

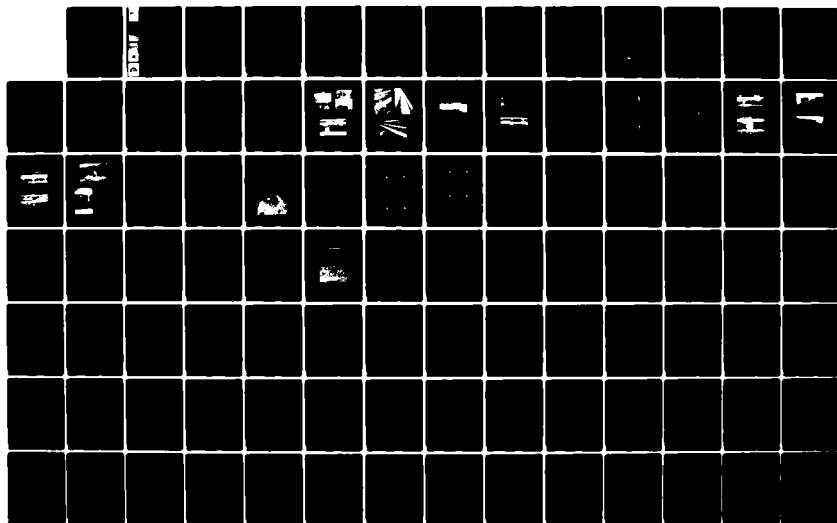
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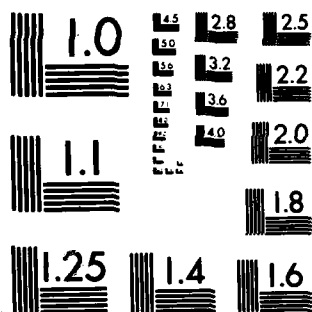
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CONDITION EVALUATION OF SUPERSONIC NAVAL ORDNANCE RESEARCH TRACK (SNORT)

by

Billy R. Sullivan, Carl E. Pace, Roy L. Campbell

Structures Laboratory

U. S. Army Engineer Waterways Experiment Station
P. O. Box 631, Vicksburg, Miss. 39180



February 1984

Final Report

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Prepared for Naval Weapons Center
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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER Miscellaneous Paper SL-84-1	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) CONDITION EVALUATION OF SUPERSONIC NAVAL ORDNANCE RESEARCH TRACK (SNORT)		5. TYPE OF REPORT & PERIOD COVERED Final report
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Billy R. Sullivan Carl E. Pace Roy L. Campbell		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS U. S. Army Engineer Waterways Experiment Station Structures Laboratory P. O. Box 631, Vicksburg, Miss. 39180		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS Naval Weapons Center China Lake, Calif.		12. REPORT DATE February 1984
		13. NUMBER OF PAGES 274
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		15. SECURITY CLASS. (of this report) Unclassified
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report) Approved for public release; distribution unlimited.		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES Available from the National Technical Information Service, 5285 Port Royal Road, Springfield, Va. 22161		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Concrete deterioration Foundation tests Concrete tests Structural analysis Corrosion		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) In December 1981, the Waterways Experiment Station, at the request of the Naval Weapons Center, began an evaluation of the condition of the Super- sonic Naval Ordnance Research Track (SNORT) at China Lake, California. The evaluation included both theoretical analysis and field tests. The concrete, soil, and water were sampled and tested in the laboratory. Nondestructive tests were used to determine locations for coring concrete and to develop a condition profile for the structure.		

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20. ABSTRACT (Continued).

> Load tests were conducted on the structure to determine deflections for comparison with analytical calculations. These comparisons show that deterioration has not reduced the structural capacity seriously at this time.

Laboratory tests show the concrete to be severely deteriorated at some locations and sound at other locations only inches away. The concrete is severely cracked, corrosion of the reinforcement is occurring, and alkali-silica reaction is evident throughout the structure. The deterioration is expected to progress and accelerate as moisture migration to the interior of the concrete increases due to crack growth and further deterioration.

The deteriorated condition of the existing track dictated a recommendation for replacement; therefore, a preliminary design for a new track was accomplished. The existing track should remain usable at current loading during construction of a new track.

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PREFACE

The investigation reported herein was conducted for the Department of the Navy, Naval Weapons Center, China Lake, California, by the Concrete Technology Division (CTD) of the Structures Laboratory (SL), U. S. Army Engineer Waterways Experiment Station (WES). Authorization for the investigation was given in MIPR N60530 80 MP70026 dated 21 March 1980, MIPR N 60530 80 MP70074 dated 22 September 1980, and in a letter from the Commander, Naval Weapons Center, China Lake, California, Ser. No. 9197 dated 20 November 1981.

The investigation was accomplished under the direction of Messrs. Bryant Mather, Chief, SL; William Flathau, Assistant Chief, SL; John M. Scanlon, Chief, CTD; and James E. McDonald, Chief, Evaluation and Monitoring Group, CTD; and under the direct supervision of Mr. Billy R. Sullivan, who served as principal investigator. The concrete coring, soil sampling and characterization, and load and deflection measurements were accomplished by Naval Weapons Center personnel under the supervision of Messrs. Winfred E. Johnson, Head, Track Operations Branch, and Rodney Kanagawa, Public Works Department of the Naval Weapons Center. The in situ pressure meter work was done under contract by Briand Engineers, College Station, Texas.

Members of the WES staff who participated in the performance of the work were Messrs. R. L. Campbell, A. M. Alexander, Tony Husbands, and G. S. Wong and Dr. Carl E. Pace. Dr. Pace was responsible for the structural analysis and supervision of the in situ pressure meter work and analysis. This report was written by Mr. Sullivan, Dr. Pace, and Mr. Campbell.

Commanders and Directors of WES during this investigation and the preparation and publication of this report were COL Nelson P. Conover, CE, and COL Tilford C. Creel, CE. Technical Director was Mr. F. R. Brown.

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CONVERSION FACTORS, NON-SI TO SI (METRIC) UNITS OF MEASUREMENT

Non-SI units of measurement used in this report can be converted to SI (metric) units as follows:

Multiply	By	To Obtain
cubic feet	0.02831685	cubic metres
cubic yards	0.7645549	cubic metres
degrees (angular)	0.1745329	radians
feet	0.3048	metres
feet per minute	0.00508	metres per second
feet per second	0.3048	metres per second
foot-kips (force)	1355.818	joules
foot-pounds	0.04214011	joules
g, standard free fall	9.806650E+00	metres per second squared
gallons	0.003785412	cubic metres
gallons per minute	0.00006309020	cubic metres per second
inches	0.0254	metres
inches per pound (force)	0.00571015	metres per newton
inch-kips	112.98484	newton metres
inch-pounds (force)	0.1129848	newton metres
kips (force)	4448.222	newtons
kips (force) per square foot	47.88026	kilopascals
microinches per inch	1.0	micrometres per metre
miles (U. S. statute)	1.609344	kilometres
pounds (force)	4.448222	newtons
pounds (force) per foot	14.59390	newtons per metre
pounds (force) per cubic inch	271.46	newtons per cubic metre
pounds (force) per square foot	47.88026	pascals
pounds (force) per square inch	6.894757	kilopascals
pounds (mass)	0.4535924	kilograms
pounds (mass) per cubic foot	16.01846	kilograms per cubic metre
pounds (mass) per cubic yard	0.5932764	kilograms per cubic metre
pounds (mass) per yard	0.41476489	kilograms per metre
square feet	0.09290304	square metres
square inches	0.0006452	square metres
tons (force) per square foot	0.09576052	megapascals
tons (2000 lb, mass)	907.1847	kilograms

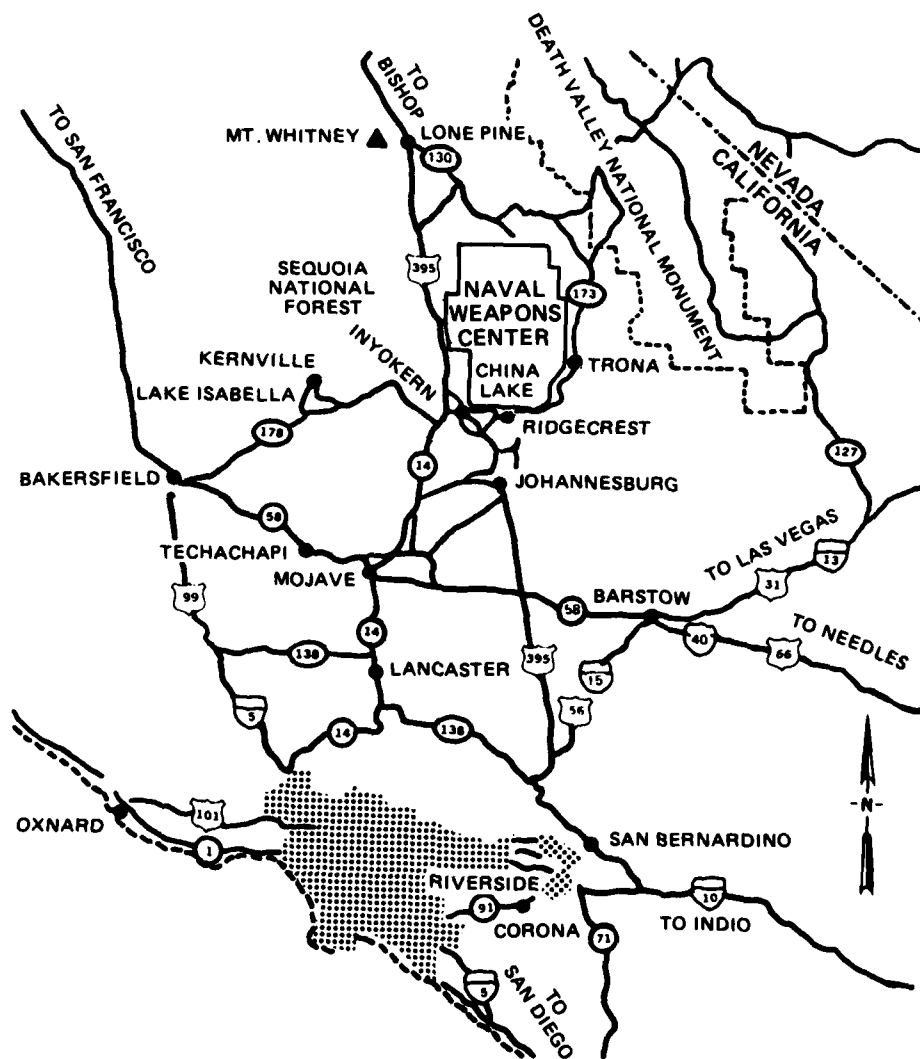


Figure 1. Naval Weapons Center vicinity map

CONDITION EVALUATION OF SUPERSONIC NAVAL
ORDNANCE RESEARCH TRACK (SNORT)

PART I: INTRODUCTION

Location

1. The Supersonic Naval Ordnance Research Track (SNORT) is located at the Naval Weapons Center, China Lake, California, in a high desert environment. Figure 1 shows vicinity and location maps for the structure, which is 4.1 miles* in length. It is used for high-speed rocket sled and large payload testing of ordnance, aircraft, missiles, ballistics, etc. Figure 2 is an aerial view of the track.

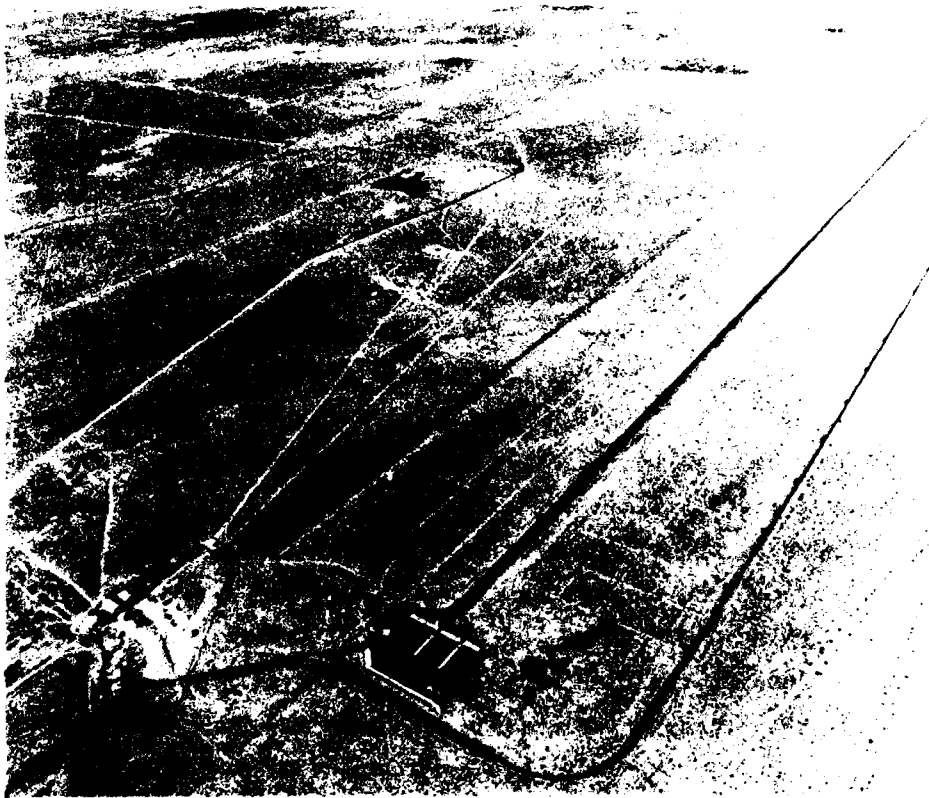


Figure 2. Aerial view of SNORT facility

* A table of factors for converting non-SI units of measurement to SI (metric) units is given on page 3.

Background

2. SNORT was constructed during the early 1950's and is currently being heavily used. No service failures have occurred although extensive cracking in the concrete is evident. Accidental detonations of munitions and derailments have damaged the track in several locations. Removal of damaged portions of the track has revealed serious corrosion of the reinforcing steel and cracking of the subsurface concrete. These findings have prompted studies to determine the causes and extent of damage to the structure and to determine possible repair procedures that will extend its useful life. The U. S. Army Engineer Waterways Experiment Station (WES) was asked to assist in this study by conducting a condition evaluation of the track.

3. A policy decision has been made by the Department of the Navy that SNORT is a necessary facility and should be rehabilitated or replaced.

4. The track is currently being used on a regular basis with no restrictions as to loads or speeds.

Track description

5. SNORT is a 21,550-ft- (4.08-mile-) long two-rail heavy-duty precision track, essentially level except for a slight downgrade toward the muzzle. Heading is 357 deg true. The track is made up of 50-ft lengths of 171-lb/yd crane rail laid at standard railroad gauge and mounted on adjustable sleepers attached to an H-shaped continuous concrete beam. The trough formed by the H has constant dimensions for the length of the track. The rail measures roughly 4 in. wide and 6 in. high and has a 1-1/4-in. web. The rail joints are butt-milled and doweled to retain rail-end alignment. The H-beam is half buried in compacted earth fill.

6. Adjustment of the sleepers permits rail alignment to be maintained vertically to within ± 0.036 in. of the theoretical track profile at any point, horizontally to within ± 0.06 in. of the theoretical centerline, and to ± 0.5 deg in rotation. Between the sleepers, the rail groove in the top of the beam is filled with asphalt to bond the rail to the beam and to dampen rail vibration. Of interest here is the fact that earthquakes of moderate intensity in this area have not affected track alignment.

7. Beginning at 11,475 ft downrange, the center of the concrete beam is used as a water-brake trough. The trough extends for 10,075 ft on a very slight downgrade to the end of the track. A storage reservoir adjacent to the

track holds 400,000 gal of water, which can be delivered through four inlets into the water-brake trough at rates up to 1,400 gal per minute. The water is recirculated into the reservoir. The depth of the water in the trough is controlled by (a) the point of entry into the water-brake trough, (b) the rate of water delivery at the entry point, and (c) the use of partial damming strips to retard the flow in the trough, or of frangible weirs to form a series of pools of varying depths. The profile of the water level is usually controlled by using a particular inlet plus partial damming; the flow rate is varied for fine adjustment. Intrusion of a scoop underneath the sled into water of graduated depth in the trough controls deceleration.

8. The sleds have metal slippers for runners which act as the structural link between the sled and rail. The slippers, which are contoured to fit around the rail, usually hold replaceable wear inserts and provide the guidance and restraint necessary to hold the sled on the track during its run.

Loading

9. Loading data were obtained from SNORT personnel and are presented in Table 1. Performance values are presented in Table 2. The test loads currently being used are less than those presented in Table 1. However, recent discussion with track personnel indicates that users want to test heavier items at higher speeds. The consequence is that the loads on the structure are increasing, and the loads in Table 1 along with dynamic load factors and rail roughness coefficients are considered to be reasonable design loads.

Materials of construction

10. The materials of construction described here are for the concrete structure and its supporting backfill. Rail materials are not discussed.

11. From the design drawings, it appears that local soil was used as backfill. It is not clear where the soil used in fill operations came from; it can be assumed that it was probably taken from borrow pits adjacent or close to the point of use.

12. The structural notes on design drawing 502669 call for the reinforcing steel to be intermediate or hard grade (ASTM A15 and A305). These standards would be 1951 or earlier issue. Both A15 and A305 have been discontinued.

13. The concrete specified on construction drawings is Y & D (Yard and Docks), Class S-1, 3000 psi at 28 days with a No. 1 aggregate. This standard would be a 1951 or earlier issue.

14. No mention is made of where the water would come from for mixing the concrete. However, the site has wells and this source was most likely used. Well water at the site was analyzed and the results are listed in Table 3.

15. While various placing sequences and construction joints are called for on the drawings, examination of the structure indicates a variety of non-specified placing practices were used. How much of this is due to repair procedures and how much is the result of actual construction practice is not known.

Previous studies

16. Previous studies have been conducted on the SNORT track by various individuals and consulting engineering firms. A summary of the studies is listed below.

- a. 4 May 1975. Letter from Dr. James Myers (AFIT/DE WPAFB) recommending steel-to-concrete potential data and mention of cathodic protection.
- b. 24 June 1975. Preliminary report by Van Dyke and Barnes provides possible explanations for causes of cracking and recommends verification of bar locations, concrete strength, existence of cracks below grade, temperature effects, test-run effects, and rail anchor bolt condition.
- c. 9 September 1975. Final report by Van Dyke and Barnes provides results of recommended work and provides description of rebars exposed at an unreported number of locations. Recommendations for repairs.
- d. 29 October 1975. Letter from China Lake Naval Weapons Center (7036/BJP:rh) summarizes report of Van Dyke and Barnes and recommends modification of suggested repair schedule.
- e. 12 April 1976. Letter from China Lake Naval Weapons Center (0736/WCB:gtl) reports moisture content of soil under web at three locations.
- f. 6 July 1976. Report from Dr. James Myers (AFIT/DE WPAFB) reports analyses of concrete samples from five locations for chlorides and sulfates.
- g. 13 May 1977. Letter (6103E/GRD) reports investigation of failed section and recommends inspection and evaluation of track condition to determine rate of deterioration and feasibility of repair or replacement. Suggests possibility of cathodic protection.
- h. 23 September 1977. Letter from Naval Construction Battalion Center, Port Hueneme, California, recommends load testing.

- i. 26 April 1978. Letter from R. P. Brown, P. E. (Florida Department of Transportation), reports chloride contents of concrete and recommends further analysis.
- j. 10 May 1978. Letter from Dr. Myers again suggests cathodic protection.
- k. October 1978. Letter from Dr. Myers reports results of track potential measurements. Suggests that beginning portion of track might not be corroding. Cautions that steel must be continuous for cathodic protection.
- l. 28 January 1980. Contract to Waters Consultants for Soil Resistivity, Field Study and Evaluation of Cathodic Protection.
- m. 18 December 1980. Visual inspection of track by WESTNAVFACENGCOM personnel.

17. Failure theories include: corrosion-induced cracking, thermal stresses, concrete shrinkage, and bending moments in the track due to aerodynamic loads on the sled.

18. The conclusions of some of the studies are listed below.

- a. There is extensive corrosion of the subgrade reinforcing and some corrosion of the abovegrade reinforcing. How much and how badly the structure is affected is unknown.
- b. The soil is considered to be very corrosive.
- c. The concrete has a high chloride content.
- d. Due to the lack of welded reinforcing bar splices and possible discontinuity, cathodic protection probably will not be cost-effective if at all technically feasible.
- e. The well water used for braking operations has a high salt (chloride) content.
- f. There is extensive cracking of the concrete.

19. From previous work and from preliminary analysis, it seems that corrosion of the reinforcing steel is one of the major causes of concrete deterioration. In order for rusting of reinforcing steel to occur, both water and oxygen must be available at the site of the corrosion. The availability of the reactants is governed by the external environment and the integrity of the concrete. Cracks in the concrete allow ingress of water, oxygen, and electrolytes such as chloride ions or sulfate ions. Chlorides are especially dangerous since they can easily migrate within the concrete to set up differential concentration cells.

20. Chloride ions are sometimes reported to depress the normally high alkaline pH of the pore fluid in the concrete and in sufficient concentration can overcome the passivating effect of hydroxyl ions (formed at the cathodic

reaction) and induce corrosion in even highly alkaline conditions. They also increase the conductivity of the concrete, allowing corrosion currents to increase and hence accelerate the rate of rusting.

21. The rusting of reinforcing steel exerts pressure on the surrounding concrete causing it to crack. As these cracks extend to the surface, they provide an outward sign that may be an indication of what is happening inside the concrete. Results of crack mapping have been used successfully to determine the nature and rate of deterioration and the timing of remedial repairs (Pollock, Kay, and Fookes 1981).

22. Other causes of concrete deterioration will be investigated in this report. The load-carrying capacity of the track in its deteriorated condition will be evaluated. From the findings in the track evaluation, conclusions will be made concerning repair of the existing track and the need for a new supersonic test track.

Purpose and Scope

23. The purpose of this investigation was to determine the structural integrity of the SNORT track and to determine safe service loads and remaining service life. Also, recommendations were to be made on repairs needed and methods of repair to be considered. Finally, this study was to develop a preliminary design and cost estimate for a new test track including enhanced capabilities needed at the facility. The initial phase of the study was to conduct those tests which will enable a decision to be made on repair and rehabilitation of the existing structure versus replacement with a new structure.

Approach

24. The structural integrity of the SNORT track was determined on the basis of field tests and analytical or laboratory work on the concrete foundation system. These tests were conducted in phases, based on the amount and type of data needed to decide on repairs or replacement of the existing test track.

25. The first phase of the study consisted of a field survey and crack mapping of the entire structure. Also, mechanical impedance testing was used to nondestructively compare the relative condition of the concrete-foundation

system along the entire track. Concrete, reinforcing steel, and soil samples were taken for a cursory examination prior to more extensive sampling later.

26. The second phase of the work consisted of concrete coring, soil sampling for laboratory tests, tests on the foundation material, and field-load testing of the structure. Field tests were conducted on the foundation using pressure meter tests and on the concrete-track system using static loads. As the track was load tested, the deflections at the positions of track loading were monitored. Samples of the reinforcing steel and water used for braking were obtained.

27. Analytical work on the structure was begun under Phase 2 for comparison with the results of field tests. This work consisted of beam-on-elastic foundation and finite-element analyses.

28. The third and final phase of the work consisted of completing the structural analysis and laboratory tests, and conducting preliminary design work and cost estimation for a replacement track.

PART II: PRELIMINARY FIELD INVESTIGATION

Field Inspection

29. In January 1982, the field survey of the SNORT structure was conducted. It included visual inspection of the concrete, noting crack size, density, and location by track stations. A written log was prepared along with photographs which documented the surface appearance of the concrete. Several samples of concrete and soil were taken for a preliminary examination prior to more extensive coring and sampling programs.

30. The survey was directed toward documenting surface deficiencies that result from or contribute to the corrosion of the reinforcing steel and threaten the integrity of the structure. The significant findings of the inspection are as follows.

Discoloration and deposits

31. Discoloration of the concrete was noted for the entire length of the structure. Much of the discoloration, especially within the trough of the structure, is believed to be the result of staining action of some of the substances contained in the well water used for deceleration of the test vehicle. The investigation by Van Dyke and Barnes* defines the various constituents contained in the well water.

32. Some of the discoloration in the faces outside the trough of the structure appears to be the result of moisture migration. It is not clear whether discoloration was due to migration of the well water from within the trough, the moisture drawn from the soil, or both. The moisture from the soil, like the well water, contains substances that could result in discoloration of the concrete.

33. In addition to the discoloration, a white "alkali" deposit appears at the waterline mark within the trough. Well water analysis* shows the water to be highly alkaline. Therefore, it appears that the main source of the alkali deposit within the trough is the well water. There are also alkali deposits on the vertical faces outside the trough. These deposits are believed to be the result of moisture migration; however, as with the discoloration of the concrete within the trough, it is not clear whether the source of

* Preliminary report, 24 June 1975.

migration was from the well water used in the trough, the moisture drawn from the soil, or both.

34. Both the discoloration and the alkali deposits are shown in Figure 3.

Transverse cracking

35. Transverse cracks (depicted in Figure 4) were noted at and between rail anchors. These cracks are generally narrow (having a maximum width of 1/32 in. or less) and extend across the top and down the sides of a wall. Transverse cracks were also noted in the floor of the trough. These cracks enable deleterious agents to enter the concrete and attack the reinforcing steel.

Longitudinal cracking

36. A longitudinal crack was observed in each of the four vertical faces of the structure. These cracks parallel the top longitudinal reinforcing in walls of the structure (Figure 5) and are generally visible for the entire length of the structure. The maximum width of the crack varies along the length of the structure and also between faces at the same stationing. It is believed that these longitudinal cracks are the result of corrosion of the top longitudinal reinforcing and that the wider the crack, the more severe the corrosion.

37. To document the severity of the longitudinal cracking along the length of the structure, each of the vertical faces was partitioned into sections of similar crack widths and assigned an evaluation number based on the frequency and range of the maximum crack widths within the section. An evaluation number for each section was assigned in accordance with the following criteria:

<u>Evaluation Number</u>	<u>Description</u>
0	No crack
1	Mostly a <i>fine</i> crack with some areas having no visible cracking
2	A <i>fine</i> crack
3	Mostly a <i>fine</i> crack with some areas of <i>medium</i> cracking
4	Areas of <i>fine</i> cracking alternating with areas of <i>medium</i> cracking

(Continued)



a. Sta 1.08, east face



b. Sta 6.00, east face



c. Sta 30.56, west face

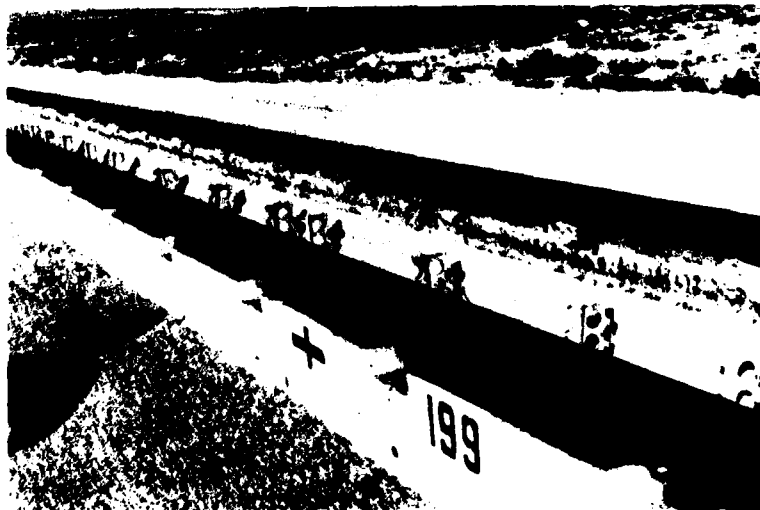
Figure 3. Discoloration and alkali deposits
on concrete surfaces (Continued)



d. Sta 74.00, east face



e. Sta 168.00, west face



f. Sta 199.00, west face

Figure 3. (Concluded)

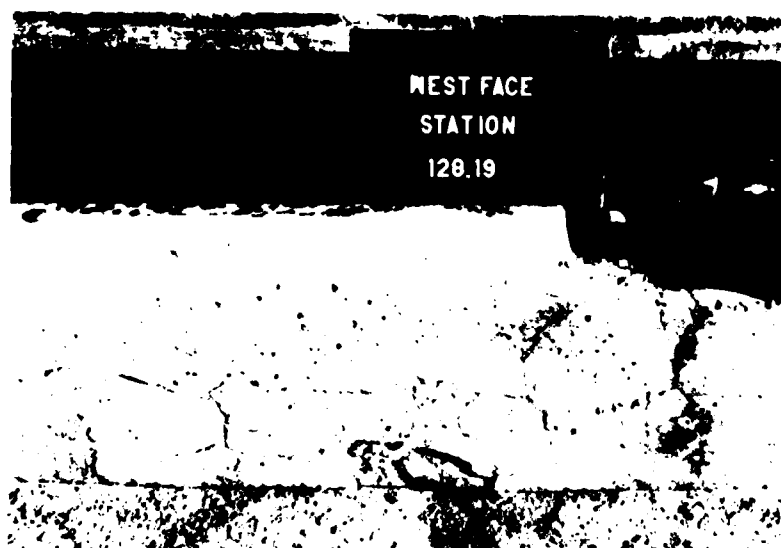


Figure 4. Transverse cracks, Sta 128.19, west face



a. Sta 182.00, west face



b. Sta 182.00, west face (closeup)

Figure 5. Longitudinal crack parallel to longitudinal reinforcing steel in legs of structure

<u>Evaluation Number</u>	<u>Description</u>
5	Mostly a <i>medium</i> crack with some areas of <i>fine</i> cracking
6	A <i>medium</i> crack
7	Mostly a <i>medium</i> crack with some areas of <i>wide</i> cracking
8	Areas of <i>medium</i> cracking alternating with areas of <i>wide</i> cracking
9	Mostly a <i>wide</i> crack with some areas of <i>medium</i> cracking
10	A <i>wide</i> crack

Types of cracks are defined below.

<u>Type of Crack</u>	<u>Maximum Crack Width Range</u>
Fine	Less than 1/32 in.
Medium	1/32 in. or greater but less than 4/32 in.
Wide	4/32 in. or greater

38. An evaluation number was obtained for each wall by averaging the evaluation number for each of its faces within a section. Similarly, an evaluation number was obtained for each section of the structure by averaging all four faces within a section. The results of the averaging are presented in Table 4 and are graphically depicted in Figures 6-8. In general, the first 5 stations and the last 100 stations of the structure contain the widest longitudinal cracks and are suspected of having the most severe corrosion in the top longitudinal reinforcing.

Spalling

39. Spalling of the tops and sides of the walls was observed at various locations along the length of the structure. The locations of the most significant areas of spalling are presented in Table 5. Some of the areas noted are depicted in Figure 9. It is believed that these spalls are the direct result of an impact force.

Construction deficiencies

40. At sta 3.07 (Figure 10), the transverse floor reinforcing extends through the outside west face of the structure. In the same area on the opposite face, holes can be seen where the transverse floor reinforcing at one time extended outside the structure. These ports provide deleterious agents with access to the interior of the concrete and its reinforcing. From approximately sta 3.50 to the end of the structure, the elevation of the floor

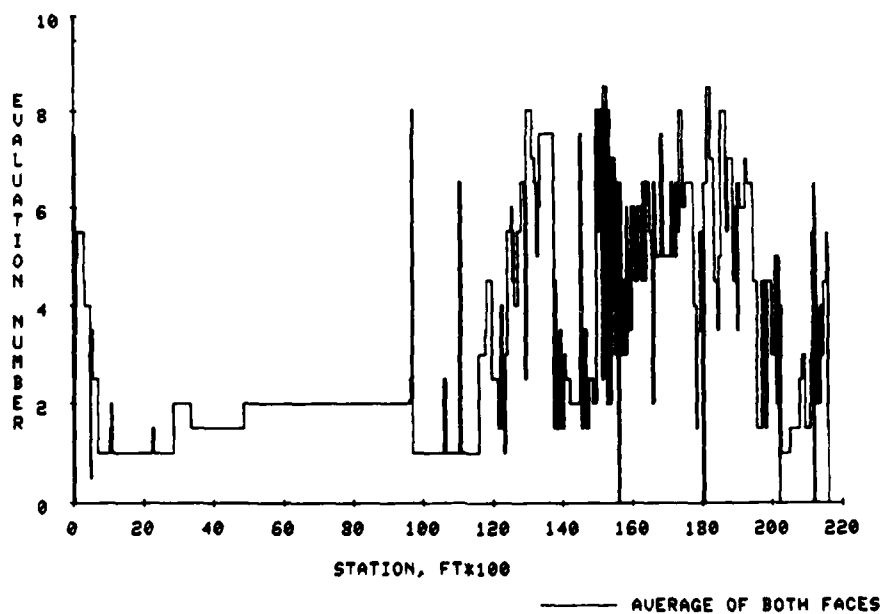


Figure 6. Evaluation of longitudinal cracking in west wall of structure

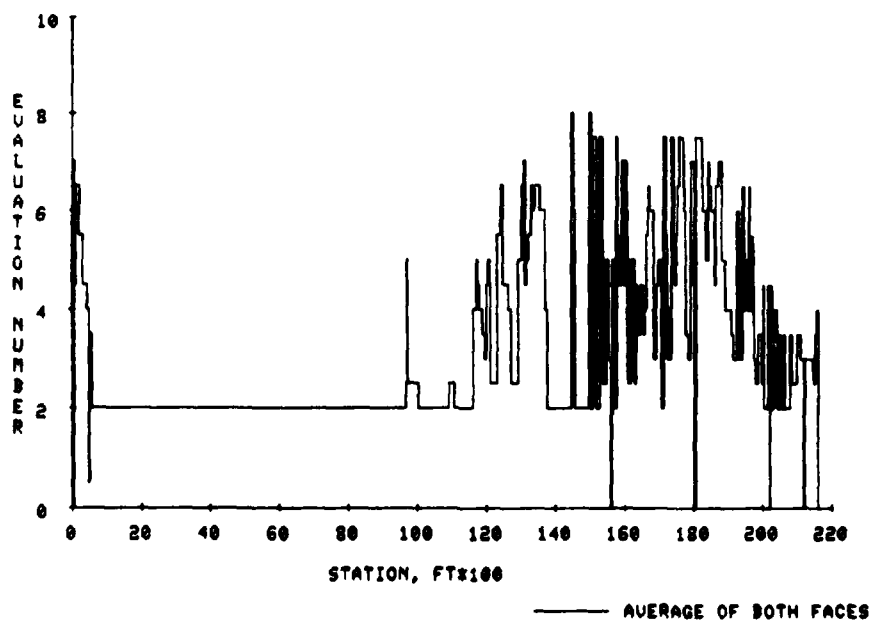


Figure 7. Evaluation of longitudinal cracking in east wall of structure

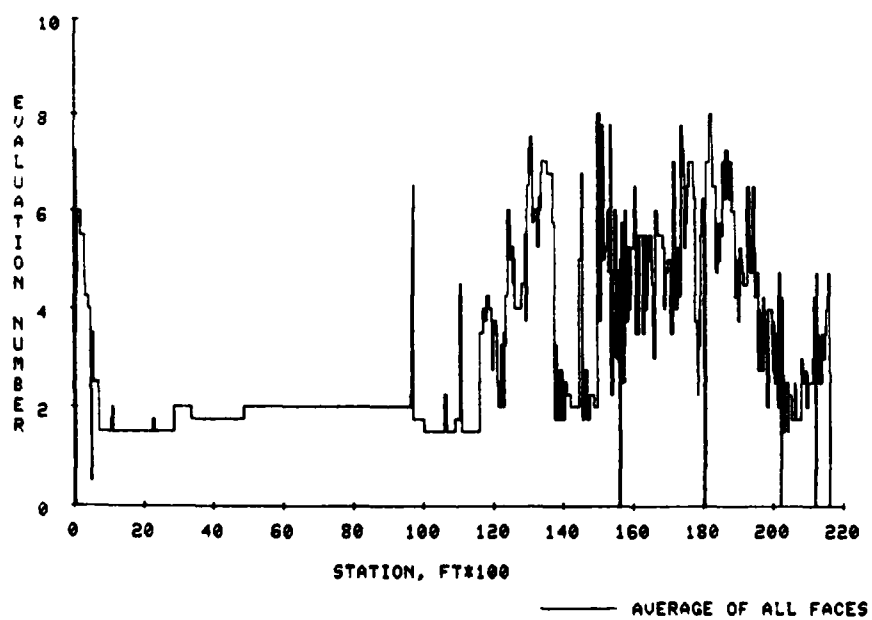
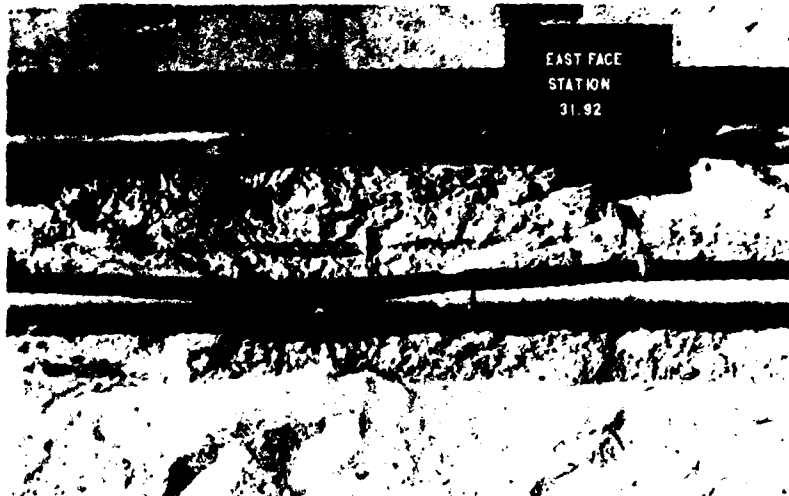


Figure 8. Evaluation of longitudinal cracking along length of structure



a. Sta 31.92, east wall, east face



b. Sta 99.98, west wall, west face

Figure 9. Areas of significant spalling (Sheet 1 of 3)

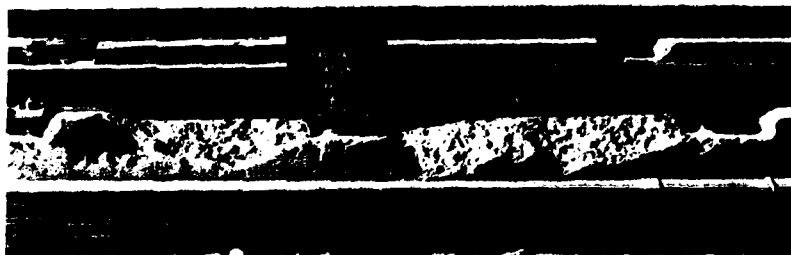


c. Sta 155.98, east wall, east face

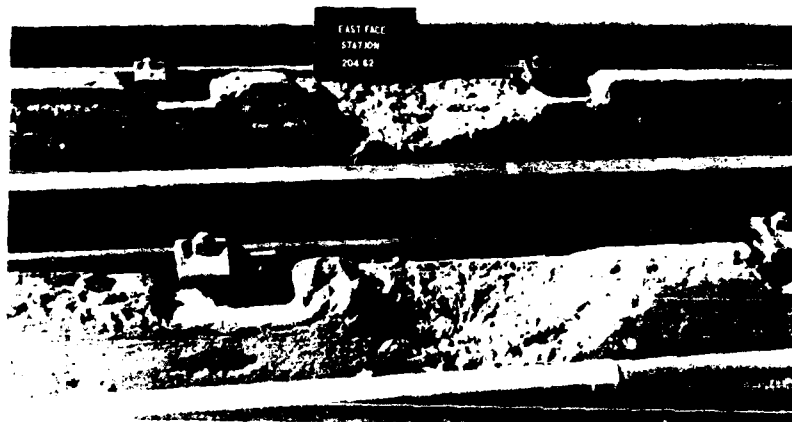


d. Sta 170.94, west wall, west face

Figure 9. (Sheet 2 of 3)



e. Sta 199.10, east wall, east face



f. Sta 204.62, west and east walls, east faces

Figure 9. (Sheet 3 of 3)



Figure 10. Transverse floor reinforcing extending outside the structure, sta 3.07, west wall, west face

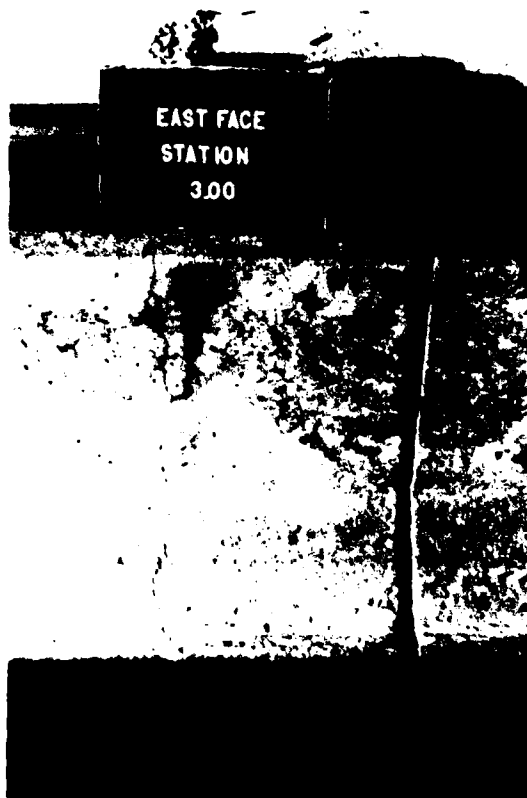


Figure 11. Construction joint in floor of structure, sta 3.00

reinforcing falls below the elevation of the ground, thereby concealing any other ports of access.

41. A number of construction joints were noted in the floor of the structure (Figure 11); however, the placement of the walls appears to be continuous. No evidence of damage due to this inconsistency was observed.

Mechanical Impedance Testing

42. Mechanical impedance tests using an impulsive loading method were conducted to check for badly deteriorated zones. The structure was excited both vertically and horizontally using an instrumented hammer with impact plates of steel, aluminum, and plastic. The hammer contained a load cell, and

an accelerometer is located on the structure from which signals are recorded on a structural analyzer. This analyzer performs a fast Fourier transform (FFT) of these signals resulting in a mechanical impedance plot or other information, as desired. The response of the structure may be monitored by comparing displacement/force (D/F) versus frequency plots at various locations along the structure.

43. Sections of track which had been replaced when damaged were also tested to provide a comparison with the remainder of the track.

44. Generally, these results show the track to be cracked completely through the vertical legs and web of the H section in many locations. The motion of the structure resulting from impact loads resonated on sections approximately 3 ft in length corresponding to the spacing of vertical cracks of the vertical sections.

45. A modal analysis of the structure was conducted. Any change in the mode of vibration would indicate a change in the mechanical characteristics of the structure. The flexural or torsional mode did not produce a resonant mode of vibration, and the mechanical impedance both vertically and torsionally was inconsistent. For the same impact force, more motion was produced near the cracks. Modal analysis showed the structure to be moving in segments corresponding to the dimension between cracks.

46. The longitudinal mode of vibration across the width of the track did not manifest itself clearly, probably due to the narrow path length joining the two sides of the H section and the large amount of damping produced by the soil. From time to time, resonance would develop and then disappear if the impact point was moved over a few feet. It is believed the resonances that did occur were due to sections in the structure bounded by cracks.

47. At some locations, motions produced in one leg of the structure were not transmitted across the web to the opposite leg, indicating that some segments were not coupled across the web due to cracks.

48. Vibration analysis showed the response of the structure to be that of short segments corresponding to the dimensions between cracks. This response was consistent throughout the structure.

49. Impact tests were used to obtain vertical deflections resulting from vertical impacts along the track.

PART III: SAMPLING OF STRUCTURE AND FOUNDATION

Introduction

50. The 4.1-mile concrete supersonic test track can be seen to have extensive deterioration. Previous studies indicate that salts from the soil and water environment have penetrated the concrete, causing the steel to corrode, and the resulting expansion cracks the concrete.

51. The study reported here was to verify certain aspects of previous studies, to determine the exact causes of the concrete deterioration, and to extrapolate what these causes mean in relation to the future use of the track. To carry out laboratory examinations of the concrete track and foundation, samples were needed. To determine how well the track supports load, structural load tests conducted in the field were needed. A structural analysis of the track was conducted, assuming no cracks and using actual material properties of the concrete and foundation material. From this analysis and comparison with the load test results, conclusions were drawn about the extent to which the track has been damaged by deterioration. The in situ properties of the foundation were determined for use in the structural analysis.

52. The approach in sampling and in situ testing was as follows:

- a. The concrete was sampled by taking 4-in. cores. The cores were obtained horizontally, vertically, and at angles. The cores were tested as follows:
 - (1) Chemical tests to determine deteriorating agents.
 - (2) Petrographic analysis to determine causes of deterioration.
 - (3) Material-properties tests to obtain parameters to use in structural analysis.
- b. The foundation material was sampled to determine its contents and density.
- c. In situ tests were performed in the foundation material to obtain parameters necessary for structural analysis.
- d. Structural load tests were performed along the entire track to determine its consistency in supporting load and to determine deflections to be used in comparisons with analytical results to determine the extent to which deterioration has damaged the track.

Concrete Coring and Sampling

53. The surface concrete of the test track was observed, sampled, and studied. Portions of the surface concrete had a hollow sound when hit with a small hammer. If this concrete was hit repeatedly, it would break away from the rest of the track (Figure 12). For a significant portion of the track, about 1 in. of surface concrete had delaminated from the rest of the track. The track is cracked extensively. The cracked and deteriorated surface concrete was observed and studied, and a condition survey report is presented in Part II giving the results.

54. Although the interior concrete could not be observed, an effort was made to determine the consistency of the interior concrete along the length of the track by using impedance measurements. The track was excited with a hammer which had a load cell behind its impact head. Natural frequencies and impedance parameters were measured and their variations along the track were used in accessing the track's consistency. These results are also presented in Part II.

55. The condition survey, impedance measurements, and observations were used in selecting the locations for coring the concrete along the test track. The coring locations were selected at stations where the concrete

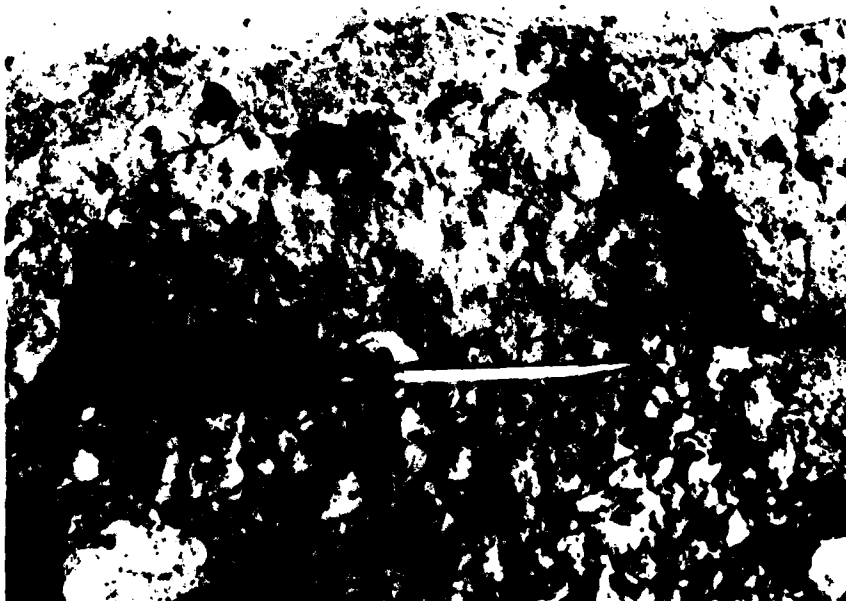


Figure 12. Surface concrete deterioration

was representative of certain lengths of track. Locations were also selected at angles and positions in the track to obtain core samples within the various track geometries and to give access to perform in situ testing of the foundation material.

56. The general locations where the cores were taken are presented in Figure 13. Detail core orientations for the slant hole (angle) and the hole

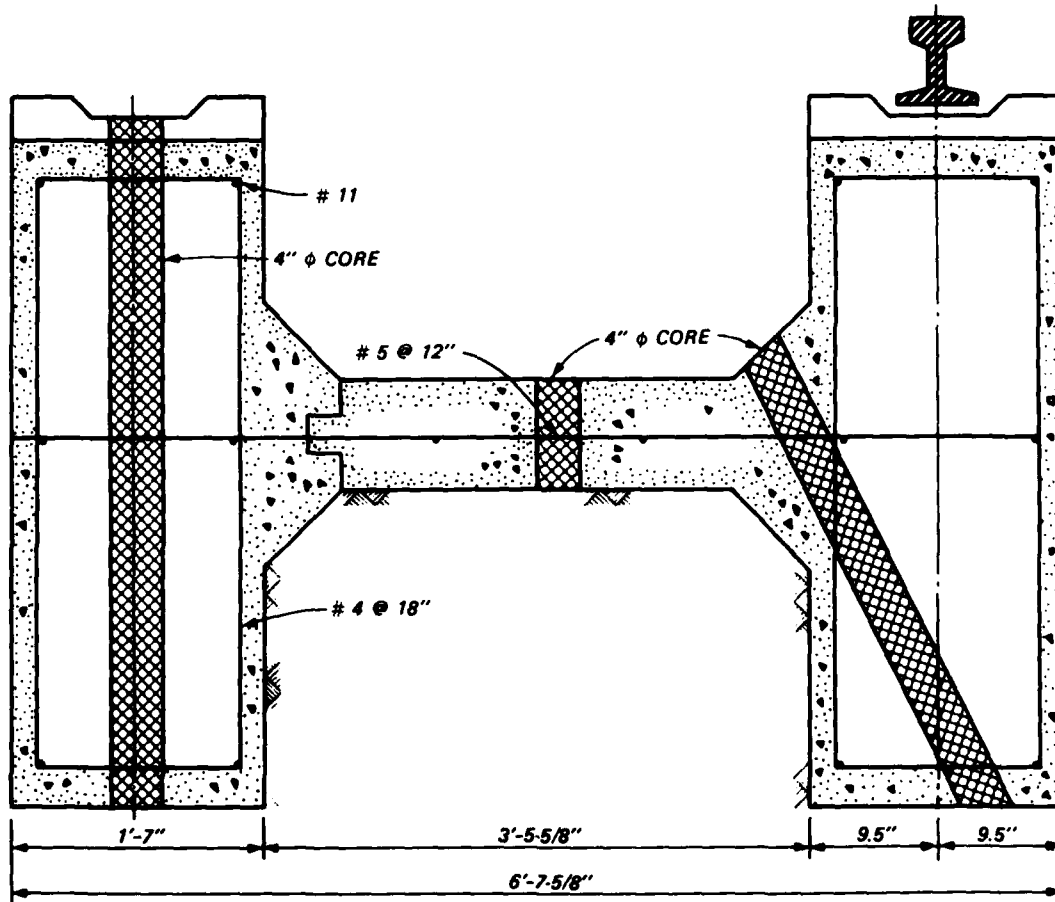


Figure 13. General core orientations

through the entire leg (access) are presented in Figures 14 and 15. The cores and the locations of the cores along the track are presented in Table 6.

Foundation Sampling

57. Sampling and characterization of the foundation material were performed by personnel of the Public Works Department at the Naval Weapons

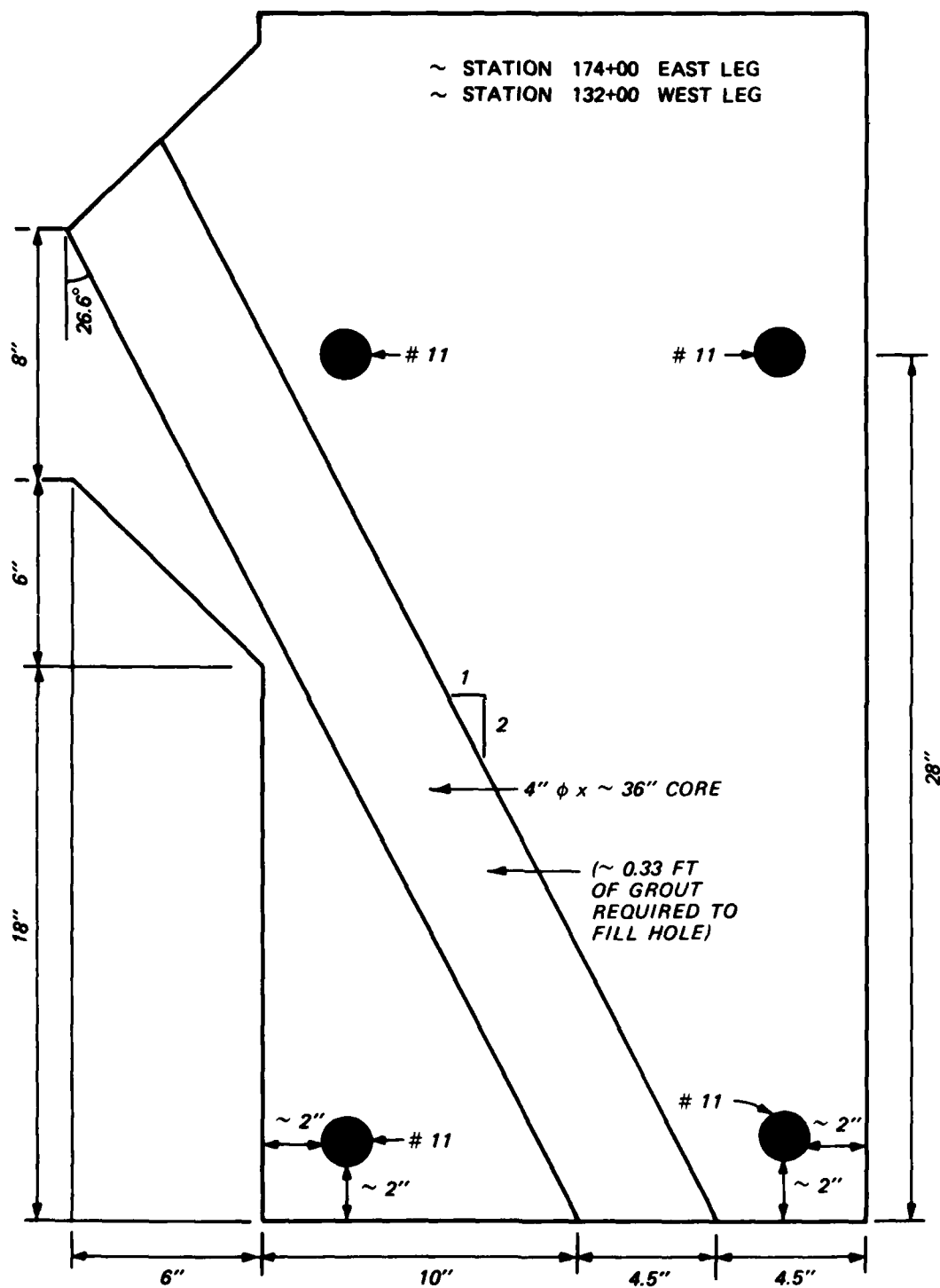


Figure 14. Detail, slant-core orientation

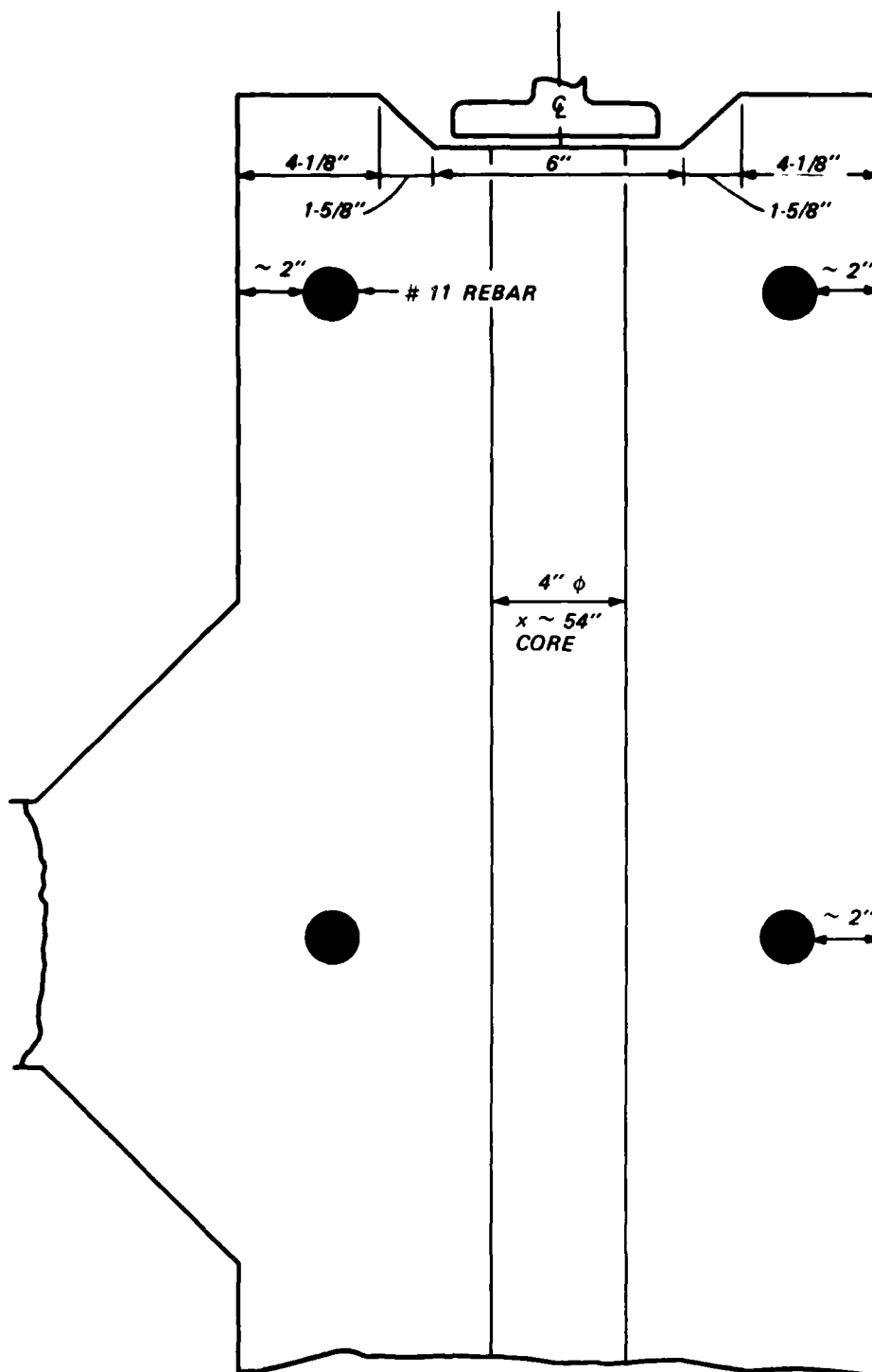


Figure 15. Detail, core location through track vertical leg

Center, China Lake. A backhoe was used to excavate to the base of the test track. At each station where an excavation was made the sand-cone method was used to determine the density of the material at the base and beside the track. Also, moisture contents were determined at various depths.

