NON-PROPRIETARY CALCULATIONS

Book 2 of 8

Attachments to PG&E Letter DIL-01-004
Dated December 21, 2001

Calculation No.

PGE-009-CALC-003

ENERCON SERVICES, INC.	ENGINEERING CALCULATION COVER SHEET	Calc. No.	PGE-009-CALC-003
		Rev.	2
		Sheet	1 of 89
Title: ISFSI Cask Storage Pad Seismic Analysis		Client:	PG&E
		Job No.	PGE-009

Purpose Of Calculation:

The purpose of this calculation is to compute the size and thickness of the ISFSI Cask Storage Pads and to compute the moments within the storage pad for the controlling seismic load combinations specified for the site. Analyses are in compliance with the seismic load combinations, as set forth, in References 2, 3, 8 and 9 for load combinations, which involve Hosgri and Long-Term Seismic Program earthquakes. The ISFSI Facility will contain (7) pads, which will support (20) HI-Storm Storage Casks per pad. The storage casks are arranged in a 5 x 4 array and are located on 17'-0" centers. The results of the analyses indicate that a pad, 105'-0" (N-S direction) x 68'-0" (E-W direction) x 7'-6" thick (nominal), is acceptable for the storage casks and the seismic loads.

This Calculation considers load combinations for the sequencing of cask placements, but does not consider load conditions other than seismic (e.g., curing temperatures and shrinkage). The results from this Calculation will be used in Calculation No. PGE-009-CALC-007 to evaluate the concrete per the design codes and to determine the size of steel reinforcement.

NOTE: This Calculation is furnished as part of PG&E Contract No. 4600010841, Change Order No. 001

Scope Of Revision:

Revised references 4 and 7 to latest revision.

Revision Impact On Results:

No impact.

STATE OF MICHIGAN
STEPHEN C. TUMMINELLI
ENGINEER
No. 28729
LICENSED PROFESSIONAL ENGINEER

☒ Safety Related ☐ Non-Safety Related

☐ Preliminary Calculation ☒ Final

Approvals
(Print Name and Sign)

Originator	S.C. TUMMINELLI	Date December 14, 2001
Reviewer		
Verification Engineer	K.L. WHITMORE	Date December 14, 2001
Approver	R.F. EVERS	Date December 14, 2001

ENERCON SERVICES, INC.

ENGINEERING CALCULATION REVISION STATUS SHEET

CALCULATION NO. **PGE-009-CALC-003**

ENGINEERING CALCULATION REVISION SUMMARY

REVISION NO.	DATE	DESCRIPTION
0	5/25/01	Initial Issue
1	11/30/01	General Revision
2	12/14/01	Revised references 4 and 7 to latest revision

CALCULATION SHEET REVISION STATUS

SHEET NO.	REVISION NO.	SHEET NO.	REVISION NO.
All	1	8	2

APPENDIX AND ATTACHMENT REVISION STATUS

APPENDIX NUMBER	ISSUE DATE	REV. DATE	REISSUE DATE	APPENDIX NUMBER	ISSUE DATE	REV. DATE	REISSUE DATE
AL-1	5/25/01	11/30/01		MD-3	5/25/01	11/30/01	
DN-1	5/25/01		11/30/01	MD-4	11/30/01		
DN-2	5/25/01		11/30/01	RL-1	5/25/01		11/30/01
DN-3	5/25/01		11/30/01	RL-2	5/25/01		11/30/01
DN-4	5/25/01		11/30/01	RL-3	11/30/01		
DN-5	11/30/01			RL-4	11/30/01		
DN-6	11/30/01			RL-5	11/30/01		
DN-7	11/30/01			RL-6	11/30/01		
DP-1	5/25/01		11/30/01	SN-1	5/25/01	11/30/01	
EN-1	11/30/01			SN-2	5/25/01		11/30/01
FC-1	11/30/01			SN-3	5/25/01	11/30/01	
FC-2	11/30/01			SN-4	5/25/01		11/30/01
LT-1	11/30/01			SN-5	5/25/01		11/30/01
MD-1	5/25/01		11/30/01	SN-6	5/25/01	11/30/01	
MD-2	5/25/01	11/30/01					

ENERCON SERVICES, INC.

JOB. NO.	PGE-009	DATE	December 14, 2001
PROJECT	DCPP ISFSI		
SUBJECT	ISFSI Cask Storage Pad Seismic Analysis		
CLIENT	PG&E-DCPP	ORIGINATOR	S. C. Tumminelli
REVIEWER	K. L. Whitmore	APPROVED	R. F. Evers
CALCULATION NO.	PGE-009-CALC-003	REVISION	2

Method of Review:

The calculation has been independently reviewed in accordance with the requirements of ENERCON Corporate Standard Procedure 3.01. The independent verification of the calculation was performed by a detailed review and check of the entire calculation. This included verification of inputs, methodology, results and conclusions as well as a check of the mathematical accuracy of the computations.

Results:

The calculation has been independently verified to be mathematically correct and to be performed in accordance with license and design basis requirements and applicable codes. Inputs are appropriate and are obtained from verified source documents. The calculation is sufficiently documented and detailed to permit independent verification. No assumptions are made other than conservative simplifying assumptions which are identified and do not require confirmation. The methodology used is appropriate and consistent with the purpose of the calculation.

With the exception of the use of non-linear contact elements between the bottom of the concrete support pad and the surface of the rock, the analysis documented in this calculation is a straightforward, first order linear static analysis. The analysis is performed using ANSYS, a computer analysis code that is in widespread use throughout the nuclear industry and that is known to produce accurate results when utilized appropriately.

The use of the non-linear contact elements has been separately verified in computer verification and validation report PGE-009-VVR-003. These elements are designed to transfer compression loads from the concrete pad to the rock but to not transfer any tension loads across the surface. This allows the pad to lift free from the rock in the model if the loads and geometry indicate that liftoff should occur. As documented in PGE-009-VVR-003, these elements have been shown to produce results that are consistent with theoretical values and hand calculations. Thus, the use of these elements in the analysis produces appropriate results.

As indicated in Appendix MD-3, the boundary conditions used in the model are appropriate and do not appreciably affect the results of the analysis. The three directional components of the earthquake load are applied in a conservative and realistic manner that adequately captures the expected behavior during an actual earthquake.

Thus, the analysis has been independently verified to be technically correct and to be consistent with license and design basis requirements. The results and conclusions accurately reflect the findings of the calculation. Thus, the concrete pad has been shown to be of an adequate size to support 20 fully loaded spent fuel storage casks during a seismic event at Diablo Canyon Power Plant.

ENERCON SERVICES, INC.

JOB. NO.	PGE-009	DATE	November 30, 2001
PROJECT	DCPP ISFSI		
SUBJECT	ISFSI Cask Storage Pad Seismic Analysis		
CLIENT	PG&E-DCPP	ORIGINATOR	S. C. Tumminelli
REVIEWER	K. L. Whitmore	APPROVED	R. F. Evers
CALCULATION NO.	PGE-009-CALC-003	REVISION	1

Table of Contents

DN-5	Max Pad and Cask Displacements – 90% Pad Density	33 pages
DN-6	Max Displacements and Stresses – Cask Extraction	43 pages
DN-7	Max Pad and Cask Displacements – Soft Rock with Nu = 0.23	19 pages
DP-1	Pad Vertical Displacement Plots – Soft Rock Model	11 pages
SN-1	Maximum and Minimum Pad X and Z Stresses	229 pages
SN-2	Maximum Rock Vertical Stresses	87 pages
SN-3	Max and Min Pad Stresses – 90% Pad Density	37 pages
SN-6	Max and Min Pad Stresses – Soft Rock with Nu = 0.23	18 pages
FC-1	Pad Internal Forces – Soft Rock Model	338 pages
FC-2	Pad Internal Forces – Soft Rock with Nu = 0.23	205 pages
EN-1	Envelope Data – Cask Placement Sequence	47 pages
LT-1	Analyses for Adjusted LTSP Loads	62 pages

The following appendices provide the data that supports the boundary condition study presented in Appendix MD-3.

RL-2	BC Study - Reaction Loads	85 pages
DN-3	BC Study - Maximum Pad Displacements	45 pages
DN-4	BC Study - Maximum Cask Displacements	36 pages
SN-4	BC Study - Maximum and Minimum Pad X and Z Stresses	92 pages
SN-5	BC Study - Maximum Rock Vertical Stresses	58 pages

ISFSI Pad Seismic Analysis

The primary purpose of this calculation is to determine the storage pad size and thickness required to resist the loads resulting from seismic accelerations applied to the pad and to the used fuel storage casks anchored to the pad. The limiting parameter considered in this assessment is that the pad displacement under the pad dead weight and seismic loads be held to an acceptable value. The analyses presented herein demonstrate that the pad displacements are within acceptable limits. Further this calculation demonstrates that the pad stresses are low and the rock bearing stresses are within acceptable limits for the pad configuration analyzed. Finally, this calculation provides pad internal forces and moments to be used in a subsequent calculation to demonstrate that the design is compliant with the ACI Code and to size the pad reinforcement for the seismic loads.

This initial portion of this calculation is performed for the fully loaded configuration, i.e., the pad is designed to accommodate 20 storage casks, and the analyses are performed for the condition of 20 fully loaded casks in place on the pad. Each cask will be physically anchored to the pad with an embedment support structure, evaluated and designed in Calculation 001 (Reference 6). The pad analyses are performed for seismic loads selected to maximize the pad displacements. These analyses are performed for a range of rock properties that have been determined to exist at the site. Additional calculations are then performed that evaluate the pad for the most demanding of the seismic loads and rock properties for the following conditions:

- Pad mass reduced to 90% of its expected value. Necessary to demonstrate ACI Code compliance and to bound the possible as built configurations.
- Cask Placement Sequence. These analyses evaluate the pad for configurations that will exist during the cask placement sequence.
- Cask Extraction. These analyses evaluate the pad for the situation where three casks must be removed from a fully loaded pad.
- Effects of Poisson's Ratio of the Rock. These analyses are designed to provide bounding data for the calculation of pad internal forces and moments.

The pad internal forces and moments will be used in subsequent calculations to demonstrate ACI Code compliance and to determine the required size of reinforcement. These subsequent calculations will also address stresses due to temperature and shrinkage that are not addressed in this calculation.

The analyses performed in this calculation are in compliance with the seismic load combinations involving the Hosgri and Long Term Seismic Program seismic events set forth in PG&E Specification 10012-N-NPG, Holtec report HI-2002511, USNRC NUREG 1536 and ACI 349-97 (References 2, 3, 8, and 9 respectively).

The ISFSI facility will contain 7 pads, each of which will support 20 HI-Storm storage casks. The casks will be arranged in a 5 x 4 array, 17 feet center to center of casks, located in the center of each pad. The

results of these analyses indicate that the pad, 105 feet N-S by 68 feet E-W and nominally 7.5 feet thick, is acceptable for the storage casks and the seismic loads, see Figure 1.

Each cask will be attached to an embedment support structure, which will be embedded within the pads (see Reference 6). These embedment structures will transfer the applied loads from the casks to the pads. Compression from the casks to the pad will be transferred directly through a bearing plate and a prepared concrete surface within the embedment structure. Tension will be transferred through rods extending from the concrete surface to anchor plates deep within the pad. The casks are approximately 134 inches in diameter and have a support flange with an outer diameter of 146.5 inches. The diameter of the hold down stud circle is 139.5 inches (Reference 7).

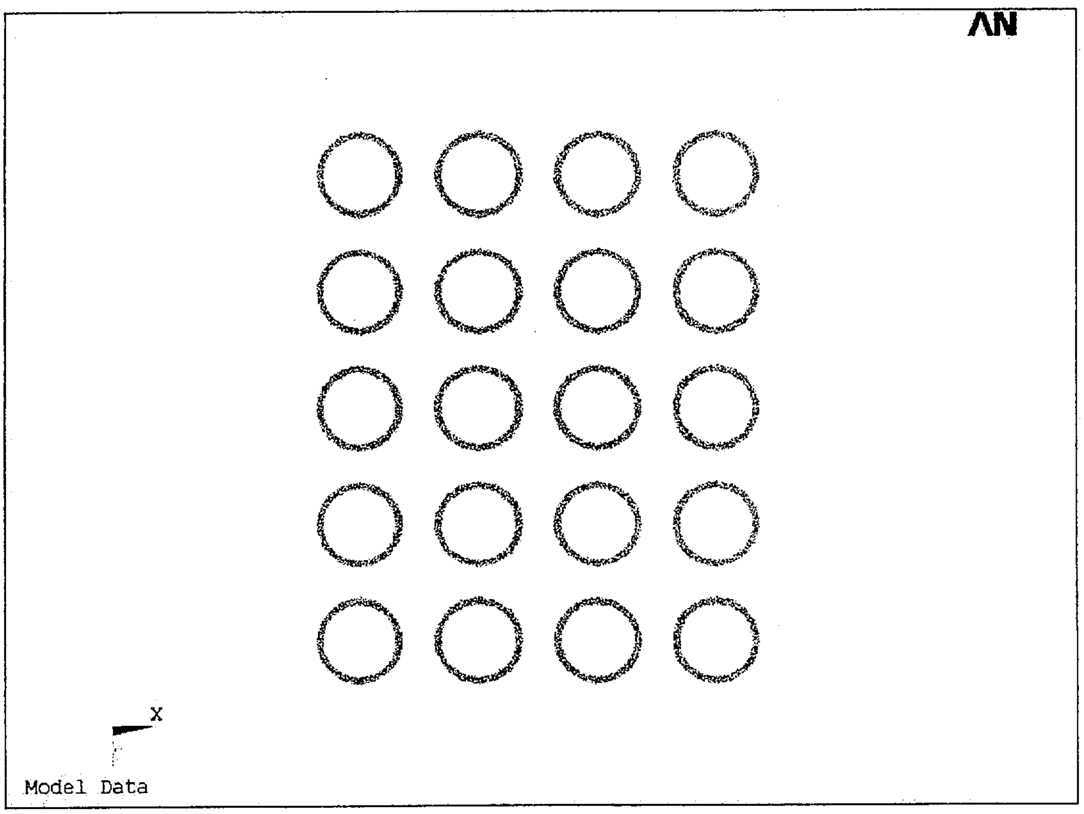


Figure 1 - Plan of One Pad with Casks

Holtec, the cask designer, has supplied the cask loads for the Hosgri and the LTSP earthquakes (Reference 4, page 9). See Table 1 herein. These, together with the seismic ZPAs from PG&E (Reference 2), are the input loads for this calculation. The pads are to be constructed from 5000 psi concrete with 60,000 psi reinforcing steel, and they are to be placed directly on the cut rock. The pads will not be physically attached to the rock.

The analysis described below is a non-linear static analysis wherein the concrete pad is allowed to lift off the rock support if the loads and geometry dictate that liftoff should occur. All material properties are linear and small deflection theory is used. Compression only gap elements are used at the interface between the pad and the rock. This is the only non-linear modeling feature in the analyses, otherwise the analysis is first order linear. The analysis software is ANSYS, Release 5.7 (Reference 1).

References

1. ANSYS, Release 5.7, ANSYS, Inc., Southpointe, 275 Technology Drive, Canonsburg, PA 15317.
2. PG&E Specification, 10012-N-NPG, Rev 2.
3. HOLTEC Report HI-2002511, Rev.2, Design Criteria Document for the ISFSI Pad for Anchored HI-Storm 100 Deployment at the Diablo Canyon Power Plant, dated July 12, 2001.
4. HOLTEC Report HI-2012618, Rev. 5, Analysis of Anchored HI-Storm Casks at the Diablo Canyon ISFSI, dated December 11, 2001.
5. Not Used
6. ENERCON Calculation PGE-009-CALC-001, Embedment Support Structure, latest revision.
7. Holtec Drawing 3570, Rev 2, Cask Anchor Stud and Sector Lug Arrangement, Dec.12, 2001.
8. USNRC, NUREG 1536,: Standard Review Plan for Dry Cask Storage Systems
9. ACI 349-97, Code Requirements for Nuclear Safety Related Concrete Structures
10. USNRC Draft Regulatory Guide DG-1098, Safety-Related Concrete Structures for Nuclear Power Plants (Other Than Reactor Vessels and Containments), dated August 2000.
11. PG&E Calculation 52.27.100.711, Development of Young's Modulus and Poisson's Ratios for the DCPP ISFSI Based on Field Data (Ref. GEO.DCPP.01.01), Rev 0, November 9, 2001.
12. PG&E Calculation 52.27.100.725, Development of Young's Modulus and Poisson's Ratios for the DCPP ISFSI Based on Laboratory Data (GEO Sciences # GEO.DCPP.01.15), Rev 1, November 27, 2001.

Pad ANSYS Static Model Construction Description

The static analysis model is a solid finite element model. This model is non-linear due to the contact surface between the rock and the concrete pad. Except for the treatment of the interface surface between the pad and the rock, the model is constructed entirely of three dimensional solid elements. At the interface surface, contact elements transmit compression loads only, no tensile loads are transmitted through this interface. Also, at the interface, shear loads are transmitted from the pad into the rock through constraint equations. This shear interface simulates a contact surface that extends over the entire area of the pad. Since the model is constructed using solid elements, there are three translation degrees of freedom at each node. The rotations at the nodes are not included in the solution. The models are constructed in a Cartesian coordinate system with X pointing West, Y pointing vertically up and Z pointing North.

The geometry of the pad, casks and rock elements is shown in Figure 2, below.

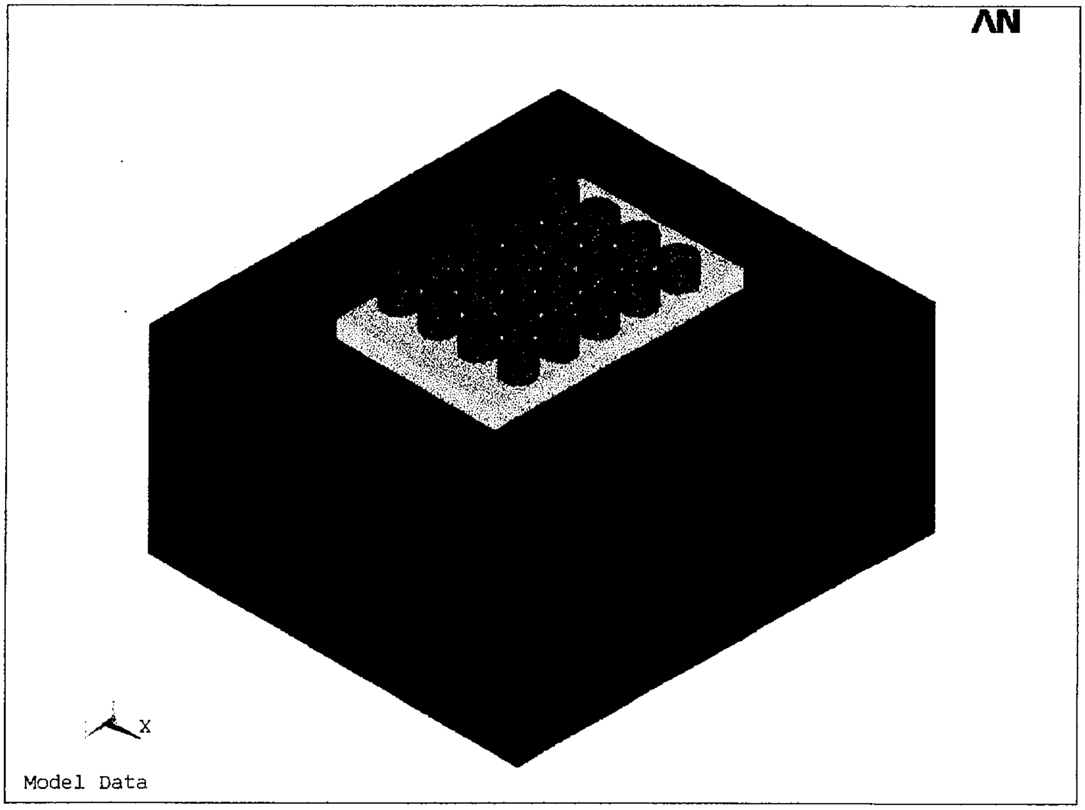


Figure 2 - Isometric of casks, pad and rock

The completed model with the finite element mesh is shown in Figure 3 below. The "extra strip" of elements immediately around the pad is an analysis surface for the contact (compression only) elements. The various parts of the model are presented and described below.

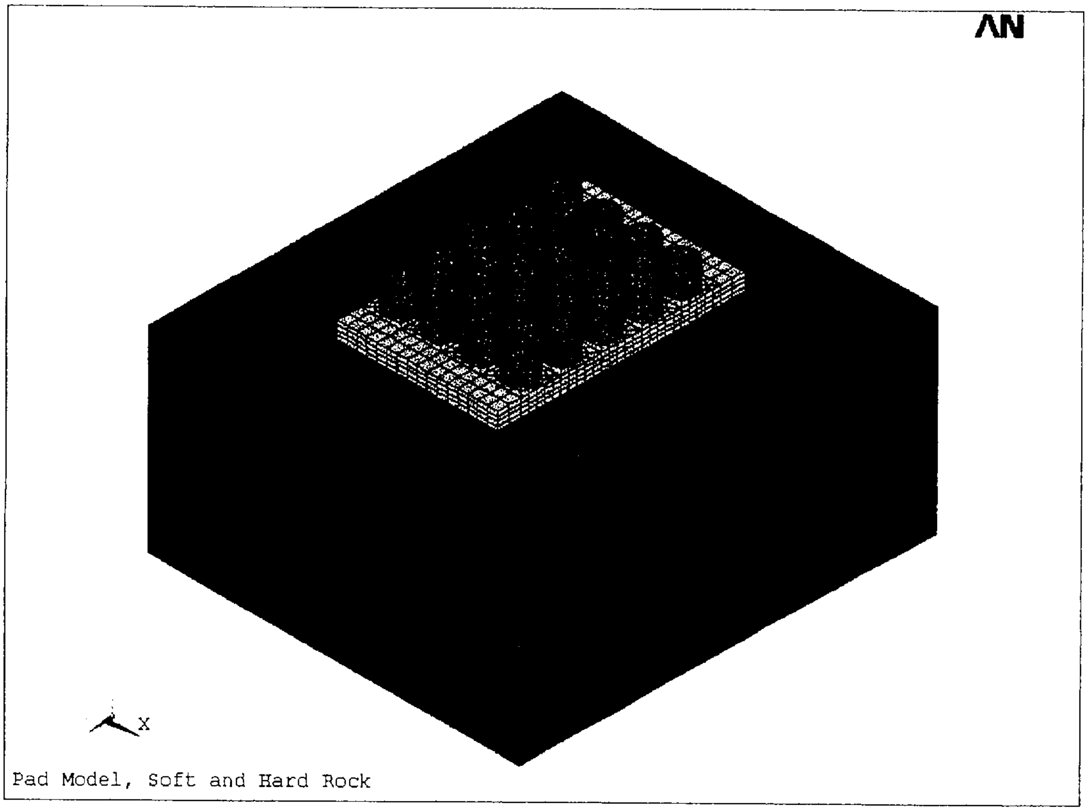


Figure 3 – Full Model With Finite Element Mesh

Concrete Pad

The concrete pad is modeled with Element Type #1. Element Type #1 is the ANSYS SOLID45 8-noded structural solid element. No special features of this element were invoked. Thus, the element uses its full integration scheme, and its extra displacement shapes are included. Hence, the use of four elements through the thickness results in a very accurate model for the pad. In plan, the mesh is designed to accommodate the configuration of the casks. The concrete is designated Material Type 1 and is assumed to be homogenous with a Young's modulus of 4.0×10^6psi (57000 x SQRT (5000)). (The analysis results confirm that this is a reasonable assumption, since no cracking due to the application of the seismic loads is expected to occur.) A Poisson's ratio of 0.15 is used for this material. This material has a density of $2.2465 \times 10^{-4} lb_m/in^3$ or $150 lb_f/ft^3$. This is the only element type in the model to have a density assigned to it. This will be further discussed below.

The concrete pad's overall dimensions are 105 feet in the Z-direction, 68 feet in the X-direction, and 7.5 feet thick. The cask center to center spacing is 17 feet in both directions. The pad mesh is designed to mate with the bases of the casks. Those dimensions are given in the Cask section below. The following Figures 4, 5 and 6 show the pad surface and a close up of the mesh at one cask location. The completed model with the material numbers identified for the various materials is shown in Figures 11 and 12.

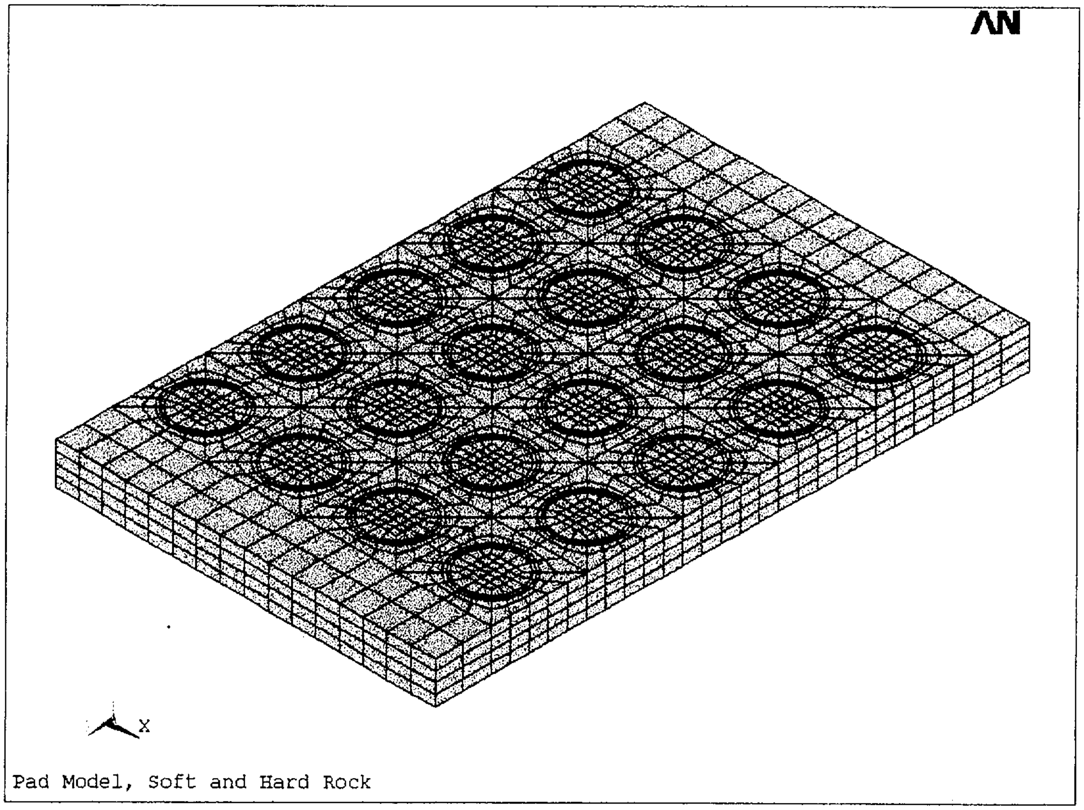


Figure 4 – Isometric view of the Concrete Pad

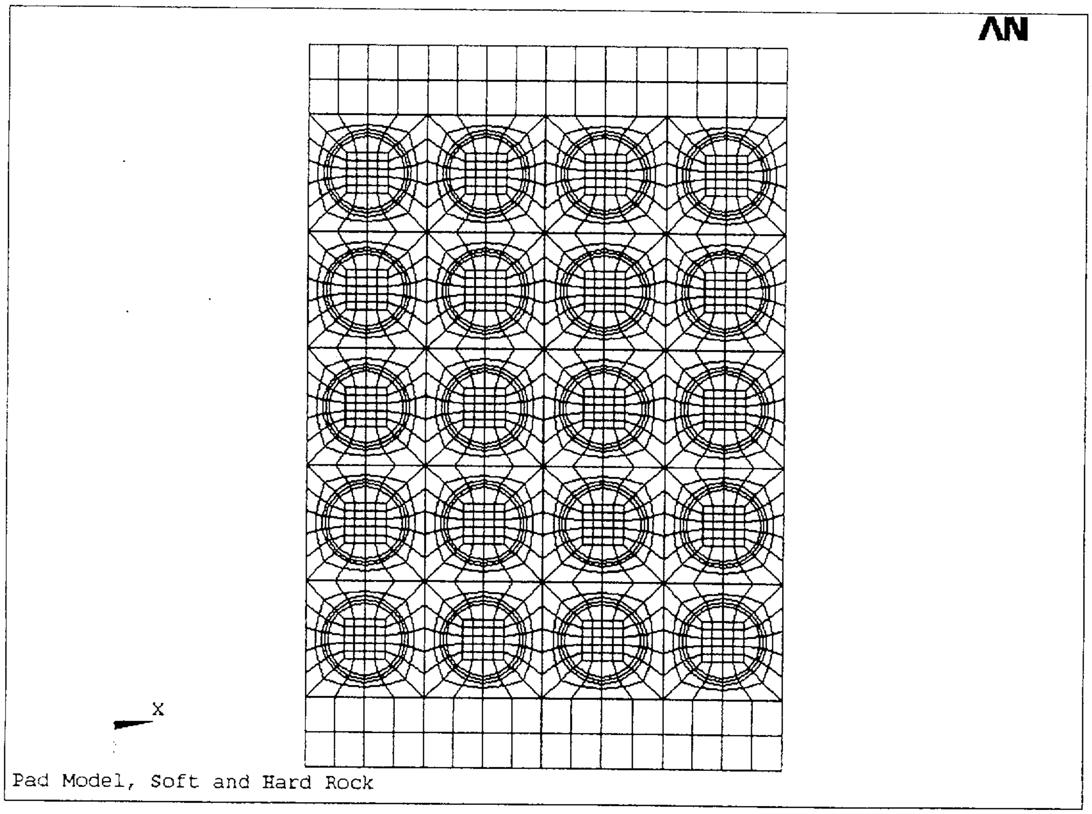


Figure 5 – Top view of the Concrete Pad

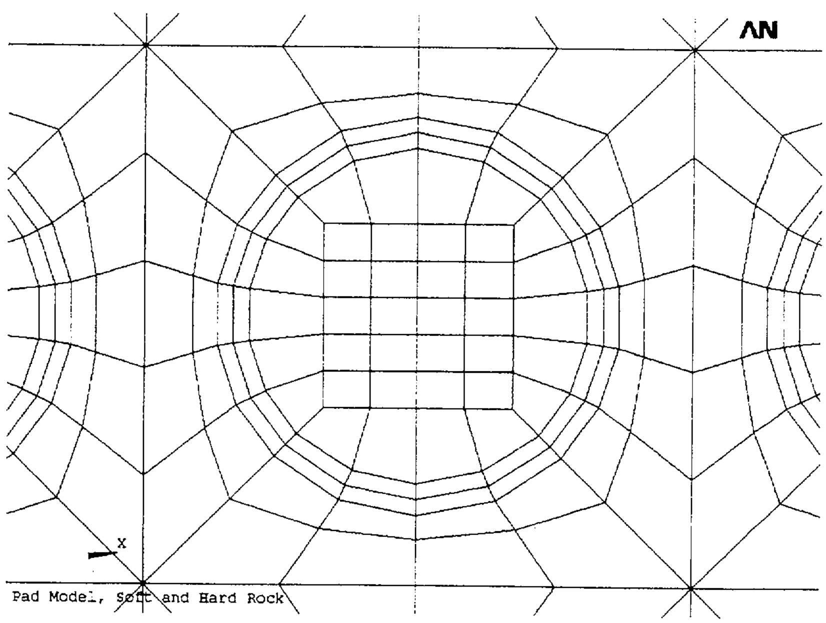


Figure 6 – Close up of the Concrete Pad at one cask location

Rock

The rock is modeled with Element Type #2. Element Type #2 is also the ANSYS SOLID45 8-noded structural solid element. As with the use of this element for the pad, no special features of this element were invoked for the rock. The rock is designated Material Type 2 and is assumed to be homogeneous.

The rock data has evolved over the course of the analysis due to the fact that rock testing and data reduction were in process while the initial analysis and design were also in process. There are two types of rock beneath the footprint of the seven pads, altered sandstone and dolomite. The altered sandstone is referred to herein as "soft rock" and the dolomite is referred to as "hard rock". The final rock properties are all documented in two PG&E calculations, References 11 and 12. These calculations document the results of testing performed on the rock using field data (Ref. 11) and lab data (Ref. 12). Three full sets of analyses were performed and are documented here. The first two are for the values concluded to be for the range of design values, the third was for an assessment for very hard rock, since one data point indicated that this was a possibility at one time. However, the final data reduction did not conclude that there was enough of this very hard rock to perform design basis analyses. A summary of the final soil properties for design is provided in Reference 12. The Poisson's ratios used in the analyses are closer to the higher values from the field data than the lab data. The effects of the lower Poisson's ratios from the lab data are subsequently discussed and evaluated in this calculation.

Full Set of Rock Properties Specified and Properties Used for Analysis

Rock	Young's modulus	Poisson's ratio
Altered Sandstone Soft – field data Soft – lab data	 0.2×10^6 0.21×10^6	 0.31 0.23
Used in Analysis	0.2×10^6	0.35
Dolomite Hard – field data Hard – lab data	 2.0×10^6 1.3 to 1.5×10^6	 0.37 0.22
Used in Analysis	2.0×10^6	0.35
Dolomite Very Hard - lab data	4.9×10^6	0.23
Used in Analysis	4.9×10^6	0.24

The rock portion of the model is wide and thick to insure that the rock extends a sufficient distance from the pad so that the boundary conditions of the rock do not affect the stiffness of the rock beneath the pad. It is 158 feet in the X direction, 175 feet in the Z, and is 85 feet thick, see Figure 7 below. The pad is located in the center of the rock surface. The boundary conditions for the rock model are that all three degrees of freedom are fixed on the sides and on the bottom of the rock. These are applied as loads in the ANSYS system and will be discussed again below. The completed model with the material numbers identified for the various materials is shown in Figures 11 and 12.

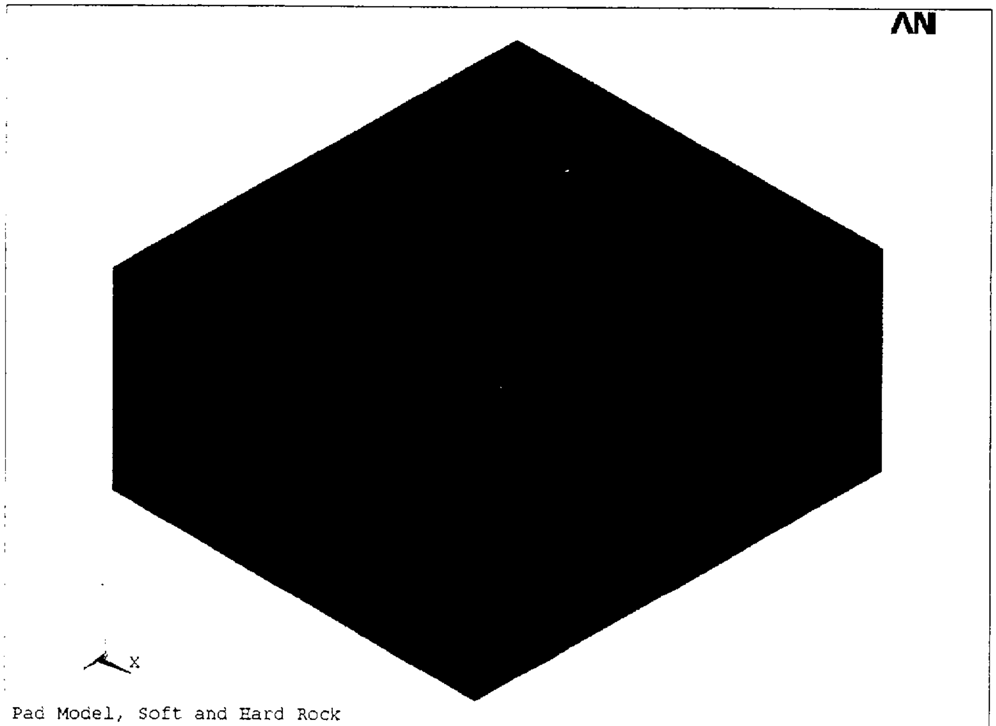


Figure 7 – Isometric view of the Rock

Casks

The casks are modeled with Element Type #4. Element Type #4 is the ANSYS SOLID45 8-noded structural solid element. Again, as with the use of this element for the pad, no special features of this element were invoked. The casks are modeled up to a plane 118.5 inches above the pad (Reference 4, Table 1). This is the location of the Center of Gravity of the casks and is, therefore, where the loads are applied. This is further discussed in detail below.

The casks are attached to the concrete pad to transmit load directly into the pad without complex interfaces. The only function of the casks in the model is to deliver the loads and moments to the pad at the appropriate locations and with the appropriate distribution, as least with respect to delivering the load over the appropriate surface area. The mean diameter of the cask wall in the model is 139 inches,

which is the diameter of the hold down stud circle (139.5 inches). The cask wall thickness in the model is 12 inches.

The casks have a fundamental frequency of 16 Hz when analyzed with the embedment structure. Therefore, given the geometry of the modeled casks and a total mass of 360 kips (Reference 4, Table 1 (270+90)) located at 118.5 inches from the pad surface, a Young's modulus of 409000 psi was computed to provide casks with fundamental frequencies of 16 Hz. See Appendix MD-2 for the details. A Poisson's Ratio of 0.30 is used for this element type, which is designated Material Type #4.

Twenty casks are positioned on the pad as shown in the following Figure 8. The subsequent Figures 9 and 10 show a view looking down on a cask, alone, and then with the pad beneath it. The completed model with the material numbers identified for the various materials is shown in Figures 11 and 12.

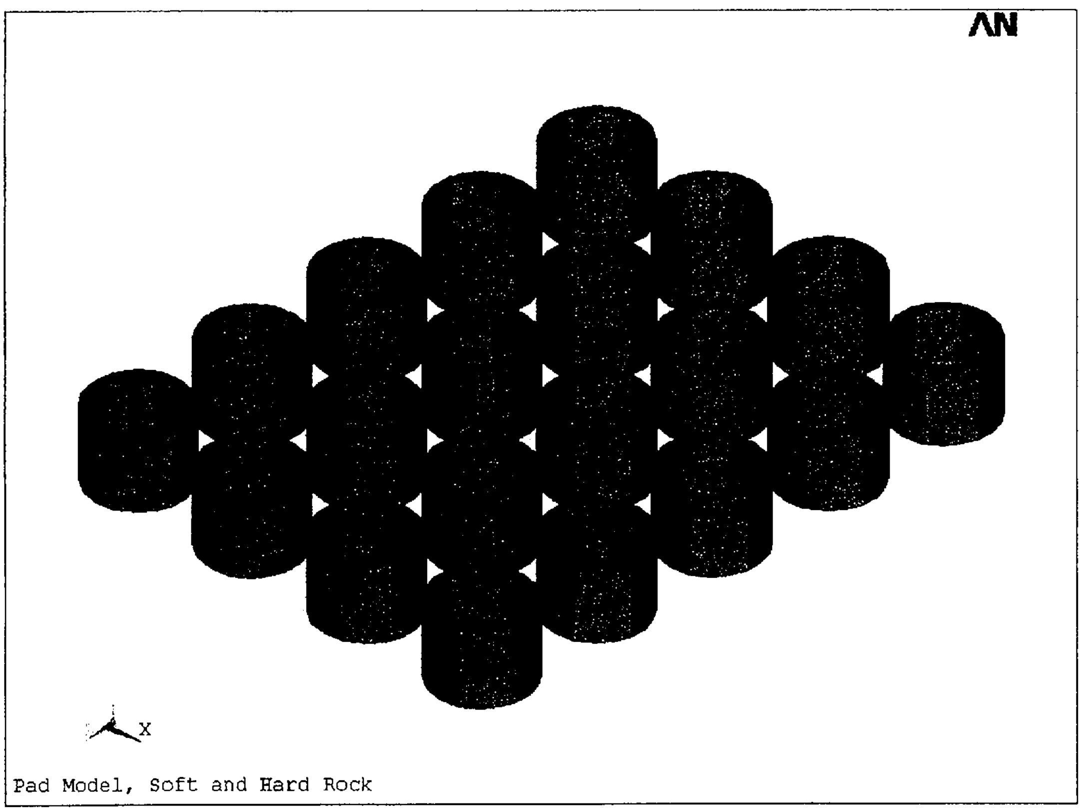


Figure 8 – Isometric view of the Casks (modeled to CG of actual cask)

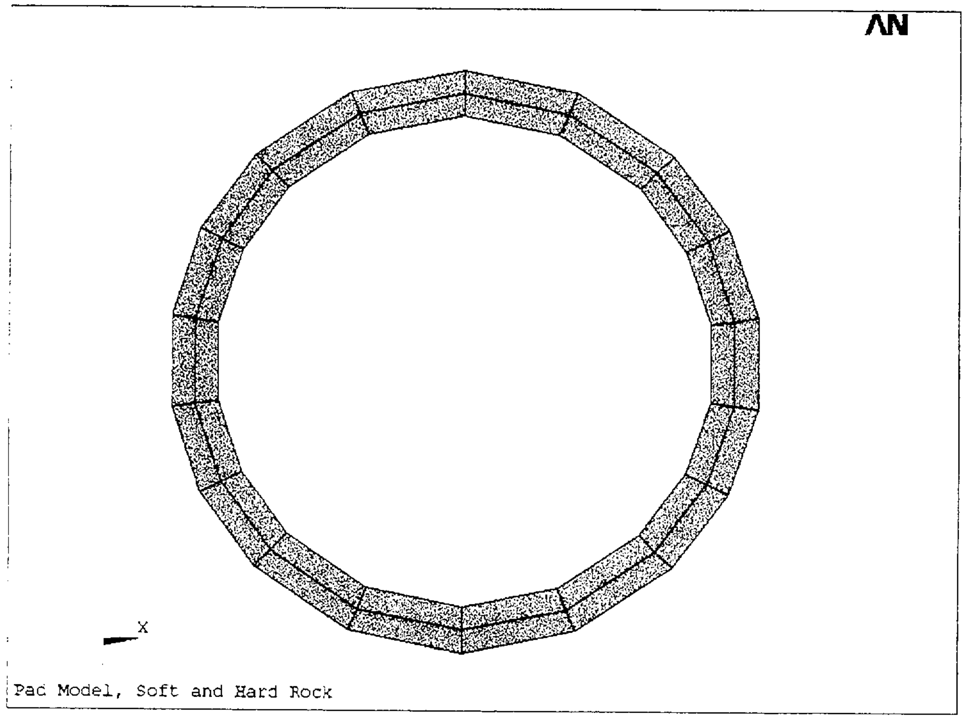


Figure 9 – Top view of one Cask model showing two elements through the thickness

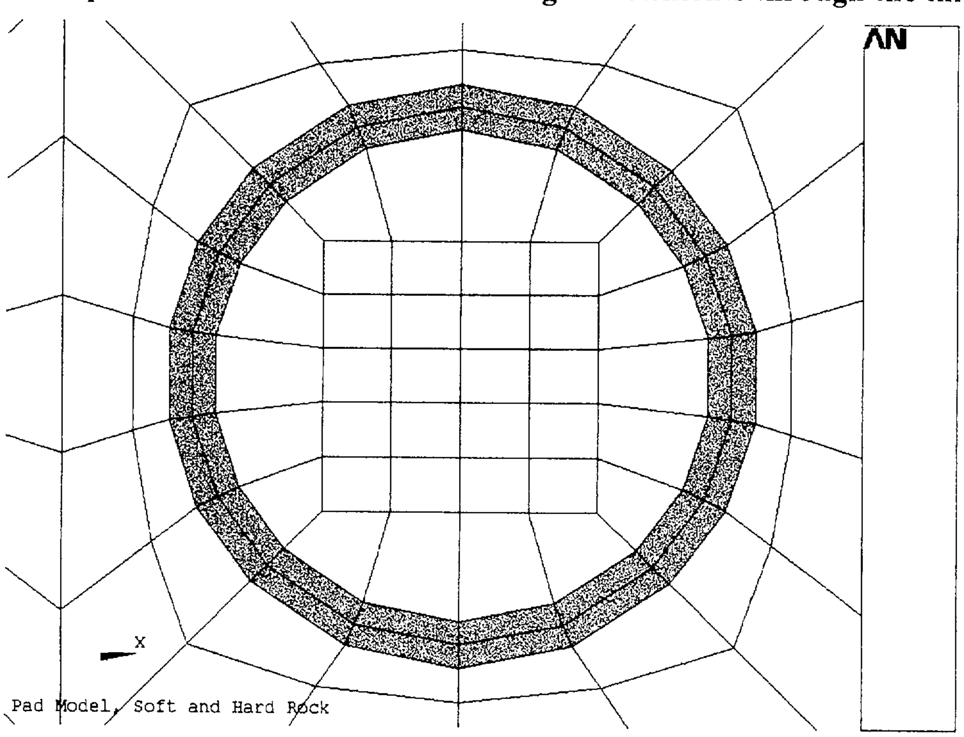


Figure 10 – Top view of one Cask with the concrete pad beneath it

Material Numbers

The Figures 11 and 12 below show the completed model with the element material numbers.

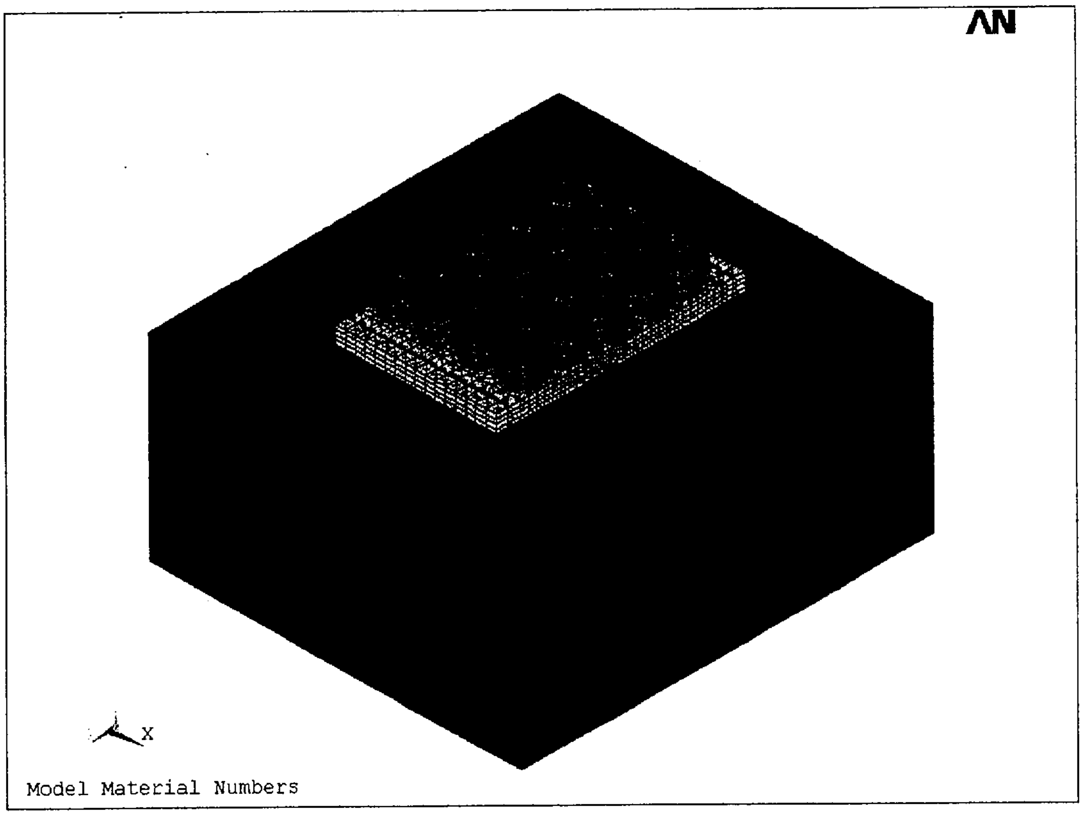


Figure 11 - Full Model with Material Numbers

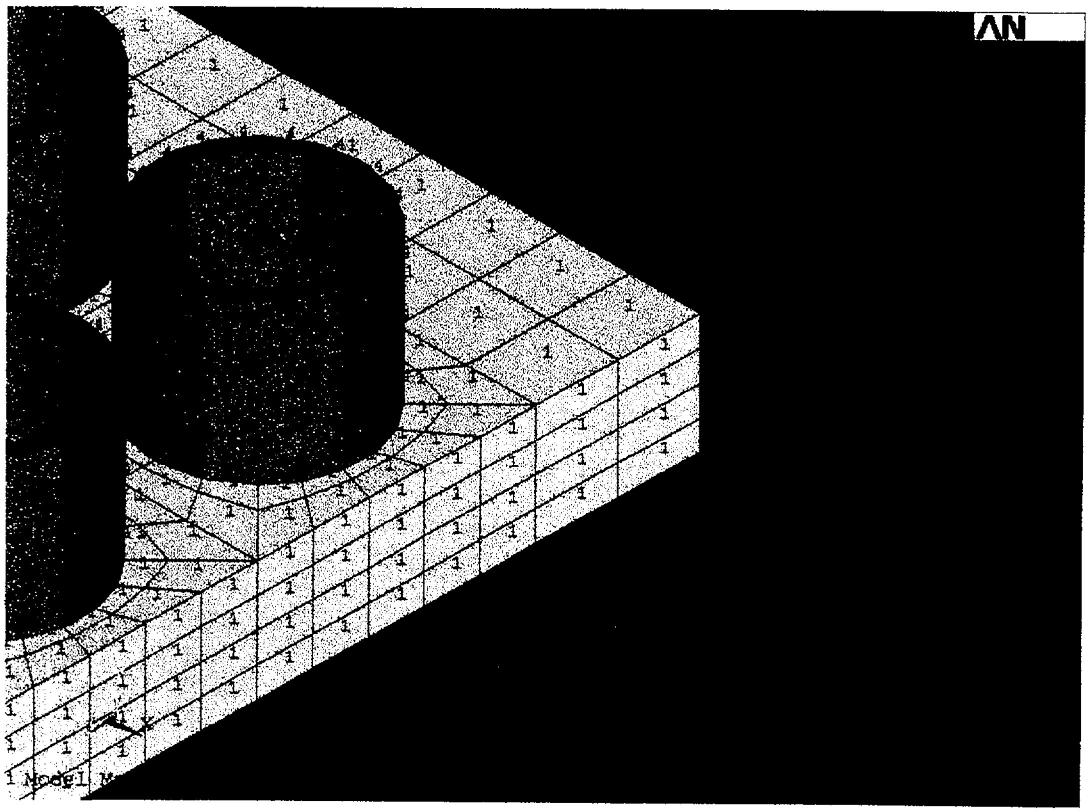


Figure 12 - Close-up of Model with Material Numbers

Contact Elements

The contact elements are generated by the ANSYS "Contact Wizard" using 3-D surface to surface contact elements. The ANSYS software requires that the contact elements be specified between two surfaces, a "target" surface and a "contact" surface, which are defined as two different element types. The rock surface is designated the "contact" surface, Element Type #5, CONTA174, and the concrete surface is designated the "target" surface, Element Type #6, TARGE170. These elements transmit compression loads from one surface to the other. No tensile forces are transmitted through this interface. These elements are, therefore, non-linear elements.

These elements are actually surfaces that overlay the structural elements and they can be thought of as permitting the interfacing characteristics desired, i.e., permitting compressive forces between the surfaces when penetration is attempted and permitting separation between the surfaces with no forces present when gaps are present. The alignment of the meshes of the two surfaces such that the nodes are coincident is not necessary and not recommended. ANSYS handles all the necessary geometric details to create the compression only elements. The default parameters are used which have been shown to provide the best compromise between accuracy and solution convergence times. The element stiffnesses

and convergence parameters are actually computed from the geometry and material properties of the adjoining elements. The "target" surface is recommended to be the surface with the harder material as well as the one with the finer mesh of elements, which is the pad in this model. The softer material as well as the one with the coarse mesh of elements is the "contact" surface, which is the rock in this model. The "target" surface is shown below, Figure 13, followed by a plot of the "contact" surface, Figure 14. This contact surface is also shown as the "extra strip" surrounding the pad in Figure 3, above.

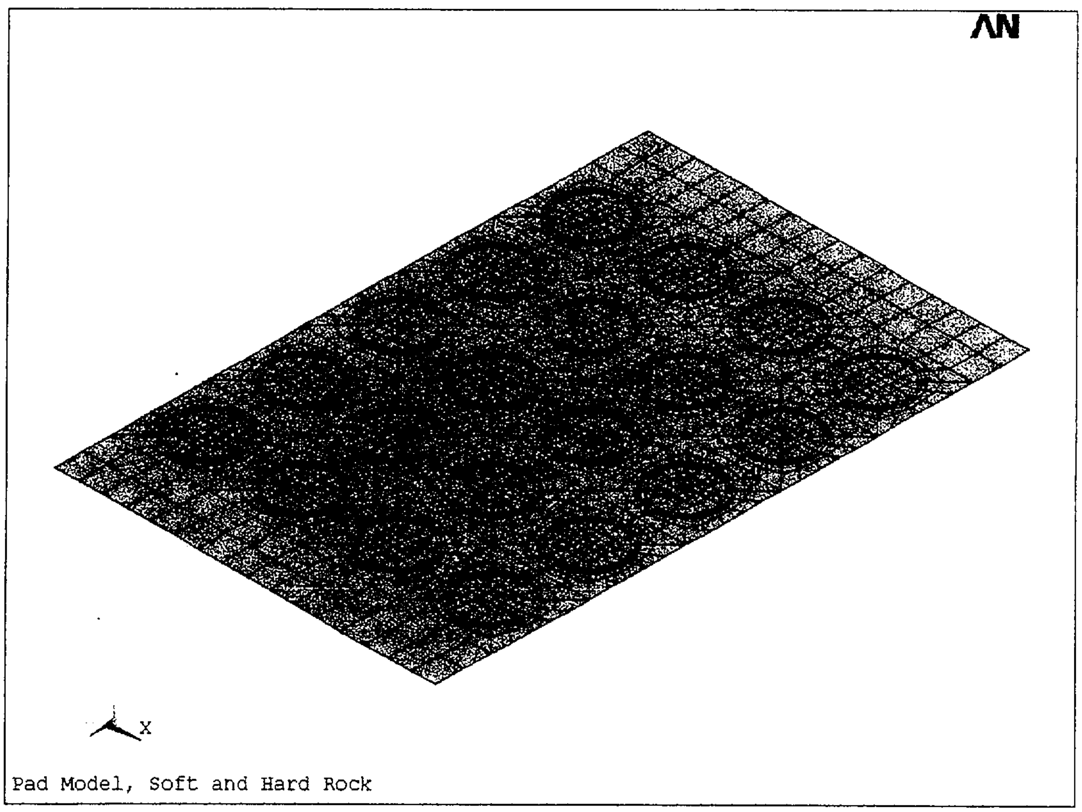


Figure 13 – Target surface located at the bottom of the Pad

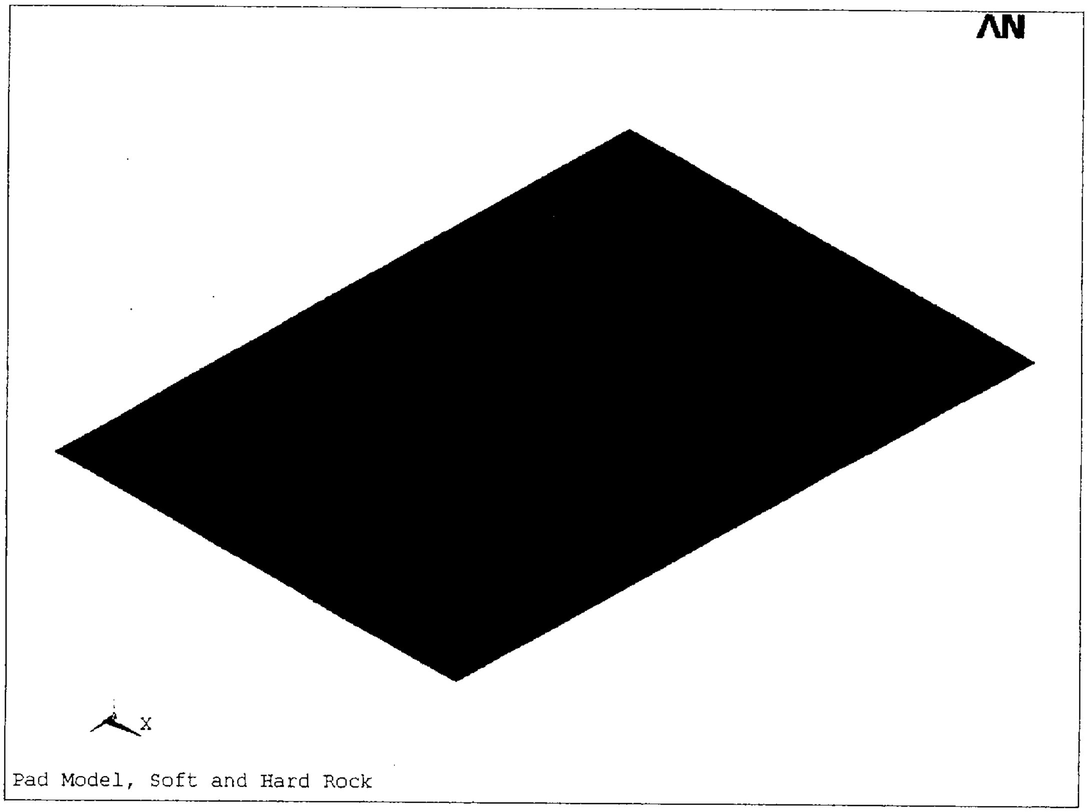


Figure 14 – Contact surface located on the surface of the Rock

Constraint Equations

The pad is also tied to the rock in the X and Z directions at the pad rock interface using constraint equations. In this case, the ANSYS constraint equation generator is used. This generator allows a selected set of nodes to be tied to another selected set of nodes through rigid body constraint equations. The first set of nodes is the set at the bottom of the pad, which is called "BASE" in the following Figure 15. The second set is the set associated with elements in the rock mass, called "ROCK" in the same figure. ANSYS automatically writes the constraint equations based upon the locations of the nodes associated with the elements, to those of the nodes at the bottom of the pad. These equations effectively constrain the pad to the rock surface in local areas continuously across the surface of the pad. Hence, a "rigid body" type of constraint across the entire surface is not formed. Since this portion of the model is first order linear, pad lift off does not affect shear transfer between the pad and the rock in the analysis.

