .43 .809
    .44 .951
    .45 1
    .46 .951
    .47 .809
    .48 .588
    .49 .309
    .5 0
    .51 -.309
    .52 -.588
    .53 -.809
    .54 -.951
```

```
.55 -1
.56 -.951
.57 -.809
.58 -.588
.59 -.309
.6 0
.61 .309
.62 .588
.63 .809
.64 .951
.65 1
.66 .951
.67 .809
.68 .588
.69 .309
.7 0
.71 -.309
.72 -.588
.73 -.809
.74 -.951
.75 -1
.76 -.951
.77 -.809
.78 -.588
.79 -.309
.8 0
.81 .309
.82 .588
.83 .809
.84 .951
.85 1
.86 .951
.87 .809
.88 .588
.89 .309
.9 0
.91 -.309
.92 -.588
.93 -.809
.94 -.951
.95 -1
.96 -.951
.97 -.809
.98 -.588
.99 -.309
1 0
1.01 .309
1.02 .588
1.03 .809
1.04 .951
1.05 1
1.06 .951
1.07 .809
1.08 .588
1.09 .309
1.1 0
1.11 -.309
1.12 -.588
1.13 -.809
1.14 -.951
```

```
1.15 -1
1.16 -.951
1.17 -.809
1.18 -.588
1.19 -.309
1.2 0
1.21 .309
1.22 .588
1.23 .809
1.24 .951
1.25 1
1.26 .951
1.27 .809
1.28 .588
1.29 .309
1.3 0
1.31 -.309
1.32 -.588
1.33 -.809
1.34 -.951
1.35 -1
1.36 -.951
1.37 -.809
1.38 -.588
1.39 -.309
1.4 0
1.41 .309
1.42 .588
1.43 .809
1.44 .951
1.45 1
1.46 .951
1.47 .809
1.48 .588
1.49 .309
1.5 0
1.51 -.309
1.52 -.588
1.53 -.809
1.54 -.951
1.55 -1
1.56 -.951
1.57 -.809
1.58 -.588
1.59 -.309
1.6 0
1.61 .309
1.62 .588
1.63 .809
1.64 .951
1.65 1
1.66 .951
1.67 .809
1.68 .588
1.69 .309
1.7 0
1.71 -.309
1.72 -.588
1.73 -.809
1.74 -.951
```

```
1.75 -1
1.76 -.951
1.77 -.809
1.78 -.588
1.79 -.309
1.8 0
1.81 .309
1.82 .588
1.83 .809
1.84 .951
1.85 1
1.86 .951
1.87 .809
1.88 .588
1.89 .309
1.9 0
1.91 -.309
1.92 -.588
1.93 -.809
1.94 -.951
1.95 -1
1.96 -.951
1.97 -.809
1.98 -.588
1.99 -.309
2 0
2.01 .309
2.02 .588
2.03 .809
2.04 .951
2.05 1
2.06 .951
2.07 .809
2.08 .588
2.09 .309
2.1 0
2.11 -.309
2.12 -.588
2.13 -.809
2.14 -.951
2.15 -1
2.16 -.951
2.17 -.809
2.18 -.588
2.19 -.309
2.2 0
2.21 .309
2.22 .588
2.23 .809
2.24 .951
2.25 1
2.26 .951
2.27 .809
2.28 .588
2.29 .309
2.3 0
2.31 -.309
2.32 -.588
2.33 -.809
2.34 -.951
```

```
2.35 -1
2.36 -.951
2.37 -.809
2.38 -.588
2.39 -.309
2.4 0
2.41 .309
2.42 .588
2.43 .809
2.44 .951
2.45 1
2.46 .951
2.47 .809
2.48 .588
2.49 .309
2.5 0
2.51 -.309
2.52 -.588
2.53 -.809
2.54 -.951
2.55 -1
2.56 -.951
2.57 -.809
2.58 -.588
2.59 -.309
2.6 0
2.61 .309
2.62 .588
2.63 .809
2.64 .951
2.65 1
2.66 .951
2.67 .809
2.68 .588
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13.68 .588
13.69 .309
13.7 -5.62E-08
13.71 -.309
13.72 -.588
13.73 -.809
13.74 -.951
```

```
13.75 -1
13.76 -.951
13.77 -.809
13.78 -.588
13.79 -.309
13.8 5.66E-08
13.81 .309
13.82 .588
13.83 .809
13.84 .951
13.85 1
13.86 .951
13.87 .809
13.88 .588
13.89 .309
13.9 -5.7E-08
13.91 -.309
13.92 -.588
13.93 -.809
13.94 -.951
13.95 -1
13.96 -.951
13.97 -.809
13.98 -.588
13.99 -.309
14 5.74E-08
14.01 .309
14.02 .588
14.03 .809
14.04 .951
14.05 1
14.06 .951
14.07 .809
14.08 .588
14.09 .309
14.1 -5.78E-08
14.11 -.309
14.12 -.588
14.13 -.809
14.14 -.951
14.15 -1
14.16 -.951
14.17 -.809
14.18 -.588
14.19 -.309
14.2 5.82E-08
14.21 .309
14.22 .588
14.23 .809
14.24 .951
14.25 1
14.26 .951
14.27 .809
14.28 .588
14.29 .309
14.3 -5.87E-08
14.31 -.309
14.32 -.588
14.33 -.809
14.34 -.951
```

```
14.35 -1
14.36 -.951
14.37 -.809
14.38 -.588
14.39 -.309
14.4 5.91E-08
14.41 .309
14.42 .588
14.43 .809
14.44 .951
14.45 1
14.46 .951
14.47 .809
14.48 .588
14.49 .309
14.5 -5.95E-08
14.51 -.309
14.52 -.588
14.53 -.809
14.54 -.951
14.55 -1
14.56 -.951
14.57 -.809
14.58 -.588
14.59 -.309
14.6 5.99E-08
14.61 .309
14.62 .588
14.63 .809
14.64 .951
14.65 1
14.66 .951
14.67 .809
14.68 .588
14.69 .309
14.7 -6.03E-08
14.71 -.309
14.72 -.588
14.73 -.809
14.74 -.951
14.75 -1
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14.77 -.809
14.78 -.588
14.79 -.309
14.8 6.07E-08
14.81 .309
14.82 .588
14.83 .809
14.84 .951
14.85 1
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14.87 .809
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14.89 .309
14.9 -6.11E-08
14.91 -.309
14.92 -.588
14.93 -.809
14.94 -.951
```

```
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14.97 -.809
14.98 -.588
14.99 -.309
15 6.15E-08
15.01 .309
15.02 .588
15.03 .809
15.04 .951
15.05 1
15.06 .951
15.07 .809
15.08 .588
15.09 .309
15.1 -6.19E-08
15.11 -.309
15.12 -.588
15.13 -.809
15.14 -.951
15.15 -1
15.16 -.951
15.17 -.809
15.18 -.588
15.19 -.309
15.2 6.23E-08
15.21 .309
15.22 .588
15.23 .809
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15.27 .809
15.28 .588
15.29 .309
15.3 -6.28E-08
15.31 -.309
15.32 -.588
15.33 -.809
15.34 -.951
15.35 -1
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15.37 -.809
15.38 -.588
15.39 -.309
15.4 6.32E-08
15.41 .309
15.42 .588
15.43 .809
15.44 .951
15.45 1
15.46 .951
15.47 .809
15.48 .588
15.49 .309
15.5 -6.36E-08
15.51 -.309
15.52 -.588
15.53 -.809
15.54 -.951
```

```
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15.57 -.809
15.58 -.588
15.59 -.309
15.6 6.4E-08
15.61 .309
15.62 .588
15.63 .809
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15.67 .809
15.68 .588
15.69 .309
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15.72 -.588
15.73 -.809
15.74 -.951
15.75 -1
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15.77 -.809
15.78 -.588
15.79 -.309
15.8 6.48E-08
15.81 .309
15.82 .588
15.83 .809
15.84 .951
15.85 1
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15.87 .809
15.88 .588
15.89 .309
15.9 -6.52E-08
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15.92 -.588
15.93 -.809
15.94 -.951
15.95 -1
15.96 -.951
15.97 -.809
15.98 -.588
15.99 -.309
16 6.56E-08
16.01 .309
16.02 .588
16.03 .809
16.04 .951
16.05 1
16.06 .951
16.07 .809
16.08 .588
16.09 .309
16.1 -6.6E-08
16.11 -.309
16.12 -.588
16.13 -.809
16.14 -.951
```

```
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16.22 .588
16.23 .809
16.24 .951
16.25 1
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16.27 .809
16.28 .588
16.29 .309
16.3 -6.69E-08
16.31 -.309
16.32 -.588
16.33 -.809
16.34 -.951
16.35 -1
16.36 -.951
16.37 -.809
16.38 -.588
16.39 -.309
16.4 6.73E-08
16.41 .309
16.42 .588
16.43 .809
16.44 .951
16.45 1
16.46 .951
16.47 .809
16.48 .588
16.49 .309
16.5 -6.77E-08
16.51 -.309
16.52 -.588
16.53 -.809
16.54 -.951
16.55 -1
16.56 -.951
16.57 -.809
16.58 -.588
16.59 -.309
16.6 6.81E-08
16.61 .309
16.62 .588
16.63 .809
16.64 .951
16.65 1
16.66 .951
16.67 .809
16.68 .588
16.69 .309
16.7 -6.85E-08
16.71 -.309
16.72 -.588
16.73 -.809
16.74 -.951
```

```
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16.77 -.809
16.78 -.588
16.79 -.309
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16.81 .309
16.82 .588
16.83 .809
16.84 .951
16.85 1
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16.87 .809
16.88 .588
16.89 .309
16.9 -6.93E-08
16.91 -.309
16.92 -.588
16.93 -.809
16.94 -.951
16.95 -1
16.96 -.951
16.97 -.809
16.98 -.588
16.99 -.309
17 6.97E-08
17.01 .309
17.02 .588
17.03 .809
17.04 .951
17.05 1
17.06 .951
17.07 .809
17.08 .588
17.09 .309
17.1 -7.01E-08
17.11 -.309
17.12 -.588
17.13 -.809
17.14 -.951
17.15 -1
17.16 -.951
17.17 -.809
17.18 -.588
17.19 -.309
17.2 7.06E-08
17.21 .309
17.22 .588
17.23 .809
17.24 .951
17.25 1
17.26 .951
17.27 .809
17.28 .588
17.29 .309
17.3 -7.1E-08
17.31 -.309
17.32 -.588
17.33 -.809
17.34 -.951
```

```
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17.37 -.809
17.38 -.588
17.39 -.309
17.4 7.14E-08
17.41 .309
17.42 .588
17.43 .809
17.44 .951
17.45 1
17.46 .951
17.47 .809
17.48 .588
17.49 .309
17.5 -7.18E-08
17.51 -.309
17.52 -.588
17.53 -.809
17.54 -.951
17.55 -1
17.56 -.951
17.57 -.809
17.58 -.588
17.59 -.309
17.6 7.22E-08
17.61 .309
17.62 .588
17.63 .809
17.64 .951
17.65 1
17.66 .951
17.67 .809
17.68 .588
17.69 .309
17.7 -7.26E-08
17.71 -.309
17.72 -.588
17.73 -.809
17.74 -.951
17.75 -1
17.76 -.951
17.77 -.809
17.78 -.588
17.79 -.309
17.8 7.3E-08
17.81 .309
17.82 .588
17.83 .809
17.84 .951
17.85 1
17.86 .951
17.87 .809
17.88 .588
17.89 .309
17.9 -7.34E-08
17.91 -.309
17.92 -.588
17.93 -.809
17.94 -.951
```

```
17.95 -1
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17.97 -.809
17.98 -.588
17.99 -.309
18 7.38E-08
18.01 .309
18.02 .588
18.03 .809
18.04 .951
18.05 1
18.06 .951
18.07 .809
18.08 .588
18.09 .309
18.1 -7.42E-08
18.11 -.309
18.12 -.588
18.13 -.809
18.14 -.951
18.15 -1
18.16 -.951
18.17 -.809
18.18 -.588
18.19 -.309
18.2 7.47E-08
18.21 .309
18.22 .588
18.23 .809
18.24 .951
18.25 1
18.26 .951
18.27 .809
18.28 .588
18.29 .309
18.3 -7.51E-08
18.31 -.309
18.32 -.588
18.33 -.809
18.34 -.951
18.35 -1
18.36 -.951
18.37 -.809
18.38 -.588
18.39 -.309
18.4 7.55E-08
18.41 .309
18.42 .588
18.43 .809
18.44 .951
18.45 1
18.46 .951
18.47 .809
18.48 .588
18.49 .309
18.5 -7.59E-08
18.51 -.309
18.52 -.588
18.53 -.809
18.54 -.951
```

```
18.55 -1
18.56 -.951
18.57 -.809
18.58 -.588
18.59 -.309
18.6 7.63E-08
18.61 .309
18.62 .588
18.63 .809
18.64 .951
18.65 1
18.66 .951
18.67 .809
18.68 .588
18.69 .309
18.7 -7.67E-08
18.71 -.309
18.72 -.588
18.73 -.809
18.74 -.951
18.75 -1
18.76 -.951
18.77 -.809
18.78 -.588
18.79 -.309
18.8 7.71E-08
18.81 .309
18.82 .588
18.83 .809
18.84 .951
18.85 1
18.86 .951
18.87 .809
18.88 .588
18.89 .309
18.9 -7.75E-08
18.91 -.309
18.92 -.588
18.93 -.809
18.94 -.951
18.95 -1
18.96 -.951
18.97 -.809
18.98 -.588
18.99 -.309
19 7.79E-08
19.01 .309
19.02 .588
19.03 .809
19.04 .951
19.05 1
19.06 .951
19.07 .809
19.08 .588
19.09 .309
19.1 -7.84E-08
19.11 -.309
19.12 -.588
19.13 -.809
19.14 -.951
```