58. An auger was used to obtain samples below the bottom of the test track.

PART IV: LABORATORY TEST RESULTS

Concrete-Core Tests

59. The location and orientation of the concrete-core specimens are presented in Part III.

60. The ultimate tensile and compressive strengths of the concrete specimens were obtained in order to compare any stresses in the track to these allowables. It was necessary to have the modulus of elasticity (E), Poisson's ratio (μ), and the shear modulus (G) for finite-element analysis. The results of the tests on the specimens which were strain gaged are presented in Table 7 and Figures 16-19. All core testing results are presented in Table 8.

61. The tensile strength is a little less than 10 percent of the ultimate compressive strength, but it is still adequate. The ultimate unconfined compressive strength is adequate and substantiates previous unconfined compressive test results. There is a variation in the modulus of elasticity results which could be a reflection of the deterioration in the concrete track.

62. The physical properties of the concrete are adequate and will be used in analytical and comparative studies.

Foundation Characterization

63. Samples of the foundation material at China Lake were tested. The results are presented in Table 9. The in-place density of the foundation material was determined, and samples of the foundation material were obtained and classified.

64. The density of the foundation material varies from 94.8 to 132 lb/ft³. This is a wide variation and indicates some change in foundation material along the track length.

65. The water content, soil classification, liquid limit, plastic limit, and plasticity index are presented in Table 9. The variations in these values are mainly dependent on the section of the hard strata of caliche. The caliche would trap and hold moisture above its location because of its density and impermeability.

Petrographic Analysis

66. Twenty-two concrete cores and ten soil samples from SNORT were

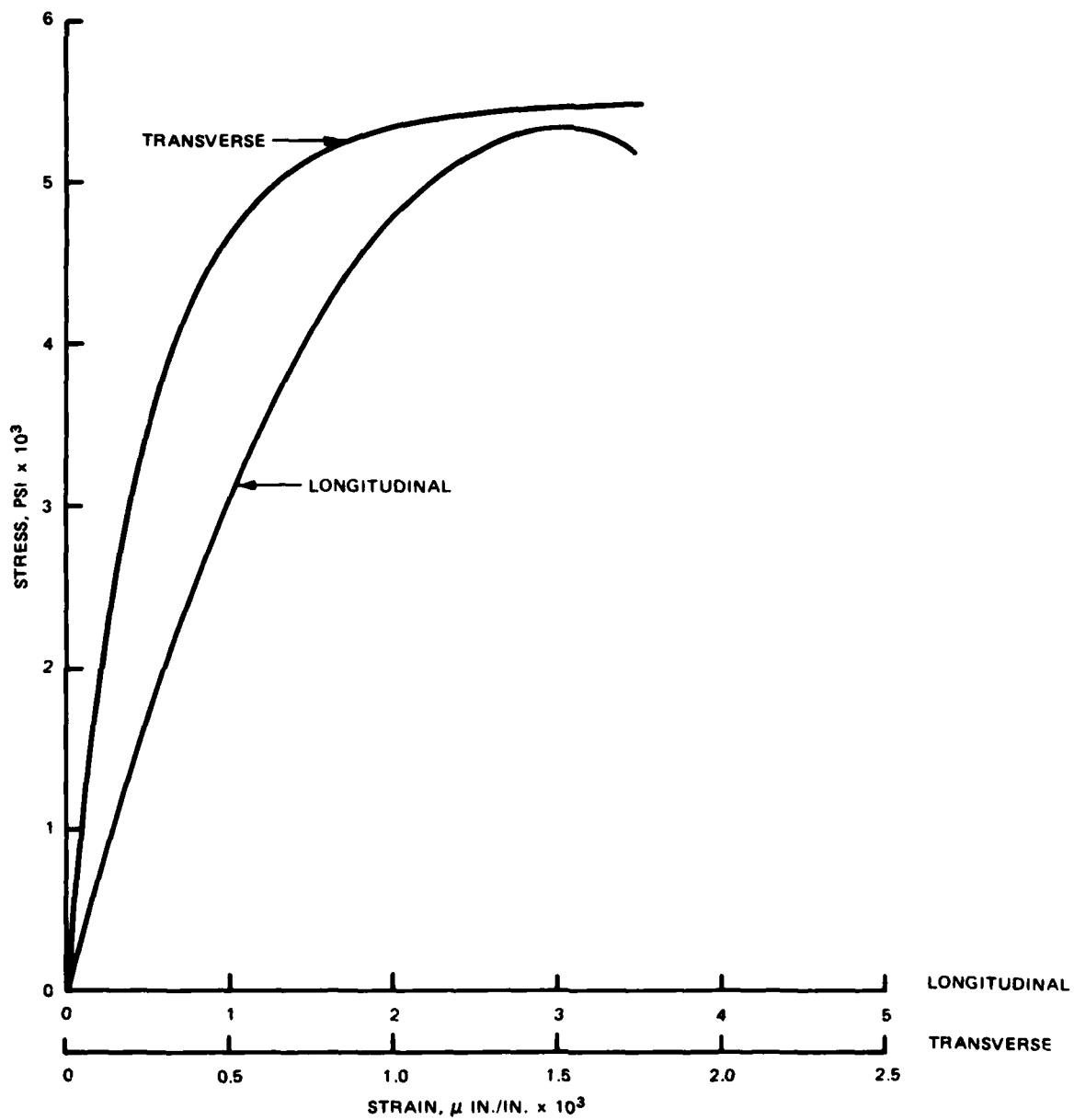


Figure 16. Stress versus strain, specimen HC 96

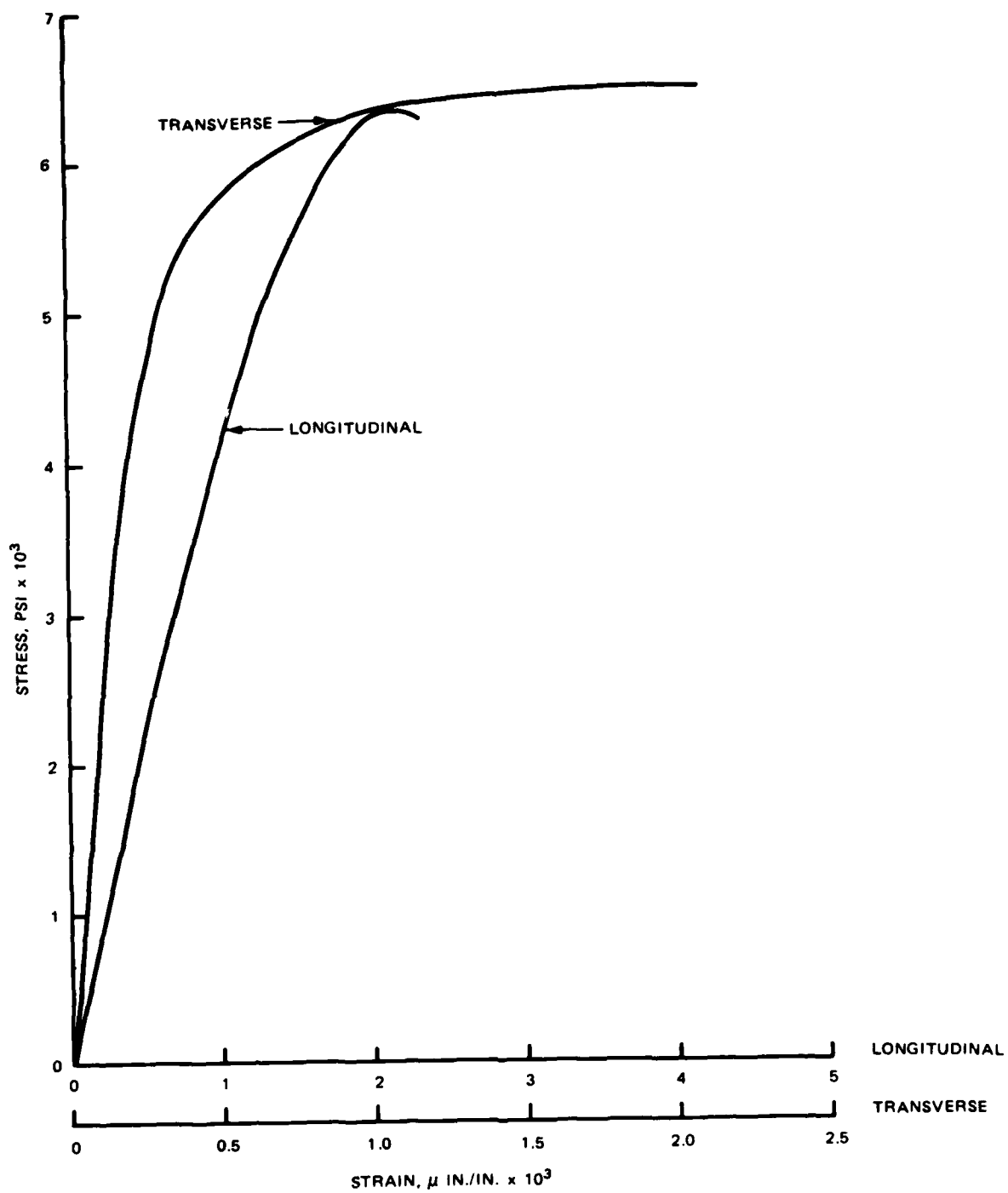


Figure 17. Stress versus strain, specimen VC 12000

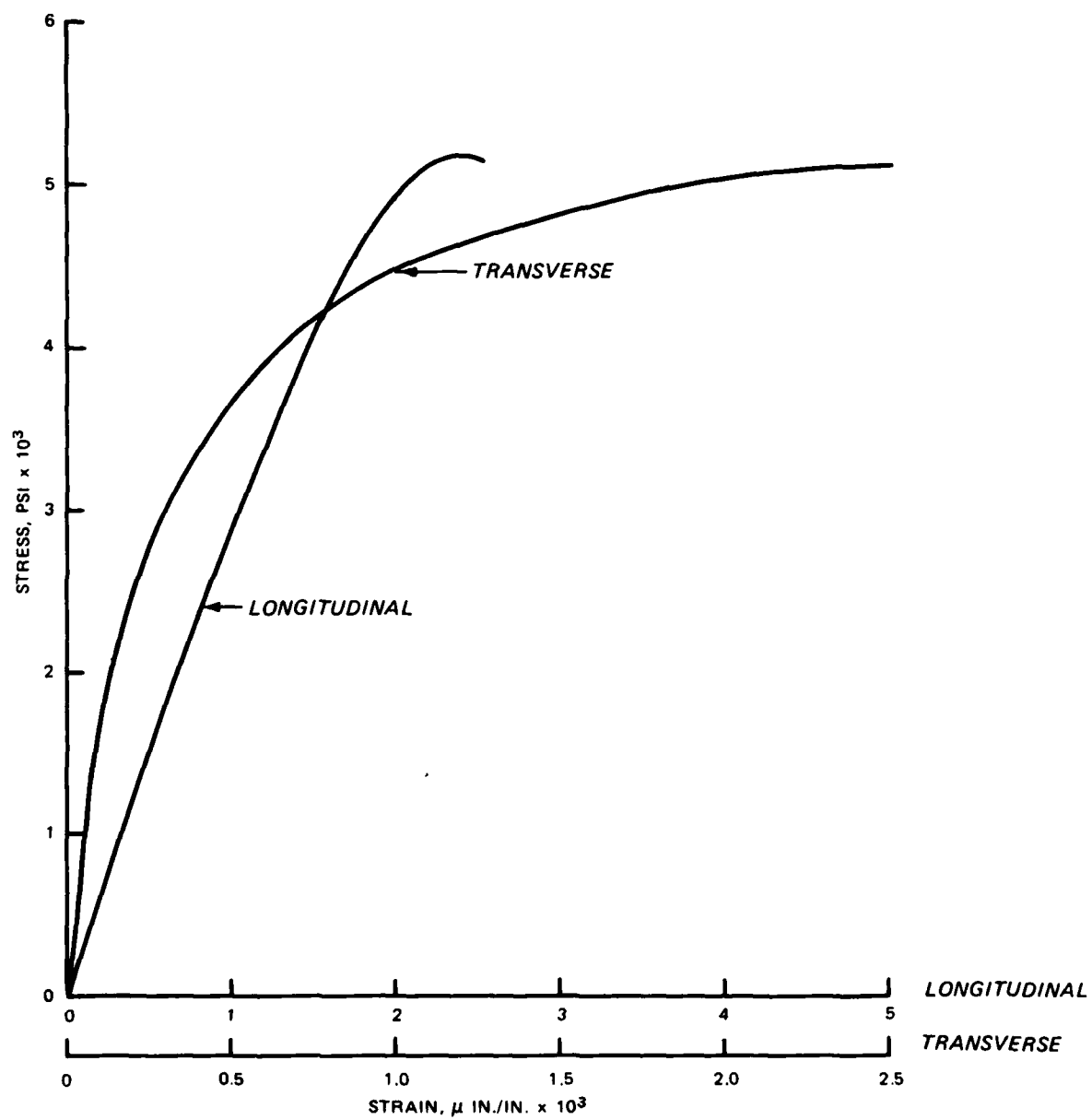


Figure 18. Stress versus strain, specimen VC 13996

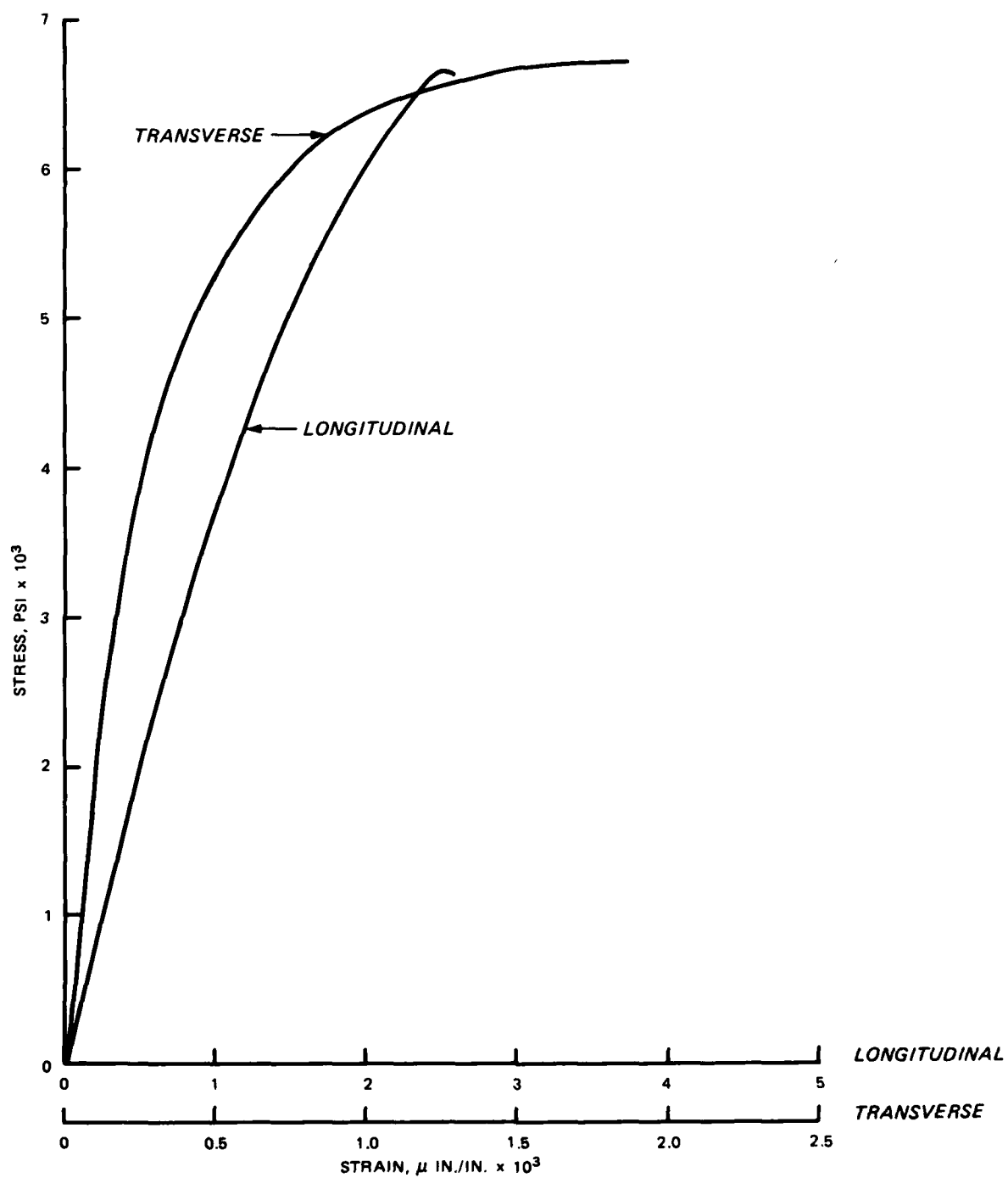


Figure 19. Stress versus strain, specimen VC 21496

received at WES from the Naval Weapons Center on 2 June 1982. The samples were assigned the SL serial numbers indicated:

4-in.-Diameter Concrete Cores			
SL Serial No. CL-39*	Field Identification		Boring Direction
	Sta No.	Location	
CON-7	0+96	East wall	Horizontal
CON-8	24+50	Floor	Vertical
CON-9	79+52	Floor	Vertical
CON-10	96+96	West wall	Horizontal
CON-11	120+00	Floor	Vertical
CON-12	129+99	West wall	Horizontal
CON-13	129+96	East wall	Horizontal
CON-14	139+96	East wall	Vertical
CON-15**	150+96	West wall	Horizontal
CON-16	150+96	East wall	Horizontal
CON-17	155+00	Floor	Vertical
CON-18	164+98	Floor	Vertical
CON-19	173+99	West wall	Horizontal
CON-20	173+99	East side	Inclined
CON-21	180+00	Floor	Vertical
CON-22	181+94	East wall	Horizontal
CON-23	181+99	West side	Inclined
CON-24	200+00	Floor	Vertical
CON-25	210+00	Floor	Vertical
CON-26	214+96	West wall	Horizontal
CON-27	214+96	West wall	Vertical
CON-28	214+96	East wall	Horizontal

Soil Samples	
SL Serial No. CL-39†	Sta No.
SS-3	1+08
SS-4	24+50
SS-5	24+56
SS-6	79+50
SS-7	120+00
SS-8	155+00
SS-9	165+00
SS-10	180+00
SS-11	200+00
SS-12	210+00

* CON-1 through -6 were hand samples.

** One short core was terminated by major reinforcing steel and one long core was taken slightly above first.

† SS-1 and -2 were earlier hand samples.

Procedure

67. The 22 concrete cores were examined visually and logged. Those cores that were intact and long enough for physical testing were set aside. The fragments of cores after this testing were examined to detect evidence of possible deleterious chemical reactions or other problems. A stereomicroscope and a polarizing microscope were used as needed for these and other examinations.

68. Petrographic examination of the concrete was made using guidance from Standard Recommended Practice for Petrographic Examination of Hardened Concrete (Method CRD-C 57-78)(U. S. Army Engineer Waterways Experiment Station 1949). This method is also ASTM C 856. Detailed examination was made of concrete from eight cores representing different concrete conditions and various locations within the structure. The fractured surfaces of broken cores were examined. Reaction products found on these surfaces were identified using X-ray diffraction and microscopy.

69. Pieces of intact cores were broken to allow examination of freshly fractured surfaces. One piece of core was sawed longitudinally, and the sawed surface was ground smooth before being examined.

70. The paste portions of several cores were concentrated by selective grinding and sieving. These paste concentrates were then examined by X-ray diffraction to determine phase compositions.

71. Ten soil samples were taken along the length of the SNORT track. Eight of these samples were examined by X-ray diffraction to determine mineralogical composition.

72. All X-ray patterns were made with an X-ray diffractometer using nickel-filtered copper radiation.

Results

73. The concrete tended to be composed of 3/4- to 1-in. maximum size coarse aggregate. The coarse aggregate was generally fine-grained dark igneous rock particles. The fine aggregate was a natural siliceous sand. The particles for both the coarse and fine aggregates tended to have angular edges, but they were believed to be of natural gravel and sand.

74. The nonair-entrained concrete was well consolidated and generally homogeneous throughout the structure. Discontinuities and irregularities in the concrete are identified in Figures 20-23.

75. The concrete cores from the floor of the track ranged in quality

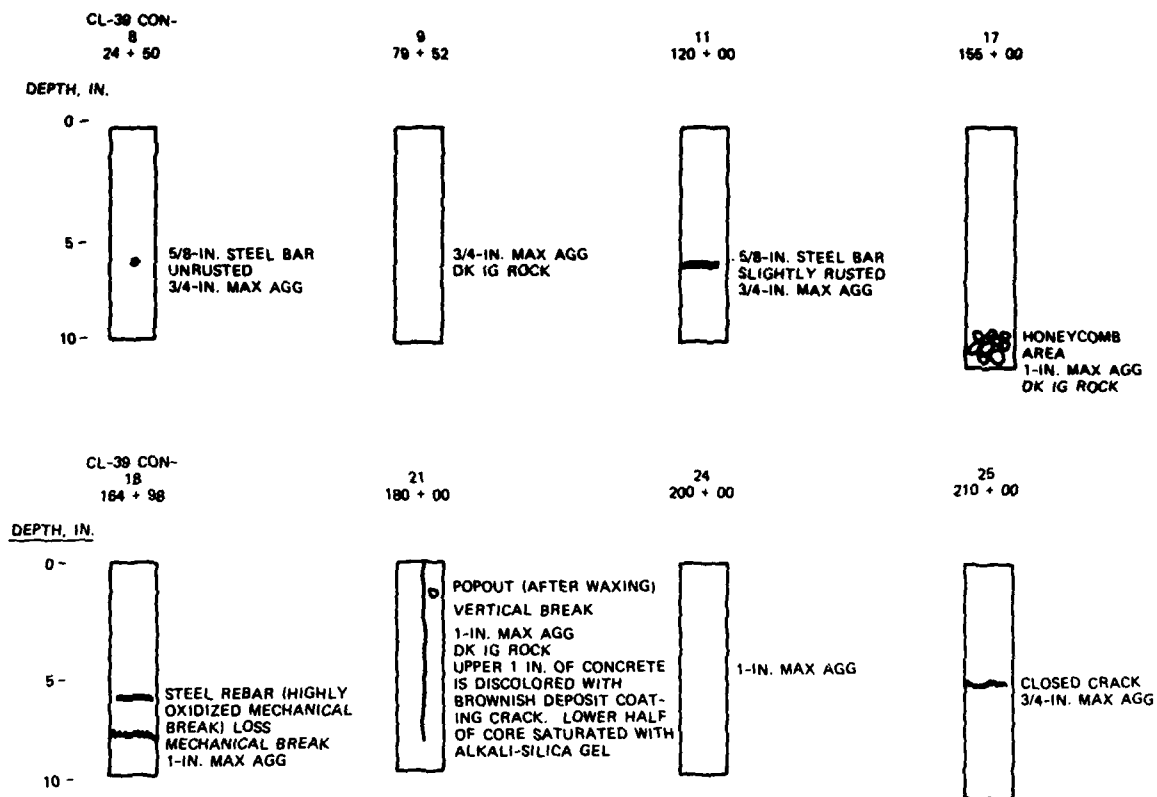


Figure 20. Logs of eight vertical SNORT cores from web (floor)

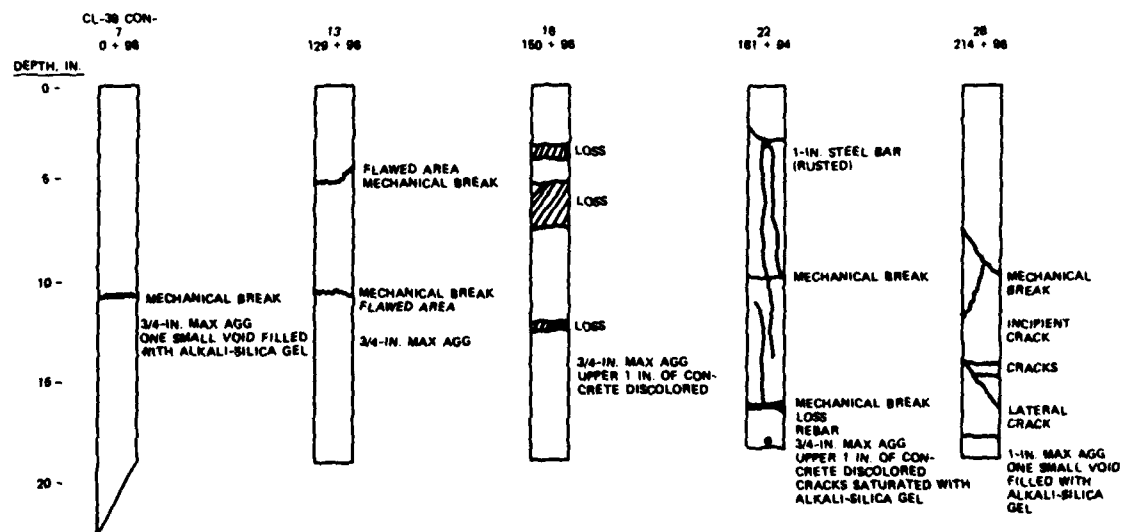


Figure 21. Logs of five horizontal SNORT cores from east rail support

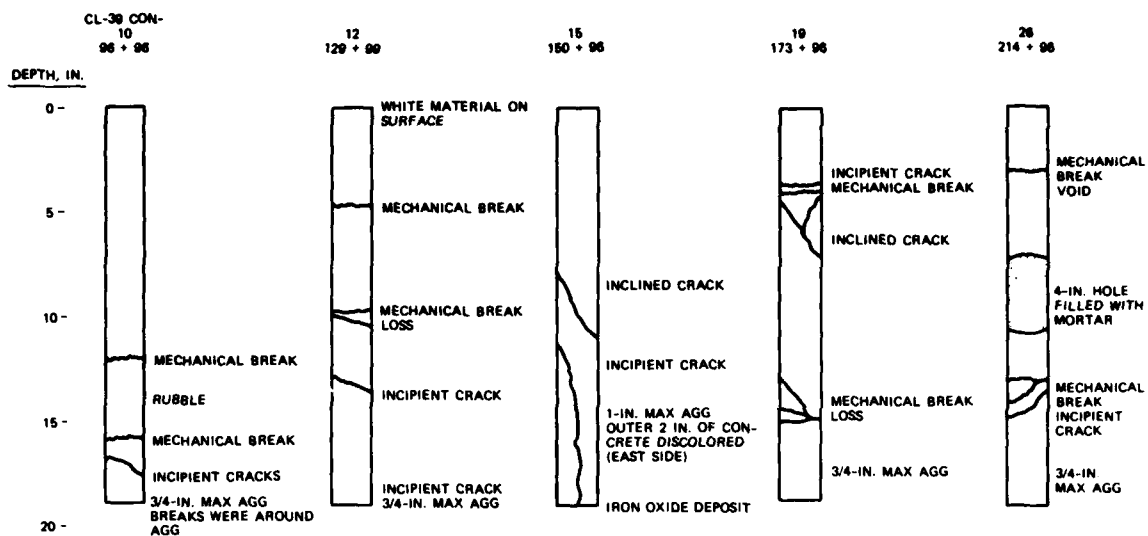


Figure 22. Logs of five horizontal SNORT cores from west rail support

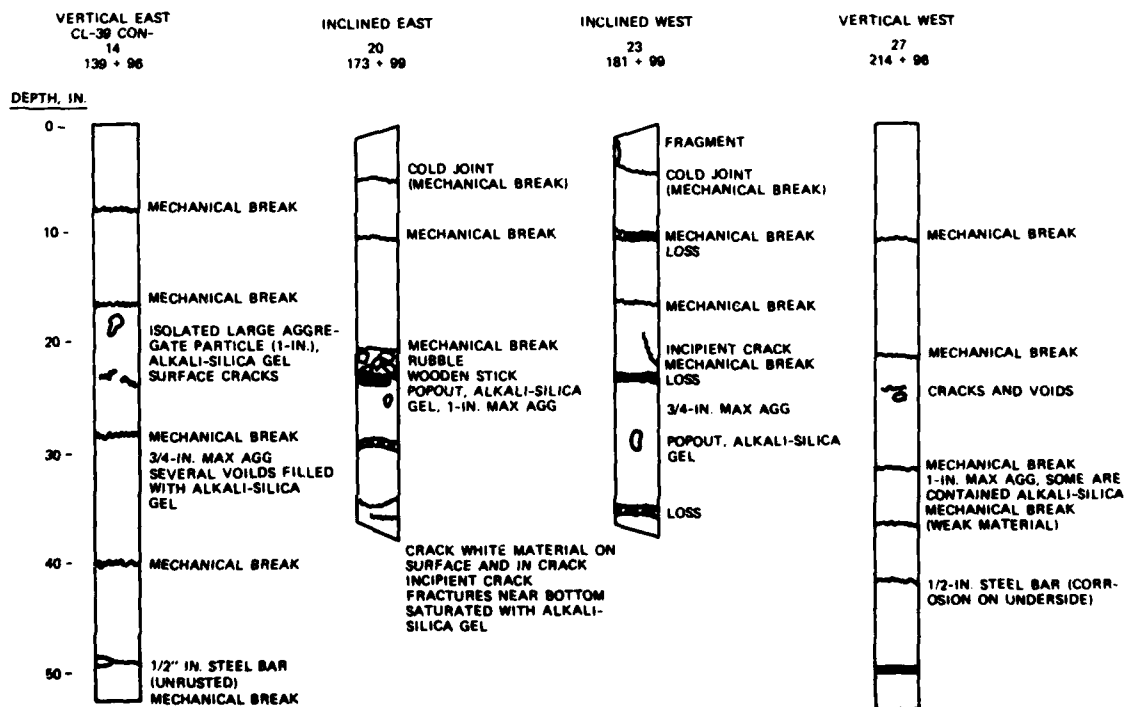


Figure 23. Logs of four inclined and vertical SNORT cores (into rail supports)

from good intact concrete core typified by sample CL-39 CON-8 nearer the upper end of the track (no rust on embedded steel), to core where embedded steel in the concrete was only slightly rusted (CL-39 CON-11), to highly rusted embedded steel in core CL-39 CON-18 toward the other end of the track (Figure 24a). Major cracks in the concrete had developed in core CL-39 CON-21. The cracked surfaces were coated with a brownish deposit. The lower portion of core CL-39 CON-18 was saturated with white alkali-silica gel that coated fractured surfaces and filled voids. Alkali-silica reaction was also the cause of popouts on the cored surface. The fine-grained dusky yellow (5Y 6/4) (Pollock, Kay, and Fookes 1981) aggregate particle causing one popout was composed of reactive ingredients including cristobalite, tridymite, and glass having an index of refraction lower than 1.544.* The associated alkali-silica gel had a clear vitreous appearance, and some central areas may be chalky white. Examination of immersion mounts with a polarizing microscope indicated an amorphous and a salt and pepper variety of alkali-silica gel.

76. The horizontal cores from the east and west support rails were in good condition from the beginning of the track to about sta 150+96, but were in worse condition thereafter. The two cores from sta 150+96 showed loss during drilling and numerous preexisting cracks propagating along the length of the core. Alkali-silica gel was identified on the crack surfaces of core CL-39 CON-22 from sta 181+94 and filling isolated voids in some of the horizontal cores throughout the length of the track.

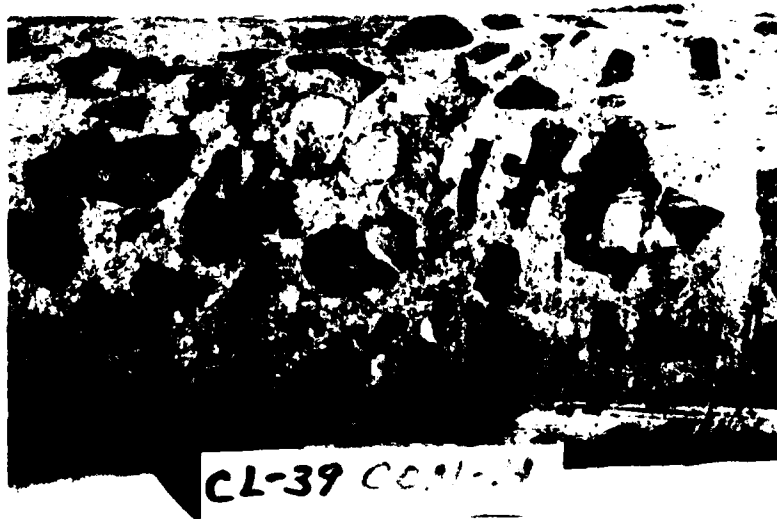
77. The inner wall concrete from cores CL-39 CON-16 and CL-39 CON-15 was discolored to a brownish color. The color varied significantly from the usually light gray color of the cement paste. The normal gray paste was composed of ettringite, tetracalcium aluminate dichloride-10-hydrate (chloroaluminate), calcium hydroxide calcite, and residual aluminoferrite from the cement. The brownish paste contained no calcium hydroxide, no ettringite, no chloroaluminate, and was more carbonated than the normal gray paste. The presence of chloroaluminate is due to conversion of ettringite from salt in the area and was considered normal for this situation.

78. The condition of the vertical and inclined cores representing the concrete below grade of the east and west support rails is summarized in Figure 24. Alkali-silica gel was present in all four cores. The gel

* Preliminary report, Van Dyke and Barnes, June 1975.



a. Reinforcing steel from core CL-39 CON-8 from sta 24+50 and core CL-39 CON-18 from sta 164-98. They compare the severe rusting of some steel to others that remain relatively unaffected. The 5/8-in.-diam steel bar in core CL-39 CON-18 was heavily rusted on one side and was only slightly affected on the reverse side



b. Expansion due to alkali-silica reaction has caused popouts of reactive aggregate particles after coring. The popouts occurred in less than 45 days from the time this core was drilled

Figure 24. Rusting of reinforcing steel and popouts caused by alkali-silica reaction

was generally found in isolated voids and associated with aggregate popouts on cored surfaces (Figure 24b). In core CL-39 CON-20, alkali-silica gel was found saturating the cracked area near the bottom of the core.

79. The soil samples commonly contained quartz, plagioclase feldspar, potassium feldspar, amphibole, calcite, clay-mica, smectite,* and kaolinite. Samples CL-39 SS-7, -8, -10, -11, and -12 contained more smectite than the other samples examined. No chloride-bearing minerals were detected by X-ray diffraction in any of the soils. This is somewhat surprising since, as mentioned earlier, chloride must be present to form chloroaluminate. The amounts may be below X-ray diffraction detection limits or chloride may be in the water.

Discussion

80. The concrete did not display uniform deterioration. The intact cores or cores where the breaks were caused mechanically tended to be in good physical condition. However, some cores showed signs of deterioration that were generally due to rusting of steel and alkali-silica reaction. The concrete near sta 180+00 showed both rusting of reinforcing steel and alkali-silica reaction.

81. As mentioned earlier, the chloroaluminate found in the cement paste indicates that chloride ions were and probably still are available for corrosion of the steel embedded in the concrete.

82. Alkali-silica reaction did not appear to be a primary cause of the deterioration but has contributed significantly to the degradation of the concrete in some instances. The presence of silica gel throughout the structure and observation of alkali-silica-caused popouts on cored surfaces suggest that the reaction may play an even more important role in the future degradation of the concrete.

83. Smectite, an expansive clay, was detected as a constituent in the soil in small quantities.

Conclusions

84. Concrete cores from the test track ranged from good to poor quality with better quality cores nearer the beginning of the track.

85. Deterioration was due to both rusting of embedded steel and to alkali-silica reaction. It was not possible to determine which factor started

* Swelling clay; the montmorillonite-saponite group.

first or was most important. The source of the chloride that rusted the steel was not specifically identified.

86. Since coring, the development of popouts on concrete surfaces has occurred due to alkali-silica reaction. This shows that the reaction is not exhausted; all it needs is a favorable environment for more reaction to occur.

87. The soil at the test track contains some swelling clay.

88. If the concrete is replaced, precautions should be taken to avoid the use of reactive materials so that an alkali-silica reaction will not take place; it might be desirable to avoid the use of embedded steel since corrosion of it has been a problem. Finally, it would be desirable to stabilize the soil so that foundation movement would be minimal.

Chemical Analysis of Soils, Water, and
Concrete Core from SNORT

89. Ten soil samples described earlier and two water samples were received by the Chemistry Unit, Materials and Concrete Analysis Group, on 2 June 1982. Below is the description of water samples.

<u>Sample Description</u>	<u>WES Designated No.</u>
Tap water	CL-39 W-2
Pond water	CL-39 W-1

90. The ten soil samples were analyzed for chlorides, sulfates, pH, and resistivity. All soils were prepared by air drying for 3 days, then grinding the samples to pass a 300- μ m (No. 50) sieve. These parameters were chosen to determine if the soil would be corrosive to the concrete or reinforcement steel in the concrete. The results are shown in Table 10.

91. The chloride contents of the soils were determined by boiling 5 g of the soil in 100 ml of distilled water for 10 min, filtering to remove the soil particles, and determining the chlorides in the filtrate by potentiometric titration. The sulfates were determined by shaking 4 g of the soil in 100 ml of distilled water for 1 hr, filtering to remove the soil particles, and determining the sulfates in the filtrate by a turbimetric method. Resistivity was determined by a method found in Black (1965). The resistivity of extracts from a soil-to-water ratio of 1:2 were measured. The soils and water were shaken for 1 hr, filtered to remove soil particles, and the resistivity

of the extract was measured using a conductivity meter. The pH was determined by a method found in Black (1965).

92. The two water samples were analyzed for chlorides, sulfates, pH, resistivity, total solids, hardness, alkalinity, magnesium, sodium, potassium, and calcium. The results are shown in Table 11.

93. A concrete core designated as core CON-18 164+99 was analyzed for chloride content. Five sections of the core were analyzed for chloride content. The core was broken at a reinforcing bar located approximately 2 in. from the bottom side. The 2-in. section below the reinforcing bar was broken into two parts and the section above the reinforcing bar, approximately 6 in. high, was intact except for a corner off the top which was missing. Below is a description of the sections tested and the weight of each section.

<u>Section</u>	<u>Description</u>	<u>Weight, g</u>
1	Top of core approximately 1 in. thick	249
2	Area just below section 1 approximately 1 in. thick	229
3	Section next to and above reinforcing bar approximately 1/2 in. thick	176
4	Section next to and below reinforcing bar approximately 1 in. thick	428
5	Bottom of core approximately 1-1/4 in. thick	568

The chloride content of each section is shown in Table 12.

94. The soil test results indicate that the soil could be corrosive to steel. The resistivity of the soil-to-water extracts 1:2 was low, with a range from 94 to 2180 ohms/cm. The average resistivity of the ten soils was 860 ohms/cm, indicating a high amount of soluble salts. The concentration of water-soluble sulfates found in the soils was not excessively high. The water-soluble sulfates ranged from a low of <50 µg/g to a high of 1830 µg/g (<0.005 to 0.183 percent). ACI Manual of Concrete Practice (1980), Part I, states that water-soluble sulfates in soils with a range of 0.10 to 0.20 would be a moderate exposure to concrete and recommends a Type II, IP(MS), or IS(MS) cement be used for sulfate resistance. The water-soluble chlorides in the soils ranged from a low of 38 µg/g to a high of 1530 µg/g, and the average chloride content for the ten soils was 518 µg/g.

95. The water analysis test results indicate that the two waters should not be corrosive to steel or concrete. The chloride contents for CL-39 W-1

and CL-39 W-2 were low, 101 mg/l and 34.1 mg/l, respectively. The sulfate contents were also low, 68.5 mg/l and 44.8 mg/l.

96. The chloride content of the concrete core was found to be high. The bottom portions of core sections 4 and 5 were found to contain the greatest amount of chlorides, 0.251 and 0.243 percent chloride, respectively. This suggests that the soil may be contributing to the chloride content of the concrete. More concrete core analysis would be needed to confirm this theory. The average chloride content of the five sections analyzed was 0.177 percent chloride. Based on 4000 lb/cu yd, the concrete would contain 7.08 lb of chloride per cubic yard. Clear and Hay (1977) report that the chloride content corrosion threshold of concrete is approximately 1.3 lb of chloride per cubic yard. The amount found in the core greatly exceeds this value, which indicates that chlorides in the concrete are contributing to the corrosion of the reinforcement steel.

PART V: FIELD TEST RESULTS

In Situ Pressure Meter Tests

97. Because the foundation material at China Lake is sandy with inclusions of layers of caliche, WES personnel decided that in situ tests should be conducted to determine the modulus of subgrade reaction, modulus of elasticity, and shear modulus for the foundation.

98. The pressure meter method has been used and verified over the last 20 years, and it was used in testing and obtaining material properties of the foundation.

99. The geotechnical investigation reported herein was undertaken as part of the evaluation of the existing SNORT structure (Figure 25). The work consisted of performing pressure meter tests at various stations along the track in order to obtain the foundation properties as follows:

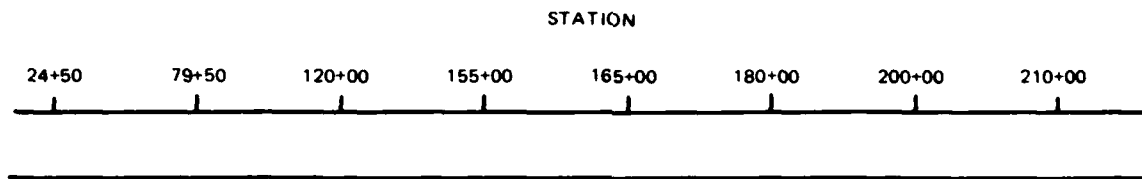
- a. A subgrade modulus for the foundation.
- b. The elastic properties: modulus of elasticity (E) and shear modulus (G).
- c. An estimate of Poisson's ratio.
- d. An estimate of ultimate bearing capacity and settlement for static loads for an average foundation condition.

100. The pressure meter tests were performed at 8 stations along the track; a total of 46 tests were performed between 20 May and 26 May 1982.

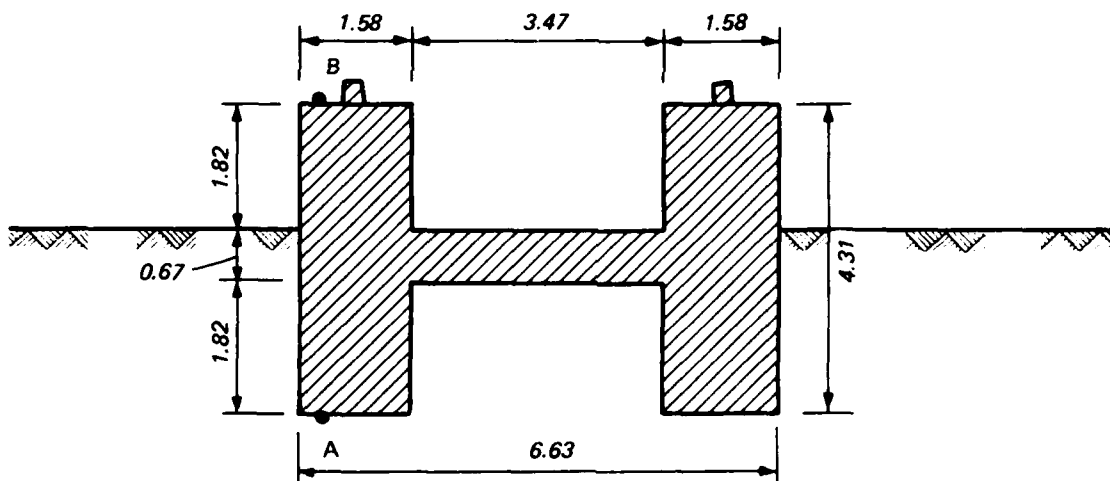
Pressure meter testing

101. Two pressure meters (PMT) were used at the site. With the pressure meter model B. S., 44 tests were performed; this pressure meter is a monocellular strain-controlled pressure meter, the probe is 60 mm in diameter and has an initial deflated volume of 1000 cm³. With the pavement pressure meter, two tests were performed; this pressure meter is a monocellular strain-controlled pressure meter, the probe is 32 mm in diameter and has an initial deflated volume of 200 cm³. Both PMT probes are inflated with water.

102. For 36 of the 46 tests, the borehole was prepared by augering in the dry with a 65-mm-diam hand auger; for the remaining 10 tests the soil was too hard to be drilled with the hand auger; these 10 tests were performed in holes prepared by rotary drilling with a 2.5-in. drill bit, a portable power auger, and a forklift for downward thrust. Results of pressure meter testing



PLAN VIEW



CROSS SECTION
DISTANCES IN FEET

Figure 25. Track plan view and cross section

are presented in Appendix A. The drilling procedure used for each test is indicated on each test curve presented in the appendix.

103. The raw data obtained in the field were reduced; corrections were applied for membrane resistance and volume losses in order to obtain the corrected curve. For each test, a raw curve, a volume loss curve, a membrane resistance curve, and a corrected curve are presented in Appendix A. A first loading modulus E_o , a reload modulus E_R , and a limit pressure P_L were also calculated. The first loading modulus was obtained from the straight part of the PMT curve on the first loading; the reload modulus was obtained from the slope of the unload-reload cycle; the limit pressure was estimated mostly by manual extension of the curve but sometimes by assuming $E_o/P_L = 10$. The detailed profiles of E_o , E_R , and P_L are given in Figures 26-28, respectively.

104. The average pressure meter parameters at each depth were obtained by averaging all values at that depth. This resulted in three average profiles: one for E_o , one for E_R , one for P_L . These averages are listed in Table 13.

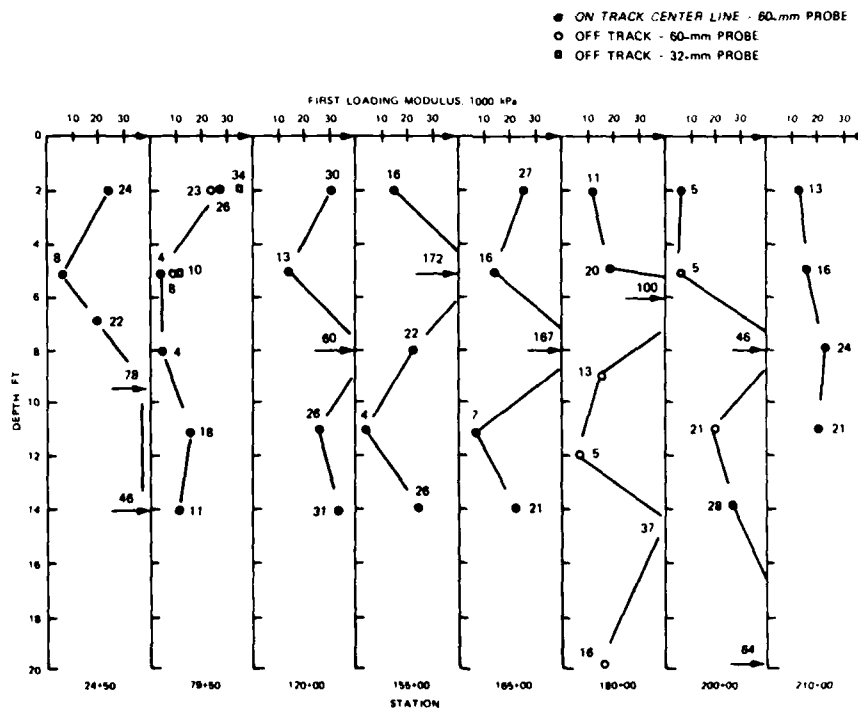


Figure 26. First loading modulus (1000 kPa)

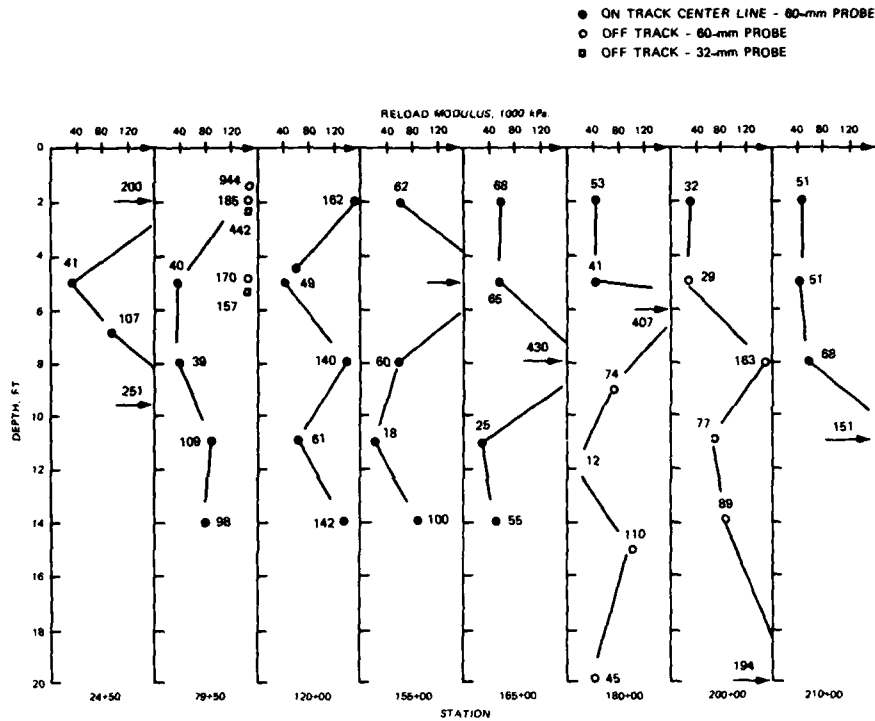


Figure 27. Reload modulus (1000 kPa)

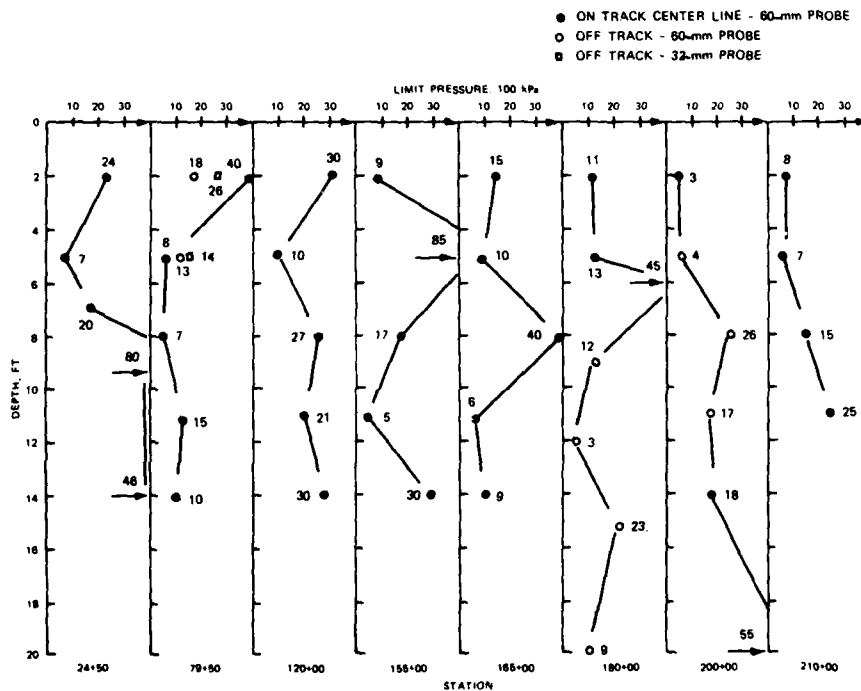


Figure 28. Limit pressure (100 kPa)

Foundation condition

105. On the basis of the pressure meter parameters and visual inspection, the soil can be classified as a medium to dense, fine clean sand. At almost all stations, a 2- to 3-ft-thick layer of cemented sand was encountered; it was most often found between the 5- and 10-ft depth.

106. The water table was not encountered within the first 20 ft. The moisture content of the sand is low; it is highest close to the surface under the track and decreases with depth.

Moduli of elasticity, Poisson's ratio

107. For each test a "Young's modulus" for the sand was obtained from the first loading modulus E_o as follows:

$$E_{\text{Young's}} = \frac{E_o}{\alpha} \quad (1)$$

where α is a rheological parameter recommended by Ménard (Baguelin, Jiziquel, and Shields 1978). For the sand of the SNORT track a value of 1/3 was selected; this made all $E_{\text{Young's}}$ three times larger than all E_o 's. The values of $E_{\text{Young's}}$ are summarized in Table 14.

108. An average $E_{\text{Young's}}$ was calculated for each station; the averaging technique used was a harmonic average weighted on the basis of an assumed stress distribution with depth. The average $E_{\text{Young's}}$ for each station is presented in Table 14.

109. Poisson's ratio is not measured during a pressure meter test. Also, Poisson's ratio varies with strain and will typically have low values at very small strains and values often larger than 0.5 at or after failure. For this medium-to-dense sand, a value of 0.35 to 0.4 appears reasonable for small strains.

110. The average shear moduli G was obtained from the average $E_{\text{Young's}}$ at each station as follows:

$$G = \frac{E_{\text{Young's}}}{2(1 + \nu)} \quad (2)$$

where $\nu = 0.35$. The values of G are presented in Table 14.

Bearing capacity analysis

111. The ultimate bearing capacity (P_{ult}) can be evaluated from the pressure meter limit pressure profile. The station which has the smallest

limit pressures close to the surface is sta 200+00 where the limit pressure within the zone of interest averages 350 kPa. For sta 200+00 the ultimate bearing pressure that can be resisted by the soil under the track is calculated to be 360 kPa, or 7200 lb/ft².

112. The stations which have the highest limit pressures close to the surface are sta 79+50, 120+00, and 155+00. For these stations the limit pressure averages 2,000 kPa; this leads to an ultimate bearing pressure of 2,010 kPa, or 40,200 lb/ft².

113. The factor of safety against failure of the soil under the track for the usual loads applied to the track can be evaluated in two ways:

- a. The beam-on-elastic foundation analysis gives the maximum pressure ($P_{\max}$) on the soil under various loads. The ratio $P_{\text{ult}}/P_{\max}$ gives the factor of safety for each case (Table 15).
- b. The ultimate bearing capacity can be multiplied by the appropriate contact area A under the track in order to obtain the ultimate load Q_u that the track can carry.

$$A = B \times L \quad (3)$$

where B = track width

L = transfer length

The variation of Q_u versus L is plotted in Figure 29.

Settlement analysis

114. The settlement of the track under load can be estimated by the pressure meter method or by the beam-on-elastic foundation analysis. This section deals with the pressure meter method only. Settlement calculations were performed for an 80,000-lb load uniformly distributed over the area equal to the width of the track times the transfer length (L).

$$q = \frac{80,000}{6.64 \times L} \quad (4)$$

The choice of transfer length will therefore influence the results; the settlement predictions are presented as a function of the transfer length for the worst condition (Figure 30) and for the best condition (Figure 31). The results have been extended to a 160,000-lb load.