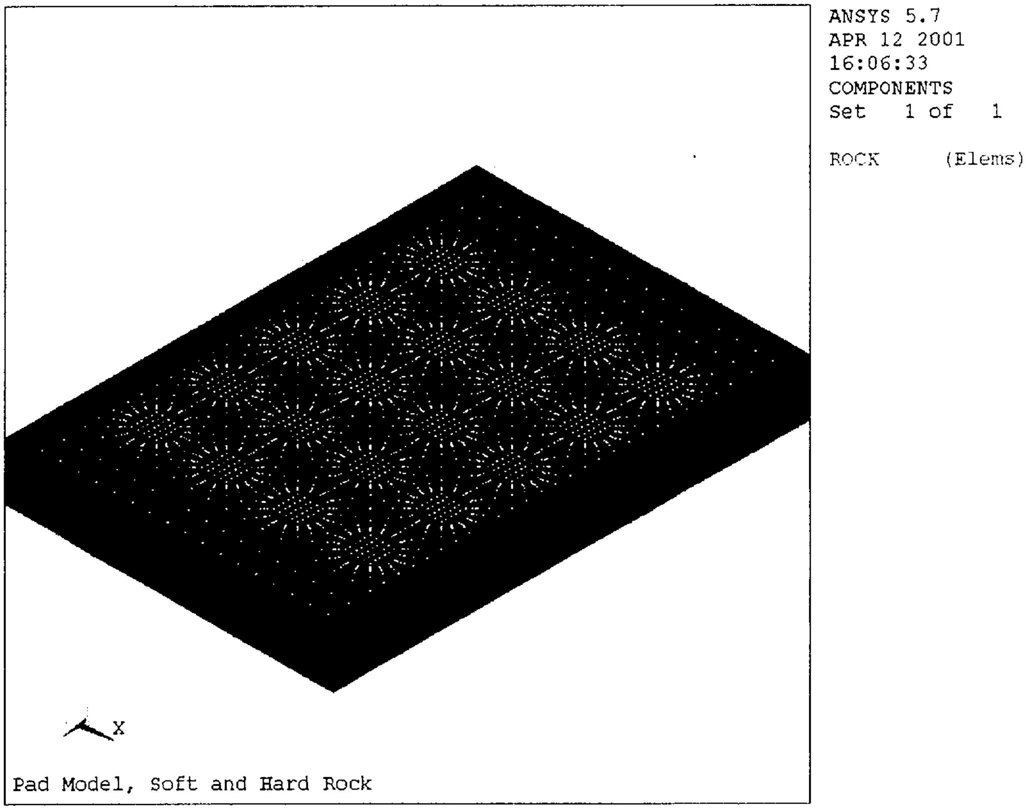


Figure 15 – Constraint Equations
Showing the nodes at the bottom of the Pad superimposed
on the related elements of the Rock

Boundary Conditions

The only boundary conditions in the model are on the rock mass. The nodes of the rock elements are constrained in the all three translation directions at the bottom and on the four sides of the rock for all load steps. Rotation degrees of freedom do not have to be constrained because rotation degrees of freedom are not in the solution set of displacements for this model. The bottom and sides of the rock mass are far enough away from the pad that any variations of boundary constraints on the boundary surfaces will not significantly affect the stiffness of the rock beneath the pad. And will not, therefore, affect the response of the pad to the applied loads. Details of a boundary condition study are presented in Appendix MD-3 and its associated Appendices that provide the justification for the boundary conditions chosen. Figure 16 shows the boundary conditions applied to the nodes on the sides and bottom of the rock mass. The following Figures 17 and 18 provide more detail.

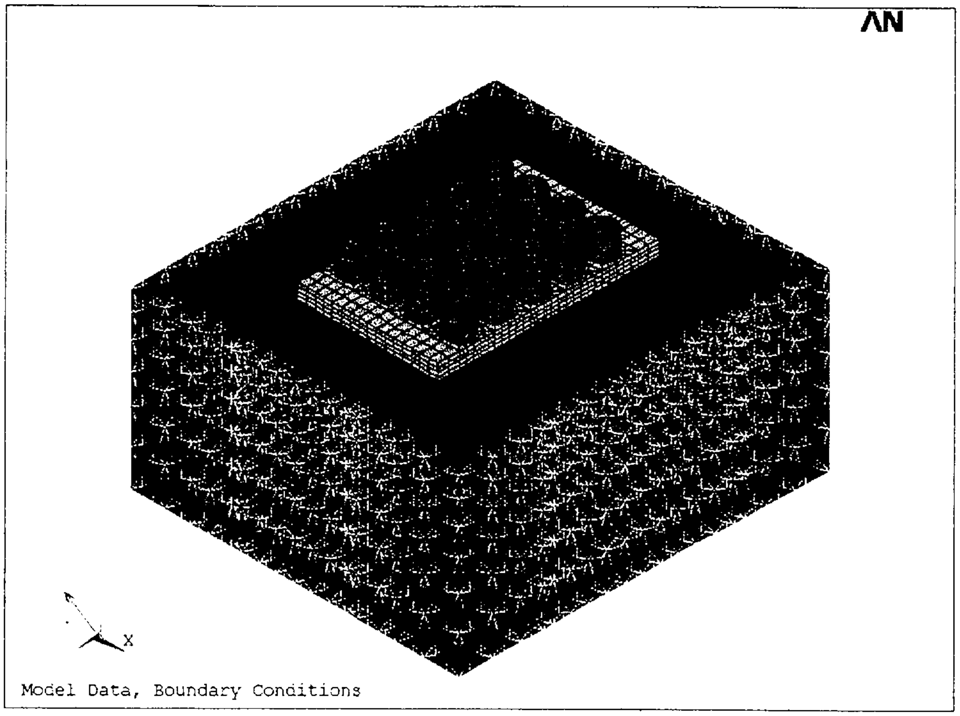


Figure 16 - Isometric of Boundary Conditions on the Rock Mass

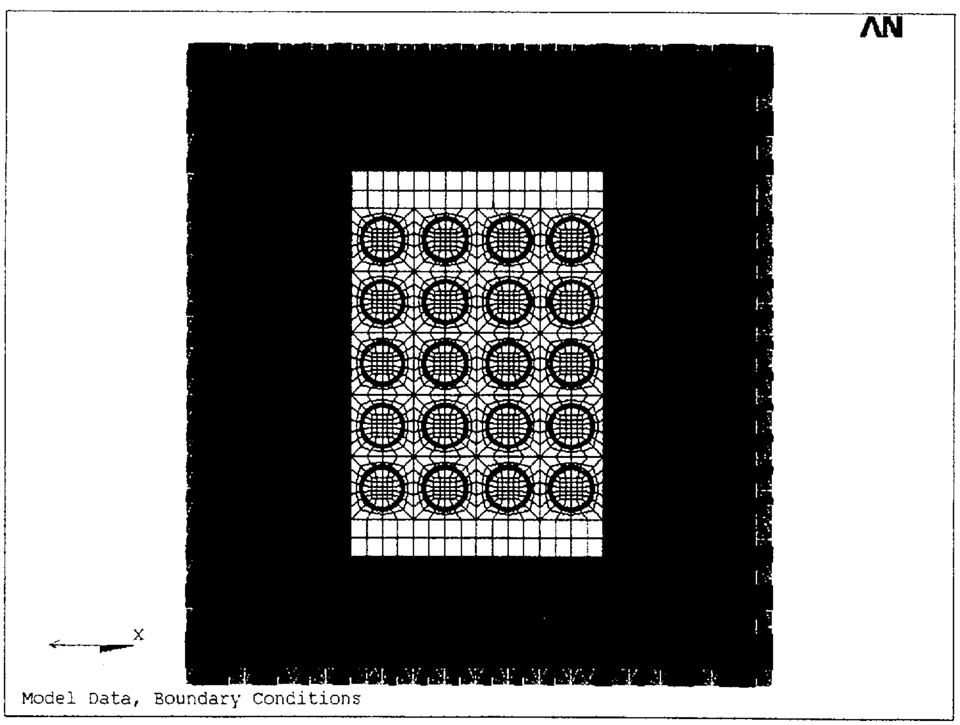


Figure 17 - Boundary Conditions on the Rock Mass Looking Down

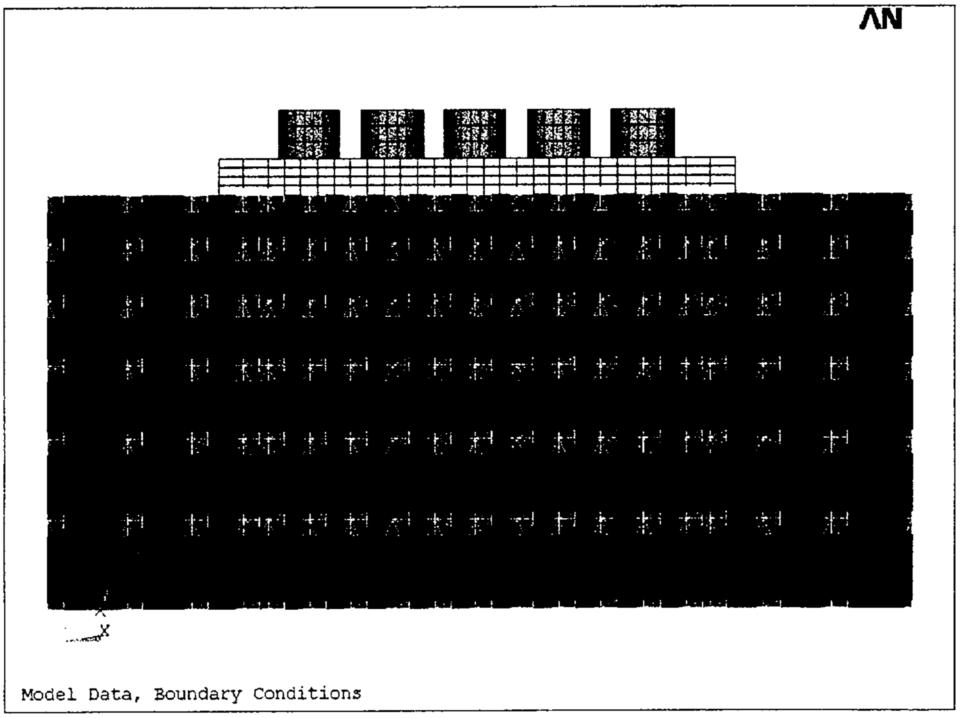


Figure 18 - Boundary Conditions on the Rock Mass Looking from the Side

Gravity and Seismic Loads

The "soft", "hard" and "very hard" rock models are loaded using the same load steps. Holtec supplied four sets of loads (Reference 4). The load table that Holtec provided is replicated in Table 1, column numbers are added. These loads were examined and two sets were selected for rigorous analysis. These sets were judged to be the controlling sets of loads and are the results from cask analyses for the Hosgri Earthquake (HE Column 1), and Long Term Seismic Program (LTSP Column 2). This judgement is based on an examination of those load components that are expected to produce the highest potential to uplift the pad. Therefore, the combination of net shear with minimum interface compression was used for comparison. The HE (1) values are 515.0 and 127.6 kips, and the LTSP (2) values are 440.0 and 105.8 kips. The judgement could not be made that either of these would control, so both were selected for analysis. Subsequent to these analyses, the LTSP (2) net shear was increased by 5% from the 440 kips to 462 kips. This increase does not alter any of the conclusions presented here. Supporting analyses for the adjusted LTSP loads are provided in Appendix LT-1.

The HE (3) values are 428.0 and 130.6 kips. The judgement here is that the HE (1) combination will control over the HE (3), noting that the slight increase of 130.6 Vs 127.6 does not offset the lessor shear value of 428.0 Vs. 515.0 kips. The same argument applies to the LTSP (2) Vs. LTSP (4) though two cases of LTSP (4) were run to validate the judgement. The highest cask down load is HE (3), this case

was run to examine the potential for high moments local to a cask, particularly for the soft rock model. Finally, some cases were examined that maximized the vertical component rather than the shear, simply to insure that nothing was overlooked.

More detail regarding the explicit load vectors and directions is provided below, however the general arrangement of the load cases is as follows:

- Gravity is load case 1
- HE (1) with shear maximized is examined in load cases 2 to 6
- HE (1) with vertical up component maximized is examined in load cases 7 and 8
- HE (3) with vertical down component maximized is examined in load cases 9 and 10
- LTSP (2) with shear maximized is examined in load cases 11 to 15
- LTSP (2) with vertical up component maximized is examined in load cases 16 and 17
- LTSP (4) with vertical up component maximized is examined in load cases 18 and 19

The loads are applied at the tops of the modeled casks, 118.5 inches from the pad, which is at the center of gravity of the actual casks. This method of load application produces the same moments and shears at the bases of the casks as shown in the Holtec report (see note * in the Table). During implementation of the load application, the total set of loads, horizontal and vertical, from all 20 casks is computed and is equally divided among all the nodes in the model at the tops of the modeled casks. These are shown in the following Figure 19. The subsequent Figure 20 shows these nodes for one cask.

Table 1 – Seismic Loads from Holtec

SEISMIC EVENT AT ISFSI****	HE (1)	LTSP (2)	HE** (3)	LTSP** (4)
Maximum/Minimum Interface Compression Force (kips)***	674.2/127.6	684.1/105.8	773.3/130.6	632.0/55.6
Maximum Interface Shear Force Along X-Axis (kips) *	509.4	432.0	379.9	325.8
Maximum Interface Shear Force Along Y-Axis (kips)*	460.5	355.5	426.1	364.6
Maximum Net Interface Shear Force (kips)	515.0	440.0	428.0	390.0
Maximum Interface Moment About X-Axis At Interface (kip-In)	54,564	42,139.2	50,498	43,209
Maximum Interface Moment About Y-Axis At Interface (kip-In)	60,369	51,197.2	45,017	38,603
Maximum Net Interface Moment (kip-In)	61,000	52,000	50,500	46,000
Effective COF at Cask/Embedment Interface	0.180	0.154	0.150	0.132
Maximum Tensile Load in Embedment Anchor Rods (kips)	62.13	48.85	49.73	42.34

* Base Maximum Shear forces are computed by dividing the appropriate maximum moment by the height to the centroid (118.5 inch). Y-Shear goes with MX, X-Shear goes with MY.

** These simulations have the vertical excitation reversed in direction over the total event time.

*** Includes dead load = 360,000 lb.

**** The moments and forces reported above act at the lower surface of the embedment plate. The X, Y, Z axes are located at a point on the cask longitudinal centerline (extended to the bottom surface of the embedment plate). The X, Y directions correspond to the East-West and North-South directions, respectively, and the Z-axis is vertically upward.

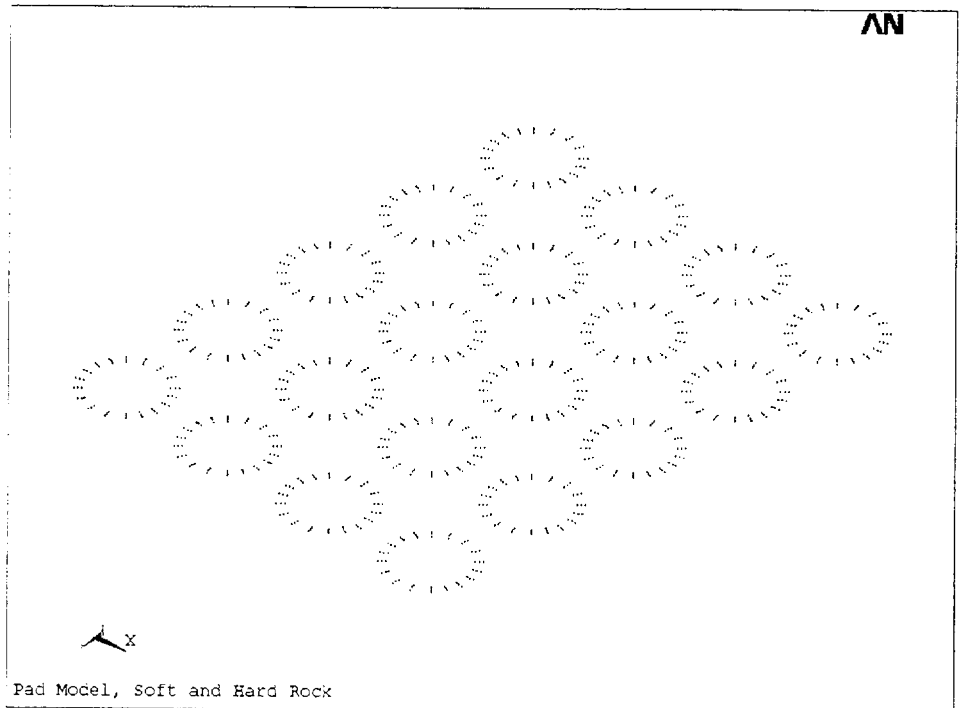


Figure 19 – Nodes at the tops of all casks where the loads are applied

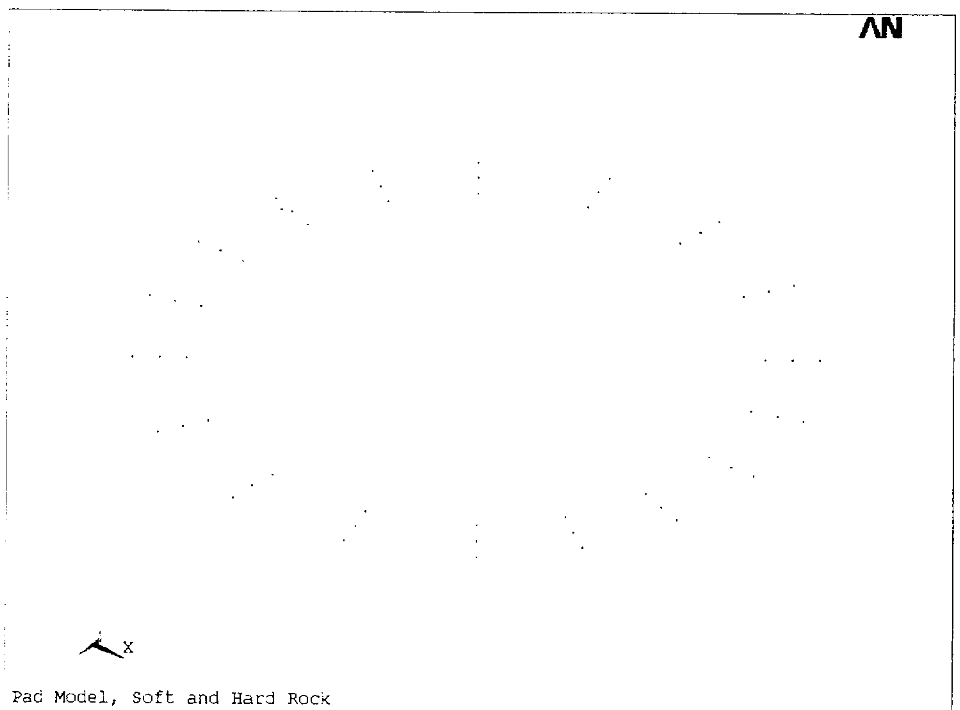


Figure 20 – Close up of the nodes at one cask

The HE loads are applied with the HE ZPAs applied to the pad, and the LTSP loads are applied with the LTSP ZPAs. See Reference 2, Appendix A for the ZPAs. These are applied as accelerations to the pad mass. This is the reason that the pad is the only portion of the model with mass. The seismic acceleration of the mass of the casks is accounted for in the cask loads supplied by Holtec.

The method of seismic load component combination was followed, as prescribed by PG&E (Reference 2). Holtec computed the net shear, vector sum of components, for each time step in their analyses and reported the maximum values. These are taken to equal 100% of the one and 40% of the other horizontal load component. This load vector was then "aimed" in various directions in an effort to produce the greatest pad uplift and moment in a seismic event that the geometry, mass distribution and loads would permit. The vertical load was taken as 40% of the seismic up load computed from the Holtec data. Since the pad with the casks is a doubly symmetric structure, the loads had to be "aimed" in only one quadrant to provide a complete set of responses. The quadrant chosen is the northwest quadrant. Therefore, the vector is aimed in the following directions: North, North 32.93 degrees West (actually aimed at the opposite corner of the pad), North 45 degrees West, North 57.07 degrees West (symmetric with the 45 degree line), and West. The vector sum of the 100% and 40% ZPAs was also computed, and "aimed" in the same direction as the cask load, along with 40% of the vertical ZPA in the up direction. These cases were analyzed for the HE (1) and LTSP (2) loads.

In addition, the 40-100-40 load components were analyzed for the HE(1) and LTSP(2) in the North and West directions only, along with HE(3) maximum downward load and LTSP(4) maximum upward load applied in the North and West directions. The pad ZPAs were phased and aimed with the cask loads for these cases also.

The applied loads for both the soft rock, hard rock, and very hard rock models are as follows (the details of the load calculations and the ANSYS input files are provided in Appendix AL-1):

1 Gravity, pad plus 20 casks. This is 360 kips per cask down plus 1G applied for the pad weight.

2 Gravity plus the Hosgri Earthquake loads from the Holtec Report Column 1, HE(1), plus the Hosgri ZPAs applied to the pad. The cask loads are 515 kips horizontal and 267.04 kips down. The horizontal pad acceleration is 0.808G and the vertical acceleration is 0.2G up. The net vertical acceleration applied to the model is, therefore 1.0G – 0.2G = 0.8G down. These are the 100-40-40 seismic components. All horizontal loads are applied in the North direction.

3 Gravity plus HE(1) plus Hosgri ZPAs. Same loads as Load Step 2. All horizontal loads applied at North 32.93° West.

4 Gravity plus HE(1) plus Hosgri ZPAs. Same loads as Load Step 2. All horizontal loads applied at North 45° West.

5 Gravity plus HE(1) plus Hosgri ZPAs. Same loads as Load Step 2. All horizontal loads applied at North 57.07° West.

6 Gravity plus HE(1) plus Hosgri ZPAs. Same loads as Load Step 2. All horizontal loads are applied in the West direction.

7 Gravity plus HE(1) plus Hosgri ZPAs. The cask loads are 206 kips horizontal and 127.6 kips down. The horizontal pad acceleration is 0.424G horizontal and 0.500G up. The net vertical acceleration applied to the model is, therefore 1.0G – 0.5G = 0.5G down. These are the 40-100-40 seismic components. All horizontal loads are applied in the North direction.

8 Gravity plus HE(1) plus Hosgri ZPAs. Same loads as Load Step 7. All horizontal loads are applied in the West direction.

9 Gravity plus the Hosgri Earthquake loads from the Holtec Report Column 3, HE(3), plus the Hosgri ZPAs applied to the pad. The cask loads are 171.2 kips horizontal and 773.3 kips down. The horizontal pad acceleration is 0.424G horizontal and 0.500G down. The net vertical acceleration applied to the model is, therefore 1.0G + 0.5G = 1.5G down. These are the 40-100-40 seismic components for the maximum down loads for all load cases. All horizontal loads are applied in the North direction.

10 Gravity plus HE(3) plus Hosgri ZPAs. Same loads as Load Step 9. All horizontal loads are applied in the West direction.

11 Gravity plus the Long Term Seismic Program loads from the Holtec Report Column 2, LTSP(2), plus the LTSP ZPAs applied to the pad. The cask loads are 440 kips horizontal and 258.32 kips down. The horizontal pad acceleration is 0.894G horizontal and 0.280G up. The net vertical acceleration applied to the model is, therefore 1.00G – 0.28G = 0.72G down. These are the 100-40-40 seismic components. All horizontal loads are applied in the North direction.

12 Gravity plus LTSP(2) plus LTSP ZPAs. Same loads as Load Step 11. All horizontal loads applied at North 32.93° West.

13 Gravity plus LTSP(2) plus LTSP ZPAs. Same loads as Load Step 11. All horizontal loads applied at North 45° West.

14 Gravity plus LTSP(2) plus LTSP ZPAs. Same loads as Load Step 11. All horizontal loads applied at North 57.07° West.

15 Gravity plus LTSP(2) plus LTSP ZPAs. Same loads as Load Step 11. All horizontal loads are applied in the West direction.

16 Gravity plus LTSP(2) plus LTSP ZPAs. The cask loads are 176 kips horizontal and 105.8 kips down. The horizontal pad acceleration is 0.470G horizontal and 0.700G up. The net vertical acceleration applied to the model is, therefore 1.0G – 0.7G = 0.3G down. These are the 40-100-40 seismic components. All horizontal loads are applied in the North direction.

17 Gravity plus LTSP(2) plus LTSP ZPAs. Same loads as Load Step 16. All horizontal loads are applied in the West direction.

18 Gravity plus the Long Term Seismic Program loads from the Holtec Report Column 4, LTSP(4), plus the LTSP ZPAs applied to the pad. The cask loads are 156 kips horizontal and 55.6 kips down. The horizontal pad acceleration is 0.470G horizontal and 0.700G up. The net vertical acceleration applied to the model is, therefore 1.0G – 0.7G = 0.3G down. These are the 40-100-40 seismic components. All horizontal loads are applied in the North direction.

19 Gravity plus LTSP(4) plus LTSP ZPAs. Same loads as Load Step 18. All horizontal loads are applied in the West direction.

In each load step, these loads are applied to the model all at once, i.e., the gravity plus the seismic horizontal and vertical loads are applied concurrently. The ANSYS program was then instructed to iterate until the solution converged.

These sets of loads are conservative since the reduction in response due to phasing of the acceleration components of the pad to the response of the casks is not considered. Only the phasing of the directional acceleration components of the pad response, and cask response, is considered through the application of the 100-40-40 rule.

Analysis Results

Pad Response – Displacements and Stresses

The analyses were performed on the three models, one for soft, one for hard and one for very hard rock. These analyses produced three separate databases of results.

Prior to evaluation, all load steps were checked for equilibrium. The forces applied on all the casks, and the forces between the pad and the rock, and the rock boundary were computed manually. The ANSYS results databases were then scanned for these same values and the results were compared to each other. In all cases, they agree, see Appendix RL-1.

The analysis results were then scanned using the ANSYS Post Processor. First the data were scanned and sorted for the maximum displacement anywhere on the pad, δ_{Max}, see Appendix DN-1 for the details. Then the results were scanned and sorted for the maximum displacements at the centerlines of all 14 casks on the perimeter of the 4 x 5 cask array, δ_{Cask}, see Appendix DN-2 for the details. Vertical displacement plots of the pad, for the soft rock model, are provided for all 19 load steps in Appendix DP-1. Finally, the results were scanned and sorted for the max/min stresses in the two, X and Z directions, and for the maximum principal stress, $\sigma_{1\ Max}$ (largest tensile stress), and the minimum principal stress, $\sigma_{3\ Min}$ (largest compressive stress). See Appendix SN-1 for details. The results for the soft rock, hard rock and very hard rock cases are presented in Tables 2, 3, 4 and 5 below. The displacements are in inches, and the stresses in psi.

Table 2 – MAXIMUM PAD and CASK DISPLACEMENTS

LS	EQ	Direction	Maximum Pad δ_{Max}			Maximum Cask δ_{Cask}		
			Soft	Hard	V Hard	Soft	Hard	V Hard
1		Gravity	-0.011	-0.001	-0.0005	-0.026**	-0.003+	-0.0015++
2	HE(1)	N	0.058	0.027	0.020	0.0005	0.005	0.004
3	HE(1)	N32.93W	0.099	0.045	0.035	0.022	0.015	0.013
4	HE(1)	N45W	0.101	0.046	0.036	0.027	0.018	0.015
5	HE(1)	N57.07W	0.094	0.043	0.033	0.028	0.019	0.016
6	HE(1)	W	0.047	0.032	0.027	0.013	0.014	0.013
7	HE(1)*	N	0.010	0.005	0.003	-0.007	-0.0003	0.00002
8	HE(1)*	W	0.009	0.007	0.006	-0.004	0.002	0.002
9	HE(3)*	N	-0.014	-0.001	-0.0006	-0.045	-0.005	-0.003
10	HE(3)*	W	-0.014	-0.001	-0.0007	-0.044	-0.005	-0.002
11	L(2)	N	0.049	0.022	0.017	-0.002	0.004	0.003
12	L(2)	N32.93W	0.082	0.037	0.028	0.015	0.011	0.009
13	L(2)	N45W	0.083	0.038	0.029	0.019	0.013	0.011
14	L(2)	N57.07W	0.077	0.035	0.026	0.019	0.014	0.011
15	L(2)	W	0.039	0.024	0.021	0.008	0.010	0.009
16	L(2)*	N	0.022	0.010	0.008	-0.0005	0.002	0.001
17	L(2)*	W	0.018	0.010	0.009	0.004	0.004	0.004
18	L(4)*	N	0.025	0.011	0.009	0.003	0.003	0.002
19	L(4)*	W	0.023	0.014	0.012	0.010	0.007	0.007

* Load components are combined using the 40-100-40 rule. All others combined using 100-40-40 rule.
** Values range from –0.026 to –0.034 (Perimeter casks only)
+ Values range from –0.003 to –0.004 (Perimeter casks only)
++ Values range from –0.0015 to –0.0018 (Perimeter casks only)

ENERCON SERVICES, INC.

JOB. NO.	PGE-009	DATE	November 30, 2001
PROJECT	DCPP ISFSI		
SUBJECT	ISFSI Cask Storage Pad Seismic Analysis		
CLIENT	PG&E-DCPP	ORIGINATOR	S. C. Tumminelli
REVIEWER	K. L. Whitmore	APPROVED	R. F. Evers
CALCULATION NO.	PGE-009-CALC-003	REVISION	1

Table 3 – PAD STRESS RESPONSES – SOFT ROCK

LS	EQ	Direction	$\sigma_{X\ Max}$	$\sigma_{X\ Min}$	$\sigma_{Z\ Max}$	$\sigma_{Z\ Min}$	$\sigma_{1\ Max}$	$\sigma_{3\ Min}$
1		Gravity	33	-63	23	-55	35	-117
2	HE(1)	N	46	-107	270	-404	341	-642
3	HE(1)	N32.93W	144	-271	235	-410	359	-801
4	HE(1)	N45W	192	-322	209	-379	355	-806
5	HE(1)	N57.07W	234	-359	176	-329	347	-778
6	HE(1)	W	261	-405	62	-135	314	-595
7	HE(1)*	N	20	-44	129	-179	164	-287
8	HE(1)*	W	121	-180	28	-61	148	-265
9	HE(3)*	N	62	-117	83	-206	115	-349
10	HE(3)*	W	83	-248	60	-108	102	-349
11	L(2)	N	44	-94	261	-381	329	-600
12	L(2)	N32.93W	137	-255	227	-383	347	-748
13	L(2)	N45W	183	-302	201	-354	344	-752
14	L(2)	N57.07W	223	-338	167	-307	336	-725
15	L(2)	W	254	-379	57	-123	303	-556
16	L(2)*	N	20	-39	120	-172	151	-269
17	L(2)*	W	117	-170	24	-53	140	-250
18	L(4)*	N	19	-34	112	-162	142	-252
19	L(4)*	W	108	-159	22	-49	130	-241

* Load components are combined using the 40-100-40 rule. All others combined using 100-40-40 rule.

Table 4 – PAD STRESS RESPONSES – HARD ROCK

LS	EQ	Direction	$\sigma_{X\,Max}$	$\sigma_{X\,Min}$	$\sigma_{Z\,Max}$	$\sigma_{Z\,Min}$	$\sigma_{1\,Max}$	$\sigma_{3\,Min}$
1		Gravity	16	-20	9	-19	17	-54
2	HE(1)	N	51	-79	75	-196	164	-230
3	HE(1)	N32.93W	70	-132	71	-168	156	-227
4	HE(1)	N45W	81	-177	63	-137	155	-231
5	HE(1)	N57.07W	89	-210	60	-103	158	-239
6	HE(1)	W	94	-244	52	-77	161	-267
7	HE(1)*	N	20	-29	31	-56	64	-94
8	HE(1)*	W	39	-86	19	-31	63	-105
9	HE(3)*	N	40	-44	37	-78	41	-163
10	HE(3)*	W	62	-71	27	-43	65	-182
11	L(2)	N	43	-69	63	-166	138	-199
12	L(2)	N32.93W	62	-111	60	-147	129	-198
13	L(2)	N45W	71	-151	54	-122	129	-202
14	L(2)	N57.07W	78	-181	51	-93	131	-208
15	L(2)	W	82	-210	41	-68	135	-231
16	L(2)*	N	17	-28	25	-70	55	-82
17	L(2)*	W	33	-87	16	-28	54	-95
18	L(4)*	N	15	-25	23	-66	52	-75
19	L(4)*	W	28	-81	16	-23	51	-87

* Load components are combined using the 40-100-40 rule. All others combined using 100-40-40 rule.

Table 5 – PAD STRESS RESPONSES – VERY HARD ROCK

LS	EQ	Direction	$\sigma_{X\ Max}$	$\sigma_{X\ Min}$	$\sigma_{Z\ Max}$	$\sigma_{Z\ Min}$	$\sigma_{1\ Max}$	$\sigma_{3\ Min}$
1		Gravity	17	-17	11	-16	17	-54
2	HE(1)	N	53	-74	80	-184	164	-229
3	HE(1)	N32.93W	70	-124	70	-157	156	-227
4	HE(1)	N45W	81	-167	60	-128	155	-230
5	HE(1)	N57.07W	89	-197	55	-94	158	-238
6	HE(1)	W	93	-230	57	-70	161	-254
7	HE(1)*	N	21	-27	32	-52	64	-94
8	HE(1)*	W	39	-82	21	-29	63	-99
9	HE(3)*	N	41	-38	40	-70	42	-163
10	HE(3)*	W	63	-65	29	-36	66	-182
11	L(2)	N	45	-64	67	-156	138	-199
12	L(2)	N32.93W	61	-104	59	-135	129	-198
13	L(2)	N45W	71	-142	51	-110	129	-201
14	L(2)	N57.07W	78	-170	48	-82	131	-207
15	L(2)	W	82	-197	47	-62	135	-219
16	L(2)*	N	18	-26	26	-66	55	-80
17	L(2)*	W	33	-81	18	-25	54	-90
18	L(4)*	N	16	-23	24	-62	52	-71
19	L(4)*	W	28	-76	19	-21	51	-82

* Load components are combined using the 40-100-40 rule. All others combined using 100-40-40 rule.

These results clearly show that the dominating load steps are those that result from the analyses for the soft rock model. The maximum pad displacement for any of these load steps is 0.101 inches up (LS 4) and the maximum cask vertical displacement is 0.028 inches up (LS 5). Both of these values are small and are clearly acceptable. The maximum values of stress in the X direction are 261 psi (LS 6) and –405 psi (also LS 6). In the Z direction they are 270 psi (LS 2) and –410 psi (LS 3). The maximum principal stress is 359 psi (LS 3) and the minimum value is –806 psi (LS 4).

A reasonable value for tensile stress that causes concrete to crack is 7.5 SQRT(f_c') = 530 psi, (Reference 9, Eq. 9-9). Therefore, as discussed above, since the largest tensile stress is 359 psi, concrete cracking due to the application of seismic loads is not expected to occur. Further, the maximum compressive stress of 806 psi is clearly acceptable since f_c' is 5000 psi.

A broader view of this data shows that the load cases where the components are combined using the 100-40-40 rule control the bending stress design of the pad and that the Hosgri (1) produces slightly more demanding pad stresses than the Long Term Seismic Program (2). Thus, these analyses also serve as a set of screening calculations, whereby, except for the applied pressures to the cut rock, see Table 12, further consideration for pad design need only be given to the Hosgri (1) seismic event analyzed using the soft rock model. A full set of displacement plots of the pad for all Load Steps for the soft rock model is provided on Appendix DP-1. A full set of plots, displacements and stresses, for Load Step 6 for the soft rock model is provided below, Figures 21 to 26.

An examination of these plots indicates that at least some of the maximum values are a result of the modeling. The high X direction stresses at the edge of the pad (405 psi), Figure 24, are a result of the fact that the rock constraint provided through the constraint equations ends abruptly. And, the Z direction stresses, Figure 25, at the same location, are a result of Poisson effects.

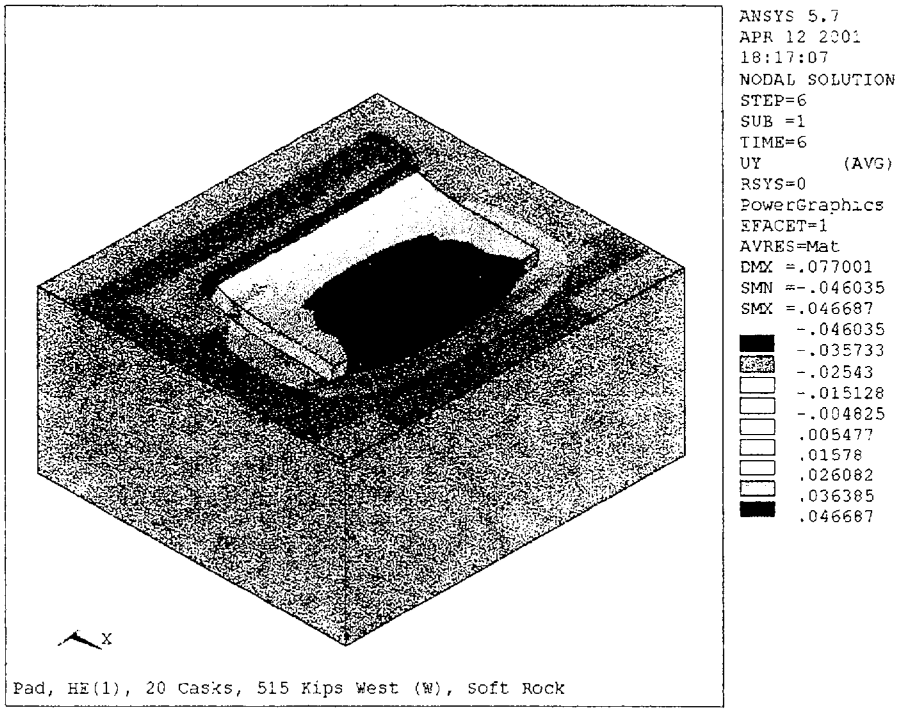


Figure 21 – Pad and rock vertical displacements for Load Step 6 – Loads are applied to the West

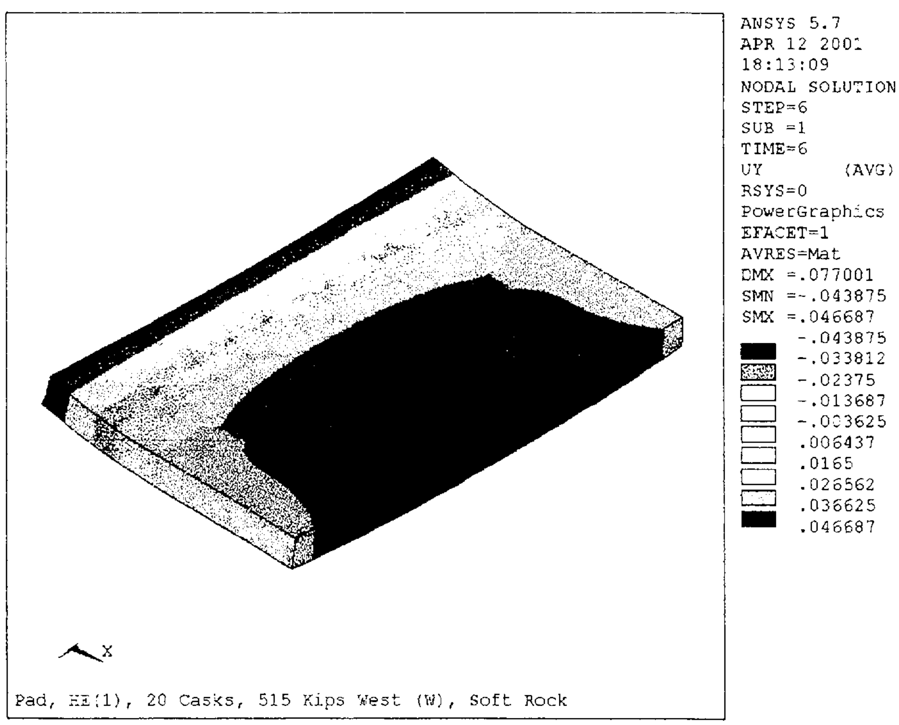


Figure 22 – Pad vertical displacements for Load Step 6 – Loads are applied to the West

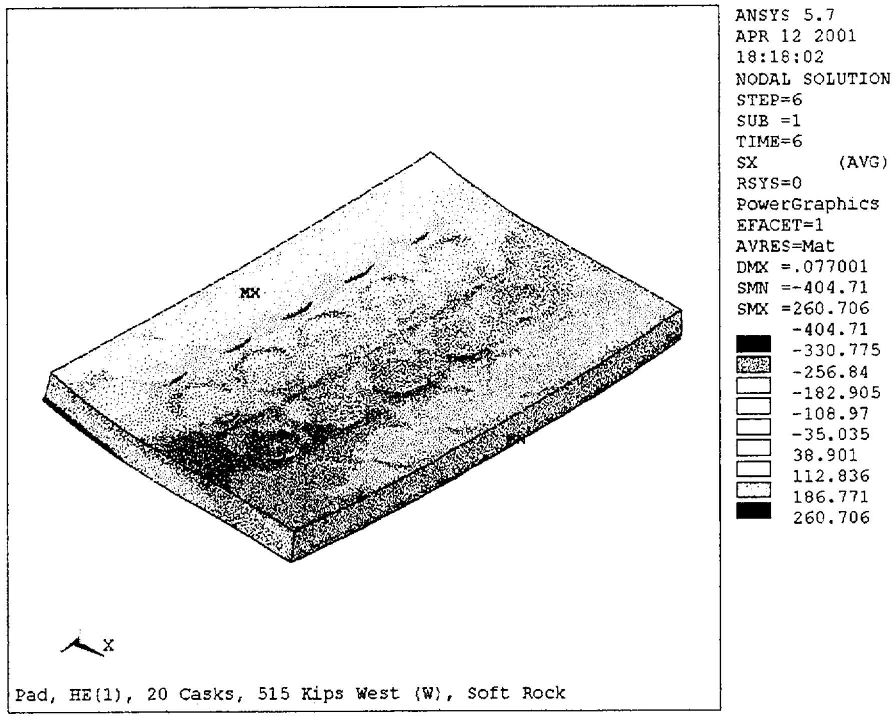


Figure 23 – X direction stresses looking from the top for Load Step 6

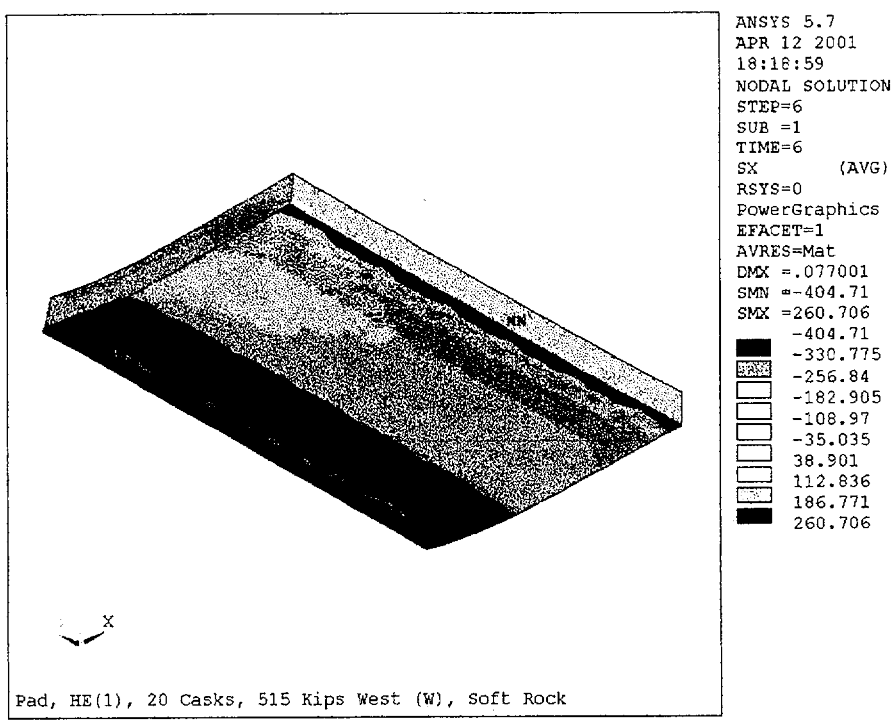


Figure 24 – X direction stresses looking from the bottom for Load Step 6

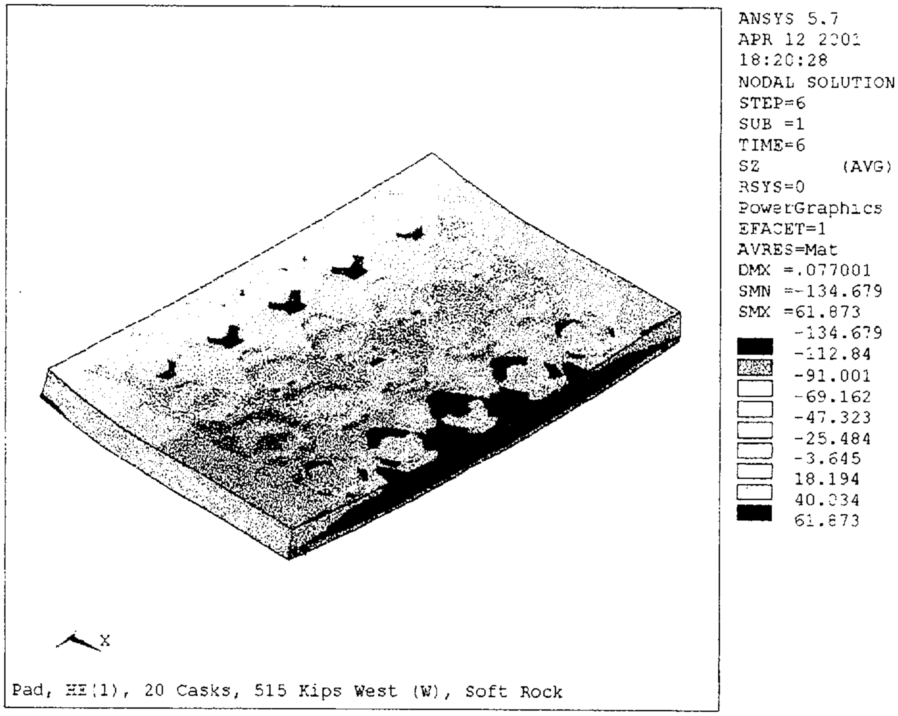


Figure 25 – Z direction stresses looking from the top for Load Step 6

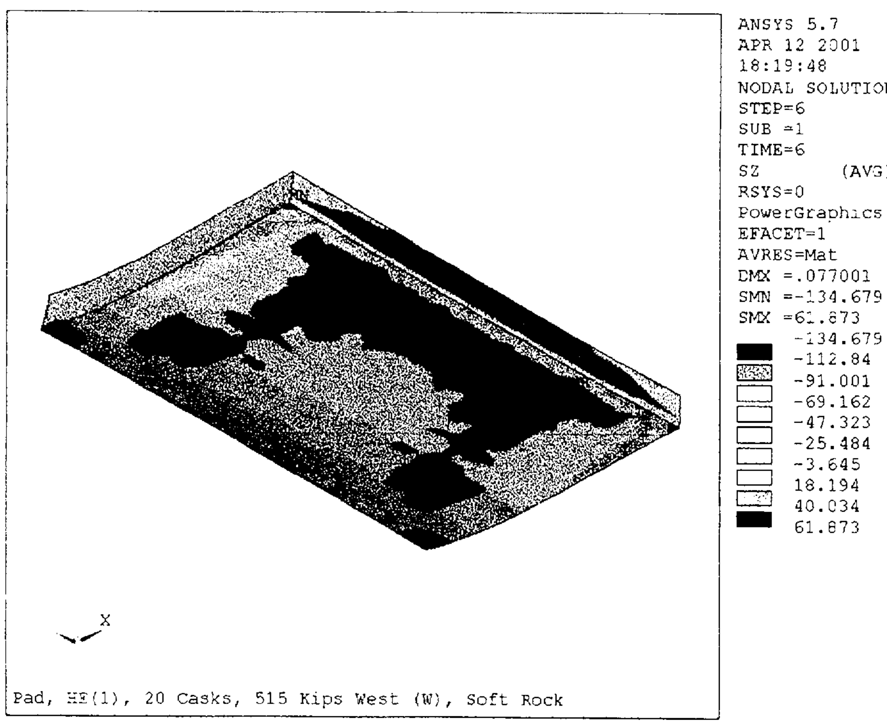


Figure 26 – Z direction stresses looking from the bottom for Load Step 6

Pad Response – Internal Forces

In order to evaluate the concrete sections and design the reinforcement, the pad internal forces and moments are required. These, of course, are the stress resultants, on a user specified section and the moments are computed about a user specified point. Since the model of the pad is constructed from "brick" elements, these quantities are not readily available from the ANSYS database. These values can, however, be computed from the nodal force data. In these analyses, the data for the pad are processed for a series of "strips" whereby the pad is sectioned into strips, and then each strip is further sectioned to reveal cross sections, or selected surfaces, of the pad. The center of the cross section is specified for moment calculation and the internal forces are computed for the selected surface.

An examination of the displacements and stresses indicates that the displaced shape and resultant stresses are generally consistent with a single curvature response of the pad, i.e., the pad lifts off the rock gradually and then conforms to the surface of the rock. See Figures 21 to 26, and Appendix DP-1. It does not exhibit the type of reverse curvature and resultant abrupt changes from positive moment to negative moment as would be observed for a beam with a series of concentrated applied moments. The reason for this is that the weight of the pad and the resultant inertia loads are comparable to those of the casks. The relevant parameters for the Hosgri load cases 2 to 6 are as follows:

Total Cask Weight 20*360 = 7200 kips
Pad Weight 0.15*68*105*7.5 = 8033 kips

Net Horizontal Cask Shear 20*515 = 10300 kips
Net Horizontal Pad Shear 0.808*8033 = 6490 kips

Net Vertical Cask Down 20*267.04 = 5341 kips
Net Vertical Pad Down 0.8*8033 = 6426 kips

Therefore, the mass of the pad and its inertia loads are as important to the overall response of the pad as the applied loads from the casks. In addition, the casks apply their loads over a diameter of approximately 12 feet while the pad in the analysis is just 7.5 feet thick. Hence, though the applied stresses tend to concentrate at the sides of the casks toward and away from the direction of the "aimed" seismic load, they do apply loads over their curved areas, and the resultant stresses do tend to "radiate" from the cask locations. Thus, the selection of pad locations midway between the casks, as opposed to the edges of the casks, will result in applied forces and moments of sufficient accuracy to appropriately size the reinforcement.

A strip is shown in Figure 27. The elements on the side(s) of a particular strip are isolated from the remainder of the pad. Further, the elements on one side of the selected surface are eliminated. Then a node (or point, defined by its coordinates) is specified. In the current analyses, the center of each selected surface is specified. The ANSYS program is then instructed to compute the stress resultants and print them to a file. The program actually uses the nodal forces rather than integrating stresses. The

forces/moments computed are those that the elements are applying to the selected nodes. The negative of these values are the forces that must be applied to the section, i.e. selected nodes, to maintain equilibrium, such as would be seen in a free body diagram. The forces are computed in the Global Coordinate System. Figure 28 shows the two types of strips used to section and the pad, and the coordinate system.

The signs of the computed internal forces must be carefully observed. ANSYS computes the forces in the Global Coordinate System (this is the default). Hence for Z Strips positive Mx means that tensile stresses exist on the bottom of the pad, and positive Fz means that net compression exists on the cross section. For X Strips, positive Mz means that compressive stresses exist on the bottom of the pad, and positive Fx means that net compression exists on the cross section. These conventions hold true for all sections on the strips except the last section. The last sections for each strip have the contributing elements that are on the opposite sides of the cross sections from the other cross sections. Thus the signs of the computed internal forces relative to the stresses are reversed. For the last sections on the Z Strips, positive Mx means that compressive stresses exist on the bottom of the pad, and positive Fz means that net tension exists on the cross section. For the last sections on the X Strips positive Mz means that tensile stresses exist on the bottom of the pad, and positive Fx means that net tension exists on the cross section. The table below summarizes the sign convention:

Sign Convention for Internal Forces

Z Strips	+Mx ➔ tensile stresses on bottom of pad +Fz ➔ net compression on cross section
Z Strips - Last Section, Line 1	+Mx ➔ compressive stresses on bottom of pad +Fz ➔ net tension on cross section
X Strips	+Mz ➔ compressive stresses on bottom of pad +Fx ➔ net compression on cross section
X Strips – Last Section, Line A	+Mz ➔ tensile stresses on bottom of pad +Fx ➔ net tension on cross section

Sections throughout the pad are isolated and the internal forces acting upon them are computed. The pad is thus divided into four North-South strips, A-B through D-E, and seven East-West strips, 1-3, 3-4 through 7-8 and 8-10. Figure 29 shows the grid line layout of the strips, and Figure 30 shows the locations and designation used for two sections. Each North-South strip is then sequentially reduced a line at a time, from Line 10 to 1. Similarly, each East-West strip is sequentially reduced a line at a time, from Line E to A. Thus, there are ten sections for each of the four Z Strips isolated, and five sections for each of the seven X Strips isolated, for a total of 75 cross sections for the calculation of internal pad forces. All strips are seventeen feet wide except strips 1-3 and 8-10, which are ten feet wide.

The last sections for the Z Strips are the Line 1 sections, and the last sections for the X strips are the Line A sections.

Figures 31 and 32 show a sample of the various sections used, generated by the ANSYS program. All are provided in Appendix MD-4.

The data from the file are then compiled and provided in Tables 6 to 10. See Appendix FC-1 for the ANSYS input and output files. Since the Hosgri HE (1) event using the soft rock analysis is the most demanding for the pad design, only the Hosgri results for the soft rock analyses were processed. The stress results show that these will provide the controlling forces and moments for the design of the pad. The forces for pad design are provided in Table 11.