```
19.15 -1
19.16 -.951
19.17 -.809
19.18 -.588
19.19 -.309
19.2 7.88E-08
19.21 .309
19.22 .588
19.23 .809
19.24 .951
19.25 1
19.26 .951
19.27 .809
19.28 .588
19.29 .309
19.3 -7.92E-08
19.31 -.309
19.32 -.588
19.33 -.809
19.34 -.951
19.35 -1
19.36 -.951
19.37 -.809
19.38 -.588
19.39 -.309
19.4 7.96E-08
19.41 .309
19.42 .588
19.43 .809
19.44 .951
19.45 1
19.46 .951
19.47 .809
19.48 .588
19.49 .309
19.5 -8E-08
19.51 -.309
19.52 -.588
19.53 -.809
19.54 -.951
19.55 -1
19.56 -.951
19.57 -.809
19.58 -.588
19.59 -.309
19.6 8.04E-08
19.61 .309
19.62 .588
19.63 .809
19.64 .951
19.65 1
19.66 .951
19.67 .809
19.68 .588
19.69 .309
19.7 -8.08E-08
19.71 -.309
19.72 -.588
19.73 -.809
19.74 -.951
```

```
    19.75 -1
    19.76 -.951
    19.77 -.809
    19.78 -.588
    19.79 -.309
    19.8 8.12E-08
    19.81 .309
    19.82 .588
    19.83 .809
    19.84 .951
    19.85 1
    19.86 .951
    19.87 .809
    19.88 .588
    19.89 .309
    19.9 -8.16E-08
    19.91 -.309
    19.92 -.588
    19.93 -.809
    19.94 -.951
    19.95 -1
    19.96 -.951
    19.97 -.809
    19.98 -.588
    19.99 -.309
    20 8.21E-08

HISTORY
  NAME=GRAVITY TYPE=NON NSTEP=10 DT=1 DAMP=.99
    LOAD=GRAVITY FUNC=RAMP5 SF=1 AT=0
  NAME=SINE TYPE=NON NSTEP=1000 DT=.005 DAMP=0 PREV=GRAVITY
    MODE=1 DAMP=.05
    MODE=2 DAMP=.05
    MODE=3 DAMP=.05
    ACC=U1  ANG=0 FUNC=SINE SF=579.6 AT=0

OUTPUT
; No Output Requested

END

; The following data is used for graphics, design and pushover analysis.
; If changes are made to the analysis data above, then the following data
; should be checked for consistency.
SAP2000 V7.10 SUPPLEMENTAL DATA
  GRID GLOBAL  X "1"  0
  GRID GLOBAL  Y "2"  0
  GRID GLOBAL  Z "3"  0
  GRID GLOBAL  Z "4"  118.5
  MATERIAL STEEL FY 36
  MATERIAL CONC FYREBAR 60 FYSHEAR 40 FC 4 FCSHEAR 4
  STATICLOAD GRAVITY TYPE DEAD
END SUPPLEMENTAL DATA
```

```
ISFSI Pad Sliding Analyses (V&V - Sy=0.5g, u=1.19)

; File C:\DATA\SAP2000N\Pad sliding\Verif\Sy=0.5g, u=1.19.s2k saved 11/16/01
9:16:05 in Kip-in

SYSTEM
  DOF=UX,UY,UZ,RX,RY,RZ  LENGTH=IN  FORCE=Kip  LINES=56

JOINT
  1  X=0  Y=0  Z=118.5
  4  X=0  Y=0  Z=0

RESTRAINT
  ADD=4  DOF=R1;R2,R3

PATTERN
  NAME=DEFAULT

MASS
  ADD=4  U1=20.704  U2=20.704  U3=20.704
  ADD=1  U1=18.63354  U2=18.63354  U3=18.63354

MATERIAL
  NAME=STEEL  IDES=S
    T=0  E=29000  U=.3  A=.0000065  FY=36
  NAME=CONC  IDES=C  M=2.246377E-07  W=.0000868
    T=0  E=3600  U=.2  A=.0000055
  NAME=RIGID  IDES=N
    T=0  E=16000  U=.2  A=0

FRAME SECTION
  NAME=FSEC1 MAT=STEEL SH=R T=18,10 A=180 J=3916.671 I=4860,1500 AS=150,150
  NAME=CASK MAT=STEEL A=30059.1 J=1E+07 I=3557015,3557015 AS=1E+07,1E+07 S=1,1
Z=1,1 R=1,1 T=18,10

NLPROP
  NAME=CONTACT    TYPE=Isolator2  M=.168  W=65
    DOF=U1  KE=1E+08  CE=0  K=1E+08
    DOF=U2  KE=1E+07  CE=0  K=1E+07  FRICT=1.19,1.19
    DOF=U3  KE=1E+07  CE=0  K=1E+07  FRICT=1.19,1.19

FRAME
  1  J=1,4  SEC=CASK  NSEG=2  ANG=0

NLLINK
  1  J=4  NLP=CONTACT  ANG=0  AXDIR=+Z

LOAD
  NAME=GRAVITY  SW=1
    TYPE=FORCE
      ADD=4  UZ=-8000
      ADD=1  UZ=-7200

MODE
  TYPE=RITZ  N=12
    ACC=UX
    ACC=UZ
    LOAD=GRAVITY
    NLLINK=*
```

```
FUNCTION
 NAME=RAMP5 NPL=1 PRINT=Y
   0 0
   5 1
 NAME=SINE NPL=1 PRINT=Y
   0 0
   .01 .309
   .02 .588
   .03 .809
   .04 .951
   .05 1
   .06 .951
   .07 .809
   .08 .588
   .09 .309
   .1 0
   .11 -.309
   .12 -.588
   .13 -.809
   .14 -.951
   .15 -1
   .16 -.951
   .17 -.809
   .18 -.588
   .19 -.309
   .2 0
   .21 .309
   .22 .588
   .23 .809
   .24 .951
   .25 1
   .26 .951
   .27 .809
   .28 .588
   .29 .309
   .3 0
   .31 -.309
   .32 -.588
   .33 -.809
   .34 -.951
   .35 -1
   .36 -.951
   .37 -.809
   .38 -.588
   .39 -.309
   .4 0
   .41 .309
   .42 .588
   .43 .809
   .44 .951
   .45 1
   .46 .951
   .47 .809
   .48 .588
   .49 .309
   .5 0
   .51 -.309
   .52 -.588
   .53 -.809
   .54 -.951
```

```
.55 -1
.56 -.951
.57 -.809
.58 -.588
.59 -.309
.6 0
.61 .309
.62 .588
.63 .809
.64 .951
.65 1
.66 .951
.67 .809
.68 .588
.69 .309
.7 0
.71 -.309
.72 -.588
.73 -.809
.74 -.951
.75 -1
.76 -.951
.77 -.809
.78 -.588
.79 -.309
.8 0
.81 .309
.82 .588
.83 .809
.84 .951
.85 1
.86 .951
.87 .809
.88 .588
.89 .309
.9 0
.91 -.309
.92 -.588
.93 -.809
.94 -.951
.95 -1
.96 -.951
.97 -.809
.98 -.588
.99 -.309
1 0
1.01 .309
1.02 .588
1.03 .809
1.04 .951
1.05 1
1.06 .951
1.07 .809
1.08 .588
1.09 .309
1.1 0
1.11 -.309
1.12 -.588
1.13 -.809
1.14 -.951
```

```
1.15 -1
1.16 -.951
1.17 -.809
1.18 -.588
1.19 -.309
1.2 0
1.21 .309
1.22 .588
1.23 .809
1.24 .951
1.25 1
1.26 .951
1.27 .809
1.28 .588
1.29 .309
1.3 0
1.31 -.309
1.32 -.588
1.33 -.809
1.34 -.951
1.35 -1
1.36 -.951
1.37 -.809
1.38 -.588
1.39 -.309
1.4 0
1.41 .309
1.42 .588
1.43 .809
1.44 .951
1.45 1
1.46 .951
1.47 .809
1.48 .588
1.49 .309
1.5 0
1.51 -.309
1.52 -.588
1.53 -.809
1.54 -.951
1.55 -1
1.56 -.951
1.57 -.809
1.58 -.588
1.59 -.309
1.6 0
1.61 .309
1.62 .588
1.63 .809
1.64 .951
1.65 1
1.66 .951
1.67 .809
1.68 .588
1.69 .309
1.7 0
1.71 -.309
1.72 -.588
1.73 -.809
1.74 -.951
```

```
1.75 -1
1.76 -.951
1.77 -.809
1.78 -.588
1.79 -.309
1.8 0
1.81 .309
1.82 .588
1.83 .809
1.84 .951
1.85 1
1.86 .951
1.87 .809
1.88 .588
1.89 .309
1.9 0
1.91 -.309
1.92 -.588
1.93 -.809
1.94 -.951
1.95 -1
1.96 -.951
1.97 -.809
1.98 -.588
1.99 -.309
2 0
2.01 .309
2.02 .588
2.03 .809
2.04 .951
2.05 1
2.06 .951
2.07 .809
2.08 .588
2.09 .309
2.1 0
2.11 -.309
2.12 -.588
2.13 -.809
2.14 -.951
2.15 -1
2.16 -.951
2.17 -.809
2.18 -.588
2.19 -.309
2.2 0
2.21 .309
2.22 .588
2.23 .809
2.24 .951
2.25 1
2.26 .951
2.27 .809
2.28 .588
2.29 .309
2.3 0
2.31 -.309
2.32 -.588
2.33 -.809
2.34 -.951
```

```
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2.37 -.809
2.38 -.588
2.39 -.309
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2.41 .309
2.42 .588
2.43 .809
2.44 .951
2.45 1
2.46 .951
2.47 .809
2.48 .588
2.49 .309
2.5 0
2.51 -.309
2.52 -.588
2.53 -.809
2.54 -.951
2.55 -1
2.56 -.951
2.57 -.809
2.58 -.588
2.59 -.309
2.6 0
2.61 .309
2.62 .588
2.63 .809
2.64 .951
2.65 1
2.66 .951
2.67 .809
2.68 .588
2.69 .309
2.7 0
2.71 -.309
2.72 -.588
2.73 -.809
2.74 -.951
2.75 -1
2.76 -.951
2.77 -.809
2.78 -.588
2.79 -.309
2.8 0
2.81 .309
2.82 .588
2.83 .809
2.84 .951
2.85 1
2.86 .951
2.87 .809
2.88 .588
2.89 .309
2.9 0
2.91 -.309
2.92 -.588
2.93 -.809
2.94 -.951
```

```
2.95 -1
2.96 -.951
2.97 -.809
2.98 -.588
2.99 -.309
3 0
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3.02 .588
3.03 .809
3.04 .951
3.05 1
3.06 .951
3.07 .809
3.08 .588
3.09 .309
3.1 0
3.11 -.309
3.12 -.588
3.13 -.809
3.14 -.951
3.15 -1
3.16 -.951
3.17 -.809
3.18 -.588
3.19 -.309
3.2 0
3.21 .309
3.22 .588
3.23 .809
3.24 .951
3.25 1
3.26 .951
3.27 .809
3.28 .588
3.29 .309
3.3 -1.35E-08
3.31 -.309
3.32 -.588
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14.28 .588
14.29 .309
14.3 -5.87E-08
14.31 -.309
14.32 -.588
14.33 -.809
14.34 -.951
```

```
14.35 -1
14.36 -.951
14.37 -.809
14.38 -.588
14.39 -.309
14.4 5.91E-08
14.41 .309
14.42 .588
14.43 .809
14.44 .951
14.45 1
14.46 .951
14.47 .809
14.48 .588
14.49 .309
14.5 -5.95E-08
14.51 -.309
14.52 -.588
14.53 -.809
14.54 -.951
14.55 -1
14.56 -.951
14.57 -.809
14.58 -.588
14.59 -.309
14.6 5.99E-08
14.61 .309
14.62 .588
14.63 .809
14.64 .951
14.65 1
14.66 .951
14.67 .809
14.68 .588
14.69 .309
14.7 -6.03E-08
14.71 -.309
14.72 -.588
14.73 -.809
14.74 -.951
14.75 -1
14.76 -.951
14.77 -.809
14.78 -.588
14.79 -.309
14.8 6.07E-08
14.81 .309
14.82 .588
14.83 .809
14.84 .951
14.85 1
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14.9 -6.11E-08
14.91 -.309
14.92 -.588
14.93 -.809
14.94 -.951
```

```
14.95 -1
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14.97 -.809
14.98 -.588
14.99 -.309
15 6.15E-08
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15.02 .588
15.03 .809
15.04 .951
15.05 1
15.06 .951
15.07 .809
15.08 .588
15.09 .309
15.1 -6.19E-08
15.11 -.309
15.12 -.588
15.13 -.809
15.14 -.951
15.15 -1
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15.17 -.809
15.18 -.588
15.19 -.309
15.2 6.23E-08
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15.22 .588
15.23 .809
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15.3 -6.28E-08
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15.32 -.588
15.33 -.809
15.34 -.951
15.35 -1
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15.37 -.809
15.38 -.588
15.39 -.309
15.4 6.32E-08
15.41 .309
15.42 .588
15.43 .809
15.44 .951
15.45 1
15.46 .951
15.47 .809
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15.49 .309
15.5 -6.36E-08
15.51 -.309
15.52 -.588
15.53 -.809
15.54 -.951
```