115. Under the 80,000-lb load, for the worst condition (sta 200+00) and

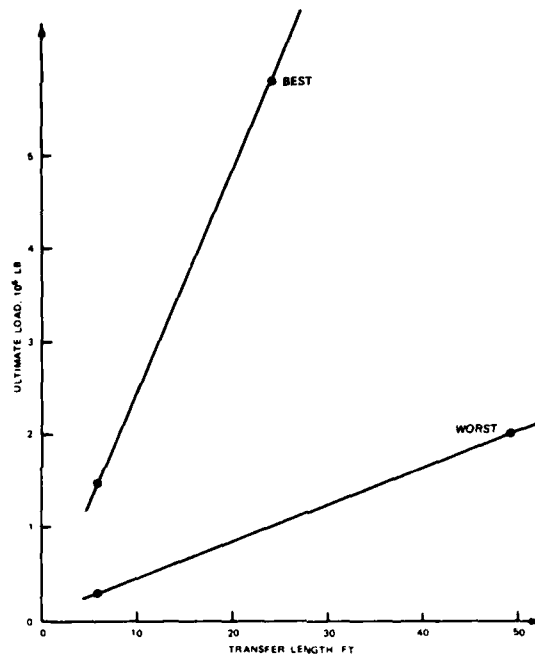


Figure 29. Result of bearing capacity analysis

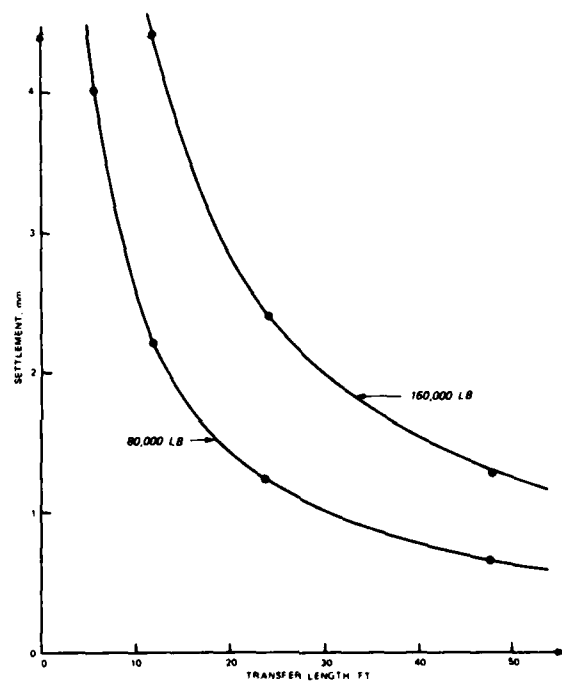


Figure 30. Result of settlement analysis for worst condition: static analysis

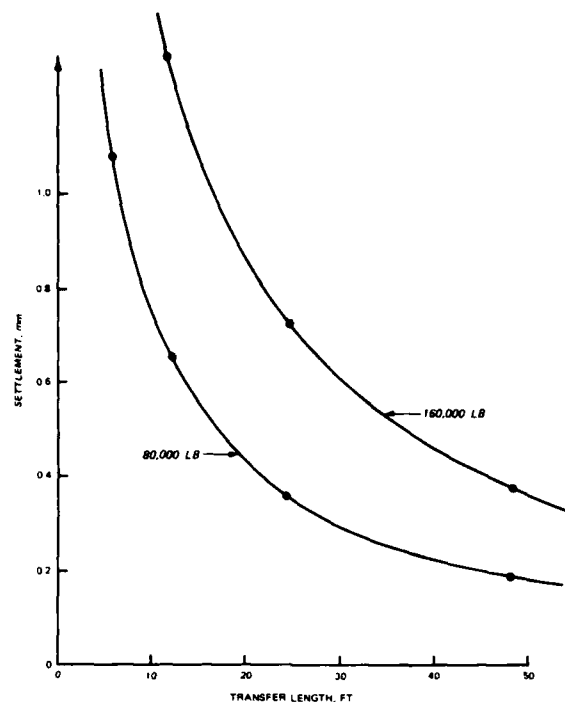


Figure 31. Result of settlement analysis for best condition: static analysis

for a reasonable transfer length of 30 ft, the calculated settlement is 1 mm or 39/1000 in. Under the 80,000-lb load, for the best condition (sta 120+00) and for a transfer length of 30 ft, the calculated settlement is 0.3 mm or 12/1000 in.

116. All previous analyses were performed for a static load which would remain on the track for a very long period of time. Instead, the track will be loaded dynamically by a rocket; this event will create a rapid load-unload cycle on the soil. It may then be more appropriate to calculate the settlement under this dynamic condition by using the pressure meter modulus E_R obtained from the unload-reload cycle of the test. This was done for an average soil E_R profile, and another settlement versus transfer length plot was obtained (Figure 32). According to these calculations, the settlement under a fast-traveling 80,000-lb point load, for an average soil condition, and for a 30-ft transfer length is 0.075 mm or 3/1000 in.

117. Load tests were performed on the track and the observed settlement under an 80,000-lb point static load varied between 5/1000 in. and 20/1000 in., depending on the station.

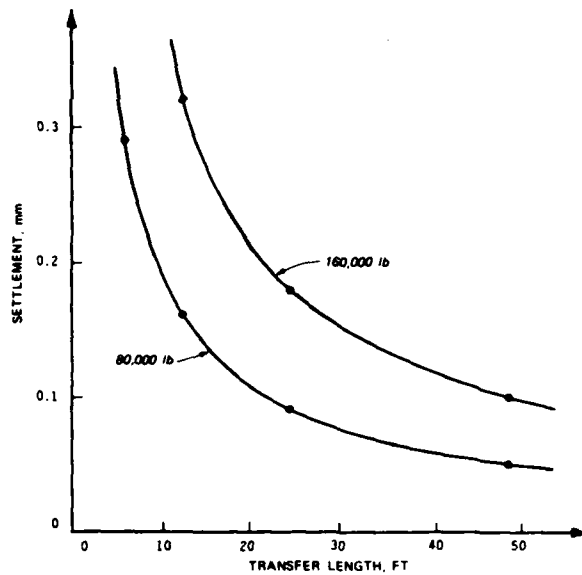


Figure 32. Result of settlement analysis for average condition: pseudo-dynamic analysis

Modulus of subgrade reaction

118. The modulus of subgrade reaction K is defined as:

$$K = \frac{q}{s} \quad (5)$$

where

q = pressure applied by the foundation

s = settlement

The value of K depends on many factors and is not a constant for a given soil. It has been calculated here on the basis of the settlement calculated for a corresponding bearing pressure obtained from Equation 4. Values of K as a function of the bearing pressure are presented in Figure 33 for the worst and best soil conditions. Values of K are also presented for each station for a bearing pressure of 28 kPa in Table 16.

Beam-on-elastic foundation analysis

119. The track was modeled using a beam-on-elastic foundation program. The assumptions made are listed in Table 17. A total of 11 different cases were modeled (Table 18). First, it was found that a minimum track length of

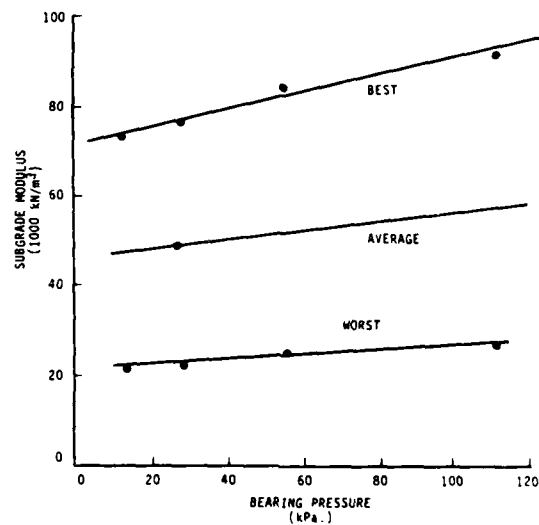


Figure 33. Modulus of subgrade reaction as a function of bearing pressure

100 ft is necessary to properly model the problem; shorter lengths will lead to higher deflections. Second, it was found that the track should be divided in elements which have a maximum length of 1 ft; longer elements will lead to larger deflections.

120. Under the 80,000-lb single load, the maximum deflection was 2.23×10^{-3} in. for the worst soil condition (Figure 34) and 0.89×10^{-3} in. for the strongest soil condition (Table 19).

121. Under the two 68,000-lb loads, applied 16 ft apart, the maximum settlement was 1.84×10^{-3} in. for the worst soil condition (Figure 35) and 0.73×10^{-3} in. for the strongest soil condition (Table 19). The maximum deflection occurred under the 80,000-lb load (Figure 34) and was smaller under the two 68,000-lb loads than under the single 80,000-lb load. This tends to indicate that the distance of 16 ft between the two 68,000-lb loads reduces the interaction between the two loads down to a negligible level.

122. The settlements obtained with the beam-on-elastic foundation simulation are much smaller than the observed settlements in the field. This may be due to a number of reasons; one reason could be as follows.

123. The predicted deflection is the one that will occur immediately under the track (Point A in Figure 25) while the observed deflection is

Soil: $K_{\text{soil}} = 21,500 \text{ kN/m}^3 = 79.2 \text{ lb/in}^3$
 Load: 80,000-lb single-point load

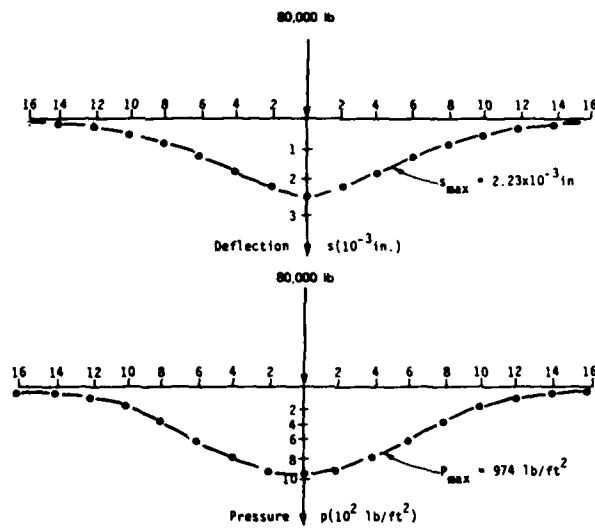


Figure 34. Computed deflections with 80,000-lb single-point load

Soil: $K_{\text{soil}} = 21,500 \text{ kN/m}^3 = 79.2 \text{ lb/in}^3$
 Load: Two 68,000-lb point loads 16 ft apart

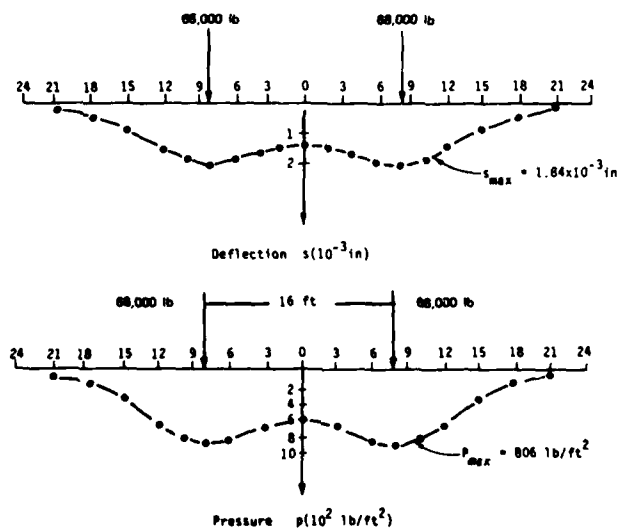


Figure 35. Computed deflections with two 68,000-lb point loads 16 ft apart

measured on top of the track (Point B in Figure 25); the compression of the track between A and B may not be negligible since longitudinal cracks exist and will close first before transmitting the load to the soil. Overall, however, the deflections (whether measured or calculated by the pressure meter method or the beam-on-elastic foundation method) are always smaller than 40×10^{-3} in.

Structural Load Tests

124. The concrete in the test track at China Lake is extensively deteriorated and will deteriorate more rapidly in the future.

125. It was not known how much the deterioration of the track may have affected its load-carrying capacity. The concrete track was overdesigned, and for the deterioration it has experienced up to this point it is possible that the track is capable of carrying design loads. To determine what the condition of the track is in relation to load, it was necessary to perform field-load tests.

126. Field-load tests were performed using downward and upward direction loads. The downward load was 80,000 lb on four shoes, two on each track spaced 8 ft 4 in. apart. The up load was approximately 30,000 lb on two shoes, one on each track. The up load was applied at the rail supports.

127. Using the properties of the track and foundation materials in a beam-on-elastic foundation analysis, one can determine what the deflection of the track should be assuming the track is not cracked and the surface concrete and reinforcing steel are not deteriorated. The deflections of the track under field-load tests can be compared with the deflections of the track from analytical results under the same loading condition, and conclusions can then be drawn as to how badly the track has been affected by the deterioration. The up loads were placed on the track at 66 locations. These loadings helped to determine the carrying capacity of the anchor bolts which hold the crane rail in place and gave some idea of the deflection of the concrete track and rail in an upward direction.

128. The down-load tests were performed by placing weights on a platform mounted on shoes which were supported on the track. Two 40,000-lb blocks were used as weights. A transit was used to take elevation readings on the concrete track and at the center of the platform location after the platform

was positioned. Elevation readings were then taken at the same position (the transit rod was never moved) after the load was applied and after the load was removed. The same procedure of taking readings was performed for the up loads.

129. The test results for the structural load testing are presented in Tables 20 and 21, respectively, for the down loads and up loads. The average down load deflections for the east leg and the west leg were 0.0084 in. and 0.0078 in., respectively. The average up-load deflections for the east leg and west leg were 0.0042 in. and 0.0041 in., respectively.

PART VI: STRUCTURAL ANALYSIS OF EXISTING TEST TRACK

Introduction

130. The existing SNORT structure at China Lake is cracked excessively, and the concrete is showing signs of extensive deterioration. From laboratory testing and analysis, it was found that some reinforcing steel is badly corroded, and there is potential for extensive corrosion. The concrete is experiencing alkali-silica reaction and under favorable moisture conditions, rapid deterioration could result. Under these deteriorating conditions and due to the fact that the concrete track cannot be rehabilitated to eliminate the active deterioration, the track is not dependable for long-term future use.

131. The structural analysis of the existing track consisted of:

- a. Using design loads to determine stresses in the crane rail, tie down bolts, and concrete track for limiting and average soil conditions.
- b. For design loads, deflections were determined in the concrete track for limiting and average soil conditions.
- c. For loads imposed during field testing, deflections were determined in the concrete track for limiting and average soil conditions.
- d. Deflections of the concrete track, as measured under field load tests, were presented and compared with the deflections obtained from analytical results. The analytical results were obtained using actual material properties of the track and foundation material without considering cracking or surface concrete deterioration. This comparison gave some indication of how the track has been affected by concrete cracking and steel and concrete deterioration.

Analysis of Existing Track Under Design Loads

Design loads

132. The design loads are presented in Table 22. These are the maximum static down loads and inertial up and side loads which will be supported by 12 shoes (6 on each rail) for both rail loads, and 6 shoes for one rail load. These loads are the maximum loads that have ever been supported by 12 shoes (6 on each rail) for both rail loads and 6 shoes for one rail load and are

the maximum loads that have been used on the SNORT track. These loads are reasonable design loads for future testing. The shoes are approximately 8 ft 4 in. apart, and the spacing of the crane rail supports are 4 ft 2 in. apart. Therefore a minimum length over which the load is transferred to the track will occur when the shoes are directly above every other crane rail support. This procedure gave a greater concentration of load at any loading position and was used to determine the stresses in the crane rail, anchor bolts, and concrete track.

133. The stresses due to the static and inertial loadings were determined first; then, by applying dynamic load factors and crane rail roughness factors, the maximum stresses for the dynamic conditions were inferred.

Design methods

134. The beam-on-elastic foundation method was used for analysis of the existing track. From preliminary analysis using beam-on-elastic foundation analysis and finite-element analysis, it was found that the stresses and stress concentrations in the track are low. Because the normal operating stresses in the track are low, the beam-on-elastic foundation analysis is adequate without the detail analysis by finite elements.

135. The theory of beam-on-elastic foundation analysis is presented in many textbooks.

136. It can be considered that the test track at China Lake rests on a continuous elastic foundation. Superposition may be used to combine the effect of various combinations of loads.

137. The properties of the foundation along the length of the existing test track vary to some degree; therefore, the analysis will be performed using limiting and average foundation properties.

138. Since the problem is statically indeterminate, the equilibrium equations

$$\Sigma F = 0 \quad (6)$$

$$\Sigma M = 0 \quad (7)$$

cannot be used to obtain a solution to the static case loadings. The equation of the elastic curve assumed by the beam

$$EI \left(\frac{d^2 y}{dx^2} \right) = -M \quad (8)$$

was used and the solution to the problem was obtained by using Equations 6, 7, and 8. The deflection of the beam was assumed to be proportional to the pressure q under the beam. By differentiating both sides of Equation 6, we obtain

$$EI \left(\frac{d^4 y}{dx^4} \right) = - \frac{d^2 M}{dx^2} \quad (9)$$

but

$$\frac{d^2 M}{dx^2} = q \quad (10)$$

Assume the positive sense of x is to the right and positive y is upwards; then

$$EI \left(\frac{d^4 y}{dx^4} \right) = +q \quad (11)$$

The pressure per unit length of beam q is

$$q = wk_o y \quad (12)$$

where w is the width of the bottom of the beam, k_o is the force exerted by the elastic support per unit deflection of the support, and y is the beam deflection. When Equation 12 is inserted into Equation 11, we have the deformation equation

$$EI \left(\frac{d^4 y}{dx^4} \right) = wk_o y \quad (13)$$

which was used with the equilibrium Equations 6 and 7 to obtain shears, moments, and deflections in the test track at China Lake.

139. A computer program was used to obtain the analytical results and these results were plotted to give a clear picture of the deflections, shears, and moments in the test track.

Length of supersonic track
to consider in analysis

140. The test track is approximately 4.1 miles in length; therefore, for any sled position the track will not be affected significantly along its entire length. The question, then, is what length of track is significantly affected by any sled position.

141. The beam-on-elastic foundation analysis was used and results were obtained for different lengths of track (40, 50, 60, 70, 80, 90, 100, and 200 ft). From these results, the minimum length of track was determined such that the shears, moments, and deflections will not be significantly affected even if a longer length of track is analyzed.

142. It was found that the results were accurate if 100-ft lengths of track were used. Since it cost very little more, a 200-ft length of track was analyzed by the beam-on-elastic foundation analysis. In the design of the new track, a 100-ft length of track will be used in the finite-element analysis because the cost is much greater as the size of the three-dimensional finite-element problem is increased.

143. For the beam-on-elastic foundation analysis, different spring spacings were used to make sure the analytical model was accurate for the continuously supported track.

Design load stresses in crane
rail, anchor bolts, and concrete track

144. Down loads on both rails of 136,000 lb and a maximum side load of 50,000 lb at 8 ft above the rail were considered. The 136,000-lb and the 50,000-lb loads act on 12 shoes, 6 on each track, with an 8-ft-4-in. spacing of shoes. The side load will result in horizontal loads through the centroid of the track plus a torque on the track. The shear stresses, due to the torque, cannot be obtained by the beam-on-elastic foundation analysis code which presently exists. These stresses will be calculated analytically and the results added to the effects caused by the vertical and side loads.

145. Results from the down load of 136,000 lb for limiting and average soil conditions (Table 23) are presented in Appendix B (Figures B1-B9). The deflection due to the weight of the structure was assumed to have occurred uniformly along the length of the track and does not affect the stresses in the structure. Therefore, it is not presented in the results from the beam-on-elastic foundation analysis.

146. The moment of inertia of the total track section was used in the beam-on-elastic foundation analysis. That is, the moment of inertia of the cracked section as used in the working-stress theory of reinforced concrete design was not used. Using the moment of inertia of the total track section makes the structure stiffer and is a conservative analysis because less load is transferred along the structure length to the foundation which causes the moments in the structure to be larger. If the concrete section is considered cracked and the tensile concrete area is neglected in the analysis, the maximum moments in the track are approximately one-half of those which are obtained when the total structure is considered effective.

147. The results of the beam-on-elastic foundation analysis for the 50,000-lb side load through the centroid of the section are presented in Figures B7-B9.

148. The results of the beam-on-elastic foundation analysis for the field-test load supported on four shoes (two on each crane rail) are presented in Figures B4-B6.

149. The maximum moments, shears, and deflections for the design down load of 136,000 lb and the field test down load of 80,000 lb are presented, respectively, in Tables 24 and 25. The deflections, moments, and shears due to the 50,000-lb side load acting through the centroid of the track section are presented in Table 26.

150. The section of the existing track and the axes are presented in Figure 36. The moments of inertia about the X-X and Y-Y axes are calculated below assuming compression in the top of the test track. Since the steel crane rails are not continuous and are not composite with the concrete H-sections, they are neglected in the computations. This will produce a conservative result because the crane rails are staggered and even at the weakest section (where two crane rails meet), the crane rail on the opposite side is not separated and has rigidity. If the stresses in the existing test are low, then the track is safe for future use.

151. The moments of inertia are calculated below.

152. Assume compression in the top of the track and calculate the moment of inertia about the X-X axis. Calculate kd .

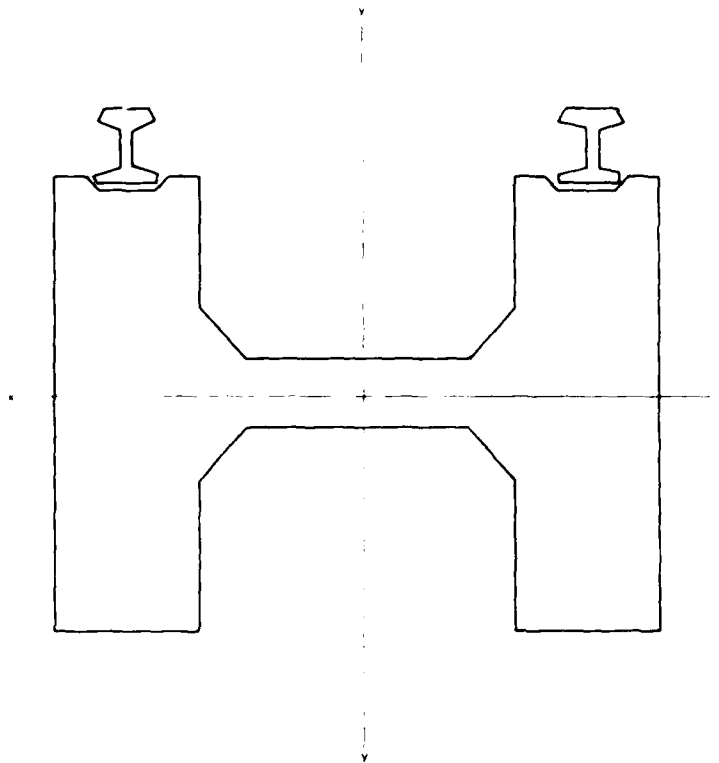


Figure 36. Section of track showing axes orientation

$$(13.41)(kd - 0.81) + (2.64)(kd - 1.08) + (19kd - 30.88)$$

$$\times \left(\frac{kd - 1.625}{2} \right) + \left[2 \left(\frac{30}{3.66} \right) - 1 \right] [3.12(kd - 6.95)] = (0.93) \frac{30}{3.66} (25.25 - kd)$$

$$+ (2) \left(\frac{30}{3.66} \right) (49.69 - kd) 9.5kd^2 + 57.2kd - 1329.41 = 0$$

$$kd = \frac{-57.2 \pm (57.2)^2 - (4)(9.5)(-1329.41)}{2(9.5)} = \frac{-57.2 \pm 231.93}{19}$$

$$= 9.2 \text{ in.}$$

Calculate I_{X-X} .

$$\begin{aligned}
 & (4) \left[(4.125) \left(\frac{1.625}{3} \right)^3 + (4.125)(1.625)(9.2 - 1.625)^2 \right] = 24 + 385 = 409 \\
 & + 4 \left[\frac{(1.625)(1.625)^3}{36} + \frac{(1.625)^2}{2} (8.12)^2 \right] = 0.77 + 348 = 349 \\
 & + (2) \frac{(19)(7.575)^3}{3} = 5,506 \\
 & \left[2 \left(\frac{30}{3.66} \right) - 1 \right] (2)(3.12)(2.25)^2 = 486 \\
 & + (2)(0.93) \left(\frac{30}{3.66} \right) (25.25 - 9.2)^2 = 3,928 \\
 & + (2)(2) \left(\frac{30}{3.66} \right) (49.69 - 9.2)^2 = 53,752 \\
 & I_{X-X} = 64,430
 \end{aligned}$$

Calculate the moment of inertia about the Y-Y axis. Calculate kd .

$$\begin{aligned}
 & (51.62)(kd) \left(\frac{kd}{2} \right) + (1.56 + 0.31 + 1)(kd - 3) \left[2 \left(\frac{30}{3.66} \right) - 1 \right] = \left(\frac{30}{3.66} \right) \\
 & \times [(1.56 + 0.31 + 1)(16 - kd) + 0.31(32 - kd) + 0.31(47.62 - kd) \\
 & - (1.56 + 0.31 + 1)(63.62 - kd) + (1.56 + 0.31 + 1)76.62 - kd \\
 & 25.81(kd)^2 + 2.87(kd - 3)(15.39) = (8.2)[2.87(16 - kd) + 0.31(32 - kd) \\
 & + 0.31(47.62 - kd) + (2.87)(63.62 - kd) \\
 & + 2.87(76.62 - kd)] \\
 & 25.81(kd)^2 + 44.18(kd) - 132.54 = 8.2[45.42 - 2.87(kd) + 9.92 - 0.31(kd) \\
 & + 14.76 - 0.31(kd) + 182.59 - 2.87(kd) \\
 & + 219.90 - 2.87(kd)] \\
 & 25.81(kd)^2 + 44.18(kd) - 132.54 = 8.2[4.73.09 - 9.23(kd)] \\
 & 25.81(kd)^2 + 44.18(kd) - 132.54 = 3877.79 - 75.66(kd) \\
 & 25.81(kd)^2 + 119.84(kd) - 4010.33 = 0
 \end{aligned}$$

$$kd = \frac{-119.84 + \sqrt{(119.84)^2 + 4(25.81)(4010.33)}}{2(25.81)}$$

$$kd = \frac{-119.84 + 654.51}{51.62}$$

$$kd = 10.36 \text{ in.}$$

Calculate I_{Y-Y} .

$$\frac{(51.62)(10.36)^3}{3} = 19,133$$

$$\left[2\left(\frac{30}{3.66}\right) - 1\right](2.87)(10.36 - 3)^2 = 2,393$$

$$\left(\frac{30}{3.66}\right)(2.87)(16 - 10.36)^2 = 748$$

$$\left(\frac{30}{3.66}\right)(0.31)(32 - 10.36)^2 = 1,190$$

$$\left(\frac{30}{3.66}\right)(0.31)(47.62 - 10.36)^2 = 3,528$$

$$\left(\frac{30}{3.66}\right)(2.87)(63.62 - 10.36)^2 = 66,730$$

$$\left(\frac{30}{3.66}\right)(2.87)(76.62 - 10.36)^2 = 103,282$$

$$I_{Y-Y} = 197,004 \text{ in.}^4$$

153. Assume tension in the top of the track and calculate the moment of inertia about the X-X axis.

$$(19kd)\left(\frac{kd}{2}\right) + \left[2\left(\frac{30}{3.66}\right) - 1\right][2(kd - 3.56)] = \left(\frac{30}{3.66}\right)[3.12(46.3 - kd) + 0.93(28 - kd)]$$

$$9.5(kd)^2 + 30.79(kd) - 54.80 = 1397.51 - 33.2(kd)$$

$$9.5(kd)^2 + 63.99(kd) - 1452.31 = 0$$

$$kd = \frac{-63.99 + (63.99)^2 + 4(9.5)(1452.31)}{2(9.5)}$$

$$kd = \frac{-63.99 + 243.38}{19}$$

$$kd = 9.45 \text{ in.}$$

154. Calculate I_{X-X} when tension is in the top of the track.

$$2\left(\frac{19(9.45)^3}{3}\right) = 10,690$$

$$2(3.12)\left(\frac{30}{3.66}\right)(46.3 - 9.45)^2 = 69,568$$

$$2(0.93)\left(\frac{30}{3.66}\right)(28 - 9.45)^2 = 5,246$$

$$2(2)\left[2\left(\frac{30}{3.66}\right) - 1\right](9.45 - 3.56)^2 = 2,136$$

$$I_{X-X} = 87,640 \text{ in.}^4$$

155. The compressive stress in the concrete can now be calculated for each of the foundation modulus constants. For $k = 79.2 \text{ lb/in.}^3$

$$f_{\text{compressive}} = \frac{(1.21 \times 10^6)(9.2)}{64,430} + \frac{(9.6 \times 10^5)(10.36)}{197,004}$$

$$= 173 + 50 = 223 \text{ psi}$$

For $k = 175 \text{ lb/in.}^3$

$$f_{\text{compressive}} = \frac{(7.3 \times 10^5)(9.2)}{64,430} + \frac{(5.8 \times 10^5)(10.36)}{197,004}$$

$$= 104 + 31$$

$$= 135 \text{ psi}$$

For $k = 271.1 \text{ lb/in.}^3$

$$f_{\text{compressive}} = \frac{(5.8 \times 10^5)(9.2)}{64,430} + \frac{(4.3 \times 10^5)(10.36)}{197,004}$$

$$= 83 + 23$$

$$= 106 \text{ psi}$$

156. Calculate the tensile stress in the reinforcing steel
 $k = 79.2 \text{ lb/in.}^3$

$$f_{\text{steel}} = \left[\frac{(1.21 \times 10^6)(40.49)}{64,430} + \frac{(9.6 \times 10^5)(66.27)}{197,004} \right] \frac{30}{3.66}$$

$$= (760 + 323) \frac{30}{3.66} = 8880 \text{ psi}$$

For $k = 175 \text{ lb/in.}^3$

$$f_{\text{steel}} = \left[\frac{(7.3 \times 10^5)(40.49)}{64,430} + \frac{(5.8 \times 10^5)(66.27)}{197,004} \right] \frac{30}{3.66}$$

$$= (459 + 195) \frac{30}{3.66} = 5360 \text{ psi}$$

For $k = 271.1 \text{ lb/in.}^3$

$$f_{\text{steel}} = \left[\frac{(5.8 \times 10^5)(40.49)}{64,430} + \frac{(4.3 \times 10^5)(66.27)}{197,004} \right] \frac{30}{3.66}$$

$$= (364 + 145) \frac{30}{3.66} = 4172 \text{ psi}$$

157. The maximum shear stress will occur when the track is subjected to the 136,000-lb down load or when it is subjected to half the down load with the inertia loads causing a torque.

$$\tau_{136,000 \text{ lb}} = \frac{18,480}{2,066} = 8.9 \text{ psi} \quad \text{O.K.}$$

$$\tau_{\frac{136,000}{2} \text{ lb}} + \tau_{50,000 \text{ lb}} + \text{torque shear} = \frac{18,480}{(2)(2,066)} + \frac{8835}{2399}$$

$$+ \frac{(6.4 \times 10^6) \sqrt{(39.81)^2 + (26.71)^2}}{6(463,624 + 1,966,817)} = 4.5 + 3.7 + 21 = 29.2 \text{ psi} \quad \text{O.K.}$$

158. The stress is very low in the concrete and the reinforcing steel when subjected to static down and inertia side loads. The maximum compressive concrete stress is 223 psi and the maximum tensile steel stress is 8880 psi.

159. The shear stress is approximately 29 psi, which is low. The torque load is applied along the track at the six shoe locations, and the shear is computed as 1/6 the total torque stress because the foundation will react and reduce the shear from shoe location to shoe location.

160. If a dynamic load factor of 2 is used, it can be seen that the

compressive concrete, tensile reinforcing, and shear stresses are still below the allowables. The allowable compressive concrete stress is assumed to be $5,670/2 = 2,835$ psi; the tensile steel stress, 20,000 psi; and the shear stress, 316 psi.

161. If a severe loading is considered where a dynamic load factor of 2 and a rail roughness coefficient of 6 (using only 1/2 the static loading) are applied at the same time, the stresses will be increased by approximately 6 times. The compressive and shear concrete stresses will be below the allowable level. The tensile stress in the reinforcing steel would be 53,280 psi, which appears to be above the allowable and above the ultimate of the reinforcing steel (40,000 psi). Since this is such an extreme loading and the stresses due to the dynamic loading will dissipate rather rapidly with depth, these maximum tensile stresses will never be mobilized.

162. To be sure the steel stress is not excessive, ultimate strength design will be used to calculate the ultimate moment capacity of the concrete section based on the lower four No. 9 bars and the six No. 5 bars being tensile reinforcement. The center of gravity of the tensile steel is

$$\bar{y} = \frac{(6)(0.31)(28 + (4)(1)(3.56))}{(6)(0.31) + (4)(1)} = 11.32 \text{ in.}$$

$$d = 53.25 \text{ in.} - 1.63 \text{ in.} - 11.32 \text{ in.} = 40.30 \text{ in.}$$

$$d' = 53.25 \text{ in.} - 1.63 \text{ in.} - 46.30 \text{ in.} = 5.32 \text{ in.}$$

$$A_s = 6(0.31) + (4)(1) = 5.86 \text{ in.}^2$$

$$A'_s = 4(1.56) = 6.24 \text{ in.}^2$$

163. Since the area of the compressive steel is greater than the area of the tensile steel, the ultimate moment will be based on the area of tensile steel.

$$M_u = \phi A_s f_y (d - d')$$

$$M_u = (0.9)(5.86)(40,000)(40.31 - 5.32)$$

$$= 7,381,490 \text{ in.-lb}$$

164. From Table 24, the maximum moment due to the 136,000-lb down load is 1.21×10^6 in.-lb. A factor of 6 applied to this moment gives 7.26×10^6 in.-lb, which is less than the 7.38×10^6 -in.-lb capacity of the section. This gives a safety factor of approximately 1, and for this extreme loading and these conservative assumptions the reinforcing steel in the section is considered adequate.

165. The stress in the crane rail is adequate since the crane rail will only be required to carry about

$$\begin{aligned} & \frac{(EI)_{\text{crane rail}}}{(EI)_{\text{crane rail}} + (EI)_{\text{concrete tract}}} \\ &= \frac{(74)(30 \times 10^6)}{(74)(30 \times 10^6) + (3.66 \times 10^6)(4.6 \times 10^5)} \\ &= \frac{2.2 \times 10^9}{1.7 \times 10^{12}} \approx 0.1 \text{ percent of the induced moment.} \end{aligned}$$

This would cause a maximum stress in the crane rail of

$$\frac{(0.001)(7.26 \times 10^6)(3)}{74} = 294 \text{ psi .}$$

166. The up loads on the track are secondary in relation to the weight of the track itself. Up loading may result in overstress in the anchors and this would be the only cause for concern. The stresses in the anchors are calculated below.

Stress in anchors

$$1\text{-in.-diameter area} = \frac{(3.14)(1)^2}{4} = 0.785 \text{ in.}$$

$$\text{Stress in bar due to design load} = \frac{11,333 \text{ lb}}{(2)(0.785)} = 7219 \text{ psi}$$

$$\text{For field load tests} = \frac{15,000 \text{ lb}}{(2)(0.785)} = 9554 \text{ psi}$$

167. The anchor stress under design load is 7219 psi. With a dynamic load factor of 2, the stress would be a little over 14,000 psi, which is below

the allowable of 20,000 psi for the anchor rods.

168. For the extreme loading of 6 times the static loading, the stress in the anchors would be excessive. For the loads which are commonly applied to the SNORT structure, the anchor stresses are adequate.

169. The deflections from the field load test are presented in Table 20. The average deflection of the west wall is 0.0078 in. and for the east wall is 0.0084 in.

170. The analytical results were obtained (Table 25) assuming the track is uncracked and the surface concrete and reinforcing steel are nondeteriorated.

171. By comparing the results of the deflections obtained in the load testing with the analytical results, it is seen that they compare well. Since the deflections by analytical computations are a little higher than those which were obtained in the field, it appears that the deterioration of the test track has not progressed to the point that the load-carrying capacity of the track has been reduced. Therefore, the existing track can be used without problems while the new track is being built.

PART VII: DESIGN OF NEW SUPERSONIC TEST TRACK

Introduction

172. Since the existing test track is extensively cracked, deteriorated, and cannot be rehabilitated to eliminate the deteriorating agents which may cause rapid concrete deterioration, it is suggested that a new test track be constructed. The existing test track can be used to conduct field tests while the new track is being built.

Geometric Configuration and Reinforcement

173. The first considerations in the design of a new supersonic test track at China Lake are the geometrical configuration and the steel reinforcement for the concrete track. The general geometric configuration and steel reinforcement are presented in Figure 37.

174. The thicknesses of concrete sections and steel reinforcement were selected as minima, which would be prudent for a supersonic test track which will be subjected to extensive dynamic testing. The stresses under short-term static and dynamic tests may be lower than allowables, but this will add to long-term durability and testing potential.

175. It is important to have substantial reinforcing in a track subjected to dynamic loading. The reinforcing steel will help keep down cracking

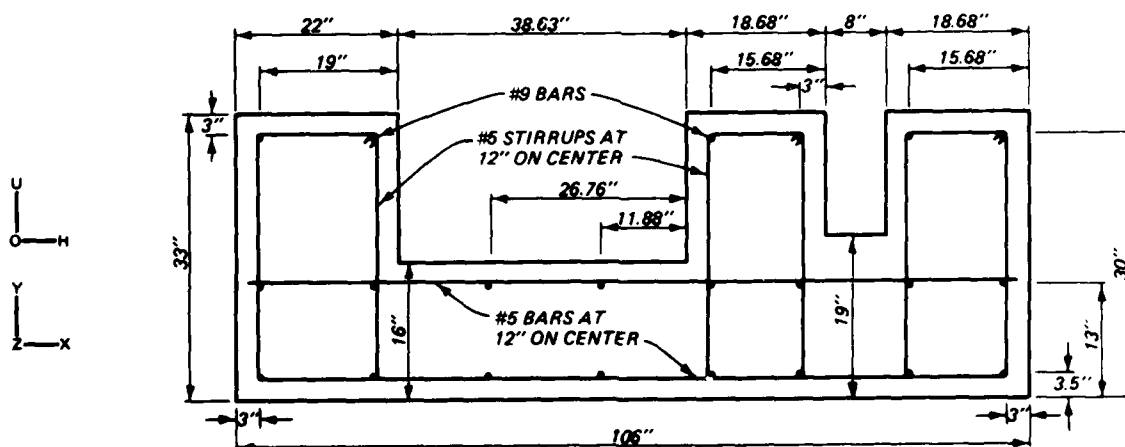


Figure 37. Configuration and reinforcement of proposed test track

due to vibrations, stress concentrations, fatigue loading, expansion and contraction, or any other effects which will tend to crack the concrete by tension stresses.

176. There are three track gages. The gage between the outer two rails is 84 in. or 7 ft. The intermediate gage is 56.5 in. and the narrow gage is 27.5 in. The rails with gage 56.5 in. will extend for the entire length of supersonic test track which is 8 miles. The 56.5-in. gage is that of the existing SNORT track and most other existing supersonic test tracks. The gage of the outer rails (84 in. or 7 ft) is the gage of the Holloman test track. The 84-in. gage track will extend for only 6 miles of the 8-mile track. The narrowest gage (27.5 in.) can be used for what were previously monorail tests. This gage, even though it is narrow, will give stability to the sled and test vehicle and can use braking capability with water in the narrow trough.

Material Properties

177. The assumed concrete properties are presented in Table 27. The same foundation properties as determined at the existing test track will be used for the design of the new test track. The same crane rail will be adequate, but larger tie-down anchors will be suggested.

Design Procedure

178. The design of the new track consisted of assuming a geometrical configuration of track and determining specific steel reinforcement that is not overstressed when subjected to design loads. The design loads were those that were used in the analysis of the existing track. Various combinations of the loadings were used, and a dynamic load factor of 2.0 and a rail roughness coefficient of 6 were applied to 1/2 the dead load to account for dynamic amplifications.

179. Two independent methods of analysis were used in evaluating the proposed test track. The beam-on-elastic foundation method was used to obtain a conventional sectional analysis of the track. The beam-on-elastic foundation analysis does not allow a consideration of stress concentrations or allow for the effect of positioning loads at various locations on the track cross section. A 200-ft length of track was used in the beam-on-elastic foundation

analysis and the results from various loads will be superpositioned to obtain stresses for specific case loadings.

180. The finite-element analysis was used to obtain stress concentrations in the concrete section of the proposed track for 16 load cases. A 100-ft length of track was used in the finite-element analysis. The load cases are presented in Appendix C (Figures C1-C7). The finite-element analysis will allow the effects of torsion, side loads, and vertical loads as well as the properties of the foundation to be taken into account simultaneously.

181. The results of the beam-on-elastic foundation analysis are also presented in Appendix C (Figures C18-C48). The maximum and minimum values of deflection, bending moment, and shear are presented in Table 28. The maximum concrete compressive stresses are presented in Table 29. These stresses were calculated using the same concept as that used in the calculations for the existing track. The tension area of concrete in the track section was used in the beam-on-elastic foundation analysis but was neglected when performing stress computations.

182. Since it is planned to have the crane rails continuous on the new track, the crane rails will add some resistance to deflection of the proposed track. Since the crane rails will not be tied composite to the concrete track, the amount of moment or load which will be taken individually by the concrete track or the crane rails will be proportional to the products of their moment of inertia and modulus of elasticity, respectively. The products of moment of inertia and modulus of elasticity for the track and rails are given in Table 30.

183. It can be seen from the relative ratios that most of the load will be taken by the concrete track. In fact, the amount taken by the rails is so small that it is not considered in computing maximum concrete stresses.

184. The maximum concrete stresses are due to a combination of the vertical and side loads. They are very small in relation to a 4000-psi maximum compressive stress; therefore, the track is satisfactory in relation to these stresses. When a total dynamic amplification factor of 6 is applied to the maximum stress, it is close to the 4000-psi ultimate strength of the concrete ($6 \times 634 = 3804$ psi). For such extreme case loadings, this is adequate.

185. The maximum reinforcing steel stress is 12,400 psi, which is not excessive. The dynamic amplification factor of 6 causes the stress in the steel to be above the ultimate of 40,000 psi. A maximum moment obtained by

ultimate strength design is a better way to judge the adequacy of the steel reinforcement. The ultimate strength moment is 13,340,000 in.-lb. This maximum moment capacity is much larger than any of the moments presented in Table 28; therefore, the proposed track section is considered adequate in relation to the beam-on-elastic foundation analysis results.

186. The maximum shear stress is difficult to obtain from the beam-on-elastic foundation analysis. It is difficult to determine how the shear from torsion is distributed because part of it will be taken by the interaction of the track with the foundation. The shear stress from finite-element analysis will be used to judge the adequacy of the beam in shear. These values of shear are presented in Table 31. The maximum shear value of 228 psi is less than the allowable of 316 psi for 4000-psi concrete that is reinforced with stirrups and main steel.

187. The deflections, moments, and shears for designing the transverse steel in the proposed test track were determined by beam-on-elastic foundation analysis. The deflections, moments, and shears are presented in Figures 38-40 for a 1-ft-wide transverse section. Considering the worst soil condition, the maximum moment is 22,700 in.-lb for static load and 136,200 in.-lb for the dynamic case. The ultimate moment of the 16-in. section with No. 5 bars is

$$\begin{aligned} M_u &= (0.9)(0.62)(40,000)(12.7 - 3.3) \\ &= 209,808 \text{ in.-lb} \end{aligned}$$

The shear stress is $1224 \text{ lb}/11.7 \times 12 = 8.7 \text{ psi}$ for the static load or 52.2 psi for the dynamic case. No. 5 bars on 12-in. centers are suggested as transverse steel for the proposed test track.

188. The anchor bolts for the proposed test track are determined as follows. Assume an up load at one shoe of 11,333 lb and a dynamic amplification factor of 6 which makes the maximum design load $= 11,333 \times 6 \approx 68,000$ per two anchor rods. Assume an allowable stress for this extreme condition as the yield strength of the anchor bar (40,000 psi).

$$40,000 = \frac{68,000}{(2) \text{ Area}_{\text{one anchor bar}}}$$

$$\text{Area}_{\text{one anchor bar}} = \frac{68,000}{(2)(40,000)} = 0.85 \text{ in.}$$

Use 1-1/4-in. anchor bars.

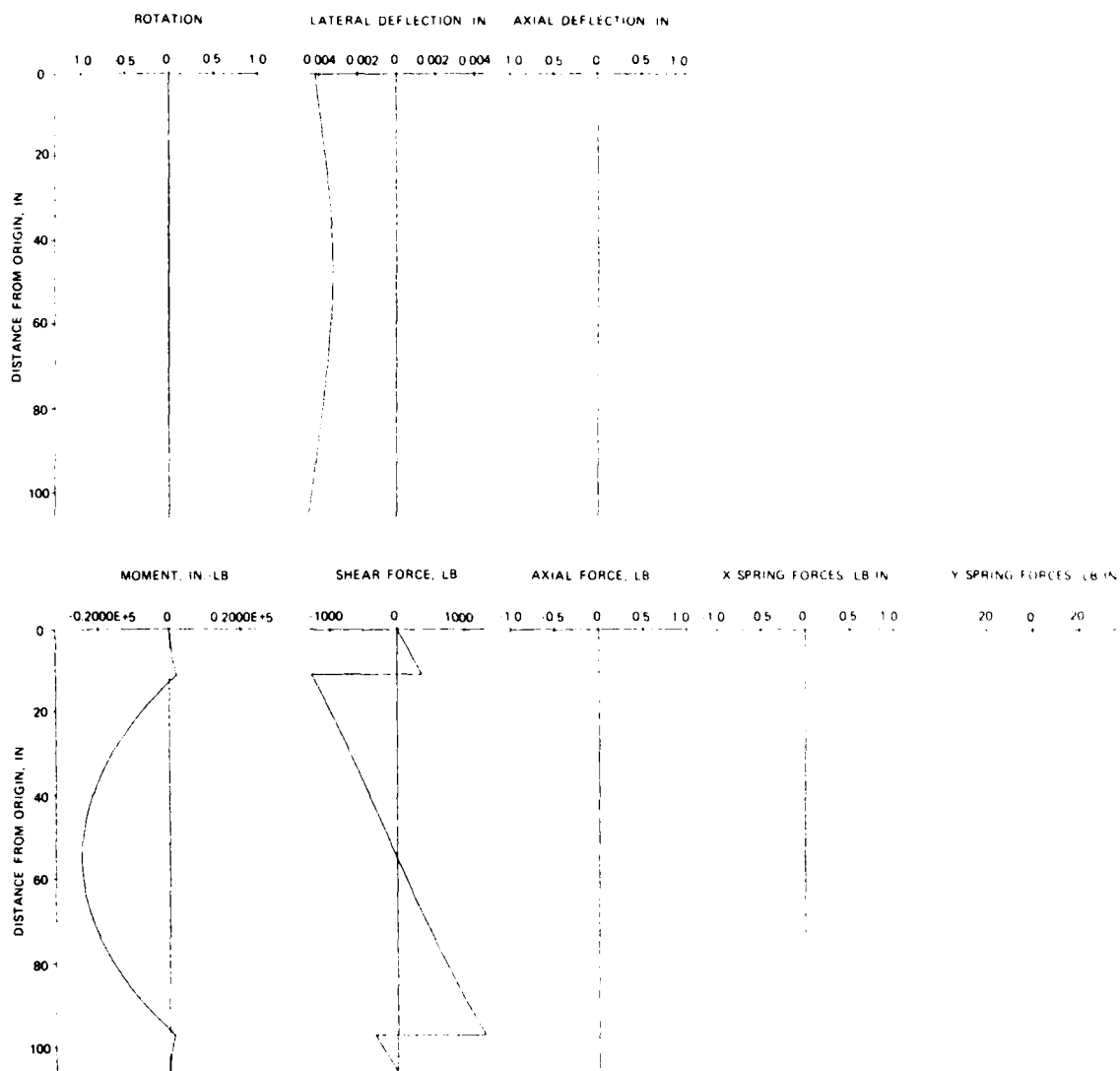


Figure 38. Beam-on-elastic foundation analysis, transverse section,
136,000-lb loading, $K = 79.2 \text{ lb/in.}^3$

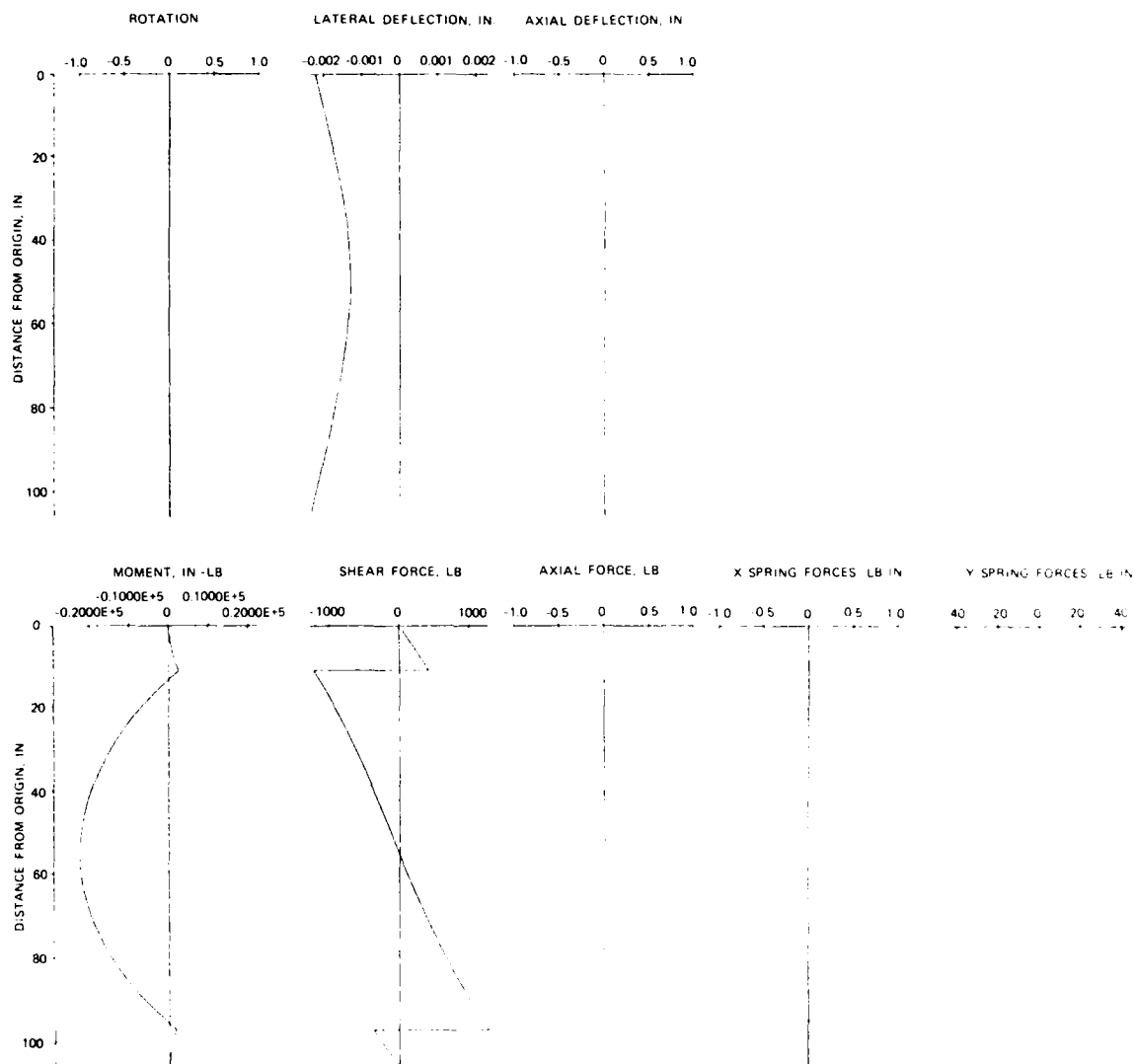


Figure 39. Beam-on-elastic foundation analysis, transverse section,
136,000-lb loading, $K = 17.5 \text{ lb/in.}^3$

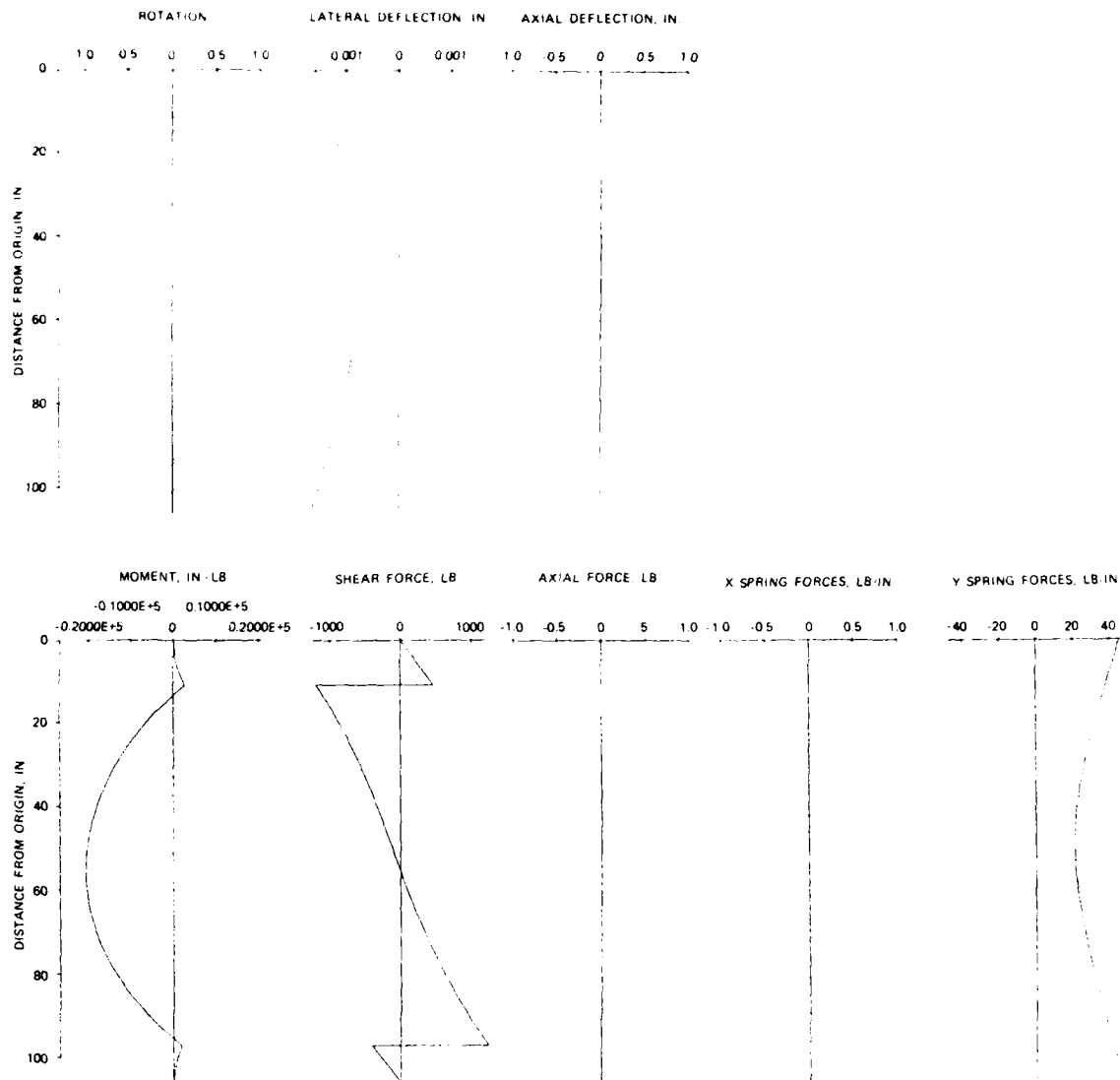


Figure 40. Beam-on-elastic foundation analysis, transverse section, 136,000-lb loading, $K = 271.1 \text{ lb/in.}^3$

189. The results of the finite-element analysis will be presented next and a discussion of the results of the beam-on-elastic foundation and finite-element analysis given later.

Finite-Element Analysis

Background

190. A finite-element analysis of the proposed SNORT track was made using a structural analysis computer program called SAP V. The variable-node (brick) element of the program was used to model the concrete structure, and the boundary (spring) element of the program was used to model the soil resistance. A 100-ft length of track was selected for the analysis; however, only half the length (50 ft) was required as input to the program due to symmetry created by placing the center of gravity of the loads at the midpoint of the 100-ft length.

Input

191. The 50-ft length of structure was input as 12 planes of variable-node (brick) elements for a total of 384 elements. Figure 41 shows the positions of the elements in the first plane. Element numbers for the same position in each succeeding plane are increased by 1. The first plane of elements is adjacent to the midpoint of the full 100-ft section. All elements are 50 in. in length and have the material properties of the concrete for the proposed track (Table 27).

192. The soil resistance was modeled using 13 planes of boundary (spring) elements with 36 elements per plane for a total of 468 boundary

1/12-R	1/60-R				1/180-R	1/228-R		1/300-R	1/348-R
1/24-R	1/72-R				1/192-R	1/240-R		1/312-R	1/360-R
1/36-R	1/84-R	1/108-R	1/132-R	1/156-R	1/204-R	1/252-R	1/276-R	1/324-R	1/372-R
1/48-R	1/96-R	1/120-R	1/144-R	1/168-R	1/216-R	1/264-R	1/288-R	1/336-R	1/384-R

Figure 41. Finite-element grid

elements. The strut resistance that aids in resisting lateral displacement of the structure was modeled using 39 boundary elements normal to the vertical face opposing the applied lateral loads. The spring constant assigned to these elements was linearly varied between $k = 0 \text{ lb/in.}^3$ at the soil surface (assumed to be 16 in. above the base of the structure) and 175 lb/in.^3 at the base of the structure. Skin friction along the vertical faces was considered negligible, and therefore, was not included in the analysis. The bearing resistance of the soil along the base of the structure was modeled using 143 boundary elements normal to the plane of the base. The spring constant assigned these elements was 175 lb/in.^3 . The shear resistance was modeled using 286 elements (143 in the lateral and 143 in the longitudinal directions) within the plane of the base of the structure. The spring constant assigned these elements was 75 lb/in.^3 .