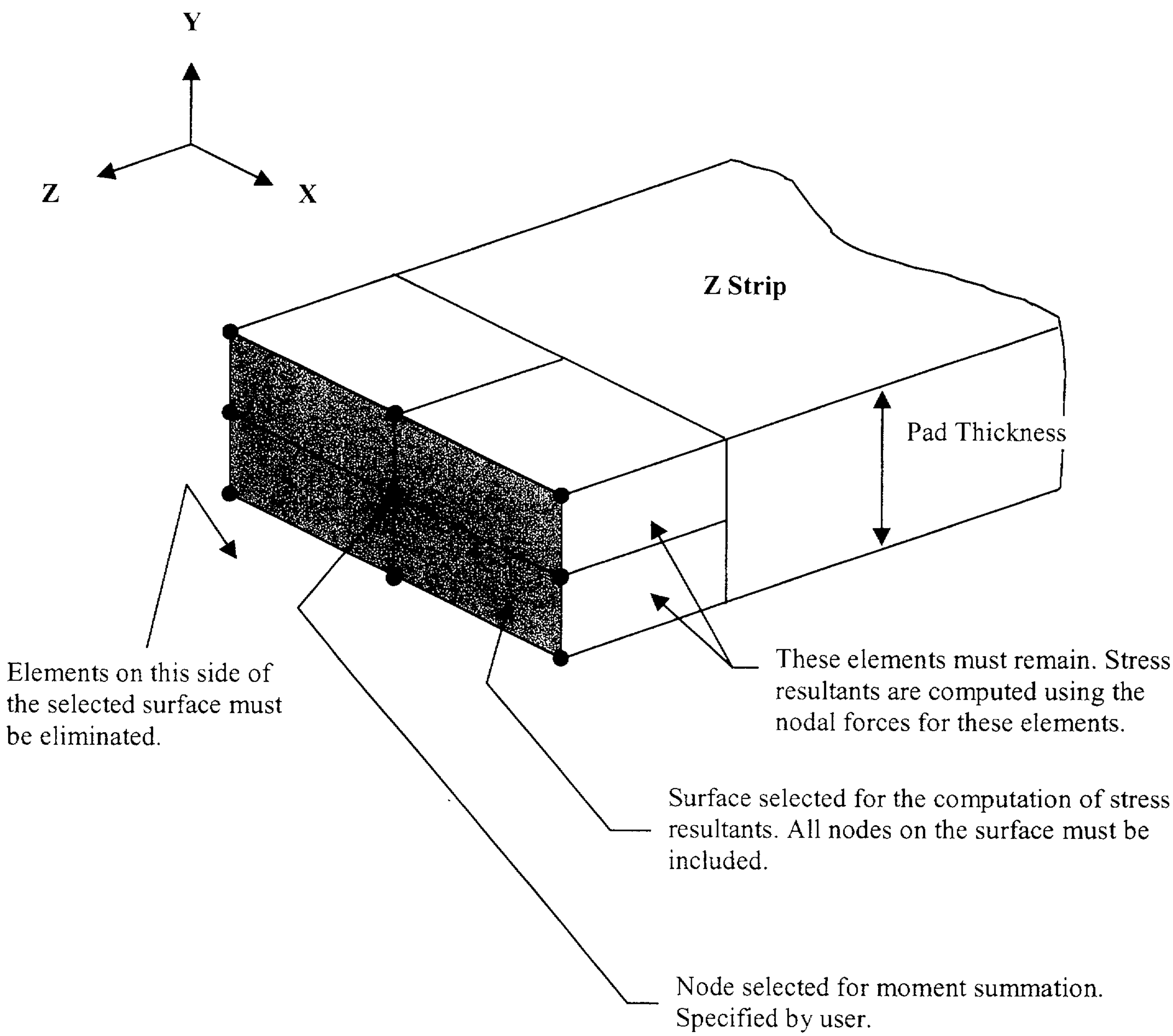
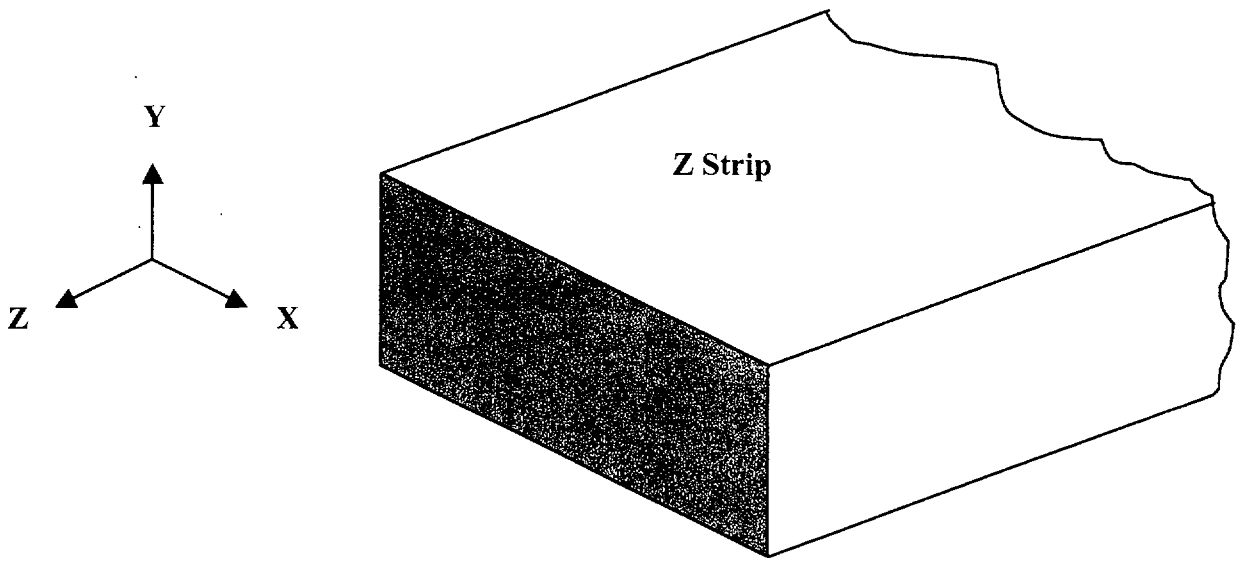
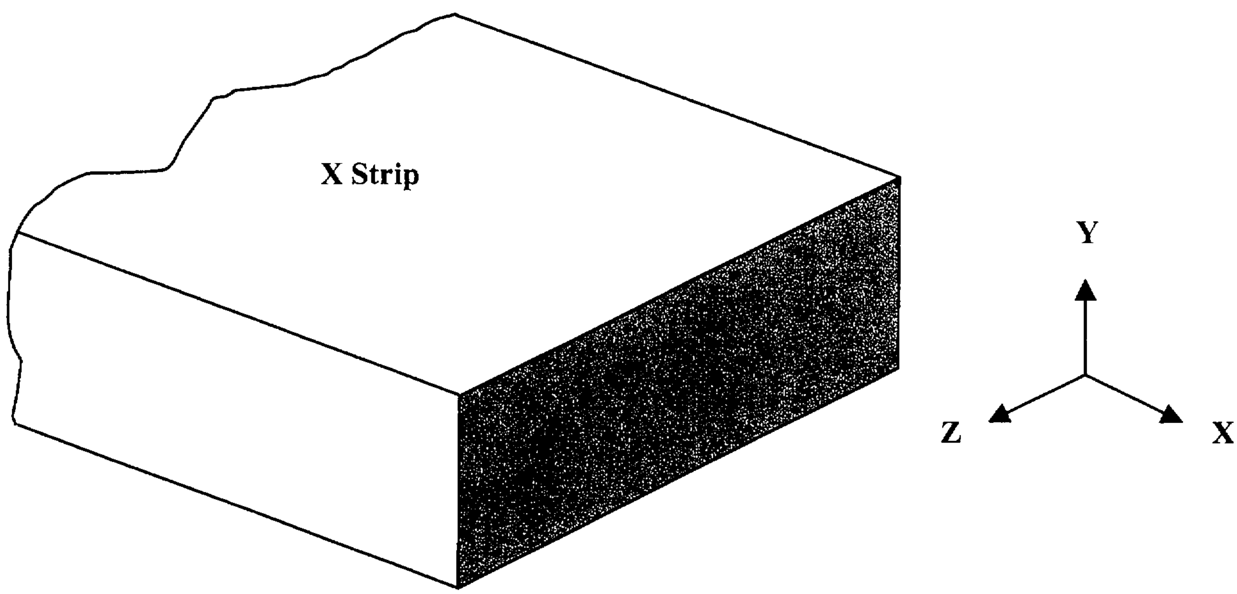


Figure 27 – Strip/Selected Surface



Coordinate system and section for Z strips.



Coordinate system and section for X strips

Figure 28 - Strips and Coordinate System

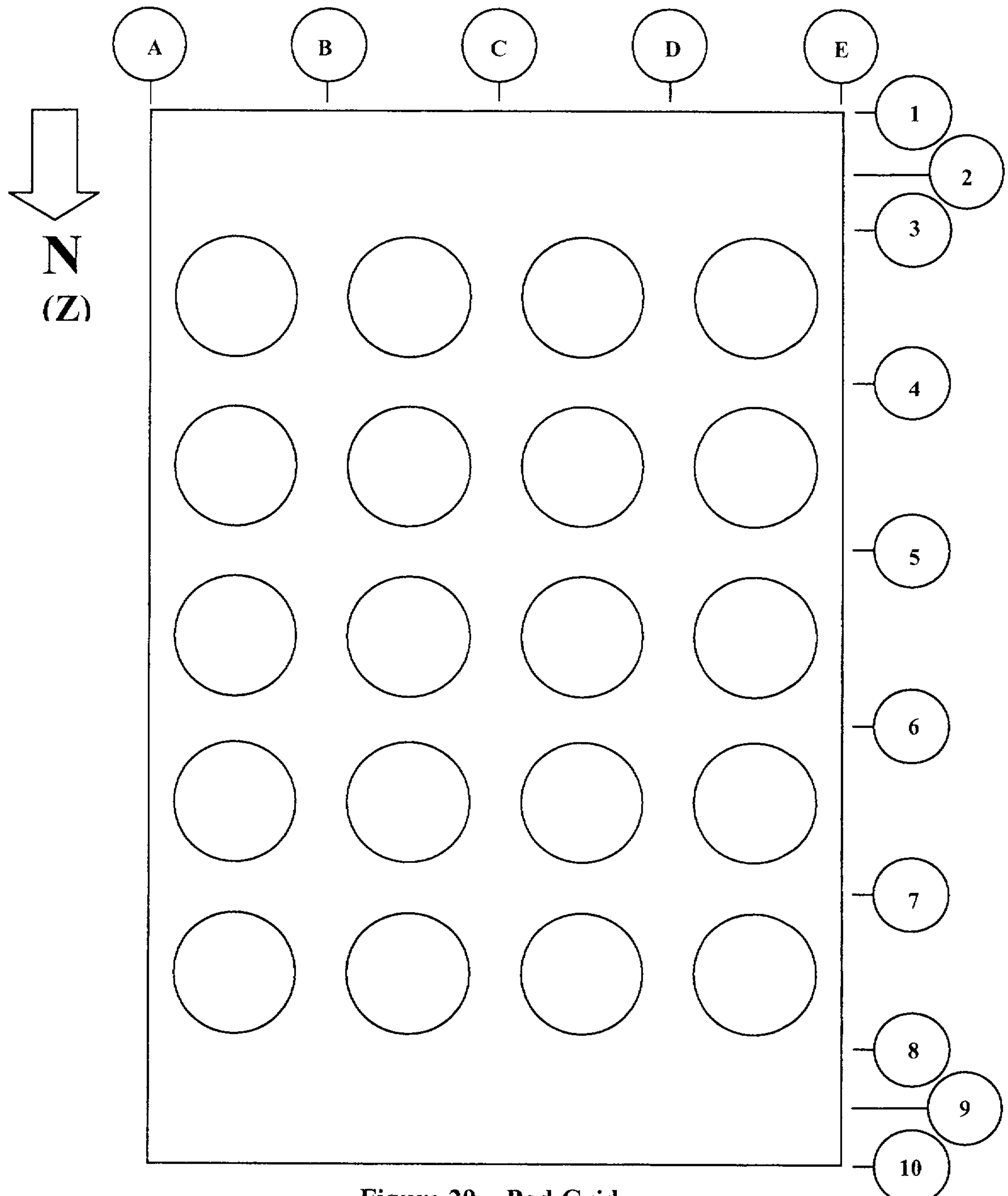


Figure 29 – Pad Grid

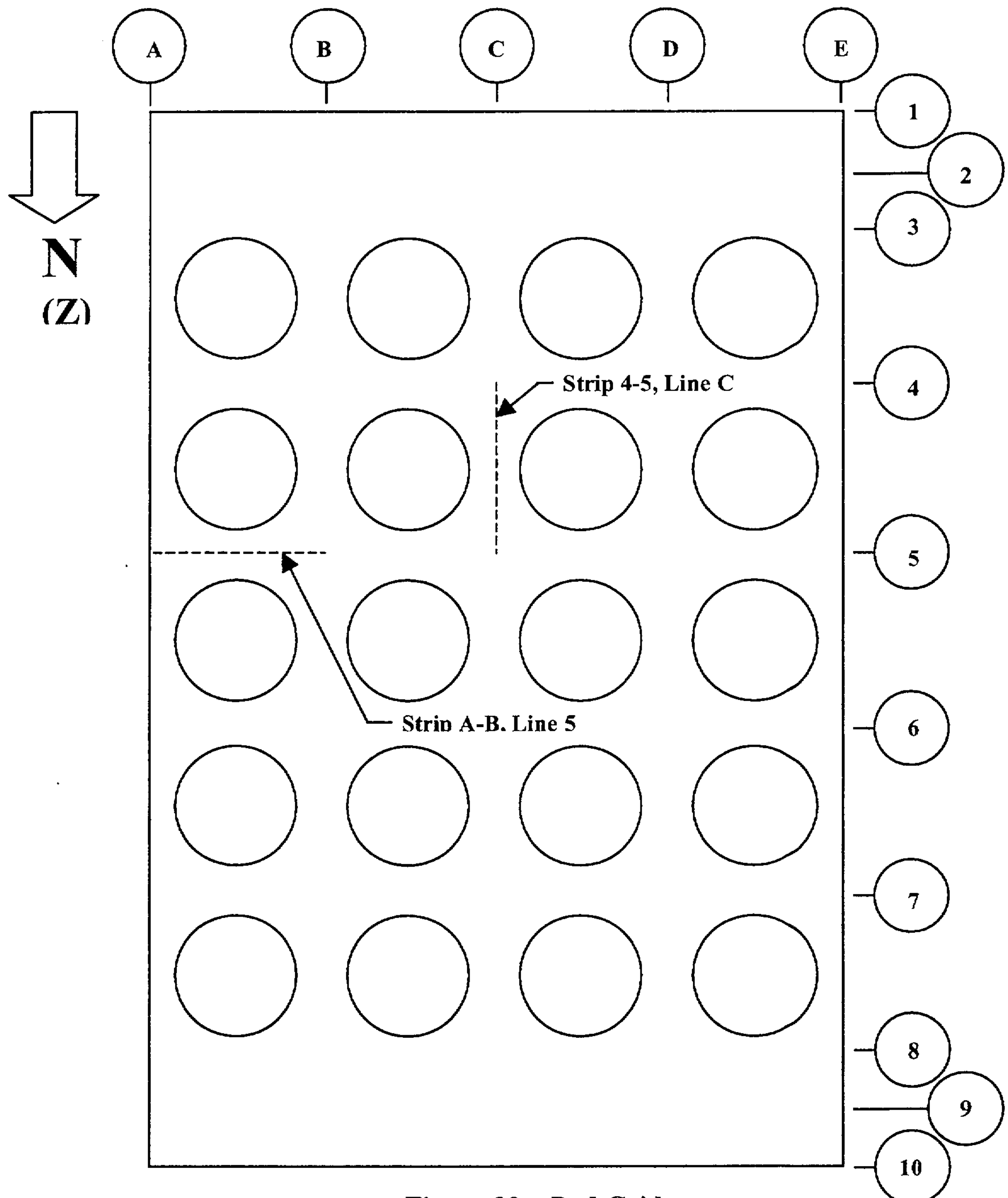
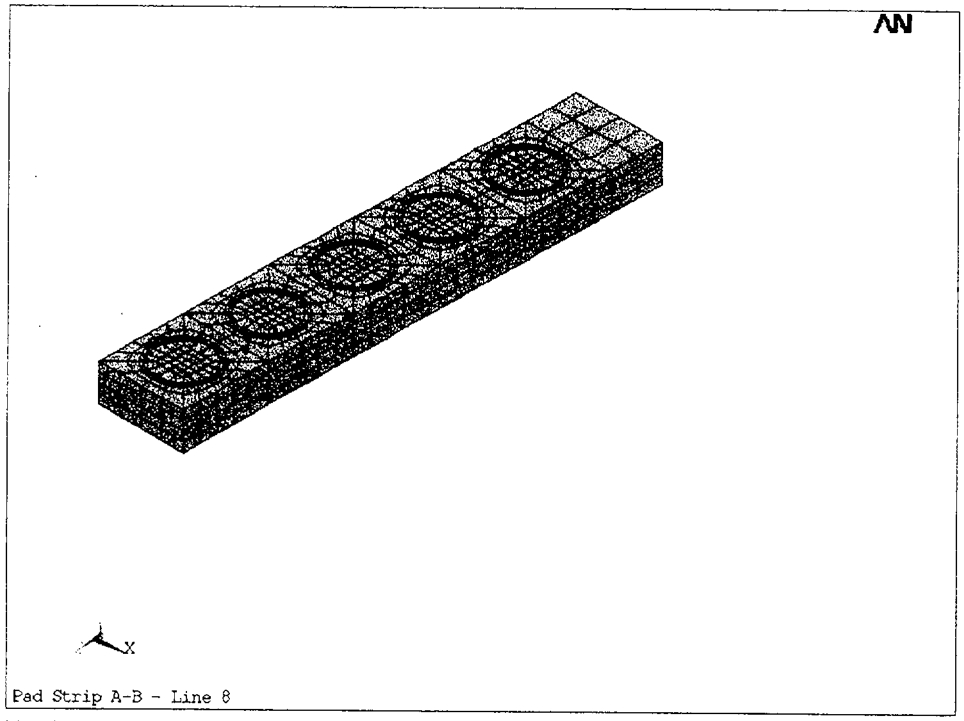


Figure 30 – Pad Grid



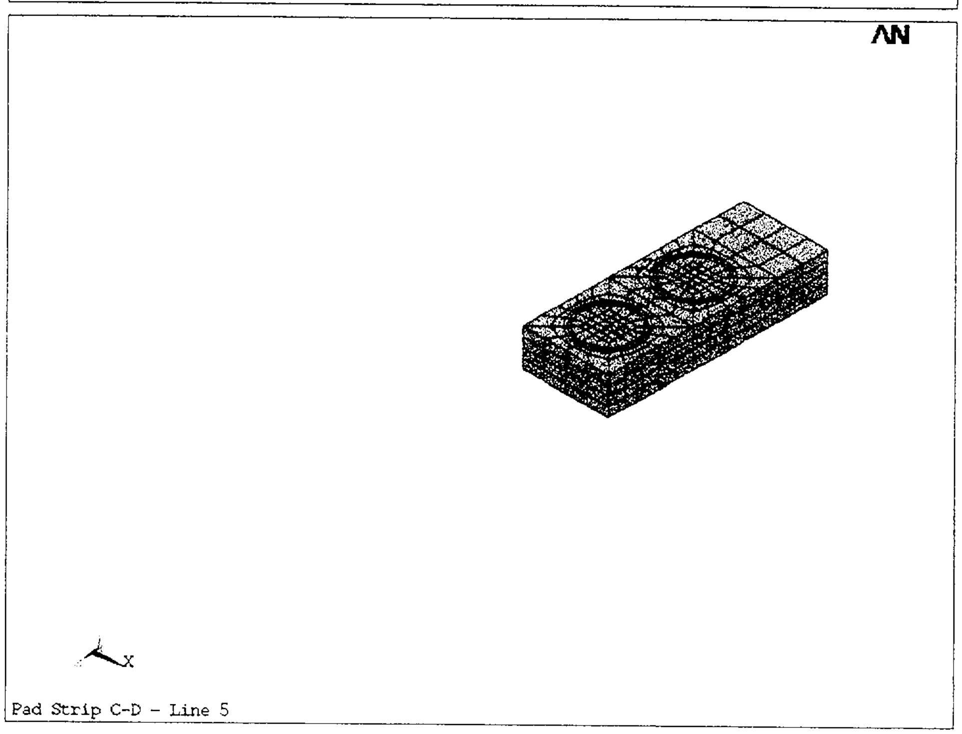
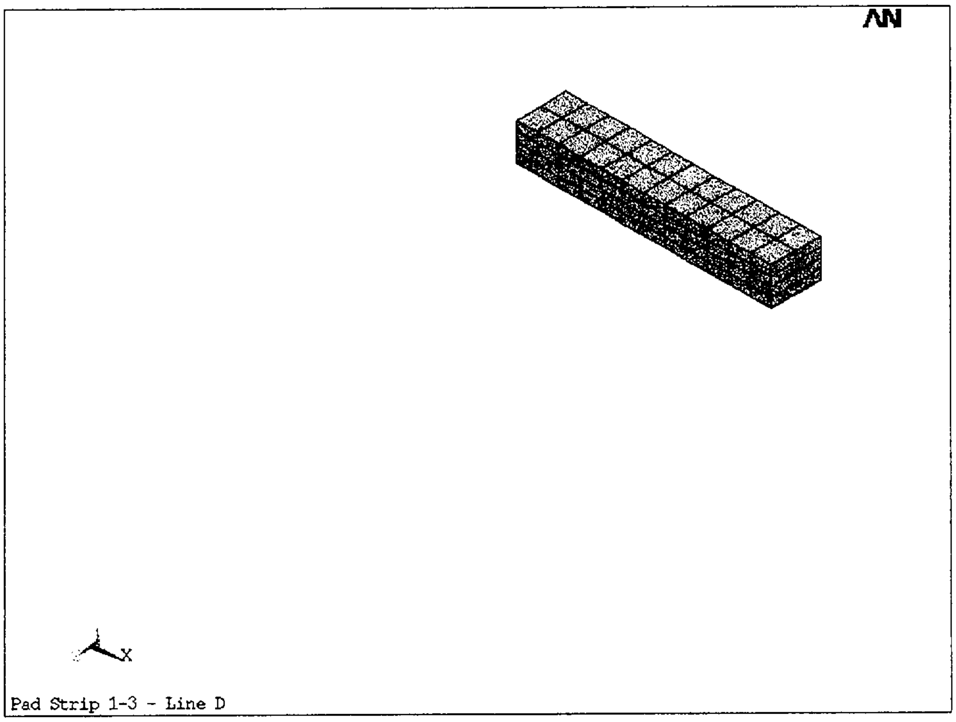


Figure 31 – North/South (Z) Strips



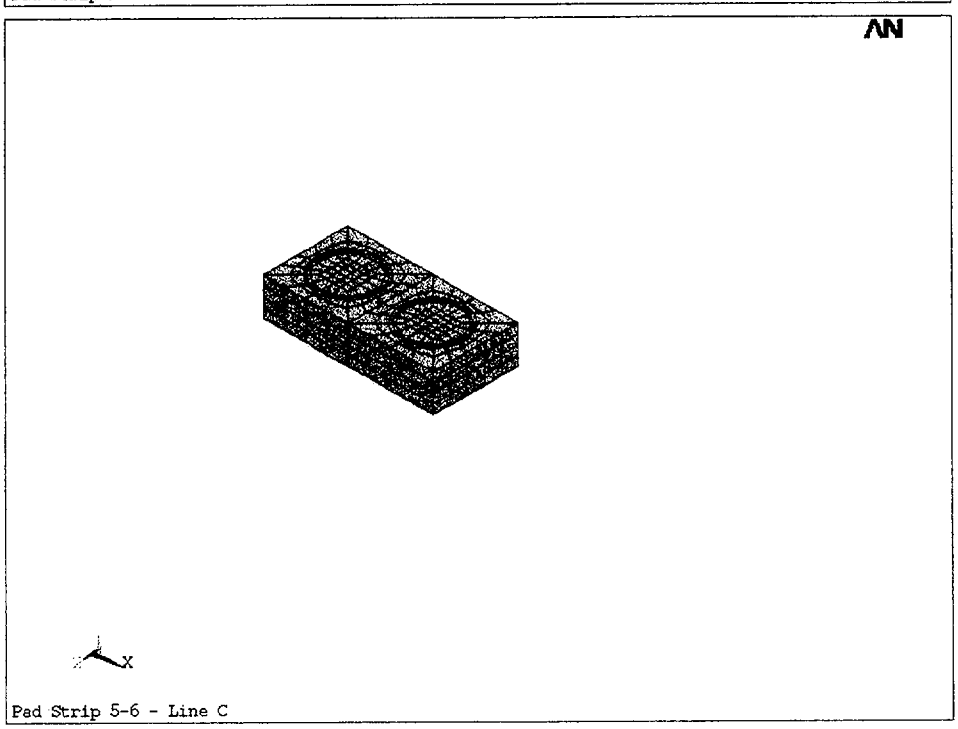


Figure 32 – East/West (X) Strips

Table 6 (1/3) - HE (1) NORTH – Z STRIPS – INTERNAL FORCES

Line	Force/Moment	Strip			
		A-B	B-C	C-D	D-E
10	Fy Fz Mx	-479342 984456 -0.443E8	-430237 921036 -0.414E8	Sym. With B-C	Sym. With A-B
9	Fy Fz Mx	-532371 941641 -0.197E8	-469565 785822 -0.150E8	Sym. With B-C	Sym. With A-B
8	Fy Fz Mx	-527383 971263 4488084	-436497 778974 8354419	Sym. With B-C	Sym. With A-B
7	Fy Fz Mx	-549967 776479 -900395	-440869 632337 1854746	Sym. With B-C	Sym. With A-B
6	Fy Fz Mx	-568401 488622 576226	-453052 447516 3581983	Sym. With B-C	Sym. With A-B
5	Fy Fz Mx	-625312 202111 8951040	-490995 238016 0.127E8	Sym. With B-C	Sym. With A-B
4	Fy Fz Mx	-731078 -97229 0.333E8	-634149 8119 0.345E8	Sym. With B-C	Sym. With A-B
3	Fy Fz Mx	-176465 -460244 0.165E8	-129535 -343547 0.153E8	Sym. With B-C	Sym. With A-B
2	Fy Fz Mx	-88102 -528563 0.242E8	-64899 -473992 0.233E8	Sym. With B-C	Sym. With A-B
1	Fy Fz Mx	11602 605828 -0.272E8	-11601 551257 -0.249E8	Sym. With B-C	Sym. With A-B

Table 6 (2/3) - HE (1) NORTH – X STRIPS – INTERNAL FORCES

Line	Force/Moment	Strip			
		1-3	3-4	4-5	5-6
E	Fx Fy Mz	69141 -55218 1778811	59429 -104528 1889824	119874 -176353 5555787	130021 -185489 5975053
D	Fx Fy Mz	270128 -31071 3922969	211324 -81250 -8350719	182824 -37720 -7976190	194517 -41194 -7447854
C	Fx Fy Mz	311040 -4693 -5851179	280349 -55875 -0.107E8	208770 -15420 -8936599	215522 -18372 -8006198
B	Fx Fy Mz	243769 22875 -4296744	185685 -28073 -7574883	182342 12084 -7876086	191851 11885 -7733355
A	Fx Fy Mz	-69141 -55218 1778811	-59429 -104528 -1889825	-119874 -176353 -5555787	-130021 -185490 -5975054

Table 6 (3/3) - HE (1) NORTH – X STRIPS – INTERNAL FORCES

Line	Force/Moment	Strip		
		6-7	7-8	8-10
E	Fx Fy Mz	123553 -177456 5562018	115783 -187168 5165282	29304 -85803 3192955
D	Fx Fy Mz	194123 -42445 -7318432	85375 -49296 -7170075	-157783 -28401 -1449223
C	Fx Fy Mz	208684 -22028 -7748704	46752 -32661 -7143824	-175859 -28973 -1135164
B	Fx Fy Mz	191504 5855 -7564913	119437 -4868 -7416332	-138212 -21959 -1359089
A	Fx Fy Mz	-123553 -177456 5562019	-115783 -187168 -5165281	-29304 -85803 -3192957

Table 7 (1/3) - HE (1) N 32.93 W – Z STRIPS – INTERNAL FORCES

Line	Force/Moment	Strip			
		A-B	B-C	C-D	D-E
10	Fy Fz Mx	-389254 801209 -0.345E8	-388772 783126 -0.353E8	-383148 798373 -0.359E8	-442900 873057 -0.408E8
9	Fy Fz Mx	-433936 836009 -0.141E8	-413802 677379 -0.122E8	-412225 678284 -0.127E8	-486561 769405 -0.187E8
8	Fy Fz Mx	-410580 932447 5679663	-380100 680829 7885156	-379675 662665 7661142	-507225 723971 3114136
7	Fy Fz Mx	-460869 934240 1656574	-381138 623931 2821450	-372961 494679 2541931	-488408 420015 -914486
6	Fy Fz Mx	-498597 782025 5782106	-394766 507279 4869688	-382051 302985 3437506	-493842 91509 -855625
5	Fy Fz Mx	-545048 555056 0.183E8	-430138 333949 0.136E8	-403350 123732 9497611	-517184 -170261 3131378
4	Fy Fz Mx	-456383 224496 0.336E8	-513914 96580 0.308E8	-454508 -52112 0.241E8	-549745 -387865 0.149E8
3	Fy Fz Mx	-151186 -300717 0.122E8	-106893 -265320 0.128E8	-127649 -294964 0.122E8	-226272 -491737 0.103E8
2	Fy Fz Mx	-71335 -417731 0.202E8	-55886 -388470 0.195E8	-63676 -405838 0.198E8	-115104 -487285 0.195E8
1	Fy Fz Mx	-5165 482565 -0.221E8	-20614 453304 -0.206E8	-12824 470671 -0.213E8	38604 552119 -0.241E8

Table 7 (2/3) - HE (1) N 32.93 W – X STRIPS – INTERNAL FORCES

Line	Force/Moment	Strip			
		1-3	3-4	4-5	5-6
E	Fx Fy Mz	283498 -79106 0.111E8	452129 -380041 0.203E8	529907 -448504 0.239E8	538508 -443223 0.242E8
D	Fx Fy Mz	386061 -97049 -1256206	347454 -378377 -2437693	305481 -328155 -1664003	317380 -312784 -1234268
C	Fx Fy Mz	321049 -66042 -9826424	334474 -378145 -0.164E8	255649 -310132 -0.117E8	250783 -284839 -9174402
B	Fx Fy Mz	153172 -6305 -0.126E8	174951 -277562 -0.247E8	134715 -323232 -0.226E8	119990 -270045 -0.181E8
A	Fx Fy Mz	105479 -56731 5947292	210988 -11001 9325835	238003 -23791 0.109E8	252640 -456 0.115E8

Table 7 (3/3) - HE (1) N 32.93 W – X Strips – Internal Forces

Line	Force/Moment	Strip		
		6-7	7-8	8-10
E	Fx Fy Mz	518752 -432162 0.232E8	478957 -426549 0.213E8	283952 -184953 0.149E8
D	Fx Fy Mz	307254 -305279 -1270735	221313 -301199 -1470806	10178 -119097 2597690
C	Fx Fy Mz	236869 -275898 -8288187	89813 -273999 -7253060	-141236 -115063 150097
B	Fx Fy Mz	115016 -256132 -0.162E8	40040 -252228 -0.143E8	-246062 -116171 -3002323
A	Fx Fy Mz	248129 11657 0.110E8	234107 11915 0.103E8	219737 24900 8945723

Table 8 (1/3) - HE (1) N 45 W – Z STRIPS – INTERNAL FORCES

Line	Force/Moment	Strip			
		A-B	B-C	C-D	D-E
10	Fy Fz Mx	-325352 664004 -0.276E8	-357842 674343 -0.305E8	-347015 693901 -0.313E8	-396089 761311 -0.363E8
9	Fy Fz Mx	-362194 727818 -0.104E8	-371083 589027 -0.101E8	-365986 589800 -0.107E8	-438809 643616 -0.170E8
8	Fy Fz Mx	-343322 840754 6379130	-336051 595729 7532480	-333261 571757 7168576	-462441 573564 2584175
7	Fy Fz Mx	-399885 922218 3262280	-332033 580897 3685275	-318752 414353 3172163	-426063 258937 -393060
6	Fy Fz Mx	-438641 831122 7631121	-342728 497441 5575850	-325679 236265 3587737	-426967 -54653 -881510
5	Fy Fz Mx	-465772 638180 0.184E8	-369446 350564 0.126E8	-339732 84504 7999275	-440479 -282309 1976080
4	Fy Fz Mx	-373012 307826 0.280E8	-413726 124277 0.255E8	-348295 -44466 0.180E8	-441523 -436877 9904902
3	Fy Fz Mx	-137725 -224139 -186997	-92139 -211155 0.111E8	-120453 -241789 0.100E8	-214610 -453792 5127026
2	Fy Fz Mx	-61874 -351226 0.176E8	-48875 -325452 0.167E8	-59466 -340128 0.167E8	-135786 -417498 0.141E8
1	Fy Fz Mx	-14626 405828 -0.190E8	-27625 380054 -0.174E8	-17034 394730 -0.180E8	59286 472100 -0.200E8

Table 8 (2/3) - HE (1) N 45 W – X STRIPS – INTERNAL FORCES

Line	Force/Moment	Strip			
		1-3	3-4	4-5	5-6
E	Fx Fy Mz	372673 -126085 0.155E8	579982 -470689 0.261E8	652001 -520256 0.293E8	662871 -518256 0.297E8
D	Fx Fy Mz	426121 -138189 -1335521	402216 -454611 -2050754	351134 -411375 -345760	360782 -397072 325408
C	Fx Fy Mz	325233 -99116 -0.122E8	362866 -468289 -0.199E8	283100 -402202 -0.145E8	272998 -378309 -0.114E8
B	Fx Fy Mz	125910 -19847 -0.162E8	190056 -344044 -0.324E8	149033 -448914 -0.319E8	117907 -424565 -0.273E8
A	Fx Fy Mz	157191 -59518 8290350	282957 5109 0.124E8	318364 -14886 0.143E8	340419 97 0.153E8

Table 8 (3/3) - HE (1) N 45 W – X Strips – Internal Forces

Line	Force/Moment	Strip		
		6-7	7-8	8-10
E	Fx Fy Mz	640137 -507141 0.286E8	589823 -493633 0.262E8	366057 -215619 0.185E8
D	Fx Fy Mz	346794 -387703 397700	275615 -379997 263964	86547 -147402 3755967
C	Fx Fy Mz	257122 -362466 -9854861	126085 -353165 -8168614	-99190 -146313 228578
B	Fx Fy Mz	108262 -382498 -0.240E8	33846 -350581 -0.199E8	-248825 -157283 -4749089
A	Fx Fy Mz	338346 13916 0.150E8	325587 20970 0.142E8	282880 33425 0.125E8

Table 9 (1/3) - HE (1) N 57.07 W – Z STRIPS – INTERNAL FORCES

Line	Force/Moment	Strip			
		A-B	B-C	C-D	D-E
10	Fy Fz Mx	-247620 500694 -0.197E8	-318496 540665 -0.246E8	-303039 564231 -0.255E8	-340405 620784 -0.303E8
9	Fy Fz Mx	-275731 592301 -6523518	-315240 480352 -7340447	-308980 480970 -8158849	-375239 493941 -0.143E8
8	Fy Fz Mx	-263576 715855 6524561	-278920 490374 7092327	-275781 461400 6608839	-399808 402743 2220029
7	Fy Fz Mx	-315591 874679 5162040	-268302 521455 4810041	-251966 326173 3973422	-345651 96470 372199
6	Fy Fz Mx	-346785 846870 8720461	-275775 473106 6222828	-256457 171235 3842488	-342788 -184069 -685040
5	Fy Fz Mx	-354246 690846 0.155E8	-295110 354621 0.111E8	-265631 53375 6744046	-349588 -362607 1317446
4	Fy Fz Mx	-293556 378042 0.215E8	-302758 158280 0.194E8	-257699 -25643 0.127E8	-336965 -446219 6974362
3	Fy Fz Mx	-118617 -137704 8640674	-73319 -143957 9219277	-119870 -170375 6553221	-160367 -372712 1536800
2	Fy Fz Mx	-49072 -271218 0.146E8	-39726 -245947 0.133E8	-56627 -250692 0.125E8	-126340 -306845 8396794
1	Fy Fz Mx	-27428 313198 -0.153E8	-36774 287926 -0.134E8	-19873 292671 -0.136E8	49840 348825 -0.137E8

Table 9 (2/3) - HE (1) N 57.07 W – X STRIPS – INTERNAL FORCES

Line	Force/Moment	Strip			
		1-3	3-4	4-5	5-6
E	Fx Fy Mz	450218 -177633 0.197E8	679590 -528402 0.304E8	749805 -577059 0.336E8	763680 -579257 0.342E8
D	Fx Fy Mz	444534 -182106 -136072	443412 -491581 -879857	388621 -475709 702827	396899 -465942 1401693
C	Fx Fy Mz	314728 -142078 -0.140E8	380706 -526190 -0.227E8	306788 -476190 -0.172E8	291856 -459813 -0.141E8
B	Fx Fy Mz	94084 -38765 -0.195E8	200348 -399797 -0.390E8	170344 -482381 -0.401E8	139190 -539145 -0.359E8
A	Fx Fy Mz	203417 -61455 0.104E8	342100 16577 0.150E8	379049 -3860 0.169E8	403341 4614 0.180E8

ENERCON SERVICES, INC.	JOB. NO. PGE-009	DATE November 30, 2001	
	PROJECT DCPP ISFSI		
	SUBJECT ISFSI Cask Storage Pad Seismic Analysis		
	CLIENT PG&E-DCPP	ORIGINATOR S. C. Tumminelli	
	REVIEWER K. L. Whitmore	APPROVED R. F. Evers	
	CALCULATION NO. PGE-009-CALC-003	REVISION 1	

Table 9 (3/3) - HE (1) N 57.07 W – X Strips – Internal Forces

Line	Force/Moment	Strip		
		6-7	7-8	8-10
E	Fx Fy Mz	739447 -568509 0.330E8	680607 -546884 0.302E8	432652 -232478 0.213E8
D	Fx Fy Mz	380446 -456362 1600167	327981 -445652 1638774	165085 -171680 4643853
C	Fx Fy Mz	275914 -441812 -0.121E8	170069 -424563 -9714659	-42161 -176363 -51248
B	Fx Fy Mz	118953 -531133 -0.320E8	41416 -471289 -0.269E8	-225013 -201104 -7807333
A	Fx Fy Mz	403758 15376 0.178E8	393858 27793 0.172E8	315633 955 0.146E8

Table 10 (1/3) - HE (1) WEST – Z STRIPS – INTERNAL FORCES

Line	Force/Moment	Strip			
		A-B	B-C	C-D	D-E
10	Fy Fz Mx	-89382 38589 983130	-127868 91044 -3706622	-152281 129661 -6061128	-143481 140044 -9185582
9	Fy Fz Mx	-65182 174217 4598607	-119504 123475 1073714	-116961 122259 395996	-150936 19445 -4240410
8	Fy Fz Mx	-36098 298134 7173904	-106948 144979 5903260	-88183 106397 4849006	-171805 -102709 1543524
7	Fy Fz Mx	-15956 648248 9604255	-31402 318485 9232858	-23333 88655 6862494	-60070 -291139 3417829
6	Fy Fz Mx	-28443 796550 9092937	-26025 383567 8121906	-23057 41805 5033766	-52228 -401664 764098
5	Fy Fz Mx	-46973 776337 8985788	-28304 373753 8376861	-27930 45884 5228107	-54469 -389753 1073675
4	Fy Fz Mx	-55924 586490 9173212	-17482 289296 9953764	-15753 101657 7341382	-34866 -253450 4496735
3	Fy Fz Mx	-11424 174172 6188009	42596 123453 5921344	40225 122275 5107146	74413 19398 2521466
2	Fy Fz Mx	12764 38618 4038801	51143 90943 1664371	75743 129645 780213	66980 139995 -2869666
1	Fy Fz Mx	-89264 -38618 -977960	-127643 -90943 3699209	-152243 -129645 6059382	-143480 -139995 9183442

Table 10 (2/3) - HE (1) WEST – X STRIPS – INTERNAL FORCES

Line	Force/Moment	Strip			
		1-3	3-4	4-5	5-6
E	Fx Fy Mz	525273 -239121 0.245E8	793710 -603514 0.353E8	864466 -644896 0.386E8	886415 -653720 0.396E8
D	Fx Fy Mz	359377 -207832 4887233	439877 -537258 2676159	428621 -547955 2511197	442417 -550606 2533592
C	Fx Fy Mz	155772 -229902 -5421793	313732 -533490 -0.174E8	319608 -544956 -0.182E8	322227 -547001 -0.184E8
B	Fx Fy Mz	-49505 -146374 -0.218E8	154160 -511333 -0.449E8	176810 -540098 -0.476E8	171332 -546142 -0.481E8
A	Fx Fy Mz	304554 -51285 0.148E8	439648 28776 0.193E8	461317 15306 0.203E8	471814 14470 0.208E8

Table 10 (3/3) - HE (1) WEST – X STRIPS – INTERNAL FORCES

Line	Force/Moment	Strip		
		6-7	7-8	8-10
E	Fx Fy Mz	Sym. with 4-5	Sym. with 3-4	Sym. with 1-3
D	Fx Fy Mz	Sym. with 4-5	Sym. with 3-4	Sym. with 1-3
C	Fx Fy Mz	Sym. with 4-5	Sym. with 3-4	Sym. with 1-3
B	Fx Fy Mz	Sym. with 4-5	Sym. with 3-4	Sym. with 1-3
A	Fx Fy Mz	Sym. With 4-5	Sym. with 3-4	Sym. with 1-3

All the moment and axial force data in Tables 6 through 10 are plotted in Figures 33 and 34 below. The input data was adjusted for the 10 foot strips (factored by 1.7) and for the last section (signs were reversed). Table 11 presents design data from each quadrant, i.e., all the combinations of controlling signed values of moment and axial force, along with the maximum shear values, scanned manually.

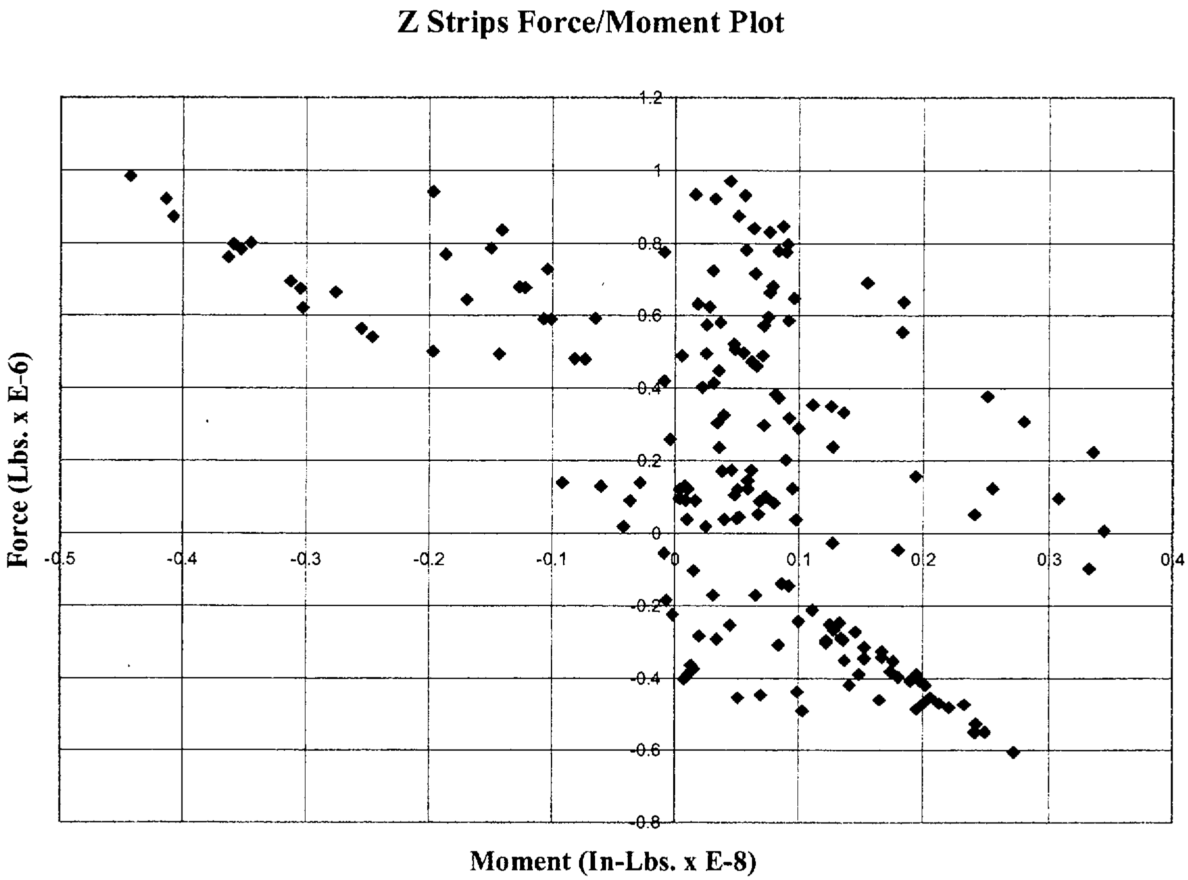


Figure 33 – Z Strips Internal Forces

X Strips Force/Moment Plot

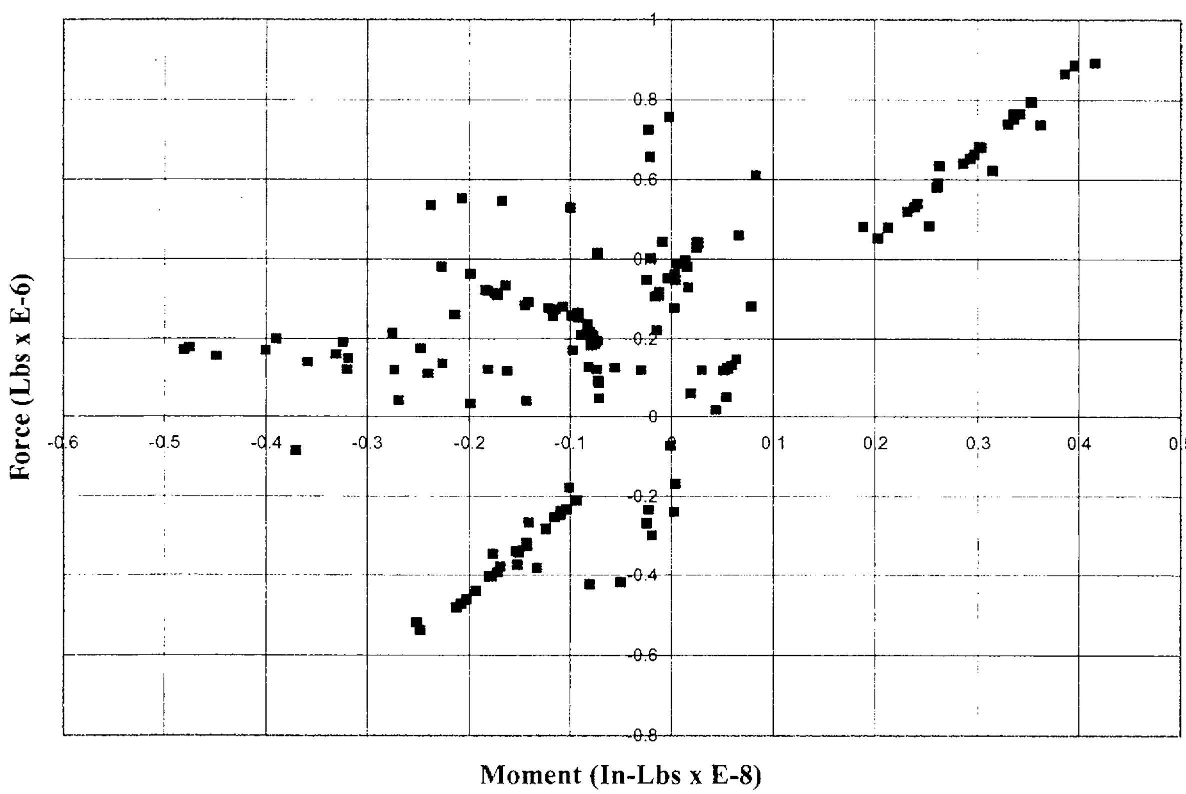


Figure 34 – X Strips Internal Forces

Table 11 (1/2) - Z Strips – Internal Forces for Design

Quadrant	Mx	Fz	Location/Table Ref.
+Mx Ten. on Bot. +Fz Comp. on Sect.	0.0449E8 0.184E8 0.336E8 0.345E8	0.971E6 0.638E6 0.224E6 0.00812E6	A-B/8 Table 6 A-B/5 Table 8 A-B/4 Table 7 B-C/4 Table 6
-Mx Comp. On Bot. +Fz Comp. on Sect.	-0.443E8	0.984E6	A-B/10 Table 6
-Mx Comp. On Bot. -Fz Ten. on Sect.	-0.00187E8	-0.224E6	A-B/3 Table 8
+Mx Ten. on Bot. -Fz Ten. on Sect.	0.333E8 0.272E8	-0.097E6 -0.606E6	B-C/4 Table 6 A-B/1 Table 6
Shear Force	Fy	-731078	A-B/4 Table 6

Table 11 (2/2) - X Strips – Internal Forces for Design

Quadrant	Mz	Fx	Location/Table Ref.
+Mz Comp. on Bot. +Fx Comp. on Sect.	0.4165E8	0.8925E6	1-3/E Table 10*
-Mz Ten. on Bot. +Fx Comp. on Sect.	-0.00231E8 -0.238E8 -0.476E8 -0.481E8	0.7565E6 0.5355E6 0.177E6 0.171E6	1-3/D Table 9* 1-3/C Table 9* 4-5/B Table 10 5-6/B Table 10
-Mz Ten. on Bot. -Fx Ten. on Sect.	-0.370E8 -0.2516E8 -0.2482E8	-0.08415E6 -0.5185E6 -0.5372E6	1-3/B Table 10* 1-3/A Table 10* 8-10/A Table 9*
+Mz Comp. on Bot. -Fx Ten. on Sect.	0.00255E8	-0.2397E6	8-10/C Table 7*
Shear Force	Fy	-653720	5-6/E Table 10

* Factor of 1.7 applied.

Adjustments to these values will be made using factors developed later in this calculation.

Rock Bearing Pressures

The database was scanned using the ANSYS post processor for the maximum compressive stress in the rock beneath the pad. The results are provided in Table 12 below. See Appendix SN-2 for the details.

Table 12 - ROCK RESPONSE – PRESSURE (STRESS) RESULTS

LS	EQ	Direction	SOFT	HARD	V HARD
			$\sigma_{Y\ Max}$	$\sigma_{Y\ Max}$	$\sigma_{Y\ Max}$
1		Gravity	-15.72	-16.32	-16.36
2	HE(1)	N	-18.25	-20.38	-23.86
3	HE(1)	N32.93W	-21.72	-25.06	-27.61
4	HE(1)	N45W	-24.20	-27.92	-31.13
5	HE(1)	N57.07W	-26.36	-30.61	-34.42
6	HE(1)	W	-29.31	-34.28	-38.92
7	HE(1)*	N	-8.77	-9.60	-11.05
8	HE(1)*	W	-13.39	-15.39	-17.35
9	HE(3)*	N	-28.94	-30.10	-30.18
10	HE(3)*	W	-32.05	-34.13	-36.24
11	L(2)	N	-16.65	-17.93	-21.00
12	L(2)	N32.93W	-19.61	-22.38	-24.61
13	L(2)	N45W	-21.78	-24.93	-27.77
14	L(2)	N57.07W	-23.71	-27.35	-30.75
15	L(2)	W	-26.32	-30.55	-34.68
16	L(2)*	N	-7.17	-7.16	-8.50
17	L(2)*	W	-10.95	-12.64	-14.37
18	L(4)*	N	-6.63	-6.11	-7.27
19	L(4)*	W	-9.44	-10.93	-12.47

* Load components are combined using the 40-100-40 rule. All others combined using 100-40-40 rule.

The applied gravity bearing pressure is 16.36 psi = 16.36*144/1000 = 2.36 ksf. The allowable bearing pressure is 40 ksf, (Section 6.4.3.5, Reference 2). Therefore, this is acceptable with ample margin.

The maximum applied gravity plus seismic pressures all occur in the very hard rock analyses. These pressures are (see Table 12):

38.92 psi for LS 6, HE(1) West, combined via the 100-40-40 rule
36.24 psi for LS 10 HE(3) West, combined via the 40-100-40 rule
34.68 psi for LS 15 LTSP(2) West, combined via the 100-40-40 rule

The application of the Holtec force components and the pad accelerations for LS 10 were designed to maximize the applied bearing pressure. However, the components and accelerations for LS 6 and 15 were designed to maximize uplift. The results from these two analyses are adjusted to reflect the maximum down components. Use a 17-foot square associated with a single cask.

For the Hosgri load cases, use the maximum down component from HE(3) rather than HE(1) to be conservative (See Table 1 and the descriptions of the load steps). Therefore:

Max. Dn for HE is 360 + 0.40 * (773.3 - 360) = 525.32 kips and
Δ Dn = 525.32 – 267.04 kips = 258.28 kips

Max Δ Dn acceleration is 2 * 0.20 = 0.40G
Thus, Δ pad load is 0.40 * (17*17*7.5*0.15) = 130.05 kips.

Thus, Net Δ Dn = 258.28 + 130.05 = 388.33 kips.

And the increase in bearing pressure is $\dfrac{388.33}{17*17} = 1.344$ ksf

Adding this to the LS 6 result of 38.92 psi is:

Net Pressure = 38.92*144/1000 + 1.344 = 6.95 ksf.

The LTSP value is computed similarly:

Max. Dn for LTSP is 360 + 0.40 * (684.1 - 360) = 489.64 kips and
Δ Dn = 489.64 – 258.32 kips = 231.32 kips

Max Δ Dn acceleration is 2 * 0.28 = 0.56G
Thus, Δ pad load is 0.56 * (17*17*7.5*0.15) = 182.07 kips.

Thus, Net Δ Dn = 231.32 + 182.07 = 413.39 kips.

And the increase in bearing pressure is $\frac{413.39}{17*17} = 1.430$ ksf

Adding this to the LS 15 result of 34.68 psi is:

Net Pressure = 34.68*144/1000 + 1.430 = 6.42 ksf.

Therefore, the maximum applied gravity plus seismic bearing pressure is 6.95 ksf. The allowable bearing pressure is 52 ksf, (Section 6.4.3.5, Reference 2). This is also acceptable with ample margin.

The vertical stresses are plotted below in Figures 35 to 38 for Load Steps 6 and 10. These plots show that the computed maximum pressures are very local within the rock mass.