```
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15.57 -.809
15.58 -.588
15.59 -.309
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15.62 .588
15.63 .809
15.64 .951
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15.68 .588
15.69 .309
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15.72 -.588
15.73 -.809
15.74 -.951
15.75 -1
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15.77 -.809
15.78 -.588
15.79 -.309
15.8 6.48E-08
15.81 .309
15.82 .588
15.83 .809
15.84 .951
15.85 1
15.86 .951
15.87 .809
15.88 .588
15.89 .309
15.9 -6.52E-08
15.91 -.309
15.92 -.588
15.93 -.809
15.94 -.951
15.95 -1
15.96 -.951
15.97 -.809
15.98 -.588
15.99 -.309
16 6.56E-08
16.01 .309
16.02 .588
16.03 .809
16.04 .951
16.05 1
16.06 .951
16.07 .809
16.08 .588
16.09 .309
16.1 -6.6E-08
16.11 -.309
16.12 -.588
16.13 -.809
16.14 -.951
```

```
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16.17 -.809
16.18 -.588
16.19 -.309
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16.23 .809
16.24 .951
16.25 1
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16.27 .809
16.28 .588
16.29 .309
16.3 -6.69E-08
16.31 -.309
16.32 -.588
16.33 -.809
16.34 -.951
16.35 -1
16.36 -.951
16.37 -.809
16.38 -.588
16.39 -.309
16.4 6.73E-08
16.41 .309
16.42 .588
16.43 .809
16.44 .951
16.45 1
16.46 .951
16.47 .809
16.48 .588
16.49 .309
16.5 -6.77E-08
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16.52 -.588
16.53 -.809
16.54 -.951
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16.57 -.809
16.58 -.588
16.59 -.309
16.6 6.81E-08
16.61 .309
16.62 .588
16.63 .809
16.64 .951
16.65 1
16.66 .951
16.67 .809
16.68 .588
16.69 .309
16.7 -6.85E-08
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16.72 -.588
16.73 -.809
16.74 -.951
```

```
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16.78 -.588
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16.81 .309
16.82 .588
16.83 .809
16.84 .951
16.85 1
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16.87 .809
16.88 .588
16.89 .309
16.9 -6.93E-08
16.91 -.309
16.92 -.588
16.93 -.809
16.94 -.951
16.95 -1
16.96 -.951
16.97 -.809
16.98 -.588
16.99 -.309
17 6.97E-08
17.01 .309
17.02 .588
17.03 .809
17.04 .951
17.05 1
17.06 .951
17.07 .809
17.08 .588
17.09 .309
17.1 -7.01E-08
17.11 -.309
17.12 -.588
17.13 -.809
17.14 -.951
17.15 -1
17.16 -.951
17.17 -.809
17.18 -.588
17.19 -.309
17.2 7.06E-08
17.21 .309
17.22 .588
17.23 .809
17.24 .951
17.25 1
17.26 .951
17.27 .809
17.28 .588
17.29 .309
17.3 -7.1E-08
17.31 -.309
17.32 -.588
17.33 -.809
17.34 -.951
```

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17.38 -.588
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17.4 7.14E-08
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17.44 .951
17.45 1
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17.47 .809
17.48 .588
17.49 .309
17.5 -7.18E-08
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17.52 -.588
17.53 -.809
17.54 -.951
17.55 -1
17.56 -.951
17.57 -.809
17.58 -.588
17.59 -.309
17.6 7.22E-08
17.61 .309
17.62 .588
17.63 .809
17.64 .951
17.65 1
17.66 .951
17.67 .809
17.68 .588
17.69 .309
17.7 -7.26E-08
17.71 -.309
17.72 -.588
17.73 -.809
17.74 -.951
17.75 -1
17.76 -.951
17.77 -.809
17.78 -.588
17.79 -.309
17.8 7.3E-08
17.81 .309
17.82 .588
17.83 .809
17.84 .951
17.85 1
17.86 .951
17.87 .809
17.88 .588
17.89 .309
17.9 -7.34E-08
17.91 -.309
17.92 -.588
17.93 -.809
17.94 -.951
```

```
17.95 -1
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17.97 -.809
17.98 -.588
17.99 -.309
18 7.38E-08
18.01 .309
18.02 .588
18.03 .809
18.04 .951
18.05 1
18.06 .951
18.07 .809
18.08 .588
18.09 .309
18.1 -7.42E-08
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18.15 -1
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18.17 -.809
18.18 -.588
18.19 -.309
18.2 7.47E-08
18.21 .309
18.22 .588
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18.28 .588
18.29 .309
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18.33 -.809
18.34 -.951
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18.37 -.809
18.38 -.588
18.39 -.309
18.4 7.55E-08
18.41 .309
18.42 .588
18.43 .809
18.44 .951
18.45 1
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18.49 .309
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18.52 -.588
18.53 -.809
18.54 -.951
```

```
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18.57 -.809
18.58 -.588
18.59 -.309
18.6 7.63E-08
18.61 .309
18.62 .588
18.63 .809
18.64 .951
18.65 1
18.66 .951
18.67 .809
18.68 .588
18.69 .309
18.7 -7.67E-08
18.71 -.309
18.72 -.588
18.73 -.809
18.74 -.951
18.75 -1
18.76 -.951
18.77 -.809
18.78 -.588
18.79 -.309
18.8 7.71E-08
18.81 .309
18.82 .588
18.83 .809
18.84 .951
18.85 1
18.86 .951
18.87 .809
18.88 .588
18.89 .309
18.9 -7.75E-08
18.91 -.309
18.92 -.588
18.93 -.809
18.94 -.951
18.95 -1
18.96 -.951
18.97 -.809
18.98 -.588
18.99 -.309
19 7.79E-08
19.01 .309
19.02 .588
19.03 .809
19.04 .951
19.05 1
19.06 .951
19.07 .809
19.08 .588
19.09 .309
19.1 -7.84E-08
19.11 -.309
19.12 -.588
19.13 -.809
19.14 -.951
```

```
19.15 -1
19.16 -.951
19.17 -.809
19.18 -.588
19.19 -.309
19.2 7.88E-08
19.21 .309
19.22 .588
19.23 .809
19.24 .951
19.25 1
19.26 .951
19.27 .809
19.28 .588
19.29 .309
19.3 -7.92E-08
19.31 -.309
19.32 -.588
19.33 -.809
19.34 -.951
19.35 -1
19.36 -.951
19.37 -.809
19.38 -.588
19.39 -.309
19.4 7.96E-08
19.41 .309
19.42 .588
19.43 .809
19.44 .951
19.45 1
19.46 .951
19.47 .809
19.48 .588
19.49 .309
19.5 -8E-08
19.51 -.309
19.52 -.588
19.53 -.809
19.54 -.951
19.55 -1
19.56 -.951
19.57 -.809
19.58 -.588
19.59 -.309
19.6 8.04E-08
19.61 .309
19.62 .588
19.63 .809
19.64 .951
19.65 1
19.66 .951
19.67 .809
19.68 .588
19.69 .309
19.7 -8.08E-08
19.71 -.309
19.72 -.588
19.73 -.809
19.74 -.951
```

```
    19.75 -1
    19.76 -.951
    19.77 -.809
    19.78 -.588
    19.79 -.309
    19.8 8.12E-08
    19.81 .309
    19.82 .588
    19.83 .809
    19.84 .951
    19.85 1
    19.86 .951
    19.87 .809
    19.88 .588
    19.89 .309
    19.9 -8.16E-08
    19.91 -.309
    19.92 -.588
    19.93 -.809
    19.94 -.951
    19.95 -1
    19.96 -.951
    19.97 -.809
    19.98 -.588
    19.99 -.309
    20 8.21E-08

HISTORY
  NAME=GRAVITY TYPE=NON NSTEP=10 DT=1 DAMP=.99
    LOAD=GRAVITY FUNC=RAMP5 SF=1 AT=0
  NAME=SINE TYPE=NON NSTEP=1000 DT=.005 DAMP=0 PREV=GRAVITY
    MODE=1 DAMP=.05
    MODE=2 DAMP=.05
    MODE=3 DAMP=.05
    ACC=U2  ANG=0 FUNC=SINE SF=193.2 AT=0

OUTPUT
; No Output Requested

END

; The following data is used for graphics, design and pushover analysis.
; If changes are made to the analysis data above, then the following data
; should be checked for consistency.
SAP2000 V7.10 SUPPLEMENTAL DATA
  GRID GLOBAL  X "1"  0
  GRID GLOBAL  Y "2"  0
  GRID GLOBAL  Z "3"  0
  GRID GLOBAL  Z "4"  118.5
  MATERIAL STEEL FY 36
  MATERIAL CONC FYREBAR 60 FYSHEAR 40 FC 4 FCSHEAR 4
  STATICLOAD GRAVITY TYPE DEAD
END SUPPLEMENTAL DATA
```

```
ISFSI Pad Seismic Sliding Analyses (V&V - Sy=1.5g, u=1.19)

; File C:\DATA\SAP2000N\Pad sliding\Verif\Sy=1.5g, u=1.19.s2k saved 11/16/01
9:21:41 in Kip-in

SYSTEM
  DOF=UX,UY,UZ,RX,RY,RZ  LENGTH=IN  FORCE=Kip  LINES=56

JOINT
  1  X=0  Y=0  Z=118.5
  4  X=0  Y=0  Z=0

RESTRAINT
  ADD=4  DOF=R1,R2,R3

PATTERN
  NAME=DEFAULT

MASS
  ADD=4  U1=20.704  U2=20.704  U3=20.704
  ADD=1  U1=18.63354  U2=18.63354  U3=18.63354

MATERIAL
  NAME=STEEL  IDES=S
    T=0  E=29000  U=.3  A=.0000065  FY=36
  NAME=CONC  IDES=C  M=2.246377E-07  W=.0000868
    T=0  E=3600  U=.2  A=.0000055
  NAME=RIGID  IDES=N
    T=0  E=16000  U=.2  A=0

FRAME SECTION
  NAME=FSEC1 MAT=STEEL SH=R T=18,10 A=180 J=3916.671 I=4860,1500 AS=150,150
  NAME=CASK MAT=STEEL A=30059.1 J=1E+07 I=3557015,3557015 AS=1E+07,1E+07 S=1,1
Z=1,1 R=1,1 T=18,10

NLPROP
  NAME=CONTACT    TYPE=Isolator2  M=.168  W=65
    DOF=U1  KE=1E+08  CE=0  K=1E+08
    DOF=U2  KE=1E+07  CE=0  K=1E+07  FRICT=1.19,1.19
    DOF=U3  KE=1E+07  CE=0  K=1E+07  FRICT=1.19,1.19

FRAME
  1  J=1,4  SEC=CASK  NSEG=2  ANG=0

NLLINK
  1  J=4  NLP=CONTACT  ANG=0  AXDIR=+Z

LOAD
  NAME=GRAVITY  SW=1
    TYPE=FORCE
      ADD=4  UZ=-8000
      ADD=1  UZ=-7200

MODE
  TYPE=RITZ  N=12
    ACC=UX
    ACC=UZ
    LOAD=GRAVITY
    NLLINK=*
```

```
FUNCTION
 NAME=RAMP5 NPL=1 PRINT=Y
  0 0
  5 1
 NAME=SINE NPL=1 PRINT=Y
  0 0
  .01 .309
  .02 .588
  .03 .809
  .04 .951
  .05 1
  .06 .951
  .07 .809
  .08 .588
  .09 .309
  .1 0
  .11 -.309
  .12 -.588
  .13 -.809
  .14 -.951
  .15 -1
  .16 -.951
  .17 -.809
  .18 -.588
  .19 -.309
  .2 0
  .21 .309
  .22 .588
  .23 .809
  .24 .951
  .25 1
  .26 .951
  .27 .809
  .28 .588
  .29 .309
  .3 0
  .31 -.309
  .32 -.588
  .33 -.809
  .34 -.951
  .35 -1
  .36 -.951
  .37 -.809
  .38 -.588
  .39 -.309
  .4 0
  .41 .309
  .42 .588
  .43 .809
  .44 .951
  .45 1
  .46 .951
  .47 .809
  .48 .588
  .49 .309
  .5 0
  .51 -.309
  .52 -.588
  .53 -.809
  .54 -.951
```

```
.55 -1
.56 -.951
.57 -.809
.58 -.588
.59 -.309
.6 0
.61 .309
.62 .588
.63 .809
.64 .951
.65 1
.66 .951
.67 .809
.68 .588
.69 .309
.7 0
.71 -.309
.72 -.588
.73 -.809
.74 -.951
.75 -1
.76 -.951
.77 -.809
.78 -.588
.79 -.309
.8 0
.81 .309
.82 .588
.83 .809
.84 .951
.85 1
.86 .951
.87 .809
.88 .588
.89 .309
.9 0
.91 -.309
.92 -.588
.93 -.809
.94 -.951
.95 -1
.96 -.951
.97 -.809
.98 -.588
.99 -.309
1 0
1.01 .309
1.02 .588
1.03 .809
1.04 .951
1.05 1
1.06 .951
1.07 .809
1.08 .588
1.09 .309
1.1 0
1.11 -.309
1.12 -.588
1.13 -.809
1.14 -.951
```

```
1.15 -1
1.16 -.951
1.17 -.809
1.18 -.588
1.19 -.309
1.2 0
1.21 .309
1.22 .588
1.23 .809
1.24 .951
1.25 1
1.26 .951
1.27 .809
1.28 .588
1.29 .309
1.3 0
1.31 -.309
1.32 -.588
1.33 -.809
1.34 -.951
1.35 -1
1.36 -.951
1.37 -.809
1.38 -.588
1.39 -.309
1.4 0
1.41 .309
1.42 .588
1.43 .809
1.44 .951
1.45 1
1.46 .951
1.47 .809
1.48 .588
1.49 .309
1.5 0
1.51 -.309
1.52 -.588
1.53 -.809
1.54 -.951
1.55 -1
1.56 -.951
1.57 -.809
1.58 -.588
1.59 -.309
1.6 0
1.61 .309
1.62 .588
1.63 .809
1.64 .951
1.65 1
1.66 .951
1.67 .809
1.68 .588
1.69 .309
1.7 0
1.71 -.309
1.72 -.588
1.73 -.809
1.74 -.951
```

```
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1.77 -.809
1.78 -.588
1.79 -.309
1.8 0
1.81 .309
1.82 .588
1.83 .809
1.84 .951
1.85 1
1.86 .951
1.87 .809
1.88 .588
1.89 .309
1.9 0
1.91 -.309
1.92 -.588
1.93 -.809
1.94 -.951
1.95 -1
1.96 -.951
1.97 -.809
1.98 -.588
1.99 -.309
2 0
2.01 .309
2.02 .588
2.03 .809
2.04 .951
2.05 1
2.06 .951
2.07 .809
2.08 .588
2.09 .309
2.1 0
2.11 -.309
2.12 -.588
2.13 -.809
2.14 -.951
2.15 -1
2.16 -.951
2.17 -.809
2.18 -.588
2.19 -.309
2.2 0
2.21 .309
2.22 .588
2.23 .809
2.24 .951
2.25 1
2.26 .951
2.27 .809
2.28 .588
2.29 .309
2.3 0
2.31 -.309
2.32 -.588
2.33 -.809
2.34 -.951
```

```
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2.37 -.809
2.38 -.588
2.39 -.309
2.4 0
2.41 .309
2.42 .588
2.43 .809
2.44 .951
2.45 1
2.46 .951
2.47 .809
2.48 .588
2.49 .309
2.5 0
2.51 -.309
2.52 -.588
2.53 -.809
2.54 -.951
2.55 -1
2.56 -.951
2.57 -.809
2.58 -.588
2.59 -.309
2.6 0
2.61 .309
2.62 .588
2.63 .809
2.64 .951
2.65 1
2.66 .951
2.67 .809
2.68 .588
2.69 .309
2.7 0
2.71 -.309
2.72 -.588
2.73 -.809
2.74 -.951
2.75 -1
2.76 -.951
2.77 -.809
2.78 -.588
2.79 -.309
2.8 0
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2.82 .588
2.83 .809
2.84 .951
2.85 1
2.86 .951
2.87 .809
2.88 .588
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2.9 0
2.91 -.309
2.92 -.588
2.93 -.809
2.94 -.951
```

```
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2.97 -.809
2.98 -.588
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3.03 .809
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3.05 1
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3.07 .809
3.08 .588
3.09 .309
3.1 0
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3.12 -.588
3.13 -.809
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3.16 -.951
3.17 -.809
3.18 -.588
3.19 -.309
3.2 0
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3.24 .951
3.25 1
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3.27 .809
3.28 .588
3.29 .309
3.3 -1.35E-08
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3.32 -.588
3.33 -.809
3.34 -.951
3.35 -1
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3.37 -.809
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3.39 -.309
3.4 1.39E-08
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```

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14.91 -.309
14.92 -.588
14.93 -.809
14.94 -.951
```

```
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14.97 -.809
14.98 -.588
14.99 -.309
15 6.15E-08
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15.02 .588
15.03 .809
15.04 .951
15.05 1
15.06 .951
15.07 .809
15.08 .588
15.09 .309
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15.12 -.588
15.13 -.809
15.14 -.951
15.15 -1
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15.17 -.809
15.18 -.588
15.19 -.309
15.2 6.23E-08
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15.22 .588
15.23 .809
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15.29 .309
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15.35 -1
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15.4 6.32E-08
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15.52 -.588
15.53 -.809
15.54 -.951
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15.8 6.48E-08
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15.94 -.951
15.95 -1
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15.97 -.809
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16.07 .809
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16.12 -.588
16.13 -.809
16.14 -.951
```