193. There were 17 load cases included in the analysis. Load cases 1 and 5 represented the normal static loads applied to the outermost rails. Load cases 9 and 13 represented the normal static loads applied to the nearest two rails. Load cases 1 and 9 are the maximum downward static loads, while load cases 5 and 13 are the maximum upward static loads. Load cases that included the effects of inertia loads were input for each static load case. Load cases that simulated the dynamic loadings were input for each static and inertia load case. A dynamic factor of 2 and/or a rail roughness coefficient of 6 applied to one-half the dead load was used for each of the dynamic load cases. Load case 17 included the weight of the structure only. All other load cases also included the weight of the structure. A summary of the applied loads is presented in Table 32. Again, the applied loads are depicted by load case in Appendix C (Figures C1-C7).

Output

194. Output indicated that the most severe load condition was that represented by load case 12. This load case included inertia loads with a dynamic load factor of 2 and/or a rail roughness coefficient of 6 applied to one-half the dead load. The loads were applied to the nearest two rails. This resulted in maximum normal compressive stress of 357 psi, normal tensile stress of 363 psi, and shear stress of 228 psi.

195. A summary of the resulting minimum and maximum stresses for all load cases is presented in Table 31. Details of the finite-element analysis showing undeformed and deformed grids and normal and shear stresses for each

load case are presented in Appendix D (Figures D1-D17). All stresses were computed at the centroid of the elements.

196. Since there is some twist in the track in the finite-element analysis because the vertical and lateral loads are applied simultaneously, a better comparison of the deflections and stresses for the beam-on-elastic foundation analysis and the finite-element analysis results is obtained by using finite-element analysis results for elements near the center of the track section. Table 33 gives the comparison of deflections from beam-on-elastic foundation and the finite-element analysis results. These comparisons are excellent.

197. The comparison of stresses in the concrete for beam-on-elastic foundation analysis and finite-element analysis must also be considered carefully. The stresses in the finite-element analysis are at the center of the approximate 8-in. by 8-in. by 50-in. elements and not at the outer concrete surface as figured by the beam-on-elastic foundation analysis. It is considered best to be conservative and use the compressive concrete stresses as obtained by the beam-on-elastic foundation analysis for the preliminary design of the proposed test track.

198. The track section in Figure C1 is considered adequate but not too conservative since the dimensions are about minimum for a dynamic test track and some stress magnitudes seem to be as large as desirable in relation to maximum allowable values.

Preliminary Cost Estimate of New Track

199. A preliminary cost projection was made for the major items needed for the new track facility. The new track parallels the existing track so that some facilities can be shared. These costs are based on a preliminary estimate done by Naval Weapons Center personnel in 1977. All costs were indexed to 1982 prices. A contingency of 15 percent is included in the preliminary cost figures.

Preliminary Cost Estimate

Civil

Earthwork
Construction Survey
Drainage

\$ 1,830K
550K
847K

(Continued)

Civil (Continued)

Water Brake System	2,222K
Access Roads	10,005K
Gates	<u>44K</u>
Subtotal	\$15,498K

Electrical and Mechanical

Electrical	\$ 573K
Distribution	3,638K
Camera and Signal Cable	3,509K
Electrical Warning System	165K
Track Grounding	165K
Track Magnetic Coils	<u>2,198K</u>
Subtotal	\$10,248K

Architectural and Structural

Concrete (24,000 cu yd @ \$164/cu yd)	\$ 3,936K
Reinforcing steel (4,300,000 lb @ \$1.00/lb)	4,300K
Rails 171 lb B.S. (6,620,000 lb @ \$1.90/lb)	
(includes tie downs and alignment)	12,578K
Forms (650,000 SF @ \$10.00 SF)	6,500K
Underpass (1 ea)	
Concrete	109K
Reinforcing steel	78K
Forms	156K
Access Tunnel	1,092K
Loader Barricade Building	70K
Tie Down Grid	117K
Large Camera Stations	234K
Small Camera Stations	390K
Concrete P. C. Vault	62K
Droop Snoot Pad	55K
T. M. Van Barricades	180K
Breach Barricades	<u>468K</u>
Subtotal	\$30,325K

Other

Relocate SAM-D Towers	90K
Laser Alignment System	<u>100K</u>
Total	\$56,261K

Say \$56M

PART VIII: CONCLUSIONS AND RECOMMENDATIONS

200. The field inspection and overall analysis of the SNORT structure reveals extensive cracking of concrete. The concrete is cracked both longitudinally and vertically, and mechanical impedance tests as well as coring show that, in general, the cracks extend through the sections of the structure. The longitudinal cracks follow the reinforcing on both legs, which indicates corrosion and expansion of the steel which produce cracks in the concrete.

201. Cracks in the concrete will allow the penetration of water and chlorides which will accelerate corrosion of the reinforcing steel and cracking of the concrete. Rusting of the reinforcing steel was severe at some locations and nonexistent at others, but due to the entry of water through cracks and wicking along the steel, the steel corrosion will become more widespread and extensive in the future. Some reinforcing steel is badly corroded and because chemical analysis shows that the concrete has a high chloride content, future corrosion of the reinforcing steel can be expected.

202. The concrete is showing signs of extensive deterioration. Some sections of the surface concrete sound hollow when tapped with a hammer. Continued tapping will cause about a 1-in. depth of surface to fall from the tapped area.

203. The concrete is experiencing alkali-silica reaction and under favorable moisture conditions, rapid deterioration can result.

204. Because of the deteriorating conditions and the fact that the concrete track cannot be rehabilitated to eliminate active deterioration, the track is not dependable for long-term future use. Since a policy decision has been made by the Department of the Navy that the SNORT structure is a necessary facility and should be rehabilitated or replaced, it then follows that a replacement is essential.

205. At present, the interior concrete has competent engineering properties and from field-load tests it was found that the SNORT structure has adequate capability for field tests during the time in which a new track is being constructed. This assumes that the initiation of the new track construction will start immediately, and the planning and construction will be completed in 5 years.

206. In situ testing demonstrated that the foundation at the SNORT site

is structurally adequate for the loads imposed by a test track.

207. The proposed test track will extend the testing capabilities and hence the progressive development of our military capabilities. It is recommended that the new test track proposed in this study be constructed.

208. All components of the concrete to be used in the new test track and the concrete mixture itself should be thoroughly studied and developed such that a durable and nondeteriorating product is produced. The reinforcing steel should be coated such that it will not deteriorate even if, for some reason, deteriorating agents reach the steel.

209. It is suggested that the crane rail be made continuous so as to decrease rail roughness.

210. Consideration of a system to slipform the concrete is suggested to cut down on costs and construction time.

211. If a new track is not constructed, long-term supersonic testing will be impaired. The new supersonic test track will eliminate future problems (which are now apparent from the use of the existing SNORT structure) and will be progressive in supersonic testing and the development of military capabilities.

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Table 1
Loads Possible on SNORT

<u>Type of Load</u>	<u>Nominal Load, lb</u>	
	<u>One Rail</u>	<u>Both Rails</u>
Down load	68,000	136,000
Up load	37,500	75,000
Side load		
At 6-1/2 ft above rails and 2100-fps velocity	--	38,000
At 8 ft above rails and 1500-fps velocity	--	50,000

Table 2
Typical SNORT Performance Values

<u>Weight of Payload + Carriage lb (mass)</u>	<u>Accelera- tion g's</u>	<u>Maximum Velocity fps</u>	<u>Duration of Maximum Velocity sec</u>	<u>Decelera- tion g's</u>	<u>Decelera- tion Distance ft</u>
200	100+	3500+	4.1	30	6300
5,000	20	2500	7.2	15	4100
10,000	15	1500	10.4	10	3500
20,000	10	1000	16.9	5	3100

Table 3
Analysis of Well Water

<u>Analysis</u>	<u>Station 146</u>	<u>Station 196</u>
Principal constituents, mg/L		
Cations		
Calcium	6.7	133.0
Magnesium	1.2	6.8
Sodium	83.0	860.0
Anions		
Bicarbonate	140.0	53.0
Sulfate	46.0	1554.0
Chloride	10.0	436.0
Nitrate	2.1	49.0
Other constituents, mg/L		
Boron	0.94	7.3
Silica	8.7	4.4
Iron	2.0	0.01
Manganese	0.02	0.02
Orthophosphate	2.0	0.37
Nitrate	0.47	11.0
Total alkalinity CaCO_3	115	44
Total hardness CaCO_3	22	360
Dissolved solids	284	3136
pH	7.99	7.43
Conductivity, micromhos/cm @ 25°C	380	4480

Table 4
Evaluation of Longitudinal Cracking

Begin Station	End Station	Evaluation No.		Evaluation No.		West Wall Average	East Wall Average	Structure Average
		West Wall West Face	West Wall East Face	East Wall West Face	East Wall East Face			
0.50	0.55	6	9	10	4	7.5	7	7.25
0.55	0.75	2	3	5	4	2.5	4.5	3.5
0.75	1.00	2	8	5	4	5	4.5	4.75
1.00	1.10	2	8	9	4	5	6.5	5.75
1.10	2.00	3	8	9	4	5.5	6.5	6
2.00	3.05	3	8	7	4	5.5	5.5	5.5
3.05	3.25	3	6	5	4	4.5	4.5	4.5
3.25	4.25	2	6	5	4	4	4.5	4.25
4.25	4.83	2	6	4	4	4	4	4
4.83	5.04	1	0	1	0	0.5	0.5	0.5
5.04	5.55	1	6	4	3	3.5	3.5	3.5
5.55	7.10	1	4	1	3	2.5	2	2.25
7.10	10.40	1	1	1	3	1	2	1.5
10.40	10.75	2	1	1	3	1.5	2	1.75
10.75	11.00	3	1	1	3	2	2	2
11.00	22.40	1	1	1	3	1	2	1.5
22.40	22.90	2	1	1	3	1.5	2	1.75
22.90	22.60	1	1	1	3	1	2	1.5
28.60	33.55	3	1	1	3	2	2	2
33.55	48.70	2	1	1	3	1.5	2	1.75
48.70	96.35	3	1	1	3	2	2	2
96.35	96.58	4	1	1	3	2.5	2	2.25
96.52	96.75	4	1	1	4	2.5	2.5	2.5
96.75	96.95	10	6	1	4	8	2.5	5.25
96.95	97.05	10	6	6	4	8	5	6.5
97.05	100.20	1	1	1	4	1	2.5	1.75
100.20	105.85	1	1	1	3	1	2	1.5
105.25	106.50	4	1	1	3	2.5	2	2.25
106.50	109.00	1	1	1	3	1	2	1.5
109.00	109.92	1	1	2	3	1	2.5	1.75
109.92	110.28	1	1	1	4	1	2.5	1.75
110.28	110.49	7	6	1	4	6.5	2.5	4.5
110.49	110.80	7	6	1	3	6.5	2	4.25
110.80	115.90	1	1	1	3	1	2	1.5
115.90	116.03	5	1	1	3	3	2	2.5
116.03	117.01	5	1	5	3	3	4	3.5
117.01	117.25	5	1	7	3	3	5	4
117.25	117.68	5	1	6	3	3	4.5	3.75
117.62	118.00	5	2	5	3	3.5	4	3.75
118.00	118.70	5	4	5	3	4.5	4	4.25
118.70	119.40	5	4	4	3	4.5	3.5	4
119.40	119.60	5	4	3	3	4.5	3	3.75
119.60	119.90	1	4	3	3	2.5	3	2.75
119.90	120.34	1	4	6	3	2.5	4.5	3.5
120.34	120.82	1	4	6	4	2.5	5	3.75
120.82	121.00	1	4	6	3	2.5	4.5	3.5
121.00	121.35	1	4	2	3	2.5	2.5	2.5
121.35	122.17	1	2	2	3	1.5	2.5	2
122.17	122.65	6	2	2	3	4	2.5	3.25
122.65	123.00	1	2	2	3	1.5	2.5	2
123.00	123.15	1	2	5	6	1.5	5.5	3.5
123.15	123.48	1	1	5	6	1	5.5	3.25
123.48	124.00	5	1	5	6	3	5.5	4.25
124.00	124.62	5	6	7	6	5.5	6.5	6
124.62	125.25	5	6	5	4	5.5	4.5	5
125.25	125.60	5	7	5	4	6	4.5	5.25
125.60	125.85	5	4	5	4	4.5	4.5	4.5
125.85	126.00	7	4	5	4	5.5	4.5	5
126.00	126.20	7	1	5	4	4	4.5	4.25
126.20	127.05	7	1	4	4	4	4	4

(Continued)

(Sheet 1 of 4)

Table 4 (Continued)

Begin Station	End Station	Evaluation No.		Evaluation No.		West Wall Average	East Wall Average	Structure Average
		West Wall West Face	West Wall East Face	East Wall West Face	East Wall East Face			
127.05	128.05	7	4	2	3	5.5	2.5	4
128.05	129.10	9	4	2	3	6.5	2.5	4.5
129.10	129.25	9	3	6	4	6	5	5.5
129.25	129.58	2	3	6	4	2.5	5	3.75
129.58	130.18	9	7	6	4	8	5	6.5
130.18	130.30	9	7	6	7	8	6.5	7.25
130.30	130.60	9	7	4	7	8	5.5	6.75
130.60	131.08	9	7	7	7	8	7	7.5
131.08	131.25	9	7	2	7	8	4.5	6.25
131.25	131.56	9	5	2	7	7	4.5	5.75
131.56	132.02	9	5	3	7	7	5	6
132.02	132.55	9	4	4	7	6.5	5.5	6
132.55	132.96	6	4	4	7	5	5.5	5.25
132.96	133.30	6	6	6	7	6	6.5	6.25
133.30	133.50	6	6	5	7	6	6	6
133.50	133.80	9	6	5	7	7.5	6	6.75
133.80	135.35	9	6	6	7	7.5	6.5	7
135.35	136.95	9	6	5	7	7.5	6	6.75
136.95	137.53	9	6	4	4	7.5	4	5.75
137.53	137.75	2	1	1	3	1.5	2	1.75
137.75	138.15	8	1	1	3	4.5	2	3.25
138.15	139.10	2	1	1	3	1.5	2	1.75
139.10	139.60	6	1	1	3	3.5	2	2.75
139.60	140.40	2	1	1	3	1.5	2	1.75
140.40	140.85	5	1	1	3	3	2	2.5
140.85	142.10	4	1	1	3	2.5	2	2.25
142.10	144.52	3	1	1	3	2	2	2
144.52	145.13	3	1	9	7	2	8	5
145.13	145.54	9	6	9	3	7.5	6	6.75
145.54	146.00	2	1	1	3	1.5	2	1.75
146.00	146.80	6	1	1	3	3.5	2	2.75
146.80	147.52	2	1	1	3	1.5	2	1.75
147.52	148.80	4	1	1	3	2.5	2	2.25
148.80	149.71	3	1	1	3	2	2	2
149.71	150.28	10	6	9	7	8	8	8
150.28	150.69	10	1	1	3	5.5	2	3.75
150.69	151.27	10	6	8	7	8	7.5	7.75
151.27	151.42	4	6	8	7	5	7.5	6.25
151.42	151.74	4	1	8	7	2.5	7.5	5
151.74	152.75	10	7	1	3	8.5	2	5.25
152.75	152.85	2	7	8	7	4.5	7.5	6
152.85	153.28	2	2	8	7	2	7.5	4.75
153.28	153.55	10	6	8	7	8	7.5	7.75
153.55	154.00	2	2	2	3	2	2.5	2.25
154.00	154.56	8	6	2	3	7	2.5	4.75
154.56	155.08	8	6	7	3	7	5	6
155.08	155.40	4	2	3	3	3	3	3
155.40	155.66	7	2	3	3	4.5	3	3.75
155.66	155.98	7	6	3	3	6.5	3	4.75
155.98	156.29	0	0	0	0	0	0	0
156.29	156.60	9	1	4	6	5	5	5
156.60	156.72	9	4	4	6	6.5	5	5.75
156.72	157.25	5	1	1	3	3	2	2.5
157.25	157.46	5	4	1	3	4.5	2	3.25
157.46	157.72	5	4	9	6	4.5	7.5	6
157.72	158.10	5	1	5	6	3	5.5	4.25
158.10	158.40	5	1	3	6	3	4.5	3.75
158.40	158.55	5	7	3	6	6	4.5	5.25
158.55	159.10	5	2	3	6	3.5	4.5	4
159.10	159.65	5	2	8	6	3.5	7	5.25
159.65	160.06	7	5	3	6	6	4.5	5.25
160.06	160.30	7	5	8	6	6	7	6.5
160.30	160.65	7	5	8	4	6	6	6
160.65	161.55	7	2	1	4	4.5	2.5	3.5
161.55	162.65	7	5	6	4	6	5	5.5

(Continued)

(Sheet 2 of 4)

Table 4 (Continued)

Begin Station	End Station	Evaluation No.		Evaluation No.		West Wall Average	East Wall Average	Structure Average
		West Wall West Face	West Wall East Face	East Wall West Face	East Wall East Face			
162.65	163.15	7	2	1	4	4.5	2.5	3.5
163.15	163.55	7	6	5	4	6.5	4.5	5.5
163.55	163.85	7	2	3	4	4.5	3.5	4
163.85	164.40	9	4	3	4	6.5	3.5	5
164.40	164.90	9	4	3	6	6.5	4.5	5.5
164.90	165.15	9	2	3	6	5.5	4.5	5
165.15	165.63	9	2	3	4	5.5	3.5	4.5
165.63	166.09	2	2	1	7	2	4	3
166.07	166.62	9	4	4	7	6.5	5.5	6
166.62	166.90	9	1	6	7	5	6.5	5.75
166.70	162.24	9	1	5	7	5	6	5.5
162.24	168.75	9	6	2	4	7.5	3	5.25
162.75	169.00	9	1	2	4	5	3	4
169.00	169.65	9	1	5	4	5	4.5	4.75
169.65	170.55	9	1	6	4	5	5	5
170.55	171.15	9	1	1	3	5	2	3.5
171.15	171.60	9	4	8	7	6.5	7.5	7
171.60	171.85	9	1	8	7	5	7.5	6.25
171.85	172.15	9	1	4	7	5	5.5	5.25
172.15	172.55	9	1	4	2	5	3	4
172.55	173.03	9	4	4	4	6.5	4	5.25
173.03	173.20	9	2	4	4	5.5	4	4.75
173.20	173.35	9	2	2	4	5.5	3	4.25
173.35	173.50	9	2	2	7	5.5	4.5	5
173.50	174.00	9	7	8	7	8	7.5	7.75
174.00	174.25	9	7	6	7	8	6.5	7.25
174.25	174.48	9	7	6	5	8	5.5	6.75
174.48	174.75	5	7	4	5	6	4.5	5.25
174.75	175.15	5	7	6	5	6	5.5	5.75
175.15	175.29	5	7	6	7	6	6.5	6.25
175.29	175.65	9	4	6	7	6.5	6.5	6.5
175.65	176.95	9	4	8	7	6.5	7.5	7
176.95	177.15	9	4	6	7	6.5	6.5	6.5
177.15	177.55	9	4	6	6	6.5	6	6.25
177.55	178.30	7	1	1	6	4	3.5	3.75
178.30	178.50	2	1	1	5	1.5	3	2.25
178.50	178.92	6	1	1	5	3.5	3	3.25
178.92	179.08	6	1	1	8	3.5	4.5	4
179.08	179.50	6	1	6	8	3.5	7	5.5
179.50	180.14	10	1	6	8	5.5	7	6.25
180.14	180.51	0	0	0	0	0	0	0
180.51	180.58	9	1	7	8	5	7.5	6.25
180.58	181.50	9	4	7	8	6.5	7.5	7
181.50	182.35	9	8	7	8	8.5	7.5	8
182.35	183.50	9	8	5	8	8.5	6.5	7.5
182.50	183.49	9	5	5	7	7	6	6.5
183.49	184.02	4	5	3	7	4.5	5	4.75
184.02	184.30	4	5	7	7	4.5	7	5.75
184.30	184.75	4	3	6	7	3.5	6.5	5
184.75	184.90	7	3	6	7	5	6.5	5.75
184.90	185.44	7	5	5	7	5	6	5.5
185.44	186.02	9	7	5	7	8	6	7
186.02	186.25	9	7	2	7	8	4.5	6.25
186.25	187.03	9	7	6	7	8	6.5	7.25
187.03	187.20	9	3	6	8	6	7	6.5
187.20	187.50	8	3	6	8	5.5	7	6.25
187.50	188.05	8	6	6	8	7	7	7
188.05	189.06	8	6	3	7	7	5	6
189.06	189.46	3	6	1	7	4.5	4	4.25
189.46	190.00	6	6	1	7	6	4	5
190.00	190.33	1	6	1	7	3.5	4	3.75
190.33	190.85	7	6	1	7	6.5	4	5.25
190.85	191.06	7	6	1	6	6.5	3.5	5
191.06	191.35	7	5	1	6	6	3.5	4.75
191.35	192.52	7	5	1	5	6	3	4.5

(Continued)

(Sheet 3 of 4)

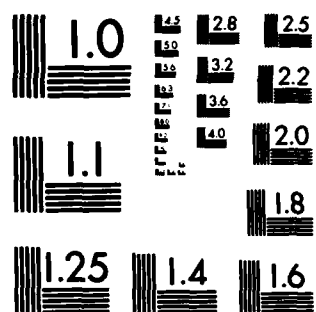
Table 4 (Concluded)

Begin Station	End Station	Evaluation No.		Evaluation No.		West Wall Average	East Wall Average	Structure Average
		West Wall West Face	West Wall East Face	East Wall West Face	East Wall East Face			
192.52	193.05	7	7	6	6	7	6	6.5
193.05	193.25	8	5	3	6	6.5	4.5	5.5
193.25	194.00	8	5	3	3	6.5	3	4.75
194.00	194.10	8	5	6	5	6.5	5.5	6
194.10	194.56	8	5	6	7	6.5	6.5	6.5
194.56	194.67	8	5	4	4	6.5	4	5.25
194.67	195.00	8	1	4	4	4.5	4	4.25
195.00	195.70	8	1	6	4	4.5	5	4.75
195.70	196.00	2	1	4	4	1.5	4	2.75
196.00	196.15	2	1	6	7	1.5	6.5	4
196.15	196.52	2	1	6	5	1.5	5.5	3.5
196.52	197.06	2	1	3	5	1.5	4	2.75
197.06	197.16	2	1	6	5	1.5	5.5	3.5
197.16	197.40	8	1	3	5	4.5	4	4.25
197.40	197.80	8	1	3	3	4.5	3	3.75
197.80	198.08	8	1	2	3	4.5	2.5	3.5
198.08	198.55	2	1	2	3	1.5	2.5	2
198.55	199.68	8	1	4	3	4.5	3.5	4
199.68	199.84	8	1	2	3	4.5	2.5	3.5
199.84	200.10	5	1	2	3	3	2.5	2.75
200.10	200.23	5	1	6	3	3	4.5	3.75
200.23	200.87	5	1	1	3	3	2	2.5
200.87	201.28	7	3	1	3	5	2	3.5
201.28	201.48	2		1	3	2	2	2
201.48	201.92	6	4	6	3	5	4.5	4.75
201.92	202.05	6	2	6	3	4	4.5	4.25
202.05	202.18	0	0	0	0	0	0	0
202.18	202.55	7	1	6	3	4	4.5	4.25
202.55	203.06	1	1	1	3	1	2	1.5
203.06	204.02	1	1	5	3	1	4	2.5
204.02	204.70	1	1	1	3	1	2	1.5
204.70	205.04	1	1	4	3	1	3.5	2.25
205.04	206.00	2	1	1	3	1.5	2	1.75
206.00	206.20	2	1	4	3	1.5	3.5	2.5
206.20	207.77	2	1	1	3	1.5	2	1.75
207.77	208.06	4	1	1	6	2.5	3.5	3
208.06	208.25	4	1	4	3	2.5	3.5	3
208.25	208.56	4	1	2	3	2.5	2.5	2.5
208.56	209.35	2	4	2	3	3	2.5	2.75
209.35	209.80	2	1	2	3	1.5	2.5	2
209.80	210.86	2	1	4	3	1.5	3.5	2.5
210.86	211.18	3	1	3	3	2	3	2.5
211.18	211.54	3	3	3	3	3	3	3
211.54	211.87	8	3	3	3	5.5	3	4.25
211.87	212.08	0	0	0	0	0	0	0
212.08	212.44	8	5	3	3	6.5	3	4.75
212.44	212.75	3	5	3	3	4	3	3.5
212.75	212.90	3	1	3	3	2	3	2.5
212.90	213.25	3	4	3	3	3.5	3	3.25
213.25	213.70	3	1	3	3	2	3	2.5
213.70	214.21	7	1	3	3	4	3	3.5
214.21	214.53	2	4	3	3	3	3	3
214.53	215.00	8	1	2	3	4.5	2.5	3.5
215.00	215.53	8	1	2	5	4.5	3.5	4
215.53	215.92	10	1	2	6	5.5	4	4.75
215.92	216.02	2	1	2	6	1.5	4	2.75

AD-A140 036 CONDITION EVALUATION OF SUPERSONIC NAVAL ORDNANCE
RESEARCH TRACK (SNORT)(U) ARMY ENGINEER WATERWAYS
EXPERIMENT STATION VICKSBURG MS STRUC..

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UNCLASSIFIED B R SULLIVAN ET AL. FEB 84 WES/MP/SL-84-1 F/G 13/13 NL



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

Table 5
Location of Areas of Significant Spalling

Station No.	Wall		Face	
	West	East	West	East
10.52	X		X	
10.53		X		X
10.66	X		X	
31.92		X		X
96.12		X	X	
99.96		X		X
99.98	X		X	
140.75	X		X	
145.44	X		X	
155.98		X		X
156.00	X		X	
170.94	X		X	
170.94		X		X
171.07	X		X	
173.12	X		X	
181.02		X	X	
199.08		X	X	
199.10		X		X
204.62	X			X
204.62		X		X

Table 6
Detailed Core Data and Core Locations

<u>Core Identification</u>	<u>SL No.</u>	<u>Station</u>	<u>Section</u>	<u>Plane</u>	<u>Starting Location</u>	<u>Distance from Starting Location, in.</u>
<u>Unconfined Compression Tests</u>						
	CL-39					
HC 96*	CON-7	0+96	East leg	Horizontal	East face	5
VC 7952W	CON-9	79+52	Floor	Vertical	Top face	4
HC 9696	CON-10	96+96	West leg	Horizontal	West face	6
VC 12000W*	CON-11	120+00	Floor	Vertical	Top face	4
VC 13496	CON-14	139+96	East leg	Vertical	Top face	12
VC 13996*	CON-14	139+96	East leg	Vertical	Top face	34
HC 15096**	CON-16	150+96	West leg	Horizontal	West face	3.5
VC 15500	CON-17	155+00	Floor	Vertical	Top face	4
SC 17399	CON-20	173+99	East leg	Slanted	West face	15
VC 21496	CON-27	214+96	West leg	Vertical	Top face	5
VC 21496*	CON-27	214+96	West leg	Vertical	Top face	15
<u>Tensile Splitting Tests</u>						
HC 96	CON-7	0+96	East leg	Horizontal	East face	15
VC 2450W†	CON-9	24+50	Floor	Vertical	Top face	4
HC 12996	CON-13	129+96	East leg	Horizontal	West face	15
VC 13976	CON-14	139+96	East leg	Vertical	Top face	43
HC 12199**	CON-23	181+99	West leg	Slanted	East face	7
VC 20000W	CON-24	200+00	Floor	Vertical	Top face	4
VC 21496	CON-27	214+96	West leg	Vertical	Top face	27
HC 21496**	CON-28	214+96	East leg	Horizontal	West face	3.5

* Strain gaged.

** Short core.

† Steel bar in specimen.

Table 7
Properties from Strain-Gaged Specimens

Property	Cylinder Identification and Location			
	HC 96 Sta 0+96 East wall	VC 12000 Sta 120+00 Floor	VC 13996 Sta 139+96 East wall	VC 21496 Sta 214+96 West wall
σ_{ult} , psi	5290	6240	5000	6530
S_2 (at 40% σ_{ult}), millionths	2120	2500	2000	2610
ϵ_2 (strain at S_2), millionths	630	575	680	675
S_1 (σ at strain of 50 μ in./in.), millionths	140	170	1190	170
ϵ_{t1} (transverse strain at S_1), millionths	10	5	10	10
ϵ_{t2} (transverse strain at S_2), millionths	120	110	140	145
E , millions of psi	3.41	4.44	2.87	3.90
μ	0.19	0.20	0.21	0.22
Average E = 3.66×10^6 psi				
Average μ = 0.205				
G = 1.52×10^6 psi				

Table 8
Concrete Core Test Results

Station	Ultimate Tensile- Splitting Strength psi	Ultimate Compressive Strength psi	Modulus of Elasticity 10^6 psi	Poisson's Ratio	Shear Modulus 10^6 psi
0+96	460	5290	3.41	0.19	1.43
24+50	570	--	--	--	--
79+52	--	6280	--	--	--
96+96	--	4450	--	--	--
120+00	--	6240	4.44	0.20	1.85
129+96	390	--	--	--	--
139+96	710	6190*	2.87	0.21	1.19
150+96	--	4080	--	--	--
155+00	--	7180	--	--	--
173+99	--	4440	--	--	--
181+99	410	--	--	--	--
200+00	640	--	--	--	--
214+96	440*	6020*	3.90	0.22	1.60

* Two-cylinder average.

Table 9
Results of Tests on Foundation Material

Depth ft	Water Content %	Density pcf	Soil Classi- fication	Liquid Limit	Plastic Limit	Plas- ticity Index	Comments
<u>SNORT Sta 24+50</u>							
3			SM			NP	Silty sands, sand-silt mixtures
Under footing	5.9		SM			NP	Silty sands, sand-silt mixtures
5	5.1		SM			NP	Silty sands, sand-silt mixtures
5.5	5.5	132	SM			NP	Silty sands, sand-silt mixtures
6	5.9		SM			NP	Silty sands, sand-silt mixtures
7	5.1		SM			NP	Silty sands, sand-silt mixtures
8	3.9		SW-SM			NP	Well-graded sands, gravelly sands little or no fines/silty sands sands, sand-silt mixtures some caliche
9	6.3		SM			NP	Silty sands, sand-silt mixtures
11	6.5		SW-SM			NP	Silty sands, sand-silt mixtures/ well-graded sands, gravelly sands, little or no fines, some caliche
14	6.4		SM			NP	Silty sand, sand-silt mixtures
<u>SNORT Sta 70+50</u>							
3			SM			NP	Silty sands, sand-silt mixtures
Under footing			SM			NP	Silty sands, sand-silt mixtures
7	2.5	113	SW-SM				Well-graded sands, gravelly sands, little or no fines/silty sands, sand-silt mixtures
8	3.4		SW				Well-graded sands, gravelly sands, little or no fines
12.5	3.1		SW				Well-graded sands, gravelly sands, little or no fines
14	3.0		SW				Well-graded sands, gravelly sands, little or no fines
<u>SNORT Sta 120</u>							
3			SM			NP	Silty sands, sand-silt mixtures
Under footing	3.8		SM			NP	Silty sands, sand-silt mixtures
7	7.7	115	SM-SC	26.9	20.3	6.6	Silty sands, sand-silt mixtures/ clayey sands, sand-clay mixtures
7.5	6.7		SM			NP	Silty sands, sand-silt mixtures
10	6.3		SM			NP	Silty sands, sand-silt mixtures
14	7.2		SM			NP	Silty sands, sand-silt mixtures
<u>SNORT Sta 155</u>							
3			SM	24.0	21.5	2.5	Silty sands, sand-silt mixtures
Under footing	14.8		CL	29.6	19.9	9.7	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, lean clays
7	6.8	94.8	SM	42.8	37.0	5.8	Silty sands, sand-silt mixtures/ some caliche

(Continued)

(Sheet 1 of 3)

Table 9 (Continued)

Depth ft	Water Content %	Density pcf	Soil Classi- fication	Liquid Limit	Plastic Limit	Plas- ticity Index	Comments
<u>SNORT Sta 155 (Continued)</u>							
10	11.2		ML	39.0	26.6	12.4	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity, some caliche
14	13.7		ML	39.0	26.9	12.1	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, or clayey silts with slight plasticity, some caliche
<u>SNORT Sta 165</u>							
3			ML	30.0	20.2	10.7	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity
Under footing	12.0		SM			NP	Silty sands, sand-silt mixtures
6	15.1	130	SM	29.3	20.4	8.9	Silty sands, sand-silt mixtures, some caliche
9	17.0		SM	31.2	24.0	7.2	Silty sands, sand-silt mixtures, some caliche
14	27.9		ML	50.0	36.7	13.3	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity
<u>SNORT Sta 180</u>							
3			SM	24.3	20.7	3.6	Silty sands, sand-silt mixtures
Under footing	16.7		SM			NP	Silty sands, sand-silt mixtures
6.5	7.2	116	SW-SM			NP	Well-graded sands, gravelly sands, little or no fines/silty sands, sand-silt mixtures
8.5	20.9		SM	31.8	28.8	3.0	Silty sands, sand-silt mixtures
9.5	23.8		SM	34.4	28.4	6.0	Silty sands, sand-silt mixtures
14	31.9		ML	38.0	30.5	7.5	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity
<u>SNORT Sta 200</u>							
3			SM	NP	NP	NP	Silty sands, sand-silt mixtures
Under footing	8.3		SM	NP	NP	NP	Silty sands, sand-silt mixtures
6	8.0	129	SM	NP	NP	NP	Silty sands, sand-silt mixtures, some caliche
7.5	27.9		MH	42.5	26.2	16.3	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic soils
10.5	26.5		ML	36.5	31.7	4.8	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity
14	17.7		ML	31.2	28.1	3.1	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity

(Continued)

(Sheet 2 of 3)

Table 9 (Concluded)

Depth ft	Water Content %	Density pcf	Soil Classi- fication	Liquid Limit	Plastic Limit	Plas- ticity Index	Comments
SNORT Sta 210							
3.5			SM	NP	NP	NP	Silty sands, sand-silt mixtures
Under footing	11.1		SM	NP	NP	NP	Silty sands, sand-silt mixtures
6	13.8	110	SM	23.4	21.2	2.2	Silty sands, sand-silt mixtures
7.5	13.8		SC	29.5	19.3	10.2	Clayey sands, sand-clay mixtures
10	5.3		SM	NP	NP	NP	Silty sands, sand-silt mixtures
11.5	4.5		SM	NP	NP	NP	Silty sands, sand-silt mixtures
14	4.0		SW-SM	NP	NP	NP	Well-graded sands, gravelly sands, little or no fines/silty sands, sand-silt mixtures

Table 10
Chemical Test Results for Soils (SNORT)

Sample	Chloride* µg/g	Sulfate* µg/g	Resistivity** ohm-cm	pH
SS-3	1030	950	109	8.0
SS-4	70	<50	1450	8.0
SS-5	83	<50	1890	8.0
SS-6	38	<50	2180	8.8
SS-7	43	<50	1170	8.6
SS-8	1530	1730	709	8.3
SS-9	916	1830	94	8.1
SS-10	135	150	585	8.8
SS-11	793	330	156	8.2
SS-12	542	180	258	8.6

* Chlorides and sulfates are water-soluble extracts.

** Soil-to-water extract 1:2.

Table 11
Analysis for Water Samples (SNORT)

Parameter	Pond Sample CL-39 W-1	Tap Sample CL-39 W-2
Chlorides	101 mg/l	34.1 mg/l
Sulfates	68.5 mg/l	44.8 mg/l
pH	6.7	7.6
Resistivity	1295 ohms-cm	2490 ohms-cm
Total solids	464 mg/l	254 mg/l
Hardness	52.6 mg/l as CaCO ₃	83.3 mg/l as CaCO ₃
Alkalinity	129 mg/l as CaCO ₃	101 mg/l as CaCO ₃
Magnesium	5.5 mg/l	7.0 mg/l
Sodium	130.0 mg/l	42.3 mg/l
Potassium	9.0 mg/l	3.0 mg/l
Calcium	13.8 mg/l	25.2 mg/l

Table 12
Chloride Content of Concrete Core

<u>Section of Core</u>	<u>Chloride, %</u>
1	0.132
2	0.072
3	0.187
4	0.251
5	0.243

Table 13
Pressure Meter Average Results

<u>Depth ft</u>	<u>E_o kPa</u>	<u>E_R kPa</u>	<u>P_L kPa</u>	<u>$\frac{E_R}{E_o}$</u>	<u>$\frac{E_o}{P_L}$</u>
2	19,000	196,000	1750	10	11
5	32,000	45,000	1800	1.4	18
8	48,000	143,000	2400	3	20
11	20,000	88,000	2100	4.4	9.5
14	29,000	99,000	2400	3.4	12
20	40,000	120,000	3200	3	12.5

Table 14

Moduli of Elasticity, kPa

Depth ft	Station								Average of Stations
	<u>24+50</u>	<u>79+50</u>	<u>120+00</u>	<u>155+00</u>	<u>165+00</u>	<u>180+00</u>	<u>200+00</u>	<u>210+00</u>	
2	72,000	78,000	90,000	48,000	81,000	33,000	15,000	39,000	
3									
4									
5	24,000	12,000	39,000	516,000	48,000	60,000	15,000	48,000	
6						300,000			
7	66,000								
8		12,000	180,000	66,000	501,000		138,000	72,000	
9	234,000					39,000			
10									
11		54,000	78,000	120,000	21,000		63,000	63,000	
12						15,000			
14	138,00	33,000	93,000	78,000	63,000		84,000		
15						111,000			
20						48,000	192,000		
Average E (kPa)	51,400	22,300	67,100	56,800	56,000	45,800	24,800	51,200	46,900
Average G (kPa)	19,000	8,300	24,900	21,000	20,700	17,000	9,200	19,000	17,400

Table 15
Factors of Safety Against Bearing Capacity Failure

Condition	One 80,000-lb Single Load	Two 68,000-lb Point Loads 16 ft Apart
$K_{\text{worst}} = 79.2 \text{ lb/in.}^3$	7.4	8.9
$K_{\text{best}} = 271.1 \text{ lb/in.}^3$	30.8	37.5

Table 16
Modulus of Subgrade Reaction at Each Station

Transfer Length = 24 ft

Load = 80,000 lb

Average Pressure = 28 kPa

Station	E_d kPa	E_c kPa	s mm	K kN/m^3
24+50	17,100	24,000	0.50	56,000
79+50	7,400	26,000	1.00	28,000
120+00	22,400	30,000	0.38	73,700
155+00	18,900	26,000	0.45	62,200
165+00	18,700	27,000	0.45	62,200
180+00	15,300	11,000	0.66	42,400
200+00	8,300	5,000	1.30	21,500
210+00	17,100	13,000	0.58	48,300
$K_{\text{avg}} = 49,300 \text{ kN/m}^3$				

Table 17
Beam-on-Elastic Foundations

Assumption: Track	$I = 385,600 \text{ in.}^4$ $A = 2,274 \text{ in.}^2$ $E_c = 4.5 \times 10^6 \text{ psi}$ $c = 0.17$
Soil	1. $K_{\text{worst}} = 21,500 \text{ kN/m}^3 = 79.2 \text{ lb/in.}^3$ 2. $K_{\text{best}} = 73,600 \text{ kN/m}^3 = 271.1 \text{ lb/in.}^3$ 3. $K = 27,100 \text{ kN/m}^3 = 100 \text{ lb/in.}^3$
Load	1. 80,000-lb single-point load 2. Two 68,000-lb point loads 16 ft apart 3. 136,000-lb single-point load

Table 18
Results of Beam-on-Elastic Foundation Analysis

Length of Track ft	Element Length in.	Load lb	K lb/in. ³	Maximum Deflection 10 ⁻³ in.	Maximum Bending Moment 10 ⁶ × lb-in.	Maximum Pressure lb/ft ²
200	12	80,000	79.2	2.23	1.44	974
200	6	80,000	79.2	2.22	1.45	989
200	12	2 × 68,000 (16 ft apart)	79.2	1.84	1.11	806
200	12	80,000	271.1	0.89	1.05	1303
200	12	2 × 68,000 (16 ft apart)	271.1	0.73	0.88	1071
100	12	80,000	79.2	2.23	1.44	974
140	12	80,000	79.2	2.23	1.44	974
170	12	80,000	79.2	2.23	1.44	974
40	4.8	136,000	100	48.4	6.10	1606
40	4.8	136,000 + 1971 lb/in.	100	70.0	6.14	704
40	4.8	136,000 + 1971 lb/in.	100	80.0	6.26	731

Table 19
Computed Deflections, Strongest Soil Conditions

Soil: $K_{best} = 73,600 \text{ kN/m}^3 = 271.1 \text{ lb/in.}^3$

Load: 80,000-lb single-point load

$$S_{max} = 0.89 \times 10^{-3} \text{ in.}$$

$$P_{max} = 1303 \text{ lb/ft}^2$$

Soil: $K_{best} = 73,600 \text{ kN/m}^3 = 271.1 \text{ lb/in.}^3$

Load: Two 68,000-lb point loads 16 ft apart

$$S_{max} = 0.73 \times 10^{-3} \text{ in.}$$

$$P_{max} = 1071 \text{ lb/ft}^2$$

Table 20
Field Load Test Deflections Under 80,000-lb
Down Load

Station	Deflections, in.		Station	Deflections, in.	
	West Wall Leg	East Wall Leg		West Wall Leg	East Wall Leg
1	0.020		104	0.005	0.002
3	0.010	0.019	108	0.012	0.013
4	0.002	0.009	112	0.012	0.005
5	0.010	0.022	116	0.004	0.004
6	0.004	0.013	120.04	0.016	0.020
6	0.005	0.007	124.04	0.002	--
7.96	0.002	0.002	128.04	0.007	0.006
10	0.005	0.006	132.04	0.004	0.003
12	0.005	0.008	135.96	0.004	0.002
14	0.011	0.009	140.04	0.009	0.009
16	0.016	0.019	143.96	0.009	0.005
18	0.012	0.010	147.96	0.005	0.006
20	0.010	0.008	152.04	0.007	0.011
22	0.006	0.003	156.08	0.006	0.005
24	0.007	0.005	159.96	0.005	0.003
26	0.005	0.007	163.96	0.004	0.004
28	0.005	0.010	167.96	0.007	0.009
30	0.003	0.004	171.96	0.009	0.009
32	0.003	0.007	176.04	0.016	0.012
34	0.009	0.016	180.04	0.012	0.016
36	0.003	0.003	180.33	0.012	0.010
38	0.008	0.001	181.96	0.014	0.014
40	0.009	0.006	183.96	0.007	0.008
42	0.010	0.013	188.04	0.006	0.004
44	0.004	0.003	191.96	0.002	0.005
46	0.017	0.016	197.96	0.012	0.011
50	0.015	0.014	200.04	0.005	0.006
52	0.013	0.008	203.96	0.007	0.005
56	0.002	0.002	209.96	0.008	0.006
60	0.004	0.001	212.04	0.012	0.016
64	0.002	0.005	213.96	0.010	0.012
68	0.005	0.002	215.66	0.014	0.013
72	0.012	0.014	120.38	0.017	0.014
76	0.004	0.006	91.92	0.007	0.012
80	0.005	0.005	47.96	0.003	0.005
84	0.010	0.009	3.96	0.003	0.001
88	0.009	0.010	1.96	0.004	0.001
92	0.002	0.012	0.96	0.008	0.010
96	0.010	0.013	Average	0.0078	0.0084
100.04	0.010	0.011			

Table 21
Field Load Test Deflections Under 26,000-lb
Up Load

Station	Deflections, in.		Station	Deflections, in.	
	West Wall Leg	East Wall Leg		West Wall Leg	East Wall Leg
22-2	0.004	0.004	132-2	0.006	0.006
24-2	0.002	0.001	136-2	0.005	0.009
26-2	0.003	0.003	140-2	0.005	0.006
28-2	0.007	0.008	144-2	0.006	0.004
30-2	0.002	0.004	148-2	0.005	0.010
32-2	0.003	0.003	152-2	0.001	0.003
34-2	0.003	0.005	156-2	0.005	0.004
36-2	0.002	0.004	160-2	0.002	0.002
37-2	0.003	0.002	164-2	0.004	0.005
40-2	0	0.001	168-4	0.004	0.003
42-2	0.005	0.003	172-2	0.005	0.006
44-2	0.007	0.005	176-2	0.006	0.005
46-2	0.005	0.002	180+2	0.002	0.002
48-2	0.003	0.001	180+32	0.011	0.009
50-2	0.003	0.003	182-2	0.003	0.004
52-2	0.003	0.001	184-2	0.008	0.008
56-2	0.004	0.004	188-2	0.004	0.005
60-2	0.004	0.003	192-2	0.005	0.004
64-2	0.002	0.001	196-2	0.005	0.003
68-2	0.003	0.005	200-2	0.005	0.003
72-2	0.004	0.003	204-2	0.005	0.005
76-2	0.004	0.002	208-2	0.006	0.002
80-2	0.006	0.003	212-2	0.005	0.003
84-2	0.002	0.002	214-2	0.011	0.009
88-2	0.002	0.002	215+64	0.002	0.006
92-2	0.006	0.004	152-4	0.002	0.003
96-2	0.005	0.005	148-2	0.004	0.004
100+2	0.004	0.001	120+40	0.006	0.012
104-2	0.003	0.001	80-2	0.006	0.009
108-2	0.001	0.001	22-6	0.003	0.004
112-2	0.003	0.003	2-2	0.005	0.005
116-2	0.003	0.004	Average	0.0042	0.0041
120+2	0.003	0.005			
124-2	0.005	0.004			
128-2	0.005	0.003			

Table 22
Design Loads

Type of Load	Nominal Load, lb	
	One Rail	Both Rails
Down load	68,000	136,000
Up load	37,500	75,000
Side load		
At 6-1/2 ft above rails and 2100-fps velocity	--	38,000
At 8 ft above rails and 1500-fps velocity	--	50,000

Table 23
Limiting and Average Soil Conditions

Soil Condition	Modulus of Subgrade Reaction
	lb/in. ³
Worst	79.2
Average	175
Best	271.1

Table 24
Maximum Moments, Shears, and Deflections,
Down Load of 136,000 lb

Parameter	136,000-lb Down Load, Both Rails, 12 Shoes		
	k = 79.2 lb/in. ³	k = 175 lb/in. ³	k = 271.1 lb/in. ³
Deflection (in.)	0.0013 -0.0355	0.0006 -0.0170	0.0004 -0.0114
Shear (lb)	18,480 -18,480	15,830 -15,830	14,730 -14,730
Bending moment (in.-lb)	1.21×10^6 -7.8×10^5	7.3×10^5 -5.3×10^5	5.8×10^5 -4.2×10^5

Table 25
Maximum Moments, Shears, and Deflections,
Down Load of 80,000 lb

Parameter	Down Load of 80,000 lb, Both Rails, 4 Shoes		
	$k = 79.2 \text{ lb/in.}^3$	$k = 175 \text{ lb/in.}^3$	$k = 271.1 \text{ lb/in.}^3$
Deflection (in.)	0.0010 -0.0255	0.0005 -0.0130	0.0003 -0.0088
Shear (lb)	17,520 -17,520	15,120 -15,120	13,390 -13,930
Bending moment (in.-lb)	1.4×10^6 -6.3×10^5	9.1×10^5 -4.6×10^5	7.1×10^5 -3.8×10^5

Table 26
Maximum Deflections, Moments, and Shears
Side Load of 50,000 lb

Parameter	Side Load of 50,000 lb, Both Rails, 12 Shoes		
	$k = 79.2 \text{ lb/in.}^3$	$k = 175 \text{ lb/in.}^3$	$k = 271.1 \text{ lb/in.}^3$
Deflection (in.)	0.0005 -0.0113	0.0002 -0.0057	0.00014 -0.0038
Shear (lb)	8835 -8835	7401 -7401	6734 -6734
Bending moment (in.-lb)	9.6×10^5 -4.9×10^5	5.8×10^5 -3.5×10^5	4.3×10^5 -2.8×10^5

Table 27
Material Properties Used for Proposed Track

Ultimate Compressive Strength, f'_c , psi	Modulus of Elasticity, E , psi	Poisson's Ratio ν	Modulus of Rigidity, G , psi
4000	3,750,000	0.20	1,560,000

Table 28

Maximum Deflections, Moments, and Shears from Beam-on-Elastic Foundation Analysis

Load Case	Soil Constant, K , lb/in. ³	Vertical Load, FZ						Traverse Load, FX					
		DZ			MXZ			DX			MZZ		
		Min in.	Max in.	Min in.-lb	Max in.-lb	Min lb	Max lb	Min in.	Max in.	Min in.-lb	Max in.-lb	Min lb	Max lb
1	79.2	-0.0288	0.0009	-395,800	545,200	-14,440	14,440	-0.0083	0.0003	-479,300	941,600	-8,776	8,776
	175.0	-0.0130	0.0004	-266,200	419,000	-13,060	13,060	-0.0077	0.0003	-461,800	893,400	-8,605	8,605
	271.1	-0.0083	0.0003	-216,300	389,000	-12,710	12,710	-0.0072	0.0003	-448,300	851,700	-8,454	8,454
2		.1009	0.0030	-1,385,000	1,908,000	-50,550	50,550	-0.0083	0.0003	-479,300	941,600	-8,776	8,776
		0.0456	0.0015	-931,600	1,467,000	-45,720	45,720	-0.0077	0.0003	-461,800	893,400	-8,605	8,605
		-0.0292	0.0010	-756,900	1,362,000	-44,480	44,480	-0.0072	0.0003	-448,300	851,700	-8,454	8,454
3		-0.0576	0.0019	-791,600	1,090,000	-28,880	28,880	-0.0167	0.0007	-958,600	1,883,000	-17,550	17,550
		-0.0260	0.0009	-532,400	838,100	-26,130	26,130	-0.0155	0.0006	-923,700	1,787,000	-17,210	17,210
	271.1	-0.0167	0.0006	-432,500	778,000	-25,420	25,420	-0.0144	0.0006	-896,700	1,703,000	-16,910	16,910
4	79.2	-0.2018	0.0066	-2,771,000	3,816,000	-101,100	101,100	-0.0167	0.0007	-958,600	1,883,000	-17,550	17,550
	175.0	-0.0910	0.0030	-1,836,000	2,933,000	-91,450	91,450	-0.0155	0.0006	-923,700	1,787,000	-17,210	17,210
	271.1	-0.0584	0.0020	-1,439,000	2,723,000	-88,960	88,960	-0.0144	0.0006	-896,700	1,703,000	-16,910	16,910
5	79.2	-0.0310	0.0000	-300,700	218,200	-7,964	7,964	-0.0083	0.0003	-479,300	941,600	-8,776	8,776
	175.0	-0.0140	0.0000	-231,100	146,800	-7,205	7,205	-0.0077	0.0003	-461,800	893,400	-8,605	8,605
	271.1	-0.0090	0.0000	-214,500	119,300	-7,008	7,008	-0.0072	0.0003	-448,300	851,700	-8,454	8,454
6	79.2	-0.0320	0.0172	-901,900	654,800	-23,890	23,890	-0.0083	0.0003	-479,300	941,600	-8,776	8,776
	175.0	-0.0145	0.0078	-693,300	440,400	-21,610	21,610	-0.0077	0.0003	-461,800	893,400	-8,605	8,605
	271.1	-0.0093	0.0049	-643,600	357,800	-21,020	21,020	-0.0072	0.0003	-448,300	851,700	-8,454	8,454
7	79.2	-0.0315	0.0013	-601,300	436,500	-15,930	15,930	-0.0167	0.0007	-958,600	1,883,000	-17,550	17,550
	175.0	-0.0142	0.0006	-462,200	293,600	-14,410	14,410	-0.0155	0.0006	-923,700	1,787,000	-17,210	17,210
	271.0	-0.0091	0.0003	-429,000	238,500	-14,020	14,020	-0.0144	0.0006	-896,700	1,703,000	-16,910	16,910
8	79.2	-0.0336	0.0649	-1,804,000	1,310,000	-47,790	47,790	-0.0167	0.0007	-958,600	1,883,000	-17,550	17,550
	175.0	-0.0152	0.0293	-1,387,000	880,700	-43,230	43,230	-0.0155	0.0006	-923,700	1,787,000	-17,210	17,210
	271.1	-0.0098	0.0187	-1,287,000	715,500	-42,050	42,050	-0.0144	0.0006	-896,700	1,703,000	-16,910	16,910
17	79.2	-0.0304	0.0000	0	0	0	0	0.0	0.0	0	0	0	0
	175.0	-0.0138	0.0000	0	0	0	0	0.0	0.0	0	0	0	0
	271.1	-0.0089	0.0000	0	0	0	0	0.0	0.0	0	0	0	0

Table 29
Maximum Compressive Stresses in Concrete Track

<u>Load Case</u>	<u>Soil Constant lb/in.³</u>	<u>Maximum Compressive Stresses in Concrete Track</u>
1	79.2	117
	175	95
	271.1	91
2	79.2	316
	175	250
	271.1	233
3	79.2	235
	175	194
	271.1	181
4	79.2	634
	175	501
	271.1	466
5	79.2	69
	175	57
	271.1	51
6	79.2	133
	175	100
	271.1	86
7	79.2	139
	175	114
	271.1	102
8	79.2	267
	175	200
	271.1	172

Table 30
Relative Stiffness About Y-Y and X-X Axes

<u>Item</u>	<u>I_o</u>	<u>E</u>	<u>I_o × E</u>
<u>Y-Y Axis</u>			
Concrete track	451,194	30×10^6	13.5×10^{12}
Crane rails	100	3.75×10^6	3.8×10^8
<u>X-X Axis</u>			
Concrete track	50,810	30×10^6	1.5×10^{12}
Crane rails	297	3.75×10^6	1.1×10^9

Table 31

Minimum and Maximum Stress from Finite-Element Analysis Results

Load Case	Normal*						Shear					
	SX		SY		SZ		VXY		VYZ		VZY	
	Min psi	Max psi	Min psi	Max psi	Min psi	Max psi	Min psi	Max psi	Min psi	Max psi	Min psi	Max psi
1	-16	15	-20	19	-16	4	-8	4	-9	11	-4	5
2	-47	46	-53	49	-58	14	-13	6	-30	27	-16	14
3	-29	27	-41	39	-32	8	-16	8	-18	22	-7	11
4	-91	89	-106	98	-117	28	-26	11	-61	54	-32	27
5	-9	7	-17	17	-5	10	-10	6	-12	7	-2	4
6	-20	19	-24	25	-7	29	-13	12	-23	15	-5	9
7	-21	15	-33	35	-9	21	-20	12	-24	14	-5	8
8	-44	41	-48	51	-14	58	-25	23	-45	30	-11	19
9	-15	24	-32	58	-16	2	-27	23	-22	32	-5	8
10	-39	46	-182	186	-62	15	-79	98	-70	124	-18	18
11	-26	46	-65	117	-31	5	-54	46	-44	63	-9	16
12	-71	86	-357	363	-100	21	-145	176	-127	228	-33	44
13	-15	25	-36	34	-6	10	-12	8	-12	4	-3	9
14	-22	25	-44	101	-7	31	-34	17	-38	21	-5	15
15	-28	46	-72	69	-10	22	-24	15	-24	8	-6	18
16	-43	47	-88	202	-14	62	-69	35	-76	42	-10	30
17	-3	3	-1	1	-2	0	0	0	0	0	-1	1

* Note a negative (-) normal stress is a compressive stress.