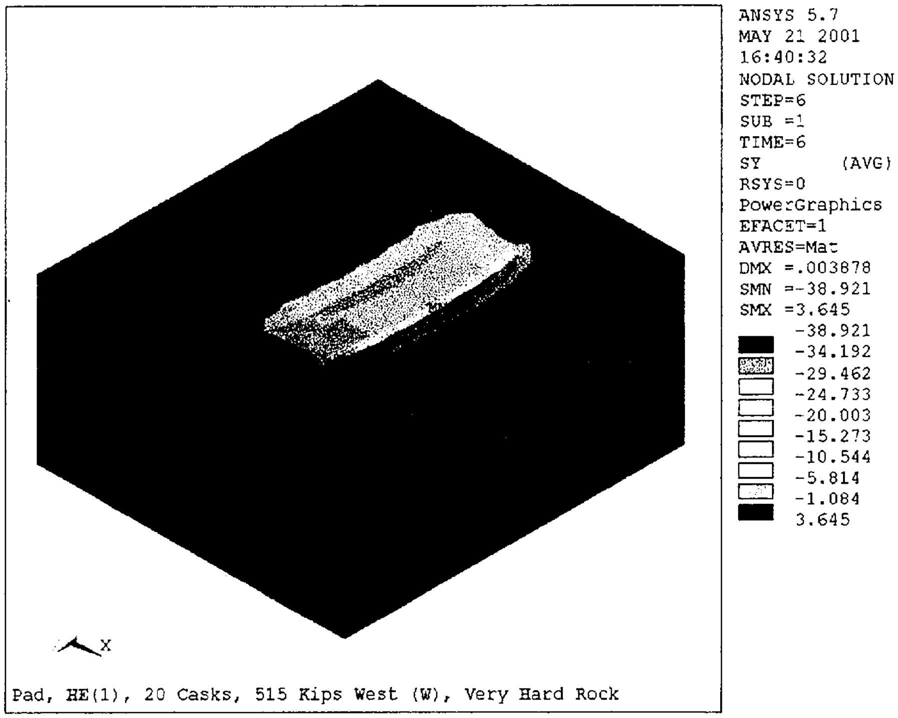


Figure 35 – Rock Y direction stresses for Load Step 6

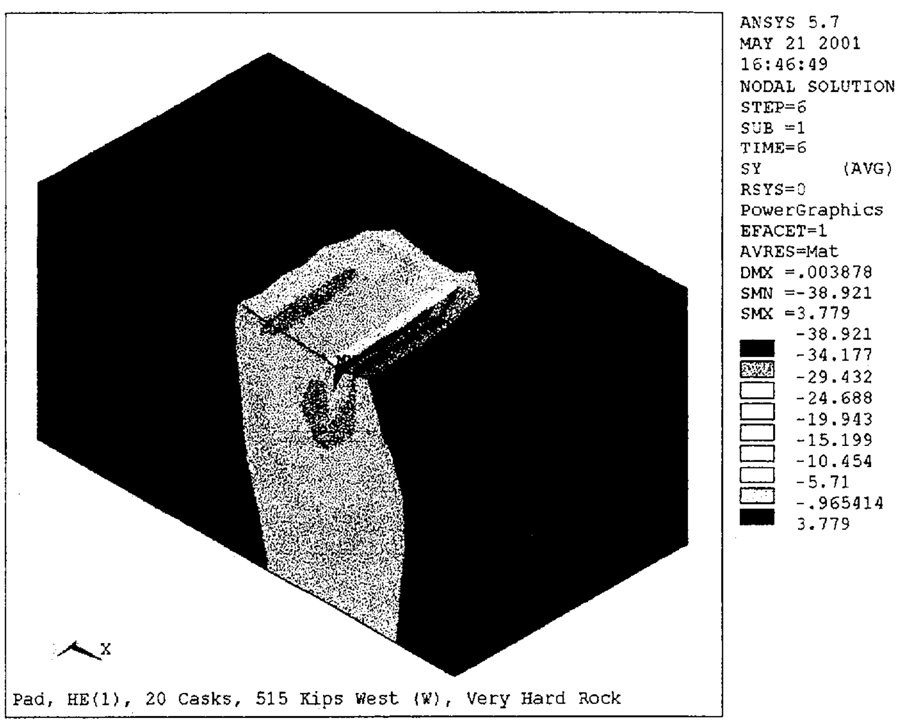


Figure 36 – Rock Y direction stresses, cutaway, for Load Step 6

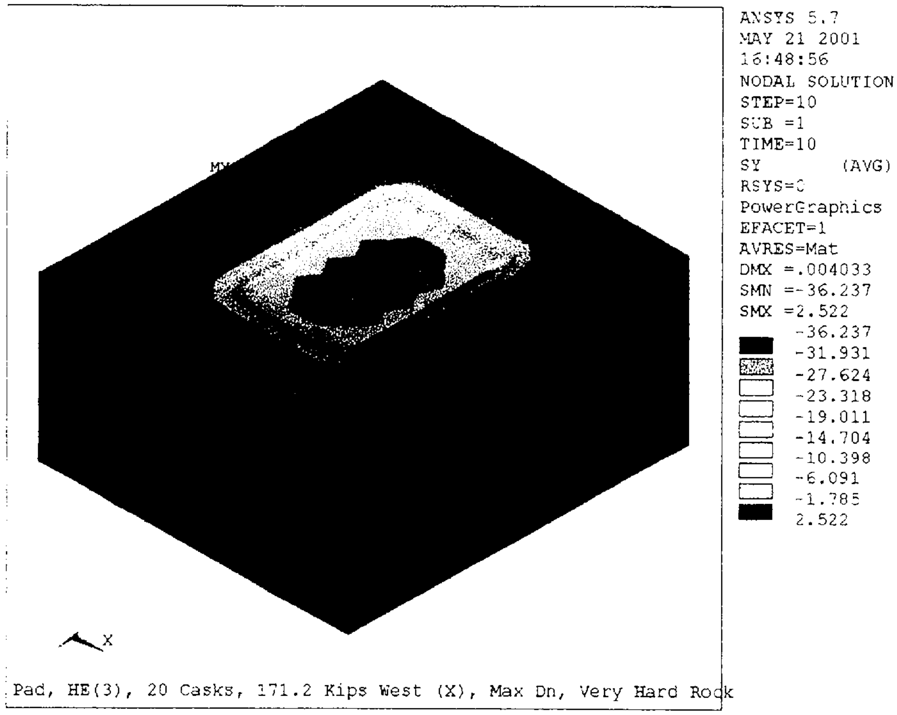


Figure 37 – Rock Y direction stresses for Load Step 10 – Max Down

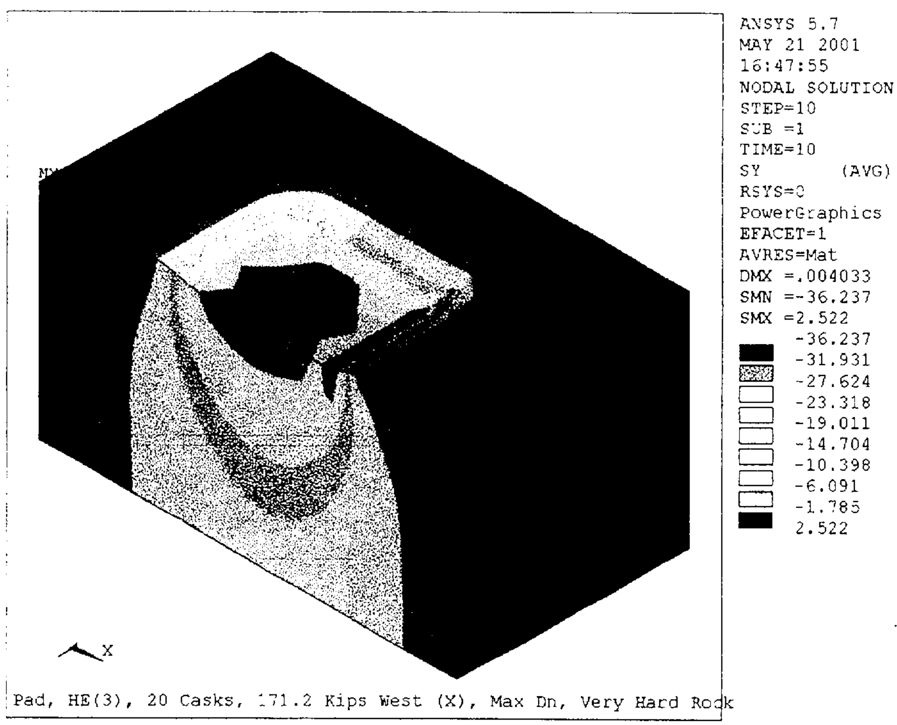


Figure 38 – Rock Y direction stresses, cutaway, Load Step 10 – Max Down

Pad Response at Reduced Concrete Density

The various design codes and documents require that when dead weight assists in providing resistance to the applied loads, that the structure be assessed assuming that the dead weight is reduced to 90% of its design value (See Reference 9, Section 9.2.3. Reference 8, Table 3-1 requires a reduction to 95%, see definition of D.). In the case of the pad, of course, the dead weight of the pad provides the resistance to lift off during a seismic event. The pad, however, also participates on the demand side of this evaluation. Since the center of gravity of the pad is above the rock, the acceleration of the pad itself will result in an applied moment tending to lift the pad off the rock. However, the pad can have only one density. Therefore, the analysis was rerun for the soft rock model, using a concrete weight density of 135 pcf, which is equal to 90% of 150 pcf. The applied load on the pad along with its resisting effects were both reduced.

Since the relative proportions of response could not be ascertained a priori, both the Hosgri and LTSP loads were applied. These are Load Steps 2 through 6 and 11 through 15, see Tables 2 and 3.

The reaction evaluation is presented in Appendix RL-3, the pad and cask displacements are presented in Appendix DN-5, and the pad X and Z stresses are presented in Appendix SN-3. The results are presented in Table 13 along with the bounding results from the soft rock analyses using normal weight concrete.

Table 13 – MAXIMUM PAD RESPONSES - REDUCED CONCRETE DENSITY SOFT ROCK

LS	EQ	Direction	δ_{Max}	δ_{Cask}	$\sigma_{X\ Max}$	$\sigma_{X\ Min}$	$\sigma_{Z\ Max}$	$\sigma_{Z\ Min}$
Envelope of 19 Basic Load Cases, normal density see Tables 2 and 3			0.101	0.028	261	-405	270	-410
2	HE(1)	N	0.067	0.00529	46	-106	254	-392
3	HE(1)	N32.93W	0.110	0.0295	141	-262	220	-398
4	HE(1)	N45W	0.112	0.0351	185	-311	196	-368
5	HE(1)	N57.07W	0.105	0.0359	225	-348	166	-320
6	HE(1)	W	0.052	0.0178	247	-393	60	-131
11	L(2)	N	0.054	0.00104	42	-94	245	-366
12	L(2)	N32.93W	0.089	0.0199	131	-244	212	-370
13	L(2)	N45W	0.091	0.0238	176	-290	188	-341
14	L(2)	N57.07W	0.084	0.0243	213	-324	158	-296
15	L(2)	W	0.042	0.0111	240	-365	55	-119

* Load components are combined using the 40-100-40 rule.

Comparing these results to the normal weight concrete results, the displacements are increased by 10 to 11 percent owing to the reduction in weight holding the pad and casks down. These displacements are, however, still small and acceptable. The stresses are all either the same or slightly lower than those shown in Table 3, since the net horizontal force is reduced. These results clearly show that additional evaluations of this analysis are not warranted and that the postulation of a reduced concrete density to 90 percent of its design value does not present a challenge to the design.

Pad Response for Cask Placement Sequence

The pad has been analyzed for a cask placement sequence that begins with placing the first cask at the southern most row. Figure 39 shows the placement sequence beginning with cask number 1 and ending with cask number 20. The pad was analyzed for the various cask configurations that will occur through the sequence of placing the casks on the pad. All configurations were analyzed from the placement of cask number 1 to the placement of cask number 14. The remaining configurations, 15 through 19, were not specifically analyzed, since the results clearly show that the pad response approaches that of the fully loaded pad, all 20 casks, asymptotically.

Each configuration was analyzed for the Hosgri HE(1) earthquake aimed at 45 degrees around the compass, since many of the cask placement configurations are not symmetrical. Where symmetrical configurations were encountered, the analysis took advantage of them. Therefore, the analyses are for HE(1) aimed at North, North 45 West, West, South 45 West, South, South 45 East, East, and North 45 East. The pad accelerations were also aimed in the same directions as the loads. The soft rock model was used for analysis since that has been shown to result in the highest displacements and stresses.

The calculations were performed in sets. Thus cask placement sequence 1 though 1 to 6 were analyzed together (42 load steps), 1 to 7 through 1 to 10 (26 load steps), and then 1 to 11 through 1 to 14 (26 load steps). In all, therefore, 94 load steps were analyzed. In order to minimize the volume of paperwork, these three sets were then enveloped to produce a conservative set of response results. The individual load cases were enveloped for maximum responses, which provide the displacements and the maximum positive (tensile) stresses, and they were enveloped for minimum responses, which provide the maximum negative (compressive) stresses. The displacement envelopes are exact, the stress envelopes are either exact or conservative, since ANSYS envelopes the element stresses and then provides nodal average stresses from these.

As an example, take two elements with a node between them. Say for the first load case, the element stresses are 100 and 200, with the nodal average of 150. See Table below. Now, say for the second load case, the element stresses are 150 and 150, with a nodal average of 150. The true envelope of these cases would be a nodal average of 150. However, since ANSYS envelops the element stresses, it will provide an enveloped nodal average of 175.

Load Case	Stress in Element Number 1	Stress in Element Number 2	Nodal Stress
1	100	200	150
2	150	150	150
Envelope using nodal envelope			150
Envelope using element envelope	150	200	175

Obviously, this is a vastly simplified representation of the process ANSYS actually uses since the elements are numerically integrated and the nodal averaging algorithms are much more complex than a simple average, yet the concept presented is accurate. Of course, if the maximum and minimum values are controlled by adjacent elements from the same load case, then the envelope algorithm will provide the exact result.

The reaction calculation is provided in Appendix RL-4, and the enveloping data files are provided in Appendix EN-1. The results are provided in Table 14 below.

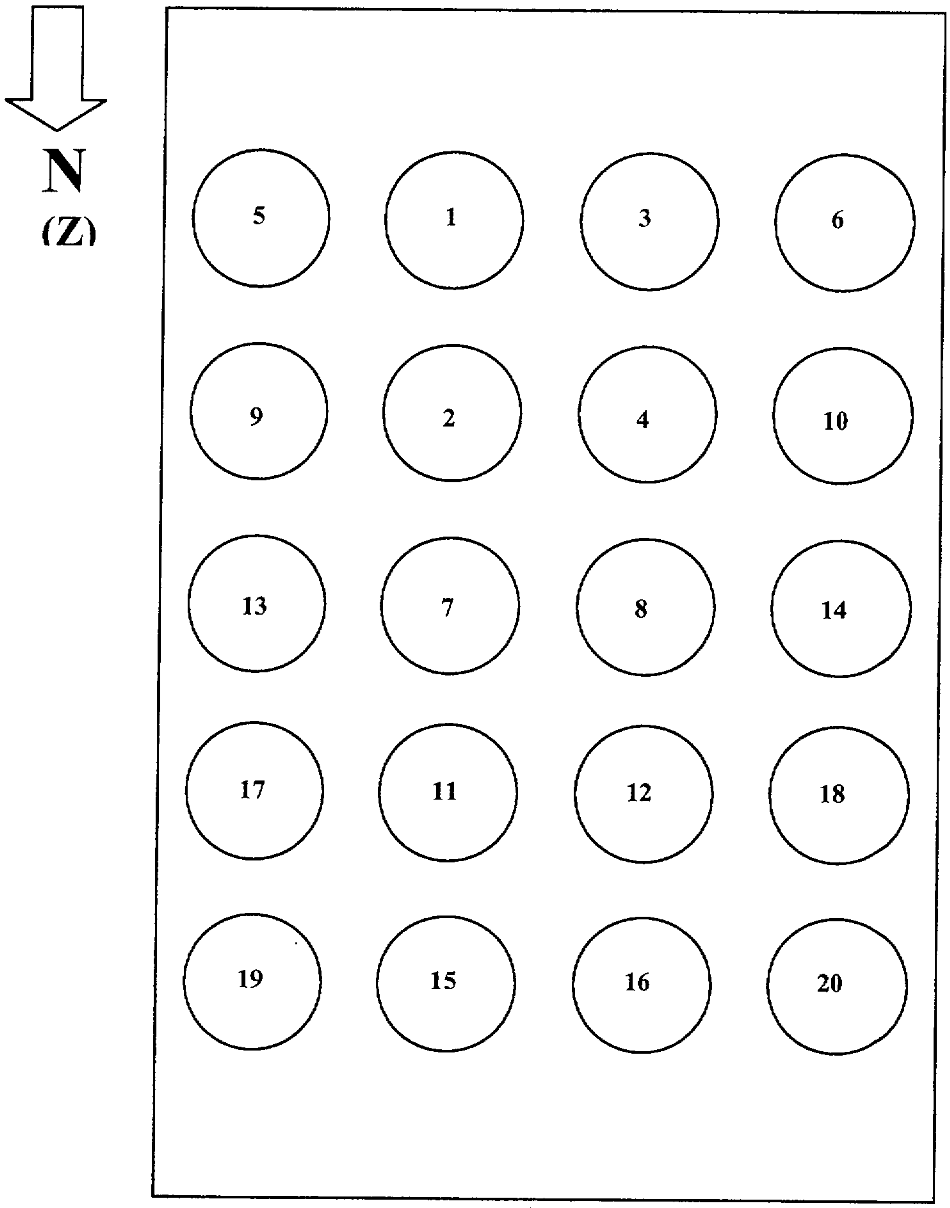


Figure 39 – Cask Placement Sequence

Table 14 - CASK PLACEMENT SEQUENCCE
ENVELOPE OF PAD RESPONSES – SOFT ROCK

Loads/Rock Characteristics	δ_{Max}	δ_{Cask}	$\sigma_{X\ Max}$	$\sigma_{X\ Min}$	$\sigma_{Z\ Max}$	$\sigma_{Z\ Min}$
Envelope of 19 Basic Load Cases, see Tables 2 and 3	0.101	0.028	261	-405	270	-410
42 Hosgri Load Cases/Soft Rock/Casks 1 to 1 to 6*	0.035	-0.003	199	-280	163	-243
26 Hosgri Load Cases/Soft Rock/Casks 1 to 7, to 1 to 10**	0.061	0.008	230	-332	199	-295
26 Hosgri Load Cases/Soft Rock/Casks 1 to 11, to 1 to 14***	0.080	0.017	247	-364	237	-337

All load components are combined using the 100-40-40 rule.

* Includes casks placed in sequence 1, 1 and 2, 1 to 3, 1 to 4, 1 to 5 and 1 to 6.
** Includes casks placed in sequence 1 to 7, 1 to 8, 1 to 9 and 1 to 10.
*** Includes casks placed in sequence 1 to 11, 1 to 12, 1 to 13 and 1 to 14.

The results provided in the Table show that the displacements and stresses for the cases analyzed for the placement sequence configurations described above, are all bounded by the fully loaded analyses (all 20 casks on the pad) previously presented. Thus the results for the fully loaded analyses will be used for concrete section evaluation and reinforcement design, and further consideration of the cask placement sequence results is not warranted.

Pad Response for Cask Extraction

The pad has been analyzed for a cask extraction event. In this analyses one of the two casks in the middle of the pad is to be removed (extracted), i.e., either cask 7 or 8, either from the North or the South. Due to the symmetry of the pad and the casks, it does not matter whether the cask to be removed is 7 or 8, nor does it matter if either of these is removed from the North or South. In this analysis the cask to be removed is number 7 and it is assumed that it will be removed from the South, hence the analysis was performed with casks 1, 2 and 7 removed, see Figure 40. As with the analyses for the cask placement, this configuration was analyzed for the 8 Hosgri load cases aimed at 45 degrees around the compass, again using the soft rock model.

The reaction results are presented in Appendix RL-5 and the displacement and stress results are shown in Appendix DN-6. The results are tabulated in Table 16 below along with the results for the envelope of the 19 load cases from Tables 2 and 3. And, as with the sequencing calculations, these results show that the cask extraction pad response is bounded by the fully loaded pad response. Therefore, the fully loaded pad response will be used for the design of the pad, and further consideration of the cask extraction pad response is not warranted.

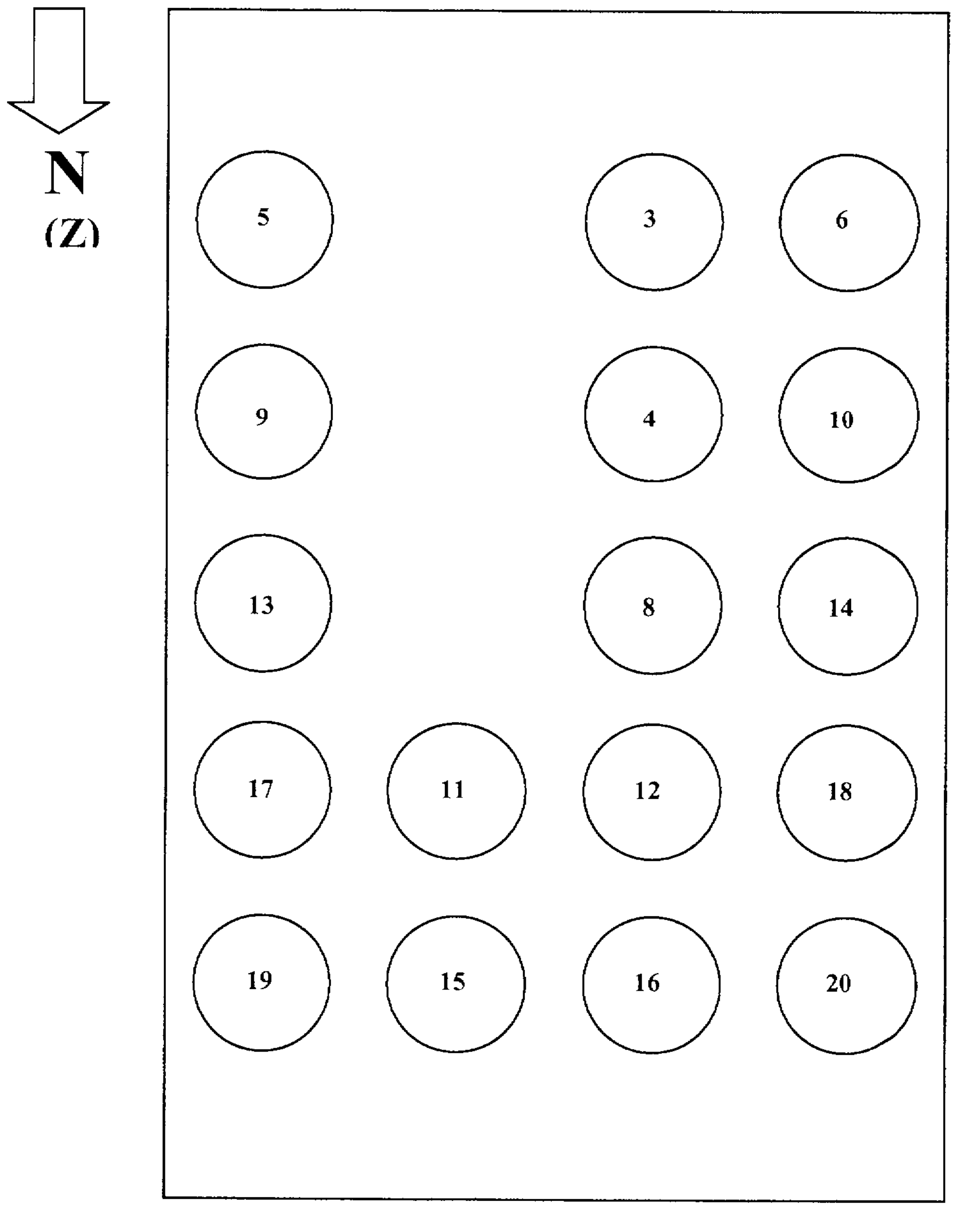


Figure 40 – Cask Extraction

Table 15 - PAD RESPONSES CASK EXTRACTION SOFT ROCK

Direction of Seismic Accel.	δ_{Max}	δ_{Cask}	$\sigma_{X\ Max}$	$\sigma_{X\ Min}$	$\sigma_{Z\ Max}$	$\sigma_{Z\ Min}$
Envelope of 19 Basic Load Cases, see Tables 2 and 3	0.101	0.028	261	-405	270	-410
N Load Step 1	0.040	-0.005	48	-100	257	-373
N 45 W Load Step 2	0.056	0.006	174	-301	201	-344
W Load Step 3	0.039	0.008	246	-366	64	-130
S 45 W Load Step 4	0.086	0.020	169	-277	184	-354
S Load Step 5	0.050	-0.002	48	-108	252	-376
S 45 E Load Step 6	0.088	0.021	168	-277	190	-336
E Load Step 7	0.041	0.010	245	-370	71	-122
N 45 E Load Step 8	0.073	0.014	182	-310	205	-340

All load components are combined using the 100-40-40 rule.

Effects of Poisson's Ratio of the Rock

As presented earlier, the lab data for the rock at the site suggests that the Poisson's ratio for the altered sandstone, the "soft rock", may be as low as 0.23, rather than the 0.35 used in the soft rock analyses. Further, the lab data suggests that the Poisson's ratio for the dolomite, the "hard rock", may be as low as 0.22, rather than the 0.35 used in the analyses, and that the Young's modulus may be 1.3 to 1.5×10^6 psi rather than the 2.0×10^6 psi used in the analyses.

The dolomite will be addressed first. The pad was analyzed for "hard rock" using a Young's modulus of 2.0×10^6 psi with a Poisson's ratio of 0.35, and for "very hard rock" using a Young's modulus of 4.9×10^6 psi with a Poisson's ratio of 0.24. These analyses show that the pad displacements for both are much less than those for the soft rock cases (see Table 2). Further, the stresses for these two cases are quite similar to one another and much less demanding on the pad than stresses from the soft rock analyses (see Tables 3, 4 and 5). Thus for the relatively hard rock cases, the analyses show that the pad responses are both lower than the soft rock responses, and relatively insensitive to the value of Poisson's ratio. Also, the reduction of the Young's modulus for the hard rock is bounded by the soft rock analyses for the Poisson's ratio of 0.35. Further, the reduction of Poisson's ratio for the soft rock is addressed below. Therefore, the reduction of the Young's modulus and Poisson's ratio for the hard rock do not require further analysis.

Concentrating on the effects of the reduction in Poisson's ratio for the soft rock, the pad was reanalyzed for the HE(1) load cases, North, N 45 W and W and the LTSP L(2) load cases North, N 45 W and W for the soft rock with Poisson's ratio of 0.23. The reactions are evaluated in Appendix RL-6. The pad and cask displacements are provided in Appendix DN-7, and the maximum and minimum stresses are provided in Appendix SN-6. The results are compared to the pad results for soft rock with Poisson's ratio of 0.35. The comparisons are tabulated below for the displacements and stresses.

Table 16 - SOFT ROCK – COMPARITIVE DISPLACEMENT ANALYSIS

LS*	EQ	Dir.	δ_{Max} $\nu = 0.35$	δ_{Max} $\nu = 0.23$	Ratio** 0.23/0.35	δ_{Cask} $\nu = 0.35$	δ_{Cask} $\nu = 0.23$	Ratio** 0.23/0.35
2/1	HE(1)	N	0.0584	0.0576	0.986	.000451	-.000578	See ***
4/2	HE(1)	N45W	0.1006	0.1023	1.017	0.0271	0.0272	1.004
6/3	HE(1)	W	0.0467	0.0470	1.006	0.0133	0.0127	0.955
11/4	L(2)	N	0.0488	0.0484	0.992	-0.00237	-0.00308	See ***
13/5	L(2)	N45W	0.0832	0.0848	1.019	0.0186	0.0187	1.005
15/6	L(2)	W	0.0387	0.0391	1.010	0.00824	0.00767	See ***

* LS X/Y where X is the load step from the $\nu = 0.35$ analyses and Y is the load step from the $\nu = 0.23$ analyses.
** Ratio of the value from the $\nu = 0.23$ divided by the value from the $\nu = 0.35$ analyses.
*** Values are too small for the Ratio to have meaning.

Table 17 - SOFT ROCK – PAD COMPARITIVE STRESS (SIG X) ANALYSIS

LS*	EQ	Dir.	$\sigma_{X\ Max}$ $\nu = 0.35$	$\sigma_{X\ Max}$ $\nu = 0.23$	Ratio** 0.23/0.35	$\sigma_{X\ Min}$ $\nu = 0.35$	$\sigma_{X\ Min}$ $\nu = 0.23$	Ratio** 0.23/0.35
2/1	HE(1)	N	45.59	44.63	0.979	-106.68	-139.90	1.311
4/2	HE(1)	N45W	192.06	189.04	0.984	-321.51	-394.56	1.227
6/3	HE(1)	W	260.71	272.47	1.045	-404.71	-460.11	1.137
11/4	L(2)	N	43.57	35.95	0.825	-93.91	-128.78	1.371
13/5	L(2)	N45W	183.34	180.17	0.983	-302.29	-369.68	1.223
15/6	L(2)	W	253.65	263.02	1.037	-378.76	-429.04	1.133

* LS X/Y where X is the load step from the $\nu = 0.35$ analyses and Y is the load step from the $\nu = 0.23$ analyses.
** Ratio of the value from the $\nu = 0.23$ divided by the value from the $\nu = 0.35$ analyses.

Table 18 - SOFT ROCK – PAD COMPARITIVE STRESS (SIG Z) ANALYSIS

LS*	EQ	Direction	$\sigma_{Z\,Max}$ v = 0.35	$\sigma_{Z\,Max}$ v = 0.23	Ratio** 0.23/0.35	$\sigma_{Z\,Min}$ v = 0.35	$\sigma_{Z\,Min}$ v = 0.23	Ratio** 0.23/0.35
2/1	HE(1)	N	269.97	280.07	1.037	-404.12	-449.39	1.112
4/2	HE(1)	N45W	208.72	222.39	1.065	-378.79	-433.00	1.143
6/3	HE(1)	W	61.87	56.02	0.905	-134.68	-177.74	1.320
11/4	L(2)	N	260.53	269.72	1.035	-380.65	-422.34	1.110
13/5	L(2)	N45W	200.56	213.55	1.065	-353.70	-403.75	1.142
15/6	L(2)	W	56.50	51.16	0.905	-122.82	-162.76	1.325

* LS X/Y where X is the load step from the v = 0.35 analyses and Y is the load step from the v = 0.23 analyses.

** Ratio of the value from the v = 0.23 divided by the value from the v = 0.35 analyses.

The displacements are very well behaved (Table 16) with the maximum pad displacements all within 2% of each other. The stresses, however, show variances of almost 40% in some cases. In order to further assess this sensitivity, the pad internal forces were computed and compared to one another. See Appendix FC-2 for the details of the internal force calculation. Ratios for moment and axial force are computed only for moments greater than 0.1E8. Ratios for all shear forces are computed. The comparisons are made for the North and West analyses, only, since these have resulted in the largest pad responses, see Tables 17 and 18.

Table 19 HE (1) NORTH – Z STRIPS INTERNAL FORCES – COMPARATIVE ANALYSIS

Line	Force/Moment	Strip		
		A-B (0.35)	A-B (0.23)	0.23/0.35*
10	Fy Fz Mx	-479342 984456 -0.443E8	-486236 1056226 -0.477E8	1.014 1.073 1.077
9	Fy Fz Mx	-532371 941641 -0.197E8	-579752 986962 -0.217E8	1.089 1.048 1.102
8	Fy Fz Mx	-527383 971263 4488084	-542959 1008112 3083858	1.030
7	Fy Fz Mx	-549967 776479 -900395	-559467 835299 -1285165	1.017
6	Fy Fz Mx	-568401 488622 576226	-570592 560207 578436	1.004
5	Fy Fz Mx	-625312 202111 8951040	-618684 272231 8473042	0.989
4	Fy Fz Mx	-731078 -97229 0.333E8	-731523 -73224 0.324E8	1.001 0.753 0.973
3	Fy Fz Mx	-176465 -460244 0.165E8	-176349 -453476 0.162E8	0.999 0.985 0.982
2	Fy Fz Mx	-88102 -528563 0.242E8	-87845 -534106 0.245E8	0.997 1.010 1.012
1	Fy Fz Mx	11602 605828 -0.272E8	11345 611371 -0.274E8	0.978 1.009 1.007

* Only ratios of moments greater than 0.1E8 are computed.

Table 20 (1/2) HE (1) WEST – X STRIPS INTERNAL FORCES – COMPARATIVE ANALYSIS

Line	Force/Moment	Strip		
		3-4 (0.35)	3-4 (0.23)	0.23/0.35*
E	Fx Fy Mz	793710 -603514 0.353E8	888726 -613179 0.395E8	1.120 1.016 1.119
D	Fx Fy Mz	439877 -537258 2676159	489562 -543989 3583756	1.013
C	Fx Fy Mz	313732 -533490 -0.174E8	358032 -530277 -0.167E8	1.141 0.994 0.960
B	Fx Fy Mz	154160 -511333 -0.449E8	155203 -511651 -0.449E8	1.007 1.001 1.000
A	Fx Fy Mz	439648 28776 0.193E8	449329 28907 0.197E8	1.022 1.005 1.021

* Only ratios of moments greater than 0.1E8 are computed.

Table 2- (2/2) HE (1) WEST – X STRIPS INTERNAL FORCES – COMPARATIVE ANALYSIS

Line	Force/Moment	Strip		
		5-6 (0.35)	5-6 (0.23)	0.23/0.35*
E	Fx Fy Mz	886415 -653720 0.396E8	989014 –661832 0.442E8	1.116 1.012 1.116
D	Fx Fy Mz	442417 -550606 2533592	497106 –555914 3455052	1.010
C	Fx Fy Mz	322227 -547001 -0.184E8	378021 –541934 –0.177E8	1.173 0.991 0.962
B	Fx Fy Mz	171332 -546142 -0.481E8	181250 –544841 –0.477E8	1.058 0.998 0.992
A	Fx Fy Mz	471814 14470 0.208E8	474332 14191 0.210E8	1.005 0.981 1.010

* Only ratios of moments greater than 0.1E8 are computed.

The tables provide ratios, as before. An examination of this data shows that the internal forces are somewhat better behaved than the stresses, but they still appear to be very sensitive to the value of Poisson's ratio. These ratios are plotted in Figures 41 and 42 below.

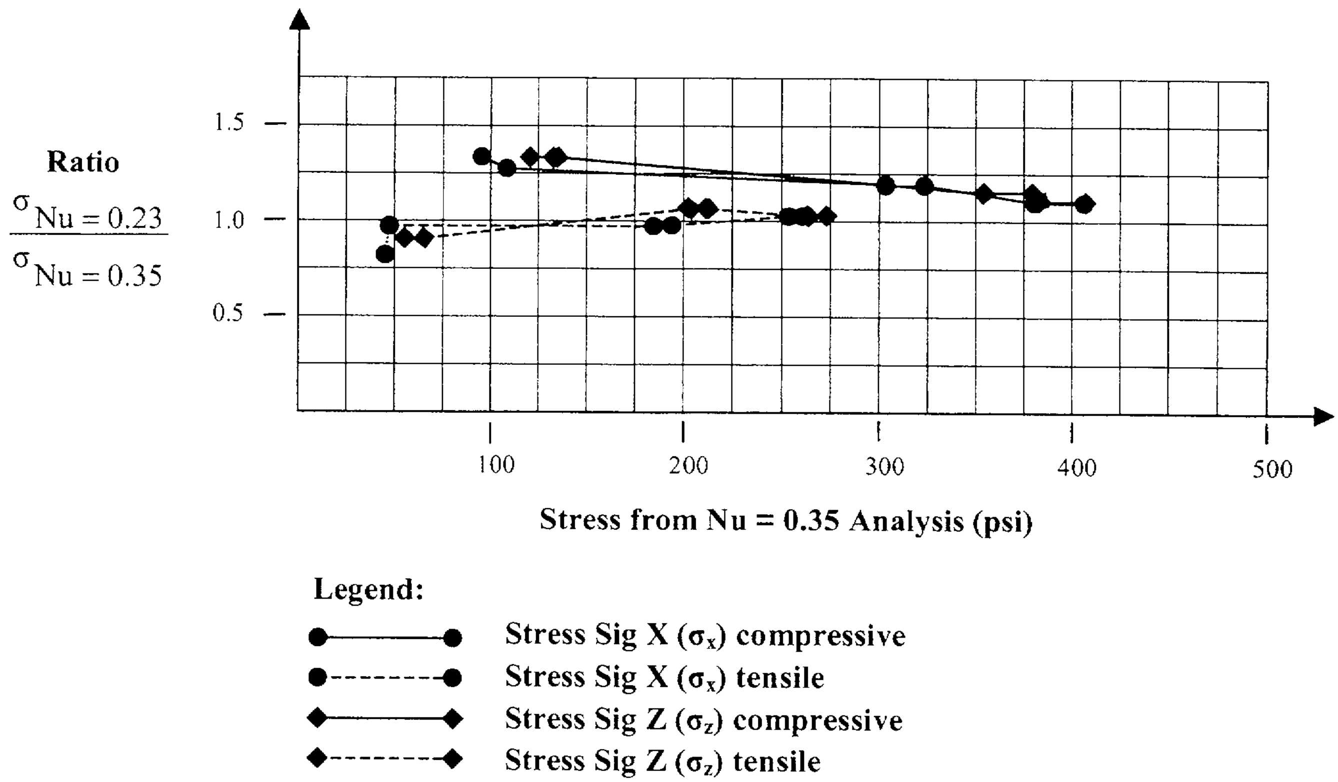


Figure 41 – Plot of Stress Sensitivity to Nu

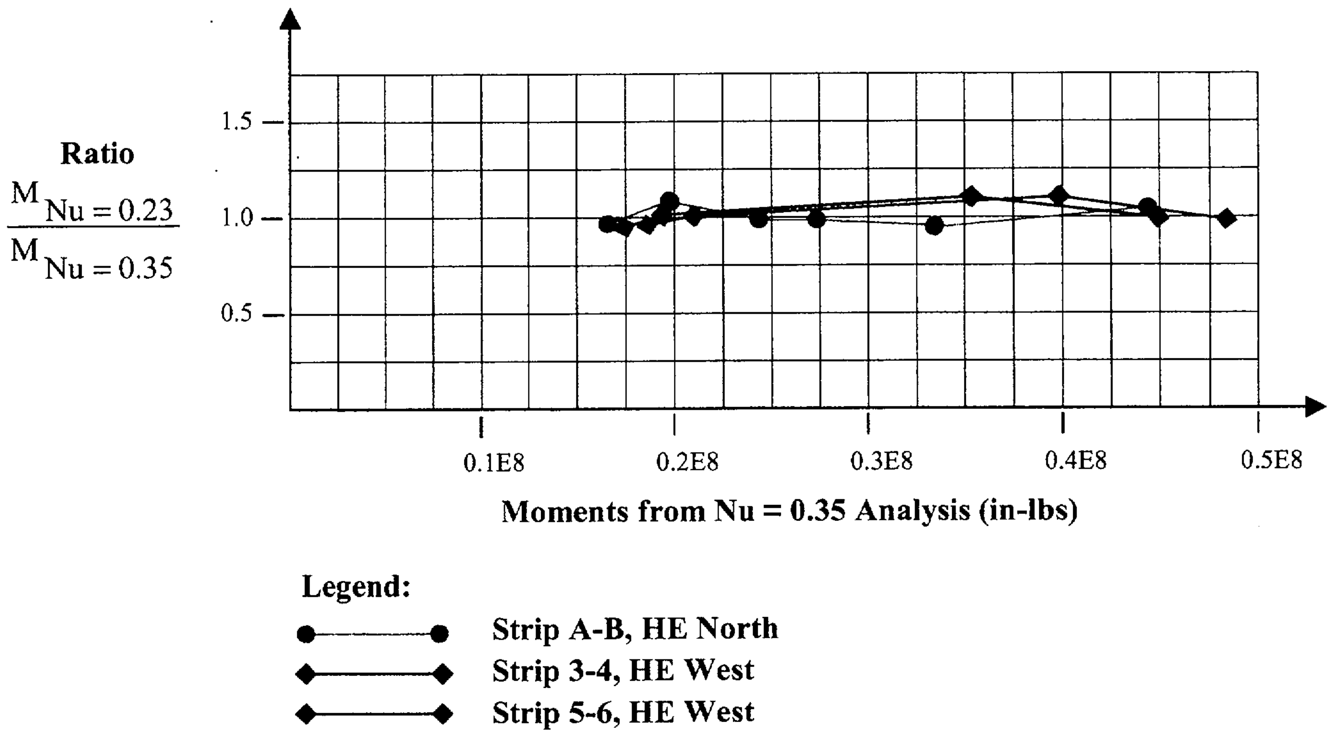


Figure 42 – Plot of Internal Moment Sensitivity to Nu

These plots demonstrate that, generally, as the values of the response parameter become larger, the sensitivity of the value to Poisson's becomes smaller. Referring back to the stress Tables 17 and 18, a close examination of this data shows that the most sensitive stresses are those that are the result of maintaining compatibility between the pad and the rock alone, and not a response that is required to maintain equilibrium to the applied loads. (Such stresses would be referred to as "Secondary Stresses" in ASME analyses.) The most sensitive stresses are the X stresses due to the applied load in the North (Z direction) and the Z stresses due to the applied load in the West (X direction). The sensitivity becomes less for the NW load cases and then less again for those stresses that are required to maintain equilibrium to the applied loads, i.e., X stresses due to W (X) loads, and Z stresses due to N (Z) loads. The ratios for this last class of stress range from a low of 1.110 to a high of 1.137.

The internal force comparisons are only for the internal forces that are required for equilibrium, Z strips for the North (Z) HE(1) and X strips for the West (X) HE(1), and the ratios are only computed for moments that are greater than 0.1E8, i.e., only moments of some significance are examined. These

values are better behaved than the stresses, i.e., all closer to one. The internal forces must sum to provide equilibrium together with the applied loads, which is a condition not imposed on maximum stresses.

The plots and the tables show that the controlling moments are very well behaved, where the ratio for the controlling Mx moment due to the North HE(1) is 1.077 (see Table 19, Strip A-B/Line 10), and the ratios for the controlling Mz moment due to the West HE(1) is 0.992 (see Table 20 (1/2), Strip 5-6/Line B). In most instances, the ratios of the axial forces vary as the moments; see Table 19 A-B/Lines 10,3,2 and 1, and Table 20 (1/2) 3-4, lines E, B and A. In some instances, the axial forces do not exhibit this behavior as in A-B/Line 9 and 3-4/Line C, but the force ratios are all within the range of moment ratios. The shear ratios are very well behaved, most being within 5% of one another, regardless of the variances in moments and axial forces. The ratio for the controlling axial force is 1.001, see A-B, Line 4.

In order to provide conservative values for design, and to provide for variability in Young's modulus and Poisson's ratio presented in the supporting calculations, References 11 and 12, a factor of 1.15 will be applied to all the internal forces presented in Table 11. These factored forces will be used for the pad design.

Summary and Conclusions

This calculation has presented the results of seismic analyses for the ISFSI storage pad to be installed at the ISFSI site at the Diablo Canyon Power Plant. The pad has been analyzed for a variety of loads taken from the Holtec cask analysis, together with several sets of rock properties identified for the site. These analyses comprise a screening set of analyses that identify that the "soft rock" conditions are the most demanding for the pad. The pad has been shown to respond to the various seismic loads with the specified sets of rock properties with low and acceptable displacements and low stresses. The internal forces computed will be used to size the reinforcing steel and formally evaluate the pad per the applicable Codes and Specifications.

Subsequent to these screening calculations, the pad response was assessed for its seismic response under the following:

- A postulated reduction in density to 90% of its original value.
- Cask placement sequence
- Cask extraction configuration
- Effects of variations in the specified rock parameters

The pad response including the first three effects were all shown to be bounded by the pad response from the soft rock analysis that was part of the screening calculations. The effects of variation of rock parameters resulted in a factor to be applied to the internal forces for the formal Code assessment to be performed in subsequent calculations. The pad displacements for all analyzed conditions and configurations are shown to be small and acceptable. Therefore, the ISFSI storage pad analyzed in this calculation is suitable for use at the Diablo Canyon Power Plant ISFSI site.

Table 11 provides the calculated internal forces and moments resulting from the screening sets of analyses. These values are to be factored up by 1.15 and the resulting forces and moments are to be used to demonstrate compliance with the design Codes and Specifications, and to design the reinforcing steel.

Originator: S. C. Tumminelli
Date: May 25, 2001
Revised: November 30, 2001

Appendix AL-1

Calculation and Application of Loads

This Appendix presents the calculations for the applied loads, both the specified cask and accelerated pad, for all 19 load cases analyzed for the soft rock, hard rock and very hard rock models.

The description of the loads and their load steps is provided in the body of the calculation. The loads are from Holtec, Reference 4, and the ZPAs are from PG&E, Reference 2.

Following the calculations of the loads, the input files for the soft, hard and very hard rock models are provided. The only difference in the input files is in the title, "Soft" Vs "Hard" Vs "Very Hard".

Appendix Contents

Below are the calculations for the pad accelerations and the cask loads for each load step:

Hosgri ZPAs, X, Y and Z are 0.75, 0.50, and 0.75 G.

Combine by 100-40-40 rule:

Horizontal	= Vector sum (0.75,0.4*0.75)	= 0.808G Horizontal
Vertical	= 0.4*0.50	= 0.200G Up
Vertical w/gravity	= 1.00 - 0.20	= 0.800G Down

Combine by 40-100-40 rule:

Horizontal	= Vector sum 0.4*(0.75,0.75)	= 0.424G Horizontal
Vertical	= 0.50	= 0.500G Up
Vertical w/gravity	= 1.00 - 0.50	= 0.500G Down

LTSP ZPAs, X, Y and Z are 0.83, 0.70, and 0.83 G.

Combine by 100-40-40 rule:

Horizontal	= Vector sum (0.83,0.4*0.83)	= 0.894G Horizontal
Vertical	= 0.4*0.70	= 0.280G Up
Vertical w/gravity	= 1.00 - 0.28	= 0.720G Down

Combine by 40-100-40 rule:

Horizontal	= Vector sum 0.4*(0.83,0.83)	= 0.470G Horizontal
Vertical	= 0.70	= 0.700G Up
Vertical w/gravity	= 1.00 - 0.70	= 0.300G Down

Application of Holtec Loads:

Cask weight is always 360 Kip

Hosgri Earthquake, HE, Column 1

Max/Min Vert.	= 674.2/127.6 Kip includes gravity
Max Shear	= 515 Kip

Combine by 100-40-40 rule:

Shear will be = 515 Kip in the specified direction
Adjust vertical load:
Maximum Seismic Vertical up = 360 - 127.6 = 232.4 Kip Up

40%* Max. Seismic Vertical = 0.40*232.4 = 92.96 Kip Up
Thus, net gravity + 40% Vertical Up = 360 - 92.96 = 267.04 Kip Down

Load Step 2 - Apply in the North (Z) direction:

Fx = 0	Note the order, X, Z and Y for forces and
Fz = 515000	x, y, and z for accelerations.
Fy = -267040	
Ax = 0	In ANSYS the supports are accelerated into the
Ay = +0.800G	structure. Therefore a +y (up) acceleration is in the
Az = -0.808G	direction of gravity.

Load Step 3 - Apply in the North 32.93 degrees West direction (see notes LS 2):

Fx = 515000*sin (32.93)	= 279961
Fz = 515000*cos (32.93)	= 432258
Fy	= -267040
Ax = -0.808*sin (32.93)	= -0.439G
Ay	= 0.800G
Az = -0.808*cos (32.93)	= -0.678G

Load Step 4 - Apply in the North 45 degrees West direction (see notes LS 2):

Fx = 515000*sin (45)	= 364160
Fz = 515000*cos (45)	= 364160
Fy	= -267040
Ax = -0,808*sin (45)	= -0.571G
Ay	= 0.800G
Az = -0.808*cos (45)	= -0.571G

Load Step 5 - Apply in the North 57.07 degrees West direction (see notes LS 2):

Fx = 515000*sin (57.07)	= 432258
Fz = 515000*cos (57.07)	= 279961
Fy	= -267040
Ax = -0.808*sin (57.07)	= -0.678G
Ay	= 0.800G
Az = -0.808*cos (57.07)	= -0.439G

Load Step 6 - Apply in the West direction (see notes LS 2):

Fx = 515000
Fz = 0

Fy = -267040
Ax = -0.808G
Ay = 0.800G
Az = 0

Combine by 40-100-40 rule:

Shear will be = 0.40*515 = 206 Kip in the specified direction
Maximum Seismic Vertical Down = 127.6 Kip Down

Load Step 7 - Apply in the North direction (see notes LS 2):

Fx = 0
Fz = 206000
Fy = -127600
Ax = 0
Ay = 0.500G
Az = -0.424G

Load Step 8 - Apply in the West direction (see notes LS 2):

Fx = 206000
Fz = 0
Fy = -127600
Ax = -0.424G
Ay = 0.500G
Az = 0

Hosgri Earthquake, HE, Column 3. This load case has the maximum down load.

Max/Min Vert. = 773.3/130.6 Kip includes gravity
Max Shear = 428 Kip

Combine by 40-100-40 rule:

Shear will be = 0.40*428 = 171.2 Kip in the specified direction
Maximum Seismic Vertical Down = 773.3 Kip Down

Apply maximum vertical down acceleration = 1.0 + 0.5 = 1.5G

Load Step 9 - Apply in the North direction (see notes LS 2):

Fx = 0
Fz = 171200
Fy = -773300
Ax = 0
Ay = 1.500G
Az = -0.424G

Load Step 10 - Apply in the West direction (see notes LS 2):

Fx = 171200
Fz = 0
Fy = -773300
Ax = -0.424G
Ay = 1.500G
Az = 0

Long Term Seismic Program Earthquake, LTSP, Column 2

Max/Min Vert. = 684.1/105.8 Kip includes gravity
Max Shear = 440 Kip

Combine by 100-40-40 rule:

Shear will be = 440 Kip in the specified direction
Adjust vertical load:
Maximum Seismic Vertical up = 360 - 105.8 = 254.2 Kip Up
40%* Max. Seismic Vertical = 0.40*254.2 = 101.68 Kip Up
Thus, net gravity + 40% Vertical Up = 360 - 101.68 = 258.32 Kip Down

Load Step 11 - Apply in the North (Z) direction (see notes LS 2):

Fx = 0
Fz = 440000
Fy = -258320
Ax = 0
Ay = +0.720G
Az = -0.894G

Load Step 12 - Apply in the North 32.93 degrees West direction (see notes LS 2):

Fx = 440000*sin (32.93) = 239190
Fz = 440000*cos (32.93) = 369308
Fy = -258320
Ax = -0.894*sin (32.93) = -0.486G

Ay	= 0.720G
Az = -0.894*cos (32.93)	= -0.750G

Load Step 13 - Apply in the North 45 degrees West direction (see notes LS 2):

Fx = 440000*sin (45)	= 311127
Fz = 440000*cos (45)	= 311127
Fy	= -258320
Ax = -0.894*sin (45)	= -0.632G
Ay	= 0.720G
Az = -0.894*cos (45)	= -0.632G

Load Step 14 - Apply in the North 57.07 degrees West direction (see notes LS 2):

Fx = 440000*sin (57.07)	= 369308
Fz = 440000*cos (57.07)	= 239190
Fy	= -258320
Ax = -0.894*sin (57.07)	= -0.750G
Ay	= 0.720G
Az = -0.894*cos (57.07)	= -0.486G

Load Step 15 - Apply in the West direction (see notes LS 2):

Fx = 440000
Fz = 0
Fy = -258320
Ax = -0.894G
Ay = 0,720G
Az = 0

Combine by 40-100-40 rule:

Shear will be = 0.40*440 = 176 Kip in the specified direction
Maximum Seismic Vertical Down = 105.8 Kip Down

Load Step 16 - Apply in the North direction (see notes LS 2):

Fx = 0
Fz = 176000
Fy = -105800
Ax = 0
Ay = 0.300G
Az = -0.470G

Load Step 17 - Apply in the West direction (see notes LS 2):

Fx = 176000
Fz = 0
Fy = -105800
Ax = -0.470G
Ay = 0.300G
Az = 0

Long Term Seismic Program Earthquake, LTSP, Column 4

Max/Min Vert. = 632/55.6 Kip includes gravity
Max Shear = 390 Kip

Combine by 40-100-40 rule:

Shear will be = 0.40*390 = 156 Kip in the specified direction
Maximum Seismic Vertical Down = 55.6 Kip Down

Load Step 18 - Apply in the North direction (see notes LS 2):

Fx = 0
Fz = 156000
Fy = -55600
Ax = 0
Ay = 0.300G
Az = -0.470G

Load Step 19 - Apply in the West direction (see notes LS 2):

Fx = 156000
Fz = 0
Fy = -55600
Ax = -0.470G
Ay = 0.300G
Az = 0

Following is the ANSYS input file that generates load steps for the soft rock analyses:

```
nall
eall
!
!           "cask" is all 20 casks
!
!           Load Step #1
!
lsclear,all
cmsel,s,boundary
d,all,all
/title,Pad, Gravity, 20 Casks, Soft Rock
acel,,386.4
cmsel,s,cask
f,all,fy,-360000*20/1080
nall
eall
lswrite,1
!
!           Load Step #2
!
lsclear,all
cmsel,s,boundary
d,all,all
/title,Pad, HE(1), 20 Casks, 515 Kips North (Z), Soft Rock
acel,,0.8*386.4,-0.808*386.4
cmsel,s,cask
f,all,fz,515000*20/1080
f,all,fy,-267040*20/1080
nall
eall
lswrite,2
!
!           Load Step #3
!
lsclear,all
cmsel,s,boundary
d,all,all
/title,Pad, HE(1), 20 Casks, 515 Kips N 32.93 W (Z,X), Soft Rock
acel,-0.439*386.4,0.8*386.4,-0.678*386.4
cmsel,s,cask
f,all,fx,279961*20/1080
f,all,fz,432258*20/1080
f,all,fy,-267040*20/1080
nall
eall
lswrite,3
!
!           Load Step #4
!
lsclear,all
cmsel,s,boundary
```

```
d,all,all
/title,Pad, HE(1), 20 Casks, 515 Kips N 45 W (Z,X), Soft Rock
acel,-0.571*386.4,0.800*386.4,-0.571*386.4
cmsel,s,cask
f,all,fx,364160*20/1080
f,all,fz,364160*20/1080
f,all,fy,-267040*20/1080
nall
eall
lswrite,4
!
!           Load Step #5
!
lsclear,all
cmsel,s,boundary
d,all,all
/title,Pad, HE(1), 20 Casks, 515 Kips N 57.07 W (Z,X), Soft Rock
acel,-0.678*386.4,0.800*386.4,-0.439*386.4
cmsel,s,cask
f,all,fx,432258*20/1080
f,all,fz,279961*20/1080
f,all,fy,-267040*20/1080
nall
eall
lswrite,5
!
!           Load Step #6
!
lsclear,all
cmsel,s,boundary
d,all,all
/title,Pad, HE(1), 20 Casks, 515 Kips West (W), Soft Rock
acel,-0.808*386.4,0.800*386.4
cmsel,s,cask
f,all,fx,515000*20/1080
f,all,fy,-267040*20/1080
nall
eall
lswrite,6
!
!           Load Step #7
!
lsclear,all
cmsel,s,boundary
d,all,all
/title,Pad, HE(1), 20 Casks, 206 Kips North (z), Max Up, Soft Rock
acel,,0.50*386.4,-0.424*386.4
cmsel,s,cask
f,all,fz,206000*20/1080
f,all,fy,-127600*20/1080
nall
eall
lswrite,7
```

```
!
!           Load Step #8
!
lsclear,all
cmsel,s,boundary
d,all,all
/title,Pad, HE(1), 20 Casks, 206 Kips West (X), Max Up, Soft Rock
acel,-0.424*386.4,0.500*386.4
cmsel,s,cask
f,all,fx,206000*20/1080
f,all,fy,-127600*20/1080
nall
eall
lswrite,8
!
!           Load Step #9
!
lsclear,all
cmsel,s,boundary
d,all,all
/title,Pad, HE(3), 20 Casks, 171.2 Kips North (Z), Max Dn, Soft Rock
acel,,1.500*386.4,-0.424*386.4
cmsel,s,cask
f,all,fz,171200*20/1080
f,all,fy,-773300*20/1080
nall
eall
lswrite,9
!
!           Load Step #10
!
lsclear,all
cmsel,s,boundary
d,all,all
/title,Pad, HE(3), 20 Casks, 171.2 Kips West (X), Max Dn, Soft Rock
acel,-0.424*386.4,1.50*386.4
cmsel,s,cask
f,all,fx,171200*20/1080
f,all,fy,-773300*20/1080
nall
eall
lswrite,10
!
!           Load Step #11
!
lsclear,all
cmsel,s,boundary
d,all,all
/title,Pad, LTSP(2), 20 Casks, 440 Kips North (Z), Soft Rock
acel,,0.72*386.4,-0.894*386.4
cmsel,s,cask
f,all,fz,440000*20/1080
f,all,fy,-258320*20/1080
```

```
nall
eall
lswrite,11
!
!           Load Step #12
!
lsclear,all
cmsel,s,boundary
d,all,all
/title,Pad, LTSP(2), 20 Casks, 440 Kips N 32.93 W (Z,X), Soft Rock
acel,-0.486*386.4,0.72*386.4,-0.750*386.4
cmsel,s,cask
f,all,fx,239190*20/1080
f,all,fz,369308*20/1080
f,all,fy,-258320*20/1080
nall
eall
lswrite,12
!
!           Load Step #13
!
lsclear,all
cmsel,s,boundary
d,all,all
/title,Pad, LTSP(2), 20 Casks, 440 Kips N 45 W (Z,X), Soft Rock
acel,-0.632*386.4,0.720*386.4,-0.632*386.4
cmsel,s,cask
f,all,fx,311127*20/1080
f,all,fz,311127*20/1080
f,all,fy,-258320*20/1080
nall
eall
lswrite,13
!
!           Load Step #14
!
lsclear,all
cmsel,s,boundary
d,all,all
/title,Pad, LTSP(2), 20 Casks, 440 Kips N 57.03 W (Z,X), Soft Rock
acel,-0.750*386.4,0.72*386.4,-0.486*386.4
cmsel,s,cask
f,all,fx,369308*20/1080
f,all,fz,239190*20/1080
f,all,fy,-258320*20/1080
nall
eall
lswrite,14
!
!           Load Step #15
!
lsclear,all
cmsel,s,boundary
```

```
d,all,all
/title,Pad, LTSP(2), 20 Casks, 440 Kips West (X), Soft Rock
acel,-0.894*386.4,0.720*386.4
cmsel,s,cask
f,all,fx,440000*20/1080
f,all,fy,-258320*20/1080
nall
eall
lswrite,15
!
!           Load Step #16
!
lsclear,all
cmsel,s,boundary
d,all,all
/title,Pad, LTSP(2), 20 Casks, 176 Kips North (Z), Max Up, Soft Rock
acel,,0.300*386.4,-0.470*386.4
cmsel,s,cask
f,all,fz,176000*20/1080
f,all,fy,-105800*20/1080
nall
eall
lswrite,16
!
!           Load Step #17
!
lsclear,all
cmsel,s,boundary
d,all,all
/title,Pad, LTSP(2), 20 Casks, 176 Kips West (X), Max Up, Soft Rock
acel,-0.470*386.4,0.300*386.4
cmsel,s,cask
f,all,fx,176000*20/1080
f,all,fy,-105800*20/1080
nall
eall
lswrite,17
!
!           Load Step #18
!
lsclear,all
cmsel,s,boundary
d,all,all
/title,Pad, LTSP(4), 20 Casks, 156 Kips North (Z), Max Up, Soft Rock
acel,,0.300*386.4,-0.470*386.4
cmsel,s,cask
f,all,fz,156000*20/1080
f,all,fy,-55600*20/1080
nall
eall
lswrite,18
!           Load Step #19
!
```

```
lsclear,all
cmsel,s,boundary
d,all,all
/title,Pad, LTSP(4), 20 Casks, 156 Kips West (X), Max Up, Soft Rock
acel,-0.470*386.4,0.300*386.4
cmsel,s,cask
f,all,fx,156000*20/1080
f,all,fy,-55600*20/1080
nall
eall
lswrite,19
!
!
```