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16.33 -.809
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16.35 -1
16.36 -.951
16.37 -.809
16.38 -.588
16.39 -.309
16.4 6.73E-08
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16.42 .588
16.43 .809
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16.47 .809
16.48 .588
16.49 .309
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16.52 -.588
16.53 -.809
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16.59 -.309
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16.62 .588
16.63 .809
16.64 .951
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16.73 -.809
16.74 -.951
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16.92 -.588
16.93 -.809
16.94 -.951
16.95 -1
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16.97 -.809
16.98 -.588
16.99 -.309
17 6.97E-08
17.01 .309
17.02 .588
17.03 .809
17.04 .951
17.05 1
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17.07 .809
17.08 .588
17.09 .309
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17.11 -.309
17.12 -.588
17.13 -.809
17.14 -.951
17.15 -1
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17.17 -.809
17.18 -.588
17.19 -.309
17.2 7.06E-08
17.21 .309
17.22 .588
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17.25 1
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17.27 .809
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17.33 -.809
17.34 -.951
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17.55 -1
17.56 -.951
17.57 -.809
17.58 -.588
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17.6 7.22E-08
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17.65 1
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17.67 .809
17.68 .588
17.69 .309
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17.78 -.588
17.79 -.309
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17.83 .809
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17.85 1
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17.92 -.588
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17.94 -.951
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17.97 -.809
17.98 -.588
17.99 -.309
18 7.38E-08
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18.02 .588
18.03 .809
18.04 .951
18.05 1
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18.07 .809
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18.2 7.47E-08
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18.22 .588
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18.39 -.309
18.4 7.55E-08
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18.54 -.951
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18.92 -.588
18.93 -.809
18.94 -.951
18.95 -1
18.96 -.951
18.97 -.809
18.98 -.588
18.99 -.309
19 7.79E-08
19.01 .309
19.02 .588
19.03 .809
19.04 .951
19.05 1
19.06 .951
19.07 .809
19.08 .588
19.09 .309
19.1 -7.84E-08
19.11 -.309
19.12 -.588
19.13 -.809
19.14 -.951
```

```
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19.16 -.951
19.17 -.809
19.18 -.588
19.19 -.309
19.2 7.88E-08
19.21 .309
19.22 .588
19.23 .809
19.24 .951
19.25 1
19.26 .951
19.27 .809
19.28 .588
19.29 .309
19.3 -7.92E-08
19.31 -.309
19.32 -.588
19.33 -.809
19.34 -.951
19.35 -1
19.36 -.951
19.37 -.809
19.38 -.588
19.39 -.309
19.4 7.96E-08
19.41 .309
19.42 .588
19.43 .809
19.44 .951
19.45 1
19.46 .951
19.47 .809
19.48 .588
19.49 .309
19.5 -8E-08
19.51 -.309
19.52 -.588
19.53 -.809
19.54 -.951
19.55 -1
19.56 -.951
19.57 -.809
19.58 -.588
19.59 -.309
19.6 8.04E-08
19.61 .309
19.62 .588
19.63 .809
19.64 .951
19.65 1
19.66 .951
19.67 .809
19.68 .588
19.69 .309
19.7 -8.08E-08
19.71 -.309
19.72 -.588
19.73 -.809
19.74 -.951
```

```
    19.75 -1
    19.76 -.951
    19.77 -.809
    19.78 -.588
    19.79 -.309
    19.8 8.12E-08
    19.81 .309
    19.82 .588
    19.83 .809
    19.84 .951
    19.85 1
    19.86 .951
    19.87 .809
    19.88 .588
    19.89 .309
    19.9 -8.16E-08
    19.91 -.309
    19.92 -.588
    19.93 -.809
    19.94 -.951
    19.95 -1
    19.96 -.951
    19.97 -.809
    19.98 -.588
    19.99 -.309
    20 8.21E-08

HISTORY
  NAME=GRAVITY TYPE=NON NSTEP=10 DT=1 DAMP=.99
    LOAD=GRAVITY FUNC=RAMP5 SF=1 AT=0
  NAME=SINE TYPE=NON NSTEP=1000 DT=.005 DAMP=0 PREV=GRAVITY
    MODE=1 DAMP=.05
    MODE=2 DAMP=.05
    MODE=3 DAMP=.05
    ACC=U2  ANG=0 FUNC=SINE SF=579.6 AT=0

OUTPUT
; No Output Requested

END

; The following data is used for graphics, design and pushover analysis.
; If changes are made to the analysis data above, then the following data
; should be checked for consistency.
SAP2000 V7.10 SUPPLEMENTAL DATA
  GRID GLOBAL  X "1"  0
  GRID GLOBAL  Y "2"  0
  GRID GLOBAL  Z "3"  0
  GRID GLOBAL  Z "4"  118.5
  MATERIAL STEEL FY 36
  MATERIAL CONC FYREBAR 60 FYSHEAR 40 FC 4 FCSHEAR 4
  STATICLOAD GRAVITY TYPE DEAD
END SUPPLEMENTAL DATA
```

```
Client: PG&E     Project Number: 0104-0019

; File C:\DATA\SAP2000N\Pad sliding\Verif\pure slide, u=1.19.s2k saved 11/16/01
9:26:51 in Kip-in

SYSTEM
  DOF=UX,UY,UZ,RX,RY,RZ  LENGTH=IN  FORCE=Kip  LINES=56

JOINT
  4  X=0  Y=0  Z=0

PATTERN
  NAME=DEFAULT

MASS
  ADD=4  U1=39.34  U2=39.34  U3=39.34

MATERIAL
  NAME=STEEL  IDES=S  M=7.324016E-07  W=.000283
    T=0  E=29000  U=.3  A=.0000065  FY=36
  NAME=CONC  IDES=C  M=2.246377E-07  W=.0000868
    T=0  E=3600  U=.2  A=.0000055
  NAME=RIGID  IDES=N
    T=0  E=16000  U=.2  A=0

NLPROP
  NAME=CONTACT    TYPE=Isolator2  M=.168  W=65
    DOF=U1  KE=1E+08  CE=0  K=1E+08
    DOF=U2  KE=1E+07  CE=0  K=1E+07  FRICT=1.19,1.19
    DOF=U3  KE=1E+07  CE=0  K=1E+07  FRICT=1.19,1.19

NLLINK
  1  J=4  NLP=CONTACT  ANG=0  AXDIR=+Z

LOAD
  NAME=GRAVITY  SW=1
    TYPE=FORCE
      ADD=4  UZ=-15200

MODE
  TYPE=RITZ  N=12
    ACC=UX
    ACC=UZ
    LOAD=GRAVITY
    NLLINK=*

FUNCTION
  NAME=RAMP5 NPL=1 PRINT=Y
    0 0
    5 1
  NAME=SINE NPL=1 PRINT=Y
    0 0
    .01 .309
    .02 .588
    .03 .809
    .04 .951
    .05 1
    .06 .951
    .07 .809
    .08 .588
```

```
.09 .309
.1 0
.11 -.309
.12 -.588
.13 -.809
.14 -.951
.15 -1
.16 -.951
.17 -.809
.18 -.588
.19 -.309
.2 0
.21 .309
.22 .588
.23 .809
.24 .951
.25 1
.26 .951
.27 .809
.28 .588
.29 .309
.3 0
.31 -.309
.32 -.588
.33 -.809
.34 -.951
.35 -1
.36 -.951
.37 -.809
.38 -.588
.39 -.309
.4 0
.41 .309
.42 .588
.43 .809
.44 .951
.45 1
.46 .951
.47 .809
.48 .588
.49 .309
.5 0
.51 -.309
.52 -.588
.53 -.809
.54 -.951
.55 -1
.56 -.951
.57 -.809
.58 -.588
.59 -.309
.6 0
.61 .309
.62 .588
.63 .809
.64 .951
.65 1
.66 .951
.67 .809
.68 .588
```

```
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.71 -.309
.72 -.588
.73 -.809
.74 -.951
.75 -1
.76 -.951
.77 -.809
.78 -.588
.79 -.309
.8 0
.81 .309
.82 .588
.83 .809
.84 .951
.85 1
.86 .951
.87 .809
.88 .588
.89 .309
.9 0
.91 -.309
.92 -.588
.93 -.809
.94 -.951
.95 -1
.96 -.951
.97 -.809
.98 -.588
.99 -.309
1 0
1.01 .309
1.02 .588
1.03 .809
1.04 .951
1.05 1
1.06 .951
1.07 .809
1.08 .588
1.09 .309
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1.12 -.588
1.13 -.809
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1.16 -.951
1.17 -.809
1.18 -.588
1.19 -.309
1.2 0
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1.22 .588
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1.24 .951
1.25 1
1.26 .951
1.27 .809
1.28 .588
```