Table 32
Applied Loads

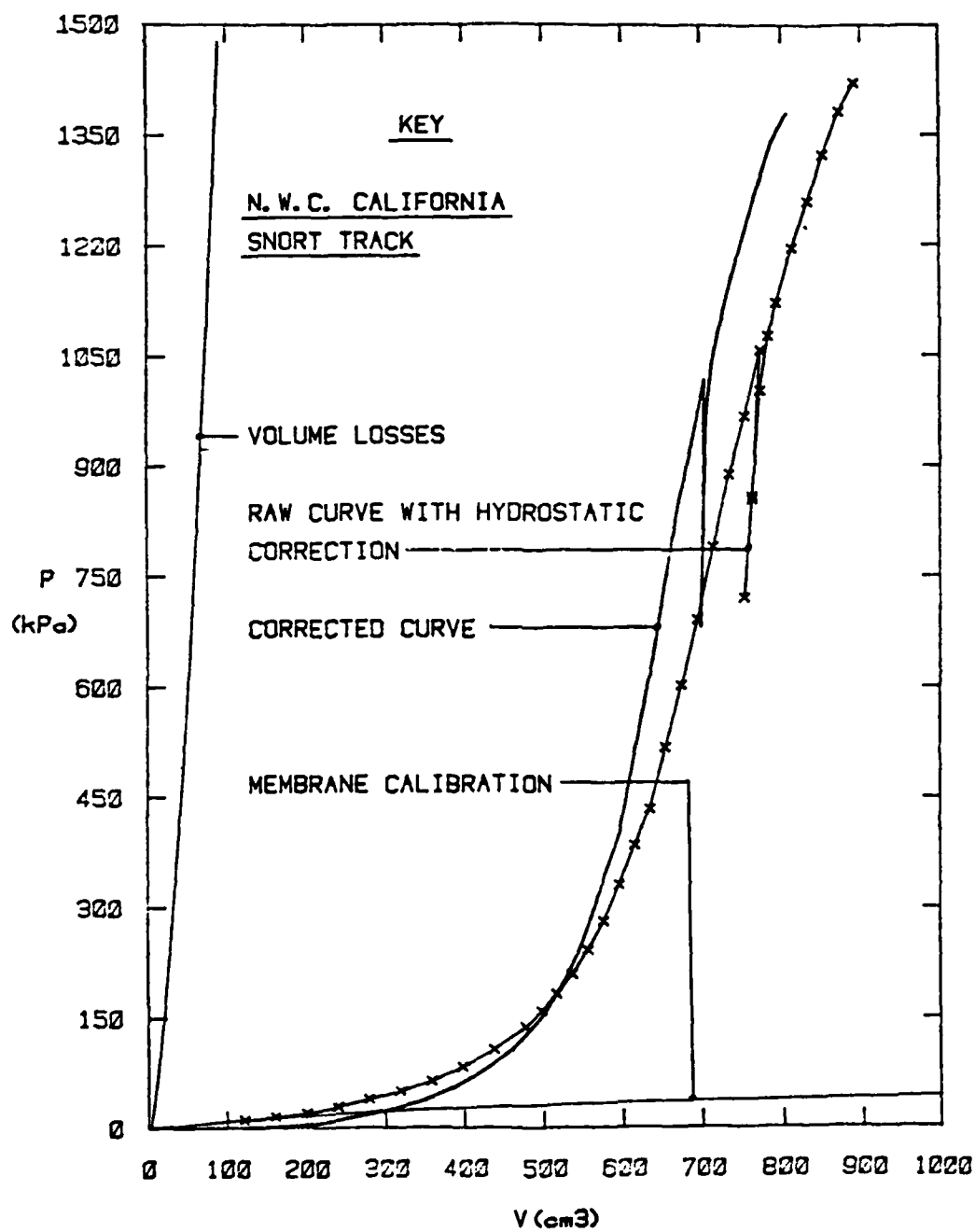
Load Case	Number Shoes	Shoe Spacing in.	Total			Per Shoe		
			FX kips	FZ kips	MY in.-kips	FX kips	FZ kips	MY in.-kips
1	12	50	50	-136	5,100	4.2	-11.3	425
2	12	50	50	-476	5,100	4.2	-39.7	425
3	12	50	100	-272	10,200	8.3	-22.7	850
4	12	50	100	-952	10,200	8.2	-79.3	850
5	12	50	50	75	5,100	4.2	6.2	425
6	12	50	50	225	5,100	4.2	18.8	425
7	12	50	100	150	10,200	8.3	12.5	850
8	12	50	100	450	10,200	8.3	37.5	850
9	6	50	50	-68	5,100	8.3	-11.3	850
10	6	50	50	-408	5,100	8.3	-68.0	850
11	6	50	100	-136	10,200	16.7	-22.7	1700
12	6	50	100	-816	10,200	16.7	-136.0	1700
13	6	50	50	38	5,100	8.3	6.2	850
14	6	50	50	188	5,100	8.3	31.2	850
15	6	50	100	75	10,200	16.7	12.5	1700
16	6	50	100	375	10,200	16.7	62.5	1700
17*	0	50	0		0	0		0

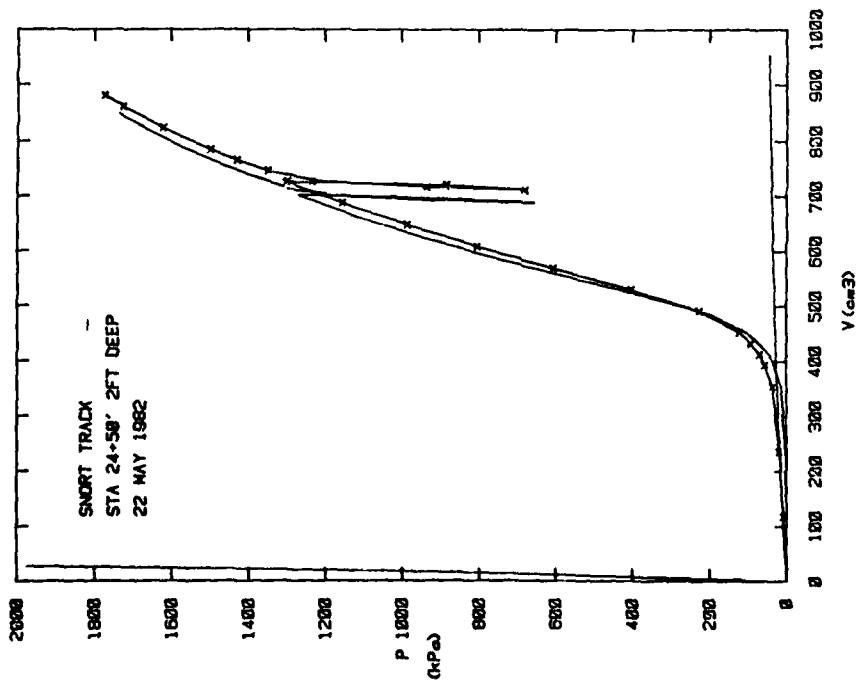
* Only weight of structure used in analysis.

Table 33
Deflections of Track at Center of Gravity of Sled Loads

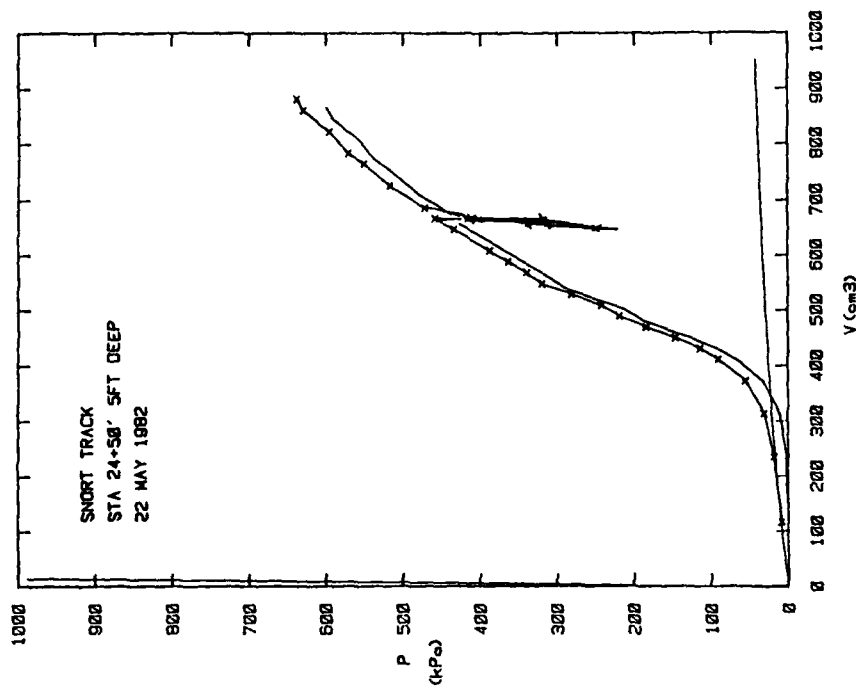
Load Case	Finite-Element Analysis				Beam on Elastic Foundation Analysis		
	Maximum Deflection Considering Twist in.	Deflection at Center Line of Beam			Deflection at Center Line of Beam		
		Vertical in.	Transverse in.	Net in.	Vertical in.	Transverse in.	Net in.
1	-0.0342	-0.0249	0.0081	-0.0262	-0.0268	0.0077	-0.0279
2	-0.0624	-0.0572	0.0078	-0.0577	-0.0594	0.0077	-0.0599
3	-0.0551	-0.0372	0.0162	-0.0406	-0.0398	0.0155	-0.0427
4	-0.1110	-0.1018	0.0153	-0.1029	-0.1048	0.0155	-0.1059
5	-0.0188	-0.0049	0.0085	-0.0098	-0.0058	0.0077	-0.0096
6	0.0246	0.0093	0.0087	0.0127	0.0080	0.0077	0.0111
7	0.0309	0.0028	0.0168	0.0170	0.0010	0.0155	0.0155
8	0.0590	0.0313	0.0171	0.0357	0.0288	0.0155	0.0327
9	-0.0506	-0.0206	0.0117	-0.0237	--	--	--
10	-0.1650	-0.0664	0.0184	-0.0689	--	--	--
11	-0.0884	-0.0285	0.0233	-0.0368	--	--	--
12	-0.2870	-0.1091	0.0348	-0.1145	--	--	--
13	-0.0166	-0.0063	0.0097	-0.0116	--	--	--
14	0.0385	0.0139	0.0067	0.0154	--	--	--
15	-0.0251	-0.0001	0.0192	-0.0192	--	--	--
16	0.0906	0.0403	0.0133	0.0424	--	--	--
17	-0.0140	-0.0126	0.0002	-0.0126	-0.0138	0.000	-0.0138

APPENDIX A: PRESSURE METER TEST CURVES

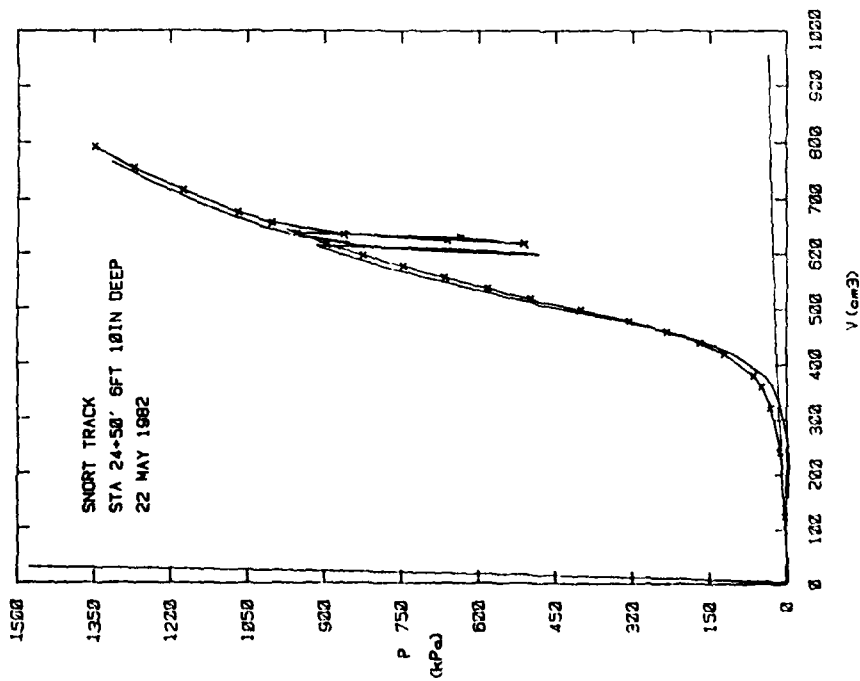




TEST NO. 1
HAND AUGERING ON TRACK CENTER LINE
 $E_o = 24100$ kPa.
 $E_R = 201000$ kPa.
 $P_L^* = 2400$ kPa.



TEST NO. 2
HAND AUGERING ON TRACK CENTER LINE
 $E_o = 7900$ kPa.
 $E_R = 40500$ kPa.
 $P_L^* = 700$ kPa.



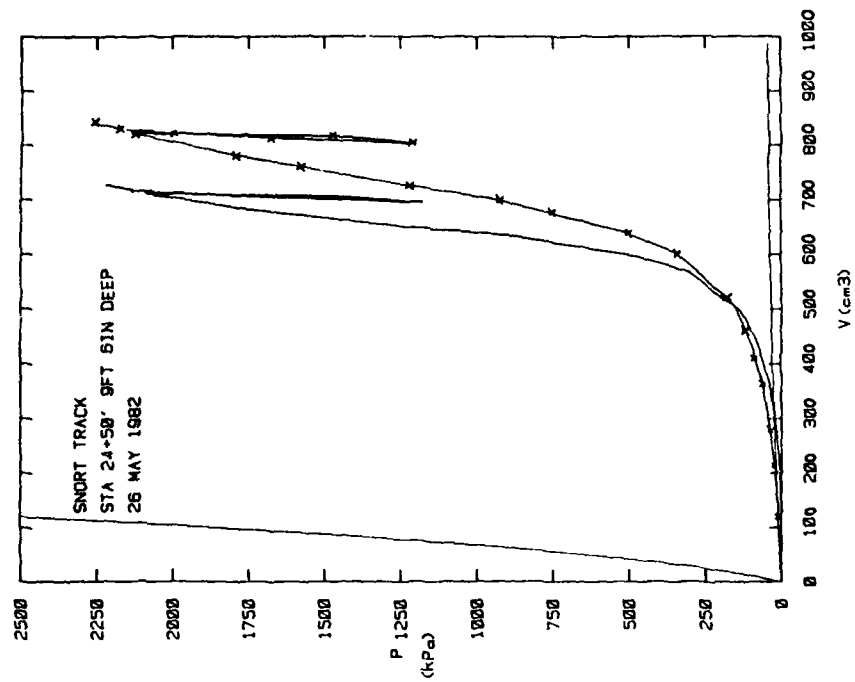
TEST NO. 3

HAND AUGERING ON TRACK CENTER LINE

$E_o = 22200 \text{ kPa.}$

$E_R = 107000 \text{ kPa.}$

$P_L^* = 1950 \text{ kPa.}$



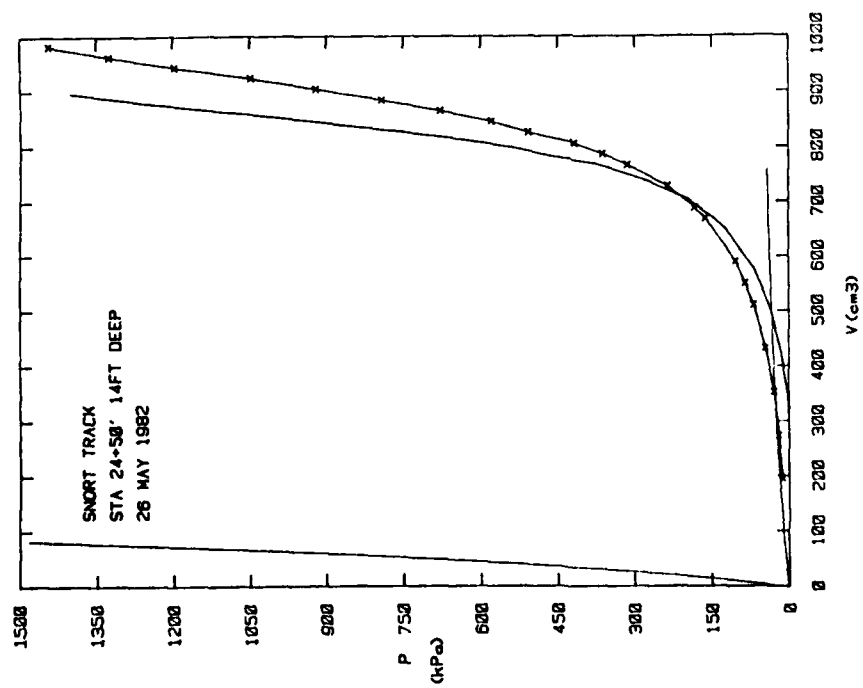
TEST NO. 4

HAND AUGERING ON TRACK CENTER LINE

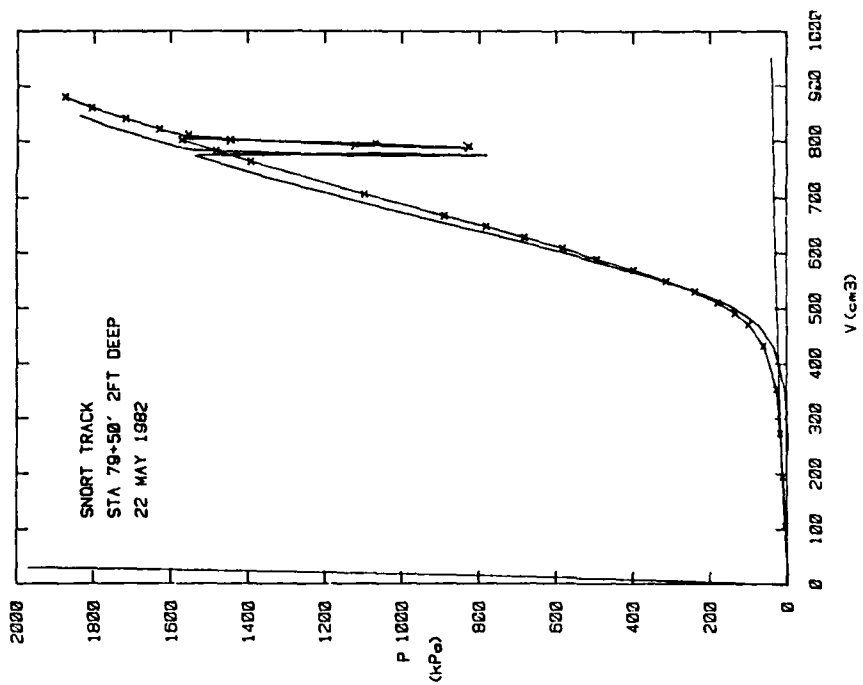
$E_o = 78400 \text{ kPa.}$

$E_R = 251000 \text{ kPa.}$

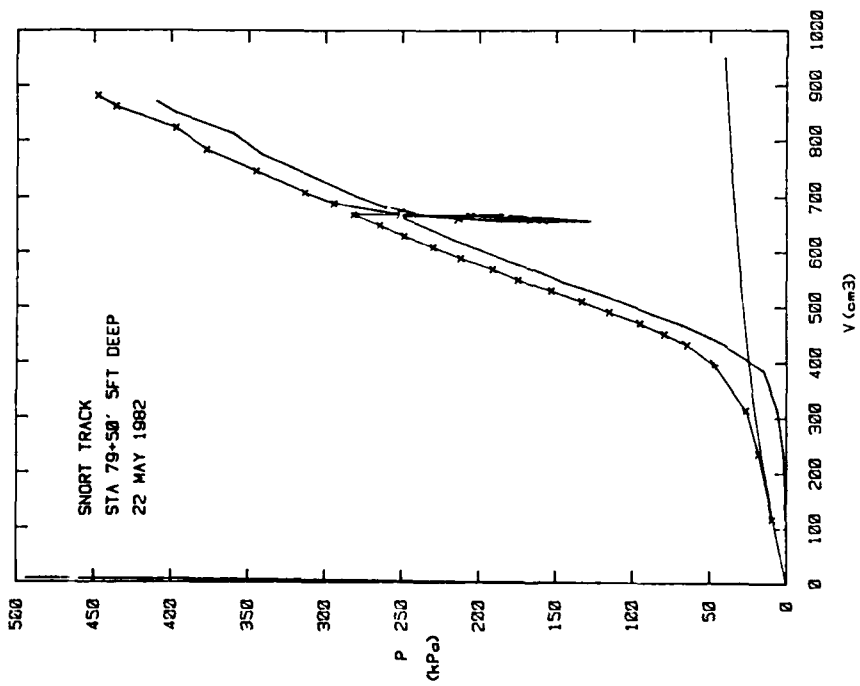
$P_L^* = 7840 \text{ kPa.}$



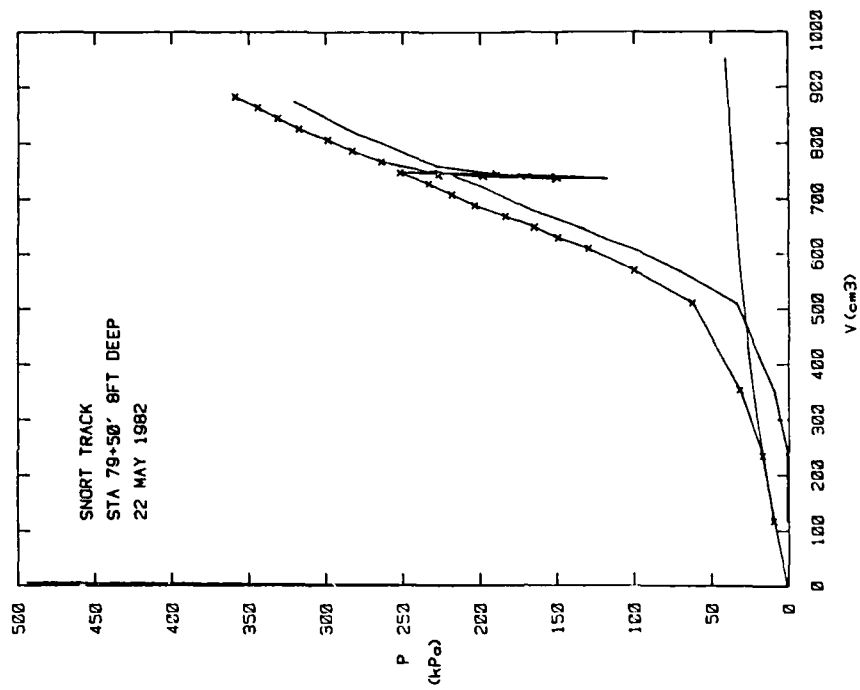
TEST NO. 5
HAND AUGERING ON TRACK CENTER LINE
 $E_o = 45600 \text{ kPa.}$
 $E_R = /$
 $P_L^* = 4560 \text{ kPa.}$



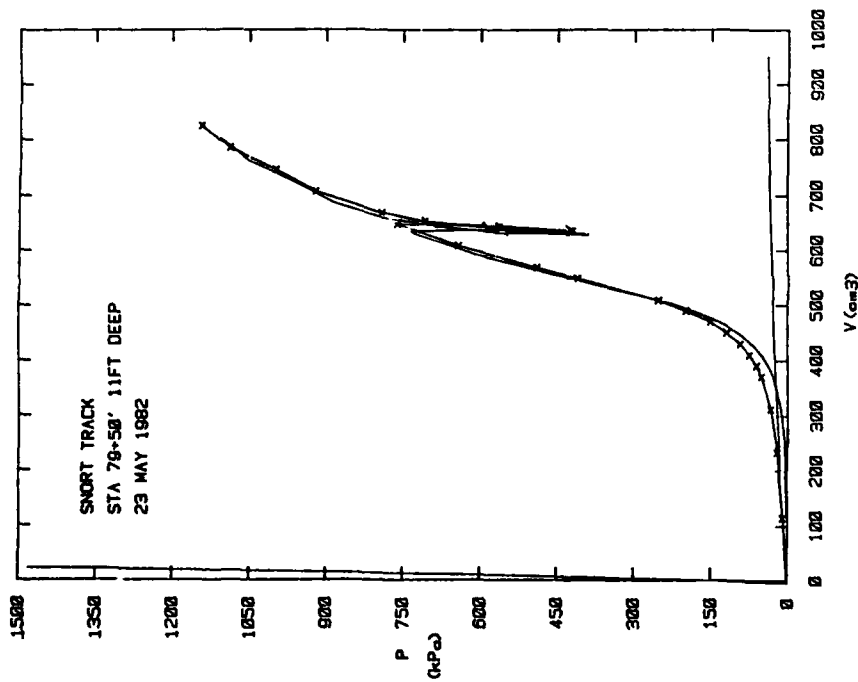
TEST NO. 6
HAND AUGERING ON TRACK CENTER LINE
 $E_o = 26100 \text{ kPa.}$
 $E_R = 944000 \text{ kPa.}$
 $P_L^* = 4000 \text{ kPa.}$



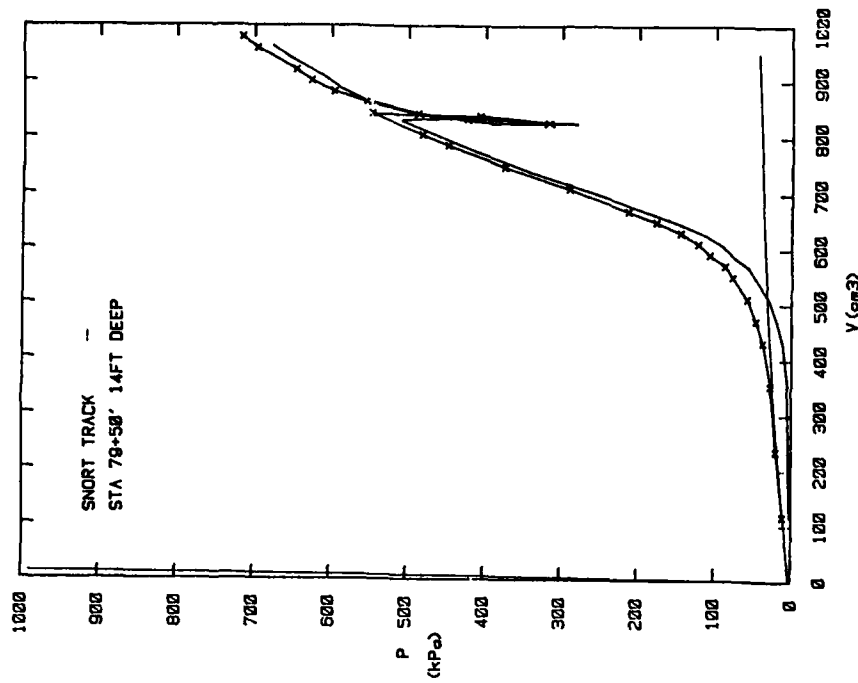
TEST NO. 7
HAND AUGERING ON TRACK CENTER LINE
 $E_o = 4300$ kPa.
 $E_R = 40300$ kPa.
 $P_L^* = 800$ kPa.



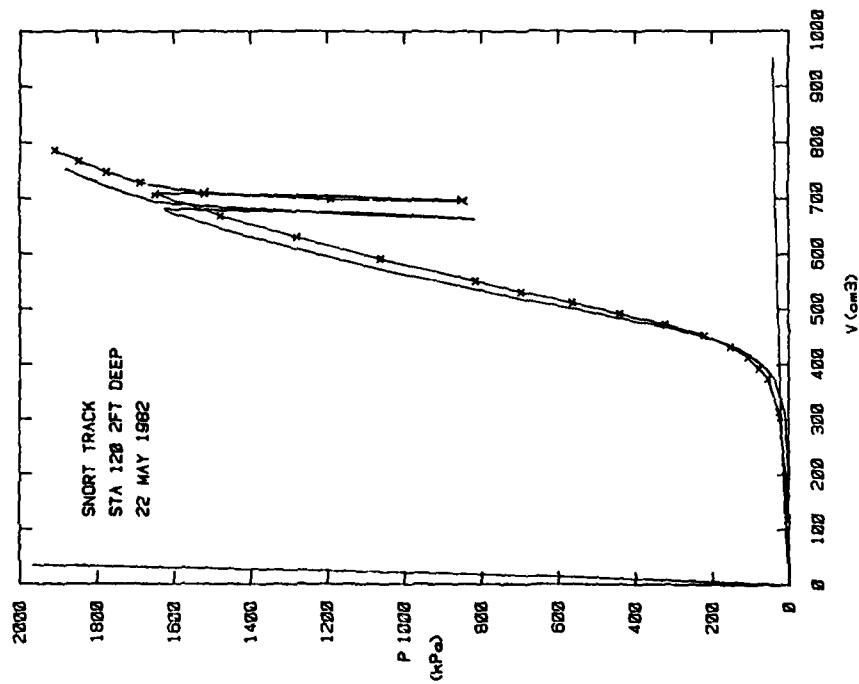
TEST NO. 8
HAND AUGERING, SLIGHT COLLAPSE OF HOLE, ON TRACK CENTER LINE
 $E_o = 4300$ kPa.
 $E_R = 38800$ kPa.
 $P_L^* = 680$ kPa.



TEST NO. 9
HAND AUGERING, POSSIBLE SLIGHT COLLAPSE, ON TRACK CENTER LINE
 $E_o = 18500$ kPa.
 $E_R = 109000$ kPa.
 $P_L^* = 1500$ kPa.



TEST NO. 10
HAND AUGERING ON TRACK CENTER LINE
 $E_o = 10700$ kPa.
 $E_R = 97600$ kPa.
 $P_L^* = 1000$ kPa.



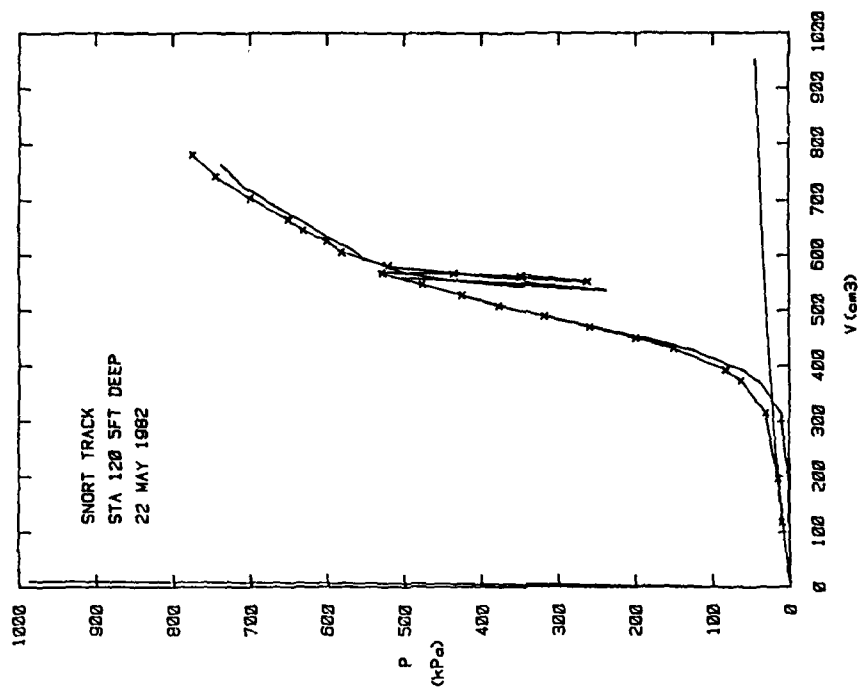
TEST NO. 11

HAND AUGERING ON TRACK CENTER LINE

$E_o = 29500$ kPa.

$E_R = 162000$ kPa.

$P_L^* = 3000$ kPa.



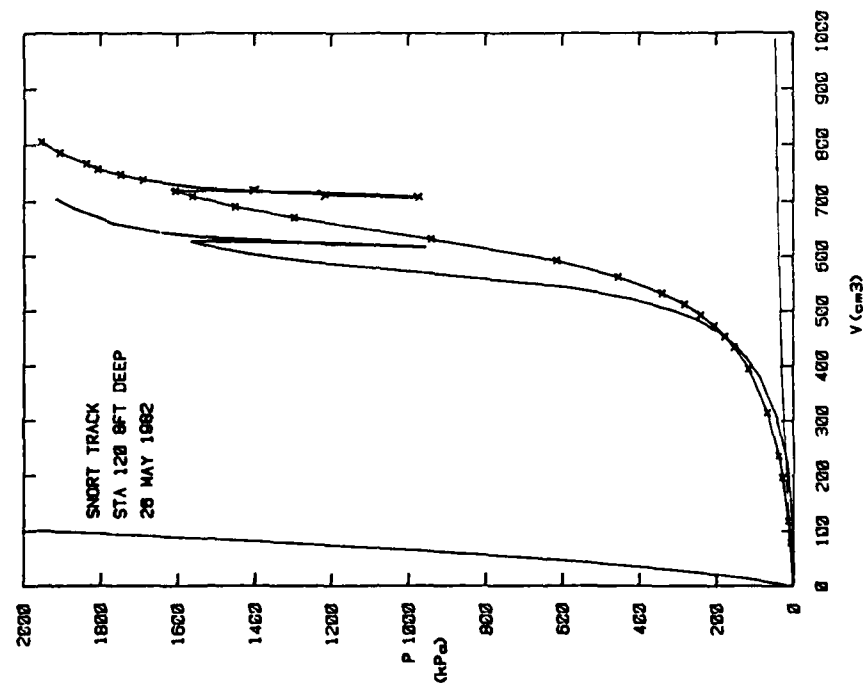
TEST NO. 12

HAND AUGERING ON TRACK CENTER LINE

$E_o = 12800$ kPa.

$E_R = 48700$ kPa.

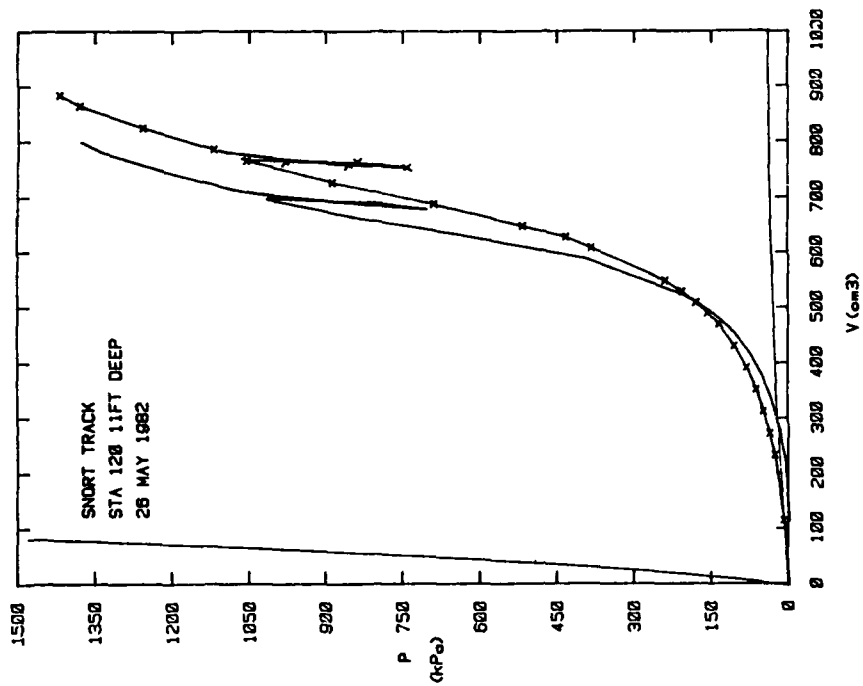
$P_L^* = 1000$ kPa.



TEST NO. 13

SOME MACHINE AUGERING ON TRACK CENTER LINE

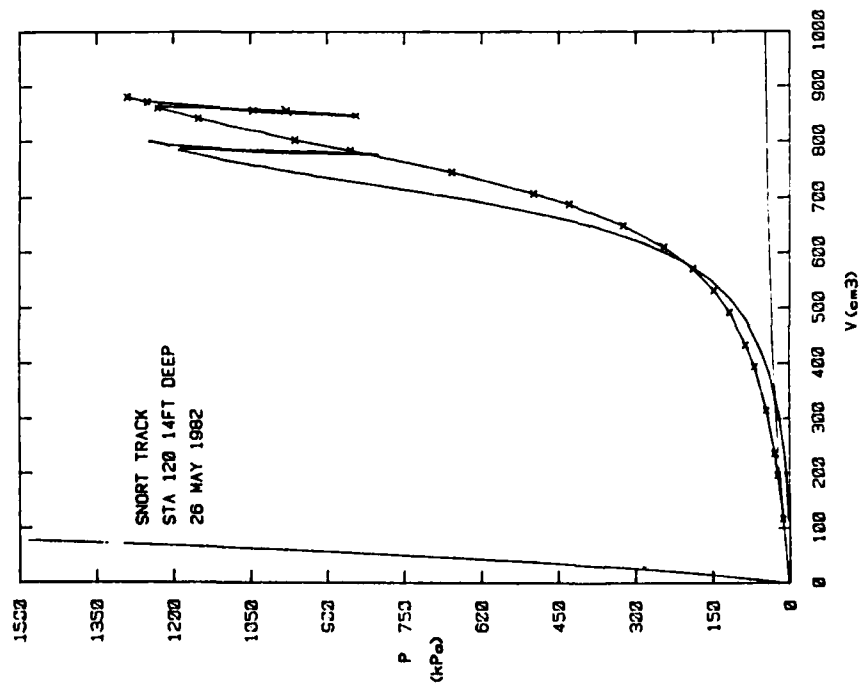
$E_o = 59600$ kPa.
 $E_R = 140000$ kPa.
 $P_o^* = 2700$ kPa.



TEST NO. 14

SOME MACHINE AUGERING ON TRACK CENTER LINE

$E_o = 26300$ kPa.
 $E_R = 60800$ kPa.
 $P_o^* = 2100$ kPa.



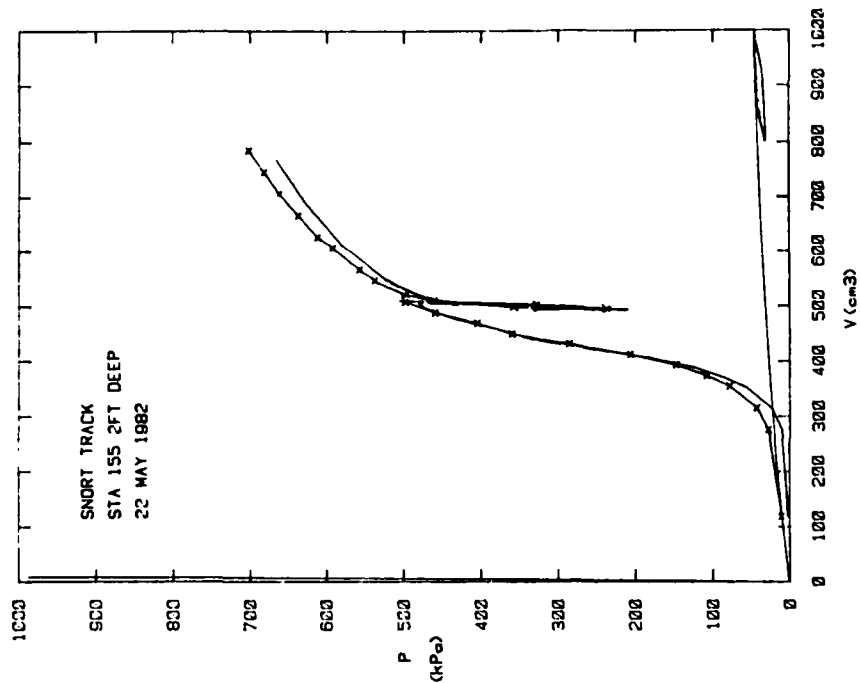
TEST NO. 15

SOME MACHINE AUGERING ON TRACK CENTER LINE

$E_o = 31000$ kPa.

$E_R = 142000$ kPa.

$P_L^* = 3000$ kPa.



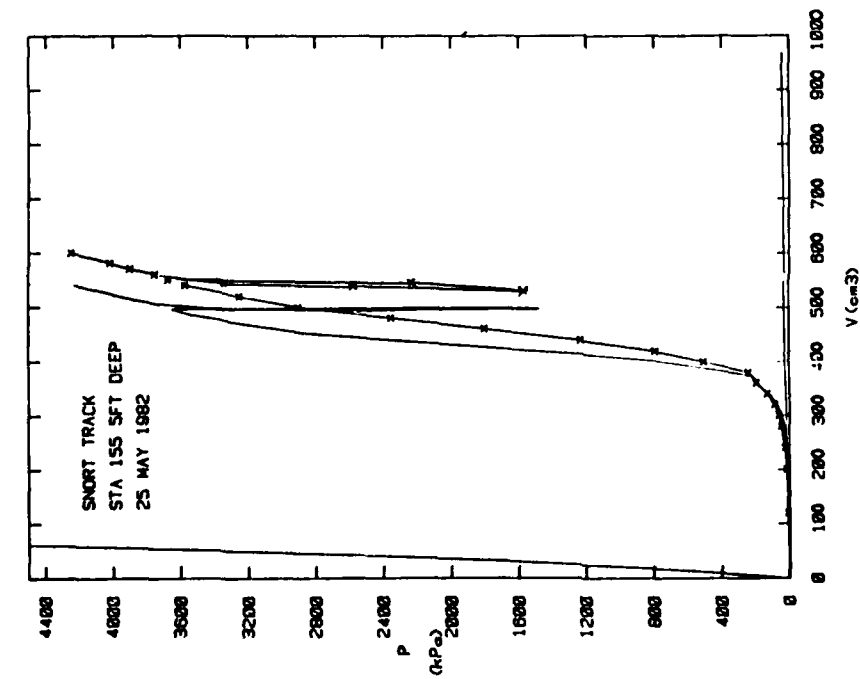
TEST NO. 16

HAND AUGERING ON TRACK CENTER LINE

$E_o = 16100$ kPa.

$E_R = 61900$ kPa.

$P_L^* = 850$ kPa.



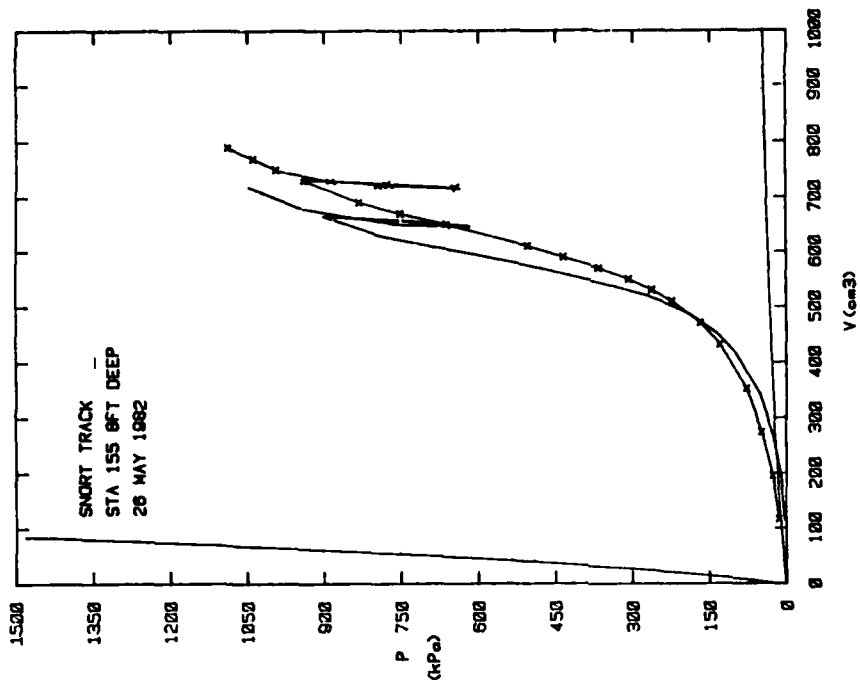
TEST NO. 17

HEAVY MACHINE AUGERING IN TRACK CENTER LINE

$E_0 = 172000 \text{ kPa}$

$E_R =$

$P_L^* = 8500 \text{ kPa}$



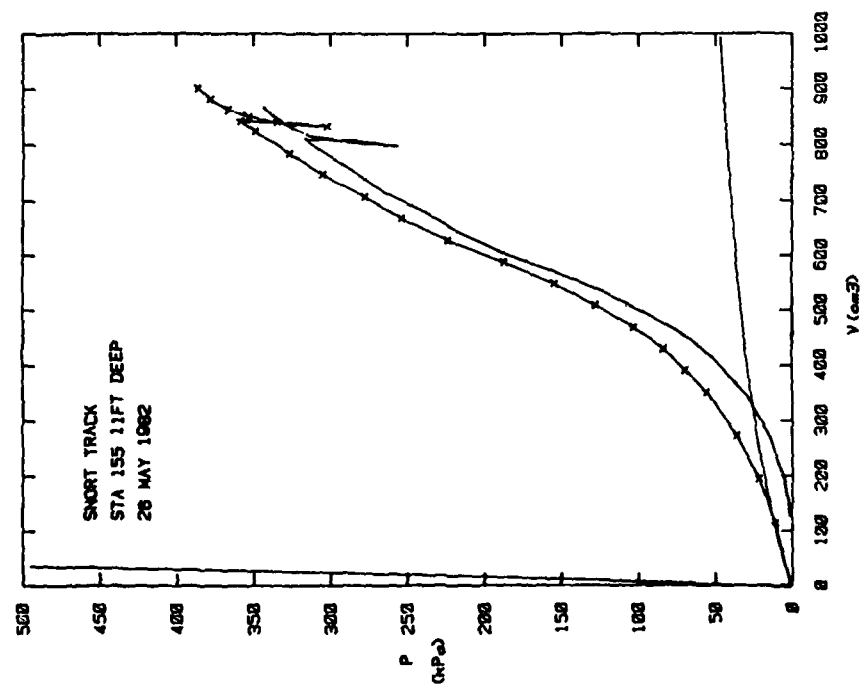
TEST NO. 18

HEAVY MACHINE AUGERING ON TRACK CENTER LINE. DISTURBANCE!

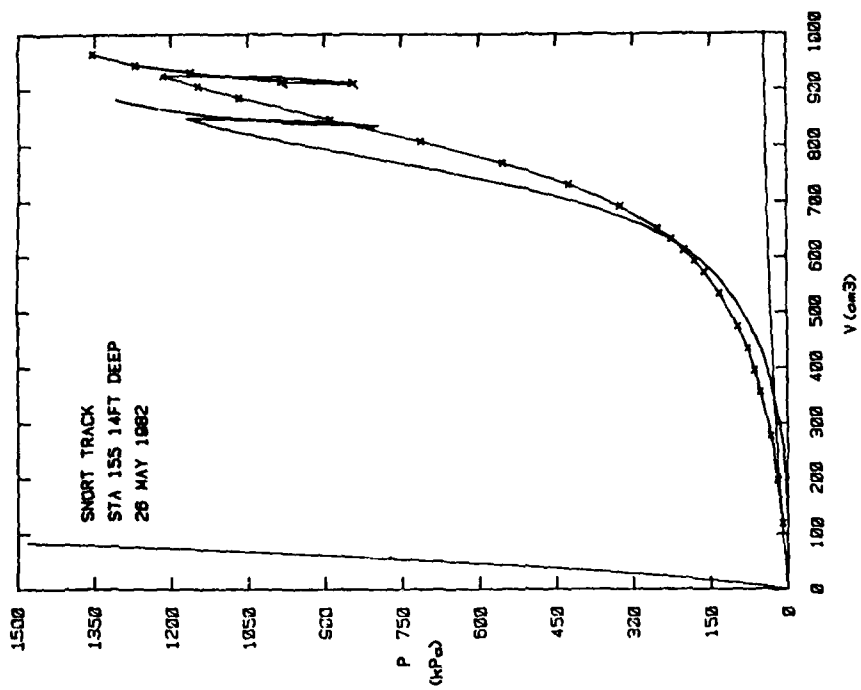
$E_0 = 22400 \text{ kPa}$

$E_R = 60000 \text{ kPa}$

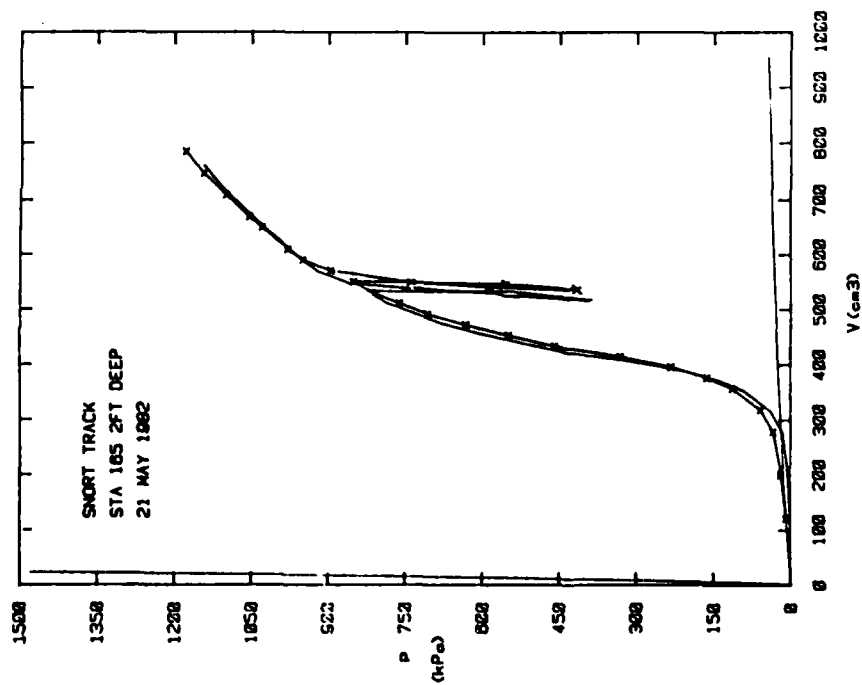
$P_L^* = 1700 \text{ kPa}$



TEST NO. 19
HEAVY MACHINE AUGERING ON TRACK CENTER LINE. DISTURBANCE!
 $E_o = 4100$ kPa.
 $E_R = 18400$ kPa.
 $P_L = 500$ kPa.



TEST NO. 20
HEAVY MACHINE AUGERING ON TRACK CENTER LINE. DISTURBANCE!
 $E_o = 26100$ kPa.
 $E_R = 105000$ kPa.
 $P_L = 3000$ kPa.



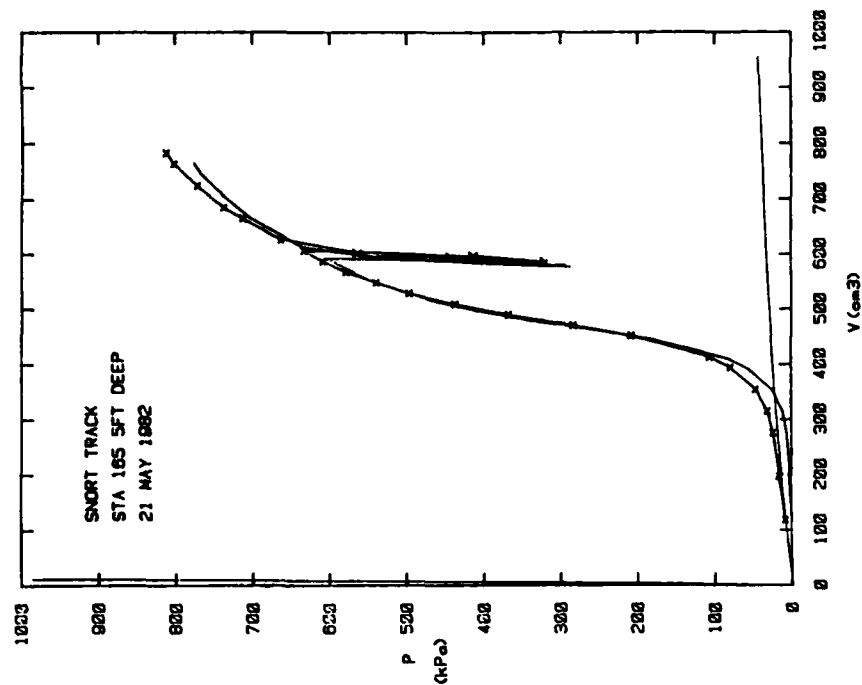
TEST NO. 21

HAND AUGERING ON TRACK CENTER LINE

$E_o = 27200$ kPa.

$E_R = 68100$ kPa.

$P_L = 1500$ kPa.



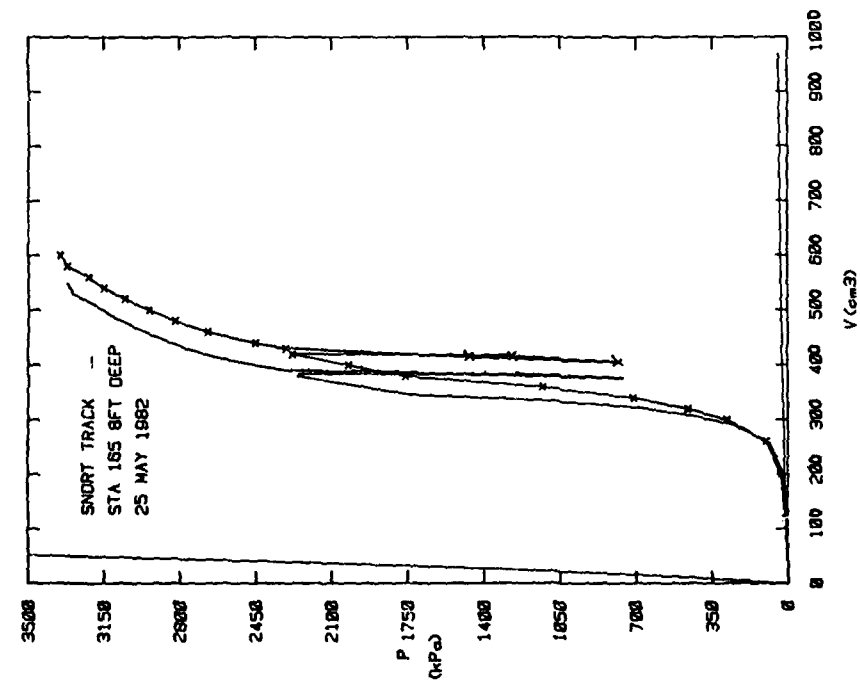
TEST NO. 22

HAND AUGERING ON TRACK CENTER LINE

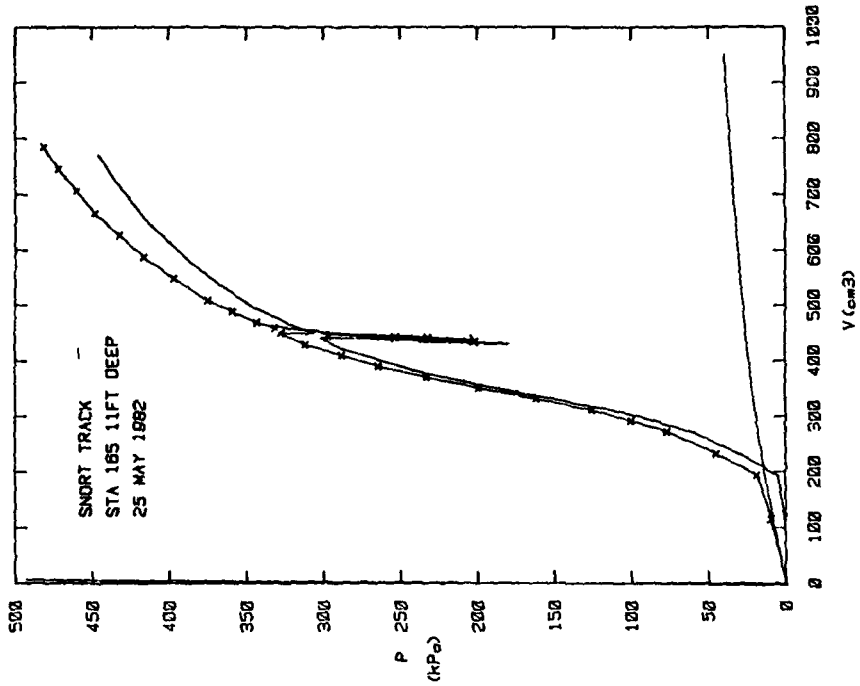
$E_o = 16200$ kPa.

$E_R = 65100$ kPa.

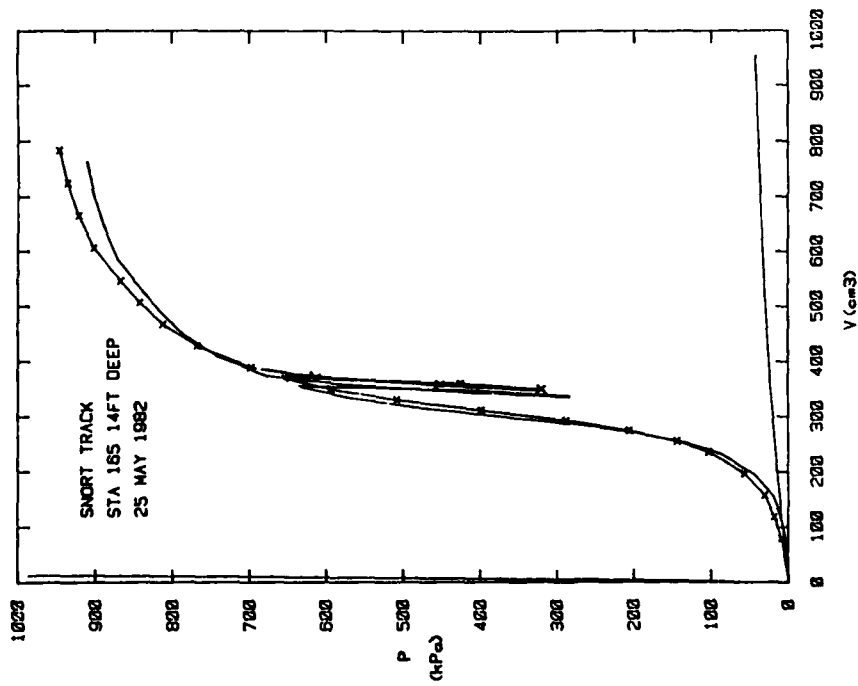
$P_L = 1000$ kPa.



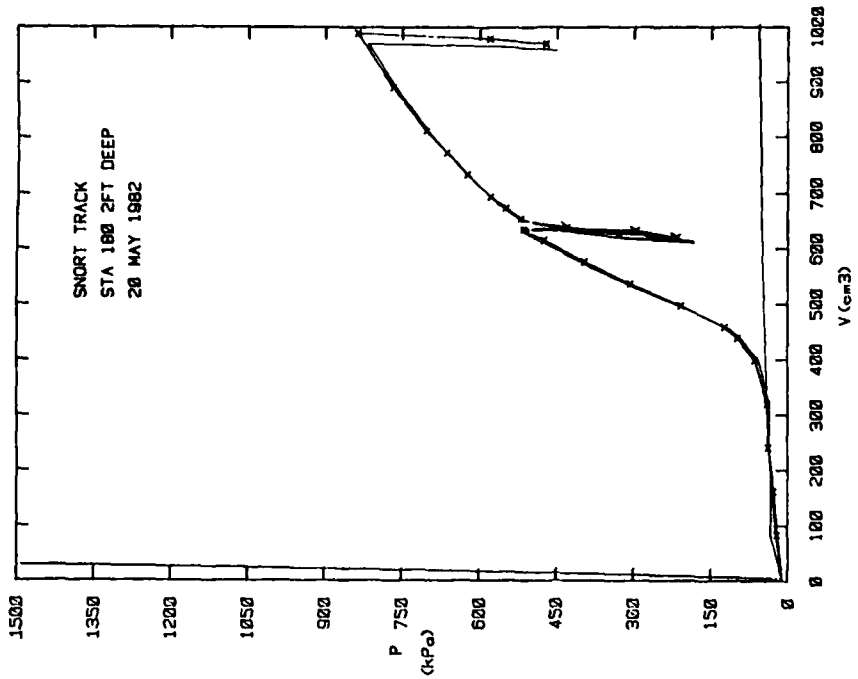
TEST NO. 23
HEAVY MACHINE AUGERING ON TRACK CENTER LINE.
HOLE SOAKED IN WATER OVERNIGHT.
 $E_o = 167000$ kPa.
 $E_R = 430000$ kPa.
 $P_L^* = 4000$ kPa.