ENERCON SERVICES, INC. Appendix AL-1 to Calculation PGE-009-CALC-003

Following is the ANSYS input file that generates load steps for the hard rock analyses:

```
nall
eall
!
!           "cask" is all 20 casks
!
!           Load Step #1
!
lsclear,all
cmsel,s,boundary
d,all,all
/title,Pad, Gravity, 20 Casks, Hard Rock
acel,,386.4
cmsel,s,cask
f,all,fy,-360000*20/1080
nall
eall
lswrite,1
!
!           Load Step #2
!
lsclear,all
cmsel,s,boundary
d,all,all
/title,Pad, HE(1), 20 Casks, 515 Kips North (Z), Hard Rock
acel,,0.8*386.4,-0.808*386.4
cmsel,s,cask
f,all,fz,515000*20/1080
f,all,fy,-267040*20/1080
nall
eall
lswrite,2
!
!           Load Step #3
!
lsclear,all
cmsel,s,boundary
d,all,all
/title,Pad, HE(1), 20 Casks, 515 Kips N 32.93 W (Z,X), Hard Rock
acel,-0.439*386.4,0.8*386.4,-0.678*386.4
cmsel,s,cask
f,all,fx,279961*20/1080
f,all,fz,432258*20/1080
f,all,fy,-267040*20/1080
nall
eall
lswrite,3
!
!           Load Step #4
!
lsclear,all
cmsel,s,boundary
```

```
d,all,all
/title,Pad, HE(1), 20 Casks, 515 Kips N 45 W (Z,X), Hard Rock
acel,-0.571*386.4,0.800*386.4,-0.571*386.4
cmsel,s,cask
f,all,fx,364160*20/1080
f,all,fz,364160*20/1080
f,all,fy,-267040*20/1080
nall
eall
lswrite,4
!
!           Load Step #5
!
lsclear,all
cmsel,s,boundary
d,all,all
/title,Pad, HE(1), 20 Casks, 515 Kips N 57.07 W (Z,X), Hard Rock
acel,-0.678*386.4,0.800*386.4,-0.439*386.4
cmsel,s,cask
f,all,fx,432258*20/1080
f,all,fz,279961*20/1080
f,all,fy,-267040*20/1080
nall
eall
lswrite,5
!
!           Load Step #6
!
lsclear,all
cmsel,s,boundary
d,all,all
/title,Pad, HE(1), 20 Casks, 515 Kips West (W), Hard Rock
acel,-0.808*386.4,0.800*386.4
cmsel,s,cask
f,all,fx,515000*20/1080
f,all,fy,-267040*20/1080
nall
eall
lswrite,6
!
!           Load Step #7
!
lsclear,all
cmsel,s,boundary
d,all,all
/title,Pad, HE(1), 20 Casks, 206 Kips North (z), Max Up, Hard Rock
acel,,0.50*386.4,-0.424*386.4
cmsel,s,cask
f,all,fz,206000*20/1080
f,all,fy,-127600*20/1080
nall
eall
lswrite,7
```

```
!
!           Load Step #8
!
lsclear,all
cmsel,s,boundary
d,all,all
/title,Pad, HE(1), 20 Casks, 206 Kips West (X), Max Up, Hard Rock
acel,-0.424*386.4,0.500*386.4
cmsel,s,cask
f,all,fx,206000*20/1080
f,all,fy,-127600*20/1080
nall
eall
lswrite,8
!
!           Load Step #9
!
lsclear,all
cmsel,s,boundary
d,all,all
/title,Pad, HE(3), 20 Casks, 171.2 Kips North (Z), Max Dn, Hard Rock
acel,,1.500*386.4,-0.424*386.4
cmsel,s,cask
f,all,fz,171200*20/1080
f,all,fy,-773300*20/1080
nall
eall
lswrite,9
!
!           Load Step #10
!
lsclear,all
cmsel,s,boundary
d,all,all
/title,Pad, HE(3), 20 Casks, 171.2 Kips West (X), Max Dn, Hard Rock
acel,-0.424*386.4,1.50*386.4
cmsel,s,cask
f,all,fx,171200*20/1080
f,all,fy,-773300*20/1080
nall
eall
lswrite,10
!
!           Load Step #11
!
lsclear,all
cmsel,s,boundary
d,all,all
/title,Pad, LTSP(2), 20 Casks, 440 Kips North (Z), Hard Rock
acel,,0.72*386.4,-0.894*386.4
cmsel,s,cask
f,all,fz,440000*20/1080
f,all,fy,-258320*20/1080
```

```
nall
eall
lswrite,11
!
!           Load Step #12
!
lsclear,all
cmsel,s,boundary
d,all,all
/title,Pad, LTSP(2), 20 Casks, 440 Kips N 32.93 W (Z,X), Hard Rock
acel,-0.486*386.4,0.72*386.4,-0.750*386.4
cmsel,s,cask
f,all,fx,239190*20/1080
f,all,fz,369308*20/1080
f,all,fy,-258320*20/1080
nall
eall
lswrite,12
!
!           Load Step #13
!
lsclear,all
cmsel,s,boundary
d,all,all
/title,Pad, LTSP(2), 20 Casks, 440 Kips N 45 W (Z,X), Hard Rock
acel,-0.632*386.4,0.720*386.4,-0.632*386.4
cmsel,s,cask
f,all,fx,311127*20/1080
f,all,fz,311127*20/1080
f,all,fy,-258320*20/1080
nall
eall
lswrite,13
!
!           Load Step #14
!
lsclear,all
cmsel,s,boundary
d,all,all
/title,Pad, LTSP(2), 20 Casks, 440 Kips N 57.03 W (Z,X), Hard Rock
acel,-0.750*386.4,0.72*386.4,-0.486*386.4
cmsel,s,cask
f,all,fx,369308*20/1080
f,all,fz,239190*20/1080
f,all,fy,-258320*20/1080
nall
eall
lswrite,14
!
!           Load Step #15
!
lsclear,all
cmsel,s,boundary
```

ENERCON SERVICES, INC.


```
d,all,all
/title,Pad, LTSP(2), 20 Casks, 440 Kips West (X), Hard Rock
acel,-0.894*386.4,0.720*386.4
cmsel,s,cask
f,all,fx,440000*20/1080
f,all,fy,-258320*20/1080
nall
eall
lswrite,15
!
!           Load Step #16
!
lsclear,all
cmsel,s,boundary
d,all,all
/title,Pad, LTSP(2), 20 Casks, 176 Kips North (Z), Max Up, Hard Rock
acel,,0.300*386.4,-0.470*386.4
cmsel,s,cask
f,all,fz,176000*20/1080
f,all,fy,-105800*20/1080
nall
eall
lswrite,16
!
!           Load Step #17
!
lsclear,all
cmsel,s,boundary
d,all,all
/title,Pad, LTSP(2), 20 Casks, 176 Kips West (X), Max Up, Hard Rock
acel,-0.470*386.4,0.300*386.4
cmsel,s,cask
f,all,fx,176000*20/1080
f,all,fy,-105800*20/1080
nall
eall
lswrite,17
!
!           Load Step #18
!
lsclear,all
cmsel,s,boundary
d,all,all
/title,Pad, LTSP(4), 20 Casks, 156 Kips North (Z), Max Up, Hard Rock
acel,,0.300*386.4,-0.470*386.4
cmsel,s,cask
f,all,fz,156000*20/1080
f,all,fy,-55600*20/1080
nall
eall
lswrite,18
!           Load Step #19
!
```

```
lsclear,all
cmsel,s,boundary
d,all,all
/title,Pad, LTSP(4), 20 Casks, 156 Kips West (X), Max Up, Hard Rock
acel,-0.470*386.4,0.300*386.4
cmsel,s,cask
f,all,fx,156000*20/1080
f,all,fy,-55600*20/1080
nall
eall
lswrite,19
!
!
```

ENERCON SERVICES, INC. Appendix AL-1 to Calculation PGE-009-CALC-003

Following is the ANSYS input file that generates load steps for the very hard rock analyses:

```
nall
eall
!
!          "cask" is all 20 casks
!
!          Load Step #1
!
lsclear,all
cmsel,s,boundary
d,all,all
/title,Pad, Gravity, 20 Casks, Very Hard Rock
acel,,386.4
cmsel,s,cask
f,all,fy,-360000*20/1080
nall
eall
lswrite,1
!
!          Load Step #2
!
lsclear,all
cmsel,s,boundary
d,all,all
/title,Pad, HE(1), 20 Casks, 515 Kips North (Z), Very Hard Rock
acel,,0.8*386.4,-0.808*386.4
cmsel,s,cask
f,all,fz,515000*20/1080
f,all,fy,-267040*20/1080
nall
eall
lswrite,2
!
!          Load Step #3
!
lsclear,all
cmsel,s,boundary
d,all,all
/title,Pad, HE(1), 20 Casks, 515 Kips N 32.93 W (Z,X), Very Hard Rock
acel,-0.439*386.4,0.8*386.4,-0.678*386.4
cmsel,s,cask
f,all,fx,279961*20/1080
f,all,fz,432258*20/1080
f,all,fy,-267040*20/1080
nall
eall
lswrite,3
!
!          Load Step #4
!
lsclear,all
cmsel,s,boundary
```

```
d,all,all
/title,Pad, HE(1), 20 Casks, 515 Kips N 45 W (Z,X), Very Hard Rock
acel,-0.571*386.4,0.800*386.4,-0.571*386.4
cmsel,s,cask
f,all,fx,364160*20/1080
f,all,fz,364160*20/1080
f,all,fy,-267040*20/1080
nall
eall
lswrite,4
!
!          Load Step #5
!
lsclear,all
cmsel,s,boundary
d,all,all
/title,Pad, HE(1), 20 Casks, 515 Kips N 57.07 W (Z,X), Very Hard Rock
acel,-0.678*386.4,0.800*386.4,-0.439*386.4
cmsel,s,cask
f,all,fx,432258*20/1080
f,all,fz,279961*20/1080
f,all,fy,-267040*20/1080
nall
eall
lswrite,5
!
!          Load Step #6
!
lsclear,all
cmsel,s,boundary
d,all,all
/title,Pad, HE(1), 20 Casks, 515 Kips West (W), Very Hard Rock
acel,-0.808*386.4,0.800*386.4
cmsel,s,cask
f,all,fx,515000*20/1080
f,all,fy,-267040*20/1080
nall
eall
lswrite,6
!
!          Load Step #7
!
lsclear,all
cmsel,s,boundary
d,all,all
/title,Pad, HE(1), 20 Casks, 206 Kips North (z), Max Up, Very Hard Rock
acel,,0.50*386.4,-0.424*386.4
cmsel,s,cask
f,all,fz,206000*20/1080
f,all,fy,-127600*20/1080
nall
eall
lswrite,7
```

```
!
!            Load Step #8
!
lsclear,all
cmsel,s,boundary
d,all,all
/title,Pad, HE(1), 20 Casks, 206 Kips West (X), Max Up, Very Hard Rock
acel,-0.424*386.4,0.500*386.4
cmsel,s,cask
f,all,fx,206000*20/1080
f,all,fy,-127600*20/1080
nall
eall
lswrite,8
!
!            Load Step #9
!
lsclear,all
cmsel,s,boundary
d,all,all
/title,Pad, HE(3), 20 Casks, 171.2 Kips North (Z), Max Dn, Very Hard Rock
acel,,1.500*386.4,-0.424*386.4
cmsel,s,cask
f,all,fz,171200*20/1080
f,all,fy,-773300*20/1080
nall
eall
lswrite,9
!
!            Load Step #10
!
lsclear,all
cmsel,s,boundary
d,all,all
/title,Pad, HE(3), 20 Casks, 171.2 Kips West (X), Max Dn, Very Hard Rock
acel,-0.424*386.4,1.50*386.4
cmsel,s,cask
f,all,fx,171200*20/1080
f,all,fy,-773300*20/1080
nall
eall
lswrite,10
!
!            Load Step #11
!
lsclear,all
cmsel,s,boundary
d,all,all
/title,Pad, LTSP(2), 20 Casks, 440 Kips North (Z), Very Hard Rock
acel,,0.72*386.4,-0.894*386.4
cmsel,s,cask
f,all,fz,440000*20/1080
f,all,fy,-258320*20/1080
```

```
nall
eall
lswrite,11
!
!            Load Step #12
!
lsclear,all
cmsel,s,boundary
d,all,all
/title,Pad, LTSP(2), 20 Casks, 440 Kips N 32.93 W (Z,X), Very Hard Rock
acel,-0.486*386.4,0.72*386.4,-0.750*386.4
cmsel,s,cask
f,all,fx,239190*20/1080
f,all,fz,369308*20/1080
f,all,fy,-258320*20/1080
nall
eall
lswrite,12
!
!            Load Step #13
!
lsclear,all
cmsel,s,boundary
d,all,all
/title,Pad, LTSP(2), 20 Casks, 440 Kips N 45 W (Z,X), Very Hard Rock
acel,-0.632*386.4,0.720*386.4,-0.632*386.4
cmsel,s,cask
f,all,fx,311127*20/1080
f,all,fz,311127*20/1080
f,all,fy,-258320*20/1080
nall
eall
lswrite,13
!
!            Load Step #14
!
lsclear,all
cmsel,s,boundary
d,all,all
/title,Pad, LTSP(2), 20 Casks, 440 Kips N 57.03 W (Z,X), Very Hard Rock
acel,-0.750*386.4,0.72*386.4,-0.486*386.4
cmsel,s,cask
f,all,fx,369308*20/1080
f,all,fz,239190*20/1080
f,all,fy,-258320*20/1080
nall
eall
lswrite,14
!
!            Load Step #15
!
lsclear,all
cmsel,s,boundary
```

```
d,all,all
/title,Pad, LTSP(2), 20 Casks, 440 Kips West (X), Very Hard Rock
acel,-0.894*386.4,0.720*386.4
cmsel,s,cask
f,all,fx,440000*20/1080
f,all,fy,-258320*20/1080
nall
eall
lswrite,15
!
!           Load Step #16
!
lsclear,all
cmsel,s,boundary
d,all,all
/title,Pad, LTSP(2), 20 Casks, 176 Kips North (Z), Max Up, Very Hard Rock
acel,,0.300*386.4,-0.470*386.4
cmsel,s,cask
f,all,fz,176000*20/1080
f,all,fy,-105800*20/1080
nall
eall
lswrite,16
!
!           Load Step #17
!
lsclear,all
cmsel,s,boundary
d,all,all
/title,Pad, LTSP(2), 20 Casks, 176 Kips West (X), Max Up, Very Hard Rock
acel,-0.470*386.4,0.300*386.4
cmsel,s,cask
f,all,fx,176000*20/1080
f,all,fy,-105800*20/1080
nall
eall
lswrite,17
!
!           Load Step #18
!
lsclear,all
cmsel,s,boundary
d,all,all
/title,Pad, LTSP(4), 20 Casks, 156 Kips North (Z), Max Up, Very Hard Rock
acel,,0.300*386.4,-0.470*386.4
cmsel,s,cask
f,all,fz,156000*20/1080
f,all,fy,-55600*20/1080
nall
eall
lswrite,18
!           Load Step #19
!
```

```
lsclear,all
cmsel,s,boundary
d,all,all
/title,Pad, LTSP(4), 20 Casks, 156 Kips West (X), Max Up, Very Hard Rock
acel,-0.470*386.4,0.300*386.4
cmsel,s,cask
f,all,fx,156000*20/1080
f,all,fy,-55600*20/1080
nall
eall
lswrite,19
!
!
```

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Appendix DN-1 to Calculation PGE-009-CALC-003

Originator: S. C. Tumminelli
Date: May 25, 2001
Reissued: November 30, 2001

Appendix DN-1

Maximum Pad Displacements

This Appendix presents the maximum displacements of the pad for all 19 load cases analyzed for the soft rock, hard rock and the very hard rock models. The input file is presented followed by the two output files for the soft and hard rock models The input file scans the two databases in one execution. This is followed by the input and output files for the very hard rock model.

Appendix Contents

Below is the ANSYS input file that scans the database for the maximum pad displacements. Element type 1 is the pad. This file processes that data for both the soft rock and hard rock analyses. Two output files are created.

```
/COM
/OUTPUT,padsoftdisp.out
/com
/COM     DISPLACEMENT DATA SORTED AND PRINTED BY LOAD STEP
/COM
/COM
/COM
/COM     THIS ROUTINE SORTS AND PRINTS DISPLACEMENT DATA BY LOAD STEP
/COM     FOR BOTH THE SOFT AND HARD ROCK MODELS
/COM
/COM
/FILE,DCSLABS2
RESUME
/header,on,off,off,off,on,off
/POST1
/COM
/COM
EALL
NALL
/COM
/COM ===============================================================================
/COM =================================   SET 1   =====================================
/COM
SET,1
ESEL,TYPE,1
NELEM
/COM
/COM ===============================================================================
/COM =======================    MAXIMUM VALUES OF Uy    ============================
/COM
NSORT,U,Y,0,0,2,SEL
PRNSOL,U
NUSORT
/COM
/COM ===============================================================================
/COM =================================   SET 2   =====================================
/COM
SET,2
ESEL,TYPE,1
NELEM
/COM
/COM ===============================================================================
/COM =======================    MAXIMUM VALUES OF Uy    ============================
/COM
NSORT,U,Y,0,0,2,SEL
PRNSOL,U
NUSORT
/COM
/COM ===============================================================================
```

```
/COM =================================  SET 3  =====================================
/COM
SET,3
ESEL,TYPE,1
NELEM
/COM
/COM ==============================================================================
/COM =======================    MAXIMUM VALUES OF Uy    ============================
/COM
NSORT,U,Y,0,0,2,SEL
PRNSOL,U
NUSORT
/COM
/COM ==============================================================================
/COM =================================  SET 4  =====================================
/COM
SET,4
ESEL,TYPE,1
NELEM
/COM
/COM ==============================================================================
/COM =======================    MAXIMUM VALUES OF Uy    ============================
/COM
NSORT,U,Y,0,0,2,SEL
PRNSOL,U
NUSORT
/COM
/COM ==============================================================================
/COM =================================  SET 5  =====================================
/COM
SET,5
ESEL,TYPE,1
NELEM
/COM
/COM ==============================================================================
/COM =======================    MAXIMUM VALUES OF Uy    ============================
/COM
NSORT,U,Y,0,0,2,SEL
PRNSOL,U
NUSORT
/COM
/COM ==============================================================================
/COM =================================  SET 6  =====================================
/COM
SET,6
ESEL,TYPE,1
NELEM
/COM
/COM ==============================================================================
/COM =======================    MAXIMUM VALUES OF Uy    ============================
/COM
NSORT,U,Y,0,0,2,SEL
PRNSOL,U
```

```
NUSORT
/COM
/COM ==============================================================================
/COM =================================  SET 7  =====================================
/COM
SET,7
ESEL,TYPE,1
NELEM
/COM
/COM ==============================================================================
/COM =======================    MAXIMUM VALUES OF Uy    ============================
/COM
NSORT,U,Y,0,0,2,SEL
PRNSOL,U
NUSORT
/COM
/COM ==============================================================================
/COM =================================  SET 8  =====================================
/COM
SET,8
ESEL,TYPE,1
NELEM
/COM
/COM ==============================================================================
/COM =======================    MAXIMUM VALUES OF Uy    ============================
/COM
NSORT,U,Y,0,0,2,SEL
PRNSOL,U
NUSORT
/COM
/COM ==============================================================================
/COM =================================  SET 9  =====================================
/COM
SET,9
ESEL,TYPE,1
NELEM
/COM
/COM ==============================================================================
/COM =======================    MAXIMUM VALUES OF Uy    ============================
/COM
NSORT,U,Y,0,0,2,SEL
PRNSOL,U
NUSORT
/COM
/COM ==============================================================================
/COM =================================  SET 10  ====================================
/COM
SET,10
ESEL,TYPE,1
NELEM
/COM
/COM ==============================================================================
/COM =======================    MAXIMUM VALUES OF Uy    ============================
```

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```
/COM
NSORT,U,Y,0,0,2,SEL
PRNSOL,U
NUSORT
/COM
/COM ===============================================================================
/COM =================================  SET 11  ====================================
/COM
SET,11
ESEL,TYPE,1
NELEM
/COM
/COM ===============================================================================
/COM =======================    MAXIMUM VALUES OF Uy    ============================
/COM
NSORT,U,Y,0,0,2,SEL
PRNSOL,U
NUSORT
/COM
/COM ===============================================================================
/COM =================================  SET 12  ====================================
/COM
SET,12
ESEL,TYPE,1
NELEM
/COM
/COM ===============================================================================
/COM =======================    MAXIMUM VALUES OF Uy    ============================
/COM
NSORT,U,Y,0,0,2,SEL
PRNSOL,U
NUSORT
/COM
/COM ===============================================================================
/COM =================================  SET 13  ====================================
/COM
SET,13
ESEL,TYPE,1
NELEM
/COM
/COM ===============================================================================
/COM =======================    MAXIMUM VALUES OF Uy    ============================
/COM
NSORT,U,Y,0,0,2,SEL
PRNSOL,U
NUSORT
/COM
/COM ===============================================================================
/COM =================================  SET 14  ====================================
/COM
SET,14
ESEL,TYPE,1
NELEM
```

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```
/COM
/COM ==============================================================================
/COM =======================    MAXIMUM VALUES OF Uy    ============================
/COM
NSORT,U,Y,0,0,2,SEL
PRNSOL,U
NUSORT
/COM
/COM ==============================================================================
/COM =================================  SET 15  ====================================
/COM
SET,15
ESEL,TYPE,1
NELEM
/COM
/COM ==============================================================================
/COM =======================    MAXIMUM VALUES OF Uy    ============================
/COM
NSORT,U,Y,0,0,2,SEL
PRNSOL,U
NUSORT
/COM
/COM ==============================================================================
/COM =================================  SET 16  ====================================
/COM
SET,16
ESEL,TYPE,1
NELEM
/COM
/COM ==============================================================================
/COM =======================    MAXIMUM VALUES OF Uy    ============================
/COM
NSORT,U,Y,0,0,2,SEL
PRNSOL,U
NUSORT
/COM
/COM ==============================================================================
/COM =================================  SET 17  ====================================
/COM
SET,17
ESEL,TYPE,1
NELEM
/COM
/COM ==============================================================================
/COM =======================    MAXIMUM VALUES OF Uy    ============================
/COM
NSORT,U,Y,0,0,2,SEL
PRNSOL,U
NUSORT
/COM
/COM ==============================================================================
/COM =================================  SET 18  ====================================
/COM
```

```
SET,18
ESEL,TYPE,1
NELEM
/COM
/COM ===============================================================================
/COM =======================    MAXIMUM VALUES OF Uy    ============================
/COM
NSORT,U,Y,0,0,2,SEL
PRNSOL,U
NUSORT
/COM
/COM ===============================================================================
/COM =================================  SET 19  ====================================
/COM
SET,19
ESEL,TYPE,1
NELEM
/COM
/COM ===============================================================================
/COM =======================    MAXIMUM VALUES OF Uy    ============================
/COM
NSORT,U,Y,0,0,2,SEL
PRNSOL,U
NUSORT
/COM
/COM ===============================================================================
/COM
/COM
FINISH
/OUTPUT,padharddisp.out
/FILE,DCSLABH2
RESUME
/header,on,off,off,off,on,off
/POST1
/COM
/COM
EALL
NALL
/COM
/COM ===============================================================================
/COM =================================  SET 1  =====================================
/COM
SET,1
ESEL,TYPE,1
NELEM
/COM
/COM ===============================================================================
/COM =======================    MAXIMUM VALUES OF Uy    ============================
/COM
NSORT,U,Y,0,0,2,SEL
PRNSOL,U
NUSORT
/COM
```

```
/COM ==============================================================================
/COM =================================  SET 2  ====================================
/COM
SET,2
ESEL,TYPE,1
NELEM
/COM
/COM ==============================================================================
/COM =======================    MAXIMUM VALUES OF Uy     ============================
/COM
NSORT,U,Y,0,0,2,SEL
PRNSOL,U
NUSORT
/COM
/COM ==============================================================================
/COM =================================  SET 3  ====================================
/COM
SET,3
ESEL,TYPE,1
NELEM
/COM
/COM ==============================================================================
/COM =======================    MAXIMUM VALUES OF Uy     ============================
/COM
NSORT,U,Y,0,0,2,SEL
PRNSOL,U
NUSORT
/COM
/COM ==============================================================================
/COM =================================  SET 4  ====================================
/COM
SET,4
ESEL,TYPE,1
NELEM
/COM
/COM ==============================================================================
/COM =======================    MAXIMUM VALUES OF Uy     ============================
/COM
NSORT,U,Y,0,0,2,SEL
PRNSOL,U
NUSORT
/COM
/COM ==============================================================================
/COM =================================  SET 5  ====================================
/COM
SET,5
ESEL,TYPE,1
NELEM
/COM
/COM ==============================================================================
/COM =======================    MAXIMUM VALUES OF Uy     ============================
/COM
NSORT,U,Y,0,0,2,SEL
```

```
PRNSOL,U
NUSORT
/COM
/COM ===============================================================================
/COM =================================  SET 6  =====================================
/COM
SET,6
ESEL,TYPE,1
NELEM
/COM
/COM ===============================================================================
/COM =======================    MAXIMUM VALUES OF Uy    ============================
/COM
NSORT,U,Y,0,0,2,SEL
PRNSOL,U
NUSORT
/COM
/COM ===============================================================================
/COM =================================  SET 7  =====================================
/COM
SET,7
ESEL,TYPE,1
NELEM
/COM
/COM ===============================================================================
/COM =======================    MAXIMUM VALUES OF Uy    ============================
/COM
NSORT,U,Y,0,0,2,SEL
PRNSOL,U
NUSORT
/COM
/COM ===============================================================================
/COM =================================  SET 8  =====================================
/COM
SET,8
ESEL,TYPE,1
NELEM
/COM
/COM ===============================================================================
/COM =======================    MAXIMUM VALUES OF Uy    ============================
/COM
NSORT,U,Y,0,0,2,SEL
PRNSOL,U
NUSORT
/COM
/COM ===============================================================================
/COM =================================  SET 9  =====================================
/COM
SET,9
ESEL,TYPE,1
NELEM
/COM
/COM ===============================================================================
```

```
/COM ======================       MAXIMUM VALUES OF Uy      ===========================
/COM
NSORT,U,Y,0,0,2,SEL
PRNSOL,U
NUSORT
/COM
/COM ================================================================================
/COM ================================  SET 10  ======================================
/COM
SET,10
ESEL,TYPE,1
NELEM
/COM
/COM ================================================================================
/COM ======================       MAXIMUM VALUES OF Uy      ===========================
/COM
NSORT,U,Y,0,0,2,SEL
PRNSOL,U
NUSORT
/COM
/COM ================================================================================
/COM ================================  SET 11  ======================================
/COM
SET,11
ESEL,TYPE,1
NELEM
/COM
/COM ================================================================================
/COM ======================       MAXIMUM VALUES OF Uy      ===========================
/COM
NSORT,U,Y,0,0,2,SEL
PRNSOL,U
NUSORT
/COM
/COM ================================================================================
/COM ================================  SET 12  ======================================
/COM
SET,12
ESEL,TYPE,1
NELEM
/COM
/COM ================================================================================
/COM ======================       MAXIMUM VALUES OF Uy      ===========================
/COM
NSORT,U,Y,0,0,2,SEL
PRNSOL,U
NUSORT
/COM
/COM ================================================================================
/COM ================================  SET 13  ======================================
/COM
SET,13
ESEL,TYPE,1
```

```
NELEM
/COM
/COM ================================================================================
/COM =======================    MAXIMUM VALUES OF Uy     ============================
/COM
NSORT,U,Y,0,0,2,SEL
PRNSOL,U
NUSORT
/COM
/COM ================================================================================
/COM =================================  SET 14  =====================================
/COM
SET,14
ESEL,TYPE,1
NELEM
/COM
/COM ================================================================================
/COM =======================    MAXIMUM VALUES OF Uy     ============================
/COM
NSORT,U,Y,0,0,2,SEL
PRNSOL,U
NUSORT
/COM
/COM ================================================================================
/COM =================================  SET 15  =====================================
/COM
SET,15
ESEL,TYPE,1
NELEM
/COM
/COM ================================================================================
/COM =======================    MAXIMUM VALUES OF Uy     ============================
/COM
NSORT,U,Y,0,0,2,SEL
PRNSOL,U
NUSORT
/COM
/COM ================================================================================
/COM =================================  SET 16  =====================================
/COM
SET,16
ESEL,TYPE,1
NELEM
/COM
/COM ================================================================================
/COM =======================    MAXIMUM VALUES OF Uy     ============================
/COM
NSORT,U,Y,0,0,2,SEL
PRNSOL,U
NUSORT
/COM
/COM ================================================================================
/COM =================================  SET 17  =====================================
```

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```
/COM
SET,17
ESEL,TYPE,1
NELEM
/COM
/COM ===========================================================================
/COM ======================     MAXIMUM VALUES OF Uy     ===========================
/COM
NSORT,U,Y,0,0,2,SEL
PRNSOL,U
NUSORT
/COM
/COM ===========================================================================
/COM ================================  SET 18  ===================================
/COM
SET,18
ESEL,TYPE,1
NELEM
/COM
/COM ===========================================================================
/COM ======================     MAXIMUM VALUES OF Uy     ===========================
/COM
NSORT,U,Y,0,0,2,SEL
PRNSOL,U
NUSORT
/COM
/COM ===========================================================================
/COM ================================  SET 19  ===================================
/COM
SET,19
ESEL,TYPE,1
NELEM
/COM
/COM ===========================================================================
/COM ======================     MAXIMUM VALUES OF Uy     ===========================
/COM
NSORT,U,Y,0,0,2,SEL
PRNSOL,U
NUSORT
/COM
/COM ===========================================================================
/COM
FINI
/OUTPUT
/EXIT
```

Below is the ANSYS output file for the maximum pad displacements for the soft rock analyses:

```
    DISPLACEMENT DATA SORTED AND PRINTED BY LOAD STEP



    THIS ROUTINE SORTS AND PRINTS DISPLACEMENT DATA BY LOAD STEP
    FOR BOTH THE SOFT AND HARD ROCK MODELS



CURRENT JOBNAME REDEFINED AS DCSLABS2

RESUME ANSYS DATA FROM FILE NAME=DCSLABS2.db

*** ANSYS GLOBAL STATUS ***

TITLE = Pad, LTSP(4), 20 Casks, 156 Kips West (X), Max Up, Soft Rock
ANALYSIS TYPE =  STATIC (STEADY-STATE)
NUMBER OF ELEMENT TYPES =      6
  15348 ELEMENTS CURRENTLY SELECTED.  MAX ELEMENT NUMBER =    33177
  17051 NODES CURRENTLY SELECTED.     MAX NODE NUMBER =       17051
    259 KEYPOINTS CURRENTLY SELECTED. MAX KEYPOINT NUMBER =     259
    250 LINES CURRENTLY SELECTED.     MAX LINE NUMBER =         396
    181 AREAS CURRENTLY SELECTED.     MAX AREA NUMBER =         295
     70 VOLUMES CURRENTLY SELECTED.   MAX VOL. NUMBER =          70
    11 COMPONENTS CURRENTLY DEFINED
MAXIMUM LINEAR PROPERTY NUMBER        =       5
MAXIMUM REAL CONSTANT SET NUMBER      =       6
ACTIVE COORDINATE SYSTEM              =       0  (CARTESIAN)
MAXIMUM CONSTRAINT EQUATION NUMBER    =    4620
NUMBER OF SPECIFIED CONSTRAINTS       =    2193
NUMBER OF NODAL LOADS                 =    2160

INITIAL JOBNAME = dcslabs2
CURRENT JOBNAME = DCSLABS2


PRINT HEADER
DO NOT PRINT SUBTITLE(S)
DO NOT PRINT LOAD STEP ID
DO NOT PRINT NOTE LINE(S)
PRINT COLUMN HEADER LABELS
DO NOT PRINT REPORT TOTALS

***** ANSYS - ENGINEERING ANALYSIS SYSTEM  RELEASE 5.7     *****
ANSYS/Structural U
00150104          VERSION=INTEL NT      16:49:39  MAY 17, 2001 CP=       2.454

Pad, LTSP(4), 20 Casks, 156 Kips West (X), Max Up, Soft Rock


         ***** ANSYS RESULTS INTERPRETATION (POST1) *****
```

```
ENTER  /SHOW,DEVICE-NAME  TO ENABLE GRAPHIC DISPLAY
ENTER  FINISH             TO LEAVE POST1

*** NOTE ***                            CP=      2.454   TIME= 16:49:39
Reading results into the database (SET command) will update the current
 displacement and force boundary conditions in the database with the
 values from the results file for that load set.  Note that any
 subsequent solutions will use these values unless action is taken to
 either SAVE the current values or not overwrite them (/EXIT,NOSAVE).


   15348  ELEMENTS (OF    15348  DEFINED) SELECTED BY  EALL  COMMAND.

   17051  NODES (OF    17051  DEFINED) SELECTED BY NALL  COMMAND.

=============================================================================
================================  SET 1  ====================================


USE LOAD STEP     1  SUBSTEP     0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=      1  SUBSTEP=      1  CUMULATIVE ITERATION=     4
  TIME/FREQUENCY=  1.0000
TITLE= Pad, Gravity, 20 Casks, Soft Rock

ESEL  FOR LABEL= TYPE  FROM      1 TO      1 BY     1

    9056  ELEMENTS (OF    15348  DEFINED) SELECTED BY  ESEL  COMMAND.

SELECT      ALL NODES HAVING ANY ELEMENT IN ELEMENT SET.

   11550 NODES (OF    17051  DEFINED) SELECTED FROM
    9056 SELECTED ELEMENTS BY NELE COMMAND.

=============================================================================
======================    MAXIMUM VALUES OF Uy    ===========================


SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=       2

SORT COMPLETED FOR       2 VALUES.

PRINT U    NODAL SOLUTION PER NODE

   NODE       UX           UY           UZ          USUM
  15443 -0.66050E-03-0.10190E-01-0.63869E-03 0.10231E-01
   7439  0.66049E-03-0.10190E-01-0.63869E-03 0.10231E-01

NODE SORT REMOVED
```

```
================================================================================
================================  SET 2  =====================================


USE LOAD STEP      2   SUBSTEP      0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=      2  SUBSTEP=      1  CUMULATIVE ITERATION=    17
  TIME/FREQUENCY=  2.0000
TITLE= Pad, HE(1), 20 Casks, 515 Kips North (Z), Soft Rock

ESEL  FOR LABEL= TYPE  FROM      1 TO      1 BY     1

    9056  ELEMENTS (OF    15348  DEFINED) SELECTED BY  ESEL  COMMAND.

SELECT      ALL NODES HAVING ANY ELEMENT IN ELEMENT SET.

   11550 NODES (OF    17051  DEFINED) SELECTED FROM
    9056 SELECTED ELEMENTS BY NELE COMMAND.

================================================================================
======================    MAXIMUM VALUES OF Uy    ============================

SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=       2

SORT COMPLETED FOR      2 VALUES.

PRINT U    NODAL SOLUTION PER NODE

   NODE       UX           UY           UZ           USUM
  15443  0.28909E-02 0.58371E-01 0.24098E-01 0.63216E-01
   7439 -0.28909E-02 0.58371E-01 0.24098E-01 0.63216E-01

NODE SORT REMOVED

================================================================================
================================  SET 3  =====================================


USE LOAD STEP      3   SUBSTEP      0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=      3  SUBSTEP=      1  CUMULATIVE ITERATION=    26
  TIME/FREQUENCY=  3.0000
TITLE= Pad, HE(1), 20 Casks, 515 Kips N 32.93 W (Z,X), Soft Rock

ESEL  FOR LABEL= TYPE  FROM      1 TO      1 BY     1

    9056  ELEMENTS (OF    15348  DEFINED) SELECTED BY  ESEL  COMMAND.

SELECT      ALL NODES HAVING ANY ELEMENT IN ELEMENT SET.
```

```
   11550 NODES (OF    17051  DEFINED) SELECTED FROM
    9056 SELECTED ELEMENTS BY NELE COMMAND.

================================================================================
======================    MAXIMUM VALUES OF Uy    ============================

SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=        2

SORT COMPLETED FOR       2 VALUES.

PRINT U    NODAL SOLUTION PER NODE

   NODE       UX           UY           UZ          USUM
  15443   0.13572E-01 0.98570E-01 0.21747E-01 0.10185
  15453   0.19969E-01 0.97876E-01 0.31920E-01 0.10487

NODE SORT REMOVED

================================================================================
================================  SET 4  ======================================


USE LOAD STEP     4   SUBSTEP     0   FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=     4  SUBSTEP=     1  CUMULATIVE ITERATION=    30
  TIME/FREQUENCY=  4.0000
TITLE= Pad, HE(1), 20 Casks, 515 Kips N 45 W (Z,X), Soft Rock

ESEL  FOR LABEL= TYPE  FROM      1 TO      1 BY     1

    9056  ELEMENTS (OF    15348  DEFINED) SELECTED BY  ESEL  COMMAND.

SELECT       ALL NODES HAVING ANY ELEMENT IN ELEMENT SET.

   11550 NODES (OF    17051  DEFINED) SELECTED FROM
    9056 SELECTED ELEMENTS BY NELE COMMAND.

================================================================================
======================    MAXIMUM VALUES OF Uy    ============================

SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=        2

SORT COMPLETED FOR       2 VALUES.

PRINT U    NODAL SOLUTION PER NODE

   NODE       UX           UY           UZ          USUM
  15443   0.16478E-01 0.10059      0.19540E-01 0.10379
  15453   0.24681E-01 0.99877E-01 0.28320E-01 0.10671
```

```
NODE SORT REMOVED

===============================================================================
=================================  SET 5  =====================================


USE LOAD STEP     5  SUBSTEP     0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=     5  SUBSTEP=     1  CUMULATIVE ITERATION=    34
  TIME/FREQUENCY=  5.0000
TITLE= Pad, HE(1), 20 Casks, 515 Kips N 57.07 W (Z,X), Soft Rock

ESEL  FOR LABEL= TYPE  FROM     1 TO     1 BY     1

    9056  ELEMENTS (OF    15348  DEFINED) SELECTED BY  ESEL  COMMAND.

SELECT      ALL NODES HAVING ANY ELEMENT IN ELEMENT SET.

   11550 NODES (OF    17051  DEFINED) SELECTED FROM
    9056 SELECTED ELEMENTS BY NELE COMMAND.

===============================================================================
======================   MAXIMUM VALUES OF Uy   ===============================

SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=       2

SORT COMPLETED FOR       2 VALUES.

PRINT U    NODAL SOLUTION PER NODE

   NODE      UX           UY           UZ           USUM
  15443  0.18842E-01 0.93894E-01 0.16674E-01 0.97207E-01
  15453  0.28349E-01 0.93182E-01 0.23602E-01 0.10022

NODE SORT REMOVED

===============================================================================
=================================  SET 6  =====================================


USE LOAD STEP     6  SUBSTEP     0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=     6  SUBSTEP=     1  CUMULATIVE ITERATION=    42
  TIME/FREQUENCY=  6.0000
TITLE= Pad, HE(1), 20 Casks, 515 Kips West (W), Soft Rock

ESEL  FOR LABEL= TYPE  FROM     1 TO     1 BY     1

    9056  ELEMENTS (OF    15348  DEFINED) SELECTED BY  ESEL  COMMAND.
```

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```
SELECT      ALL NODES HAVING ANY ELEMENT IN ELEMENT SET.

   11550 NODES (OF    17051  DEFINED) SELECTED FROM
    9056 SELECTED ELEMENTS BY NELE COMMAND.

===============================================================================
=======================    MAXIMUM VALUES OF Uy    ============================


SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=        2

SORT COMPLETED FOR        2 VALUES.

PRINT U    NODAL SOLUTION PER NODE

   NODE       UX           UY           UZ           USUM
  15443  0.22263E-01 0.46687E-01 0.51699E-02 0.51981E-01
  15363  0.22266E-01 0.46572E-01-0.51728E-02 0.51880E-01

NODE SORT REMOVED

===============================================================================
=================================  SET 7  =====================================


USE LOAD STEP     7  SUBSTEP     0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=     7  SUBSTEP=     1  CUMULATIVE ITERATION=    54
  TIME/FREQUENCY=  7.0000
TITLE= Pad, HE(1), 20 Casks, 206 Kips North (z), Max Up, Soft Rock

ESEL  FOR LABEL= TYPE  FROM     1 TO     1 BY    1

    9056  ELEMENTS (OF    15348  DEFINED) SELECTED BY  ESEL  COMMAND.

SELECT      ALL NODES HAVING ANY ELEMENT IN ELEMENT SET.

   11550 NODES (OF    17051  DEFINED) SELECTED FROM
    9056 SELECTED ELEMENTS BY NELE COMMAND.

===============================================================================
=======================    MAXIMUM VALUES OF Uy    ============================


SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=        2

SORT COMPLETED FOR        2 VALUES.

PRINT U    NODAL SOLUTION PER NODE

   NODE       UX           UY           UZ           USUM
  15443  0.12943E-02 0.10033E-01 0.11569E-01 0.15368E-01
```

```
   7439 -0.12943E-02 0.10033E-01 0.11569E-01 0.15368E-01

NODE SORT REMOVED

===============================================================================
================================  SET 8  ======================================


USE LOAD STEP     8  SUBSTEP     0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=     8  SUBSTEP=     1  CUMULATIVE ITERATION=    63
  TIME/FREQUENCY=  8.0000
TITLE= Pad, HE(1), 20 Casks, 206 Kips West (X), Max Up, Soft Rock

ESEL  FOR LABEL= TYPE  FROM     1 TO     1 BY     1

    9056  ELEMENTS (OF    15348  DEFINED) SELECTED BY  ESEL  COMMAND.

SELECT      ALL NODES HAVING ANY ELEMENT IN ELEMENT SET.

   11550 NODES (OF    17051  DEFINED) SELECTED FROM
    9056 SELECTED ELEMENTS BY NELE COMMAND.

===============================================================================
=======================    MAXIMUM VALUES OF Uy    ============================


SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=       2

SORT COMPLETED FOR       2 VALUES.

PRINT U    NODAL SOLUTION PER NODE

   NODE       UX           UY           UZ           USUM
  15443  0.10564E-01 0.90342E-02 0.22392E-02 0.14079E-01
  15363  0.10564E-01 0.90317E-02-0.22393E-02 0.14078E-01

NODE SORT REMOVED

===============================================================================
================================  SET 9  ======================================


USE LOAD STEP     9  SUBSTEP     0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=     9  SUBSTEP=     1  CUMULATIVE ITERATION=    69
  TIME/FREQUENCY=  9.0000
TITLE= Pad, HE(3), 20 Casks, 171.2 Kips North (Z), Max Dn, Soft Rock

ESEL  FOR LABEL= TYPE  FROM     1 TO     1 BY     1
```

```
    9056  ELEMENTS (OF    15348  DEFINED) SELECTED BY  ESEL  COMMAND.

 SELECT      ALL NODES HAVING ANY ELEMENT IN ELEMENT SET.

   11550 NODES (OF    17051  DEFINED) SELECTED FROM
    9056 SELECTED ELEMENTS BY NELE COMMAND.

 ===============================================================================
 =======================    MAXIMUM VALUES OF Uy    ============================

 SORT ON ITEM=U    COMPONENT=Y    ORDER= 0  KABS= 0  NMAX=       2

 SORT COMPLETED FOR       2 VALUES.

 PRINT U    NODAL SOLUTION PER NODE

   NODE      UX          UY          UZ          USUM
  15453  0.12601E-02-0.13758E-01 0.14189E-01 0.19804E-01
   7449 -0.12599E-02-0.13758E-01 0.14189E-01 0.19804E-01

 NODE SORT REMOVED

 ===============================================================================
 =================================  SET 10  ====================================


 USE LOAD STEP    10  SUBSTEP     0  FOR LOAD CASE 0

 SET COMMAND GOT LOAD STEP=    10  SUBSTEP=     1  CUMULATIVE ITERATION=    73
   TIME/FREQUENCY=  10.000
 TITLE= Pad, HE(3), 20 Casks, 171.2 Kips West (X), Max Dn, Soft Rock

 ESEL  FOR LABEL= TYPE  FROM     1 TO     1 BY     1

    9056  ELEMENTS (OF    15348  DEFINED) SELECTED BY  ESEL  COMMAND.

 SELECT      ALL NODES HAVING ANY ELEMENT IN ELEMENT SET.

   11550 NODES (OF    17051  DEFINED) SELECTED FROM
    9056 SELECTED ELEMENTS BY NELE COMMAND.

 ===============================================================================
 =======================    MAXIMUM VALUES OF Uy    ============================

 SORT ON ITEM=U    COMPONENT=Y    ORDER= 0  KABS= 0  NMAX=       2

 SORT COMPLETED FOR       2 VALUES.

 PRINT U    NODAL SOLUTION PER NODE
```

```
   NODE       UX            UY            UZ            USUM
  15363  0.94049E-02-0.13706E-01-0.10578E-02 0.16656E-01
  15443  0.94049E-02-0.13706E-01 0.10577E-02 0.16656E-01

NODE SORT REMOVED

===============================================================================
================================  SET 11  ======================================


USE LOAD STEP    11  SUBSTEP     0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=     11  SUBSTEP=      1  CUMULATIVE ITERATION=    85
  TIME/FREQUENCY=  11.000
TITLE= Pad, LTSP(2), 20 Casks, 440 Kips North (Z), Soft Rock

ESEL  FOR LABEL= TYPE  FROM      1 TO      1 BY     1

    9056  ELEMENTS (OF    15348  DEFINED) SELECTED BY  ESEL  COMMAND.

SELECT      ALL NODES HAVING ANY ELEMENT IN ELEMENT SET.

   11550 NODES (OF    17051  DEFINED) SELECTED FROM
    9056 SELECTED ELEMENTS BY NELE COMMAND.

===============================================================================
======================    MAXIMUM VALUES OF Uy    ============================


SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=       2

SORT COMPLETED FOR       2 VALUES.

PRINT U    NODAL SOLUTION PER NODE

   NODE       UX            UY            UZ            USUM
  15443  0.27762E-02 0.48794E-01 0.23252E-01 0.54122E-01
   7439 -0.27762E-02 0.48794E-01 0.23252E-01 0.54122E-01

NODE SORT REMOVED

===============================================================================
================================  SET 12  ======================================


USE LOAD STEP    12  SUBSTEP     0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=     12  SUBSTEP=      1  CUMULATIVE ITERATION=    94
  TIME/FREQUENCY=  12.000
TITLE= Pad, LTSP(2), 20 Casks, 440 Kips N 32.93 W (Z,X), Soft Rock
```

```
ESEL  FOR LABEL= TYPE  FROM      1 TO      1 BY     1

    9056  ELEMENTS (OF    15348  DEFINED) SELECTED BY  ESEL  COMMAND.

SELECT      ALL NODES HAVING ANY ELEMENT IN ELEMENT SET.

   11550 NODES (OF    17051  DEFINED) SELECTED FROM
    9056 SELECTED ELEMENTS BY NELE COMMAND.

===============================================================================
=======================    MAXIMUM VALUES OF Uy    ============================

SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=       2

SORT COMPLETED FOR       2 VALUES.

PRINT U    NODAL SOLUTION PER NODE

   NODE      UX          UY          UZ          USUM
  15443  0.13264E-01 0.81825E-01 0.21000E-01 0.85512E-01
  15453  0.19028E-01 0.81150E-01 0.30368E-01 0.88711E-01

NODE SORT REMOVED

===============================================================================
=================================  SET 13  ====================================


USE LOAD STEP    13  SUBSTEP     0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=    13  SUBSTEP=     1  CUMULATIVE ITERATION=    98
  TIME/FREQUENCY=  13.000
TITLE= Pad, LTSP(2), 20 Casks, 440 Kips N 45 W (Z,X), Soft Rock

ESEL  FOR LABEL= TYPE  FROM      1 TO      1 BY     1

    9056  ELEMENTS (OF    15348  DEFINED) SELECTED BY  ESEL  COMMAND.

SELECT      ALL NODES HAVING ANY ELEMENT IN ELEMENT SET.

   11550 NODES (OF    17051  DEFINED) SELECTED FROM
    9056 SELECTED ELEMENTS BY NELE COMMAND.

===============================================================================
=======================    MAXIMUM VALUES OF Uy    ============================

SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=       2

SORT COMPLETED FOR       2 VALUES.
```

ENERCON SERVICES, INC.


```
PRINT U    NODAL SOLUTION PER NODE

   NODE       UX           UY           UZ           USUM
  15443   0.16115E-01 0.83204E-01 0.18824E-01 0.86816E-01
  15453   0.23498E-01 0.82509E-01 0.26929E-01 0.89917E-01

NODE SORT REMOVED

===============================================================================
================================  SET 14  =====================================


USE LOAD STEP     14   SUBSTEP      0   FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=     14   SUBSTEP=      1  CUMULATIVE ITERATION=    102
  TIME/FREQUENCY=  14.000
TITLE= Pad, LTSP(2), 20 Casks, 440 Kips N 57.03 W (Z,X), Soft Rock

ESEL  FOR LABEL= TYPE  FROM      1 TO      1 BY     1

    9056  ELEMENTS (OF    15348  DEFINED) SELECTED BY  ESEL  COMMAND.

SELECT      ALL NODES HAVING ANY ELEMENT IN ELEMENT SET.

   11550 NODES (OF    17051  DEFINED) SELECTED FROM
    9056 SELECTED ELEMENTS BY NELE COMMAND.

===============================================================================
======================    MAXIMUM VALUES OF Uy    ============================

SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=        2

SORT COMPLETED FOR        2 VALUES.

PRINT U    NODAL SOLUTION PER NODE

   NODE       UX           UY           UZ           USUM
  15443   0.18441E-01 0.77183E-01 0.15965E-01 0.80946E-01
  15453   0.26968E-01 0.76491E-01 0.22417E-01 0.84147E-01

NODE SORT REMOVED

===============================================================================
================================  SET 15  =====================================


USE LOAD STEP     15   SUBSTEP      0   FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=     15   SUBSTEP=      1  CUMULATIVE ITERATION=    110
  TIME/FREQUENCY=  15.000
```

```
TITLE= Pad, LTSP(2), 20 Casks, 440 Kips West (X), Soft Rock

ESEL  FOR LABEL= TYPE  FROM      1 TO      1 BY     1

    9056  ELEMENTS (OF    15348  DEFINED) SELECTED BY  ESEL  COMMAND.

SELECT      ALL NODES HAVING ANY ELEMENT IN ELEMENT SET.

   11550 NODES (OF    17051  DEFINED) SELECTED FROM
    9056 SELECTED ELEMENTS BY NELE COMMAND.

================================================================================
=======================    MAXIMUM VALUES OF Uy    ============================

SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=       2

SORT COMPLETED FOR       2 VALUES.

PRINT U    NODAL SOLUTION PER NODE

   NODE      UX           UY           UZ           USUM
  15443   0.21562E-01 0.38709E-01 0.47068E-02 0.44559E-01
  15363   0.21563E-01 0.38699E-01-0.47073E-02 0.44550E-01

NODE SORT REMOVED

================================================================================
=================================  SET 16  ====================================


USE LOAD STEP    16  SUBSTEP     0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=    16  SUBSTEP=      1  CUMULATIVE ITERATION=   123
  TIME/FREQUENCY=  16.000
TITLE= Pad, LTSP(2), 20 Casks, 176 Kips North (Z), Max Up, Soft Rock

ESEL  FOR LABEL= TYPE  FROM      1 TO      1 BY     1

    9056  ELEMENTS (OF    15348  DEFINED) SELECTED BY  ESEL  COMMAND.

SELECT      ALL NODES HAVING ANY ELEMENT IN ELEMENT SET.

   11550 NODES (OF    17051  DEFINED) SELECTED FROM
    9056 SELECTED ELEMENTS BY NELE COMMAND.

================================================================================
=======================    MAXIMUM VALUES OF Uy    ============================

SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=       2
```

```
SORT COMPLETED FOR       2 VALUES.

PRINT U    NODAL SOLUTION PER NODE

   NODE       UX           UY           UZ          USUM
  15443   0.12772E-02 0.22290E-01 0.10659E-01 0.24741E-01
   7439  -0.12774E-02 0.22282E-01 0.10659E-01 0.24734E-01

NODE SORT REMOVED

===============================================================================
================================  SET 17  ======================================


USE LOAD STEP    17  SUBSTEP     0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=    17  SUBSTEP=     1  CUMULATIVE ITERATION=   136
  TIME/FREQUENCY=  17.000
TITLE= Pad, LTSP(2), 20 Casks, 176 Kips West (X), Max Up, Soft Rock

ESEL  FOR LABEL= TYPE  FROM      1 TO      1 BY    1

    9056  ELEMENTS (OF    15348  DEFINED) SELECTED BY  ESEL  COMMAND.

SELECT      ALL NODES HAVING ANY ELEMENT IN ELEMENT SET.

   11550 NODES (OF    17051  DEFINED) SELECTED FROM
    9056 SELECTED ELEMENTS BY NELE COMMAND.

===============================================================================
======================     MAXIMUM VALUES OF Uy     ============================


SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=       2

SORT COMPLETED FOR       2 VALUES.

PRINT U    NODAL SOLUTION PER NODE

   NODE       UX           UY           UZ          USUM
  15443   0.99218E-02 0.17631E-01 0.20669E-02 0.20336E-01
  15363   0.99230E-02 0.17593E-01-0.20680E-02 0.20304E-01

NODE SORT REMOVED

===============================================================================
================================  SET 18  ======================================


USE LOAD STEP    18  SUBSTEP     0  FOR LOAD CASE 0
```

ENERCON SERVICES, INC. Appendix DN-1 to Calculation PGE-009-CALC-003

```
SET COMMAND GOT LOAD STEP=    18  SUBSTEP=     1  CUMULATIVE ITERATION=   151
  TIME/FREQUENCY=  18.000
TITLE= Pad, LTSP(4), 20 Casks, 156 Kips North (Z), Max Up, Soft Rock

ESEL  FOR LABEL= TYPE  FROM     1 TO     1 BY    1

    9056  ELEMENTS (OF    15348  DEFINED) SELECTED BY  ESEL  COMMAND.

SELECT      ALL NODES HAVING ANY ELEMENT IN ELEMENT SET.

   11550 NODES (OF    17051  DEFINED) SELECTED FROM
    9056 SELECTED ELEMENTS BY NELE COMMAND.

===============================================================================
=======================     MAXIMUM VALUES OF Uy     ===========================

SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=       2

SORT COMPLETED FOR       2 VALUES.

PRINT U    NODAL SOLUTION PER NODE

   NODE       UX           UY           UZ           USUM
  15443   0.12293E-02 0.25461E-01 0.99999E-02 0.27382E-01
   7439  -0.12295E-02 0.25455E-01 0.10000E-01 0.27377E-01

NODE SORT REMOVED

===============================================================================
================================  SET 19  ======================================


USE LOAD STEP    19  SUBSTEP     0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=    19  SUBSTEP=     1  CUMULATIVE ITERATION=   168
  TIME/FREQUENCY=  19.000
TITLE= Pad, LTSP(4), 20 Casks, 156 Kips West (X), Max Up, Soft Rock

ESEL  FOR LABEL= TYPE  FROM     1 TO     1 BY    1

    9056  ELEMENTS (OF    15348  DEFINED) SELECTED BY  ESEL  COMMAND.

SELECT      ALL NODES HAVING ANY ELEMENT IN ELEMENT SET.

   11550 NODES (OF    17051  DEFINED) SELECTED FROM
    9056 SELECTED ELEMENTS BY NELE COMMAND.

===============================================================================
=======================     MAXIMUM VALUES OF Uy     ===========================
```

```
SORT ON ITEM=U      COMPONENT=Y      ORDER= 0  KABS= 0  NMAX=         2

SORT COMPLETED FOR        2 VALUES.

PRINT U    NODAL SOLUTION PER NODE

   NODE       UX            UY            UZ            USUM
  15443  0.92041E-02 0.22962E-01 0.20536E-02 0.24823E-01
  15363  0.92041E-02 0.22960E-01-0.20537E-02 0.24822E-01

NODE SORT REMOVED

===============================================================================


EXIT THE ANSYS POST1 DATABASE PROCESSOR


***** ROUTINE COMPLETED *****  CP =         49.241


*** NOTE ***                             CP=      49.241   TIME= 16:50:46
A total of 1 warnings and errors written to dcslabs2.err.

/OUTPUT FILE= padharddisp.out
```