```
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1.32 -.588
1.33 -.809
1.34 -.951
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1.36 -.951
1.37 -.809
1.38 -.588
1.39 -.309
1.4 0
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1.42 .588
1.43 .809
1.44 .951
1.45 1
1.46 .951
1.47 .809
1.48 .588
1.49 .309
1.5 0
1.51 -.309
1.52 -.588
1.53 -.809
1.54 -.951
1.55 -1
1.56 -.951
1.57 -.809
1.58 -.588
1.59 -.309
1.6 0
1.61 .309
1.62 .588
1.63 .809
1.64 .951
1.65 1
1.66 .951
1.67 .809
1.68 .588
1.69 .309
1.7 0
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1.72 -.588
1.73 -.809
1.74 -.951
1.75 -1
1.76 -.951
1.77 -.809
1.78 -.588
1.79 -.309
1.8 0
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1.82 .588
1.83 .809
1.84 .951
1.85 1
1.86 .951
1.87 .809
1.88 .588
```

```
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1.92 -.588
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1.94 -.951
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1.96 -.951
1.97 -.809
1.98 -.588
1.99 -.309
2 0
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2.02 .588
2.03 .809
2.04 .951
2.05 1
2.06 .951
2.07 .809
2.08 .588
2.09 .309
2.1 0
2.11 -.309
2.12 -.588
2.13 -.809
2.14 -.951
2.15 -1
2.16 -.951
2.17 -.809
2.18 -.588
2.19 -.309
2.2 0
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2.22 .588
2.23 .809
2.24 .951
2.25 1
2.26 .951
2.27 .809
2.28 .588
2.29 .309
2.3 0
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2.32 -.588
2.33 -.809
2.34 -.951
2.35 -1
2.36 -.951
2.37 -.809
2.38 -.588
2.39 -.309
2.4 0
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2.42 .588
2.43 .809
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2.45 1
2.46 .951
2.47 .809
2.48 .588
```

```
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2.59 -.309
2.6 0
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2.62 .588
2.63 .809
2.64 .951
2.65 1
2.66 .951
2.67 .809
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2.72 -.588
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2.75 -1
2.76 -.951
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2.95 -1
2.96 -.951
2.97 -.809
2.98 -.588
2.99 -.309
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3.04 .951
3.05 1
3.06 .951
3.07 .809
3.08 .588
```

```
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3.12 -.588
3.13 -.809
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3.17 -.809
3.18 -.588
3.19 -.309
3.2 0
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3.26 .951
3.27 .809
3.28 .588
3.29 .309
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3.39 -.309
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3.46 .951
3.47 .809
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3.68 .588
```