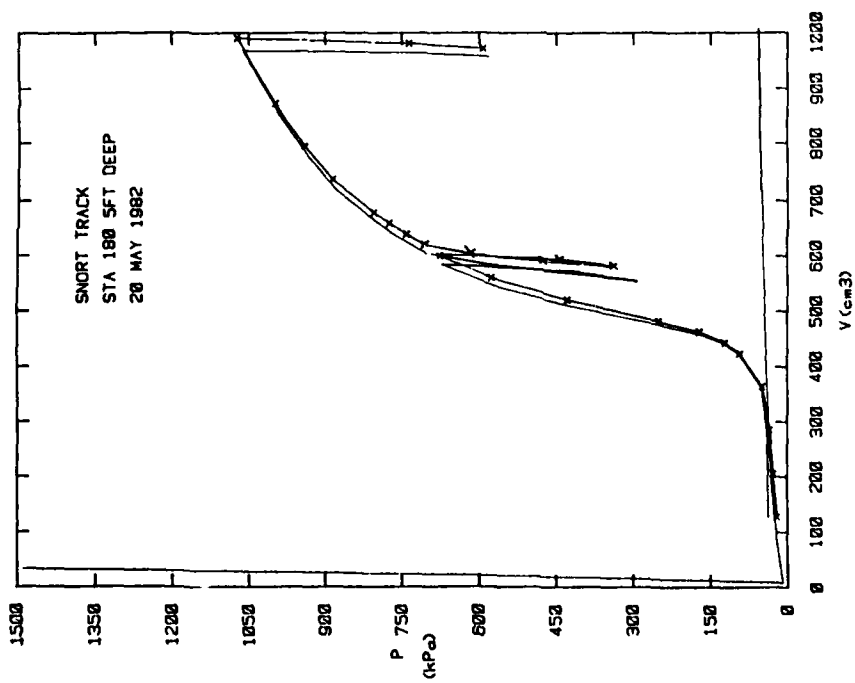
TEST NO. 24
LIGHT MACHINE AND HAND AUGERING ON TRACK CENTER LINE.
SOFT CLAY CUTTINGS.
 $E_o = 6800$ kPa.
 $E_R = 25500$ kPa.
 $P_L^* = 550$ kPa.



TEST NO. 25
HAND AUGERING, STIFF CLAY CUTTINGS, ON TRACK CENTER LINE.
 $E_o = 21200$ kPa.
 $E_R = 55300$ kPa.
 $P_L^* = 900$ kPa.



TEST NO. 26
HAND AUGERING ON TRACK CENTER LINE.
 $E_o = 11100$ kPa.
 $E_R = 53000$ kPa.
 $P_L^* = 1050$ kPa.



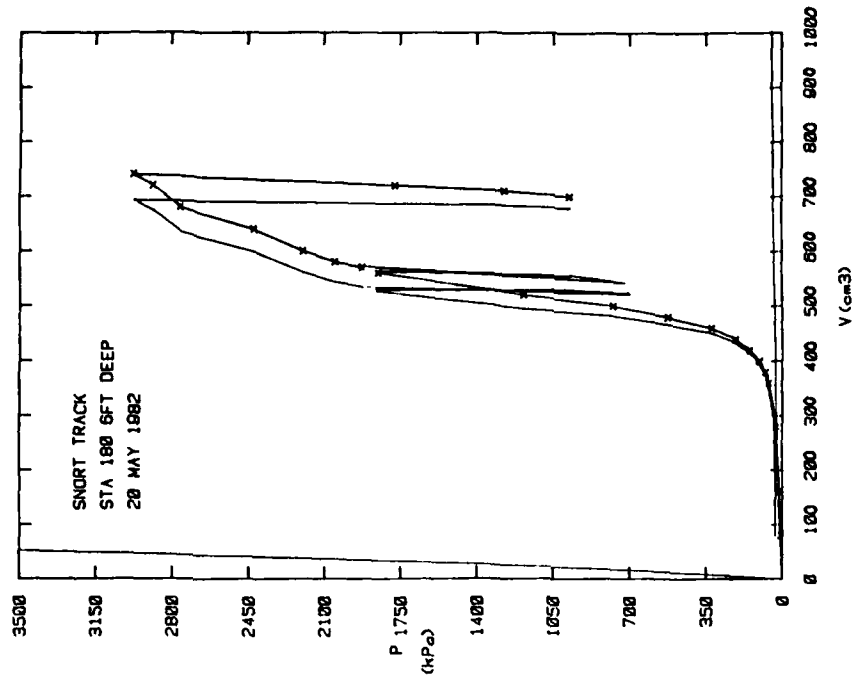
TEST NO. 27

HAND AUGERING ON TRACK CENTER LINE.

$E_0 = 20000$ kPa.

$E_R = 41300$ kPa.

$P_L^* = 1300$ kPa.



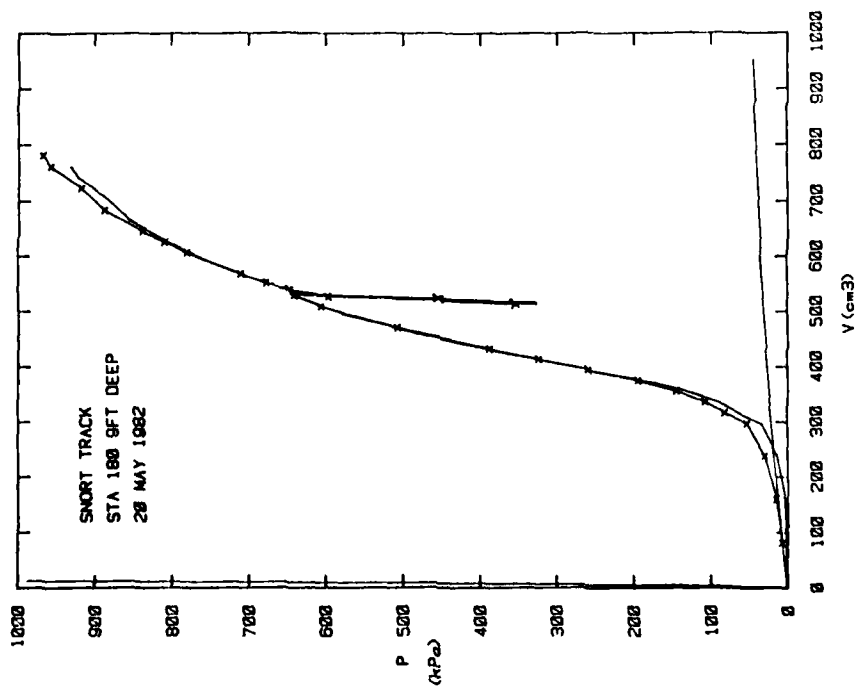
TEST NO. 28

HAND AUGERING OFF TRACK CENTER LINE.

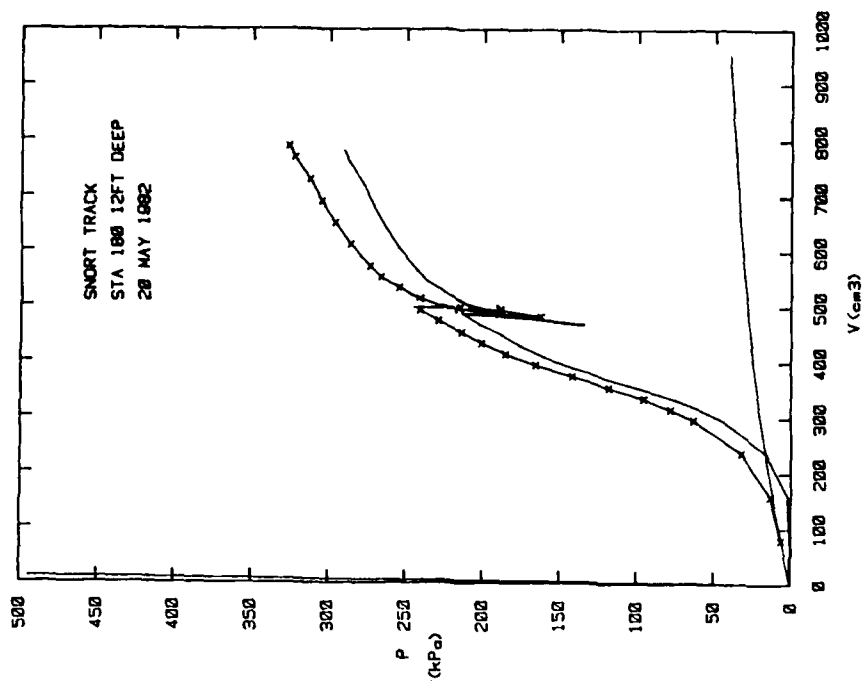
$E_0 = 101000$ kPa.

$E_R = 407000$ kPa.

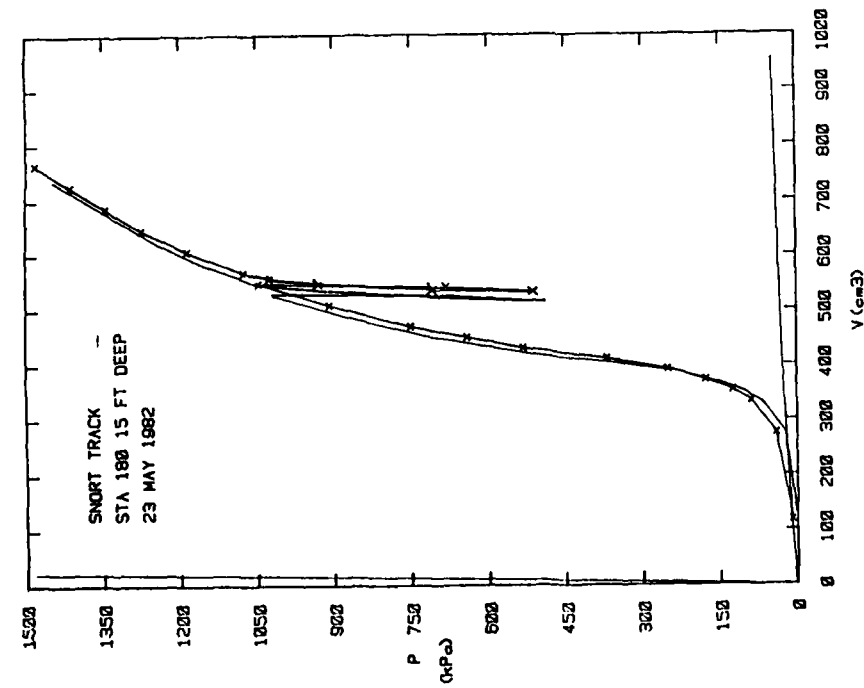
$P_L^* = 4500$ kPa.



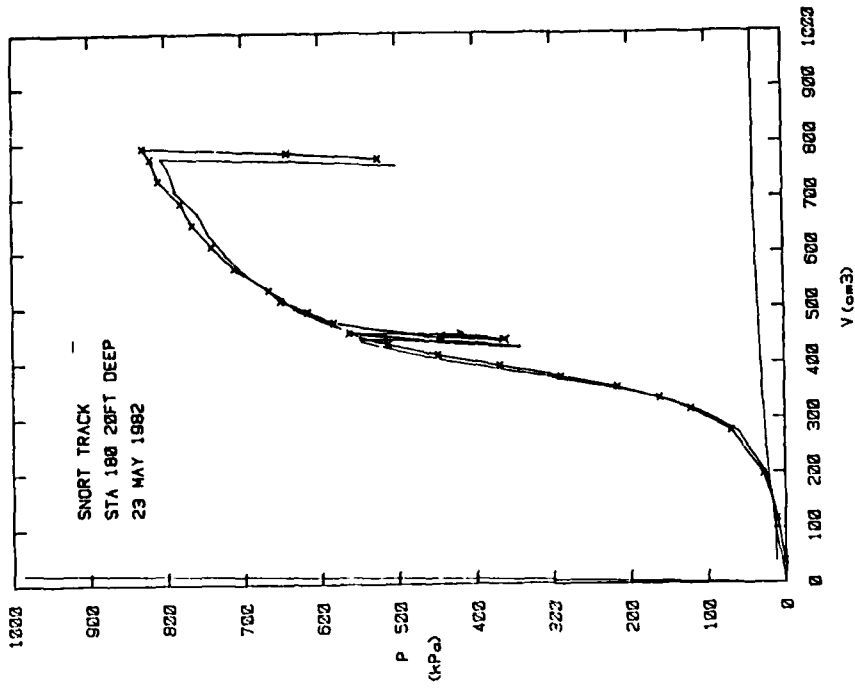
TEST NO. 29
MAINLY HAND AUGERING OFF TRACK CENTER LINE.
SOME MACHINE AUGERING.
 $E_o = 13400$ kPa.
 $E_R = 73700$ kPa.
 $P_L^* = 1200$ kPa.



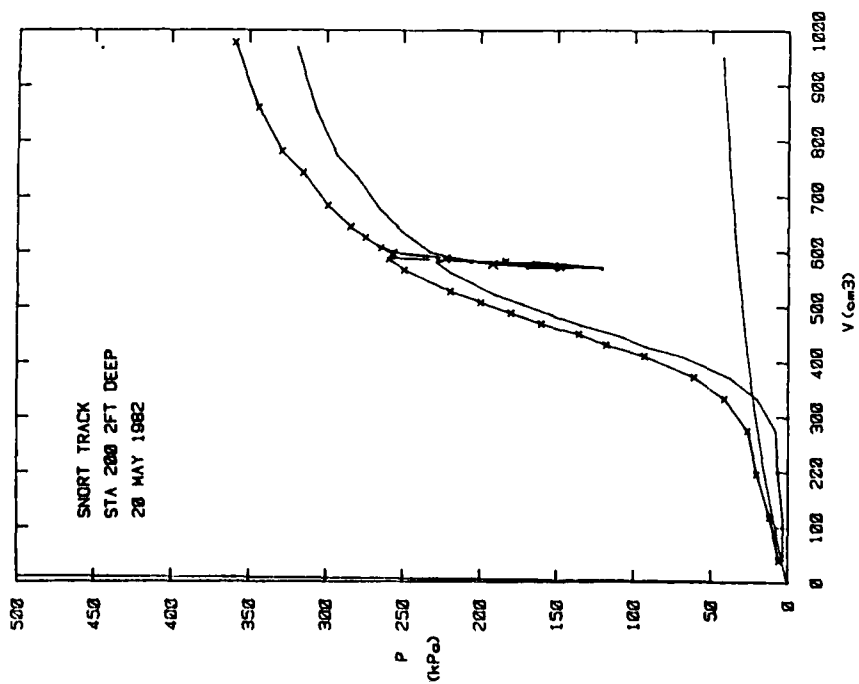
TEST NO. 30
HAND AUGERING OFF TRACK CENTER LINE.
 $E_o = 4600$ kPa.
 $E_R = 12100$ kPa.
 $P_L^* = 320$ kPa.



TEST NO. 31
HAND AUGERING OFF TRACK CENTER LINE.
 $E_o = 37100$ kPa.
 $E_R = 110000$ kPa.
 $P_L^* = 2300$ kPa.



TEST NO. 32
HAND AUGERING, CLAY CUTTINGS, OFF TRACK CENTER LINE.
 $E_o = 16400$ kPa.
 $E_R = 45200$ kPa.
 $P_L^* = 850$ kPa.



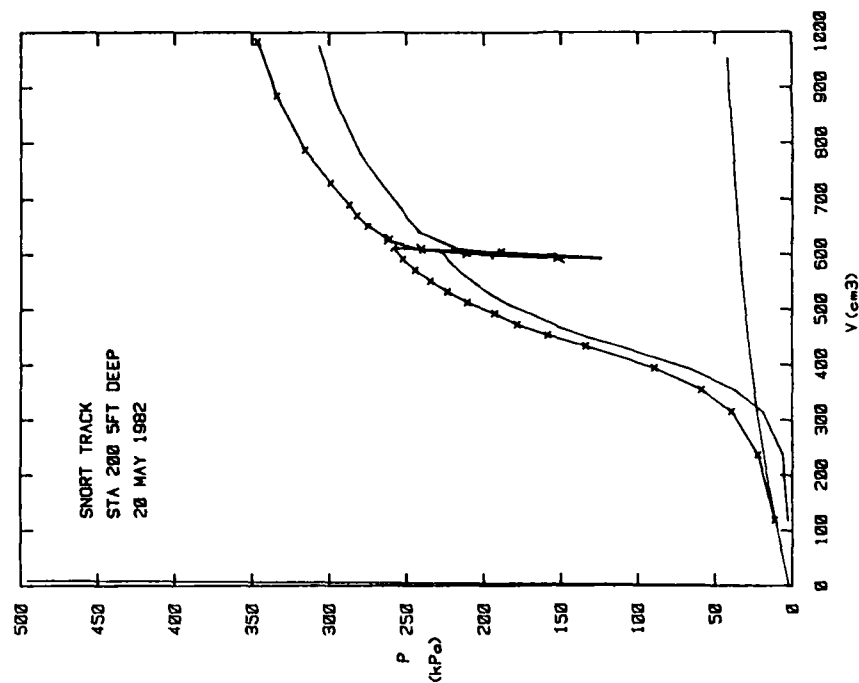
TEST NO. 33

HAND AUGERING ON TRACK CENTER LINE.

$E_o = 4700$ kPa.

$E_R = 32500$ kPa.

$P_L^* = 330$ kPa.



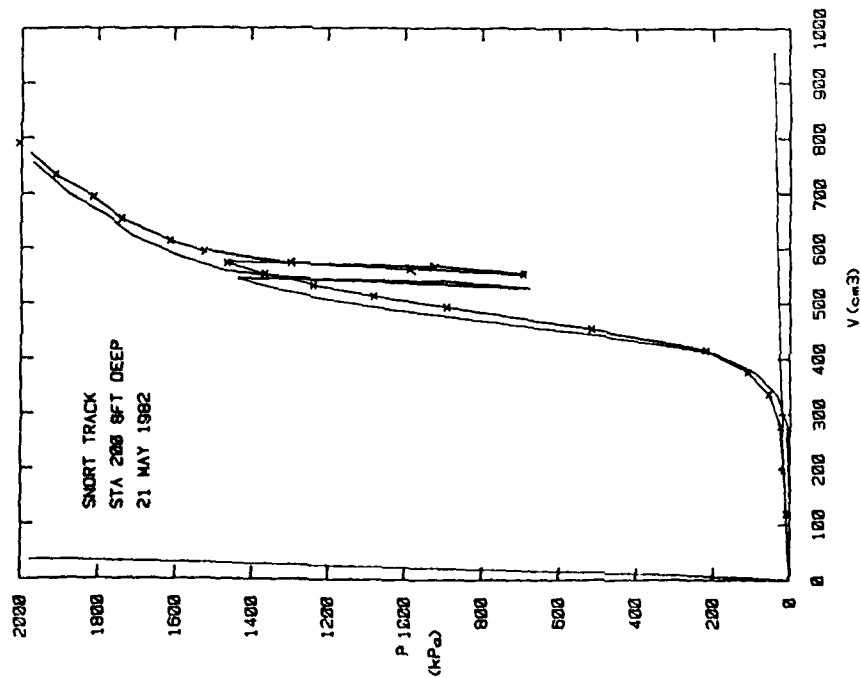
TEST NO. 34

HAND AUGERING OFF TRACK CENTER LINE.

$E_o = 4800$ kPa.

$E_R = 28600$ kPa.

$P_L^* = 350$ kPa.



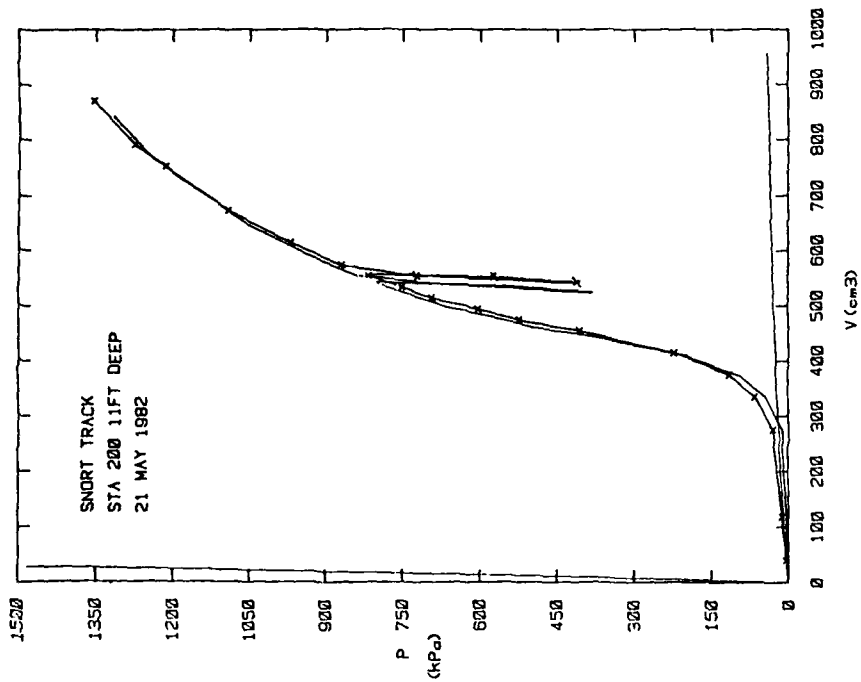
TEST NO. 35

HAND AUGERING OFF TRACK CENTER LINE.

$E_o = 46500$ kPa.

$E_R = 163000$ kPa.

$P_L^* = 2600$ kPa.



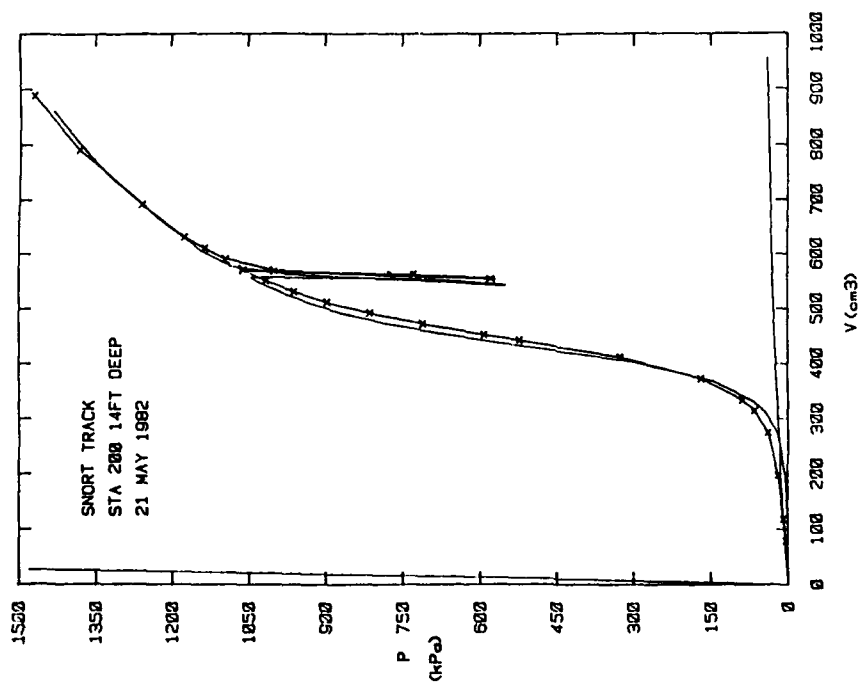
TEST NO. 36

HAND AUGERING OFF TRACK CENTER LINE.

$E_o = 21400$ kPa.

$E_R = 76800$ kPa.

$P_L^* = 1700$ kPa.



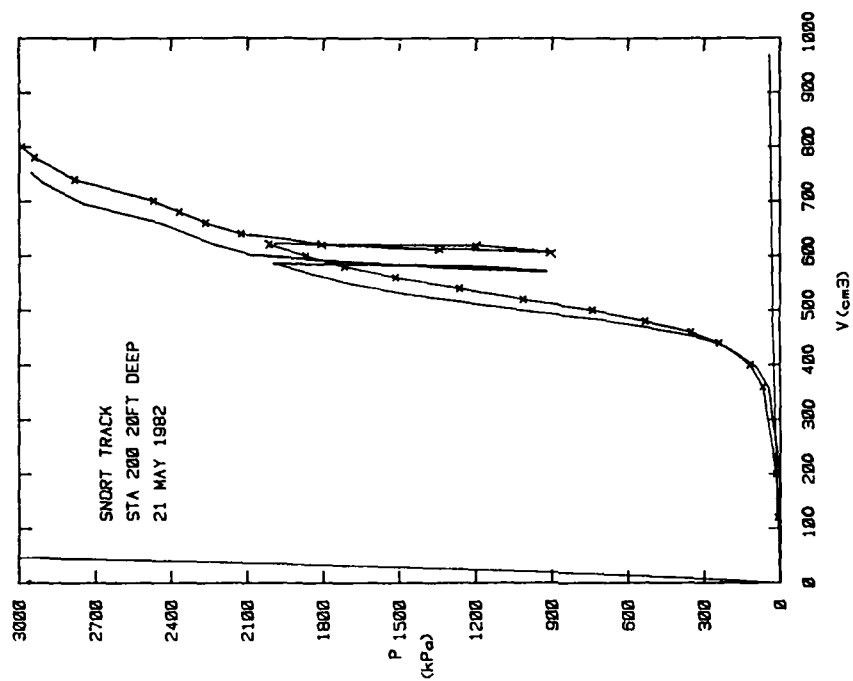
TEST NO. 37

HAND AUGERING OFF TRACK CENTER LINE.

$E_o = 28400$ kPa.

$E_R = 88600$ kPa.

$P_L^* = 1800$ kPa.



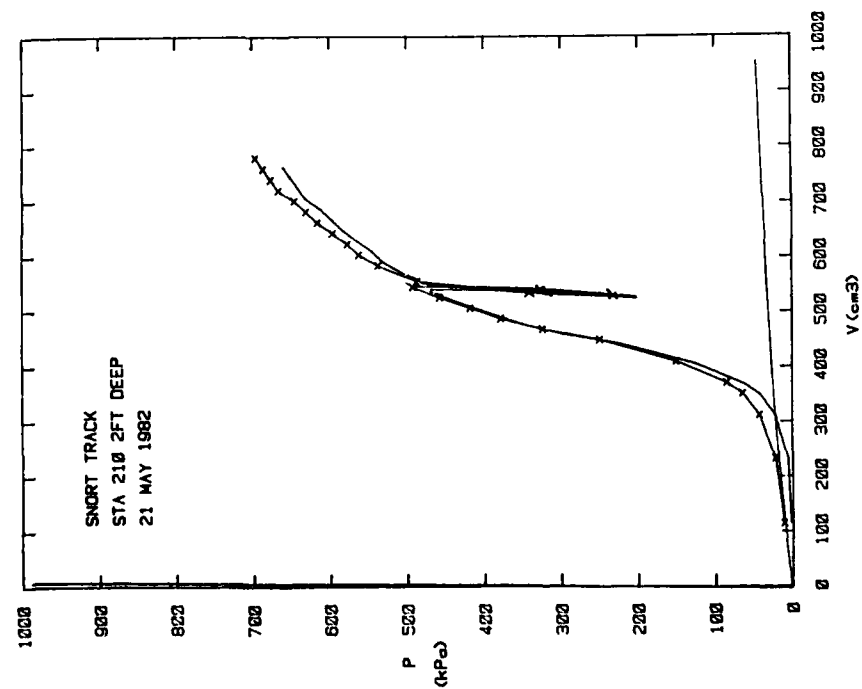
TEST NO. 38

HAND AUGERING OFF TRACK CENTER LINE.

$E_o = 64300$ kPa.

$E_R = 194000$ kPa.

$P_L^* = 5500$ kPa.



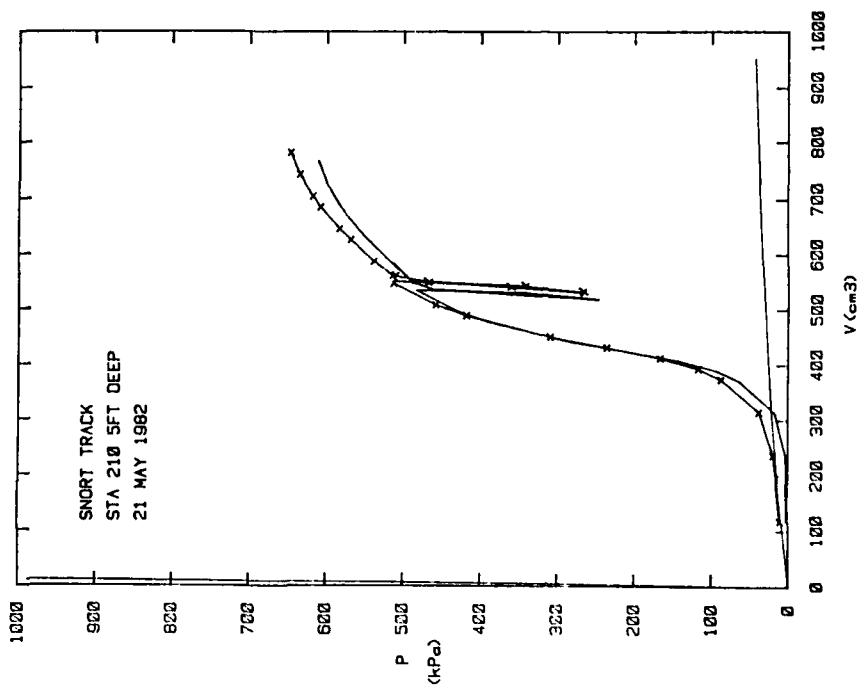
TEST NO. 39

HAND AUGERING ON TRACK CENTER LINE.

$E_o = 13300$ kPa.

$E_R = 51500$ kPa.

$P_L^* = 750$ kPa.



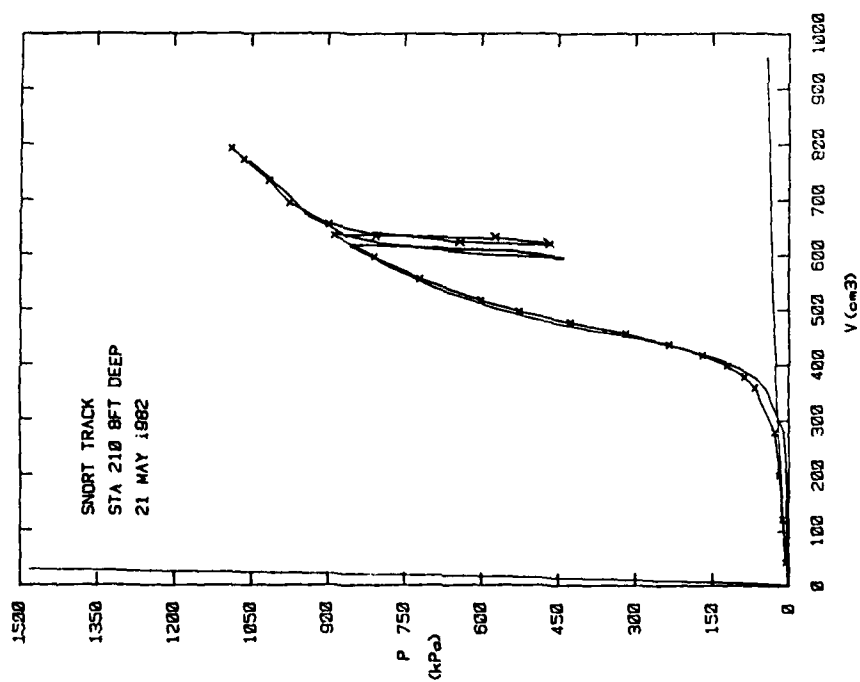
TEST NO. 40

HAND AUGERING ON TRACK CENTER LINE.

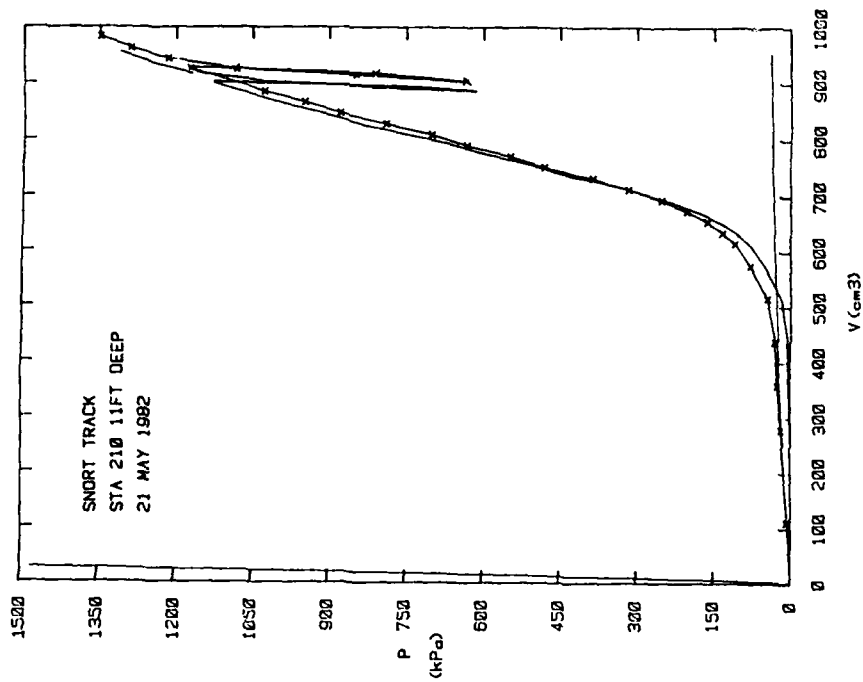
$E_o = 15900$ kPa.

$E_R = 51200$ kPa.

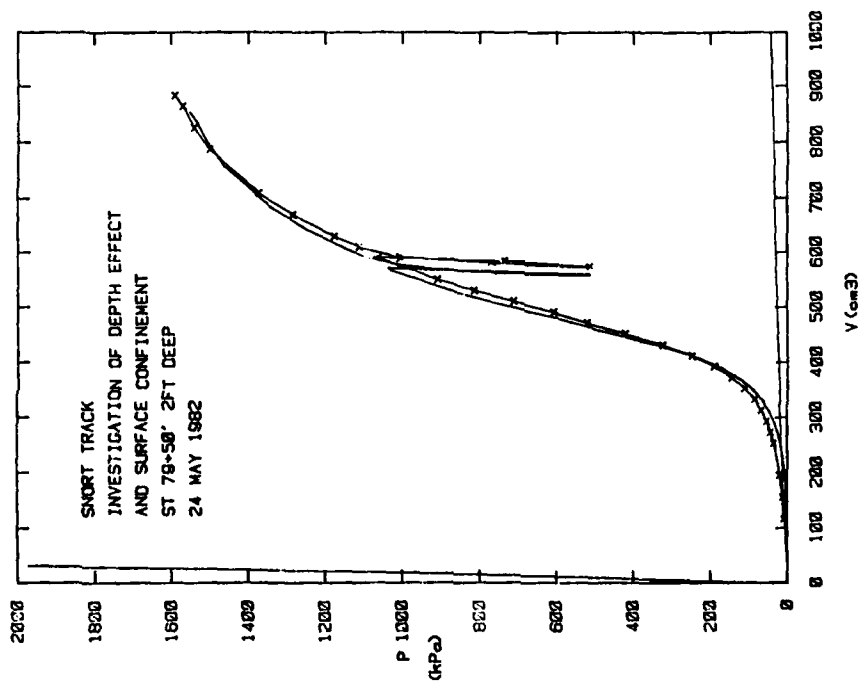
$P_L^* = 670$ kPa.



TEST NO. 41
HAND AUGERING ON TRACK CENTER LINE.
 $E_o = 23800$ kPa.
 $E_R = 67600$ kPa.
 $P_L^* = 1500$ kPa.

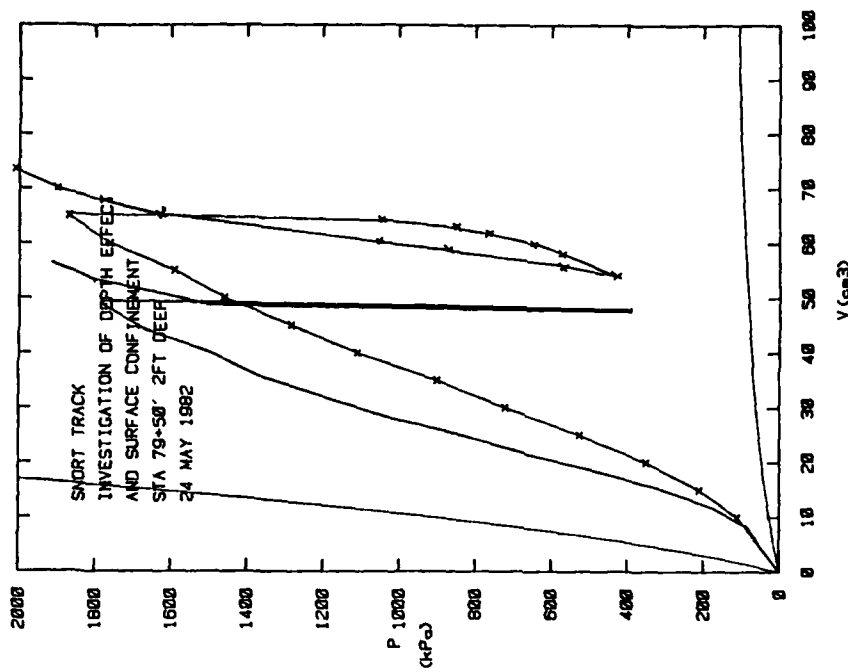


TEST NO. 42
HAND AUGERING, HOLE COLLAPSING, ON TRACK CENTER LINE.
 $E_o = 21200$ kPa.
 $E_R = 151200$ kPa.
 $P_L^* = 2500$ kPa.



TEST NO. 43 HAND AUGERING OFF TRACK

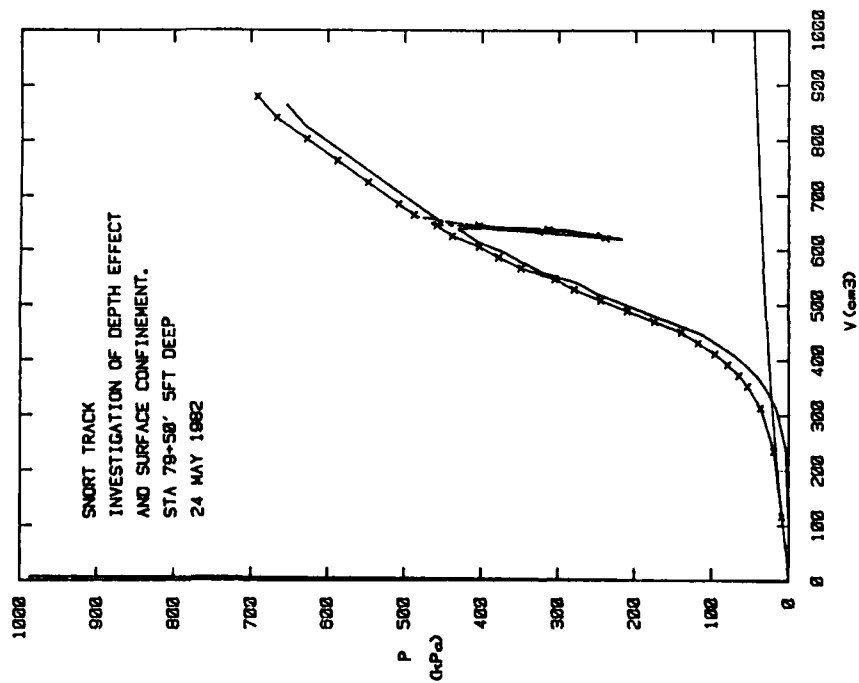
$E_0 = 22600$ kPa.
 $E_R = 185000$ kPa.
 $P_L^* = 1750$ kPa.



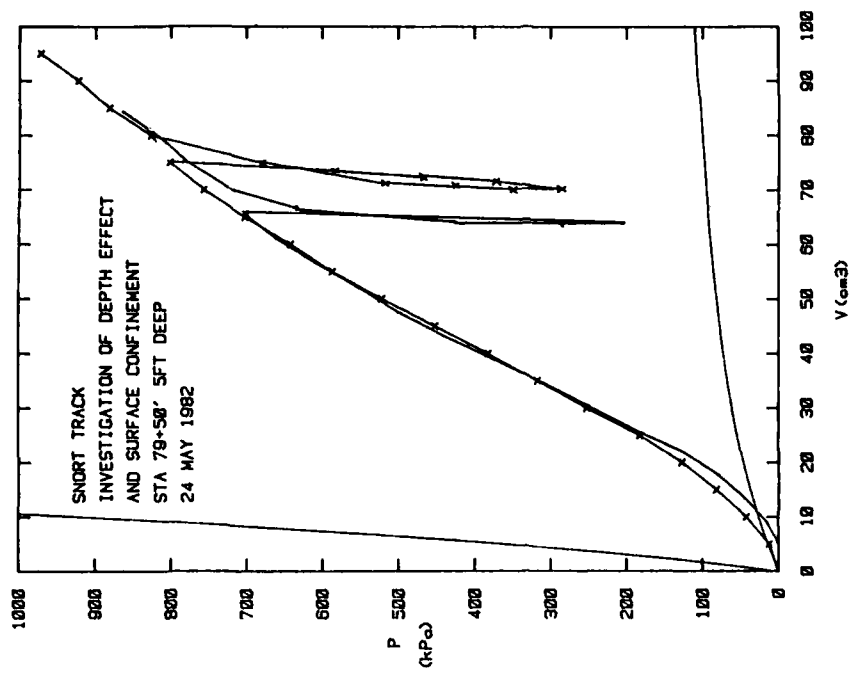
TEST NO. 44

HAND AUGERING OFF TRACK - 32 mm. PROBE.

$E_0 = 33800$ kPa.
 $E_R = 442000$ kPa.
 $P_L^* = 2600$ kPa.



TEST NO. 45
HAND AUGERING OFF TRACK
 $E_o = 8200$ kPa.
 $E_R = 170000$ kPa.
 $P_L^* = 1300$ kPa.



TEST NO. 46
HAND AUGERING OFF TRACK - 32 mm. PROBE.
 $E_o = 9700$ kPa.
 $E_R = 157000$ kPa.
 $P_L^* = 1400$ kPa.

APPENDIX B: ANALYSIS OF EXISTING TRACK
UNDER DESIGN LOADS

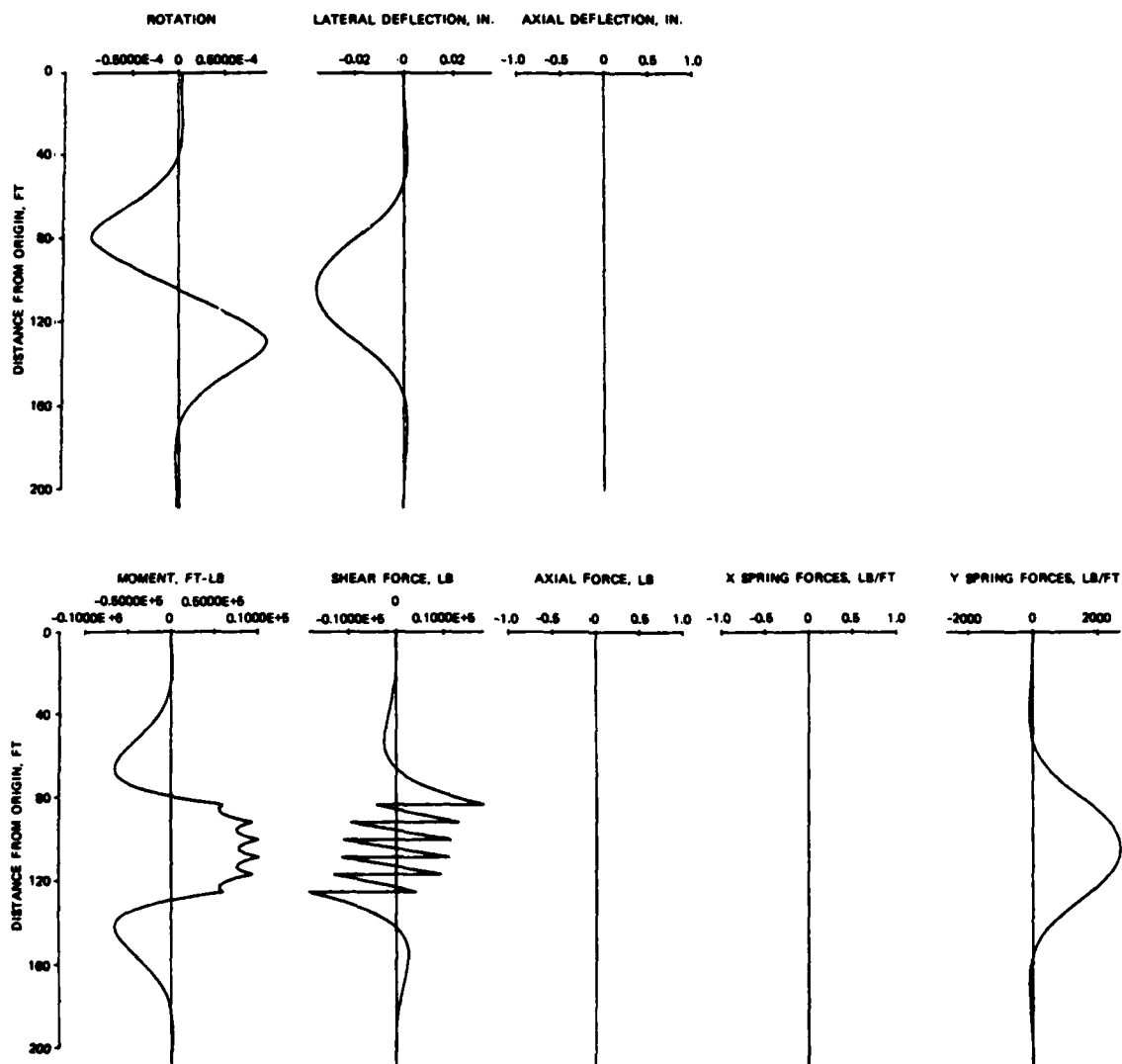


Figure B1. Axial deflection, lateral deflection, and rotation;
 $K = 79.2 \text{ lb/in.}^3$

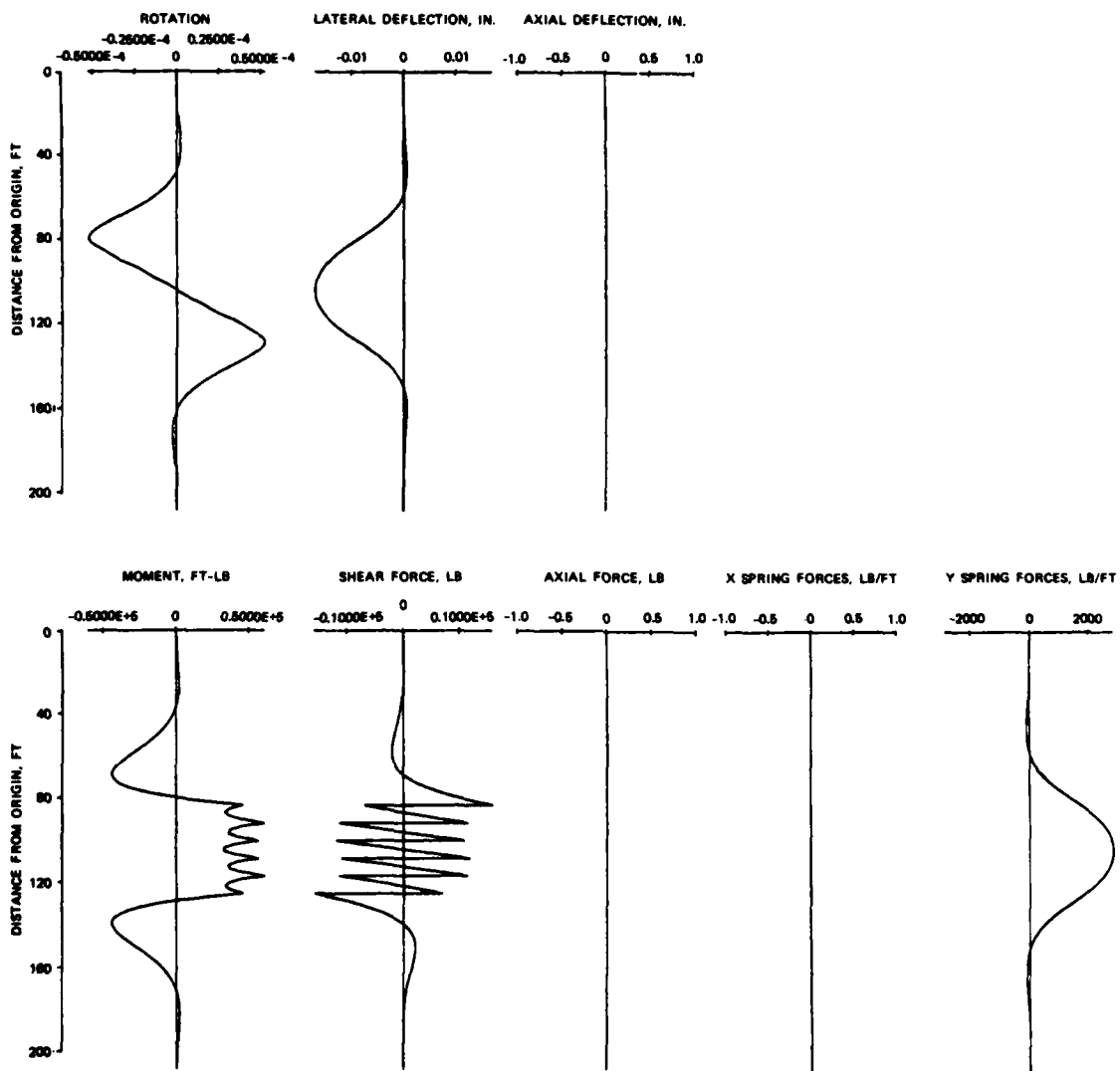


Figure B2. Axial deflection, lateral deflection, and rotation;
 $K = 175 \text{ lb/in.}^3$

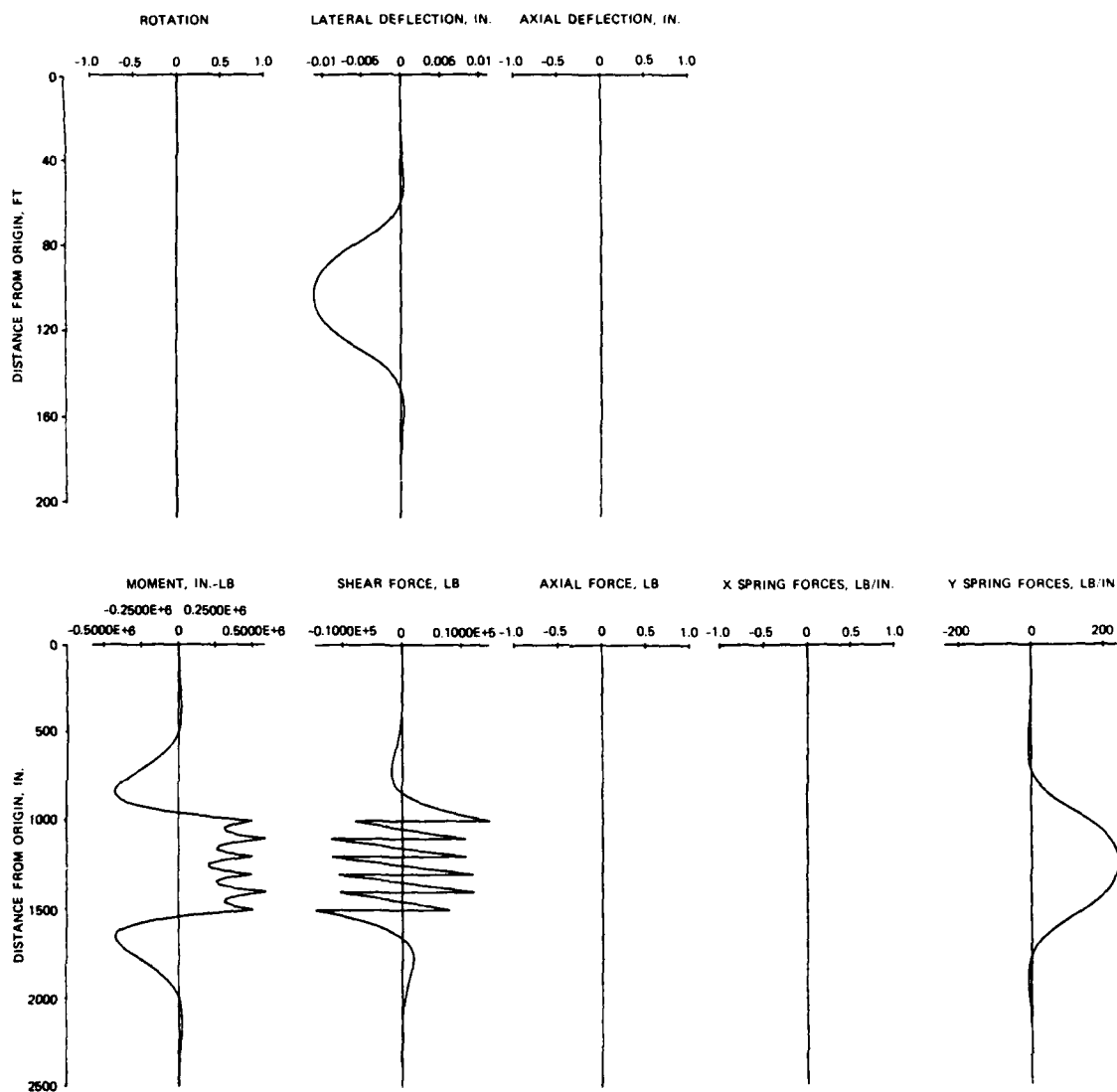


Figure B3. Axial deflection, lateral deflection, and rotation;
 $K = 271.1 \text{ lb/in.}^3$

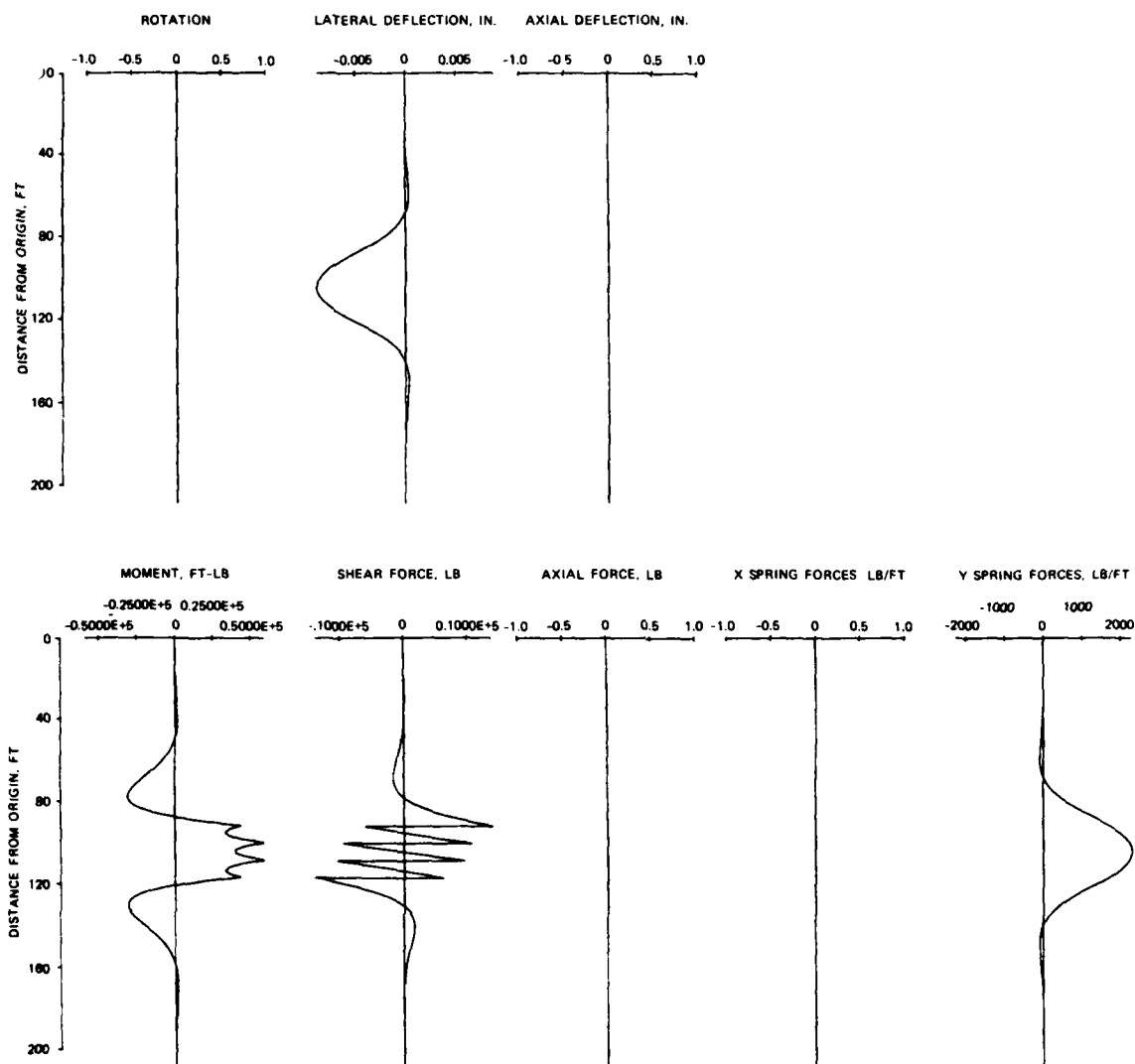


Figure B4. Results for 80,000-lb down load; field load test,
on 4 shoes, 2 on each track; $K = 79.1 \text{ lb/in.}^3$