Below is the ANSYS output file for the maximum pad displacements for the hard rock analyses:

```
CURRENT JOBNAME REDEFINED AS DCSLABH2

RESUME ANSYS DATA FROM FILE NAME=DCSLABH2.db

*** ANSYS GLOBAL STATUS ***

TITLE = Pad, LTSP(4), 20 Casks, 156 Kips West (X), Max Up, Hard Rock
ANALYSIS TYPE =  STATIC (STEADY-STATE)
NUMBER OF ELEMENT TYPES =      6
  15348 ELEMENTS CURRENTLY SELECTED.  MAX ELEMENT NUMBER =    33177
  17051 NODES CURRENTLY SELECTED.     MAX NODE NUMBER =       17051
    259 KEYPOINTS CURRENTLY SELECTED. MAX KEYPOINT NUMBER =     259
    250 LINES CURRENTLY SELECTED.     MAX LINE NUMBER =         396
    181 AREAS CURRENTLY SELECTED.     MAX AREA NUMBER =         295
     70 VOLUMES CURRENTLY SELECTED.   MAX VOL. NUMBER =          70
    11 COMPONENTS CURRENTLY DEFINED
MAXIMUM LINEAR PROPERTY NUMBER        =        5
MAXIMUM REAL CONSTANT SET NUMBER      =        6
ACTIVE COORDINATE SYSTEM              =        0  (CARTESIAN)
MAXIMUM CONSTRAINT EQUATION NUMBER    =     4620
NUMBER OF SPECIFIED CONSTRAINTS       =     2193
NUMBER OF NODAL LOADS                 =     2160

INITIAL JOBNAME = dcslabs2
CURRENT JOBNAME = DCSLABH2


PRINT HEADER
DO NOT PRINT SUBTITLE(S)
DO NOT PRINT LOAD STEP ID
DO NOT PRINT NOTE LINE(S)
PRINT COLUMN HEADER LABELS
DO NOT PRINT REPORT TOTALS

         ***** ANSYS RESULTS INTERPRETATION (POST1) *****

ENTER  /SHOW,DEVICE-NAME  TO ENABLE GRAPHIC DISPLAY
ENTER  FINISH             TO LEAVE POST1


   15348  ELEMENTS (OF    15348  DEFINED) SELECTED BY  EALL  COMMAND.

   17051  NODES (OF    17051  DEFINED) SELECTED BY NALL  COMMAND.

================================================================================
=================================  SET 1  =====================================


USE LOAD STEP     1  SUBSTEP     0  FOR LOAD CASE 0
```

```
SET COMMAND GOT LOAD STEP=      1  SUBSTEP=      1  CUMULATIVE ITERATION=      2
  TIME/FREQUENCY=  1.0000
TITLE= Pad, Gravity, 20 Casks, Hard Rock

ESEL  FOR LABEL= TYPE  FROM      1 TO      1 BY     1

    9056  ELEMENTS (OF    15348  DEFINED) SELECTED BY  ESEL  COMMAND.

SELECT       ALL NODES HAVING ANY ELEMENT IN ELEMENT SET.

   11550 NODES (OF    17051  DEFINED) SELECTED FROM
    9056 SELECTED ELEMENTS BY NELE COMMAND.

===============================================================================
=======================    MAXIMUM VALUES OF Uy    ============================


SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=       2

SORT COMPLETED FOR       2 VALUES.

PRINT U    NODAL SOLUTION PER NODE

   NODE       UX           UY           UZ           USUM
  15443  0.79339E-04-0.94462E-03 0.12113E-03 0.95566E-03
   7439 -0.79339E-04-0.94462E-03 0.12113E-03 0.95566E-03

NODE SORT REMOVED

===============================================================================
=================================  SET 2  =====================================


USE LOAD STEP     2  SUBSTEP     0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=      2  SUBSTEP=      1  CUMULATIVE ITERATION=     17
  TIME/FREQUENCY=  2.0000
TITLE= Pad, HE(1), 20 Casks, 515 Kips North (Z), Hard Rock

ESEL  FOR LABEL= TYPE  FROM      1 TO      1 BY     1

    9056  ELEMENTS (OF    15348  DEFINED) SELECTED BY  ESEL  COMMAND.

SELECT       ALL NODES HAVING ANY ELEMENT IN ELEMENT SET.

   11550 NODES (OF    17051  DEFINED) SELECTED FROM
    9056 SELECTED ELEMENTS BY NELE COMMAND.

===============================================================================
=======================    MAXIMUM VALUES OF Uy    ============================
```

ENERCON SERVICES, INC. Appendix DN-1 to Calculation PGE-009-CALC-003

```
SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=        2

SORT COMPLETED FOR       2 VALUES.

PRINT U    NODAL SOLUTION PER NODE

   NODE      UX          UY          UZ          USUM
  15443  0.50071E-03 0.26620E-01 0.18167E-02 0.26687E-01
   7439 -0.50071E-03 0.26620E-01 0.18167E-02 0.26687E-01

NODE SORT REMOVED

==============================================================================
================================  SET 3  =====================================


USE LOAD STEP     3  SUBSTEP     0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=     3  SUBSTEP=     1  CUMULATIVE ITERATION=    30
  TIME/FREQUENCY=  3.0000
TITLE= Pad, HE(1), 20 Casks, 515 Kips N 32.93 W (Z,X), Hard Rock

ESEL  FOR LABEL= TYPE  FROM      1 TO      1 BY     1

    9056  ELEMENTS (OF    15348  DEFINED) SELECTED BY  ESEL  COMMAND.

SELECT      ALL NODES HAVING ANY ELEMENT IN ELEMENT SET.

   11550 NODES (OF    17051  DEFINED) SELECTED FROM
    9056 SELECTED ELEMENTS BY NELE COMMAND.

==============================================================================
=======================    MAXIMUM VALUES OF Uy    ===========================


SORT ON ITEM=U     COMPONENT=Y.    ORDER= 0  KABS= 0  NMAX=        2

SORT COMPLETED FOR       2 VALUES.

PRINT U    NODAL SOLUTION PER NODE

   NODE      UX          UY          UZ          USUM
  15443  0.99650E-03 0.45234E-01 0.17185E-02 0.45278E-01
  15453  0.30152E-02 0.45148E-01 0.45525E-02 0.45477E-01

NODE SORT REMOVED

==============================================================================
================================  SET 4  =====================================
```

ENERCON SERVICES, INC. Appendix DN-1 to Calculation PGE-009-CALC-003

```
USE LOAD STEP     4  SUBSTEP     0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=     4  SUBSTEP=     1  CUMULATIVE ITERATION=    36
  TIME/FREQUENCY=  4.0000
TITLE= Pad, HE(1), 20 Casks, 515 Kips N 45 W (Z,X), Hard Rock

ESEL  FOR LABEL= TYPE  FROM     1 TO     1 BY    1

    9056  ELEMENTS (OF    15348  DEFINED) SELECTED BY  ESEL  COMMAND.

SELECT      ALL NODES HAVING ANY ELEMENT IN ELEMENT SET.

   11550 NODES (OF    17051  DEFINED) SELECTED FROM
    9056 SELECTED ELEMENTS BY NELE COMMAND.

===============================================================================
=======================    MAXIMUM VALUES OF Uy    ===========================

SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=       2

SORT COMPLETED FOR       2 VALUES.

PRINT U    NODAL SOLUTION PER NODE

   NODE       UX           UY           UZ           USUM
  15443  0.11166E-02 0.46181E-01 0.16295E-02 0.46223E-01
  15453  0.37418E-02 0.46093E-01 0.39783E-02 0.46416E-01

NODE SORT REMOVED

===============================================================================
=================================  SET 5  =====================================


USE LOAD STEP     5  SUBSTEP     0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=     5  SUBSTEP=     1  CUMULATIVE ITERATION=    42
  TIME/FREQUENCY=  5.0000
TITLE= Pad, HE(1), 20 Casks, 515 Kips N 57.07 W (Z,X), Hard Rock

ESEL  FOR LABEL= TYPE  FROM     1 TO     1 BY    1

    9056  ELEMENTS (OF    15348  DEFINED) SELECTED BY  ESEL  COMMAND.

SELECT      ALL NODES HAVING ANY ELEMENT IN ELEMENT SET.

   11550 NODES (OF    17051  DEFINED) SELECTED FROM
    9056 SELECTED ELEMENTS BY NELE COMMAND.

===============================================================================
```

```
=======================    MAXIMUM VALUES OF Uy    ============================


SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=       2

SORT COMPLETED FOR       2 VALUES.

PRINT U    NODAL SOLUTION PER NODE

   NODE       UX           UY           UZ          USUM
  15443   0.12264E-02 0.42812E-01 0.15071E-02 0.42856E-01
  15453   0.42545E-02 0.42724E-01 0.32051E-02 0.43055E-01

NODE SORT REMOVED

===============================================================================
=================================    SET 6    ==================================


USE LOAD STEP     6  SUBSTEP     0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=     6  SUBSTEP=     1  CUMULATIVE ITERATION=    54
  TIME/FREQUENCY=  6.0000
TITLE= Pad, HE(1), 20 Casks, 515 Kips West (W), Hard Rock

ESEL  FOR LABEL= TYPE  FROM      1 TO      1 BY     1

    9056  ELEMENTS (OF    15348  DEFINED) SELECTED BY  ESEL  COMMAND.

SELECT      ALL NODES HAVING ANY ELEMENT IN ELEMENT SET.

   11550 NODES (OF    17051  DEFINED) SELECTED FROM
    9056 SELECTED ELEMENTS BY NELE COMMAND.

===============================================================================
=======================    MAXIMUM VALUES OF Uy    ============================


SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=       2

SORT COMPLETED FOR       2 VALUES.

PRINT U    NODAL SOLUTION PER NODE

   NODE       UX           UY           UZ          USUM
  13267   0.17919E-01 0.31514E-01-0.65700E-04 0.36253E-01
  13266   0.17919E-01 0.31514E-01 0.67712E-04 0.36252E-01

NODE SORT REMOVED

===============================================================================
=================================    SET 7    ==================================
```

```
USE LOAD STEP     7  SUBSTEP     0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=     7  SUBSTEP=     1  CUMULATIVE ITERATION=    74
  TIME/FREQUENCY=  7.0000
TITLE= Pad, HE(1), 20 Casks, 206 Kips North (z), Max Up, Hard Rock

ESEL  FOR LABEL= TYPE  FROM     1 TO     1 BY     1

    9056  ELEMENTS (OF    15348  DEFINED) SELECTED BY  ESEL  COMMAND.

SELECT      ALL NODES HAVING ANY ELEMENT IN ELEMENT SET.

   11550 NODES (OF    17051  DEFINED) SELECTED FROM
    9056 SELECTED ELEMENTS BY NELE COMMAND.

===============================================================================
=======================    MAXIMUM VALUES OF Uy    ============================


SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=       2

SORT COMPLETED FOR       2 VALUES.

PRINT U    NODAL SOLUTION PER NODE

   NODE       UX          UY          UZ          USUM
  15443  0.25481E-03 0.47173E-02 0.94887E-03 0.48185E-02
   7439 -0.25484E-03 0.47147E-02 0.94891E-03 0.48160E-02

NODE SORT REMOVED

===============================================================================
=================================  SET 8  =====================================


USE LOAD STEP     8  SUBSTEP     0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=     8  SUBSTEP=     1  CUMULATIVE ITERATION=    90
  TIME/FREQUENCY=  8.0000
TITLE= Pad, HE(1), 20 Casks, 206 Kips West (X), Max Up, Hard Rock

ESEL  FOR LABEL= TYPE  FROM     1 TO     1 BY     1

    9056  ELEMENTS (OF    15348  DEFINED) SELECTED BY  ESEL  COMMAND.

SELECT      ALL NODES HAVING ANY ELEMENT IN ELEMENT SET.

   11550 NODES (OF    17051  DEFINED) SELECTED FROM
    9056 SELECTED ELEMENTS BY NELE COMMAND.
```

```
================================================================================
======================    MAXIMUM VALUES OF Uy    ============================

SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=       2

SORT COMPLETED FOR        2 VALUES.

PRINT U    NODAL SOLUTION PER NODE

   NODE       UX           UY           UZ          USUM
  13267  0.60604E-02 0.65000E-02-0.13646E-04 0.88870E-02
  13266  0.60604E-02 0.64998E-02 0.13978E-04 0.88868E-02

NODE SORT REMOVED

================================================================================
================================  SET 9  =====================================


USE LOAD STEP     9  SUBSTEP     0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=     9  SUBSTEP=     1  CUMULATIVE ITERATION=    95
  TIME/FREQUENCY=  9.0000
TITLE= Pad, HE(3), 20 Casks, 171.2 Kips North (Z), Max Dn, Hard Rock

ESEL  FOR LABEL= TYPE  FROM      1 TO      1 BY     1

    9056  ELEMENTS (OF    15348  DEFINED) SELECTED BY  ESEL  COMMAND.

SELECT       ALL NODES HAVING ANY ELEMENT IN ELEMENT SET.

   11550 NODES (OF    17051  DEFINED) SELECTED FROM
    9056 SELECTED ELEMENTS BY NELE COMMAND.

================================================================================
======================    MAXIMUM VALUES OF Uy    ============================

SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=       2

SORT COMPLETED FOR        2 VALUES.

PRINT U    NODAL SOLUTION PER NODE

   NODE       UX           UY           UZ          USUM
  15453  0.54805E-03-0.11026E-02 0.17593E-02 0.21474E-02
   7449 -0.54805E-03-0.11027E-02 0.17593E-02 0.21474E-02

NODE SORT REMOVED
```

ENERCON SERVICES, INC. Appendix DN-1 to Calculation PGE-009-CALC-003

```
===============================================================================
================================  SET 10  ======================================


USE LOAD STEP     10  SUBSTEP      0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=     10  SUBSTEP=      1  CUMULATIVE ITERATION=     99
  TIME/FREQUENCY=  10.000
TITLE= Pad, HE(3), 20 Casks, 171.2 Kips West (X), Max Dn, Hard Rock

ESEL  FOR LABEL= TYPE  FROM      1 TO      1 BY     1

    9056  ELEMENTS (OF    15348  DEFINED) SELECTED BY  ESEL  COMMAND.

SELECT      ALL NODES HAVING ANY ELEMENT IN ELEMENT SET.

   11550 NODES (OF    17051  DEFINED) SELECTED FROM
    9056 SELECTED ELEMENTS BY NELE COMMAND.

===============================================================================
======================   MAXIMUM VALUES OF Uy    ==============================


SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=       2

SORT COMPLETED FOR       2 VALUES.

PRINT U    NODAL SOLUTION PER NODE

   NODE       UX           UY           UZ           USUM
  15363  0.95802E-03-0.11714E-02-0.48684E-03 0.15896E-02
  15443  0.95802E-03-0.11714E-02 0.48684E-03 0.15896E-02

NODE SORT REMOVED

===============================================================================
================================  SET 11  ======================================


USE LOAD STEP     11  SUBSTEP      0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=     11  SUBSTEP=      1  CUMULATIVE ITERATION=    117
  TIME/FREQUENCY=  11.000
TITLE= Pad, LTSP(2), 20 Casks, 440 Kips North (Z), Hard Rock

ESEL  FOR LABEL= TYPE  FROM      1 TO      1 BY     1

    9056  ELEMENTS (OF    15348  DEFINED) SELECTED BY  ESEL  COMMAND.

SELECT      ALL NODES HAVING ANY ELEMENT IN ELEMENT SET.
```

```
   11550 NODES (OF    17051  DEFINED) SELECTED FROM
    9056 SELECTED ELEMENTS BY NELE COMMAND.

================================================================================
=======================    MAXIMUM VALUES OF Uy    ============================

SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=       2

SORT COMPLETED FOR       2 VALUES.

PRINT U    NODAL SOLUTION PER NODE

   NODE       UX           UY           UZ           USUM
  15443  0.48347E-03 0.22444E-01 0.17728E-02 0.22519E-01
   7439 -0.48347E-03 0.22444E-01 0.17728E-02 0.22519E-01

NODE SORT REMOVED

================================================================================
=================================  SET 12  =====================================


USE LOAD STEP    12  SUBSTEP     0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=    12  SUBSTEP=     1  CUMULATIVE ITERATION=   130
  TIME/FREQUENCY=  12.000
TITLE= Pad, LTSP(2), 20 Casks, 440 Kips N 32.93 W (Z,X), Hard Rock

ESEL  FOR LABEL= TYPE  FROM     1 TO     1 BY    1

    9056  ELEMENTS (OF    15348  DEFINED) SELECTED BY  ESEL  COMMAND.

SELECT      ALL NODES HAVING ANY ELEMENT IN ELEMENT SET.

   11550 NODES (OF    17051  DEFINED) SELECTED FROM
    9056 SELECTED ELEMENTS BY NELE COMMAND.

================================================================================
=======================    MAXIMUM VALUES OF Uy    ============================

SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=       2

SORT COMPLETED FOR       2 VALUES.

PRINT U    NODAL SOLUTION PER NODE

   NODE       UX           UY           UZ           USUM
  15443  0.10159E-02 0.37043E-01 0.16769E-02 0.37095E-01
  15453  0.27632E-02 0.36957E-01 0.42179E-02 0.37299E-01
```

```
NODE SORT REMOVED

================================================================================
================================  SET 13  ======================================


USE LOAD STEP     13  SUBSTEP      0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=     13  SUBSTEP=      1  CUMULATIVE ITERATION=    135
  TIME/FREQUENCY=  13.000
TITLE= Pad, LTSP(2), 20 Casks, 440 Kips N 45 W (Z,X), Hard Rock

ESEL  FOR LABEL= TYPE  FROM      1 TO      1 BY     1

    9056  ELEMENTS (OF    15348  DEFINED) SELECTED BY  ESEL  COMMAND.

SELECT      ALL NODES HAVING ANY ELEMENT IN ELEMENT SET.

   11550 NODES (OF    17051  DEFINED) SELECTED FROM
    9056 SELECTED ELEMENTS BY NELE COMMAND.

================================================================================
======================    MAXIMUM VALUES OF Uy    ============================

SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=        2

SORT COMPLETED FOR        2 VALUES.

PRINT U    NODAL SOLUTION PER NODE

   NODE       UX           UY           UZ           USUM
  15443  0.11463E-02 0.37647E-01 0.15787E-02 0.37698E-01
  15453  0.34092E-02 0.37559E-01 0.37021E-02 0.37895E-01

NODE SORT REMOVED

================================================================================
================================  SET 14  ======================================


USE LOAD STEP     14  SUBSTEP      0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=     14  SUBSTEP=      1  CUMULATIVE ITERATION=    141
  TIME/FREQUENCY=  14.000
TITLE= Pad, LTSP(2), 20 Casks, 440 Kips N 57.03 W (Z,X), Hard Rock

ESEL  FOR LABEL= TYPE  FROM      1 TO      1 BY     1

    9056  ELEMENTS (OF    15348  DEFINED) SELECTED BY  ESEL  COMMAND.
```

```
SELECT      ALL NODES HAVING ANY ELEMENT IN ELEMENT SET.

   11550 NODES (OF    17051  DEFINED) SELECTED FROM
    9056 SELECTED ELEMENTS BY NELE COMMAND.

===============================================================================
=======================     MAXIMUM VALUES OF Uy    ===========================

SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=        2

SORT COMPLETED FOR        2 VALUES.

PRINT U    NODAL SOLUTION PER NODE

   NODE       UX          UY          UZ          USUM
  15443  0.12607E-02 0.34671E-01 0.14434E-02 0.34724E-01
  15453  0.38624E-02 0.34582E-01 0.30058E-02 0.34927E-01

NODE SORT REMOVED

===============================================================================
=================================  SET 15  ====================================


USE LOAD STEP     15  SUBSTEP     0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=    15  SUBSTEP=     1  CUMULATIVE ITERATION=   153
  TIME/FREQUENCY=  15.000
TITLE= Pad, LTSP(2), 20 Casks, 440 Kips West (X), Hard Rock

ESEL  FOR LABEL= TYPE  FROM      1 TO      1 BY     1

    9056  ELEMENTS (OF    15348  DEFINED) SELECTED BY  ESEL  COMMAND.

SELECT      ALL NODES HAVING ANY ELEMENT IN ELEMENT SET.

   11550 NODES (OF    17051  DEFINED) SELECTED FROM
    9056 SELECTED ELEMENTS BY NELE COMMAND.

===============================================================================
=======================     MAXIMUM VALUES OF Uy    ===========================

SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=        2

SORT COMPLETED FOR        2 VALUES.

PRINT U    NODAL SOLUTION PER NODE

   NODE       UX          UY          UZ          USUM
  13267  0.15349E-01 0.23823E-01-0.41179E-04 0.28339E-01
```

ENERCON SERVICES, INC. Appendix DN-1 to Calculation PGE-009-CALC-003

```
  13266  0.15349E-01 0.23822E-01 0.42947E-04 0.28339E-01

NODE SORT REMOVED

=================================================================================
=================================  SET 16  ======================================


USE LOAD STEP    16  SUBSTEP     0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=    16  SUBSTEP=     1  CUMULATIVE ITERATION=   177
  TIME/FREQUENCY=  16.000
TITLE= Pad, LTSP(2), 20 Casks, 176 Kips North (Z), Max Up, Hard Rock

ESEL  FOR LABEL= TYPE  FROM     1 TO     1 BY    1

    9056  ELEMENTS (OF    15348  DEFINED) SELECTED BY  ESEL  COMMAND.

SELECT      ALL NODES HAVING ANY ELEMENT IN ELEMENT SET.

   11550 NODES (OF    17051  DEFINED) SELECTED FROM
    9056 SELECTED ELEMENTS BY NELE COMMAND.

=================================================================================
=======================    MAXIMUM VALUES OF Uy    ==============================

SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=       2

SORT COMPLETED FOR       2 VALUES.

PRINT U    NODAL SOLUTION PER NODE

   NODE      UX           UY          UZ          USUM
  15443  0.21940E-03 0.10184E-01 0.81156E-03 0.10218E-01
   7439 -0.21941E-03 0.10183E-01 0.81157E-03 0.10218E-01

NODE SORT REMOVED

=================================================================================
=================================  SET 17  ======================================


USE LOAD STEP    17  SUBSTEP     0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=    17  SUBSTEP=     1  CUMULATIVE ITERATION=   202
  TIME/FREQUENCY=  17.000
TITLE= Pad, LTSP(2), 20 Casks, 176 Kips West (X), Max Up, Hard Rock

ESEL  FOR LABEL= TYPE  FROM     1 TO     1 BY    1
```

```
    9056  ELEMENTS (OF    15348  DEFINED) SELECTED BY  ESEL  COMMAND.

SELECT       ALL NODES HAVING ANY ELEMENT IN ELEMENT SET.

   11550 NODES (OF    17051  DEFINED) SELECTED FROM
    9056 SELECTED ELEMENTS BY NELE COMMAND.

================================================================================
=======================    MAXIMUM VALUES OF Uy    ============================


SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=        2

SORT COMPLETED FOR        2 VALUES.

PRINT U    NODAL SOLUTION PER NODE

   NODE       UX           UY           UZ           USUM
  13267  0.66985E-02 0.10288E-01-0.13515E-04 0.12277E-01
  13266  0.66985E-02 0.10288E-01 0.14050E-04 0.12276E-01

NODE SORT REMOVED

================================================================================
=================================  SET 18  ====================================


USE LOAD STEP     18  SUBSTEP      0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=     18  SUBSTEP=      1  CUMULATIVE ITERATION=   227
  TIME/FREQUENCY=  18.000
TITLE= Pad, LTSP(4), 20 Casks, 156 Kips North (Z), Max Up, Hard Rock

ESEL  FOR LABEL= TYPE  FROM      1 TO      1 BY     1

    9056  ELEMENTS (OF    15348  DEFINED) SELECTED BY  ESEL  COMMAND.

SELECT       ALL NODES HAVING ANY ELEMENT IN ELEMENT SET.

   11550 NODES (OF    17051  DEFINED) SELECTED FROM
    9056 SELECTED ELEMENTS BY NELE COMMAND.

================================================================================
=======================    MAXIMUM VALUES OF Uy    ============================


SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=        2

SORT COMPLETED FOR        2 VALUES.

PRINT U    NODAL SOLUTION PER NODE
```

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```
   NODE       UX            UY            UZ            USUM
  15443   0.20127E-03 0.11268E-01 0.75320E-03 0.11295E-01
   7439  -0.20131E-03 0.11261E-01 0.75325E-03 0.11288E-01

NODE SORT REMOVED

================================================================================
================================  SET 19  =======================================


USE LOAD STEP     19  SUBSTEP     0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=     19  SUBSTEP=      1  CUMULATIVE ITERATION=    252
  TIME/FREQUENCY=  19.000
TITLE= Pad, LTSP(4), 20 Casks, 156 Kips West (X), Max Up, Hard Rock

ESEL  FOR LABEL= TYPE  FROM      1 TO      1 BY     1

    9056  ELEMENTS (OF    15348  DEFINED) SELECTED BY  ESEL  COMMAND.

SELECT      ALL NODES HAVING ANY ELEMENT IN ELEMENT SET.

   11550 NODES (OF    17051  DEFINED) SELECTED FROM
    9056 SELECTED ELEMENTS BY NELE COMMAND.

================================================================================
======================    MAXIMUM VALUES OF Uy    ==============================

SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=        2

SORT COMPLETED FOR        2 VALUES.

PRINT U    NODAL SOLUTION PER NODE

   NODE       UX            UY            UZ            USUM
  13267   0.72037E-02 0.14238E-01-0.23322E-04 0.15956E-01
  13266   0.72037E-02 0.14237E-01 0.24307E-04 0.15956E-01

NODE SORT REMOVED

================================================================================


EXIT THE ANSYS POST1 DATABASE PROCESSOR


***** ROUTINE COMPLETED *****  CP =         97.380


*** NOTE ***                              CP=      97.380   TIME= 16:51:51
```

```
A total of 1 warnings and errors written to dcslabs2.err.
```

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SERVICES, INC. Appendix DN-1 to Calculation PGE-009-CALC-003

Below is the ANSYS input file that scans the database for the maximum pad displacements. Element type 1 is the pad. This file processes that data for the very hard rock analysis.

```
/COM
/OUTPUT,padvharddisp.out
/com
/COM      DISPLACEMENT DATA SORTED AND PRINTED BY LOAD STEP
/COM
/COM
/COM
/COM      THIS ROUTINE SORTS AND PRINTS DISPLACEMENT DATA BY LOAD STEP
/COM      FOR VERY HARD ROCK MODELS
/COM
/COM
/FILE,DCSLABH6
RESUME
/header,on,off,off,off,on,off
/POST1
/COM
/COM
EALL
NALL
/COM
/COM ===============================================================================
/COM ================================  SET 1  ====================================
/COM
SET,1
ESEL,TYPE,1
NELEM
/COM
/COM ===============================================================================
/COM ======================    MAXIMUM VALUES OF Uy    ============================
/COM
NSORT,U,Y,0,0,2,SEL
PRNSOL,U
NUSORT
/COM
/COM ===============================================================================
/COM ================================  SET 2  ====================================
/COM
SET,2
ESEL,TYPE,1
NELEM
/COM
/COM ===============================================================================
/COM ======================    MAXIMUM VALUES OF Uy    ============================
/COM
NSORT,U,Y,0,0,2,SEL
PRNSOL,U
NUSORT
/COM
/COM ===============================================================================
/COM ================================  SET 3  ====================================
```

```
/COM
SET,3
ESEL,TYPE,1
NELEM
/COM
/COM ===============================================================================
/COM =======================    MAXIMUM VALUES OF Uy    ============================
/COM
NSORT,U,Y,0,0,2,SEL
PRNSOL,U
NUSORT
/COM
/COM ===============================================================================
/COM =================================  SET 4  =====================================
/COM
SET,4
ESEL,TYPE,1
NELEM
/COM
/COM ===============================================================================
/COM =======================    MAXIMUM VALUES OF Uy    ============================
/COM
NSORT,U,Y,0,0,2,SEL
PRNSOL,U
NUSORT
/COM
/COM ===============================================================================
/COM =================================  SET 5  =====================================
/COM
SET,5
ESEL,TYPE,1
NELEM
/COM
/COM ===============================================================================
/COM =======================    MAXIMUM VALUES OF Uy    ============================
/COM
NSORT,U,Y,0,0,2,SEL
PRNSOL,U
NUSORT
/COM
/COM ===============================================================================
/COM =================================  SET 6  =====================================
/COM
SET,6
ESEL,TYPE,1
NELEM
/COM
/COM ===============================================================================
/COM =======================    MAXIMUM VALUES OF Uy    ============================
/COM
NSORT,U,Y,0,0,2,SEL
PRNSOL,U
NUSORT
```

```
/COM
/COM ================================================================================
/COM =================================  SET 7  =====================================
/COM
SET,7
ESEL,TYPE,1
NELEM
/COM
/COM ================================================================================
/COM =======================    MAXIMUM VALUES OF Uy    ============================
/COM
NSORT,U,Y,0,0,2,SEL
PRNSOL,U
NUSORT
/COM
/COM ================================================================================
/COM =================================  SET 8  =====================================
/COM
SET,8
ESEL,TYPE,1
NELEM
/COM
/COM ================================================================================
/COM =======================    MAXIMUM VALUES OF Uy    ============================
/COM
NSORT,U,Y,0,0,2,SEL
PRNSOL,U
NUSORT
/COM
/COM ================================================================================
/COM =================================  SET 9  =====================================
/COM
SET,9
ESEL,TYPE,1
NELEM
/COM
/COM ================================================================================
/COM =======================    MAXIMUM VALUES OF Uy    ============================
/COM
NSORT,U,Y,0,0,2,SEL
PRNSOL,U
NUSORT
/COM
/COM ================================================================================
/COM =================================  SET 10  ====================================
/COM
SET,10
ESEL,TYPE,1
NELEM
/COM
/COM ================================================================================
/COM =======================    MAXIMUM VALUES OF Uy    ============================
/COM
```

```
NSORT,U,Y,0,0,2,SEL
PRNSOL,U
NUSORT
/COM
/COM ==============================================================================
/COM =================================  SET 11  ====================================
/COM
SET,11
ESEL,TYPE,1
NELEM
/COM
/COM ==============================================================================
/COM =======================    MAXIMUM VALUES OF Uy    ============================
/COM
NSORT,U,Y,0,0,2,SEL
PRNSOL,U
NUSORT
/COM
/COM ==============================================================================
/COM =================================  SET 12  ====================================
/COM
SET,12
ESEL,TYPE,1
NELEM
/COM
/COM ==============================================================================
/COM =======================    MAXIMUM VALUES OF Uy    ============================
/COM
NSORT,U,Y,0,0,2,SEL
PRNSOL,U
NUSORT
/COM
/COM ==============================================================================
/COM =================================  SET 13  ====================================
/COM
SET,13
ESEL,TYPE,1
NELEM
/COM
/COM ==============================================================================
/COM =======================    MAXIMUM VALUES OF Uy    ============================
/COM
NSORT,U,Y,0,0,2,SEL
PRNSOL,U
NUSORT
/COM
/COM ==============================================================================
/COM =================================  SET 14  ====================================
/COM
SET,14
ESEL,TYPE,1
NELEM
/COM
```

```
/COM ===============================================================================
/COM =======================     MAXIMUM VALUES OF Uy     ============================
/COM
NSORT,U,Y,0,0,2,SEL
PRNSOL,U
NUSORT
/COM
/COM ===============================================================================
/COM =================================  SET 15  ====================================
/COM
SET,15
ESEL,TYPE,1
NELEM
/COM
/COM ===============================================================================
/COM =======================     MAXIMUM VALUES OF Uy     ============================
/COM
NSORT,U,Y,0,0,2,SEL
PRNSOL,U
NUSORT
/COM
/COM ===============================================================================
/COM =================================  SET 16  ====================================
/COM
SET,16
ESEL,TYPE,1
NELEM
/COM
/COM ===============================================================================
/COM =======================     MAXIMUM VALUES OF Uy     ============================
/COM
NSORT,U,Y,0,0,2,SEL
PRNSOL,U
NUSORT
/COM
/COM ===============================================================================
/COM =================================  SET 17  ====================================
/COM
SET,17
ESEL,TYPE,1
NELEM
/COM
/COM ===============================================================================
/COM =======================     MAXIMUM VALUES OF Uy     ============================
/COM
NSORT,U,Y,0,0,2,SEL
PRNSOL,U
NUSORT
/COM
/COM ===============================================================================
/COM =================================  SET 18  ====================================
/COM
SET,18
```

```
ESEL,TYPE,1
NELEM
/COM
/COM ==============================================================================
/COM =======================     MAXIMUM VALUES OF Uy     ============================
/COM
NSORT,U,Y,0,0,2,SEL
PRNSOL,U
NUSORT
/COM
/COM ==============================================================================
/COM =================================  SET 19  ====================================
/COM
SET,19
ESEL,TYPE,1
NELEM
/COM
/COM ==============================================================================
/COM =======================     MAXIMUM VALUES OF Uy     ============================
/COM
NSORT,U,Y,0,0,2,SEL
PRNSOL,U
NUSORT
/COM
/COM ==============================================================================
/COM
/COM
FINISH
/OUTPUT
/EXIT
```

Below is the ANSYS output file for the maximum pad displacements for the very hard rock analyses:

```
    DISPLACEMENT DATA SORTED AND PRINTED BY LOAD STEP


    THIS ROUTINE SORTS AND PRINTS DISPLACEMENT DATA BY LOAD STEP
    FOR VERY HARD ROCK MODELS


CURRENT JOBNAME REDEFINED AS DCSLABH6

RESUME ANSYS DATA FROM FILE NAME=DCSLABH6.db

*** ANSYS GLOBAL STATUS ***

TITLE = Pad, LTSP(4), 20 Casks, 156 Kips West (X), Max Up, Very Hard Rock
ANALYSIS TYPE =  STATIC (STEADY-STATE)
NUMBER OF ELEMENT TYPES =      6
   1728 ELEMENTS CURRENTLY SELECTED.  MAX ELEMENT NUMBER =    33177
    731 NODES CURRENTLY SELECTED.     MAX NODE NUMBER =       17051
    259 KEYPOINTS CURRENTLY SELECTED. MAX KEYPOINT NUMBER =     259
    250 LINES CURRENTLY SELECTED.     MAX LINE NUMBER =         396
    181 AREAS CURRENTLY SELECTED.     MAX AREA NUMBER =         295
     70 VOLUMES CURRENTLY SELECTED.   MAX VOL. NUMBER =          70
     11 COMPONENTS CURRENTLY DEFINED
MAXIMUM LINEAR PROPERTY NUMBER        =       5
MAXIMUM REAL CONSTANT SET NUMBER      =       6
ACTIVE COORDINATE SYSTEM              =       0  (CARTESIAN)
MAXIMUM CONSTRAINT EQUATION NUMBER    =    4620
NUMBER OF SPECIFIED CONSTRAINTS       =    2193
NUMBER OF NODAL LOADS                 =    2160

INITIAL JOBNAME = dcslabh6
CURRENT JOBNAME = DCSLABH6


PRINT HEADER
DO NOT PRINT SUBTITLE(S)
DO NOT PRINT LOAD STEP ID
DO NOT PRINT NOTE LINE(S)
PRINT COLUMN HEADER LABELS
DO NOT PRINT REPORT TOTALS

***** ANSYS - ENGINEERING ANALYSIS SYSTEM  RELEASE 5.7     *****
ANSYS/Structural U
00150104          VERSION=INTEL NT      10:27:53  MAY 21, 2001 CP=      4.146

Pad, LTSP(4), 20 Casks, 156 Kips West (X), Max Up, Very Hard Rock
```

```
        ***** ANSYS RESULTS INTERPRETATION (POST1) *****

ENTER  /SHOW,DEVICE-NAME  TO ENABLE GRAPHIC DISPLAY
ENTER  FINISH             TO LEAVE POST1

*** NOTE ***                              CP=       4.146   TIME= 10:27:53
Reading results into the database (SET command) will update the current
 displacement and force boundary conditions in the database with the
 values from the results file for that load set.  Note that any
 subsequent solutions will use these values unless action is taken to
 either SAVE the current values or not overwrite them (/EXIT,NOSAVE).


   15348  ELEMENTS (OF    15348  DEFINED) SELECTED BY  EALL  COMMAND.

   17051  NODES (OF    17051  DEFINED) SELECTED BY NALL  COMMAND.

===============================================================================
================================  SET 1  ======================================


USE LOAD STEP     1  SUBSTEP     0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=     1  SUBSTEP=     1  CUMULATIVE ITERATION=     2
  TIME/FREQUENCY=  1.0000
TITLE= Pad, Gravity, 20 Casks, Very Hard Rock

ESEL  FOR LABEL= TYPE  FROM     1 TO     1 BY    1

    9056  ELEMENTS (OF    15348  DEFINED) SELECTED BY  ESEL  COMMAND.

SELECT      ALL NODES HAVING ANY ELEMENT IN ELEMENT SET.

   11550 NODES (OF    17051  DEFINED) SELECTED FROM
    9056 SELECTED ELEMENTS BY NELE COMMAND.

===============================================================================
======================    MAXIMUM VALUES OF Uy    ============================


SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=       2

SORT COMPLETED FOR       2 VALUES.

PRINT U    NODAL SOLUTION PER NODE

   NODE       UX           UY           UZ           USUM
  15443  0.11611E-03-0.50355E-03 0.15408E-03 0.53925E-03
   7439 -0.11611E-03-0.50355E-03 0.15408E-03 0.53925E-03

NODE SORT REMOVED
```

```
=============================================================================
================================  SET 2  ====================================


USE LOAD STEP     2  SUBSTEP     0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=     2  SUBSTEP=     1  CUMULATIVE ITERATION=    17
  TIME/FREQUENCY=  2.0000
TITLE= Pad, HE(1), 20 Casks, 515 Kips North (Z), Very Hard Rock

ESEL  FOR LABEL= TYPE  FROM     1 TO     1 BY    1

    9056  ELEMENTS (OF    15348  DEFINED) SELECTED BY  ESEL  COMMAND.

SELECT      ALL NODES HAVING ANY ELEMENT IN ELEMENT SET.

   11550 NODES (OF    17051  DEFINED) SELECTED FROM
    9056 SELECTED ELEMENTS BY NELE COMMAND.

=============================================================================
======================    MAXIMUM VALUES OF Uy    ===========================


SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=       2

SORT COMPLETED FOR       2 VALUES.

PRINT U    NODAL SOLUTION PER NODE

   NODE       UX           UY           UZ           USUM
  15443  0.18716E-03 0.19824E-01 0.75537E-03 0.19840E-01
   7439 -0.18716E-03 0.19824E-01 0.75537E-03 0.19840E-01

NODE SORT REMOVED

=============================================================================
================================  SET 3  ====================================


USE LOAD STEP     3  SUBSTEP     0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=     3  SUBSTEP=     1  CUMULATIVE ITERATION=    32
  TIME/FREQUENCY=  3.0000
TITLE= Pad, HE(1), 20 Casks, 515 Kips N 32.93 W (Z,X), Very Hard Rock

ESEL  FOR LABEL= TYPE  FROM     1 TO     1 BY    1

    9056  ELEMENTS (OF    15348  DEFINED) SELECTED BY  ESEL  COMMAND.

SELECT      ALL NODES HAVING ANY ELEMENT IN ELEMENT SET.
```

```
   11550 NODES (OF    17051  DEFINED) SELECTED FROM
    9056 SELECTED ELEMENTS BY NELE COMMAND.

================================================================================
=======================    MAXIMUM VALUES OF Uy    ============================

SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=        2

SORT COMPLETED FOR       2 VALUES.

PRINT U    NODAL SOLUTION PER NODE

   NODE       UX          UY          UZ          USUM
  15443  0.39024E-03 0.34871E-01 0.68632E-03 0.34880E-01
  15453  0.18734E-02 0.34831E-01 0.25981E-02 0.34978E-01

NODE SORT REMOVED

================================================================================
=================================  SET 4  ======================================


USE LOAD STEP     4  SUBSTEP     0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=     4  SUBSTEP=     1  CUMULATIVE ITERATION=    39
  TIME/FREQUENCY=  4.0000
TITLE= Pad, HE(1), 20 Casks, 515 Kips N 45 W (Z,X), Very Hard Rock

ESEL  FOR LABEL= TYPE  FROM      1 TO      1 BY     1

    9056  ELEMENTS (OF    15348  DEFINED) SELECTED BY  ESEL  COMMAND.

SELECT      ALL NODES HAVING ANY ELEMENT IN ELEMENT SET.

   11550 NODES (OF    17051  DEFINED) SELECTED FROM
    9056 SELECTED ELEMENTS BY NELE COMMAND.

================================================================================
=======================    MAXIMUM VALUES OF Uy    ============================

SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=        2

SORT COMPLETED FOR       2 VALUES.

PRINT U    NODAL SOLUTION PER NODE

   NODE       UX          UY          UZ          USUM
  15443  0.44144E-03 0.35672E-01 0.64613E-03 0.35680E-01
  15453  0.23948E-02 0.35631E-01 0.21788E-02 0.35778E-01
```

```
NODE SORT REMOVED

===============================================================================
================================  SET 5  ======================================


USE LOAD STEP     5  SUBSTEP     0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=     5  SUBSTEP=     1  CUMULATIVE ITERATION=    46
  TIME/FREQUENCY=  5.0000
TITLE= Pad, HE(1), 20 Casks, 515 Kips N 57.07 W (Z,X), Very Hard Rock

ESEL  FOR LABEL= TYPE  FROM     1 TO     1 BY    1

    9056  ELEMENTS (OF    15348  DEFINED) SELECTED BY  ESEL  COMMAND.

SELECT      ALL NODES HAVING ANY ELEMENT IN ELEMENT SET.

   11550 NODES (OF    17051  DEFINED) SELECTED FROM
    9056 SELECTED ELEMENTS BY NELE COMMAND.

===============================================================================
======================    MAXIMUM VALUES OF Uy    ============================

SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=       2

SORT COMPLETED FOR       2 VALUES.

PRINT U    NODAL SOLUTION PER NODE

   NODE       UX          UY          UZ          USUM
  15443  0.49041E-03 0.33141E-01 0.59545E-03 0.33150E-01
  15453  0.27571E-02 0.33100E-01 0.16193E-02 0.33254E-01

NODE SORT REMOVED

===============================================================================
================================  SET 6  ======================================


USE LOAD STEP     6  SUBSTEP     0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=     6  SUBSTEP=     1  CUMULATIVE ITERATION=    58
  TIME/FREQUENCY=  6.0000
TITLE= Pad, HE(1), 20 Casks, 515 Kips West (W), Very Hard Rock

ESEL  FOR LABEL= TYPE  FROM     1 TO     1 BY    1

    9056  ELEMENTS (OF    15348  DEFINED) SELECTED BY  ESEL  COMMAND.
```

```
SELECT      ALL NODES HAVING ANY ELEMENT IN ELEMENT SET.

   11550 NODES (OF    17051  DEFINED) SELECTED FROM
    9056 SELECTED ELEMENTS BY NELE COMMAND.

===============================================================================
======================    MAXIMUM VALUES OF Uy    ============================

SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=       2

SORT COMPLETED FOR       2 VALUES.

PRINT U    NODAL SOLUTION PER NODE

   NODE      UX           UY           UZ           USUM
  13267   0.13253E-01 0.27089E-01-0.10759E-03 0.30158E-01
  13266   0.13253E-01 0.27089E-01 0.10849E-03 0.30157E-01

NODE SORT REMOVED

===============================================================================
=================================  SET 7  =====================================


USE LOAD STEP     7  SUBSTEP     0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=     7  SUBSTEP=     1  CUMULATIVE ITERATION=    80
  TIME/FREQUENCY=  7.0000
TITLE= Pad, HE(1), 20 Casks, 206 Kips North (z), Max Up, Very Hard Rock

ESEL  FOR LABEL= TYPE  FROM     1 TO     1 BY     1

    9056  ELEMENTS (OF    15348  DEFINED) SELECTED BY  ESEL  COMMAND.

SELECT      ALL NODES HAVING ANY ELEMENT IN ELEMENT SET.

   11550 NODES (OF    17051  DEFINED) SELECTED FROM
    9056 SELECTED ELEMENTS BY NELE COMMAND.

===============================================================================
======================    MAXIMUM VALUES OF Uy    ============================

SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=       2

SORT COMPLETED FOR       2 VALUES.

PRINT U    NODAL SOLUTION PER NODE

   NODE      UX           UY           UZ           USUM
```

```
  15443  0.10318E-03 0.31833E-02 0.40690E-03 0.32109E-02
   7439 -0.10320E-03 0.31806E-02 0.40691E-03 0.32082E-02

NODE SORT REMOVED

================================================================================
=================================  SET 8  ======================================


USE LOAD STEP     8  SUBSTEP     0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=     8  SUBSTEP=     1  CUMULATIVE ITERATION=    99
  TIME/FREQUENCY=  8.0000
TITLE= Pad, HE(1), 20 Casks, 206 Kips West (X), Max Up, Very Hard Rock

ESEL  FOR LABEL= TYPE  FROM     1 TO     1 BY    1

    9056  ELEMENTS (OF    15348  DEFINED) SELECTED BY  ESEL  COMMAND.

SELECT      ALL NODES HAVING ANY ELEMENT IN ELEMENT SET.

   11550 NODES (OF    17051  DEFINED) SELECTED FROM
    9056 SELECTED ELEMENTS BY NELE COMMAND.

================================================================================
=======================    MAXIMUM VALUES OF Uy    ============================


SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=       2

SORT COMPLETED FOR       2 VALUES.

PRINT U    NODAL SOLUTION PER NODE

   NODE       UX          UY          UZ          USUM
  13267  0.41494E-02 0.55875E-02-0.29945E-04 0.69598E-02
  13266  0.41494E-02 0.55875E-02 0.29960E-04 0.69598E-02

NODE SORT REMOVED

================================================================================
=================================  SET 9  ======================================


USE LOAD STEP     9  SUBSTEP     0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=     9  SUBSTEP=     1  CUMULATIVE ITERATION=   103
  TIME/FREQUENCY=  9.0000
TITLE= Pad, HE(3), 20 Casks, 171.2 Kips North (Z), Max Dn, Very Hard Rock

ESEL  FOR LABEL= TYPE  FROM     1 TO     1 BY    1
```

```
    9056  ELEMENTS (OF    15348  DEFINED) SELECTED BY  ESEL  COMMAND.

SELECT       ALL NODES HAVING ANY ELEMENT IN ELEMENT SET.

   11550 NODES (OF    17051  DEFINED) SELECTED FROM
    9056 SELECTED ELEMENTS BY NELE COMMAND.

================================================================================
======================    MAXIMUM VALUES OF Uy     ============================


SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=       2

SORT COMPLETED FOR       2 VALUES.

PRINT U    NODAL SOLUTION PER NODE

   NODE       UX          UY          UZ          USUM
   7449 -0.35038E-03-0.64491E-03 0.93325E-03 0.11873E-02
  15453  0.35038E-03-0.64492E-03 0.93325E-03 0.11873E-02

NODE SORT REMOVED

================================================================================
================================  SET 10  ======================================


USE LOAD STEP    10  SUBSTEP     0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=    10  SUBSTEP=     1  CUMULATIVE ITERATION=   106
  TIME/FREQUENCY=  10.000
TITLE= Pad, HE(3), 20 Casks, 171.2 Kips West (X), Max Dn, Very Hard Rock

ESEL  FOR LABEL= TYPE  FROM      1 TO      1 BY     1

    9056  ELEMENTS (OF    15348  DEFINED) SELECTED BY  ESEL  COMMAND.

SELECT       ALL NODES HAVING ANY ELEMENT IN ELEMENT SET.

   11550 NODES (OF    17051  DEFINED) SELECTED FROM
    9056 SELECTED ELEMENTS BY NELE COMMAND.

================================================================================
======================    MAXIMUM VALUES OF Uy     ============================


SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=       2

SORT COMPLETED FOR       2 VALUES.

PRINT U    NODAL SOLUTION PER NODE
```

```
   NODE       UX           UY           UZ           USUM
  15453  0.75154E-03-0.67112E-03 0.51199E-03 0.11302E-02
  15373  0.75131E-03-0.67317E-03-0.51179E-03 0.11312E-02

NODE SORT REMOVED

===============================================================================
=================================  SET 11  ====================================


USE LOAD STEP    11  SUBSTEP     0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=    11  SUBSTEP=     1  CUMULATIVE ITERATION=   122
  TIME/FREQUENCY=  11.000
TITLE= Pad, LTSP(2), 20 Casks, 440 Kips North (Z), Very Hard Rock

ESEL  FOR LABEL= TYPE  FROM     1 TO     1 BY    1

    9056  ELEMENTS (OF    15348  DEFINED) SELECTED BY  ESEL  COMMAND.

SELECT      ALL NODES HAVING ANY ELEMENT IN ELEMENT SET.

   11550 NODES (OF    17051  DEFINED) SELECTED FROM
    9056 SELECTED ELEMENTS BY NELE COMMAND.

===============================================================================
=======================    MAXIMUM VALUES OF Uy    ============================


SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=       2

SORT COMPLETED FOR       2 VALUES.

PRINT U    NODAL SOLUTION PER NODE

   NODE       UX           UY           UZ           USUM
  15443  0.18080E-03 0.16632E-01 0.73672E-03 0.16650E-01
   7439 -0.18080E-03 0.16632E-01 0.73672E-03 0.16650E-01

NODE SORT REMOVED

===============================================================================
=================================  SET 12  ====================================


USE LOAD STEP    12  SUBSTEP     0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=    12  SUBSTEP=     1  CUMULATIVE ITERATION=   136
  TIME/FREQUENCY=  12.000
TITLE= Pad, LTSP(2), 20 Casks, 440 Kips N 32.93 W (Z,X), Very Hard Rock
```

```
ESEL  FOR LABEL= TYPE  FROM     1 TO     1 BY    1

   9056  ELEMENTS (OF   15348  DEFINED) SELECTED BY  ESEL  COMMAND.

SELECT      ALL NODES HAVING ANY ELEMENT IN ELEMENT SET.

  11550 NODES (OF   17051  DEFINED) SELECTED FROM
   9056 SELECTED ELEMENTS BY NELE COMMAND.

===============================================================================
=======================    MAXIMUM VALUES OF Uy    ============================


SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=        2

SORT COMPLETED FOR        2 VALUES.

PRINT U    NODAL SOLUTION PER NODE

   NODE       UX          UY          UZ          USUM
  15443  0.40006E-03 0.28221E-01 0.66923E-03 0.28231E-01
  15453  0.16565E-02 0.28180E-01 0.23568E-02 0.28327E-01

NODE SORT REMOVED

===============================================================================
=================================  SET 13  ====================================


USE LOAD STEP     13  SUBSTEP     0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=     13  SUBSTEP=      1  CUMULATIVE ITERATION=   142
  TIME/FREQUENCY=  13.000
TITLE= Pad, LTSP(2), 20 Casks, 440 Kips N 45 W (Z,X), Very Hard Rock

ESEL  FOR LABEL= TYPE  FROM     1 TO     1 BY    1

   9056  ELEMENTS (OF   15348  DEFINED) SELECTED BY  ESEL  COMMAND.

SELECT      ALL NODES HAVING ANY ELEMENT IN ELEMENT SET.

  11550 NODES (OF   17051  DEFINED) SELECTED FROM
   9056 SELECTED ELEMENTS BY NELE COMMAND.

===============================================================================
=======================    MAXIMUM VALUES OF Uy    ============================


SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=        2

SORT COMPLETED FOR        2 VALUES.
```

```
PRINT U    NODAL SOLUTION PER NODE

   NODE       UX           UY           UZ           USUM
  15443   0.45615E-03 0.28732E-01 0.62523E-03 0.28742E-01
  15453   0.21069E-02 0.28691E-01 0.19908E-02 0.28837E-01

NODE SORT REMOVED

===============================================================================
================================  SET 14  ====================================


USE LOAD STEP     14   SUBSTEP      0   FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=     14   SUBSTEP=      1   CUMULATIVE ITERATION=   149
  TIME/FREQUENCY=  14.000
TITLE= Pad, LTSP(2), 20 Casks, 440 Kips N 57.03 W (Z,X), Very Hard Rock

ESEL  FOR LABEL= TYPE  FROM      1 TO      1 BY     1

    9056  ELEMENTS (OF    15348  DEFINED) SELECTED BY  ESEL  COMMAND.

SELECT      ALL NODES HAVING ANY ELEMENT IN ELEMENT SET.

   11550 NODES (OF    17051  DEFINED) SELECTED FROM
    9056 SELECTED ELEMENTS BY NELE COMMAND.

===============================================================================
======================      MAXIMUM VALUES OF Uy      ============================


SORT ON ITEM=U      COMPONENT=Y      ORDER= 0  KABS= 0  NMAX=        2

SORT COMPLETED FOR        2 VALUES.

PRINT U    NODAL SOLUTION PER NODE

   NODE       UX           UY           UZ           USUM
  15443   0.50798E-03 0.26450E-01 0.56891E-03 0.26461E-01
  15453   0.24136E-02 0.26409E-01 0.15048E-02 0.26561E-01

NODE SORT REMOVED

===============================================================================
================================  SET 15  ====================================


USE LOAD STEP     15   SUBSTEP      0   FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=     15   SUBSTEP=      1   CUMULATIVE ITERATION=   161
```

```
  TIME/FREQUENCY=  15.000
TITLE= Pad, LTSP(2), 20 Casks, 440 Kips West (X), Very Hard Rock

ESEL  FOR LABEL= TYPE  FROM      1 TO      1 BY     1

    9056  ELEMENTS (OF    15348  DEFINED) SELECTED BY  ESEL  COMMAND.

SELECT      ALL NODES HAVING ANY ELEMENT IN ELEMENT SET.

   11550 NODES (OF    17051  DEFINED) SELECTED FROM
    9056 SELECTED ELEMENTS BY NELE COMMAND.

===============================================================================
=======================    MAXIMUM VALUES OF Uy    ============================

SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=       2

SORT COMPLETED FOR       2 VALUES.

PRINT U    NODAL SOLUTION PER NODE

   NODE       UX           UY           UZ          USUM
  13267   0.11119E-01 0.20649E-01-0.80301E-04 0.23453E-01
  13266   0.11119E-01 0.20649E-01 0.81810E-04 0.23452E-01

NODE SORT REMOVED

===============================================================================
=================================  SET 16  ====================================


USE LOAD STEP    16  SUBSTEP     0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=    16  SUBSTEP=     1  CUMULATIVE ITERATION=   186
  TIME/FREQUENCY=  16.000
TITLE= Pad, LTSP(2), 20 Casks, 176 Kips North (Z), Max Up, Very Hard Rock

ESEL  FOR LABEL= TYPE  FROM      1 TO      1 BY     1

    9056  ELEMENTS (OF    15348  DEFINED) SELECTED BY  ESEL  COMMAND.

SELECT      ALL NODES HAVING ANY ELEMENT IN ELEMENT SET.

   11550 NODES (OF    17051  DEFINED) SELECTED FROM
    9056 SELECTED ELEMENTS BY NELE COMMAND.

===============================================================================
=======================    MAXIMUM VALUES OF Uy    ============================

SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=       2
```

```
SORT COMPLETED FOR       2 VALUES.

PRINT U    NODAL SOLUTION PER NODE

   NODE       UX           UY           UZ          USUM
  15443  0.80410E-04 0.75494E-02 0.33461E-03 0.75572E-02
   7439 -0.80410E-04 0.75494E-02 0.33461E-03 0.75572E-02

NODE SORT REMOVED

===============================================================================
================================  SET 17  ======================================


USE LOAD STEP    17  SUBSTEP     0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=    17  SUBSTEP=     3  CUMULATIVE ITERATION=   257
  TIME/FREQUENCY=  17.000
TITLE= Pad, LTSP(2), 20 Casks, 176 Kips West (X), Max Up, Very Hard Rock

ESEL  FOR LABEL= TYPE  FROM     1 TO     1 BY    1

    9056  ELEMENTS (OF    15348  DEFINED) SELECTED BY  ESEL  COMMAND.

SELECT      ALL NODES HAVING ANY ELEMENT IN ELEMENT SET.

   11550 NODES (OF    17051  DEFINED) SELECTED FROM
    9056 SELECTED ELEMENTS BY NELE COMMAND.

===============================================================================
======================   MAXIMUM VALUES OF Uy    ===========================

SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=       2

SORT COMPLETED FOR       2 VALUES.

PRINT U    NODAL SOLUTION PER NODE

   NODE       UX           UY           UZ          USUM
  13267  0.48046E-02 0.88795E-02-0.30918E-04 0.10096E-01
  13266  0.48046E-02 0.88794E-02 0.31071E-04 0.10096E-01

NODE SORT REMOVED

===============================================================================
================================  SET 18  ======================================


USE LOAD STEP    18  SUBSTEP     0  FOR LOAD CASE 0
```

```
SET COMMAND GOT LOAD STEP=    18  SUBSTEP=     3  CUMULATIVE ITERATION=   338
  TIME/FREQUENCY=  18.000
TITLE= Pad, LTSP(4), 20 Casks, 156 Kips North (Z), Max Up, Very Hard Rock

ESEL  FOR LABEL= TYPE  FROM      1 TO      1 BY     1

    9056  ELEMENTS (OF    15348  DEFINED) SELECTED BY  ESEL  COMMAND.

SELECT      ALL NODES HAVING ANY ELEMENT IN ELEMENT SET.

   11550 NODES (OF    17051  DEFINED) SELECTED FROM
    9056 SELECTED ELEMENTS BY NELE COMMAND.

===============================================================================
=======================    MAXIMUM VALUES OF Uy    ============================

SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=        2

SORT COMPLETED FOR        2 VALUES.

PRINT U    NODAL SOLUTION PER NODE

   NODE       UX           UY           UZ           USUM
  15443  0.70791E-04 0.85939E-02 0.30561E-03 0.85996E-02
   7439 -0.70794E-04 0.85932E-02 0.30561E-03 0.85989E-02

NODE SORT REMOVED

===============================================================================
=================================  SET 19  ====================================


USE LOAD STEP     19  SUBSTEP     0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=    19  SUBSTEP=     3  CUMULATIVE ITERATION=   412
  TIME/FREQUENCY=  19.000
TITLE= Pad, LTSP(4), 20 Casks, 156 Kips West (X), Max Up, Very Hard Rock

ESEL  FOR LABEL= TYPE  FROM      1 TO      1 BY     1

    9056  ELEMENTS (OF    15348  DEFINED) SELECTED BY  ESEL  COMMAND.

SELECT      ALL NODES HAVING ANY ELEMENT IN ELEMENT SET.

   11550 NODES (OF    17051  DEFINED) SELECTED FROM
    9056 SELECTED ELEMENTS BY NELE COMMAND.

===============================================================================
=======================    MAXIMUM VALUES OF Uy    ============================
```

```
SORT ON ITEM=U      COMPONENT=Y      ORDER= 0  KABS= 0  NMAX=        2

SORT COMPLETED FOR        2 VALUES.