```
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```

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4.88 .588
```

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15.81 .309
15.82 .588
15.83 .809
15.84 .951
15.85 1
15.86 .951
15.87 .809
15.88 .588
15.89 .309
15.9 -6.52E-08
15.91 -.309
15.92 -.588
15.93 -.809
15.94 -.951
15.95 -1
15.96 -.951
15.97 -.809
15.98 -.588
15.99 -.309
16 6.56E-08
16.01 .309
16.02 .588
16.03 .809
16.04 .951
16.05 1
16.06 .951
16.07 .809
16.08 .588
16.09 .309
16.1 -6.6E-08
16.11 -.309
16.12 -.588
16.13 -.809
16.14 -.951
16.15 -1
16.16 -.951
16.17 -.809
16.18 -.588
16.19 -.309
16.2 6.64E-08
16.21 .309
16.22 .588
16.23 .809
16.24 .951
16.25 1
16.26 .951
16.27 .809
16.28 .588
```

```
16.29 .309
16.3 -6.69E-08
16.31 -.309
16.32 -.588
16.33 -.809
16.34 -.951
16.35 -1
16.36 -.951
16.37 -.809
16.38 -.588
16.39 -.309
16.4 6.73E-08
16.41 .309
16.42 .588
16.43 .809
16.44 .951
16.45 1
16.46 .951
16.47 .809
16.48 .588
16.49 .309
16.5 -6.77E-08
16.51 -.309
16.52 -.588
16.53 -.809
16.54 -.951
16.55 -1
16.56 -.951
16.57 -.809
16.58 -.588
16.59 -.309
16.6 6.81E-08
16.61 .309
16.62 .588
16.63 .809
16.64 .951
16.65 1
16.66 .951
16.67 .809
16.68 .588
16.69 .309
16.7 -6.85E-08
16.71 -.309
16.72 -.588
16.73 -.809
16.74 -.951
16.75 -1
16.76 -.951
16.77 -.809
16.78 -.588
16.79 -.309
16.8 6.89E-08
16.81 .309
16.82 .588
16.83 .809
16.84 .951
16.85 1
16.86 .951
16.87 .809
16.88 .588
```

```
16.89 .309
16.9 -6.93E-08
16.91 -.309
16.92 -.588
16.93 -.809
16.94 -.951
16.95 -1
16.96 -.951
16.97 -.809
16.98 -.588
16.99 -.309
17 6.97E-08
17.01 .309
17.02 .588
17.03 .809
17.04 .951
17.05 1
17.06 .951
17.07 .809
17.08 .588
17.09 .309
17.1 -7.01E-08
17.11 -.309
17.12 -.588
17.13 -.809
17.14 -.951
17.15 -1
17.16 -.951
17.17 -.809
17.18 -.588
17.19 -.309
17.2 7.06E-08
17.21 .309
17.22 .588
17.23 .809
17.24 .951
17.25 1
17.26 .951
17.27 .809
17.28 .588
17.29 .309
17.3 -7.1E-08
17.31 -.309
17.32 -.588
17.33 -.809
17.34 -.951
17.35 -1
17.36 -.951
17.37 -.809
17.38 -.588
17.39 -.309
17.4 7.14E-08
17.41 .309
17.42 .588
17.43 .809
17.44 .951
17.45 1
17.46 .951
17.47 .809
17.48 .588
```

```
17.49 .309
17.5 -7.18E-08
17.51 -.309
17.52 -.588
17.53 -.809
17.54 -.951
17.55 -1
17.56 -.951
17.57 -.809
17.58 -.588
17.59 -.309
17.6 7.22E-08
17.61 .309
17.62 .588
17.63 .809
17.64 .951
17.65 1
17.66 .951
17.67 .809
17.68 .588
17.69 .309
17.7 -7.26E-08
17.71 -.309
17.72 -.588
17.73 -.809
17.74 -.951
17.75 -1
17.76 -.951
17.77 -.809
17.78 -.588
17.79 -.309
17.8 7.3E-08
17.81 .309
17.82 .588
17.83 .809
17.84 .951
17.85 1
17.86 .951
17.87 .809
17.88 .588
17.89 .309
17.9 -7.34E-08
17.91 -.309
17.92 -.588
17.93 -.809
17.94 -.951
17.95 -1
17.96 -.951
17.97 -.809
17.98 -.588
17.99 -.309
18 7.38E-08
18.01 .309
18.02 .588
18.03 .809
18.04 .951
18.05 1
18.06 .951
18.07 .809
18.08 .588
```

```
18.09 .309
18.1 -7.42E-08
18.11 -.309
18.12 -.588
18.13 -.809
18.14 -.951
18.15 -1
18.16 -.951
18.17 -.809
18.18 -.588
18.19 -.309
18.2 7.47E-08
18.21 .309
18.22 .588
18.23 .809
18.24 .951
18.25 1
18.26 .951
18.27 .809
18.28 .588
18.29 .309
18.3 -7.51E-08
18.31 -.309
18.32 -.588
18.33 -.809
18.34 -.951
18.35 -1
18.36 -.951
18.37 -.809
18.38 -.588
18.39 -.309
18.4 7.55E-08
18.41 .309
18.42 .588
18.43 .809
18.44 .951
18.45 1
18.46 .951
18.47 .809
18.48 .588
18.49 .309
18.5 -7.59E-08
18.51 -.309
18.52 -.588
18.53 -.809
18.54 -.951
18.55 -1
18.56 -.951
18.57 -.809
18.58 -.588
18.59 -.309
18.6 7.63E-08
18.61 .309
18.62 .588
18.63 .809
18.64 .951
18.65 1
18.66 .951
18.67 .809
18.68 .588
```

```
18.69 .309
18.7 -7.67E-08
18.71 -.309
18.72 -.588
18.73 -.809
18.74 -.951
18.75 -1
18.76 -.951
18.77 -.809
18.78 -.588
18.79 -.309
18.8 7.71E-08
18.81 .309
18.82 .588
18.83 .809
18.84 .951
18.85 1
18.86 .951
18.87 .809
18.88 .588
18.89 .309
18.9 -7.75E-08
18.91 -.309
18.92 -.588
18.93 -.809
18.94 -.951
18.95 -1
18.96 -.951
18.97 -.809
18.98 -.588
18.99 -.309
19 7.79E-08
19.01 .309
19.02 .588
19.03 .809
19.04 .951
19.05 1
19.06 .951
19.07 .809
19.08 .588
19.09 .309
19.1 -7.84E-08
19.11 -.309
19.12 -.588
19.13 -.809
19.14 -.951
19.15 -1
19.16 -.951
19.17 -.809
19.18 -.588
19.19 -.309
19.2 7.88E-08
19.21 .309
19.22 .588
19.23 .809
19.24 .951
19.25 1
19.26 .951
19.27 .809
19.28 .588
```

```
19.29 .309
19.3 -7.92E-08
19.31 -.309
19.32 -.588
19.33 -.809
19.34 -.951
19.35 -1
19.36 -.951
19.37 -.809
19.38 -.588
19.39 -.309
19.4 7.96E-08
19.41 .309
19.42 .588
19.43 .809
19.44 .951
19.45 1
19.46 .951
19.47 .809
19.48 .588
19.49 .309
19.5 -8E-08
19.51 -.309
19.52 -.588
19.53 -.809
19.54 -.951
19.55 -1
19.56 -.951
19.57 -.809
19.58 -.588
19.59 -.309
19.6 8.04E-08
19.61 .309
19.62 .588
19.63 .809
19.64 .951
19.65 1
19.66 .951
19.67 .809
19.68 .588
19.69 .309
19.7 -8.08E-08
19.71 -.309
19.72 -.588
19.73 -.809
19.74 -.951
19.75 -1
19.76 -.951
19.77 -.809
19.78 -.588
19.79 -.309
19.8 8.12E-08
19.81 .309
19.82 .588
19.83 .809
19.84 .951
19.85 1
19.86 .951
19.87 .809
19.88 .588
```

```
    19.89 .309
    19.9 -8.16E-08
    19.91 -.309
    19.92 -.588
    19.93 -.809
    19.94 -.951
    19.95 -1
    19.96 -.951
    19.97 -.809
    19.98 -.588
    19.99 -.309
    20 8.21E-08

HISTORY
  NAME=GRAVITY TYPE=NON NSTEP=10 DT=1 DAMP=.99 FTOL=.0000001 ETOL=.0000001
    LOAD=GRAVITY FUNC=RAMP5 SF=1 AT=0
  NAME=SINE TYPE=NON NSTEP=1000 DT=.005 DAMP=0 PREV=GRAVITY
    ACC=U1  ANG=0 FUNC=SINE SF=579.6 AT=0

OUTPUT
; No Output Requested

END

; The following data is used for graphics, design and pushover analysis.
; If changes are made to the analysis data above, then the following data
; should be checked for consistency.
SAP2000 V7.10 SUPPLEMENTAL DATA
  GRID GLOBAL  X "1"  0
  GRID GLOBAL  Y "2"  0
  GRID GLOBAL  Z "3"  0
  GRID GLOBAL  Z "4"  101.68
  GRID GLOBAL  Z "5"  118.61
  MATERIAL STEEL FY 36
  MATERIAL CONC FYREBAR 60 FYSHEAR 40 FC 4 FCSHEAR 4
  STATICLOAD GRAVITY TYPE DEAD
END SUPPLEMENTAL DATA
```

```
ISFSI Pad Seismic Sliding Analyses (Set 1, u=1.19)

; File C:\DATA\SAP2000N\Pad sliding\Cases\ISFSI,set1,u=1.19.$2k saved 11/16/01
11:03:14 in Kip-in

SYSTEM
  DOF=UX,UY,UZ,RX,RY,RZ  LENGTH=IN  FORCE=Kip  LINES=56

JOINT
  1  X=0  Y=0  Z=118.5
  4  X=0  Y=0  Z=0

RESTRAINT
  ADD=4  DOF=R1,R2,R3

PATTERN
  NAME=DEFAULT

MASS
  ADD=1  U1=18.63354  U2=18.63354  U3=18.63354
  ADD=4  U1=20.704  U2=20.704  U3=20.704

MATERIAL
  NAME=STEEL  IDES=S
    T=0  E=29000  U=.3  A=.0000065  FY=36
  NAME=CONC  IDES=C  M=2.246377E-07  W=.0000868
    T=0  E=3600  U=.2  A=.0000055
  NAME=RIGID  IDES=N
    T=0  E=16000  U=.2  A=0

FRAME SECTION
  NAME=FSEC1 MAT=STEEL SH=R T=18,10 A=180 J=3916.671 I=4860,1500 AS=150,150
  NAME=CASK MAT=STEEL A=2580.8 J=1E+07 I=3557015,3557015 AS=1E+07,1E+07 S=1,1
Z=1,1 R=1,1 T=18,10

NLPROP
  NAME=CONTACT    TYPE=Isolator2  M=.168  W=65
    DOF=U1  KE=1E+08  CE=0  K=1E+08
    DOF=U2  KE=1E+07  CE=0  K=1E+07  FRICT=1.19,1.19
    DOF=U3  KE=1E+07  CE=0  K=1E+07  FRICT=1.19,1.19

FRAME
  1  J=1,4  SEC=CASK  NSEG=2  ANG=0

NLLINK
  1  J=4  NLP=CONTACT  ANG=0  AXDIR=+Z

LOAD
  NAME=GRAVITY  SW=1
    TYPE=FORCE
      ADD=1  UZ=-7200
      ADD=4  UZ=-8000

MODE
  TYPE=RITZ  N=12
    ACC=UX
    ACC=UY
    ACC=UZ
    LOAD=GRAVITY
    NLLINK=*
```

```
FUNCTION
  NAME=RAMP5 NPL=1 PRINT=Y
    0 0
    5 1
  NAME=H1 DT=0 NPL=1 PRINT=Y FILE=isset1fp.txt
  NAME=H2 DT=0 NPL=1 PRINT=Y FILE=isset1fn.txt
  NAME=V DT=0 NPL=1 PRINT=Y FILE=isset1v.txt

HISTORY
  NAME=GRAVITY TYPE=NON NSTEP=10 DT=1 DAMP=.99 FTOL=.00001 ETOL=.00001
    LOAD=GRAVITY FUNC=RAMP5 SF=1 AT=0
  NAME=SEISMIC TYPE=NON NSTEP=9625 DT=.005 DAMP=0 PREV=GRAVITY ENVE=Y
    MODE=1 DAMP=.05
    MODE=2 DAMP=.05
    MODE=3 DAMP=.05
    ACC=U1  ANG=0 FUNC=H1 SF=386.4 AT=0
    ACC=U2  ANG=0 FUNC=H2 SF=386.4 AT=0
    ACC=U3 FUNC=V SF=386.4 AT=0

OUTPUT
  ELEM=JOINT  TYPE=DISP  HIST=SEISMIC
  ELEM=FRAME  TYPE=FORCE  HIST=SEISMIC

END

; The following data is used for graphics, design and pushover analysis.
; If changes are made to the analysis data above, then the following data
; should be checked for consistency.
SAP2000 V7.10 SUPPLEMENTAL DATA
  GRID GLOBAL  X "1"  0
  GRID GLOBAL  Y "2"  0
  GRID GLOBAL  Z "3"  0
  GRID GLOBAL  Z "4"  118.5
  MATERIAL STEEL FY 36
  MATERIAL CONC FYREBAR 60 FYSHEAR 40 FC 4 FCSHEAR 4
  STATICLOAD GRAVITY TYPE DEAD
END SUPPLEMENTAL DATA
```

```
ISFSI Pad Seismic Sliding Analyses (Set 2a, u=1.19)

; File C:\DATA\SAP2000N\Pad sliding\Cases\ISFSI,set2a,u=1.19.s2k saved 11/16/01
11:13:20 in Kip-in

SYSTEM
  DOF=UX,UY,UZ,RX,RY,RZ  LENGTH=IN  FORCE=Kip  LINES=56

JOINT
  1  X=0  Y=0  Z=118.5
  4  X=0  Y=0  Z=0

RESTRAINT
  ADD=4  DOF=R1,R2,R3

PATTERN
  NAME=DEFAULT

MASS
  ADD=4  U1=20.704  U2=20.704  U3=20.704
  ADD=1  U1=18.63354  U2=18.63354  U3=18.63354

MATERIAL
  NAME=STEEL  IDES=S
    T=0  E=29000  U=.3  A=.0000065  FY=36
  NAME=CONC  IDES=C  M=2.246377E-07  W=.0000868
    T=0  E=3600  U=.2  A=.0000055
  NAME=RIGID  IDES=N
    T=0  E=16000  U=.2  A=0

FRAME SECTION
  NAME=FSEC1 MAT=STEEL SH=R T=18,10 A=180 J=3916.671 I=4860,1500 AS=150,150
  NAME=CASK MAT=STEEL A=2580.8 J=1E+07 I=3557015,3557015 AS=1E+07,1E+07 S=1,1
Z=1,1 R=1,1 T=18,10

NLPROP
  NAME=CONTACT    TYPE=Isolator2  M=.168  W=65
    DOF=U1  KE=1E+08  CE=0  K=1E+08
    DOF=U2  KE=1E+07  CE=0  K=1E+07  FRICT=1.19,1.19
    DOF=U3  KE=1E+07  CE=0  K=1E+07  FRICT=1.19,1.19

FRAME
  1  J=1,4  SEC=CASK  NSEG=2  ANG=0

NLLINK
  1  J=4  NLP=CONTACT  ANG=0  AXDIR=+Z

LOAD
  NAME=GRAVITY  SW=1
    TYPE=FORCE
      ADD=4  UZ=-8000
      ADD=1  UZ=-7200

MODE
  TYPE=RITZ  N=12
    ACC=UX
    ACC=UY
    ACC=UZ
    LOAD=GRAVITY
    NLLINK=*
```

```
FUNCTION
  NAME=RAMP5 NPL=1 PRINT=Y
    0 0
    5 1
  NAME=H1 DT=0 NPL=1 PRINT=Y FILE=iset2afp.txt
  NAME=H2 DT=0 NPL=1 PRINT=Y FILE=iset2afn.txt
  NAME=V DT=0 NPL=1 PRINT=Y FILE=iset2av.txt

HISTORY
  NAME=GRAVITY TYPE=NON NSTEP=10 DT=1 DAMP=.99
    LOAD=GRAVITY FUNC=RAMP5 SF=1 AT=0
  NAME=SEISMIC TYPE=NON NSTEP=8000 DT=.005 DAMP=0 PREV=GRAVITY ENVE=Y
    MODE=1 DAMP=.05
    MODE=2 DAMP=.05
    MODE=3 DAMP=.05
    ACC=U1  ANG=0 FUNC=H1 SF=386.4 AT=0
    ACC=U2  ANG=0 FUNC=H2 SF=386.4 AT=0
    ACC=U3 FUNC=V SF=386.4 AT=0

OUTPUT
  ELEM=JOINT  TYPE=DISP  HIST=SEISMIC
  ELEM=FRAME  TYPE=FORCE  HIST=SEISMIC

END

; The following data is used for graphics, design and pushover analysis.
; If changes are made to the analysis data above, then the following data
; should be checked for consistency.
SAP2000 V7.10 SUPPLEMENTAL DATA
  GRID GLOBAL  X "1"  0
  GRID GLOBAL  Y "2"  0
  GRID GLOBAL  Z "3"  0
  GRID GLOBAL  Z "4"  118.5
  MATERIAL STEEL FY 36
  MATERIAL CONC FYREBAR 60 FYSHEAR 40 FC 4 FCSHEAR 4
  STATICLOAD GRAVITY TYPE DEAD
END SUPPLEMENTAL DATA
```

```
ISFSI Pad Seismic Sliding Analysis (Set 3, u=1.19)

; File C:\DATA\SAP2000N\Pad sliding\Cases\ISFSI,set3,u=1.19.s2k saved 11/16/01
11:22:48 in Kip-in

SYSTEM
  DOF=UX,UY,UZ,RX,RY,RZ  LENGTH=IN  FORCE=Kip  LINES=56

JOINT
  1  X=0  Y=0  Z=118.5
  4  X=0  Y=0  Z=0

RESTRAINT
  ADD=4  DOF=R1,R2,R3

PATTERN
  NAME=DEFAULT

MASS
  ADD=4  U1=20.704  U2=20.704  U3=20.704
  ADD=1  U1=18.63354  U2=18.63354  U3=18.63354

MATERIAL
  NAME=STEEL  IDES=S
    T=0  E=29000  U=.3  A=.0000065  FY=36
  NAME=CONC  IDES=C  M=2.246377E-07  W=.0000868
    T=0  E=3600  U=.2  A=.0000055
  NAME=RIGID  IDES=N
    T=0  E=16000  U=.2  A=0

FRAME SECTION
  NAME=FSEC1 MAT=STEEL SH=R T=18,10 A=180 J=3916.671 I=4860,1500 AS=150,150
  NAME=CASK MAT=STEEL A=2580.8 J=1E+07 I=3557015,3557015 AS=1E+07,1E+07 S=1,1
Z=1,1 R=1,1 T=18,10

NLPROP
  NAME=CONTACT    TYPE=Isolator2  M=.168  W=65
    DOF=U1  KE=1E+08  CE=0  K=1E+08
    DOF=U2  KE=1E+07  CE=0  K=1E+07  FRICT=1.19,1.19
    DOF=U3  KE=1E+07  CE=0  K=1E+07  FRICT=1.19,1.19

FRAME
  1  J=1,4  SEC=CASK  NSEG=2  ANG=0

NLLINK
  1  J=4  NLP=CONTACT  ANG=0  AXDIR=+Z

LOAD
  NAME=GRAVITY  SW=1
    TYPE=FORCE
      ADD=4  UZ=-8000
      ADD=1  UZ=-7200

MODE
  TYPE=RITZ  N=12
    ACC=UX
    ACC=UY
    ACC=UZ
    LOAD=GRAVITY
    NLLINK=*
```

```
FUNCTION
  NAME=RAMP5 NPL=1 PRINT=Y
    0 0
    5 1
  NAME=H1 DT=0 NPL=1 PRINT=Y FILE=isset3fp.txt
  NAME=H2 DT=0 NPL=1 PRINT=Y FILE=isset3fn.txt
  NAME=V DT=0 NPL=1 PRINT=Y FILE=isset3v.txt

HISTORY
  NAME=GRAVITY TYPE=NON NSTEP=10 DT=1 DAMP=.99
    LOAD=GRAVITY FUNC=RAMP5 SF=1 AT=0
  NAME=SEISMIC TYPE=NON NSTEP=4391 DT=.005 DAMP=0 PREV=GRAVITY ENVE=Y
    MODE=1 DAMP=.05
    MODE=2 DAMP=.05
    MODE=3 DAMP=.05
    ACC=U1  ANG=0 FUNC=H1 SF=386.4 AT=0
    ACC=U2  ANG=0 FUNC=H2 SF=386.4 AT=0
    ACC=U3 FUNC=V SF=386.4 AT=0

OUTPUT
  ELEM=JOINT  TYPE=DISP  HIST=SEISMIC
  ELEM=FRAME  TYPE=FORCE  HIST=SEISMIC

END

; The following data is used for graphics, design and pushover analysis.
; If changes are made to the analysis data above, then the following data
; should be checked for consistency.
SAP2000 V7.10 SUPPLEMENTAL DATA
  GRID GLOBAL  X "1"  0
  GRID GLOBAL  Y "2"  0
  GRID GLOBAL  Z "3"  0
  GRID GLOBAL  Z "4"  118.5
  MATERIAL STEEL FY 36
  MATERIAL CONC FYREBAR 60 FYSHEAR 40 FC 4 FCSHEAR 4
  STATICLOAD GRAVITY TYPE DEAD
END SUPPLEMENTAL DATA
```