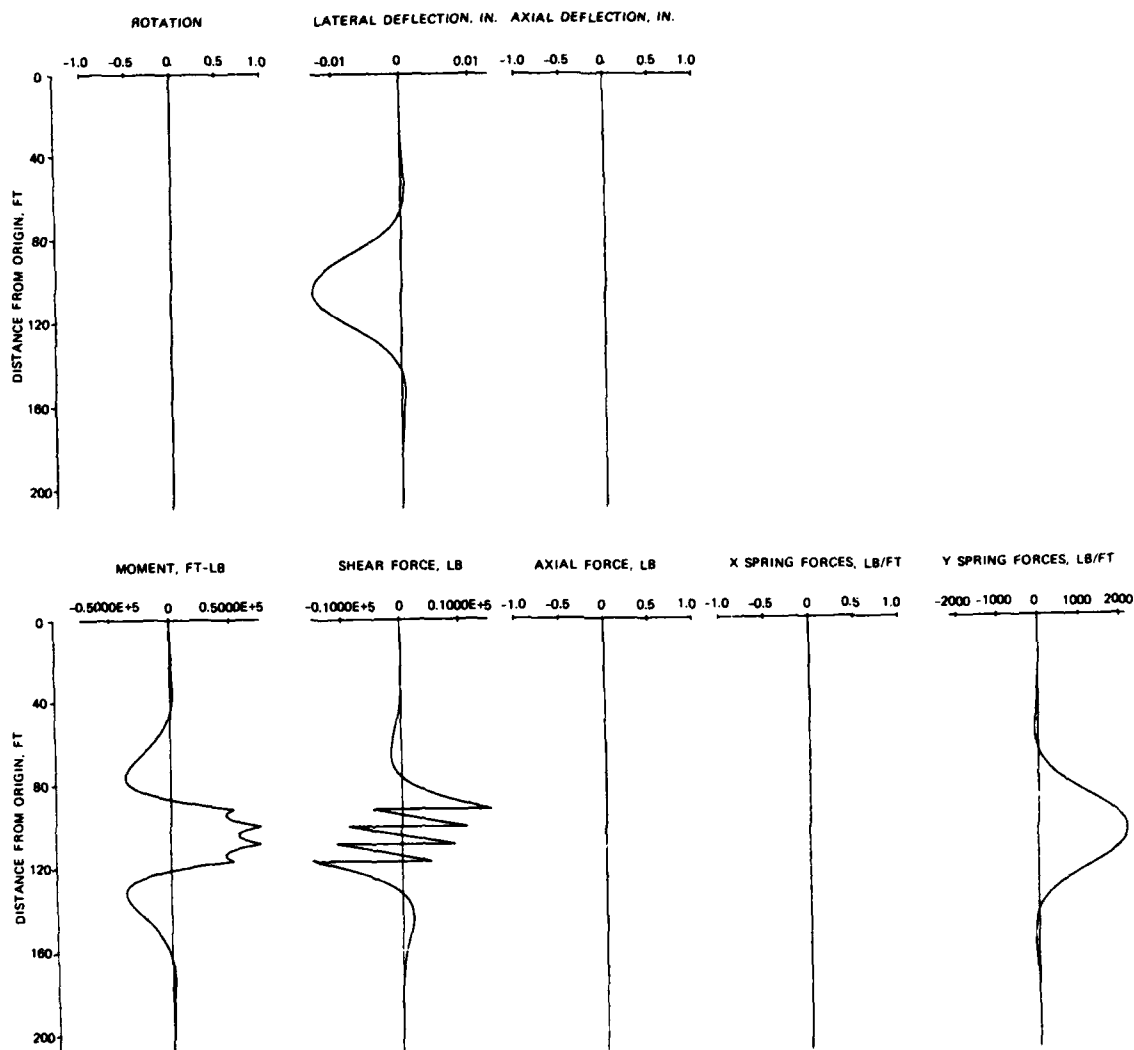


Figure B5. Results for 80,000-lb down load; field load test,
on 4 shoes, 2 on each track; $K = 175 \text{ lb/in.}^3$

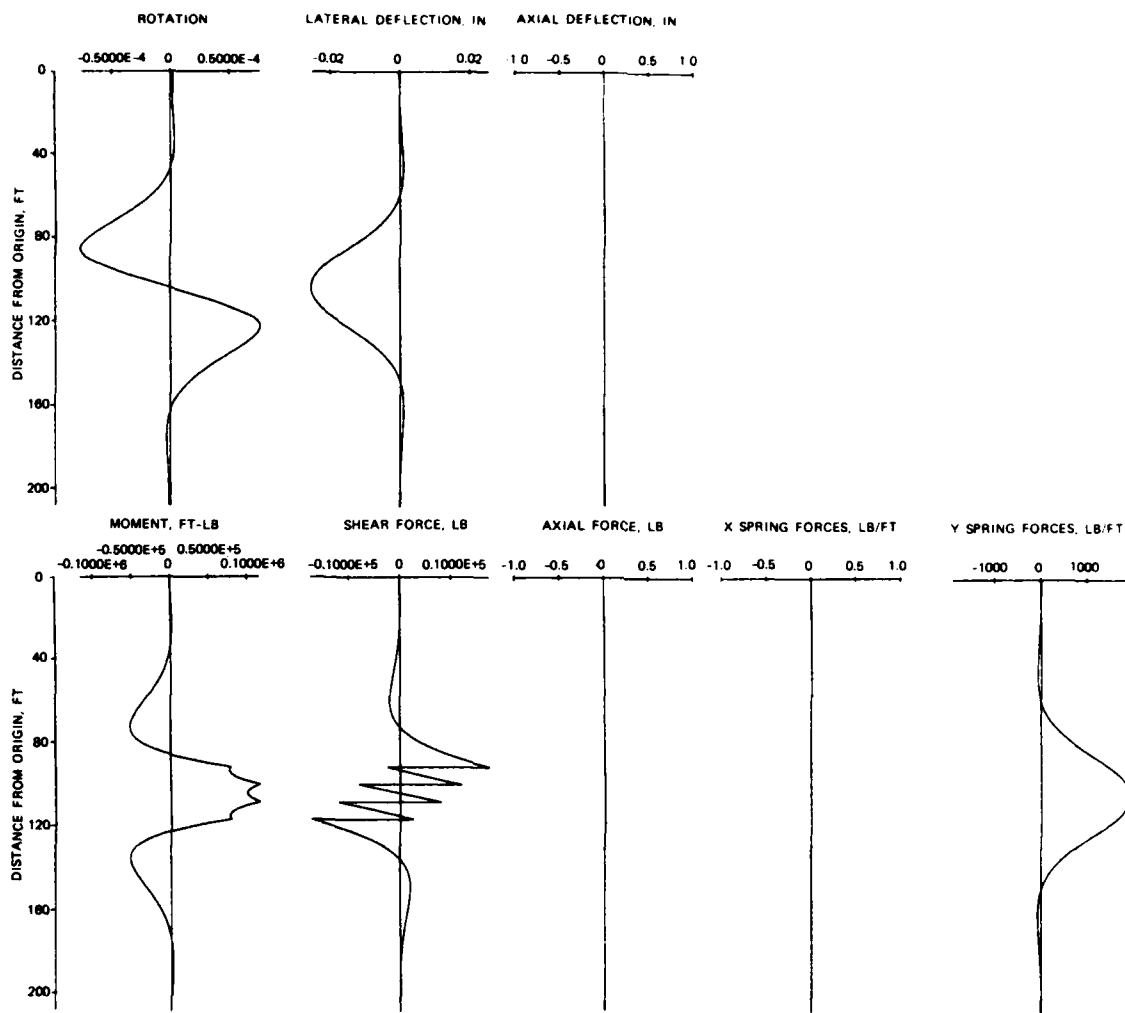


Figure B6. Results for 80,000-lb down load; field load test,
on 4 shoes, 2 on each track; $K = 271.1 \text{ lb/in.}^3$

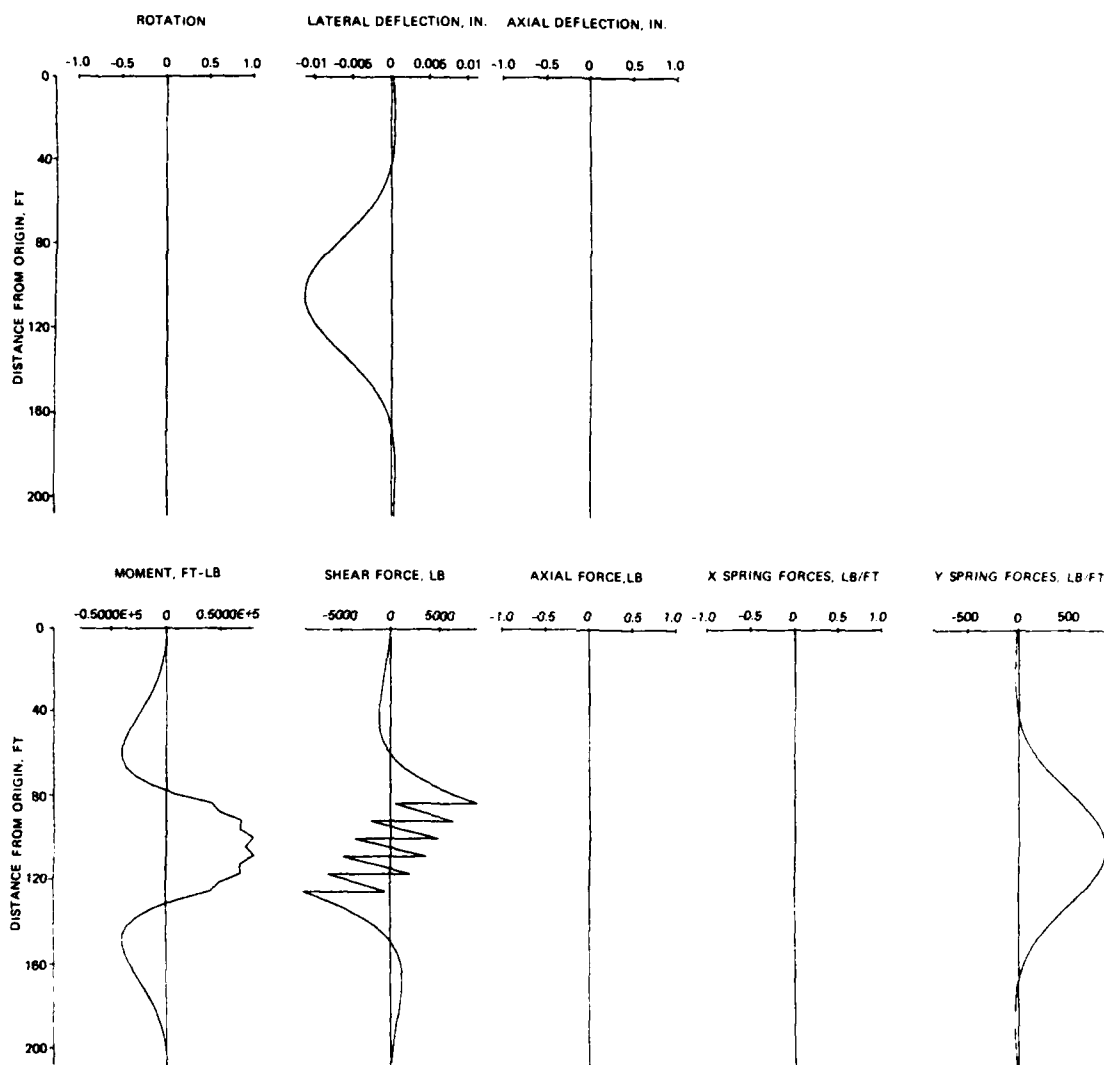


Figure B7. Results for 50,000-lb side load through centroid of track,
on 12 shoes, 6 on each track; $K = 79.1 \text{ lb/in.}^3$

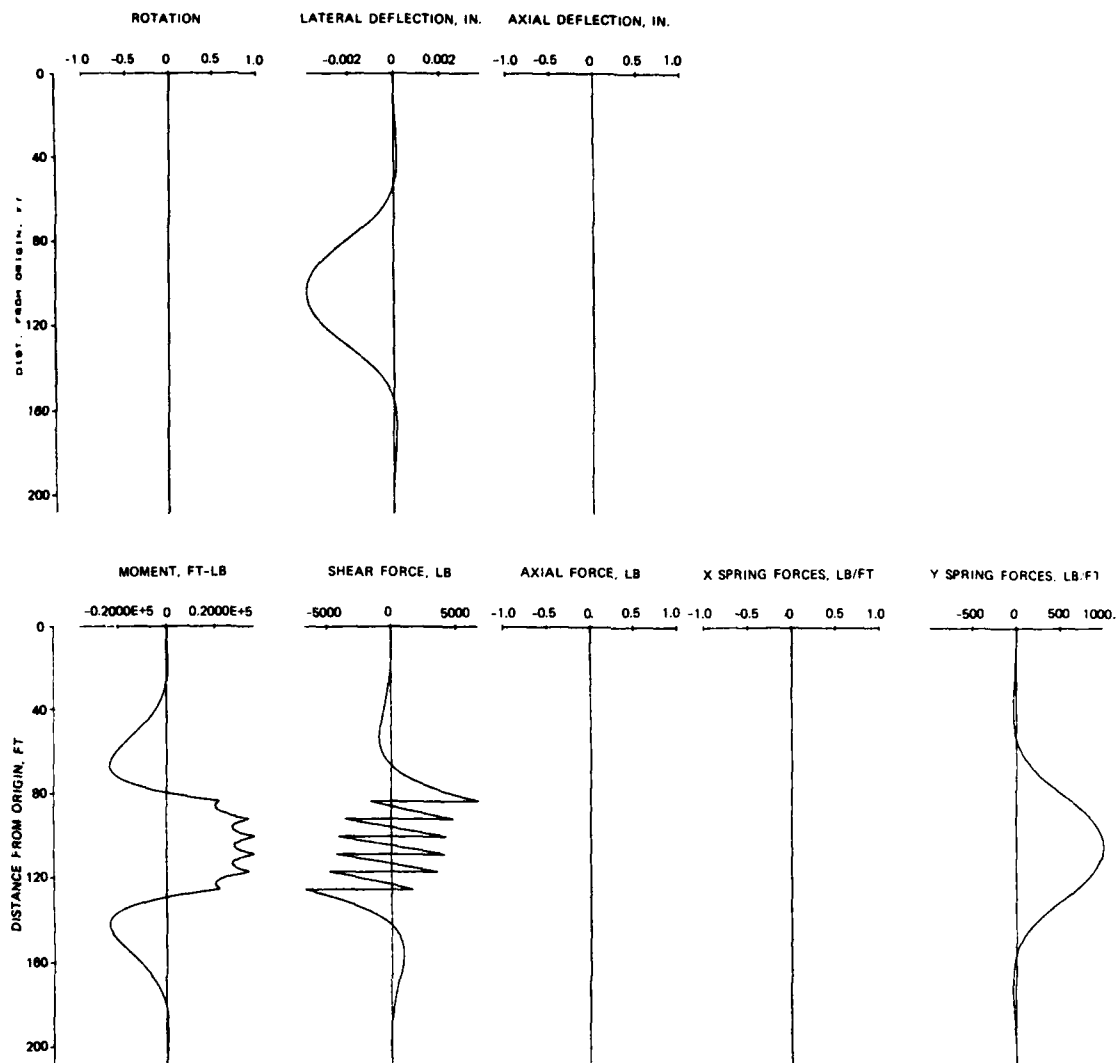


Figure B8. Results for 50,000-lb side load through centroid of track, on 12 shoes, 6 on each track; $K = 175 \text{ lb/in.}^3$

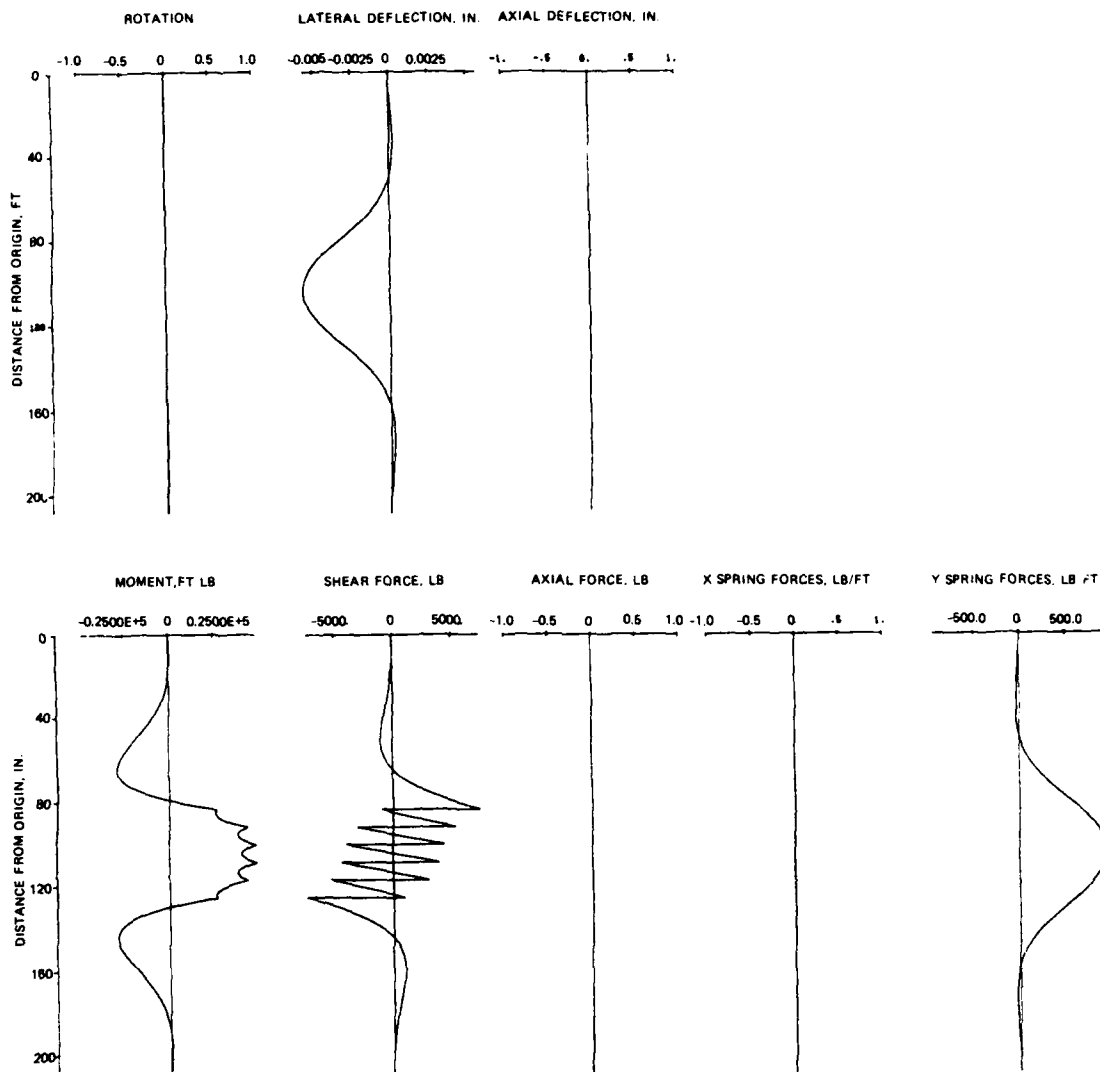


Figure B9. Results for 50,000-lb side load through centroid of track,
on 12 shoes, 6 on each track; $K = 271.1 \text{ lb/in.}^3$

APPENDIX C: STRESS EVALUATION OF PROPOSED
SNORT TEST TRACK

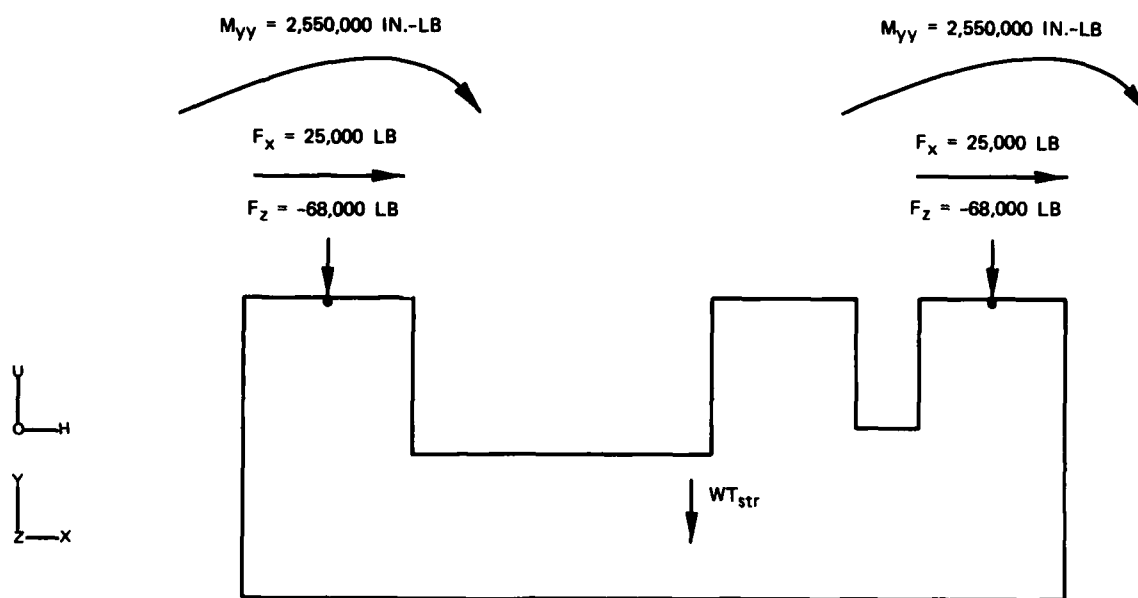


Figure C1. Applied loads, load case 1

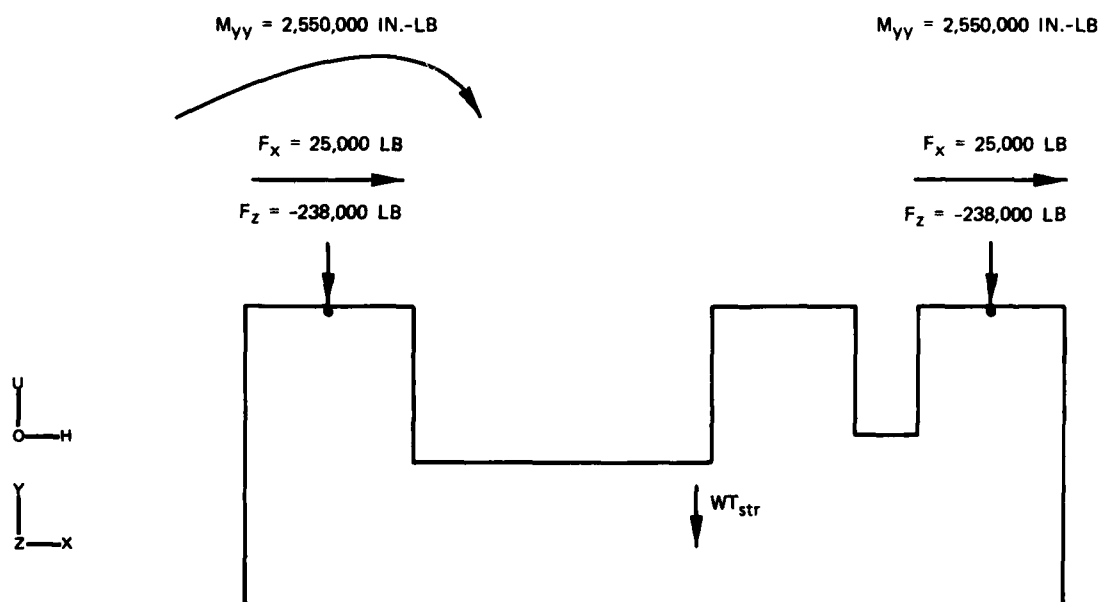


Figure C2. Applied loads, load case 2 (inertia loads for load case 1)

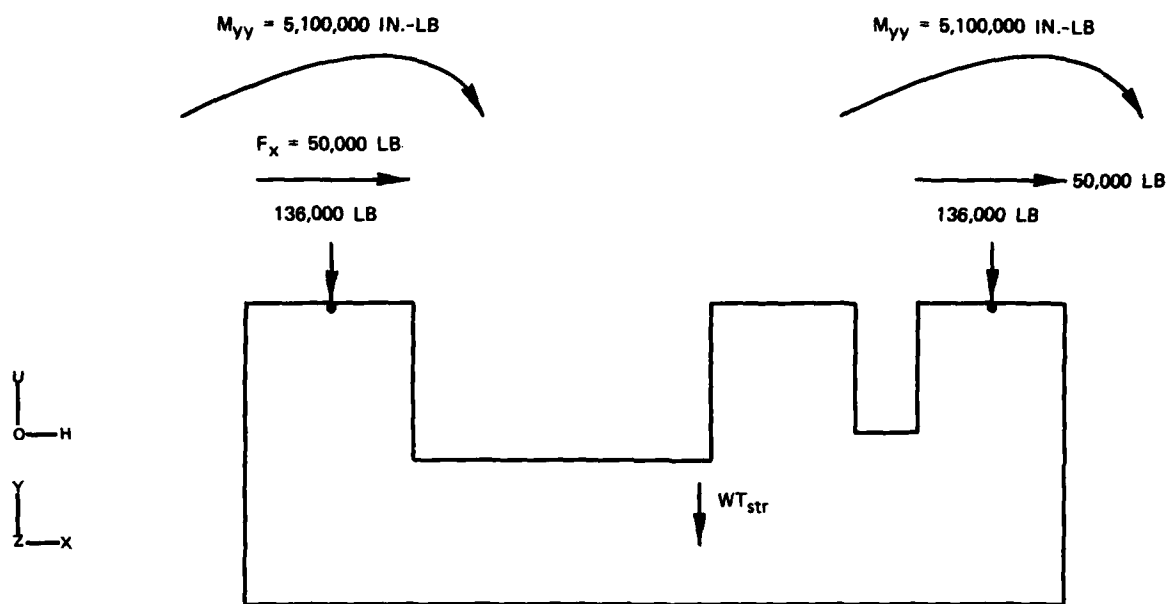


Figure C3. Applied loads, load case 3 (dynamic load factor of 2 applied to load case 1)

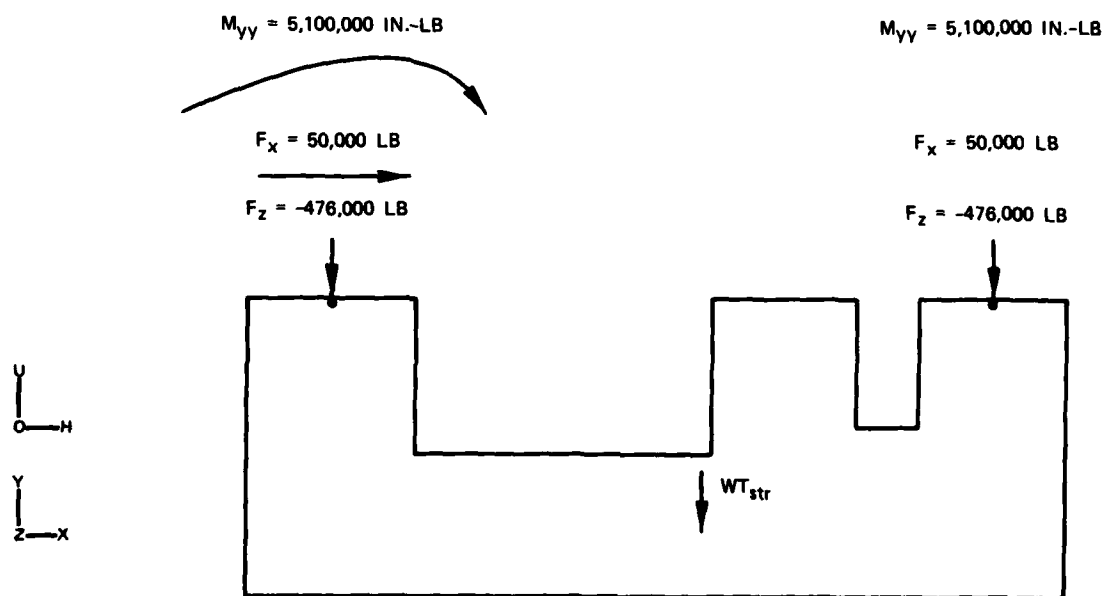


Figure C4. Applied loads, load case 4 (dynamic load factor of 2 applied to load case 2)

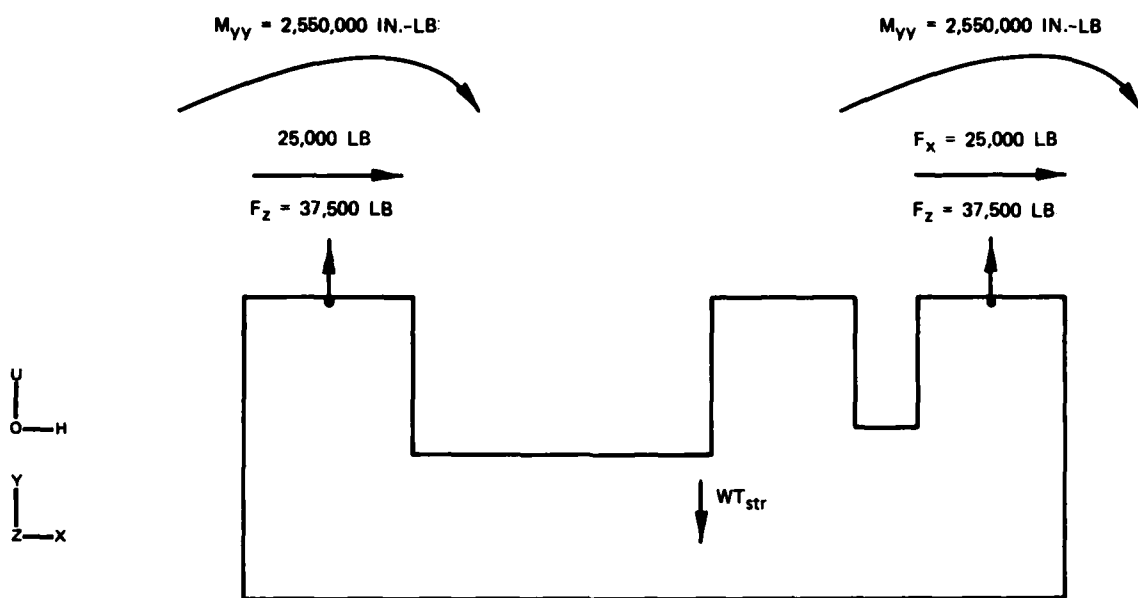


Figure C5. Applied loads, load case 5

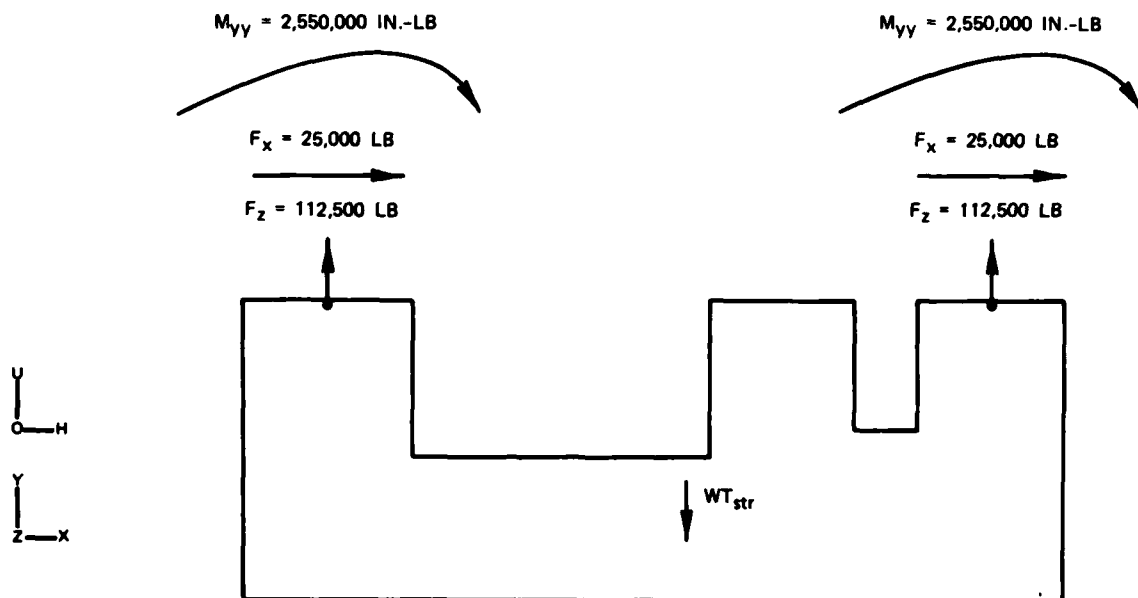


Figure C6. Applied loads, load case 6 (inertia loads for load case 5)

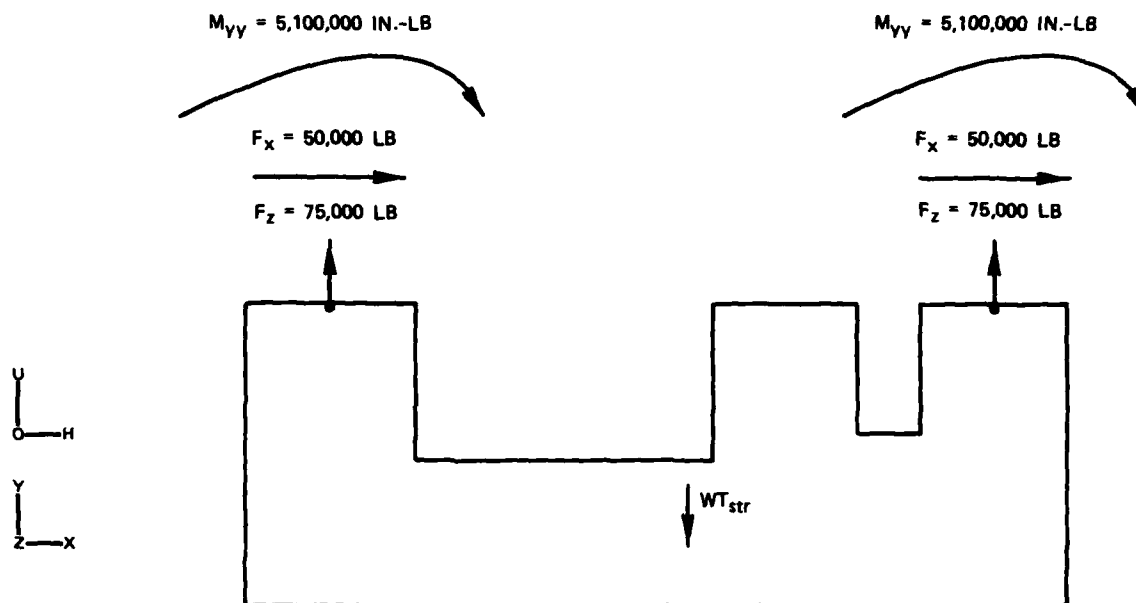


Figure C7. Applied loads, load case 7 (dynamic load factor of 2 applied to load case 5)

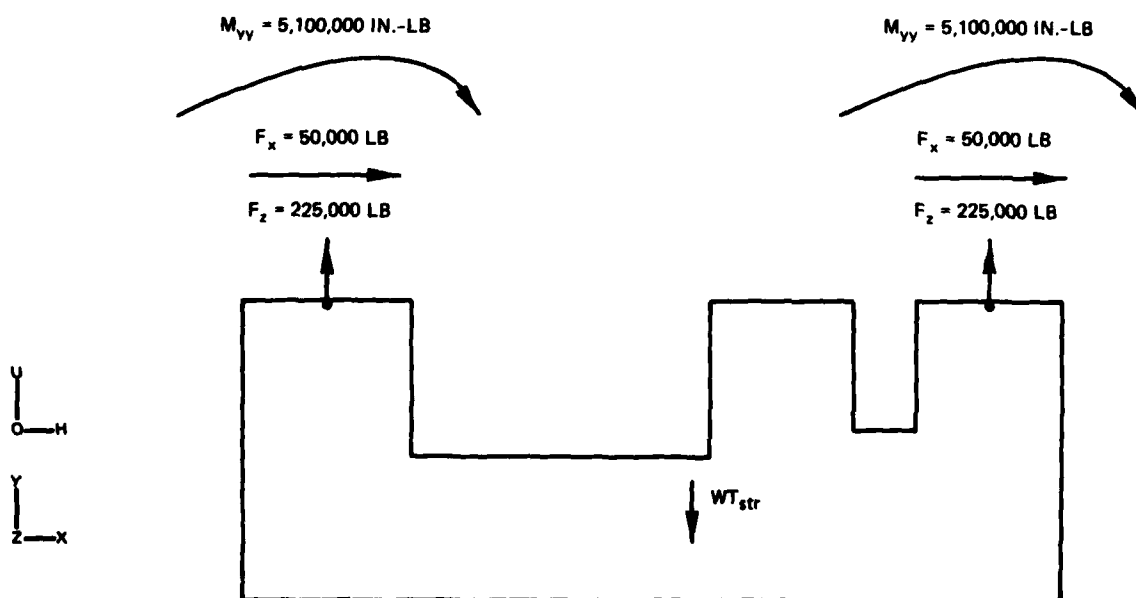


Figure C8. Applied loads, load case 8 (dynamic load factor of 2 applied to load case 6)

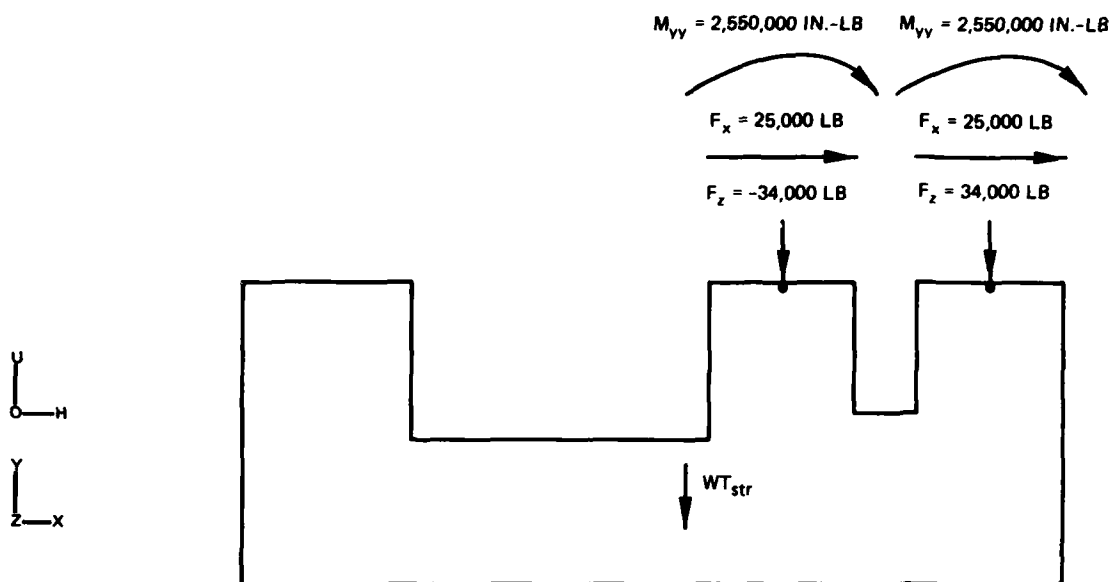


Figure C9. Applied loads, load case 9

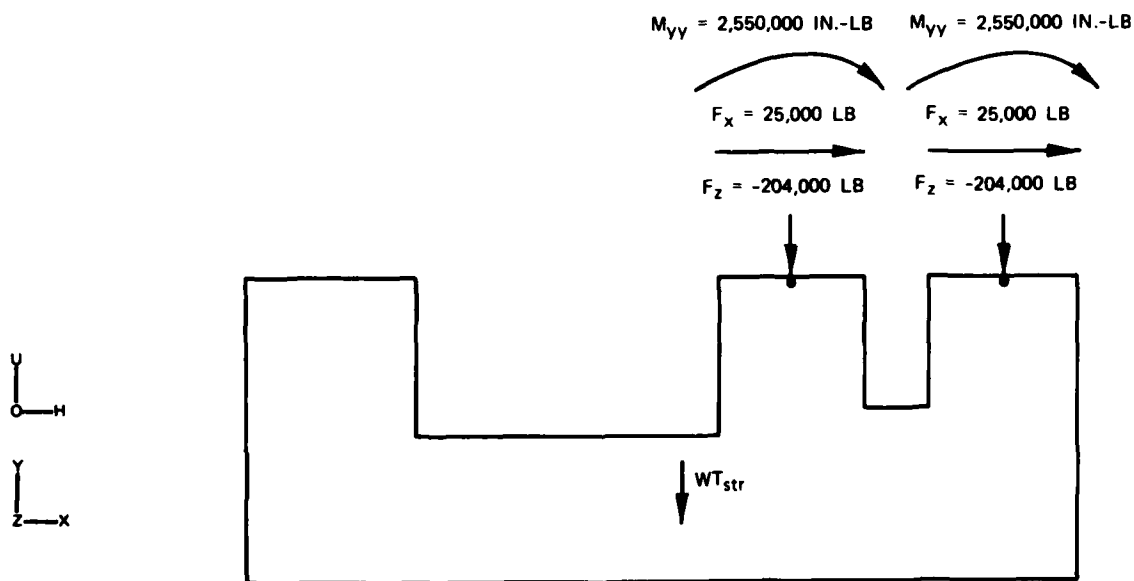


Figure C10. Applied loads, load case 10 (inertia loads for load case 9)

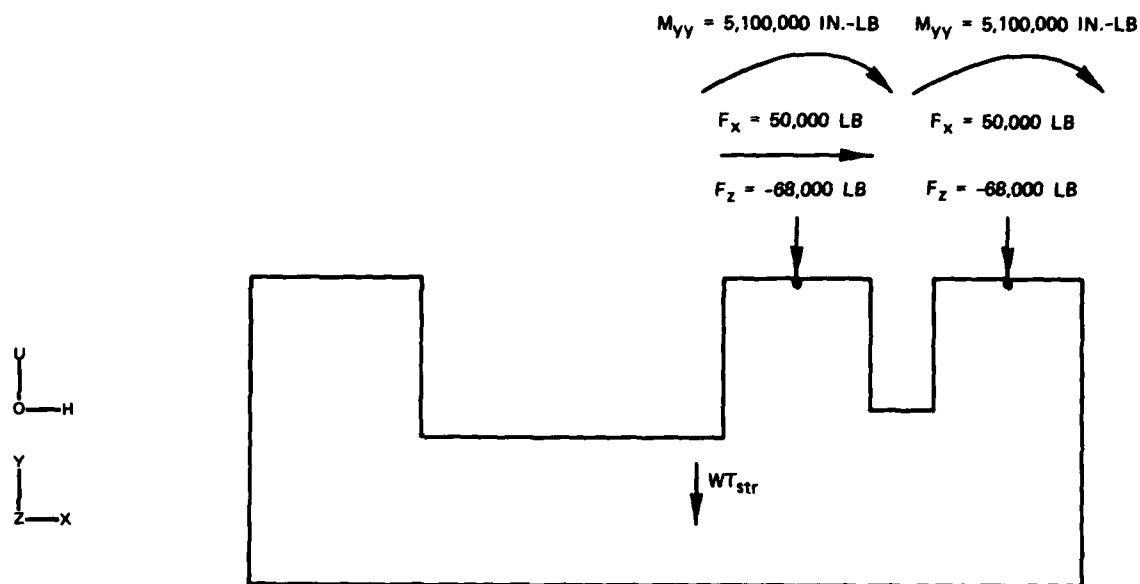


Figure C11. Applied loads, load case 11 (dynamic load factor of 2 applied to load case 9)

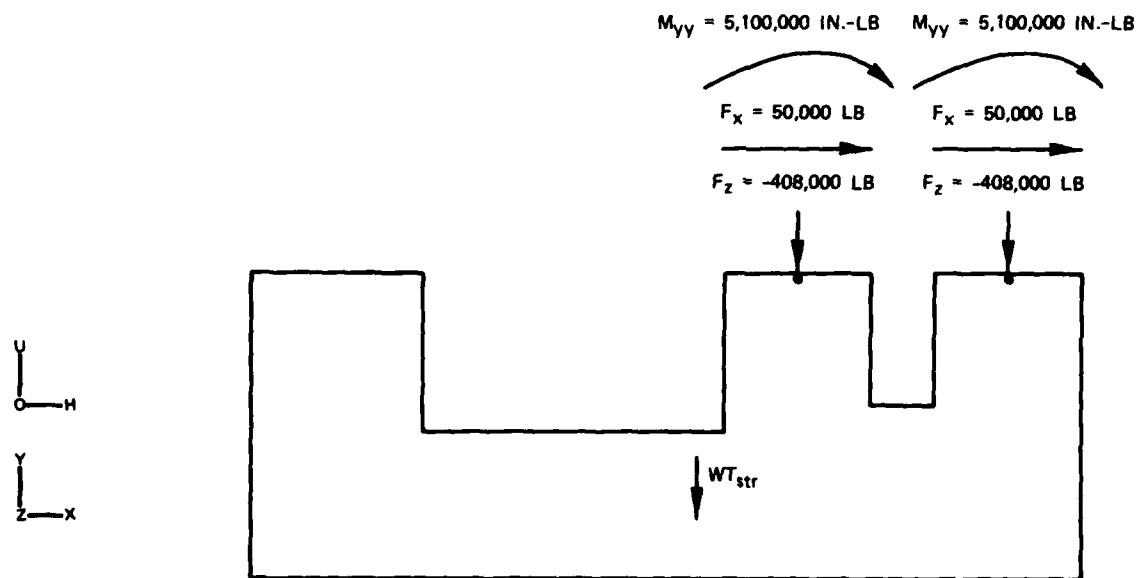


Figure C12. Applied loads, load case 12 (dynamic load factor of 2 applied to load case 1)

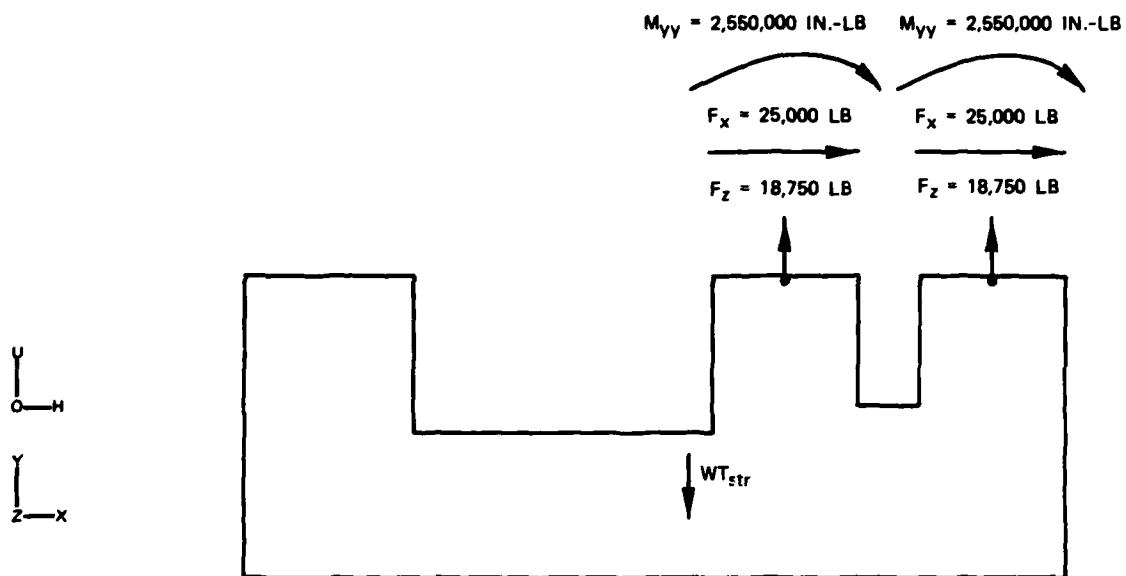


Figure C13. Applied loads, load case 13

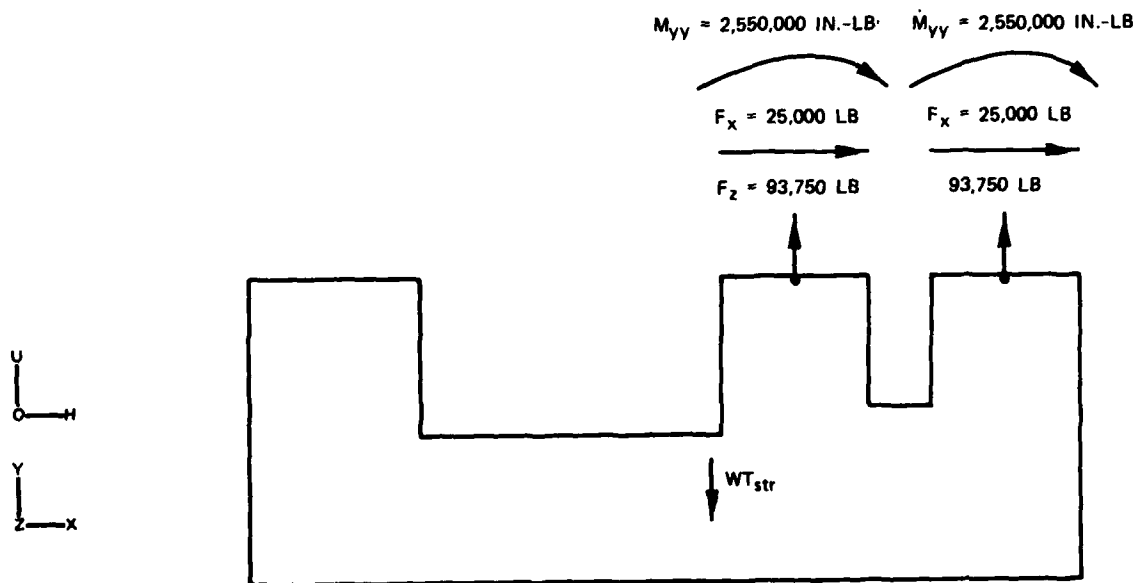


Figure C14. Applied loads, load case 14 (inertia loads for load case 13)

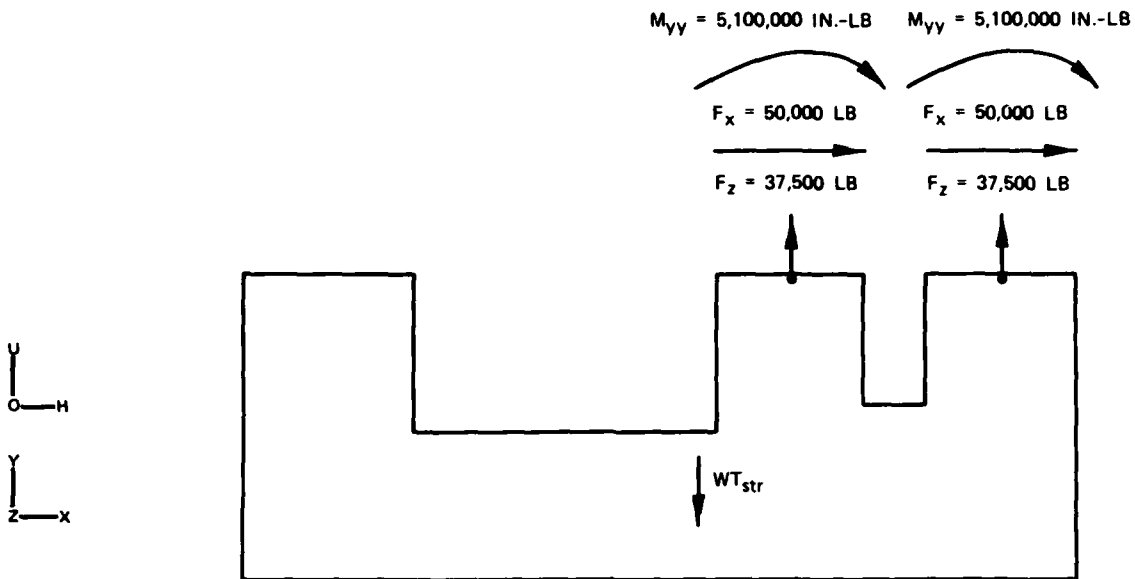


Figure C15. Applied loads, load case 15 (dynamic load factor of 2 applied to load case 13)

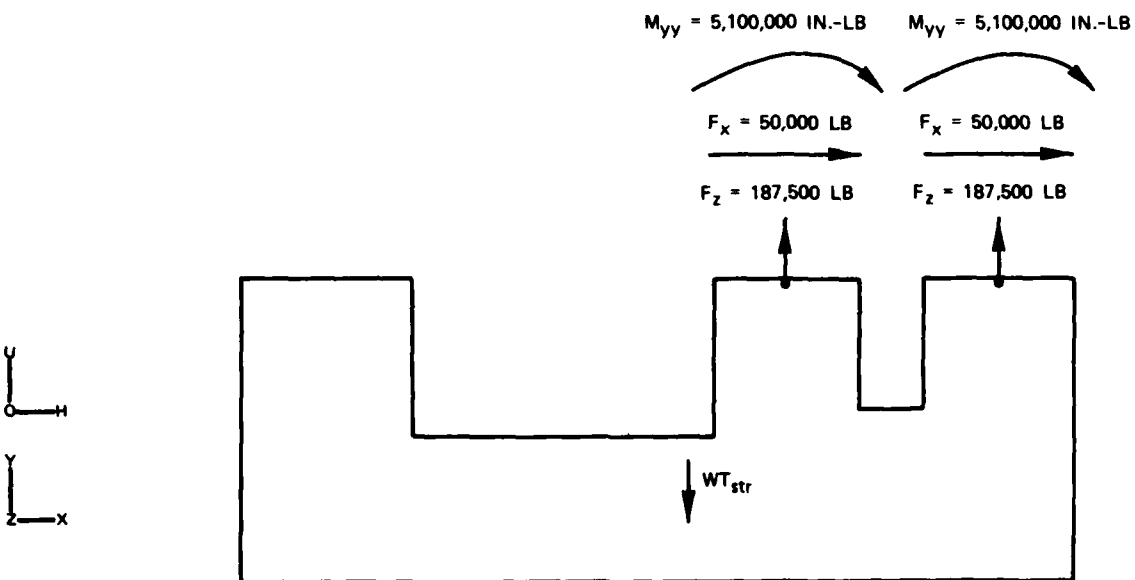


Figure C16. Applied loads, load case 16 (dynamic load factor of 2 applied to load case 14)

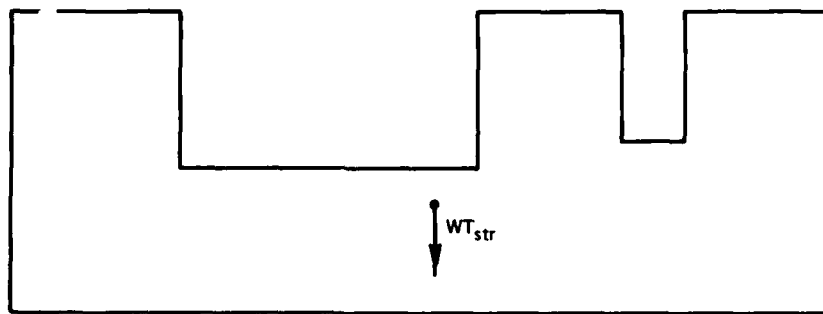
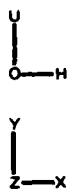


Figure C17. Applied load, load case 17 (weight of structure only)