PRINT U    NODAL SOLUTION PER NODE

   NODE       UX          UY          UZ          USUM
  13267  0.53249E-02 0.12126E-01-0.38744E-04 0.13244E-01
  13266  0.53249E-02 0.12126E-01 0.38799E-04 0.13244E-01

NODE SORT REMOVED

===============================================================================


EXIT THE ANSYS POST1 DATABASE PROCESSOR


***** ROUTINE COMPLETED *****  CP =        50.813


*** NOTE ***                                    CP=      50.813   TIME= 10:29:04
A total of 1 warnings and errors written to dcslabh6.err.
```

ENERCON
SERVICES, INC. Appendix DN-2 to Calculation PGE-009-CALC-003

Originator: S. C. Tumminelli
Date: May 25, 2001
Reissued: November 30, 2001

Appendix DN-2

Maximum Cask Displacements

This Appendix presents the maximum cask displacements for all 19 load cases analyzed for the soft rock, hard rock and very hard models. The first input file creates two output files, one for the soft and one for the hard rock models. This is followed by the input and output files for the very hard rock analyses.

Appendix Contents

Below is the ANSYS input file that scans the database for the maximum cask displacements for the soft and hard rock models. Two output files are created in one execution.

```
/output, padsoftcaskd.out
/com
/file,dcslabs2
resume
/header,on,off,off,off,on,off
/post1
eall
nall
/com,
/com, This routine selects the nodes at the centerlines of the perimeter casks
/com,   and prints out the displacements for these nodes for all 19 load steps.
/com,
/COM =================================================================================
/COM =================================================================================
/COM
/COM ========================  SELECT NODES AT THE CL OF THE CASKS ==================
/COM
nsel,node,159
nasel,node,3022
nasel,node,3735
nasel,node,4467
nasel,node,5178
nasel,node,5890
nasel,node,6602
nasel,node,8183
nasel,node,11046
nasel,node,11759
nasel,node,12491
nasel,node,13202
nasel,node,13914
nasel,node,14626
/COM =================================================================================
/COM =================================================================================
/COM ===================================  SET 1  ====================================
set,1
nsort,u,y
prdi
/COM =================================================================================
/COM =================================================================================
/COM ===================================  SET 2  ====================================
set,2
nsort,u,y
prdi
/COM =================================================================================
/COM =================================================================================
/COM ===================================  SET 3  ====================================
set,3
nsort,u,y
prdi
/COM =================================================================================
```

ENERCON
SERVICES, INC.

Appendix DN-2 to Calculation PGE-009-CALC-003

```
/COM ==============================================================================
/COM ==================================  SET 4  ===================================
set,4
nsort,u,y
prdi
/COM ==============================================================================
/COM ==============================================================================
/COM ==================================  SET 5  ===================================
set,5
nsort,u,y
prdi
/COM ==============================================================================
/COM ==============================================================================
/COM ==================================  SET 6  ===================================
set,6
nsort,u,y
prdi
/COM ==============================================================================
/COM ==============================================================================
/COM ==================================  SET 7  ===================================
set,7
nsort,u,y
prdi
/COM ==============================================================================
/COM ==============================================================================
/COM ==================================  SET 8  ===================================
set,8
nsort,u,y
prdi
/COM ==============================================================================
/COM ==============================================================================
/COM ==================================  SET 9  ===================================
set,9
nsort,u,y
prdi
/COM ==============================================================================
/COM ==============================================================================
/COM ==================================  SET 10 ===================================
set,10
nsort,u,y
prdi
/COM ==============================================================================
/COM ==============================================================================
/COM ==================================  SET 11 ===================================
set,11
nsort,u,y
prdi
/COM ==============================================================================
/COM ==============================================================================
/COM ==================================  SET 12 ===================================
set,12
nsort,u,y
prdi
```

```
/COM ===============================================================================
/COM ===============================================================================
/COM ===================================  SET 13 ====================================
set,13
nsort,u,y
prdi
/COM ===============================================================================
/COM ===============================================================================
/COM ===================================  SET 14 ====================================
set,14
nsort,u,y
prdi
/COM ===============================================================================
/COM ===============================================================================
/COM ===================================  SET 15 ====================================
set,15
nsort,u,y
prdi
/COM ===============================================================================
/COM ===============================================================================
/COM ===================================  SET 16 ====================================
set,16
nsort,u,y
prdi
/COM ===============================================================================
/COM ===============================================================================
/COM ===================================  SET 17 ====================================
set,17
nsort,u,y
prdi
/COM ===============================================================================
/COM ===============================================================================
/COM ===================================  SET 18 ====================================
set,18
nsort,u,y
prdi
/COM ===============================================================================
/COM ===============================================================================
/COM ===================================  SET 19 ====================================
set,19
nsort,u,y
prdi
/COM ===============================================================================
/COM ===============================================================================
fini
/output,padhardcaskd,out
/file,dcslabh2
resume
/header,on,off,off,off,on,off
/post1
eall
nall
/COM ===============================================================================
```

```
/COM ================================================================================
/COM
/COM ========================  SELECT NODES AT THE CL OF THE CASKS ===================
/COM
nsel,node,159
nasel,node,3022
nasel,node,3735
nasel,node,4467
nasel,node,5178
nasel,node,5890
nasel,node,6602
nasel,node,8183
nasel,node,11046
nasel,node,11759
nasel,node,12491
nasel,node,13202
nasel,node,13914
nasel,node,14626
/COM ================================================================================
/COM ================================================================================
/COM ===================================  SET 1  ====================================
set,1
nsort,u,y
prdi
/COM ================================================================================
/COM ================================================================================
/COM ===================================  SET 2  ====================================
set,2
nsort,u,y
prdi
/COM ================================================================================
/COM ================================================================================
/COM ===================================  SET 3  ====================================
set,3
nsort,u,y
prdi
/COM ================================================================================
/COM ================================================================================
/COM ===================================  SET 4  ====================================
set,4
nsort,u,y
prdi
/COM ================================================================================
/COM ================================================================================
/COM ===================================  SET 5  ====================================
set,5
nsort,u,y
prdi
/COM ================================================================================
/COM ================================================================================
/COM ===================================  SET 6  ====================================
set,6
nsort,u,y
```

ENERCON
SERVICES, INC.


```
prdi
/COM ==================================================================================
/COM ==================================================================================
/COM ====================================  SET 7  =====================================
set,7
nsort,u,y
prdi
/COM ==================================================================================
/COM ==================================================================================
/COM ====================================  SET 8  =====================================
set,8
nsort,u,y
prdi
/COM ==================================================================================
/COM ==================================================================================
/COM ====================================  SET 9  =====================================
set,9
nsort,u,y
prdi
/COM ==================================================================================
/COM ==================================================================================
/COM ====================================  SET 10 =====================================
set,10
nsort,u,y
prdi
/COM ==================================================================================
/COM ==================================================================================
/COM ====================================  SET 11 =====================================
set,11
nsort,u,y
prdi
/COM ==================================================================================
/COM ==================================================================================
/COM ====================================  SET 12 =====================================
set,12
nsort,u,y
prdi
/COM ==================================================================================
/COM ==================================================================================
/COM ====================================  SET 13 =====================================
set,13
nsort,u,y
prdi
/COM ==================================================================================
/COM ==================================================================================
/COM ====================================  SET 14 =====================================
set,14
nsort,u,y
prdi
/COM ==================================================================================
/COM ==================================================================================
/COM ====================================  SET 15 =====================================
set,15
```

```
nsort,u,y
prdi
/COM ================================================================================
/COM ================================================================================
/COM ===================================  SET 16 ====================================
set,16
nsort,u,y
prdi
/COM ================================================================================
/COM ================================================================================
/COM ===================================  SET 17 ====================================
set,17
nsort,u,y
prdi
/COM ================================================================================
/COM ================================================================================
/COM ===================================  SET 18 ====================================
set,18
nsort,u,y
prdi
/COM ================================================================================
/COM ================================================================================
/COM ===================================  SET 19 ====================================
set,19
nsort,u,y
prdi
/COM ================================================================================
/COM ================================================================================
fini
/output
/exit
```

Below is the ANSYS output file for the maximum cask displacements for the soft rock analyses:

```
CURRENT JOBNAME REDEFINED AS dcslabs2

RESUME ANSYS DATA FROM FILE NAME=dcslabs2.db

*** ANSYS GLOBAL STATUS ***

TITLE = Pad, LTSP(4), 20 Casks, 156 Kips West (X), Max Up, Soft Rock
ANALYSIS TYPE =  STATIC (STEADY-STATE)
NUMBER OF ELEMENT TYPES =      6
  15348 ELEMENTS CURRENTLY SELECTED.  MAX ELEMENT NUMBER =    33177
  17051 NODES CURRENTLY SELECTED.     MAX NODE NUMBER =       17051
    259 KEYPOINTS CURRENTLY SELECTED. MAX KEYPOINT NUMBER =     259
    250 LINES CURRENTLY SELECTED.     MAX LINE NUMBER =         396
    181 AREAS CURRENTLY SELECTED.     MAX AREA NUMBER =         295
     70 VOLUMES CURRENTLY SELECTED.   MAX VOL. NUMBER =          70
    11 COMPONENTS CURRENTLY DEFINED
MAXIMUM LINEAR PROPERTY NUMBER        =        5
MAXIMUM REAL CONSTANT SET NUMBER      =        6
ACTIVE COORDINATE SYSTEM              =        0  (CARTESIAN)
MAXIMUM CONSTRAINT EQUATION NUMBER    =     4620
NUMBER OF SPECIFIED CONSTRAINTS       =     2193
NUMBER OF NODAL LOADS                 =     2160

INITIAL JOBNAME = dcslabs2
CURRENT JOBNAME = dcslabs2


PRINT HEADER
DO NOT PRINT SUBTITLE(S)
DO NOT PRINT LOAD STEP ID
DO NOT PRINT NOTE LINE(S)
PRINT COLUMN HEADER LABELS
DO NOT PRINT REPORT TOTALS

***** ANSYS - ENGINEERING ANALYSIS SYSTEM  RELEASE 5.7     *****
ANSYS/Structural U
00150104          VERSION=INTEL NT      17:10:19  MAY 17, 2001 CP=      2.464

Pad, LTSP(4), 20 Casks, 156 Kips West (X), Max Up, Soft Rock


         ***** ANSYS RESULTS INTERPRETATION (POST1) *****

ENTER  /SHOW,DEVICE-NAME  TO ENABLE GRAPHIC DISPLAY
ENTER  FINISH             TO LEAVE POST1

*** NOTE ***                              CP=       2.474   TIME= 17:10:19
Reading results into the database (SET command) will update the current
 displacement and force boundary conditions in the database with the
 values from the results file for that load set.  Note that any
 subsequent solutions will use these values unless action is taken to
```

```
either SAVE the current values or not overwrite them (/EXIT,NOSAVE).

  15348  ELEMENTS (OF    15348  DEFINED) SELECTED BY  EALL  COMMAND.

  17051  NODES (OF    17051  DEFINED) SELECTED BY NALL  COMMAND.

This routine selects the nodes at the centerlines of the perimeter casks
  and prints out the displacements for these nodes for all 19 load steps.

================================================================================
================================================================================

======================== SELECT NODES AT THE CL OF THE CASKS ================

NSEL  FOR LABEL= NODE  FROM   159 TO   159 BY    1

      1  NODES (OF    17051  DEFINED) SELECTED BY  NSEL  COMMAND.

NASE  FOR LABEL= NODE  FROM  3022 TO  3022 BY    1

      2  NODES (OF    17051  DEFINED) SELECTED BY  NASE  COMMAND.

NASE  FOR LABEL= NODE  FROM  3735 TO  3735 BY    1

      3  NODES (OF    17051  DEFINED) SELECTED BY  NASE  COMMAND.

NASE  FOR LABEL= NODE  FROM  4467 TO  4467 BY    1

      4  NODES (OF    17051  DEFINED) SELECTED BY  NASE  COMMAND.

NASE  FOR LABEL= NODE  FROM  5178 TO  5178 BY    1

      5  NODES (OF    17051  DEFINED) SELECTED BY  NASE  COMMAND.

NASE  FOR LABEL= NODE  FROM  5890 TO  5890 BY    1

      6  NODES (OF    17051  DEFINED) SELECTED BY  NASE  COMMAND.

NASE  FOR LABEL= NODE  FROM  6602 TO  6602 BY    1

      7  NODES (OF    17051  DEFINED) SELECTED BY  NASE  COMMAND.

NASE  FOR LABEL= NODE  FROM  8183 TO  8183 BY    1

      8  NODES (OF    17051  DEFINED) SELECTED BY  NASE  COMMAND.

NASE  FOR LABEL= NODE  FROM 11046 TO 11046 BY    1

      9  NODES (OF    17051  DEFINED) SELECTED BY  NASE  COMMAND.

NASE  FOR LABEL= NODE  FROM 11759 TO 11759 BY    1
```

```
      10  NODES (OF    17051  DEFINED) SELECTED BY  NASE  COMMAND.

NASE  FOR LABEL= NODE  FROM 12491 TO 12491 BY    1

      11  NODES (OF    17051  DEFINED) SELECTED BY  NASE  COMMAND.

NASE  FOR LABEL= NODE  FROM 13202 TO 13202 BY    1

      12  NODES (OF    17051  DEFINED) SELECTED BY  NASE  COMMAND.

NASE  FOR LABEL= NODE  FROM 13914 TO 13914 BY    1

      13  NODES (OF    17051  DEFINED) SELECTED BY  NASE  COMMAND.

NASE  FOR LABEL= NODE  FROM 14626 TO 14626 BY    1

      14  NODES (OF    17051  DEFINED) SELECTED BY  NASE  COMMAND.
===============================================================================
===============================================================================
==================================  SET 1  ===================================

USE LOAD STEP     1  SUBSTEP     0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=     1  SUBSTEP=     1  CUMULATIVE ITERATION=     4
  TIME/FREQUENCY=  1.0000
TITLE= Pad, Gravity, 20 Casks, Soft Rock

SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=   17051

SORT COMPLETED FOR      14 VALUES.

PRINT DOF  NODAL SOLUTION PER NODE

   NODE       UX           UY           UZ
  11759  0.23976E-02-0.25934E-01-0.29898E-02
  14626  0.23976E-02-0.25934E-01 0.29899E-02
   6602 -0.23976E-02-0.25934E-01 0.29899E-02
   3735 -0.23976E-02-0.25934E-01-0.29899E-02
  11046  0.84671E-03-0.32000E-01 0.33257E-02
   8183  0.84671E-03-0.32000E-01-0.33257E-02
   3022 -0.84672E-03-0.32000E-01 0.33257E-02
    159 -0.84672E-03-0.32000E-01-0.33257E-02
  12491  0.28853E-02-0.32324E-01-0.13605E-02
  13914  0.28853E-02-0.32324E-01 0.13605E-02
   4467 -0.28853E-02-0.32324E-01-0.13605E-02
   5890 -0.28853E-02-0.32324E-01 0.13605E-02
  13202  0.30497E-02-0.34160E-01 0.38396E-04
   5178 -0.30497E-02-0.34160E-01 0.38396E-04
===============================================================================
===============================================================================
==================================  SET 2  ===================================
```

```
USE LOAD STEP      2  SUBSTEP      0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=      2  SUBSTEP=      1  CUMULATIVE ITERATION=     17
  TIME/FREQUENCY=  2.0000
TITLE= Pad, HE(1), 20 Casks, 515 Kips North (Z), Soft Rock

SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=   17051

SORT COMPLETED FOR      14 VALUES.

PRINT DOF  NODAL SOLUTION PER NODE

   NODE       UX          UY          UZ
  14626  0.17946E-02 0.45089E-03 0.54158E-01
   6602 -0.17946E-02 0.45089E-03 0.54158E-01
  11046  0.85672E-03-0.31840E-02 0.55992E-01
   3022 -0.85672E-03-0.31840E-02 0.55992E-01
  13914  0.19712E-02-0.22290E-01 0.48499E-01
   5890 -0.19712E-02-0.22290E-01 0.48499E-01
  11759  0.17184E-02-0.25651E-01 0.42247E-01
   3735 -0.17184E-02-0.25651E-01 0.42247E-01
  13202  0.23280E-02-0.26958E-01 0.46081E-01
   5178 -0.23280E-02-0.26958E-01 0.46081E-01
  12491  0.23114E-02-0.26967E-01 0.44366E-01
   4467 -0.23114E-02-0.26967E-01 0.44366E-01
   8183  0.52785E-03-0.31633E-01 0.44127E-01
    159 -0.52786E-03-0.31633E-01 0.44127E-01
===============================================================================
===============================================================================
===================================  SET 3  ===================================

USE LOAD STEP      3  SUBSTEP      0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=      3  SUBSTEP=      1  CUMULATIVE ITERATION=     26
  TIME/FREQUENCY=  3.0000
TITLE= Pad, HE(1), 20 Casks, 515 Kips N 32.93 W (Z,X), Soft Rock

SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=   17051

SORT COMPLETED FOR      14 VALUES.

PRINT DOF  NODAL SOLUTION PER NODE

   NODE       UX          UY          UZ
  14626  0.32931E-01 0.22345E-01 0.49506E-01
  11046  0.28977E-01-0.22689E-02 0.47994E-01
  13914  0.32714E-01-0.78650E-02 0.43654E-01
   3022  0.25852E-01-0.12221E-01 0.45401E-01
   6602  0.25115E-01-0.17162E-01 0.41103E-01
  13202  0.31900E-01-0.17466E-01 0.39184E-01
  11759  0.26874E-01-0.18986E-01 0.33611E-01
```

```
  12491  0.30241E-01-0.19177E-01 0.36121E-01
   8183  0.24738E-01-0.29550E-01 0.36194E-01
   3735  0.23030E-01-0.29725E-01 0.36618E-01
   5890  0.26047E-01-0.30233E-01 0.39132E-01
    159  0.23551E-01-0.31520E-01 0.36962E-01
   4467  0.25018E-01-0.32689E-01 0.38083E-01
   5178  0.26083E-01-0.33283E-01 0.38630E-01
=============================================================================
=============================================================================
===================================  SET 4  =================================

USE LOAD STEP     4  SUBSTEP     0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=     4  SUBSTEP=     1  CUMULATIVE ITERATION=    30
  TIME/FREQUENCY=  4.0000
TITLE= Pad, HE(1), 20 Casks, 515 Kips N 45 W (Z,X), Soft Rock

SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=   17051

SORT COMPLETED FOR      14 VALUES.

PRINT DOF  NODAL SOLUTION PER NODE

   NODE      UX          UY          UZ
  14626  0.42876E-01 0.27094E-01 0.42550E-01
  13914  0.43340E-01-0.86190E-04 0.37672E-01
  11046  0.37434E-01-0.50810E-02 0.40415E-01
  13202  0.42471E-01-0.10456E-01 0.33319E-01
  12491  0.40105E-01-0.13431E-01 0.30105E-01
  11759  0.35572E-01-0.14464E-01 0.27648E-01
   3022  0.33444E-01-0.16873E-01 0.37536E-01
   6602  0.32449E-01-0.21741E-01 0.33407E-01
   8183  0.32492E-01-0.28170E-01 0.29960E-01
   3735  0.30684E-01-0.30552E-01 0.31117E-01
    159  0.31042E-01-0.31009E-01 0.30857E-01
   5890  0.34396E-01-0.32432E-01 0.32474E-01
   4467  0.33434E-01-0.34319E-01 0.32305E-01
   5178  0.34744E-01-0.35161E-01 0.32470E-01
=============================================================================
=============================================================================
===================================  SET 5  =================================

USE LOAD STEP     5  SUBSTEP     0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=     5  SUBSTEP=     1  CUMULATIVE ITERATION=    34
  TIME/FREQUENCY=  5.0000
TITLE= Pad, HE(1), 20 Casks, 515 Kips N 57.07 W (Z,X), Soft Rock

SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=   17051

SORT COMPLETED FOR      14 VALUES.
```

ENERCON SERVICES, INC. Appendix DN-2 to Calculation PGE-009-CALC-003

```
PRINT DOF  NODAL SOLUTION PER NODE

   NODE       UX          UY          UZ
  14626  0.50621E-01 0.28189E-01 0.33449E-01
  13914  0.52050E-01 0.70019E-02 0.29670E-01
  13202  0.51492E-01-0.25844E-02 0.25941E-01
  12491  0.48736E-01-0.66512E-02 0.22786E-01
  11759  0.43385E-01-0.87057E-02 0.20437E-01
  11046  0.43873E-01-0.90003E-02 0.31083E-01
   3022  0.39220E-01-0.20944E-01 0.28479E-01
   6602  0.38233E-01-0.25008E-01 0.24915E-01
   8183  0.39081E-01-0.26420E-01 0.22351E-01
    159  0.37234E-01-0.30246E-01 0.23291E-01
   3735  0.36981E-01-0.30957E-01 0.24124E-01
   5890  0.41098E-01-0.34183E-01 0.24554E-01
   4467  0.40316E-01-0.35577E-01 0.25044E-01
   5178  0.41761E-01-0.36683E-01 0.24889E-01
==============================================================================
==============================================================================
==================================  SET 6  ===================================

USE LOAD STEP     6  SUBSTEP     0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=     6  SUBSTEP=     1  CUMULATIVE ITERATION=    42
  TIME/FREQUENCY=  6.0000
TITLE= Pad, HE(1), 20 Casks, 515 Kips West (W), Soft Rock

SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=   17051

SORT COMPLETED FOR      14 VALUES.

PRINT DOF  NODAL SOLUTION PER NODE

   NODE       UX          UY          UZ
  14626  0.56712E-01 0.13291E-01 0.46813E-02
  11759  0.56703E-01 0.13224E-01-0.46705E-02
  13914  0.61313E-01 0.10306E-01 0.25948E-02
  12491  0.61307E-01 0.10278E-01-0.25853E-02
  13202  0.62871E-01 0.93899E-02 0.90377E-04
  11046  0.49075E-01-0.19406E-01 0.31026E-02
   8183  0.49062E-01-0.19435E-01-0.30942E-02
   3022  0.45467E-01-0.26991E-01 0.19283E-02
    159  0.45462E-01-0.26995E-01-0.19250E-02
   3735  0.45083E-01-0.29784E-01 0.25944E-03
   6602  0.45085E-01-0.29785E-01-0.25670E-03
   4467  0.49000E-01-0.36700E-01 0.58681E-03
   5890  0.49001E-01-0.36701E-01-0.58399E-03
   5178  0.50301E-01-0.38610E-01-0.26849E-04
==============================================================================
==============================================================================
==================================  SET 7  ===================================
```

```
USE LOAD STEP      7  SUBSTEP     0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=      7  SUBSTEP=      1  CUMULATIVE ITERATION=    54
  TIME/FREQUENCY=  7.0000
TITLE= Pad, HE(1), 20 Casks, 206 Kips North (z), Max Up, Soft Rock

SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=   17051

SORT COMPLETED FOR       14 VALUES.

PRINT DOF  NODAL SOLUTION PER NODE

   NODE       UX           UY           UZ
  14626  0.11303E-02-0.73636E-02 0.21763E-01
   6602 -0.11304E-02-0.73637E-02 0.21763E-01
  11046  0.47549E-03-0.96951E-02 0.22641E-01
   3022 -0.47545E-03-0.96952E-02 0.22641E-01
  13914  0.11994E-02-0.13223E-01 0.20563E-01
   5890 -0.11994E-02-0.13223E-01 0.20563E-01
  11759  0.96255E-03-0.13303E-01 0.18162E-01
   3735 -0.96256E-03-0.13303E-01 0.18162E-01
  12491  0.12680E-02-0.14430E-01 0.19174E-01
   4467 -0.12680E-02-0.14430E-01 0.19174E-01
  13202  0.13044E-02-0.14622E-01 0.19915E-01
   5178 -0.13044E-02-0.14622E-01 0.19915E-01
   8183  0.30548E-03-0.16420E-01 0.18955E-01
    159 -0.30549E-03-0.16420E-01 0.18955E-01
===============================================================================
===============================================================================
===================================  SET 8  ====================================

USE LOAD STEP      8  SUBSTEP     0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=      8  SUBSTEP=      1  CUMULATIVE ITERATION=    63
  TIME/FREQUENCY=  8.0000
TITLE= Pad, HE(1), 20 Casks, 206 Kips West (X), Max Up, Soft Rock

SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=   17051

SORT COMPLETED FOR       14 VALUES.

PRINT DOF  NODAL SOLUTION PER NODE

   NODE       UX           UY           UZ
  14626  0.22906E-01-0.35240E-02 0.23635E-02
  11759  0.22906E-01-0.35254E-02-0.23634E-02
  13914  0.24859E-01-0.54216E-02 0.12675E-02
  12491  0.24859E-01-0.54221E-02-0.12674E-02
  13202  0.25525E-01-0.59826E-02 0.41558E-04
  11046  0.20540E-01-0.12707E-01 0.16385E-02
```

```
   8183  0.20539E-01-0.12708E-01-0.16386E-02
   3022  0.19414E-01-0.14626E-01 0.11071E-02
    159  0.19414E-01-0.14626E-01-0.11071E-02
   6602  0.19202E-01-0.14994E-01 0.11472E-03
   3735  0.19202E-01-0.14994E-01-0.11467E-03
   4467  0.20821E-01-0.18398E-01 0.14698E-03
   5890  0.20821E-01-0.18398E-01-0.14694E-03
   5178  0.21363E-01-0.19346E-01-0.89786E-05
===============================================================================
===============================================================================
===================================  SET 9  ===================================


USE LOAD STEP      9  SUBSTEP      0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=      9  SUBSTEP=      1  CUMULATIVE ITERATION=     69
  TIME/FREQUENCY=  9.0000
TITLE= Pad, HE(3), 20 Casks, 171.2 Kips North (Z), Max Dn, Soft Rock

SORT ON ITEM=U      COMPONENT=Y      ORDER= 0  KABS= 0  NMAX=    17051

SORT COMPLETED FOR       14 VALUES.

PRINT DOF  NODAL SOLUTION PER NODE

   NODE       UX           UY           UZ
  14626  0.43984E-02-0.45154E-01 0.22838E-01
   6602 -0.43979E-02-0.45154E-01 0.22838E-01
  11759  0.42240E-02-0.48613E-01 0.11576E-01
   3735 -0.42236E-02-0.48613E-01 0.11576E-01
   3022 -0.15868E-02-0.55730E-01 0.24274E-01
  11046  0.15871E-02-0.55730E-01 0.24274E-01
  13914  0.52200E-02-0.58661E-01 0.20060E-01
   5890 -0.52195E-02-0.58661E-01 0.20060E-01
  12491  0.52669E-02-0.59592E-01 0.14930E-01
   4467 -0.52665E-02-0.59592E-01 0.14930E-01
    159 -0.14632E-02-0.59969E-01 0.11769E-01
   8183  0.14634E-02-0.59969E-01 0.11769E-01
  13202  0.55591E-02-0.62611E-01 0.17664E-01
   5178 -0.55587E-02-0.62611E-01 0.17664E-01
===============================================================================
===============================================================================
===================================  SET 10 ===================================


USE LOAD STEP     10  SUBSTEP      0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=     10  SUBSTEP=      1  CUMULATIVE ITERATION=     73
  TIME/FREQUENCY=  10.000
TITLE= Pad, HE(3), 20 Casks, 171.2 Kips West (X), Max Dn, Soft Rock

SORT ON ITEM=U      COMPONENT=Y      ORDER= 0  KABS= 0  NMAX=    17051
```

```
SORT COMPLETED FOR      14 VALUES.

PRINT DOF  NODAL SOLUTION PER NODE

   NODE       UX           UY           UZ
  11759  0.22000E-01-0.43810E-01-0.66480E-02
  14626  0.22000E-01-0.43810E-01 0.66477E-02
   3735  0.13429E-01-0.49996E-01-0.46247E-02
   6602  0.13429E-01-0.49996E-01 0.46245E-02
  13914  0.24520E-01-0.55399E-01 0.31966E-02
  12491  0.24520E-01-0.55399E-01-0.31968E-02
  11046  0.18807E-01-0.57280E-01 0.65071E-02
   8183  0.18807E-01-0.57280E-01-0.65074E-02
    159  0.15765E-01-0.58405E-01-0.60168E-02
   3022  0.15765E-01-0.58405E-01 0.60166E-02
  13202  0.25371E-01-0.58750E-01 0.93299E-04
   5890  0.14073E-01-0.62887E-01 0.19364E-02
   4467  0.14073E-01-0.62887E-01-0.19366E-02
   5178  0.14288E-01-0.66572E-01 0.48726E-04
================================================================================
================================================================================
===================================  SET 11 ====================================


USE LOAD STEP     11  SUBSTEP      0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=     11  SUBSTEP=      1  CUMULATIVE ITERATION=    85
  TIME/FREQUENCY=  11.000
TITLE= Pad, LTSP(2), 20 Casks, 440 Kips North (Z), Soft Rock

SORT ON ITEM=U      COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=   17051

SORT COMPLETED FOR      14 VALUES.

PRINT DOF  NODAL SOLUTION PER NODE

   NODE       UX           UY           UZ
  14626  0.17323E-02-0.23658E-02 0.50293E-01
   6602 -0.17323E-02-0.23658E-02 0.50293E-01
  11046  0.80541E-03-0.58241E-02 0.52049E-01
   3022 -0.80541E-03-0.58241E-02 0.52049E-01
  13914  0.18807E-02-0.21356E-01 0.45457E-01
   5890 -0.18807E-02-0.21356E-01 0.45457E-01
  11759  0.15520E-02-0.23307E-01 0.39923E-01
   3735 -0.15520E-02-0.23307E-01 0.39923E-01
  12491  0.21362E-02-0.24868E-01 0.41876E-01
   4467 -0.21362E-02-0.24868E-01 0.41876E-01
  13202  0.21764E-02-0.25123E-01 0.43435E-01
   5178 -0.21764E-02-0.25123E-01 0.43435E-01
   8183  0.47436E-03-0.28766E-01 0.41701E-01
    159 -0.47437E-03-0.28766E-01 0.41701E-01
================================================================================
================================================================================
```

```
================================== SET 12 ==================================

USE LOAD STEP     12  SUBSTEP      0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=    12  SUBSTEP=      1  CUMULATIVE ITERATION=     94
  TIME/FREQUENCY=  12.000
TITLE= Pad, LTSP(2), 20 Casks, 440 Kips N 32.93 W (Z,X), Soft Rock

SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=    17051

SORT COMPLETED FOR      14 VALUES.

PRINT DOF  NODAL SOLUTION PER NODE

   NODE       UX           UY           UZ
  14626  0.30100E-01 0.14871E-01 0.45855E-01
  11046  0.26623E-01-0.53918E-02 0.44546E-01
  13914  0.29993E-01-0.10246E-01 0.40573E-01
   3022  0.23928E-01-0.13070E-01 0.42312E-01
   6602  0.23254E-01-0.16598E-01 0.38441E-01
  13202  0.29513E-01-0.17505E-01 0.36744E-01
  11759  0.25157E-01-0.17595E-01 0.31741E-01
  12491  0.28166E-01-0.18329E-01 0.34051E-01
   3735  0.21717E-01-0.26893E-01 0.34570E-01
   8183  0.23261E-01-0.27009E-01 0.34198E-01
   5890  0.24259E-01-0.27970E-01 0.36797E-01
    159  0.22200E-01-0.28675E-01 0.34914E-01
   4467  0.23458E-01-0.29847E-01 0.35901E-01
   5178  0.24371E-01-0.30569E-01 0.36398E-01
============================================================================
============================================================================
================================== SET 13 ==================================

USE LOAD STEP     13  SUBSTEP      0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=    13  SUBSTEP=      1  CUMULATIVE ITERATION=     98
  TIME/FREQUENCY=  13.000
TITLE= Pad, LTSP(2), 20 Casks, 440 Kips N 45 W (Z,X), Soft Rock

SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=    17051

SORT COMPLETED FOR      14 VALUES.

PRINT DOF  NODAL SOLUTION PER NODE

   NODE       UX           UY           UZ
  14626  0.39168E-01 0.18624E-01 0.39440E-01
  13914  0.39657E-01-0.40683E-02 0.34968E-01
  11046  0.34406E-01-0.78550E-02 0.37514E-01
  13202  0.39086E-01-0.11980E-01 0.31185E-01
  12491  0.37134E-01-0.13796E-01 0.28312E-01
```

```
  11759  0.33151E-01-0.13931E-01 0.26023E-01
   3022  0.31024E-01-0.16985E-01 0.35024E-01
   6602  0.30150E-01-0.20443E-01 0.31312E-01
   8183  0.30488E-01-0.25881E-01 0.28287E-01
   3735  0.28878E-01-0.27636E-01 0.29374E-01
    159  0.29214E-01-0.28250E-01 0.29144E-01
   5890  0.32060E-01-0.29835E-01 0.30552E-01
   4467  0.31314E-01-0.31272E-01 0.30445E-01
   5178  0.32450E-01-0.32187E-01 0.30591E-01
================================================================================
================================================================================
===================================  SET 14 ====================================


USE LOAD STEP     14  SUBSTEP     0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=     14  SUBSTEP=     1  CUMULATIVE ITERATION=    102
  TIME/FREQUENCY=  14.000
TITLE= Pad, LTSP(2), 20 Casks, 440 Kips N 57.03 W (Z,X), Soft Rock

SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=   17051

SORT COMPLETED FOR       14 VALUES.

PRINT DOF  NODAL SOLUTION PER NODE

   NODE       UX           UY           UZ
  14626  0.46150E-01 0.19220E-01 0.31143E-01
  13914  0.47481E-01 0.12160E-02 0.27580E-01
  13202  0.47174E-01-0.61747E-02 0.24179E-01
  12491  0.44920E-01-0.85505E-02 0.21285E-01
  11759  0.40276E-01-0.92223E-02 0.19114E-01
  11046  0.40288E-01-0.11067E-01 0.28955E-01
   3022  0.36457E-01-0.20131E-01 0.26701E-01
   6602  0.35649E-01-0.23092E-01 0.23419E-01
   8183  0.36584E-01-0.24456E-01 0.21072E-01
    159  0.34985E-01-0.27616E-01 0.21997E-01
   3735  0.34745E-01-0.28016E-01 0.22774E-01
   5890  0.38323E-01-0.31305E-01 0.23124E-01
   4467  0.37717E-01-0.32377E-01 0.23597E-01
   5178  0.38982E-01-0.33499E-01 0.23452E-01
================================================================================
================================================================================
===================================  SET 15 ====================================


USE LOAD STEP     15  SUBSTEP     0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=     15  SUBSTEP=     1  CUMULATIVE ITERATION=    110
  TIME/FREQUENCY=  15.000
TITLE= Pad, LTSP(2), 20 Casks, 440 Kips West (X), Soft Rock

SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=   17051
```

```
SORT COMPLETED FOR      14 VALUES.

PRINT DOF  NODAL SOLUTION PER NODE

   NODE       UX           UY           UZ
  14626  0.52118E-01 0.82447E-02 0.45791E-02
  11759  0.52117E-01 0.82391E-02-0.45780E-02
  13914  0.56185E-01 0.48365E-02 0.25176E-02
  12491  0.56185E-01 0.48343E-02-0.25169E-02
  13202  0.57567E-01 0.37824E-02 0.84124E-04
  11046  0.45613E-01-0.18894E-01 0.29519E-02
   8183  0.45612E-01-0.18896E-01-0.29514E-02
   3022  0.42584E-01-0.24949E-01 0.18120E-02
    159  0.42584E-01-0.24949E-01-0.18117E-02
   3735  0.42254E-01-0.27103E-01 0.26235E-03
   6602  0.42254E-01-0.27103E-01-0.26204E-03
   4467  0.45800E-01-0.33426E-01 0.54395E-03
   5890  0.45800E-01-0.33426E-01-0.54365E-03
   5178  0.46983E-01-0.35177E-01-0.26233E-04
================================================================================
================================================================================
===================================  SET 16 ====================================


USE LOAD STEP    16   SUBSTEP     0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=    16  SUBSTEP=     1  CUMULATIVE ITERATION=   123
  TIME/FREQUENCY=  16.000
TITLE= Pad, LTSP(2), 20 Casks, 176 Kips North (Z), Max Up, Soft Rock

SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=   17051

SORT COMPLETED FOR      14 VALUES.

PRINT DOF  NODAL SOLUTION PER NODE

   NODE       UX           UY           UZ
  14626  0.74511E-03-0.52798E-03 0.22797E-01
   6602 -0.74452E-03-0.53313E-03 0.22796E-01
  11046  0.35204E-03-0.20036E-02 0.23587E-01
   3022 -0.35087E-03-0.20057E-02 0.23587E-01
  13914  0.77917E-03-0.88488E-02 0.20644E-01
   5890 -0.77888E-03-0.88498E-02 0.20643E-01
   3735 -0.61210E-03-0.95070E-02 0.18262E-01
  11759  0.61219E-03-0.95070E-02 0.18262E-01
   4467 -0.87549E-03-0.10207E-01 0.19087E-01
  12491  0.87563E-03-0.10207E-01 0.19087E-01
  13202  0.89858E-03-0.10405E-01 0.19758E-01
   5178 -0.89839E-03-0.10405E-01 0.19758E-01
    159 -0.18296E-03-0.11748E-01 0.19082E-01
   8183  0.18305E-03-0.11748E-01 0.19082E-01
================================================================================
```

```
================================================================================
=================================== SET 17 =====================================

USE LOAD STEP     17  SUBSTEP      0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=     17  SUBSTEP=      1  CUMULATIVE ITERATION=    136
  TIME/FREQUENCY=  17.000
TITLE= Pad, LTSP(2), 20 Casks, 176 Kips West (X), Max Up, Soft Rock

SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=   17051

SORT COMPLETED FOR       14 VALUES.

PRINT DOF  NODAL SOLUTION PER NODE

   NODE       UX            UY            UZ
  14626  0.23426E-01 0.40128E-02 0.20481E-02
  11759  0.23423E-01 0.39923E-02-0.20448E-02
  13914  0.25147E-01 0.24083E-02 0.11242E-02
  12491  0.25145E-01 0.23999E-02-0.11214E-02
  13202  0.25732E-01 0.19068E-02 0.38583E-04
  11046  0.20620E-01-0.77241E-02 0.12615E-02
   8183  0.20617E-01-0.77314E-02-0.12598E-02
   3022  0.19311E-01-0.10294E-01 0.72565E-03
    159  0.19310E-01-0.10295E-01-0.72479E-03
   3735  0.19174E-01-0.11206E-01 0.21338E-03
   6602  0.19175E-01-0.11206E-01-0.21256E-03
   4467  0.20721E-01-0.13785E-01 0.28117E-03
   5890  0.20722E-01-0.13786E-01-0.28034E-03
   5178  0.21240E-01-0.14501E-01-0.12425E-04
================================================================================
================================================================================
=================================== SET 18 =====================================

USE LOAD STEP     18  SUBSTEP      0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=     18  SUBSTEP=      1  CUMULATIVE ITERATION=    151
  TIME/FREQUENCY=  18.000
TITLE= Pad, LTSP(4), 20 Casks, 156 Kips North (Z), Max Up, Soft Rock

SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=   17051

SORT COMPLETED FOR       14 VALUES.

PRINT DOF  NODAL SOLUTION PER NODE

   NODE       UX            UY            UZ
  14626  0.57828E-03 0.27135E-02 0.22021E-01
   6602 -0.57788E-03 0.27095E-02 0.22021E-01
  11046  0.28774E-03 0.16475E-02 0.22736E-01
   3022 -0.28687E-03 0.16458E-02 0.22736E-01
```

```
  13914  0.56408E-03-0.63085E-02 0.19783E-01
   5890 -0.56394E-03-0.63096E-02 0.19783E-01
   3735 -0.45481E-03-0.75670E-02 0.17565E-01
  11759  0.45485E-03-0.75670E-02 0.17565E-01
   4467 -0.67289E-03-0.78619E-02 0.18241E-01
  12491  0.67296E-03-0.78619E-02 0.18241E-01
  13202  0.68024E-03-0.79638E-02 0.18833E-01
   5178 -0.68016E-03-0.79640E-02 0.18833E-01
    159 -0.12879E-03-0.93626E-02 0.18367E-01
   8183  0.12884E-03-0.93626E-02 0.18367E-01
===============================================================================
===============================================================================
=================================== SET 19 ====================================


USE LOAD STEP     19  SUBSTEP      0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=     19  SUBSTEP=     1  CUMULATIVE ITERATION=   168
  TIME/FREQUENCY=  19.000
TITLE= Pad, LTSP(4), 20 Casks, 156 Kips West (X), Max Up, Soft Rock

SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=   17051

SORT COMPLETED FOR      14 VALUES.

PRINT DOF  NODAL SOLUTION PER NODE

   NODE       UX           UY           UZ
  14626  0.23333E-01 0.98912E-02 0.15722E-02
  11759  0.23333E-01 0.98899E-02-0.15721E-02
  13914  0.24984E-01 0.92044E-02 0.89434E-03
  12491  0.24984E-01 0.92038E-02-0.89419E-03
  13202  0.25553E-01 0.89742E-02 0.30929E-04
  11046  0.20392E-01-0.43832E-02 0.91735E-03
   8183  0.20392E-01-0.43839E-02-0.91730E-03
   3022  0.18749E-01-0.80209E-02 0.44415E-03
    159  0.18749E-01-0.80210E-02-0.44412E-03
   6602  0.18557E-01-0.92607E-02-0.41629E-03
   3735  0.18557E-01-0.92607E-02 0.41634E-03
   5890  0.20032E-01-0.11186E-01-0.35996E-03
   4467  0.20032E-01-0.11186E-01 0.36001E-03
   5178  0.20526E-01-0.11717E-01-0.14496E-04
===============================================================================
===============================================================================

EXIT THE ANSYS POST1 DATABASE PROCESSOR


***** ROUTINE COMPLETED *****  CP =        44.594


*** NOTE ***                                CP=      44.594   TIME= 17:11:21
```

```
A total of 1 warnings and errors written to dcslabs2.err.

/OUTPUT FILE= padhardcaskd.out
```

ENERCON SERVICES, INC. Appendix DN-2 to Calculation PGE-009-CALC-003

Below is the ANSYS output file for the maximum cask displacements for the hard rock analyses:

```
CURRENT JOBNAME REDEFINED AS dcslabh2

RESUME ANSYS DATA FROM FILE NAME=dcslabh2.db

*** ANSYS GLOBAL STATUS ***

TITLE = Pad, LTSP(4), 20 Casks, 156 Kips West (X), Max Up, Hard Rock
ANALYSIS TYPE = STATIC (STEADY-STATE)
NUMBER OF ELEMENT TYPES =       6
   9056 ELEMENTS CURRENTLY SELECTED.  MAX ELEMENT NUMBER =    33177
  11550 NODES CURRENTLY SELECTED.     MAX NODE NUMBER =       17051
    259 KEYPOINTS CURRENTLY SELECTED. MAX KEYPOINT NUMBER =     259
    250 LINES CURRENTLY SELECTED.     MAX LINE NUMBER =         396
    181 AREAS CURRENTLY SELECTED.     MAX AREA NUMBER =         295
     70 VOLUMES CURRENTLY SELECTED.   MAX VOL. NUMBER =          70
    11 COMPONENTS CURRENTLY DEFINED
MAXIMUM LINEAR PROPERTY NUMBER       =        5
MAXIMUM REAL CONSTANT SET NUMBER     =        6
ACTIVE COORDINATE SYSTEM             =        0  (CARTESIAN)
MAXIMUM CONSTRAINT EQUATION NUMBER   =     4620
NUMBER OF SPECIFIED CONSTRAINTS      =     2193
NUMBER OF NODAL LOADS                =     2160

INITIAL JOBNAME = dcslabs2
CURRENT JOBNAME = dcslabh2


PRINT HEADER
DO NOT PRINT SUBTITLE(S)
DO NOT PRINT LOAD STEP ID
DO NOT PRINT NOTE LINE(S)
PRINT COLUMN HEADER LABELS
DO NOT PRINT REPORT TOTALS

         ***** ANSYS RESULTS INTERPRETATION (POST1) *****

ENTER  /SHOW,DEVICE-NAME  TO ENABLE GRAPHIC DISPLAY
ENTER  FINISH             TO LEAVE POST1

   15348  ELEMENTS (OF    15348  DEFINED) SELECTED BY  EALL  COMMAND.

   17051  NODES (OF    17051  DEFINED) SELECTED BY NALL  COMMAND.
===============================================================================
===============================================================================

=======================  SELECT NODES AT THE CL OF THE CASKS ================


NSEL  FOR LABEL= NODE  FROM    159 TO    159 BY    1

       1  NODES (OF    17051  DEFINED) SELECTED BY  NSEL  COMMAND.
```

```
NASE  FOR LABEL= NODE  FROM  3022 TO  3022 BY    1

       2  NODES (OF    17051  DEFINED) SELECTED BY  NASE  COMMAND.

NASE  FOR LABEL= NODE  FROM  3735 TO  3735 BY    1

       3  NODES (OF    17051  DEFINED) SELECTED BY  NASE  COMMAND.

NASE  FOR LABEL= NODE  FROM  4467 TO  4467 BY    1

       4  NODES (OF    17051  DEFINED) SELECTED BY  NASE  COMMAND.

NASE  FOR LABEL= NODE  FROM  5178 TO  5178 BY    1

       5  NODES (OF    17051  DEFINED) SELECTED BY  NASE  COMMAND.

NASE  FOR LABEL= NODE  FROM  5890 TO  5890 BY    1

       6  NODES (OF    17051  DEFINED) SELECTED BY  NASE  COMMAND.

NASE  FOR LABEL= NODE  FROM  6602 TO  6602 BY    1

       7  NODES (OF    17051  DEFINED) SELECTED BY  NASE  COMMAND.

NASE  FOR LABEL= NODE  FROM  8183 TO  8183 BY    1

       8  NODES (OF    17051  DEFINED) SELECTED BY  NASE  COMMAND.

NASE  FOR LABEL= NODE  FROM 11046 TO 11046 BY    1

       9  NODES (OF    17051  DEFINED) SELECTED BY  NASE  COMMAND.

NASE  FOR LABEL= NODE  FROM 11759 TO 11759 BY    1

      10  NODES (OF    17051  DEFINED) SELECTED BY  NASE  COMMAND.

NASE  FOR LABEL= NODE  FROM 12491 TO 12491 BY    1

      11  NODES (OF    17051  DEFINED) SELECTED BY  NASE  COMMAND.

NASE  FOR LABEL= NODE  FROM 13202 TO 13202 BY    1

      12  NODES (OF    17051  DEFINED) SELECTED BY  NASE  COMMAND.

NASE  FOR LABEL= NODE  FROM 13914 TO 13914 BY    1

      13  NODES (OF    17051  DEFINED) SELECTED BY  NASE  COMMAND.

NASE  FOR LABEL= NODE  FROM 14626 TO 14626 BY    1

      14  NODES (OF    17051  DEFINED) SELECTED BY  NASE  COMMAND.
==============================================================================
```

```
================================================================================
==================================  SET 1  =====================================


USE LOAD STEP     1  SUBSTEP     0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=     1  SUBSTEP=     1  CUMULATIVE ITERATION=     2
  TIME/FREQUENCY=  1.0000
TITLE= Pad, Gravity, 20 Casks, Hard Rock

SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=   17051

SORT COMPLETED FOR      14 VALUES.

PRINT DOF  NODAL SOLUTION PER NODE

   NODE      UX           UY           UZ
  11759  0.44504E-03-0.29552E-02-0.52675E-03
   3735 -0.44504E-03-0.29552E-02-0.52675E-03
  14626  0.44504E-03-0.29552E-02 0.52675E-03
   6602 -0.44504E-03-0.29552E-02 0.52675E-03
  12491  0.53987E-03-0.35662E-02-0.22916E-03
  13914  0.53987E-03-0.35662E-02 0.22916E-03
   4467 -0.53987E-03-0.35662E-02-0.22916E-03
   5890 -0.53987E-03-0.35662E-02 0.22916E-03
   8183  0.14819E-03-0.36065E-02-0.59842E-03
    159 -0.14819E-03-0.36065E-02-0.59842E-03
  11046  0.14819E-03-0.36065E-02 0.59842E-03
   3022 -0.14819E-03-0.36065E-02 0.59842E-03
  13202  0.56911E-03-0.37223E-02 0.27296E-05
   5178 -0.56911E-03-0.37223E-02 0.27296E-05
================================================================================
================================================================================
==================================  SET 2  =====================================


USE LOAD STEP     2  SUBSTEP     0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=     2  SUBSTEP=     1  CUMULATIVE ITERATION=    17
  TIME/FREQUENCY=  2.0000
TITLE= Pad, HE(1), 20 Casks, 515 Kips North (Z), Hard Rock

SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=   17051

SORT COMPLETED FOR      14 VALUES.

PRINT DOF  NODAL SOLUTION PER NODE

   NODE      UX           UY           UZ
  14626  0.44006E-03 0.48840E-02 0.11349E-01
   6602 -0.44006E-03 0.48840E-02 0.11349E-01
   3022 -0.22353E-03 0.43763E-02 0.11865E-01
  11046  0.22353E-03 0.43763E-02 0.11865E-01
```

```
  13914  0.41936E-03-0.23911E-02 0.76633E-02
   5890 -0.41936E-03-0.23911E-02 0.76633E-02
  13202  0.39762E-03-0.28811E-02 0.68058E-02
   5178 -0.39762E-03-0.28811E-02 0.68058E-02
  12491  0.30625E-03-0.30795E-02 0.61932E-02
   4467 -0.30625E-03-0.30795E-02 0.61932E-02
   3735 -0.16636E-03-0.31492E-02 0.53467E-02
  11759  0.16636E-03-0.31492E-02 0.53467E-02
   8183  0.37567E-04-0.38261E-02 0.59486E-02
    159 -0.37567E-04-0.38261E-02 0.59486E-02
===============================================================================
===============================================================================
==================================  SET 3  ====================================

USE LOAD STEP      3  SUBSTEP      0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=      3  SUBSTEP=      1  CUMULATIVE ITERATION=     30
  TIME/FREQUENCY=  3.0000
TITLE= Pad, HE(1), 20 Casks, 515 Kips N 32.93 W (Z,X), Hard Rock

SORT ON ITEM=U      COMPONENT=Y      ORDER= 0  KABS= 0  NMAX=   17051

SORT COMPLETED FOR       14 VALUES.

PRINT DOF  NODAL SOLUTION PER NODE

   NODE       UX           UY           UZ
  14626  0.86533E-02 0.15392E-01 0.11312E-01
  11046  0.61468E-02 0.45843E-02 0.10317E-01
  13914  0.76855E-02 0.30527E-02 0.82487E-02
   3022  0.44425E-02 0.85221E-03 0.87102E-02
  13202  0.64891E-02-0.28510E-03 0.62057E-02
   6602  0.40611E-02-0.91220E-03 0.68442E-02
  12491  0.55280E-02-0.11787E-02 0.52614E-02
  11759  0.41555E-02-0.19328E-02 0.44723E-02
   5890  0.39022E-02-0.33013E-02 0.58076E-02
   3735  0.31665E-02-0.35752E-02 0.46795E-02
   8183  0.34331E-02-0.35756E-02 0.49151E-02
   5178  0.39076E-02-0.36086E-02 0.56498E-02
   4467  0.36995E-02-0.37299E-02 0.53345E-02
    159  0.32519E-02-0.37609E-02 0.50107E-02
===============================================================================
===============================================================================
==================================  SET 4  ====================================

USE LOAD STEP      4  SUBSTEP      0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=      4  SUBSTEP=      1  CUMULATIVE ITERATION=     36
  TIME/FREQUENCY=  4.0000
TITLE= Pad, HE(1), 20 Casks, 515 Kips N 45 W (Z,X), Hard Rock
```

```
SORT ON ITEM=U      COMPONENT=Y      ORDER= 0  KABS= 0  NMAX=    17051

SORT COMPLETED FOR       14 VALUES.

PRINT DOF  NODAL SOLUTION PER NODE

   NODE       UX          UY          UZ
  14626  0.11532E-01 0.17918E-01 0.94753E-02
  13914  0.10923E-01 0.71096E-02 0.72918E-02
  11046  0.79286E-02 0.33469E-02 0.83738E-02
  13202  0.97055E-02 0.29816E-02 0.55847E-02
  12491  0.82830E-02 0.10972E-02 0.46767E-02
  11759  0.61874E-02-0.58991E-03 0.40080E-02
   3022  0.55114E-02-0.82137E-03 0.66374E-02
   6602  0.48707E-02-0.20356E-02 0.50061E-02
   8183  0.46628E-02-0.34002E-02 0.41188E-02
   5890  0.51738E-02-0.35451E-02 0.47105E-02
   3735  0.42201E-02-0.36380E-02 0.39985E-02
    159  0.43279E-02-0.36649E-02 0.42020E-02
   5178  0.52444E-02-0.38312E-02 0.47219E-02
   4467  0.49611E-02-0.39040E-02 0.45359E-02
===============================================================================
===============================================================================
=================================  SET 5  =====================================


USE LOAD STEP      5  SUBSTEP      0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=      5  SUBSTEP=      1  CUMULATIVE ITERATION=     42
  TIME/FREQUENCY=  5.0000
TITLE= Pad, HE(1), 20 Casks, 515 Kips N 57.07 W (Z,X), Hard Rock

SORT ON ITEM=U      COMPONENT=Y      ORDER= 0  KABS= 0  NMAX=    17051

SORT COMPLETED FOR       14 VALUES.

PRINT DOF  NODAL SOLUTION PER NODE

   NODE       UX          UY          UZ
  14626  0.13635E-01 0.18574E-01 0.69278E-02
  13914  0.13595E-01 0.10908E-01 0.56655E-02
  13202  0.12657E-01 0.70651E-02 0.45683E-02
  12491  0.11029E-01 0.43538E-02 0.39170E-02
  11046  0.90694E-02 0.16715E-02 0.59644E-02
  11759  0.84107E-02 0.15312E-02 0.34458E-02
   3022  0.61582E-02-0.21273E-02 0.44883E-02
   6602  0.54205E-02-0.27157E-02 0.33974E-02
   8183  0.58293E-02-0.31613E-02 0.31438E-02
    159  0.52484E-02-0.35372E-02 0.31900E-02
   3735  0.50973E-02-0.36452E-02 0.31234E-02
   5890  0.61778E-02-0.37496E-02 0.34782E-02
   5178  0.63276E-02-0.40149E-02 0.35974E-02
   4467  0.60013E-02-0.40298E-02 0.35307E-02
```

```
==============================================================================
==============================================================================
==================================  SET 6  ===================================


USE LOAD STEP     6  SUBSTEP     0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=     6  SUBSTEP=     1  CUMULATIVE ITERATION=    54
  TIME/FREQUENCY=  6.0000
TITLE= Pad, HE(1), 20 Casks, 515 Kips West (W), Hard Rock

SORT ON ITEM=U      COMPONENT=Y      ORDER= 0  KABS= 0  NMAX=   17051

SORT COMPLETED FOR       14 VALUES.

PRINT DOF  NODAL SOLUTION PER NODE

   NODE      UX            UY            UZ
  13202  0.16666E-01 0.14469E-01-0.34315E-05
  13914  0.16039E-01 0.13838E-01-0.18673E-04
  12491  0.16037E-01 0.13833E-01 0.20862E-04
  14626  0.14012E-01 0.12263E-01 0.40789E-05
  11759  0.14010E-01 0.12250E-01-0.19132E-05
  11046  0.87344E-02-0.15701E-02 0.36581E-03
   8183  0.87310E-02-0.15755E-02-0.36392E-03
   3022  0.66937E-02-0.30590E-02 0.26933E-03
    159  0.66930E-02-0.30593E-02-0.26897E-03
   3735  0.63030E-02-0.33831E-02 0.78972E-04
   6602  0.63033E-02-0.33831E-02-0.78826E-04
   4467  0.73771E-02-0.40973E-02 0.13031E-03
   5890  0.73773E-02-0.40973E-02-0.13013E-03
   5178  0.76785E-02-0.42722E-02-0.67806E-05
==============================================================================
==============================================================================
==================================  SET 7  ===================================


USE LOAD STEP     7  SUBSTEP     0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=     7  SUBSTEP=     1  CUMULATIVE ITERATION=    74
  TIME/FREQUENCY=  7.0000
TITLE= Pad, HE(1), 20 Casks, 206 Kips North (z), Max Up, Hard Rock

SORT ON ITEM=U      COMPONENT=Y      ORDER= 0  KABS= 0  NMAX=   17051

SORT COMPLETED FOR       14 VALUES.