Calculation No. 52.27.100.704, Rev. 0 ISFSI Pad Seismic Sliding
Analyses - Input File
Appendix A, Page A10-2

```
ISFSI Pad Seismic Sliding Analyses (Set 5, u=1.19)

; File C:\DATA\SAP2000N\Pad sliding\Cases\ISFSI,set5,u=1.19.s2k saved 11/16/01
11:40:38 in Kip-in

SYSTEM
  DOF=UX,UY,UZ,RX,RY,RZ  LENGTH=IN  FORCE=Kip  LINES=56

JOINT
  1  X=0  Y=0  Z=118.5
  4  X=0  Y=0  Z=0

RESTRAINT
  ADD=4  DOF=R1,R2,R3

PATTERN
  NAME=DEFAULT

MASS
  ADD=4  U1=20.704  U2=20.704  U3=20.704
  ADD=1  U1=18.63354  U2=18.63354  U3=18.63354

MATERIAL
  NAME=STEEL  IDES=S
    T=0  E=29000  U=.3  A=.0000065  FY=36
  NAME=CONC  IDES=C  M=2.246377E-07  W=.0000868
    T=0  E=3600  U=.2  A=.0000055
  NAME=RIGID  IDES=N
    T=0  E=16000  U=.2  A=0

FRAME SECTION
  NAME=FSEC1 MAT=STEEL SH=R T=18,10 A=180 J=3916.671 I=4860,1500 AS=150,150
  NAME=CASK MAT=STEEL A=2580.8 J=1E+07 I=3557015,3557015 AS=1E+07,1E+07 S=1,1
Z=1,1 R=1,1 T=18,10

NLPROP
  NAME=CONTACT    TYPE=Isolator2  M=.168  W=65
    DOF=U1  KE=1E+08  CE=0  K=1E+08
    DOF=U2  KE=1E+07  CE=0  K=1E+07  FRICT=1.19,1.19
    DOF=U3  KE=1E+07  CE=0  K=1E+07  FRICT=1.19,1.19

FRAME
  1  J=1,4  SEC=CASK  NSEG=2  ANG=0

NLLINK
  1  J=4  NLP=CONTACT  ANG=0  AXDIR=+Z

LOAD
  NAME=GRAVITY  SW=1
    TYPE=FORCE
      ADD=4  UZ=-8000
      ADD=1  UZ=-7200

MODE
  TYPE=RITZ  N=12
    ACC=UX
    ACC=UY
    ACC=UZ
    LOAD=GRAVITY
```

```
    NLLINK=*

FUNCTION
  NAME=RAMP5 NPL=1 PRINT=Y
    0 0
    5 1
  NAME=H1 DT=0 NPL=1 PRINT=Y FILE=isset5fp.txt
  NAME=H2 DT=0 NPL=1 PRINT=Y FILE=isset5fn.txt
  NAME=V DT=0 NPL=1 PRINT=Y FILE=isset5v.txt

HISTORY
  NAME=GRAVITY TYPE=NON NSTEP=10 DT=1 DAMP=.99
    LOAD=GRAVITY FUNC=RAMP5 SF=1 AT=0
  NAME=SEISMIC TYPE=NON NSTEP=8000 DT=.005 DAMP=0 PREV=GRAVITY ENVE=Y
    MODE=1 DAMP=.05
    MODE=2 DAMP=.05
    MODE=3 DAMP=.05
    ACC=U1  ANG=0 FUNC=H1 SF=386.4 AT=0
    ACC=U2  ANG=0 FUNC=H2 SF=386.4 AT=0
    ACC=U3 FUNC=V SF=386.4 AT=0

OUTPUT
  ELEM=JOINT  TYPE=DISP  HIST=SEISMIC
  ELEM=FRAME  TYPE=FORCE  HIST=SEISMIC

END

; The following data is used for graphics, design and pushover analysis.
; If changes are made to the analysis data above, then the following data
; should be checked for consistency.
SAP2000 V7.10 SUPPLEMENTAL DATA
  GRID GLOBAL  X "1"  0
  GRID GLOBAL  Y "2"  0
  GRID GLOBAL  Z "3"  0
  GRID GLOBAL  Z "4"  118.5
  MATERIAL STEEL FY 36
  MATERIAL CONC FYREBAR 60 FYSHEAR 40 FC 4 FCSHEAR 4
  STATICLOAD GRAVITY TYPE DEAD
END SUPPLEMENTAL DATA
```

```
ISFSI Pad Seismic Sliding Analyses (Set 6, u=1.19)

; File C:\DATA\SAP2000N\Pad sliding\Cases\ISFSI,set6,u=1.19.s2k saved 11/16/01
12:00:16 in Kip-in

SYSTEM
  DOF=UX,UY,UZ,RX,RY,RZ  LENGTH=IN  FORCE=Kip  LINES=56

JOINT
  1  X=0  Y=0  Z=118.5
  4  X=0  Y=0  Z=0

RESTRAINT
  ADD=4  DOF=R1,R2,R3

PATTERN
  NAME=DEFAULT

MASS
  ADD=4  U1=20.704  U2=20.704  U3=20.704
  ADD=1  U1=18.63354  U2=18.63354  U3=18.63354

MATERIAL
  NAME=STEEL  IDES=S
    T=0  E=29000  U=.3  A=.0000065  FY=36
  NAME=CONC  IDES=C  M=2.246377E-07  W=.0000868
    T=0  E=3600  U=.2  A=.0000055
  NAME=RIGID  IDES=N
    T=0  E=16000  U=.2  A=0

FRAME SECTION
  NAME=FSEC1 MAT=STEEL SH=R T=18,10 A=180 J=3916.671 I=4860,1500 AS=150,150
  NAME=CASK MAT=STEEL A=2580.8 J=1E+07 I=3557015,3557015 AS=1E+07,1E+07 S=1,1
Z=1,1 R=1,1 T=18,10

NLPROP
  NAME=CONTACT    TYPE=Isolator2  M=.168  W=65
    DOF=U1  KE=1E+08  CE=0  K=1E+08
    DOF=U2  KE=1E+07  CE=0  K=1E+07  FRICT=1.19,1.19
    DOF=U3  KE=1E+07  CE=0  K=1E+07  FRICT=1.19,1.19

FRAME
  1  J=1,4  SEC=CASK  NSEG=2  ANG=0

NLLINK
  1  J=4  NLP=CONTACT  ANG=0  AXDIR=+Z

LOAD
  NAME=GRAVITY  SW=1
    TYPE=FORCE
      ADD=4  UZ=-8000
      ADD=1  UZ=-7200

MODE
  TYPE=RITZ  N=12
    ACC=UX
    ACC=UY
    ACC=UZ
    LOAD=GRAVITY
```

```
    NLLINK=*

FUNCTION
  NAME=RAMP5 NPL=1 PRINT=Y
    0 0
    5 1
  NAME=H1 DT=0 NPL=1 PRINT=Y FILE=isset6fp.txt
  NAME=H2 DT=0 NPL=1 PRINT=Y FILE=isset6fn.txt
  NAME=V DT=0 NPL=1 PRINT=Y FILE=isset6v.txt

HISTORY
  NAME=GRAVITY TYPE=NON NSTEP=10 DT=1 DAMP=.99
    LOAD=GRAVITY FUNC=RAMP5 SF=1 AT=0
  NAME=SEISMIC TYPE=NON NSTEP=7989 DT=.005 DAMP=0 PREV=GRAVITY ENVE=Y
    MODE=1 DAMP=.05
    MODE=2 DAMP=.05
    MODE=3 DAMP=.05
    ACC=U1  ANG=0 FUNC=H1 SF=386.4 AT=0
    ACC=U2  ANG=0 FUNC=H2 SF=386.4 AT=0
    ACC=U3 FUNC=V SF=386.4 AT=0

OUTPUT
  ELEM=JOINT  TYPE=DISP  HIST=SEISMIC
  ELEM=FRAME  TYPE=FORCE  HIST=SEISMIC

END

; The following data is used for graphics, design and pushover analysis.
; If changes are made to the analysis data above, then the following data
; should be checked for consistency.
SAP2000 V7.10 SUPPLEMENTAL DATA
  GRID GLOBAL  X "1"  0
  GRID GLOBAL  Y "2"  0
  GRID GLOBAL  Z "3"  0
  GRID GLOBAL  Z "4"  118.5
  MATERIAL STEEL FY 36
  MATERIAL CONC FYREBAR 60 FYSHEAR 40 FC 4 FCSHEAR 4
  STATICLOAD GRAVITY TYPE DEAD
END SUPPLEMENTAL DATA
```

```
ISFSI Pad Seismic Sliding Analyses (Set1, u=0.73)

; File C:\DATA\SAP2000N\Pad sliding\Cases\ISFSI,set1,u=0.73.s2k saved 11/16/01
12:22:10 in Kip-in

SYSTEM
  DOF=UX,UY,UZ,RX,RY,RZ  LENGTH=IN  FORCE=Kip  LINES=56

JOINT
  1  X=0  Y=0  Z=118.5
  4  X=0  Y=0  Z=0

RESTRAINT
  ADD=4  DOF=R1,R2,R3

PATTERN
  NAME=DEFAULT

MASS
  ADD=1  U1=18.63354  U2=18.63354  U3=18.63354
  ADD=4  U1=20.704  U2=20.704  U3=20.704

MATERIAL
  NAME=STEEL  IDES=S
    T=0  E=29000  U=.3  A=.0000065  FY=36
  NAME=CONC  IDES=C  M=2.246377E-07  W=.0000868
    T=0  E=3600  U=.2  A=.0000055
  NAME=RIGID  IDES=N
    T=0  E=16000  U=.2  A=0

FRAME SECTION
  NAME=FSEC1 MAT=STEEL SH=R T=18,10 A=180 J=3916.671 I=4860,1500 AS=150,150
  NAME=CASK MAT=STEEL A=2580.8 J=1E+07 I=3557015,3557015 AS=1E+07,1E+07 S=1,1
Z=1,1 R=1,1 T=18,10

NLPROP
  NAME=CONTACT    TYPE=Isolator2  M=.168  W=65
    DOF=U1  KE=1E+08  CE=0  K=1E+08
    DOF=U2  KE=1E+07  CE=0  K=1E+07  FRICT=.73,.73
    DOF=U3  KE=1E+07  CE=0  K=1E+07  FRICT=.73,.73

FRAME
  1  J=1,4  SEC=CASK  NSEG=2  ANG=0

NLLINK
  1  J=4  NLP=CONTACT  ANG=0  AXDIR=+Z

LOAD
  NAME=GRAVITY  SW=1
    TYPE=FORCE
      ADD=1  UZ=-7200
      ADD=4  UZ=-8000

MODE
  TYPE=RITZ  N=12
    ACC=UX
    ACC=UY
    ACC=UZ
    LOAD=GRAVITY
    NLLINK=*
```

```
FUNCTION
  NAME=RAMP5 NPL=1 PRINT=Y
    0 0
    5 1
  NAME=H1 DT=0 NPL=1 PRINT=Y FILE=isset1fp.txt
  NAME=H2 DT=0 NPL=1 PRINT=Y FILE=isset1fn.txt
  NAME=V DT=0 NPL=1 PRINT=Y FILE=isset1v.txt

HISTORY
  NAME=GRAVITY TYPE=NON NSTEP=10 DT=1 DAMP=.99 FTOL=.00001 ETOL=.00001
    LOAD=GRAVITY FUNC=RAMP5 SF=1 AT=0
  NAME=SEISMIC TYPE=NON NSTEP=9625 DT=.005 DAMP=0 FTOL=0.0000001 ETOL=0.0000001
    PREV=GRAVITY ENVE=Y
    MODE=1 DAMP=.05
    MODE=2 DAMP=.05
    MODE=3 DAMP=.05
    ACC=U1  ANG=0 FUNC=H1 SF=386.4 AT=0
    ACC=U2  ANG=0 FUNC=H2 SF=386.4 AT=0
    ACC=U3 FUNC=V SF=386.4 AT=0

OUTPUT
; No Output Requested

END

; The following data is used for graphics, design and pushover analysis.
; If changes are made to the analysis data above, then the following data
; should be checked for consistency.
SAP2000 V7.10 SUPPLEMENTAL DATA
  GRID GLOBAL  X "1"  0
  GRID GLOBAL  Y "2"  0
  GRID GLOBAL  Z "3"  0
  GRID GLOBAL  Z "4"  118.5
  MATERIAL STEEL FY 36
  MATERIAL CONC FYREBAR 60 FYSHEAR 40 FC 4 FCSHEAR 4
  STATICLOAD GRAVITY TYPE DEAD
END SUPPLEMENTAL DATA
```

```
ISFSI Pad Seismic Sliding Analysis (Set 2a, u=0.73)

; File C:\DATA\SAP2000N\Pad sliding\Cases\ISFSI,set2a,u=0.73.s2k saved 11/16/01
12:39:25 in Kip-in

SYSTEM
  DOF=UX,UY,UZ,RX,RY,RZ  LENGTH=IN  FORCE=Kip  LINES=56

JOINT
  1  X=0  Y=0  Z=118.5
  4  X=0  Y=0  Z=0

RESTRAINT
  ADD=4  DOF=R1,R2,R3

PATTERN
  NAME=DEFAULT

MASS
  ADD=4  U1=20.704  U2=20.704  U3=20.704
  ADD=1  U1=18.63354  U2=18.63354  U3=18.63354

MATERIAL
  NAME=STEEL  IDES=S
    T=0  E=29000  U=.3  A=.0000065  FY=36
  NAME=CONC  IDES=C  M=2.246377E-07  W=.0000868
    T=0  E=3600  U=.2  A=.0000055
  NAME=RIGID  IDES=N
    T=0  E=16000  U=.2  A=0

FRAME SECTION
  NAME=FSEC1 MAT=STEEL SH=R T=18,10 A=180 J=3916.671 I=4860,1500 AS=150,150
  NAME=CASK MAT=STEEL A=2580.8 J=1E+07 I=3557015,3557015 AS=1E+07,1E+07 S=1,1
Z=1,1 R=1,1 T=18,10

NLPROP
  NAME=CONTACT    TYPE=Isolator2  M=.168  W=65
    DOF=U1  KE=1E+08  CE=0  K=1E+08
    DOF=U2  KE=1E+07  CE=0  K=1E+07  FRICT=.73,.73
    DOF=U3  KE=1E+07  CE=0  K=1E+07  FRICT=.73,.73

FRAME
  1  J=1,4  SEC=CASK  NSEG=2  ANG=0

NLLINK
  1  J=4  NLP=CONTACT  ANG=0  AXDIR=+Z

LOAD
  NAME=GRAVITY  SW=1
    TYPE=FORCE
      ADD=4  UZ=-8000
      ADD=1  UZ=-7200

MODE
  TYPE=RITZ  N=12
    ACC=UX
    ACC=UY
    ACC=UZ
    LOAD=GRAVITY
    NLLINK=*
```

```
FUNCTION
  NAME=RAMP5 NPL=1 PRINT=Y
    0 0
    5 1
  NAME=H1 DT=0 NPL=1 PRINT=Y FILE=iset2afp.txt
  NAME=H2 DT=0 NPL=1 PRINT=Y FILE=iset2afn.txt
  NAME=V DT=0 NPL=1 PRINT=Y FILE=iset2av.txt

HISTORY
  NAME=GRAVITY TYPE=NON NSTEP=10 DT=1 DAMP=.99
    LOAD=GRAVITY FUNC=RAMP5 SF=1 AT=0
  NAME=SEISMIC TYPE=NON NSTEP=8000 DT=.005 DAMP=0 PREV=GRAVITY ENVE=Y
    MODE=1 DAMP=.05
    MODE=2 DAMP=.05
    MODE=3 DAMP=.05
    ACC=U1  ANG=0 FUNC=H1 SF=386.4 AT=0
    ACC=U2  ANG=0 FUNC=H2 SF=386.4 AT=0
    ACC=U3 FUNC=V SF=386.4 AT=0

OUTPUT
  ELEM=JOINT  TYPE=DISP  HIST=SEISMIC
  ELEM=FRAME  TYPE=FORCE  HIST=SEISMIC

END

; The following data is used for graphics, design and pushover analysis.
; If changes are made to the analysis data above, then the following data
; should be checked for consistency.
SAP2000 V7.10 SUPPLEMENTAL DATA
  GRID GLOBAL  X "1"  0
  GRID GLOBAL  Y "2"  0
  GRID GLOBAL  Z "3"  0
  GRID GLOBAL  Z "4"  118.5
  MATERIAL STEEL FY 36
  MATERIAL CONC FYREBAR 60 FYSHEAR 40 FC 4 FCSHEAR 4
  STATICLOAD GRAVITY TYPE DEAD
END SUPPLEMENTAL DATA
```

```
ISFSI Pad Seismic Sliding Analyses (Set 3, u=0.73)

; File C:\DATA\SAP2000N\Pad sliding\Cases\ISFSI,set3,u=0.73.s2k saved 11/16/01
12:53:21 in Kip-in

SYSTEM
  DOF=UX,UY,UZ,RX,RY,RZ  LENGTH=IN  FORCE=Kip  LINES=56

JOINT
  1  X=0  Y=0  Z=118.5
  4  X=0  Y=0  Z=0

RESTRAINT
  ADD=4  DOF=R1,R2,R3

PATTERN
  NAME=DEFAULT

MASS
  ADD=1  U1=18.63354  U2=18.63354  U3=18.63354
  ADD=4  U1=20.704  U2=20.704  U3=20.704

MATERIAL
  NAME=STEEL  IDES=S
    T=0  E=29000  U=.3  A=.0000065  FY=36
  NAME=CONC  IDES=C  M=2.246377E-07  W=.0000868
    T=0  E=3600  U=.2  A=.0000055
  NAME=RIGID  IDES=N
    T=0  E=16000  U=.2  A=0

FRAME SECTION
  NAME=FSEC1 MAT=STEEL SH=R T=18,10 A=180 J=3916.671 I=4860,1500 AS=150,150
  NAME=CASK MAT=STEEL A=2580.8 J=1E+07 I=3557015,3557015 AS=1E+07,1E+07 S=1,1
Z=1,1 R=1,1 T=18,10

NLPROP
  NAME=CONTACT    TYPE=Isolator2  M=.168  W=65
    DOF=U1  KE=1E+08  CE=0  K=1E+08
    DOF=U2  KE=1E+07  CE=0  K=1E+07  FRICT=.73,.73
    DOF=U3  KE=1E+07  CE=0  K=1E+07  FRICT=.73,.73

FRAME
  1  J=1,4  SEC=CASK  NSEG=2  ANG=0

NLLINK
  1  J=4  NLP=CONTACT  ANG=0  AXDIR=+Z

LOAD
  NAME=GRAVITY  SW=1
    TYPE=FORCE
      ADD=1  UZ=-7200
      ADD=4  UZ=-8000

MODE
  TYPE=RITZ  N=12
    ACC=UX
    ACC=UY
    ACC=UZ
    LOAD=GRAVITY
```

```
    NLLINK=*

FUNCTION
  NAME=RAMP5 NPL=1 PRINT=Y
    0 0
    5 1
  NAME=H1 DT=0 NPL=1 PRINT=Y FILE=isset3fp.txt
  NAME=H2 DT=0 NPL=1 PRINT=Y FILE=isset3fn.txt
  NAME=V DT=0 NPL=1 PRINT=Y FILE=isset3v.txt

HISTORY
  NAME=GRAVITY TYPE=NON NSTEP=10 DT=1 DAMP=.99 FTOL=.00001 ETOL=.00001
    LOAD=GRAVITY FUNC=RAMP5 SF=1 AT=0
  NAME=SEISMIC TYPE=NON NSTEP=4391 DT=.005 DAMP=0 FTOL=1E-5 ETOL=1E-5
    PREV=GRAVITY ENVE=Y
    MODE=1 DAMP=.05
    MODE=2 DAMP=.05
    MODE=3 DAMP=.05
    ACC=U1  ANG=0 FUNC=H1 SF=386.4 AT=0
    ACC=U2  ANG=0 FUNC=H2 SF=386.4 AT=0
    ACC=U3 FUNC=V SF=386.4 AT=0

OUTPUT
  ELEM=JOINT  TYPE=DISP  HIST=SEISMIC
  ELEM=FRAME  TYPE=FORCE  HIST=SEISMIC

END

; The following data is used for graphics, design and pushover analysis.
; If changes are made to the analysis data above, then the following data
; should be checked for consistency.
SAP2000 V7.10 SUPPLEMENTAL DATA
  GRID GLOBAL  X "1"  0
  GRID GLOBAL  Y "2"  0
  GRID GLOBAL  Z "3"  0
  GRID GLOBAL  Z "4"  118.5
  MATERIAL STEEL FY 36
  MATERIAL CONC FYREBAR 60 FYSHEAR 40 FC 4 FCSHEAR 4
  STATICLOAD GRAVITY TYPE DEAD
END SUPPLEMENTAL DATA
```

```
ISFSI Pad Seismic Sliding Analyses (Set 5, u=0.73)

; File C:\DATA\SAP2000N\Pad sliding\Cases\ISFSI,set5,u=0.73.s2k saved 11/16/01
13:12:42 in Kip-in

SYSTEM
  DOF=UX,UY,UZ,RX,RY,RZ  LENGTH=IN  FORCE=Kip  LINES=56

JOINT
  1  X=0  Y=0  Z=118.5
  4  X=0  Y=0  Z=0

RESTRAINT
  ADD=4  DOF=R1,R2,R3

PATTERN
  NAME=DEFAULT

MASS
  ADD=1  U1=18.63354  U2=18.63354  U3=18.63354
  ADD=4  U1=20.704  U2=20.704  U3=20.704

MATERIAL
  NAME=STEEL  IDES=S
    T=0  E=29000  U=.3  A=.0000065  FY=36
  NAME=CONC  IDES=C  M=2.246377E-07  W=.0000868
    T=0  E=3600  U=.2  A=.0000055
  NAME=RIGID  IDES=N
    T=0  E=16000  U=.2  A=0

FRAME SECTION
  NAME=FSEC1 MAT=STEEL SH=R T=18,10 A=180 J=3916.671 I=4860,1500 AS=150,150
  NAME=CASK MAT=STEEL A=2580.8 J=1E+07 I=3557015,3557015 AS=1E+07,1E+07 S=1,1
Z=1,1 R=1,1 T=18,10

NLPROP
  NAME=CONTACT    TYPE=Isolator2  M=.168  W=65
    DOF=U1  KE=1E+08  CE=0  K=1E+08
    DOF=U2  KE=1E+07  CE=0  K=1E+07  FRICT=.73,.73
    DOF=U3  KE=1E+07  CE=0  K=1E+07  FRICT=.73,.73

FRAME
  1  J=1,4  SEC=CASK  NSEG=2  ANG=0

NLLINK
  1  J=4  NLP=CONTACT  ANG=0  AXDIR=+Z

LOAD
  NAME=GRAVITY  SW=1
    TYPE=FORCE
      ADD=1  UZ=-7200
      ADD=4  UZ=-8000

MODE
  TYPE=RITZ  N=12
    ACC=UX
    ACC=UY
    ACC=UZ
    LOAD=GRAVITY
```

```
    NLLINK=*

 FUNCTION
   NAME=RAMP5 NPL=1 PRINT=Y
     0 0
     5 1
   NAME=H1 DT=0 NPL=1 PRINT=Y FILE=isset5fp.txt
   NAME=H2 DT=0 NPL=1 PRINT=Y FILE=isset5fn.txt
   NAME=V DT=0 NPL=1 PRINT=Y FILE=isset5v.txt

 HISTORY
   NAME=GRAVITY TYPE=NON NSTEP=10 DT=1 DAMP=.99 FTOL=.00001 ETOL=.00001
     LOAD=GRAVITY FUNC=RAMP5 SF=1 AT=0
   NAME=SEISMIC TYPE=NON NSTEP=8000 DT=.005 DAMP=0 PREV=GRAVITY ENVE=Y
     MODE=1 DAMP=.05
     MODE=2 DAMP=.05
     MODE=3 DAMP=.05
     ACC=U1  ANG=0 FUNC=H1 SF=386.4 AT=0
     ACC=U2  ANG=0 FUNC=H2 SF=386.4 AT=0
     ACC=U3 FUNC=V SF=386.4 AT=0

 OUTPUT
 ; No Output Requested

 END

 ; The following data is used for graphics, design and pushover analysis.
 ; If changes are made to the analysis data above, then the following data
 ; should be checked for consistency.
 SAP2000 V7.10 SUPPLEMENTAL DATA
   GRID GLOBAL  X "1"  0
   GRID GLOBAL  Y "2"  0
   GRID GLOBAL  Z "3"  0
   GRID GLOBAL  Z "4"  118.5
   MATERIAL STEEL FY 36
   MATERIAL CONC FYREBAR 60 FYSHEAR 40 FC 4 FCSHEAR 4
   STATICLOAD GRAVITY TYPE DEAD
 END SUPPLEMENTAL DATA
```

```
ISFSI Pad Seismic Sliding Analyses (Set 6, u=0.73)

; File C:\DATA\SAP2000N\Pad sliding\Cases\ISFSI,set6,u=0.73.s2k saved 11/16/01
13:23:09 in Kip-in

SYSTEM
  DOF=UX,UY,UZ,RX,RY,RZ  LENGTH=IN  FORCE=Kip  LINES=56

JOINT
  1  X=0  Y=0  Z=118.5
  4  X=0  Y=0  Z=0

RESTRAINT
  ADD=4  DOF=R1,R2,R3

PATTERN
  NAME=DEFAULT

MASS
  ADD=1  U1=18.63354  U2=18.63354  U3=18.63354
  ADD=4  U1=20.704  U2=20.704  U3=20.704

MATERIAL
  NAME=STEEL  IDES=S
    T=0  E=29000  U=.3  A=.0000065  FY=36
  NAME=CONC  IDES=C  M=2.246377E-07  W=.0000868
    T=0  E=3600  U=.2  A=.0000055
  NAME=RIGID  IDES=N
    T=0  E=16000  U=.2  A=0

FRAME SECTION
  NAME=FSEC1 MAT=STEEL SH=R T=18,10 A=180 J=3916.671 I=4860,1500 AS=150,150
  NAME=CASK MAT=STEEL A=2580.8 J=1E+07 I=3557015,3557015 AS=1E+07,1E+07 S=1,1
Z=1,1 R=1,1 T=18,10

NLPROP
  NAME=CONTACT    TYPE=Isolator2  M=.168  W=65
    DOF=U1  KE=1E+08  CE=0  K=1E+08
    DOF=U2  KE=1E+07  CE=0  K=1E+07  FRICT=.73,.73
    DOF=U3  KE=1E+07  CE=0  K=1E+07  FRICT=.73,.73

FRAME
  1  J=1,4  SEC=CASK  NSEG=2  ANG=0

NLLINK
  1  J=4  NLP=CONTACT  ANG=0  AXDIR=+Z

LOAD
  NAME=GRAVITY  SW=1
    TYPE=FORCE
      ADD=1  UZ=-7200
      ADD=4  UZ=-8000

MODE
  TYPE=RITZ  N=12
    ACC=UX
    ACC=UY
    ACC=UZ
    LOAD=GRAVITY
```

```
    NLLINK=*

FUNCTION
  NAME=RAMP5 NPL=1 PRINT=Y
    0 0
    5 1
  NAME=H1 DT=0 NPL=1 PRINT=Y FILE=isset6fp.txt
  NAME=H2 DT=0 NPL=1 PRINT=Y FILE=isset6fn.txt
  NAME=V DT=0 NPL=1 PRINT=Y FILE=isset6v.txt

HISTORY
  NAME=GRAVITY TYPE=NON NSTEP=10 DT=1 DAMP=.99 FTOL=.00001 ETOL=.00001
    LOAD=GRAVITY FUNC=RAMP5 SF=1 AT=0
  NAME=SEISMIC TYPE=NON NSTEP=7989 DT=.005 DAMP=0 PREV=GRAVITY ENVE=Y
    MODE=1 DAMP=.05
    MODE=2 DAMP=.05
    MODE=3 DAMP=.05
    ACC=U1  ANG=0 FUNC=H1 SF=386.4 AT=0
    ACC=U2  ANG=0 FUNC=H2 SF=386.4 AT=0
    ACC=U3 FUNC=V SF=386.4 AT=0

OUTPUT
; No Output Requested

END

; The following data is used for graphics, design and pushover analysis.
; If changes are made to the analysis data above, then the following data
; should be checked for consistency.
SAP2000 V7.10 SUPPLEMENTAL DATA
  GRID GLOBAL  X "1"  0
  GRID GLOBAL  Y "2"  0
  GRID GLOBAL  Z "3"  0
  GRID GLOBAL  Z "4"  118.5
  MATERIAL STEEL FY 36
  MATERIAL CONC FYREBAR 60 FYSHEAR 40 FC 4 FCSHEAR 4
  STATICLOAD GRAVITY TYPE DEAD
END SUPPLEMENTAL DATA
```