PRINT DOF  NODAL SOLUTION PER NODE

   NODE      UX            UY            UZ
  14626  0.27107E-03-0.29874E-03 0.35288E-02
   6602 -0.27085E-03-0.29975E-03 0.35284E-02
  11046  0.11385E-03-0.58232E-03 0.37713E-02
```

```
    3022 -0.11363E-03-0.58305E-03 0.37711E-02
   13914  0.25855E-03-0.14222E-02 0.29719E-02
    5890 -0.25849E-03-0.14222E-02 0.29718E-02
   13202  0.23895E-03-0.15700E-02 0.28410E-02
    5178 -0.23892E-03-0.15700E-02 0.28410E-02
   11759  0.11971E-03-0.16125E-02 0.22651E-02
    3735 -0.11971E-03-0.16125E-02 0.22651E-02
   12491  0.19358E-03-0.16402E-02 0.26244E-02
    4467 -0.19357E-03-0.16402E-02 0.26244E-02
    8183  0.31759E-04-0.19612E-02 0.25213E-02
     159 -0.31753E-04-0.19612E-02 0.25213E-02
==============================================================================
==============================================================================
==================================  SET 8  ===================================


USE LOAD STEP     8  SUBSTEP     0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=     8  SUBSTEP=     1  CUMULATIVE ITERATION=    90
  TIME/FREQUENCY=  8.0000
TITLE= Pad, HE(1), 20 Casks, 206 Kips West (X), Max Up, Hard Rock

SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=   17051

SORT COMPLETED FOR      14 VALUES.

PRINT DOF  NODAL SOLUTION PER NODE

   NODE       UX           UY           UZ
  13202  0.55527E-02 0.15566E-02 0.19105E-05
  13914  0.53149E-02 0.14344E-02 0.10176E-03
  12491  0.53144E-02 0.14334E-02-0.10138E-03
  14626  0.45390E-02 0.11493E-02 0.20775E-03
  11759  0.45384E-02 0.11469E-02-0.20770E-03
  11046  0.30803E-02-0.14531E-02 0.25409E-03
   8183  0.30800E-02-0.14532E-02-0.25407E-03
    159  0.27005E-02-0.16478E-02-0.18127E-03
   3022  0.27006E-02-0.16478E-02 0.18129E-03
   3735  0.25711E-02-0.17114E-02-0.21453E-04
   6602  0.25711E-02-0.17114E-02 0.21468E-04
   4467  0.30031E-02-0.20613E-02 0.29735E-04
   5890  0.30031E-02-0.20613E-02-0.29713E-04
   5178  0.31250E-02-0.21484E-02-0.22772E-05
==============================================================================
==============================================================================
==================================  SET 9  ===================================


USE LOAD STEP     9  SUBSTEP     0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=     9  SUBSTEP=     1  CUMULATIVE ITERATION=    95
  TIME/FREQUENCY=  9.0000
TITLE= Pad, HE(3), 20 Casks, 171.2 Kips North (Z), Max Dn, Hard Rock
```

```
SORT ON ITEM=U      COMPONENT=Y      ORDER= 0  KABS= 0  NMAX=    17051

SORT COMPLETED FOR       14 VALUES.

PRINT DOF  NODAL SOLUTION PER NODE

   NODE       UX            UY            UZ
  14626  0.85853E-03-0.50733E-02 0.31954E-02
   6602 -0.85849E-03-0.50733E-02 0.31954E-02
   3735 -0.72388E-03-0.56299E-02 0.12086E-02
  11759  0.72393E-03-0.56299E-02 0.12086E-02
   3022 -0.29435E-03-0.61940E-02 0.35791E-02
  11046  0.29436E-03-0.61940E-02 0.35791E-02
   5890 -0.10019E-02-0.64380E-02 0.28171E-02
  13914  0.10020E-02-0.64381E-02 0.28171E-02
   4467 -0.93981E-03-0.66215E-02 0.19603E-02
  12491  0.93988E-03-0.66215E-02 0.19603E-02
   5178 -0.10275E-02-0.68044E-02 0.24590E-02
  13202  0.10276E-02-0.68044E-02 0.24590E-02
    159 -0.23559E-03-0.68595E-02 0.13290E-02
   8183  0.23560E-03-0.68595E-02 0.13290E-02
===============================================================================
===============================================================================
===================================  SET 10 ===================================


USE LOAD STEP     10  SUBSTEP      0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=     10  SUBSTEP=      1  CUMULATIVE ITERATION=     99
  TIME/FREQUENCY=  10.000
TITLE= Pad, HE(3), 20 Casks, 171.2 Kips West (X), Max Dn, Hard Rock

SORT ON ITEM=U      COMPONENT=Y      ORDER= 0  KABS= 0  NMAX=    17051

SORT COMPLETED FOR       14 VALUES.

PRINT DOF  NODAL SOLUTION PER NODE

   NODE       UX            UY            UZ
  11759  0.31324E-02-0.49924E-02-0.11529E-02
  14626  0.31324E-02-0.49924E-02 0.11529E-02
   3735  0.15533E-02-0.57097E-02-0.82886E-03
   6602  0.15533E-02-0.57097E-02 0.82886E-03
  12491  0.37034E-02-0.60852E-02-0.53025E-03
  13914  0.37034E-02-0.60852E-02 0.53025E-03
  13202  0.38701E-02-0.63638E-02 0.67922E-05
   8183  0.25623E-02-0.64697E-02-0.11669E-02
  11046  0.25623E-02-0.64697E-02 0.11669E-02
    159  0.20330E-02-0.65833E-02-0.10813E-02
   3022  0.20330E-02-0.65833E-02 0.10813E-02
   4467  0.17653E-02-0.69733E-02-0.32533E-03
   5890  0.17653E-02-0.69733E-02 0.32533E-03
```

ENERCON SERVICES, INC. Appendix DN-2 to Calculation PGE-009-CALC-003

```
   5178  0.18208E-02-0.72913E-02 0.78036E-06
===============================================================================
===============================================================================
==================================  SET 11  ===================================


USE LOAD STEP    11  SUBSTEP     0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=     11  SUBSTEP=      1  CUMULATIVE ITERATION=   117
  TIME/FREQUENCY=  11.000
TITLE= Pad, LTSP(2), 20 Casks, 440 Kips North (Z), Hard Rock

SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=   17051

SORT COMPLETED FOR       14 VALUES.

PRINT DOF  NODAL SOLUTION PER NODE

   NODE       UX           UY           UZ
  14626  0.43451E-03 0.35457E-02 0.10113E-01
   6602 -0.43451E-03 0.35457E-02 0.10113E-01
   3022 -0.21571E-03 0.30388E-02 0.10606E-01
  11046  0.21571E-03 0.30388E-02 0.10606E-01
  13914  0.40268E-03-0.22879E-02 0.70331E-02
   5890 -0.40268E-03-0.22879E-02 0.70331E-02
  13202  0.37430E-03-0.26908E-02 0.63400E-02
   5178 -0.37430E-03-0.26908E-02 0.63400E-02
  12491  0.28597E-03-0.28465E-02 0.57939E-02
   4467 -0.28597E-03-0.28465E-02 0.57939E-02
  11759  0.14707E-03-0.28640E-02 0.50202E-02
   3735 -0.14707E-03-0.28640E-02 0.50202E-02
   8183  0.32083E-04-0.34801E-02 0.55898E-02
    159 -0.32083E-04-0.34801E-02 0.55898E-02
===============================================================================
===============================================================================
==================================  SET 12  ===================================


USE LOAD STEP    12  SUBSTEP     0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=     12  SUBSTEP=      1  CUMULATIVE ITERATION=   130
  TIME/FREQUENCY=  12.000
TITLE= Pad, LTSP(2), 20 Casks, 440 Kips N 32.93 W (Z,X), Hard Rock

SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=   17051

SORT COMPLETED FOR       14 VALUES.

PRINT DOF  NODAL SOLUTION PER NODE

   NODE       UX           UY           UZ
  14626  0.74655E-02 0.11385E-01 0.10000E-01
  11046  0.52963E-02 0.28351E-02 0.91236E-02
```

```
   13914  0.66108E-02 0.15523E-02 0.72545E-02
    3022  0.39163E-02 0.16551E-03 0.77803E-02
   13202  0.56828E-02-0.73379E-03 0.56403E-02
    6602  0.36032E-02-0.10915E-02 0.61883E-02
   12491  0.49381E-02-0.13321E-02 0.48642E-02
   11759  0.37852E-02-0.18550E-02 0.41427E-02
    5890  0.35537E-02-0.30563E-02 0.53754E-02
    3735  0.29569E-02-0.32391E-02 0.43842E-02
    8183  0.31939E-02-0.32654E-02 0.46020E-02
    5178  0.35864E-02-0.33247E-02 0.52582E-02
    4467  0.34173E-02-0.34145E-02 0.49787E-02
     159  0.30411E-02-0.34247E-02 0.46973E-02
===============================================================================
===============================================================================
===================================  SET 13  ===================================


USE LOAD STEP     13   SUBSTEP      0   FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=     13   SUBSTEP=      1  CUMULATIVE ITERATION=    135
  TIME/FREQUENCY=  13.000
TITLE= Pad, LTSP(2), 20 Casks, 440 Kips N 45 W (Z,X), Hard Rock

SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=    17051

SORT COMPLETED FOR       14 VALUES.

PRINT DOF  NODAL SOLUTION PER NODE

   NODE       UX          UY          UZ
   14626  0.99213E-02 0.13312E-01 0.84233E-02
   13914  0.93705E-02 0.45863E-02 0.64131E-02
   11046  0.68159E-02 0.18082E-02 0.74145E-02
   13202  0.84059E-02 0.16506E-02 0.50015E-02
   12491  0.72982E-02 0.40148E-03 0.42418E-02
   11759  0.55619E-02-0.77833E-03 0.36418E-02
    3022  0.49029E-02-0.11347E-02 0.59663E-02
    6602  0.43842E-02-0.19827E-02 0.45891E-02
    8183  0.43125E-02-0.31183E-02 0.38410E-02
    5890  0.47235E-02-0.32652E-02 0.43754E-02
    3735  0.39298E-02-0.32962E-02 0.37435E-02
     159  0.40347E-02-0.33429E-02 0.39340E-02
    5178  0.48118E-02-0.35181E-02 0.43971E-02
    4467  0.45763E-02-0.35668E-02 0.42313E-02
===============================================================================
===============================================================================
===================================  SET 14  ===================================


USE LOAD STEP     14   SUBSTEP      0   FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=     14   SUBSTEP=      1  CUMULATIVE ITERATION=    141
  TIME/FREQUENCY=  14.000
```

ENERCON SERVICES, INC. Appendix DN-2 to Calculation PGE-009-CALC-003

```
TITLE= Pad, LTSP(2), 20 Casks, 440 Kips N 57.03 W (Z,X), Hard Rock

SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=   17051

SORT COMPLETED FOR      14 VALUES.

PRINT DOF  NODAL SOLUTION PER NODE

   NODE      UX           UY           UZ
  14626  0.11709E-01 0.13734E-01 0.62366E-02
  13914  0.11657E-01 0.74399E-02 0.50067E-02
  13202  0.10915E-01 0.46812E-02 0.40272E-02
  12491  0.96310E-02 0.28662E-02 0.34583E-02
  11759  0.74689E-02 0.88278E-03 0.30256E-02
  11046  0.77869E-02 0.47801E-03 0.53126E-02
   3022  0.55284E-02-0.21242E-02 0.40975E-02
   6602  0.49452E-02-0.25219E-02 0.31580E-02
   8183  0.53505E-02-0.29219E-02 0.29062E-02
    159  0.48768E-02-0.32338E-02 0.29787E-02
   3735  0.47341E-02-0.33053E-02 0.29199E-02
   5890  0.56500E-02-0.34414E-02 0.32409E-02
   4467  0.55277E-02-0.36777E-02 0.32899E-02
   5178  0.58033E-02-0.36780E-02 0.33508E-02
================================================================================
================================================================================
=================================== SET 15 =====================================


USE LOAD STEP    15  SUBSTEP     0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=    15  SUBSTEP=     1  CUMULATIVE ITERATION=   153
  TIME/FREQUENCY=  15.000
TITLE= Pad, LTSP(2), 20 Casks, 440 Kips West (X), Hard Rock

SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=   17051

SORT COMPLETED FOR      14 VALUES.

PRINT DOF  NODAL SOLUTION PER NODE

   NODE      UX           UY           UZ
  13202  0.14234E-01 0.98995E-02 0.94289E-06
  13914  0.13716E-01 0.95040E-02 0.11255E-03
  12491  0.13715E-01 0.94986E-02-0.11085E-03
  14626  0.12021E-01 0.86057E-02 0.26152E-03
  11759  0.12019E-01 0.85957E-02-0.26085E-03
  11046  0.75962E-02-0.18932E-02 0.42316E-03
   8183  0.75930E-02-0.18982E-02-0.42272E-03
   3022  0.61231E-02-0.28288E-02 0.27196E-03
    159  0.61226E-02-0.28290E-02-0.27185E-03
   3735  0.57977E-02-0.30846E-02 0.62826E-04
   6602  0.57978E-02-0.30846E-02-0.62749E-04
   4467  0.67544E-02-0.37403E-02 0.11280E-03
```

```
   5890  0.67545E-02-0.37403E-02-0.11269E-03
   5178  0.70241E-02-0.39013E-02-0.62817E-05
================================================================================
================================================================================
===================================  SET 16 ====================================


USE LOAD STEP     16  SUBSTEP      0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=     16  SUBSTEP=      1  CUMULATIVE ITERATION=    177
  TIME/FREQUENCY=  16.000
TITLE= Pad, LTSP(2), 20 Casks, 176 Kips North (Z), Max Up, Hard Rock

SORT ON ITEM=U      COMPONENT=Y      ORDER= 0  KABS= 0  NMAX=    17051

SORT COMPLETED FOR       14 VALUES.

PRINT DOF  NODAL SOLUTION PER NODE

   NODE       UX           UY           UZ
  14626  0.18872E-03 0.16731E-02 0.45534E-02
   6602 -0.18863E-03 0.16727E-02 0.45534E-02
  11046  0.94550E-04 0.14543E-02 0.47766E-02
   3022 -0.94464E-04 0.14542E-02 0.47766E-02
  13914  0.16789E-03-0.94657E-03 0.31735E-02
   5890 -0.16788E-03-0.94661E-03 0.31734E-02
  13202  0.15350E-03-0.11165E-02 0.28603E-02
   5178 -0.15349E-03-0.11165E-02 0.28603E-02
  12491  0.11352E-03-0.11731E-02 0.26209E-02
   4467 -0.11352E-03-0.11731E-02 0.26209E-02
  11759  0.50243E-04-0.11732E-02 0.22852E-02
   3735 -0.50242E-04-0.11732E-02 0.22852E-02
   8183  0.91003E-05-0.14256E-02 0.25471E-02
    159 -0.90989E-05-0.14256E-02 0.25471E-02
================================================================================
================================================================================
===================================  SET 17 ====================================


USE LOAD STEP     17  SUBSTEP      0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=     17  SUBSTEP=      1  CUMULATIVE ITERATION=    202
  TIME/FREQUENCY=  17.000
TITLE= Pad, LTSP(2), 20 Casks, 176 Kips West (X), Max Up, Hard Rock

SORT ON ITEM=U      COMPONENT=Y      ORDER= 0  KABS= 0  NMAX=    17051

SORT COMPLETED FOR       14 VALUES.

PRINT DOF  NODAL SOLUTION PER NODE

   NODE       UX           UY           UZ
  13202  0.62262E-02 0.43516E-02 0.10994E-05
```

```
  13914   0.60143E-02 0.42101E-02 0.68834E-04
  12491   0.60140E-02 0.42085E-02-0.68377E-04
  14626   0.53207E-02 0.39055E-02 0.15066E-03
  11759   0.53203E-02 0.39028E-02-0.15052E-03
  11046   0.34235E-02-0.73990E-03 0.18635E-03
   8183   0.34227E-02-0.74124E-03-0.18624E-03
   3022   0.27621E-02-0.11706E-02 0.10885E-03
    159   0.27620E-02-0.11707E-02-0.10883E-03
   6602   0.26105E-02-0.12778E-02-0.42183E-04
   3735   0.26105E-02-0.12778E-02 0.42202E-04
   5890   0.30224E-02-0.15467E-02-0.54679E-04
   4467   0.30223E-02-0.15467E-02 0.54708E-04
   5178   0.31391E-02-0.16129E-02-0.28808E-05
===============================================================================
===============================================================================
==================================  SET 18  ===================================


USE LOAD STEP     18  SUBSTEP      0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=     18  SUBSTEP=      1  CUMULATIVE ITERATION=   227
  TIME/FREQUENCY=  18.000
TITLE= Pad, LTSP(4), 20 Casks, 156 Kips North (Z), Max Up, Hard Rock

SORT ON ITEM=U      COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=   17051

SORT COMPLETED FOR      14 VALUES.

PRINT DOF  NODAL SOLUTION PER NODE

   NODE       UX           UY           UZ
  14626   0.16024E-03 0.25386E-02 0.45834E-02
   6602  -0.15990E-03 0.25339E-02 0.45829E-02
  11046   0.87071E-04 0.23424E-02 0.47898E-02
   3022  -0.85705E-04 0.23397E-02 0.47899E-02
  13914   0.12673E-03-0.63955E-03 0.31237E-02
   5890  -0.12696E-03-0.64126E-03 0.31225E-02
   5178  -0.11447E-03-0.85343E-03 0.27327E-02
  13202   0.11452E-03-0.85344E-03 0.27328E-02
   4467  -0.78738E-04-0.90759E-03 0.25022E-02
  12491   0.78772E-04-0.90759E-03 0.25022E-02
   3735  -0.24962E-04-0.94112E-03 0.22010E-02
  11759   0.24979E-04-0.94112E-03 0.22011E-02
    159  -0.96546E-06-0.11443E-02 0.24550E-02
   8183   0.98444E-06-0.11443E-02 0.24550E-02
===============================================================================
===============================================================================
==================================  SET 19  ===================================


USE LOAD STEP     19  SUBSTEP      0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=     19  SUBSTEP=      1  CUMULATIVE ITERATION=   252
```

ENERCON SERVICES, INC. Appendix DN-2 to Calculation PGE-009-CALC-003

```
  TIME/FREQUENCY=  19.000
TITLE= Pad, LTSP(4), 20 Casks, 156 Kips West (X), Max Up, Hard Rock

SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=   17051

SORT COMPLETED FOR      14 VALUES.

PRINT DOF  NODAL SOLUTION PER NODE

   NODE       UX          UY          UZ
  13202  0.67677E-02 0.74629E-02-0.16855E-05
  13914  0.65405E-02 0.71864E-02-0.43871E-04
  12491  0.65400E-02 0.71835E-02 0.44795E-04
  14626  0.58269E-02 0.64564E-02-0.76524E-04
  11759  0.58262E-02 0.64510E-02 0.77119E-04
  11046  0.38101E-02 0.23614E-05 0.72071E-04
   8183  0.38090E-02-0.12716E-05-0.71403E-04
   3022  0.27673E-02-0.92069E-03 0.48579E-04
    159  0.27669E-02-0.92086E-03-0.48483E-04
   3735  0.25656E-02-0.10508E-02 0.84479E-04
   6602  0.25657E-02-0.10509E-02-0.84428E-04
   4467  0.29596E-02-0.12518E-02 0.70350E-04
   5890  0.29597E-02-0.12518E-02-0.70282E-04
   5178  0.30717E-02-0.13014E-02-0.27696E-05
===============================================================================
===============================================================================

EXIT THE ANSYS POST1 DATABASE PROCESSOR

***** ROUTINE COMPLETED *****  CP =        87.516


*** NOTE ***                              CP=      87.516   TIME= 17:12:22
A total of 1 warnings and errors written to dcslabs2.err.
```

Below is the ANSYS input file that scans the database for the maximum cask displacements for the very hard rock model.

```
/output,padvhardcaskd.out
/com
/file,dcslabh6
resume
/header,on,off,off,off,on,off
/post1
eall
nall
/com,
/com, This routine selects the nodes at the centerlines of the perimeter casks
/com,   and prints out the displacements for these nodes for all 19 load steps.
/com,
/COM ================================================================================
/COM ================================================================================
/COM
/COM =======================  SELECT NODES AT THE CL OF THE CASKS ==================
/COM
nsel,node,159
nasel,node,3022
nasel,node,3735
nasel,node,4467
nasel,node,5178
nasel,node,5890
nasel,node,6602
nasel,node,8183
nasel,node,11046
nasel,node,11759
nasel,node,12491
nasel,node,13202
nasel,node,13914
nasel,node,14626
/COM ================================================================================
/COM ================================================================================
/COM ==================================  SET 1  ====================================
set,1
nsort,u,y
prdi
/COM ================================================================================
/COM ================================================================================
/COM ==================================  SET 2  ====================================
set,2
nsort,u,y
prdi
/COM ================================================================================
/COM ================================================================================
/COM ==================================  SET 3  ====================================
set,3
nsort,u,y
prdi
/COM ================================================================================
```

```
/COM ==============================================================================
/COM ===================================  SET 4  ===================================
set,4
nsort,u,y
prdi
/COM ==============================================================================
/COM ==============================================================================
/COM ===================================  SET 5  ===================================
set,5
nsort,u,y
prdi
/COM ==============================================================================
/COM ==============================================================================
/COM ===================================  SET 6  ===================================
set,6
nsort,u,y
prdi
/COM ==============================================================================
/COM ==============================================================================
/COM ===================================  SET 7  ===================================
set,7
nsort,u,y
prdi
/COM ==============================================================================
/COM ==============================================================================
/COM ===================================  SET 8  ===================================
set,8
nsort,u,y
prdi
/COM ==============================================================================
/COM ==============================================================================
/COM ===================================  SET 9  ===================================
set,9
nsort,u,y
prdi
/COM ==============================================================================
/COM ==============================================================================
/COM ===================================  SET 10 ===================================
set,10
nsort,u,y
prdi
/COM ==============================================================================
/COM ==============================================================================
/COM ===================================  SET 11 ===================================
set,11
nsort,u,y
prdi
/COM ==============================================================================
/COM ==============================================================================
/COM ===================================  SET 12 ===================================
set,12
nsort,u,y
prdi
```

```
/COM ==============================================================================
/COM ==============================================================================
/COM ==================================  SET 13 ===================================
set,13
nsort,u,y
prdi
/COM ==============================================================================
/COM ==============================================================================
/COM ==================================  SET 14 ===================================
set,14
nsort,u,y
prdi
/COM ==============================================================================
/COM ==============================================================================
/COM ==================================  SET 15 ===================================
set,15
nsort,u,y
prdi
/COM ==============================================================================
/COM ==============================================================================
/COM ==================================  SET 16 ===================================
set,16
nsort,u,y
prdi
/COM ==============================================================================
/COM ==============================================================================
/COM ==================================  SET 17 ===================================
set,17
nsort,u,y
prdi
/COM ==============================================================================
/COM ==============================================================================
/COM ==================================  SET 18 ===================================
set,18
nsort,u,y
prdi
/COM ==============================================================================
/COM ==============================================================================
/COM ==================================  SET 19 ===================================
set,19
nsort,u,y
prdi
/COM ==============================================================================
/COM ==============================================================================
fini
/output
/exit
```

ENERCON SERVICES, INC. Appendix DN-2 to Calculation PGE-009-CALC-003

Below is the ANSYS output file for the maximum cask displacements for the very hard rock analyses:

```
CURRENT JOBNAME REDEFINED AS dcslabh6

RESUME ANSYS DATA FROM FILE NAME=dcslabh6.db

*** ANSYS GLOBAL STATUS ***

TITLE = Pad, LTSP(4), 20 Casks, 156 Kips West (X), Max Up, Very Hard Rock
ANALYSIS TYPE =  STATIC (STEADY-STATE)
NUMBER OF ELEMENT TYPES =      6
   9056 ELEMENTS CURRENTLY SELECTED.  MAX ELEMENT NUMBER =    33177
  11550 NODES CURRENTLY SELECTED.     MAX NODE NUMBER =       17051
    259 KEYPOINTS CURRENTLY SELECTED. MAX KEYPOINT NUMBER =     259
    250 LINES CURRENTLY SELECTED.     MAX LINE NUMBER =         396
    181 AREAS CURRENTLY SELECTED.     MAX AREA NUMBER =         295
     70 VOLUMES CURRENTLY SELECTED.   MAX VOL. NUMBER =          70
    11 COMPONENTS CURRENTLY DEFINED
MAXIMUM LINEAR PROPERTY NUMBER        =       5
MAXIMUM REAL CONSTANT SET NUMBER      =       6
ACTIVE COORDINATE SYSTEM              =       0  (CARTESIAN)
MAXIMUM CONSTRAINT EQUATION NUMBER    =    4620
NUMBER OF SPECIFIED CONSTRAINTS       =    2193
NUMBER OF NODAL LOADS                 =    2160

INITIAL JOBNAME = dcslabh6
CURRENT JOBNAME = dcslabh6


PRINT HEADER
DO NOT PRINT SUBTITLE(S)
DO NOT PRINT LOAD STEP ID
DO NOT PRINT NOTE LINE(S)
PRINT COLUMN HEADER LABELS
DO NOT PRINT REPORT TOTALS

***** ANSYS - ENGINEERING ANALYSIS SYSTEM  RELEASE 5.7     *****
ANSYS/Structural U
00150104          VERSION=INTEL NT      10:30:17  MAY 21, 2001 CP=      4.376

Pad, LTSP(4), 20 Casks, 156 Kips West (X), Max Up, Very Hard Rock


         ***** ANSYS RESULTS INTERPRETATION (POST1) *****

ENTER  /SHOW,DEVICE-NAME  TO ENABLE GRAPHIC DISPLAY
ENTER  FINISH             TO LEAVE POST1

*** NOTE ***                               CP=      4.376   TIME= 10:30:17
Reading results into the database (SET command) will update the current
 displacement and force boundary conditions in the database with the
 values from the results file for that load set.  Note that any
```

```
subsequent solutions will use these values unless action is taken to
either SAVE the current values or not overwrite them (/EXIT,NOSAVE).

  15348  ELEMENTS (OF    15348  DEFINED) SELECTED BY  EALL  COMMAND.

  17051  NODES (OF    17051  DEFINED) SELECTED BY NALL  COMMAND.

This routine selects the nodes at the centerlines of the perimeter casks
  and prints out the displacements for these nodes for all 19 load steps.

================================================================================
================================================================================

========================  SELECT NODES AT THE CL OF THE CASKS =================


NSEL   FOR LABEL= NODE   FROM    159 TO    159 BY     1

       1  NODES (OF    17051  DEFINED) SELECTED BY  NSEL  COMMAND.

NASE   FOR LABEL= NODE   FROM   3022 TO   3022 BY     1

       2  NODES (OF    17051  DEFINED) SELECTED BY  NASE  COMMAND.

NASE   FOR LABEL= NODE   FROM   3735 TO   3735 BY     1

       3  NODES (OF    17051  DEFINED) SELECTED BY  NASE  COMMAND.

NASE   FOR LABEL= NODE   FROM   4467 TO   4467 BY     1

       4  NODES (OF    17051  DEFINED) SELECTED BY  NASE  COMMAND.

NASE   FOR LABEL= NODE   FROM   5178 TO   5178 BY     1

       5  NODES (OF    17051  DEFINED) SELECTED BY  NASE  COMMAND.

NASE   FOR LABEL= NODE   FROM   5890 TO   5890 BY     1

       6  NODES (OF    17051  DEFINED) SELECTED BY  NASE  COMMAND.

NASE   FOR LABEL= NODE   FROM   6602 TO   6602 BY     1

       7  NODES (OF    17051  DEFINED) SELECTED BY  NASE  COMMAND.

NASE   FOR LABEL= NODE   FROM   8183 TO   8183 BY     1

       8  NODES (OF    17051  DEFINED) SELECTED BY  NASE  COMMAND.

NASE   FOR LABEL= NODE   FROM 11046 TO 11046 BY     1

       9  NODES (OF    17051  DEFINED) SELECTED BY  NASE  COMMAND.

NASE   FOR LABEL= NODE   FROM 11759 TO 11759 BY     1
```

```
      10  NODES (OF    17051  DEFINED) SELECTED BY  NASE  COMMAND.

NASE  FOR LABEL= NODE  FROM 12491 TO 12491 BY    1

      11  NODES (OF    17051  DEFINED) SELECTED BY  NASE  COMMAND.

NASE  FOR LABEL= NODE  FROM 13202 TO 13202 BY    1

      12  NODES (OF    17051  DEFINED) SELECTED BY  NASE  COMMAND.

NASE  FOR LABEL= NODE  FROM 13914 TO 13914 BY    1

      13  NODES (OF    17051  DEFINED) SELECTED BY  NASE  COMMAND.

NASE  FOR LABEL= NODE  FROM 14626 TO 14626 BY    1

      14  NODES (OF    17051  DEFINED) SELECTED BY  NASE  COMMAND.
===============================================================================
===============================================================================
===================================  SET 1  ===================================


USE LOAD STEP     1  SUBSTEP     0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=     1  SUBSTEP=     1  CUMULATIVE ITERATION=     2
  TIME/FREQUENCY=  1.0000
TITLE= Pad, Gravity, 20 Casks, Very Hard Rock

SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=   17051

SORT COMPLETED FOR      14 VALUES.

PRINT DOF  NODAL SOLUTION PER NODE

   NODE      UX          UY          UZ
  11759  0.26914E-03-0.14995E-02-0.32977E-03
   3735 -0.26914E-03-0.14995E-02-0.32977E-03
  14626  0.26914E-03-0.14995E-02 0.32977E-03
   6602 -0.26914E-03-0.14995E-02 0.32977E-03
  12491  0.32542E-03-0.17711E-02-0.14923E-03
  13914  0.32542E-03-0.17711E-02 0.14923E-03
   4467 -0.32542E-03-0.17711E-02-0.14923E-03
   5890 -0.32542E-03-0.17711E-02 0.14923E-03
   8183  0.97119E-04-0.17835E-02-0.37368E-03
    159 -0.97119E-04-0.17835E-02-0.37368E-03
  11046  0.97119E-04-0.17835E-02 0.37368E-03
   3022 -0.97119E-04-0.17835E-02 0.37368E-03
  13202  0.34362E-03-0.18427E-02 0.14098E-06
   5178 -0.34362E-03-0.18427E-02 0.14098E-06
===============================================================================
===============================================================================
===================================  SET 2  ===================================
```

```
USE LOAD STEP      2  SUBSTEP      0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=      2  SUBSTEP=      1  CUMULATIVE ITERATION=     17
  TIME/FREQUENCY=  2.0000
TITLE= Pad, HE(1), 20 Casks, 515 Kips North (Z), Very Hard Rock

SORT ON ITEM=U      COMPONENT=Y      ORDER= 0  KABS= 0  NMAX=    17051

SORT COMPLETED FOR       14 VALUES.

PRINT DOF  NODAL SOLUTION PER NODE

   NODE       UX           UY           UZ
  14626  0.15991E-03 0.41046E-02 0.73726E-02
   6602 -0.15991E-03 0.41046E-02 0.73726E-02
   3022 -0.10460E-03 0.39005E-02 0.76401E-02
  11046  0.10460E-03 0.39005E-02 0.76401E-02
  13914  0.20138E-03-0.10760E-02 0.41609E-02
   5890 -0.20138E-03-0.10760E-02 0.41609E-02
  13202  0.23798E-03-0.13847E-02 0.35184E-02
   5178 -0.23798E-03-0.13847E-02 0.35184E-02
  12491  0.21592E-03-0.16367E-02 0.31418E-02
   4467 -0.21592E-03-0.16367E-02 0.31418E-02
  11759  0.16481E-03-0.17420E-02 0.26260E-02
   3735 -0.16481E-03-0.17420E-02 0.26260E-02
   8183  0.57095E-04-0.20616E-02 0.29232E-02
    159 -0.57095E-04-0.20616E-02 0.29232E-02
================================================================================
================================================================================
===================================  SET 3  ====================================

USE LOAD STEP      3  SUBSTEP      0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=      3  SUBSTEP=      1  CUMULATIVE ITERATION=     32
  TIME/FREQUENCY=  3.0000
TITLE= Pad, HE(1), 20 Casks, 515 Kips N 32.93 W (Z,X), Very Hard Rock

SORT ON ITEM=U      COMPONENT=Y      ORDER= 0  KABS= 0  NMAX=    17051

SORT COMPLETED FOR       14 VALUES.

PRINT DOF  NODAL SOLUTION PER NODE

   NODE       UX           UY           UZ
  14626  0.62141E-02 0.12714E-01 0.75992E-02
  11046  0.40544E-02 0.41919E-02 0.66896E-02
  13914  0.52303E-02 0.31999E-02 0.50974E-02
   3022  0.26649E-02 0.12681E-02 0.53669E-02
  13202  0.41532E-02 0.54330E-03 0.34520E-02
   6602  0.24399E-02-0.11152E-03 0.40328E-02
```

```
   12491  0.34440E-02-0.26965E-03 0.28443E-02
   11759  0.25022E-02-0.92172E-03 0.24075E-02
    5890  0.20748E-02-0.16027E-02 0.30911E-02
    5178  0.20206E-02-0.18209E-02 0.28997E-02
    8183  0.18702E-02-0.18791E-02 0.24529E-02
    3735  0.16261E-02-0.19827E-02 0.22180E-02
    4467  0.19092E-02-0.20038E-02 0.26542E-02
     159  0.16842E-02-0.20246E-02 0.24397E-02
================================================================================
================================================================================
===================================  SET 4  ====================================

USE LOAD STEP     4  SUBSTEP     0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=     4  SUBSTEP=     1  CUMULATIVE ITERATION=    39
  TIME/FREQUENCY=  4.0000
TITLE= Pad, HE(1), 20 Casks, 515 Kips N 45 W (Z,X), Very Hard Rock

SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=   17051

SORT COMPLETED FOR      14 VALUES.

PRINT DOF  NODAL SOLUTION PER NODE

   NODE       UX          UY          UZ
   14626  0.84195E-02 0.14817E-01 0.62298E-02
   13914  0.77063E-02 0.65603E-02 0.45662E-02
   11046  0.52501E-02 0.32221E-02 0.52961E-02
   13202  0.65959E-02 0.32113E-02 0.32634E-02
   12491  0.54683E-02 0.15511E-02 0.27051E-02
   11759  0.38926E-02 0.57587E-04 0.23724E-02
    3022  0.31944E-02-0.22565E-04 0.38945E-02
    6602  0.27299E-02-0.91048E-03 0.28132E-02
    5890  0.27289E-02-0.17574E-02 0.25054E-02
    8183  0.25526E-02-0.17583E-02 0.20877E-02
    5178  0.27199E-02-0.19563E-02 0.24198E-02
     159  0.22561E-02-0.19606E-02 0.20361E-02
    3735  0.21898E-02-0.20096E-02 0.18576E-02
    4467  0.25771E-02-0.20941E-02 0.22350E-02
================================================================================
================================================================================
===================================  SET 5  ====================================

USE LOAD STEP     5  SUBSTEP     0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=     5  SUBSTEP=     1  CUMULATIVE ITERATION=    46
  TIME/FREQUENCY=  5.0000
TITLE= Pad, HE(1), 20 Casks, 515 Kips N 57.07 W (Z,X), Very Hard Rock

SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=   17051
```

```
SORT COMPLETED FOR      14 VALUES.

PRINT DOF  NODAL SOLUTION PER NODE

   NODE       UX           UY           UZ
  14626   0.10053E-01 0.15531E-01 0.42961E-02
  13914   0.98102E-02 0.99017E-02 0.34898E-02
  13202   0.89168E-02 0.67691E-02 0.28128E-02
  12491   0.75931E-02 0.42643E-02 0.25079E-02
  11046   0.59853E-02 0.19503E-02 0.35738E-02
  11759   0.55404E-02 0.16982E-02 0.23153E-02
   3022   0.34412E-02-0.96303E-03 0.24446E-02
   6602   0.28992E-02-0.13666E-02 0.18646E-02
   8183   0.32324E-02-0.16027E-02 0.16422E-02
    159   0.27520E-02-0.18744E-02 0.15342E-02
   5890   0.32470E-02-0.18927E-02 0.18662E-02
   3735   0.26608E-02-0.20005E-02 0.14065E-02
   5178   0.32908E-02-0.20685E-02 0.18437E-02
   4467   0.31308E-02-0.21530E-02 0.17154E-02
===============================================================================
===============================================================================
==================================  SET 6  ====================================

USE LOAD STEP     6  SUBSTEP     0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=     6  SUBSTEP=     1  CUMULATIVE ITERATION=    58
  TIME/FREQUENCY=  6.0000
TITLE= Pad, HE(1), 20 Casks, 515 Kips West (W), Very Hard Rock

SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=   17051

SORT COMPLETED FOR      14 VALUES.

PRINT DOF  NODAL SOLUTION PER NODE

   NODE       UX           UY           UZ
  13202   0.12132E-01 0.13108E-01-0.15841E-04
  13914   0.11661E-01 0.12406E-01-0.35794E-03
  12491   0.11661E-01 0.12403E-01 0.35881E-03
  14626   0.10097E-01 0.10533E-01-0.63440E-03
  11759   0.10096E-01 0.10528E-01 0.63500E-03
  11046   0.53510E-02-0.46913E-03 0.52366E-04
   8183   0.53496E-02-0.47138E-03-0.51658E-04
   3022   0.35822E-02-0.15483E-02 0.19426E-03
    159   0.35820E-02-0.15484E-02-0.19420E-03
   3735   0.33198E-02-0.18029E-02-0.13373E-03
   6602   0.33199E-02-0.18029E-02 0.13375E-03
   4467   0.38720E-02-0.21452E-02-0.30111E-04
   5890   0.38720E-02-0.21452E-02 0.30142E-04
   5178   0.40089E-02-0.22344E-02-0.14194E-05
===============================================================================
===============================================================================
```

ENERCON
SERVICES, INC.

Appendix DN-2 to Calculation PGE-009-CALC-003

```
==================================  SET 7  ==================================

USE LOAD STEP     7  SUBSTEP     0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=     7  SUBSTEP=     1  CUMULATIVE ITERATION=    80
  TIME/FREQUENCY=  7.0000
TITLE= Pad, HE(1), 20 Casks, 206 Kips North (z), Max Up, Very Hard Rock

SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=   17051

SORT COMPLETED FOR      14 VALUES.

PRINT DOF  NODAL SOLUTION PER NODE

   NODE      UX          UY          UZ
  14626  0.13159E-03 0.16427E-04 0.19894E-02
   6602 -0.13123E-03 0.15313E-04 0.19889E-02
  11046  0.58808E-04-0.10488E-03 0.21111E-02
   3022 -0.58496E-04-0.10522E-03 0.21109E-02
  13914  0.14272E-03-0.65688E-03 0.15485E-02
   5890 -0.14267E-03-0.65691E-03 0.15484E-02
  13202  0.14564E-03-0.76323E-03 0.14554E-02
   5178 -0.14562E-03-0.76323E-03 0.14554E-02
  12491  0.13004E-03-0.86189E-03 0.13264E-02
   4467 -0.13003E-03-0.86189E-03 0.13264E-02
  11759  0.10001E-03-0.88228E-03 0.11071E-02
   3735 -0.10000E-03-0.88228E-03 0.11071E-02
   8183  0.34488E-04-0.10444E-02 0.12337E-02
    159 -0.34484E-04-0.10444E-02 0.12337E-02
=============================================================================
=============================================================================
==================================  SET 8  ==================================

USE LOAD STEP     8  SUBSTEP     0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=     8  SUBSTEP=     1  CUMULATIVE ITERATION=    99
  TIME/FREQUENCY=  8.0000
TITLE= Pad, HE(1), 20 Casks, 206 Kips West (X), Max Up, Very Hard Rock

SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=   17051

SORT COMPLETED FOR      14 VALUES.

PRINT DOF  NODAL SOLUTION PER NODE

   NODE      UX          UY          UZ
  13202  0.36986E-02 0.16457E-02-0.27203E-05
  13914  0.35333E-02 0.15116E-02-0.28257E-04
  12491  0.35333E-02 0.15115E-02 0.28259E-04
  14626  0.29664E-02 0.11351E-02-0.50395E-04
  11759  0.29664E-02 0.11351E-02 0.50389E-04
```

ENERCON SERVICES, INC. Appendix DN-2 to Calculation PGE-009-CALC-003

```
  11046  0.16921E-02-0.69356E-03 0.11848E-03
   8183  0.16920E-02-0.69356E-03-0.11848E-03
    159  0.14128E-02-0.83401E-03-0.13201E-03
   3022  0.14128E-02-0.83401E-03 0.13201E-03
   3735  0.13433E-02-0.90985E-03-0.93192E-04
   6602  0.13433E-02-0.90985E-03 0.93192E-04
   4467  0.15602E-02-0.10772E-02-0.30276E-04
   5890  0.15602E-02-0.10772E-02 0.30276E-04
   5178  0.16139E-02-0.11211E-02-0.17641E-06
================================================================================
================================================================================
===================================  SET 9  ====================================

USE LOAD STEP     9  SUBSTEP     0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=     9  SUBSTEP=     1  CUMULATIVE ITERATION=   103
  TIME/FREQUENCY=  9.0000
TITLE= Pad, HE(3), 20 Casks, 171.2 Kips North (Z), Max Dn, Very Hard Rock

SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=   17051

SORT COMPLETED FOR      14 VALUES.

PRINT DOF  NODAL SOLUTION PER NODE

   NODE       UX           UY           UZ
  14626  0.49231E-03-0.25179E-02 0.17231E-02
   6602 -0.49234E-03-0.25179E-02 0.17231E-02
  11759  0.45861E-03-0.29162E-02 0.48693E-03
   3735 -0.45864E-03-0.29162E-02 0.48693E-03
  11046  0.18058E-03-0.29973E-02 0.19346E-02
   3022 -0.18058E-03-0.29973E-02 0.19346E-02
   5890 -0.59076E-03-0.31524E-02 0.15009E-02
  13914  0.59073E-03-0.31524E-02 0.15009E-02
  12491  0.57295E-03-0.33257E-02 0.94499E-03
   4467 -0.57296E-03-0.33257E-02 0.94499E-03
  13202  0.61680E-03-0.33520E-02 0.12596E-02
   5178 -0.61681E-03-0.33520E-02 0.12596E-02
   8183  0.16626E-03-0.34608E-02 0.53458E-03
    159 -0.16626E-03-0.34608E-02 0.53458E-03
================================================================================
================================================================================
===================================  SET 10 ====================================

USE LOAD STEP    10  SUBSTEP     0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=    10  SUBSTEP=     1  CUMULATIVE ITERATION=   106
  TIME/FREQUENCY=  10.000
TITLE= Pad, HE(3), 20 Casks, 171.2 Kips West (X), Max Dn, Very Hard Rock

SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=   17051
```

```
SORT COMPLETED FOR       14 VALUES.

PRINT DOF  NODAL SOLUTION PER NODE

   NODE       UX             UY            UZ
  14626  0.17206E-02-0.24970E-02 0.65073E-03
  11759  0.17205E-02-0.24970E-02-0.65067E-03
   3735  0.77053E-03-0.29370E-02-0.58515E-03
   6602  0.77054E-03-0.29370E-02 0.58516E-03
  12491  0.20250E-02-0.29708E-02-0.30219E-03
  13914  0.20250E-02-0.29708E-02 0.30220E-03
  13202  0.21095E-02-0.30948E-02-0.74582E-06
   8183  0.13789E-02-0.31823E-02-0.70738E-03
  11046  0.13789E-02-0.31823E-02 0.70739E-03
    159  0.10322E-02-0.32757E-02-0.69250E-03
   3022  0.10322E-02-0.32757E-02 0.69250E-03
   4467  0.86248E-03-0.35071E-02-0.25369E-03
   5890  0.86248E-03-0.35071E-02 0.25369E-03
   5178  0.87786E-03-0.36558E-02-0.13663E-05
===============================================================================
===============================================================================
==================================  SET 11  ====================================


USE LOAD STEP     11  SUBSTEP     0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=     11  SUBSTEP=      1  CUMULATIVE ITERATION=    122
  TIME/FREQUENCY=  11.000
TITLE= Pad, LTSP(2), 20 Casks, 440 Kips North (Z), Very Hard Rock

SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=   17051

SORT COMPLETED FOR       14 VALUES.

PRINT DOF  NODAL SOLUTION PER NODE

   NODE       UX             UY            UZ
  14626  0.16423E-03 0.30752E-02 0.64451E-02
   6602 -0.16423E-03 0.30752E-02 0.64451E-02
   3022 -0.10178E-03 0.28695E-02 0.66997E-02
  11046  0.10178E-03 0.28695E-02 0.66997E-02
  13914  0.19722E-03-0.10322E-02 0.37719E-02
   5890 -0.19722E-03-0.10322E-02 0.37719E-02
  13202  0.22466E-03-0.12978E-02 0.32538E-02
   5178 -0.22466E-03-0.12978E-02 0.32538E-02
  12491  0.20122E-03-0.15137E-02 0.29206E-02
   4467 -0.20122E-03-0.15137E-02 0.29206E-02
  11759  0.14957E-03-0.15916E-02 0.24522E-02
   3735 -0.14957E-03-0.15916E-02 0.24522E-02
   8183  0.51577E-04-0.18828E-02 0.27338E-02
    159 -0.51577E-04-0.18828E-02 0.27338E-02
===============================================================================
```

ENERCON
SERVICES, INC. Appendix DN-2 to Calculation PGE-009-CALC-003

```
================================================================================
===================================  SET 12  ===================================


USE LOAD STEP    12   SUBSTEP     0   FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=    12   SUBSTEP=     1  CUMULATIVE ITERATION=   136
  TIME/FREQUENCY=  12.000
TITLE= Pad, LTSP(2), 20 Casks, 440 Kips N 32.93 W (Z,X), Very Hard Rock

SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=   17051

SORT COMPLETED FOR      14 VALUES.

PRINT DOF  NODAL SOLUTION PER NODE

   NODE       UX           UY           UZ
  14626  0.52259E-02 0.93959E-02 0.65703E-02
  11046  0.33754E-02 0.27545E-02 0.57651E-02
  13914  0.43580E-02 0.19011E-02 0.43337E-02
   3022  0.22861E-02 0.70097E-03 0.46754E-02
  13202  0.35270E-02 0.11962E-03 0.30555E-02
   6602  0.21191E-02-0.29022E-03 0.35729E-02
  12491  0.30047E-02-0.43895E-03 0.25848E-02
  11759  0.22403E-02-0.91256E-03 0.21920E-02
   5890  0.18711E-02-0.14887E-02 0.28351E-02
   5178  0.18409E-02-0.16847E-02 0.26809E-02
   8183  0.17262E-02-0.17211E-02 0.22803E-02
   3735  0.15070E-02-0.18077E-02 0.20689E-02
   4467  0.17513E-02-0.18400E-02 0.24633E-02
    159  0.15655E-02-0.18513E-02 0.22755E-02
================================================================================
================================================================================
===================================  SET 13  ===================================


USE LOAD STEP    13   SUBSTEP     0   FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=    13   SUBSTEP=     1  CUMULATIVE ITERATION=   142
  TIME/FREQUENCY=  13.000
TITLE= Pad, LTSP(2), 20 Casks, 440 Kips N 45 W (Z,X), Very Hard Rock

SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=   17051

SORT COMPLETED FOR      14 VALUES.

PRINT DOF  NODAL SOLUTION PER NODE

   NODE       UX           UY           UZ
  14626  0.70751E-02 0.10994E-01 0.54197E-02
  13914  0.64375E-02 0.44050E-02 0.38834E-02
  13202  0.55569E-02 0.20663E-02 0.28228E-02
  11046  0.43617E-02 0.19503E-02 0.45639E-02
```

```
  12491   0.47036E-02 0.94615E-03 0.23874E-02
  11759   0.34314E-02-0.13091E-03 0.20984E-02
   3022   0.27716E-02-0.29126E-03 0.34159E-02
   6602   0.24177E-02-0.91686E-03 0.25429E-02
   8183   0.23395E-02-0.16160E-02 0.19278E-02
   5890   0.24707E-02-0.16253E-02 0.23092E-02
    159   0.20905E-02-0.17956E-02 0.18952E-02
   5178   0.24785E-02-0.18044E-02 0.22393E-02
   3735   0.20248E-02-0.18325E-02 0.17321E-02
   4467   0.23614E-02-0.19204E-02 0.20736E-02
===============================================================================
===============================================================================
===================================  SET 14 ====================================


USE LOAD STEP     14  SUBSTEP      0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=     14  SUBSTEP=      1  CUMULATIVE ITERATION=   149
  TIME/FREQUENCY=  14.000
TITLE= Pad, LTSP(2), 20 Casks, 440 Kips N 57.03 W (Z,X), Very Hard Rock

SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=    17051

SORT COMPLETED FOR       14 VALUES.

PRINT DOF  NODAL SOLUTION PER NODE

   NODE      UX          UY          UZ
  14626   0.84149E-02 0.11429E-01 0.38062E-02
  13914   0.81822E-02 0.68306E-02 0.29998E-02
  13202   0.74775E-02 0.45853E-02 0.23752E-02
  12491   0.64564E-02 0.29328E-02 0.21074E-02
  11759   0.48040E-02 0.11344E-02 0.19554E-02
  11046   0.49453E-02 0.94387E-03 0.31009E-02
   3022   0.30237E-02-0.98776E-03 0.21940E-02
   6602   0.26185E-02-0.12766E-02 0.17210E-02
   8183   0.29298E-02-0.14840E-02 0.14920E-02
    159   0.25392E-02-0.17200E-02 0.14212E-02
   5890   0.29456E-02-0.17453E-02 0.17272E-02
   3735   0.24537E-02-0.18257E-02 0.13092E-02
   5178   0.29962E-02-0.19041E-02 0.17066E-02
   4467   0.28635E-02-0.19735E-02 0.15894E-02
===============================================================================
===============================================================================
===================================  SET 15 ====================================


USE LOAD STEP     15  SUBSTEP      0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=     15  SUBSTEP=      1  CUMULATIVE ITERATION=   161
  TIME/FREQUENCY=  15.000
TITLE= Pad, LTSP(2), 20 Casks, 440 Kips West (X), Very Hard Rock
```

ENERCON
SERVICES, INC. Appendix DN-2 to Calculation PGE-009-CALC-003

```
SORT ON ITEM=U      COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=    17051

SORT COMPLETED FOR       14 VALUES.

PRINT DOF  NODAL SOLUTION PER NODE

   NODE       UX           UY           UZ
  13202  0.10129E-01 0.92667E-02-0.10312E-04
  13914  0.97491E-02 0.87823E-02-0.20749E-03
  12491  0.97481E-02 0.87782E-02 0.20903E-03
  14626  0.84664E-02 0.75292E-02-0.34840E-03
  11759  0.84650E-02 0.75210E-02 0.34936E-03
  11046  0.45051E-02-0.74842E-03 0.12668E-03
   8183  0.45025E-02-0.75229E-03-0.12604E-03
   3022  0.32451E-02-0.14361E-02 0.19827E-03
    159  0.32447E-02-0.14362E-02-0.19820E-03
   3735  0.30342E-02-0.16545E-02-0.13025E-03
   6602  0.30343E-02-0.16545E-02 0.13029E-03
   4467  0.35208E-02-0.19700E-02-0.32162E-04
   5890  0.35208E-02-0.19700E-02 0.32215E-04
   5178  0.36421E-02-0.20522E-02-0.13675E-05
===============================================================================
===============================================================================
==================================  SET 16  ===================================


USE LOAD STEP     16   SUBSTEP      0   FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=     16   SUBSTEP=      1   CUMULATIVE ITERATION=    186
  TIME/FREQUENCY=  16.000
TITLE= Pad, LTSP(2), 20 Casks, 176 Kips North (Z), Max Up, Very Hard Rock

SORT ON ITEM=U      COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=    17051

SORT COMPLETED FOR       14 VALUES.

PRINT DOF  NODAL SOLUTION PER NODE

   NODE       UX           UY           UZ
  14626  0.69534E-04 0.14295E-02 0.28905E-02
   6602 -0.69534E-04 0.14295E-02 0.28905E-02
   3022 -0.44063E-04 0.13406E-02 0.30056E-02
  11046  0.44063E-04 0.13406E-02 0.30056E-02
  13914  0.80817E-04-0.42450E-03 0.16918E-02
   5890 -0.80817E-04-0.42450E-03 0.16918E-02
  13202  0.92090E-04-0.53901E-03 0.14568E-02
   5178 -0.92090E-04-0.53901E-03 0.14568E-02
  12491  0.81351E-04-0.62699E-03 0.13111E-02
   4467 -0.81351E-04-0.62699E-03 0.13111E-02
  11759  0.58271E-04-0.65890E-03 0.11099E-02
   3735 -0.58271E-04-0.65890E-03 0.11099E-02
   8183  0.19885E-04-0.77928E-03 0.12397E-02
    159 -0.19885E-04-0.77928E-03 0.12397E-02
```

```
===============================================================================
===============================================================================
==================================  SET 17  ===================================

USE LOAD STEP    17  SUBSTEP     0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=    17  SUBSTEP=     3  CUMULATIVE ITERATION=   257
  TIME/FREQUENCY=  17.000
TITLE= Pad, LTSP(2), 20 Casks, 176 Kips West (X), Max Up, Very Hard Rock

SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=   17051

SORT COMPLETED FOR      14 VALUES.

PRINT DOF  NODAL SOLUTION PER NODE

   NODE      UX          UY          UZ
  13202  0.43869E-02 0.40415E-02-0.39809E-05
  13914  0.42340E-02 0.38564E-02-0.72125E-04
  12491  0.42339E-02 0.38560E-02 0.72332E-04
  14626  0.37165E-02 0.33850E-02-0.11788E-03
  11759  0.37164E-02 0.33840E-02 0.11795E-03
  11046  0.20204E-02-0.27861E-03 0.58217E-04
   8183  0.20200E-02-0.27934E-03-0.58303E-04
   3022  0.14551E-02-0.59631E-03 0.80848E-04
    159  0.14551E-02-0.59633E-03-0.80845E-04
   6602  0.13554E-02-0.69202E-03 0.48826E-04
   3735  0.13554E-02-0.69202E-03-0.48822E-04
   5890  0.15635E-02-0.82246E-03 0.10884E-04
   4467  0.15635E-02-0.82246E-03-0.10878E-04
   5178  0.16159E-02-0.85650E-03-0.65767E-06
===============================================================================
===============================================================================
==================================  SET 18  ===================================

USE LOAD STEP    18  SUBSTEP     0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=    18  SUBSTEP=     3  CUMULATIVE ITERATION=   338
  TIME/FREQUENCY=  18.000
TITLE= Pad, LTSP(4), 20 Casks, 156 Kips North (Z), Max Up, Very Hard Rock

SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=   17051

SORT COMPLETED FOR      14 VALUES.

PRINT DOF  NODAL SOLUTION PER NODE

   NODE      UX          UY          UZ
  14626  0.51835E-04 0.21591E-02 0.30013E-02
   6602 -0.51742E-04 0.21586E-02 0.30012E-02
  11046  0.39450E-04 0.20798E-02 0.31076E-02
```

ENERCON SERVICES, INC. Appendix DN-2 to Calculation PGE-009-CALC-003

```
    3022 -0.39306E-04 0.20796E-02 0.31076E-02
   13914  0.52679E-04-0.25410E-03 0.17179E-02
    5890 -0.52659E-04-0.25435E-03 0.17177E-02
    5178 -0.68046E-04-0.41044E-03 0.13944E-02
   13202  0.68051E-04-0.41044E-03 0.13944E-02
    4467 -0.60100E-04-0.49248E-03 0.12498E-02
   12491  0.60103E-04-0.49248E-03 0.12498E-02
   11759  0.42236E-04-0.53723E-03 0.10696E-02
    3735 -0.42235E-04-0.53723E-03 0.10696E-02
     159 -0.13927E-04-0.63607E-03 0.11958E-02
    8183  0.13928E-04-0.63607E-03 0.11958E-02
================================================================================
================================================================================
===================================  SET 19 ====================================


USE LOAD STEP     19  SUBSTEP     0  FOR LOAD CASE 0

SET COMMAND GOT LOAD STEP=     19  SUBSTEP=     3  CUMULATIVE ITERATION=   412
  TIME/FREQUENCY=  19.000
TITLE= Pad, LTSP(4), 20 Casks, 156 Kips West (X), Max Up, Very Hard Rock

SORT ON ITEM=U     COMPONENT=Y     ORDER= 0  KABS= 0  NMAX=   17051

SORT COMPLETED FOR      14 VALUES.

PRINT DOF  NODAL SOLUTION PER NODE

   NODE       UX           UY           UZ
  13202  0.49370E-02 0.65705E-02-0.63988E-05
  13914  0.47659E-02 0.62738E-02-0.16591E-03
  12491  0.47659E-02 0.62737E-02 0.16594E-03
  14626  0.42158E-02 0.54603E-02-0.30501E-03
  11759  0.42158E-02 0.54602E-02 0.30501E-03
  11046  0.24034E-02 0.24169E-03-0.34343E-04
   8183  0.24033E-02 0.24160E-03 0.34346E-04
   3022  0.14750E-02-0.46950E-03 0.37930E-04
    159  0.14749E-02-0.46950E-03-0.37930E-04
   3735  0.13278E-02-0.57497E-03-0.17641E-04
   6602  0.13278E-02-0.57497E-03 0.17642E-04
   4467  0.15291E-02-0.67422E-03 0.23797E-05
   5890  0.15291E-02-0.67422E-03-0.23788E-05
   5178  0.15807E-02-0.70048E-03-0.50913E-06
================================================================================
================================================================================

EXIT THE ANSYS POST1 DATABASE PROCESSOR


***** ROUTINE COMPLETED *****  CP =        46.517
```

```
*** NOTE ***                                    CP=      46.527   TIME= 10:31:17
A total of 1 warnings and errors written to dcslabh6.err.
```