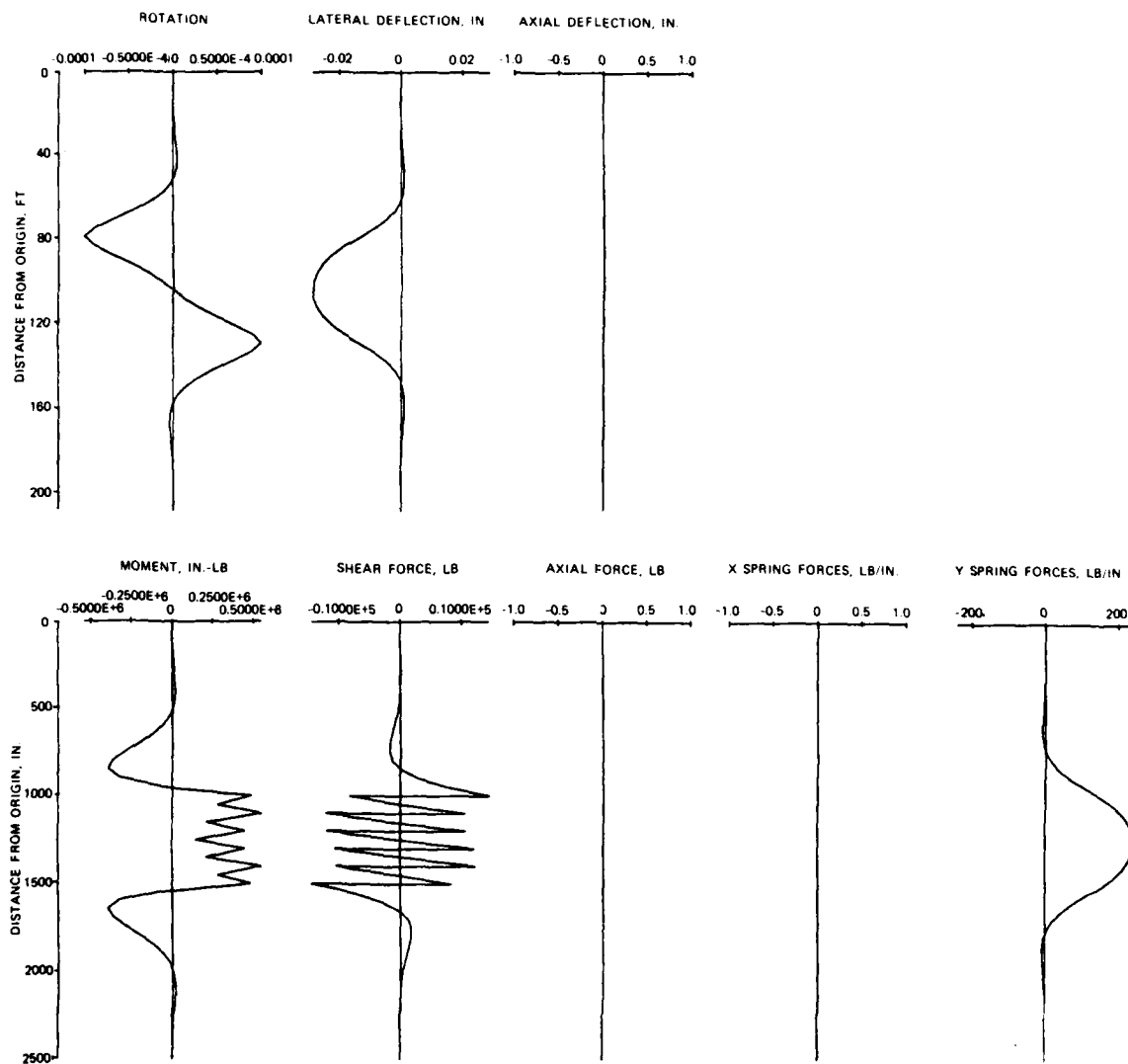


Figure C18. Beam-on-elastic foundation analysis for vertical loading of load case 1 with $K = 79.2 \text{ lb/in.}^3$

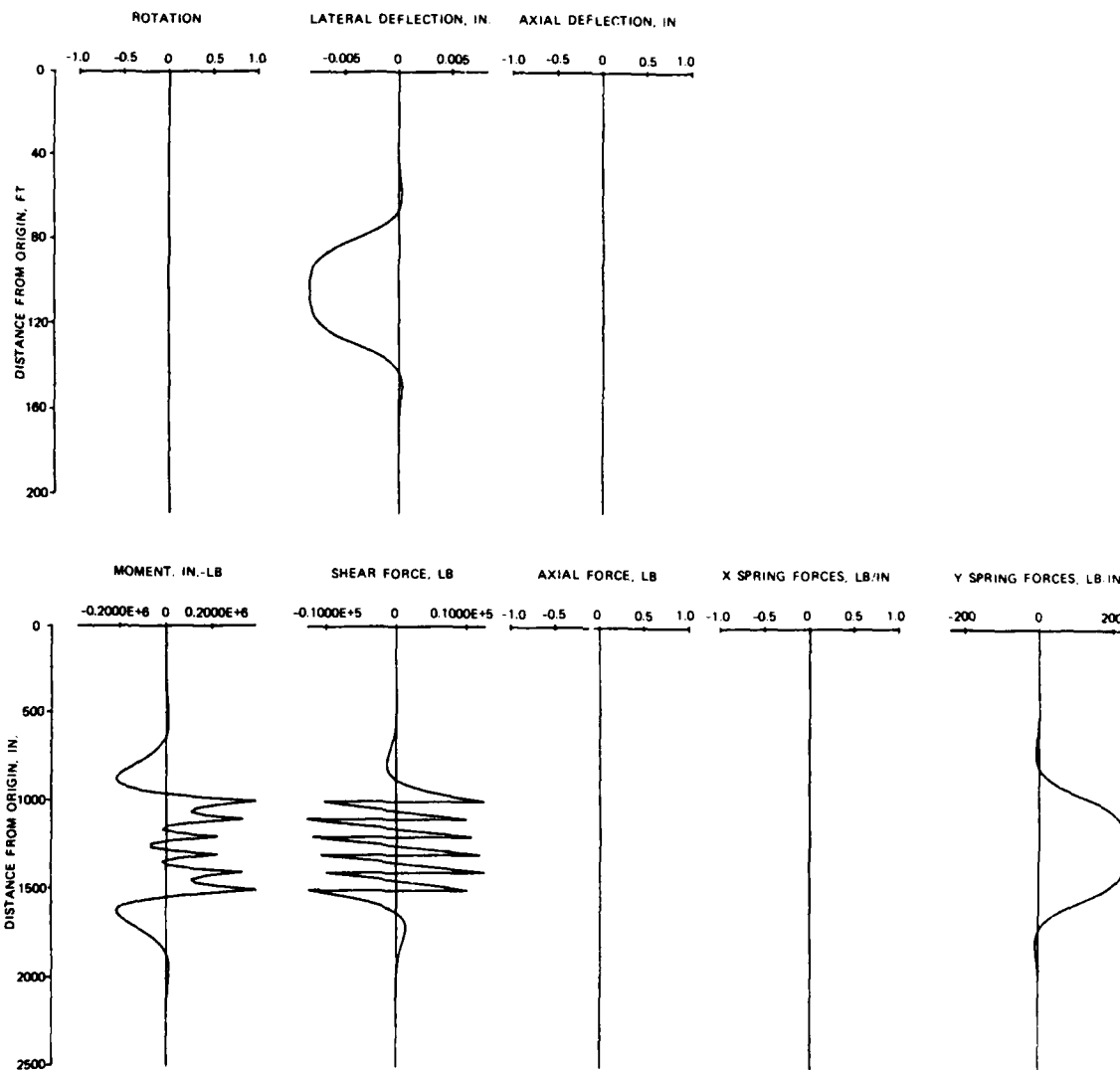


Figure C19. Beam-on-elastic foundation analysis for vertical loading of load case 1 with $K = 271.1 \text{ lb/in.}^3$

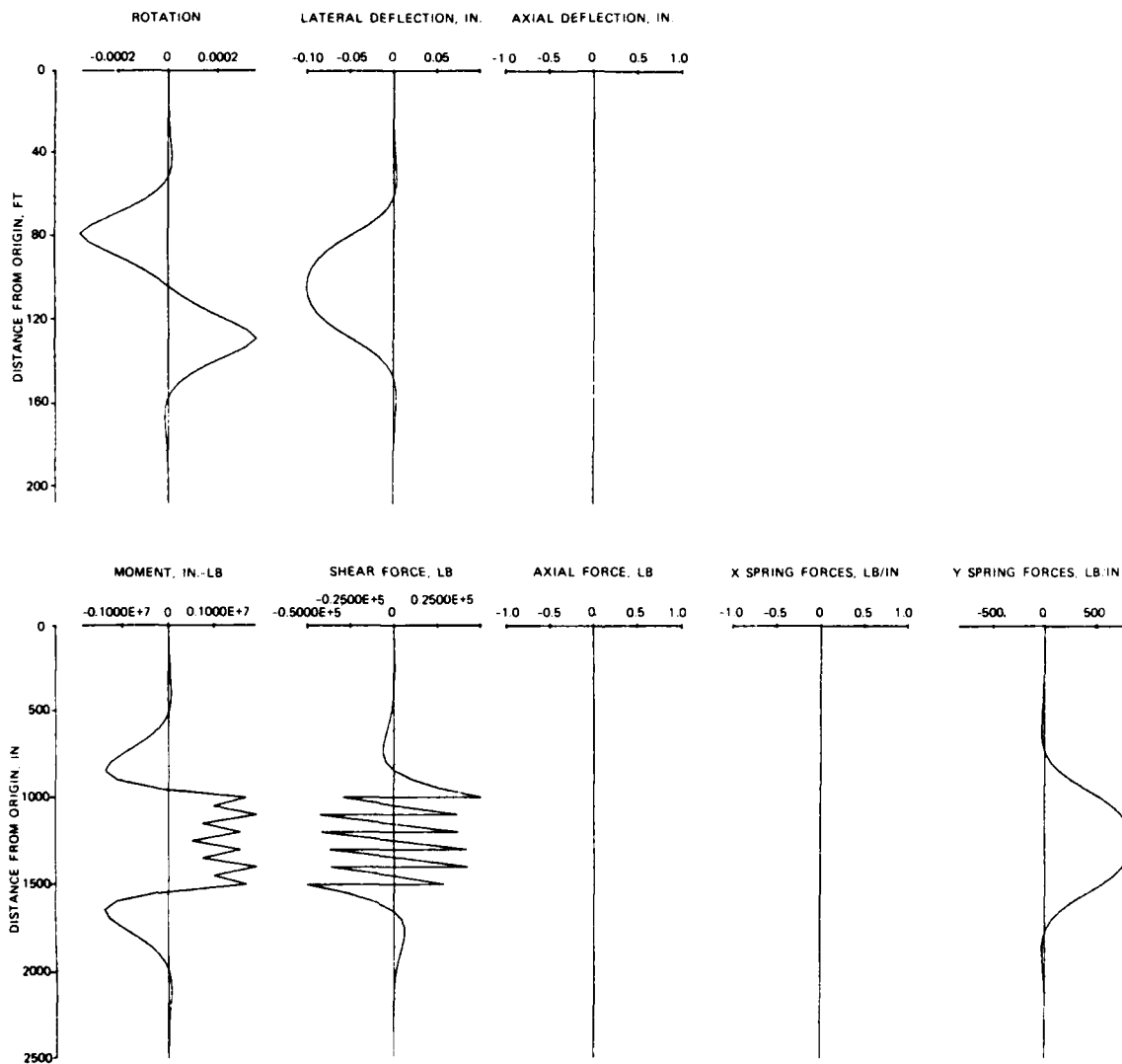


Figure C20. Beam-on-elastic foundation analysis for vertical loading of load case 2 with $K = 79.2 \text{ lb/in.}^3$

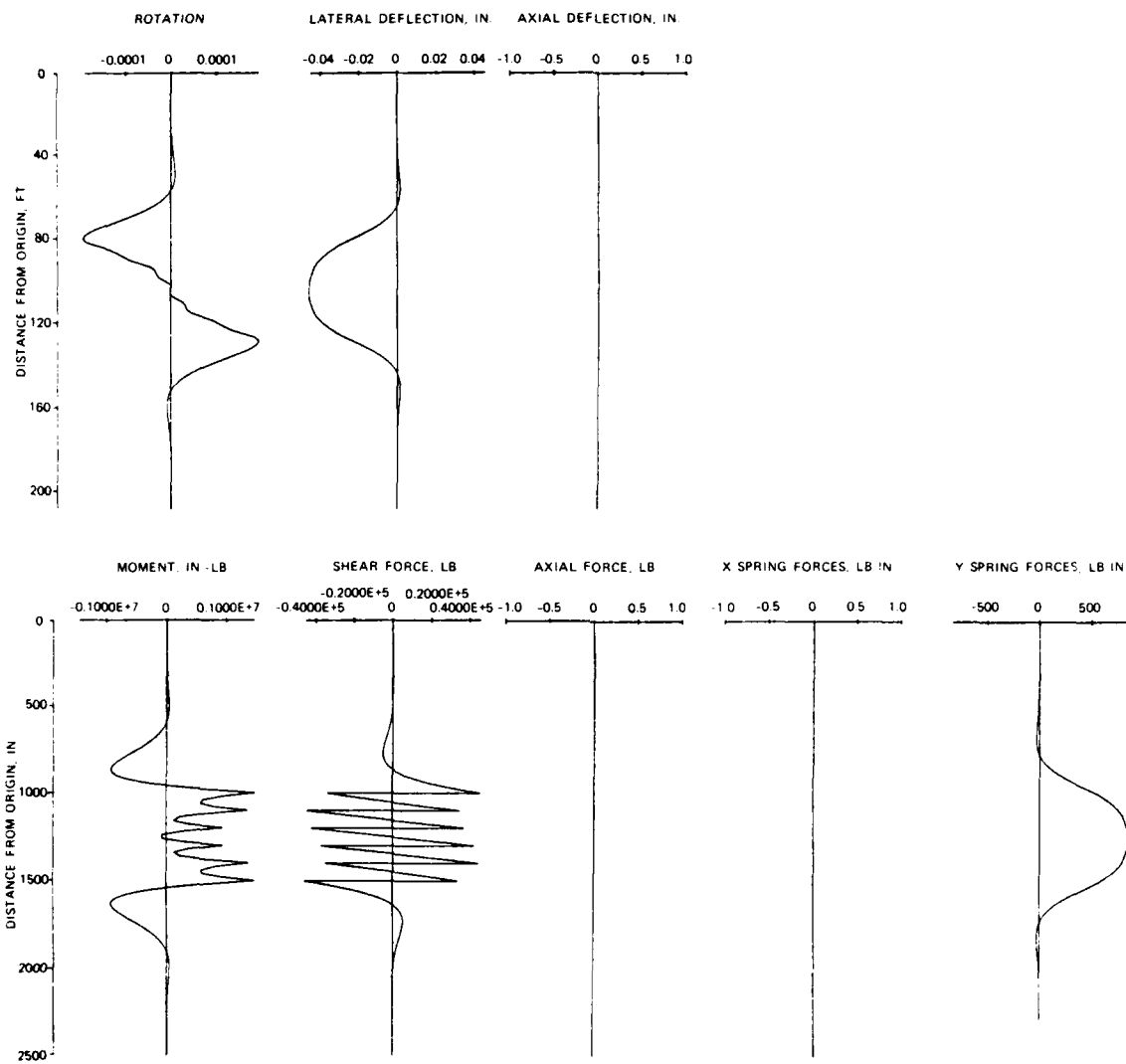


Figure C21. Beam-on-elastic foundation analysis for vertical loading of load case 2 with $K = 175 \text{ lb/in.}^3$

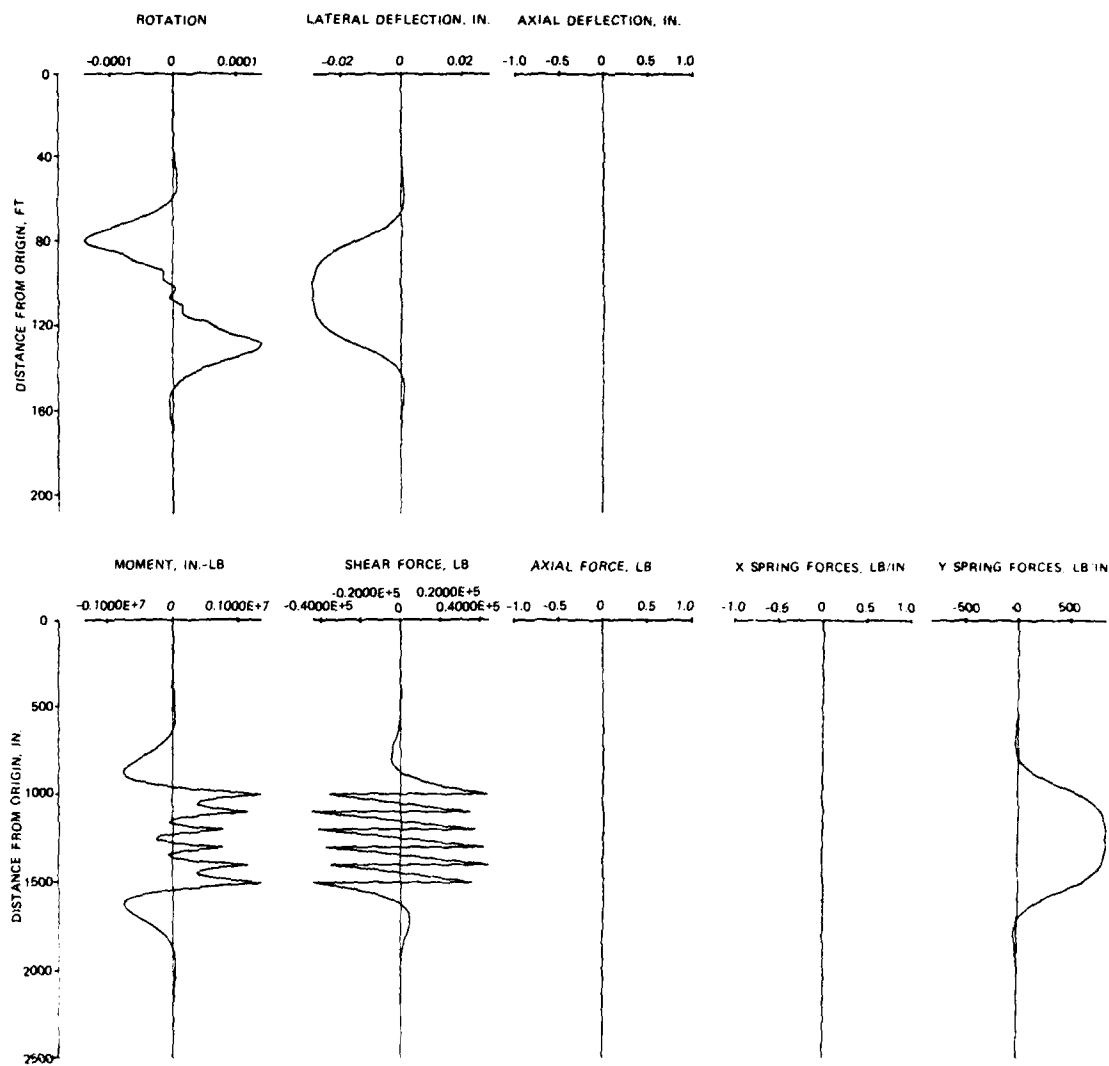


Figure C22. Beam-on-elastic foundation analysis for vertical loading of load case 2 with $K = 271.1 \text{ lb/in.}^3$

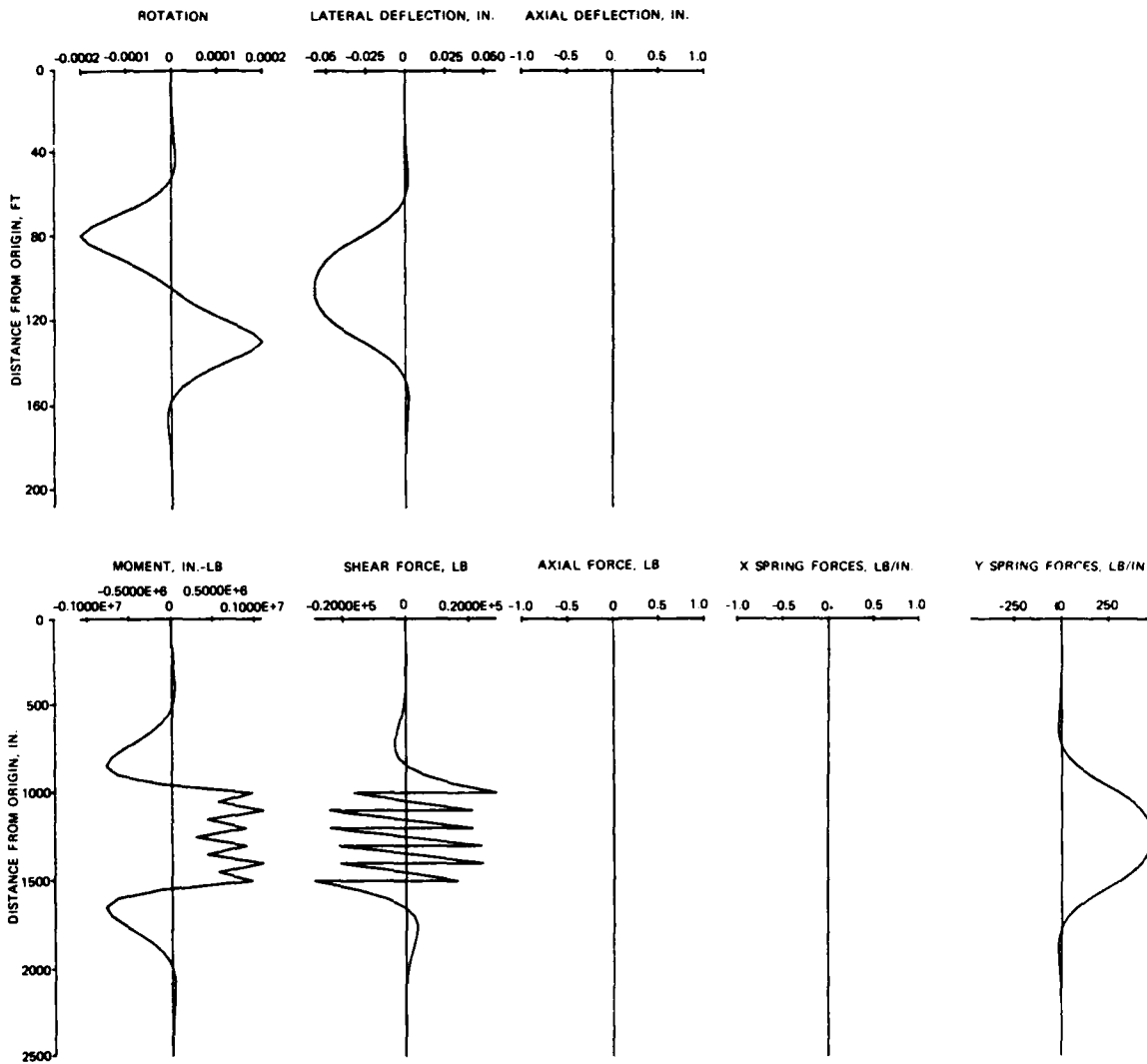


Figure C23. Beam-on-elastic foundation analysis for vertical loading of load case 3 with $K = 79.2 \text{ lb/in.}^3$

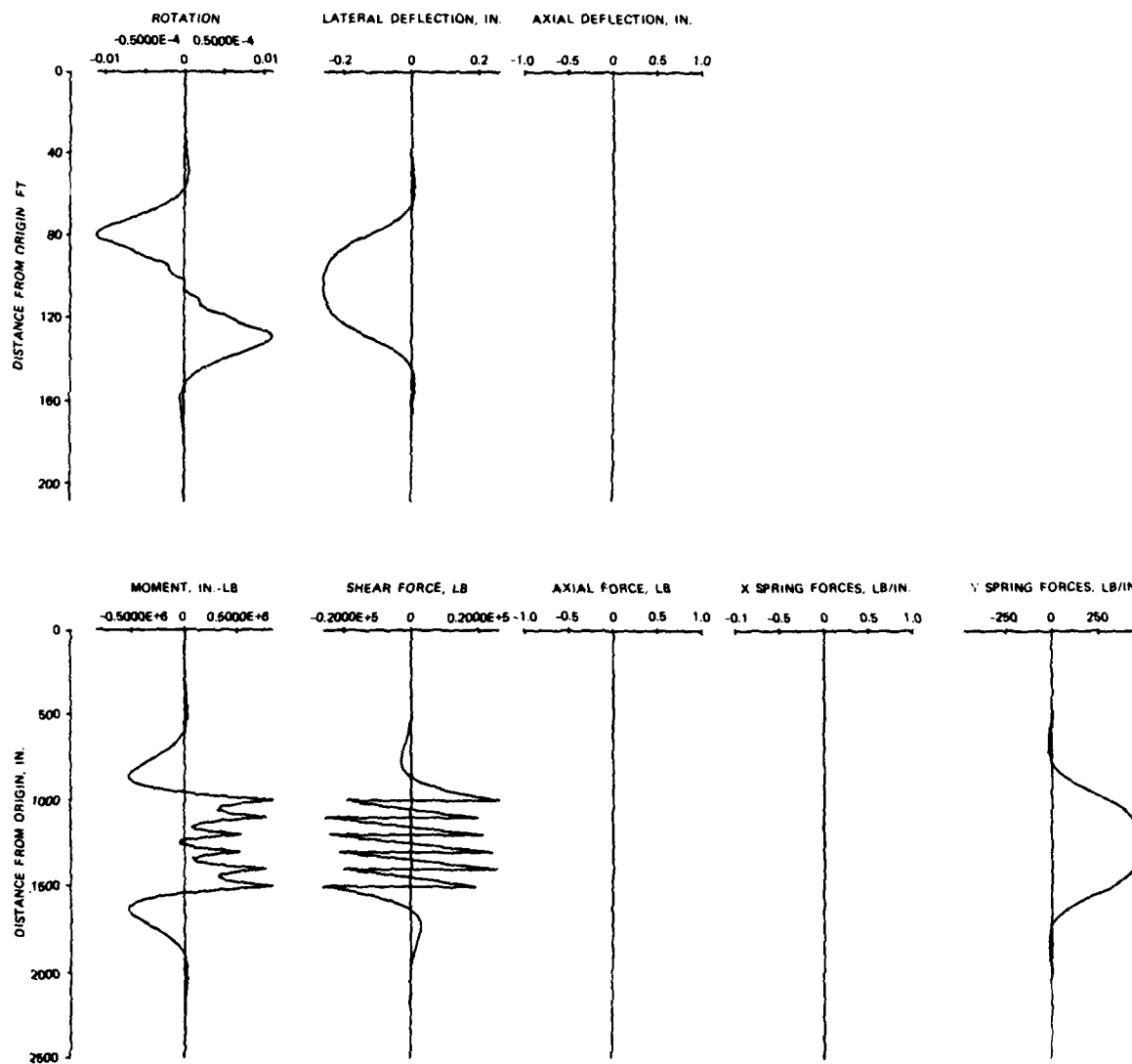


Figure C24. Beam-on-elastic foundation analysis for vertical loading of load case 3 with $K = 175 \text{ lb/in.}^3$

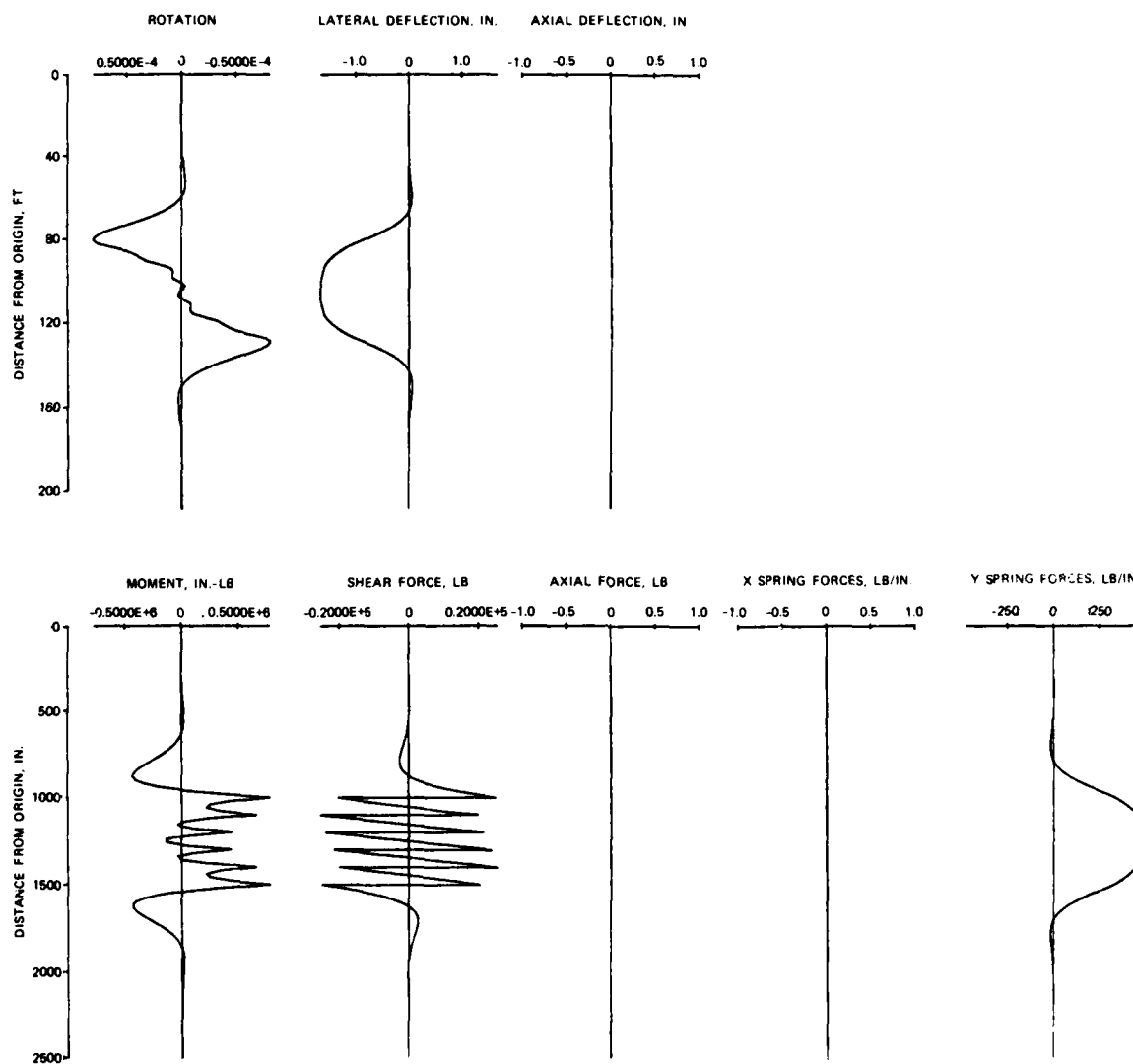


Figure C25. Beam-on-elastic foundation analysis for vertical loading of load case 3 with $K = 271.1 \text{ lb/in.}^3$

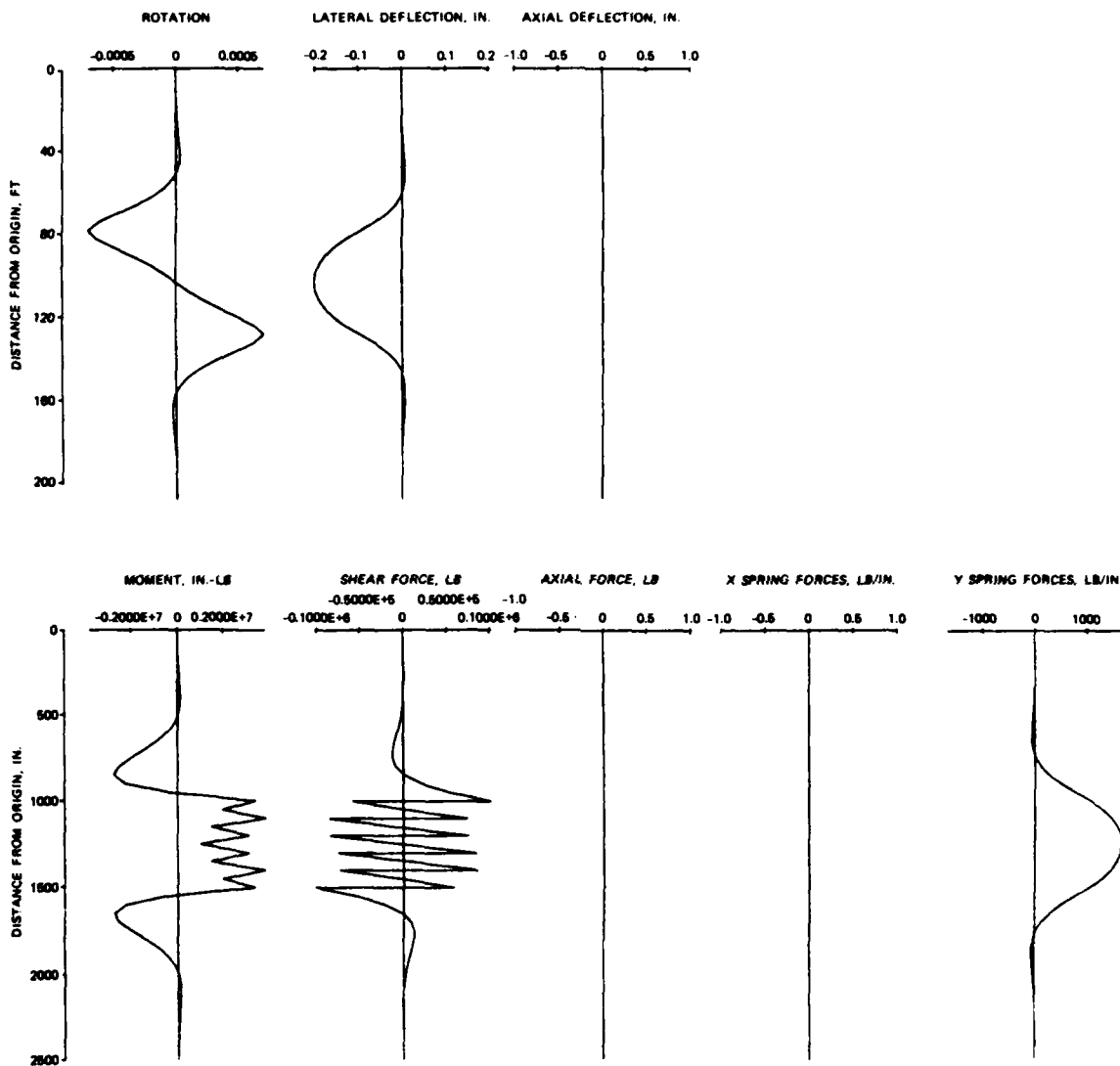


Figure C26. Beam-on-elastic foundation analysis for vertical loading of load case 4 with $K = 79.2 \text{ lb/in.}^3$

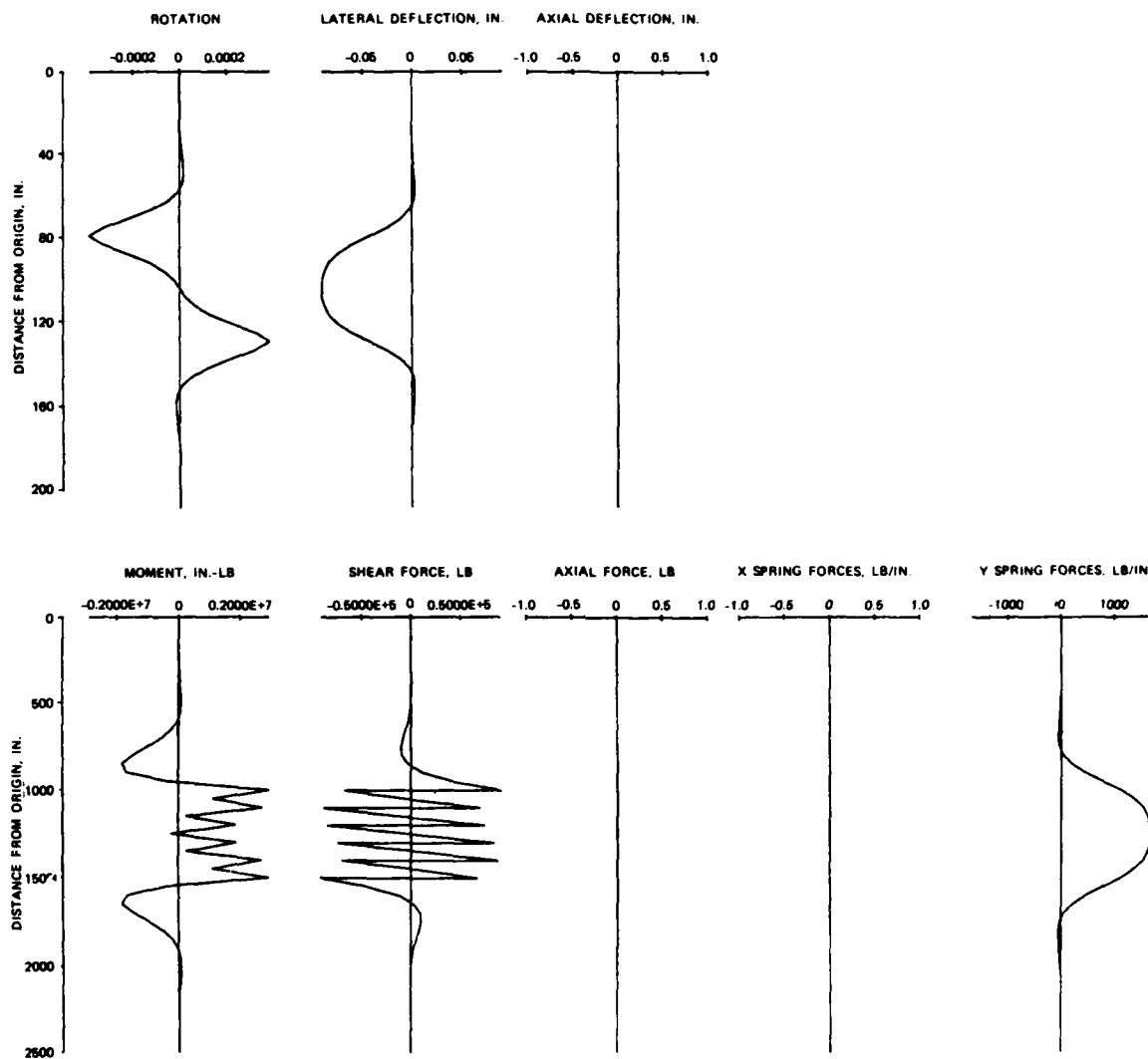


Figure C27. Beam-on-elastic foundation analysis for vertical loading of load case 4 with $K = 175 \text{ lb/in.}^3$

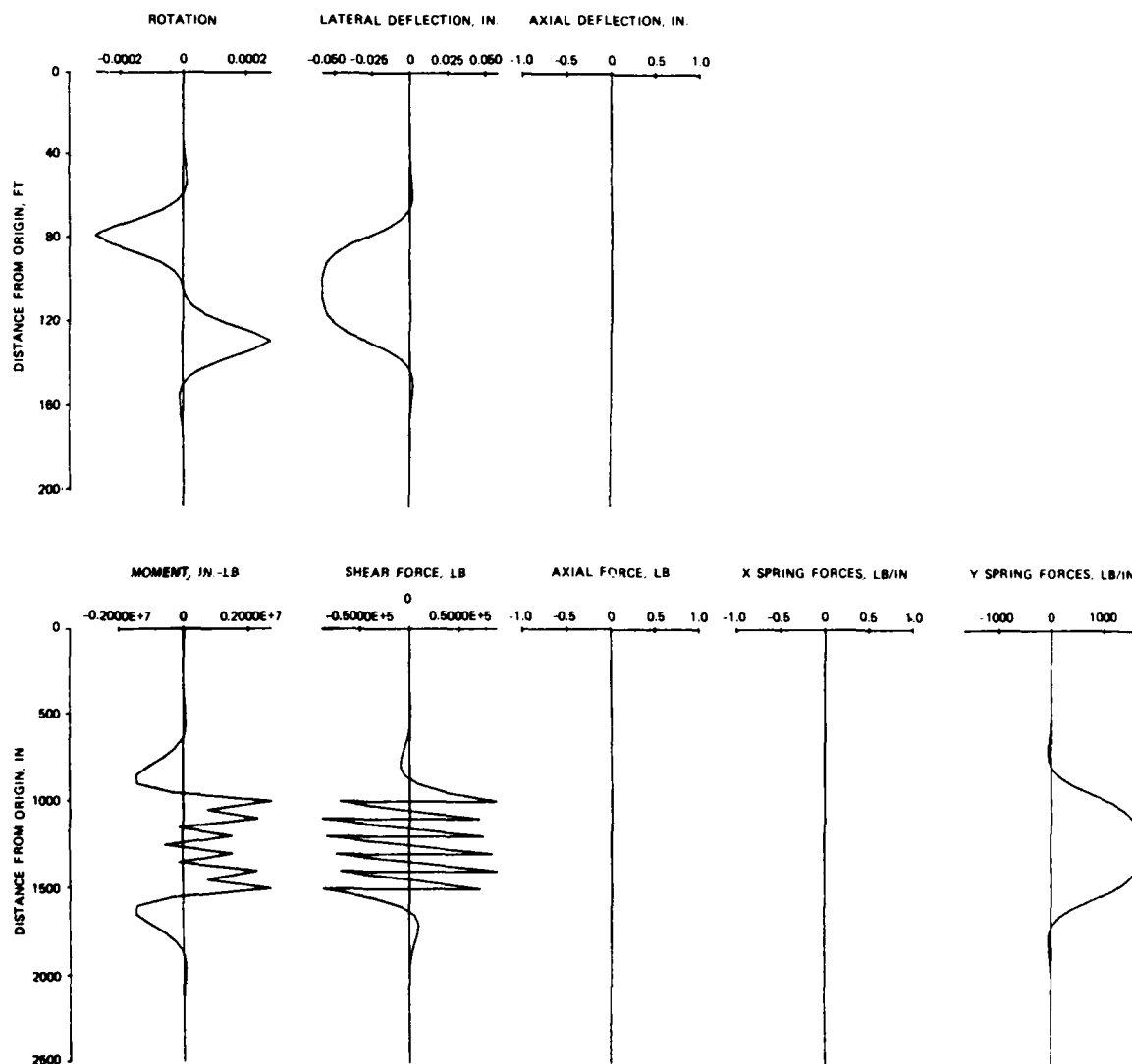


Figure C28. Beam-on-elastic foundation analysis for vertical loading of load case 4 with $K = 271.1 \text{ lb/in.}^3$

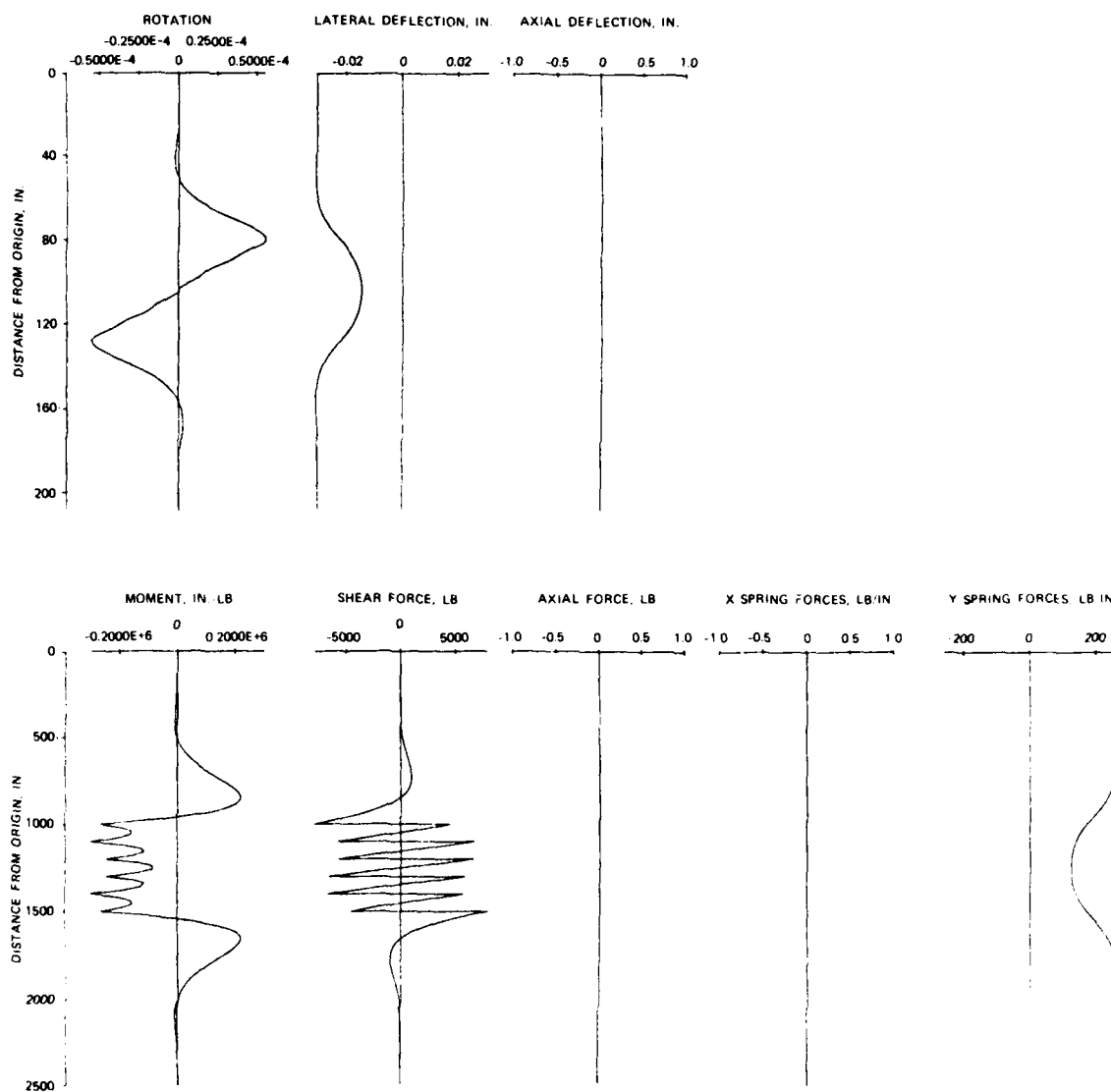


Figure C29. Beam-on-elastic foundation analysis for vertical loading of load case 5 with $K = 79.2 \text{ lb/in.}^3$

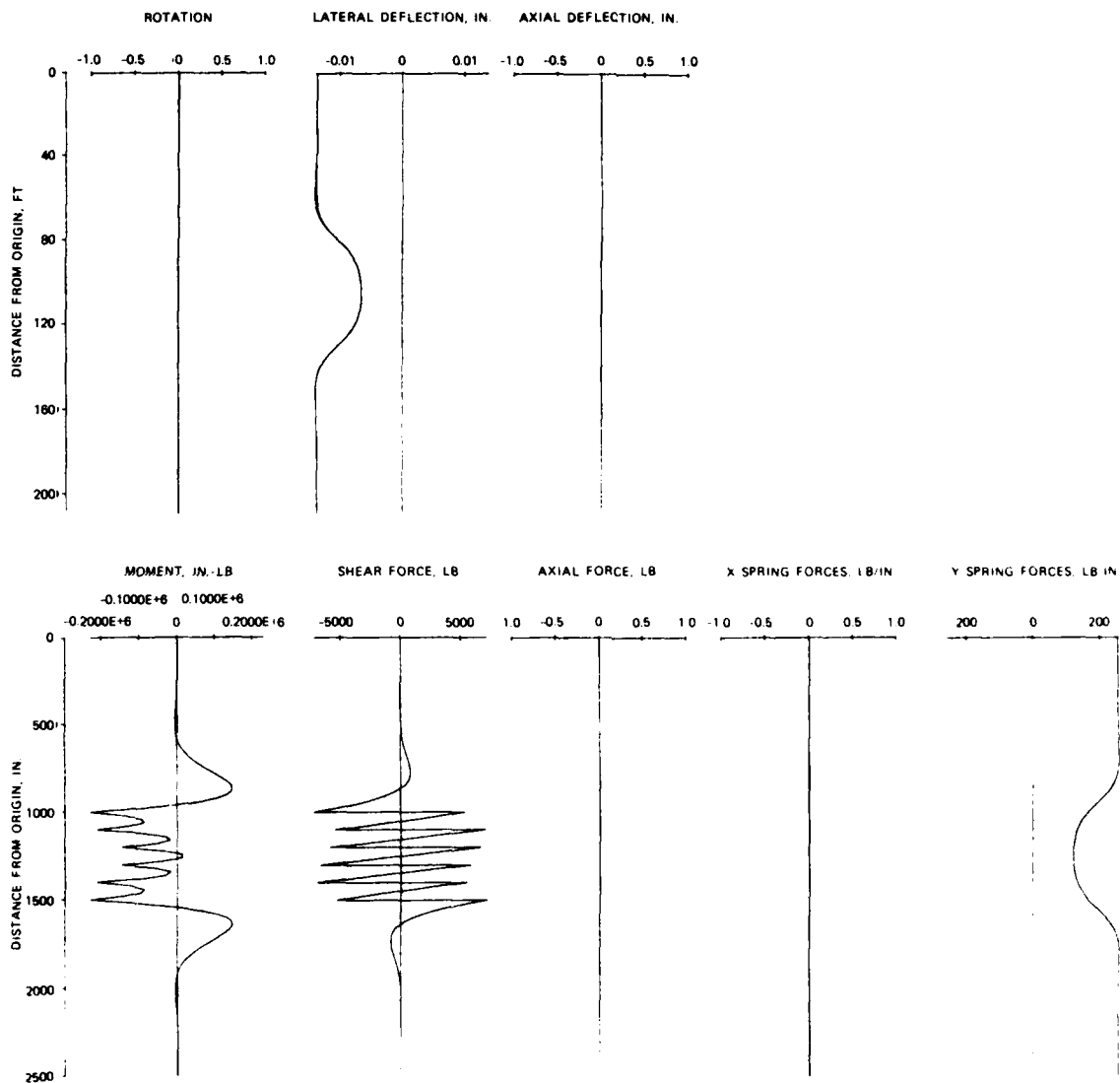


Figure C30. Beam-on-elastic foundation analysis for vertical loading of load case 5 with $K = 175 \text{ lb/in.}^3$

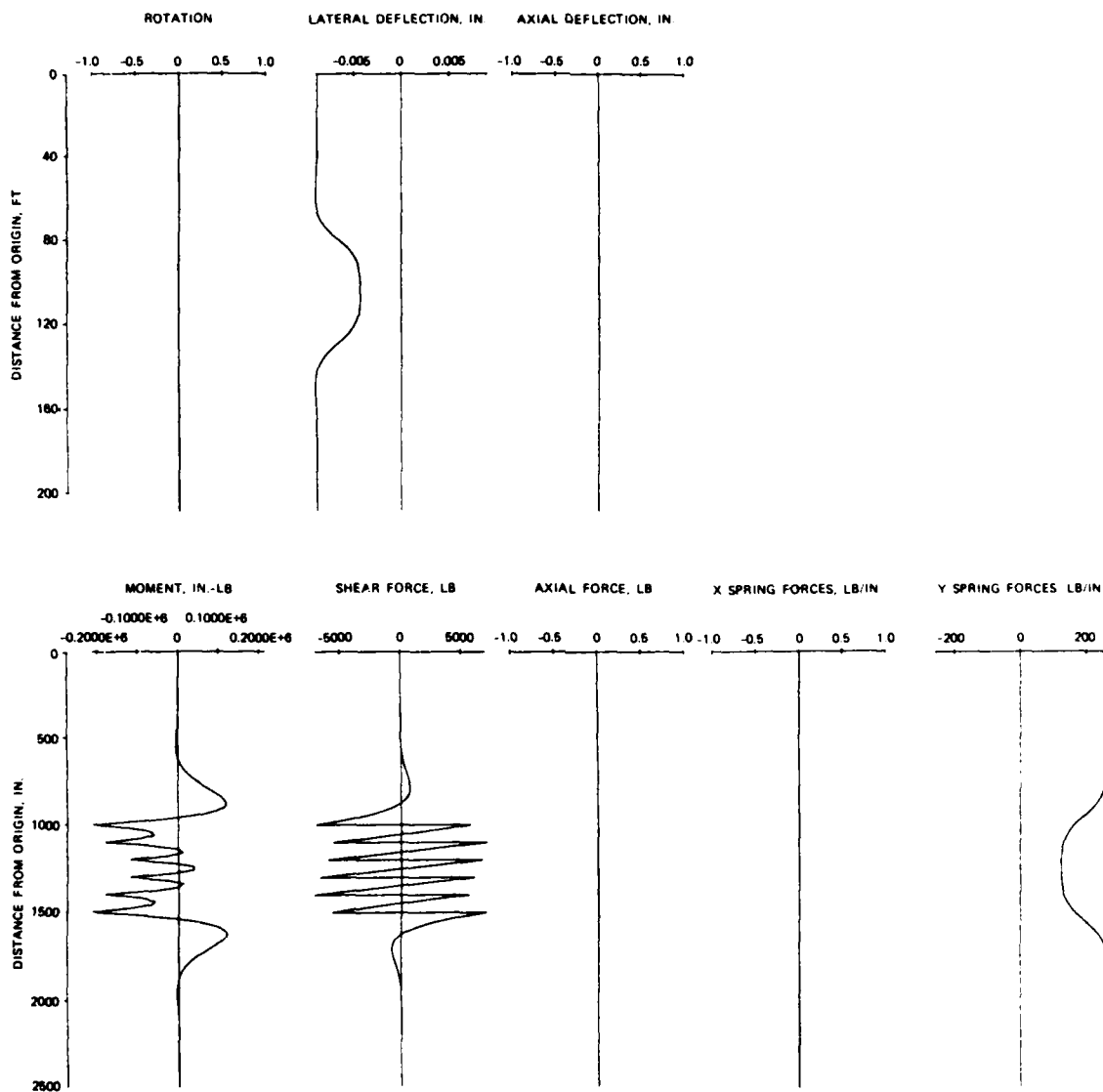


Figure C31. Beam-on-elastic foundation analysis for vertical loading of load case 5 with $K = 271.1 \text{ lb/in.}^3$

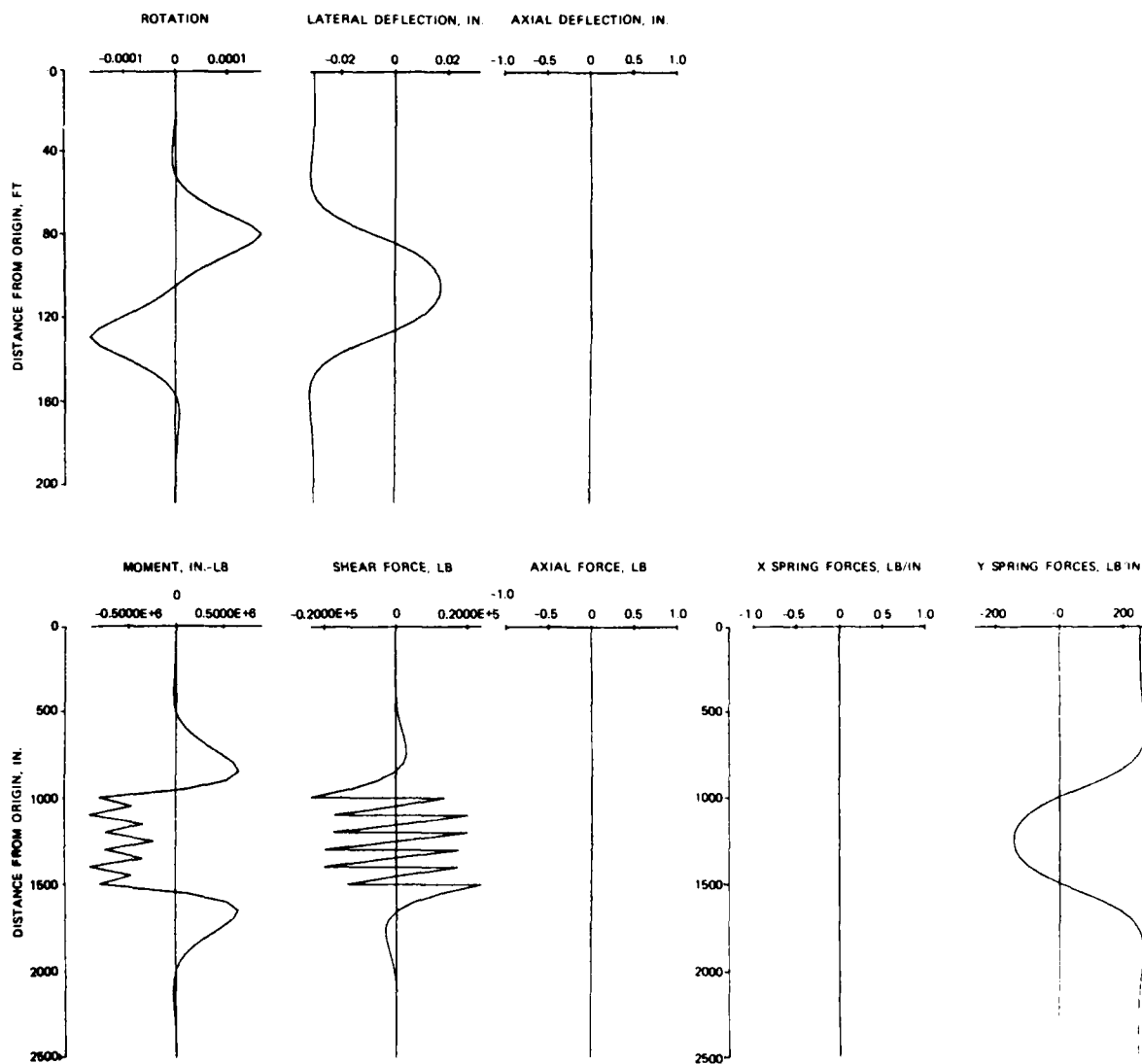


Figure C32. Beam-on-elastic foundation analysis for vertical loading of load case 6 with $K = 79.2 \text{ lb/in.}^3$

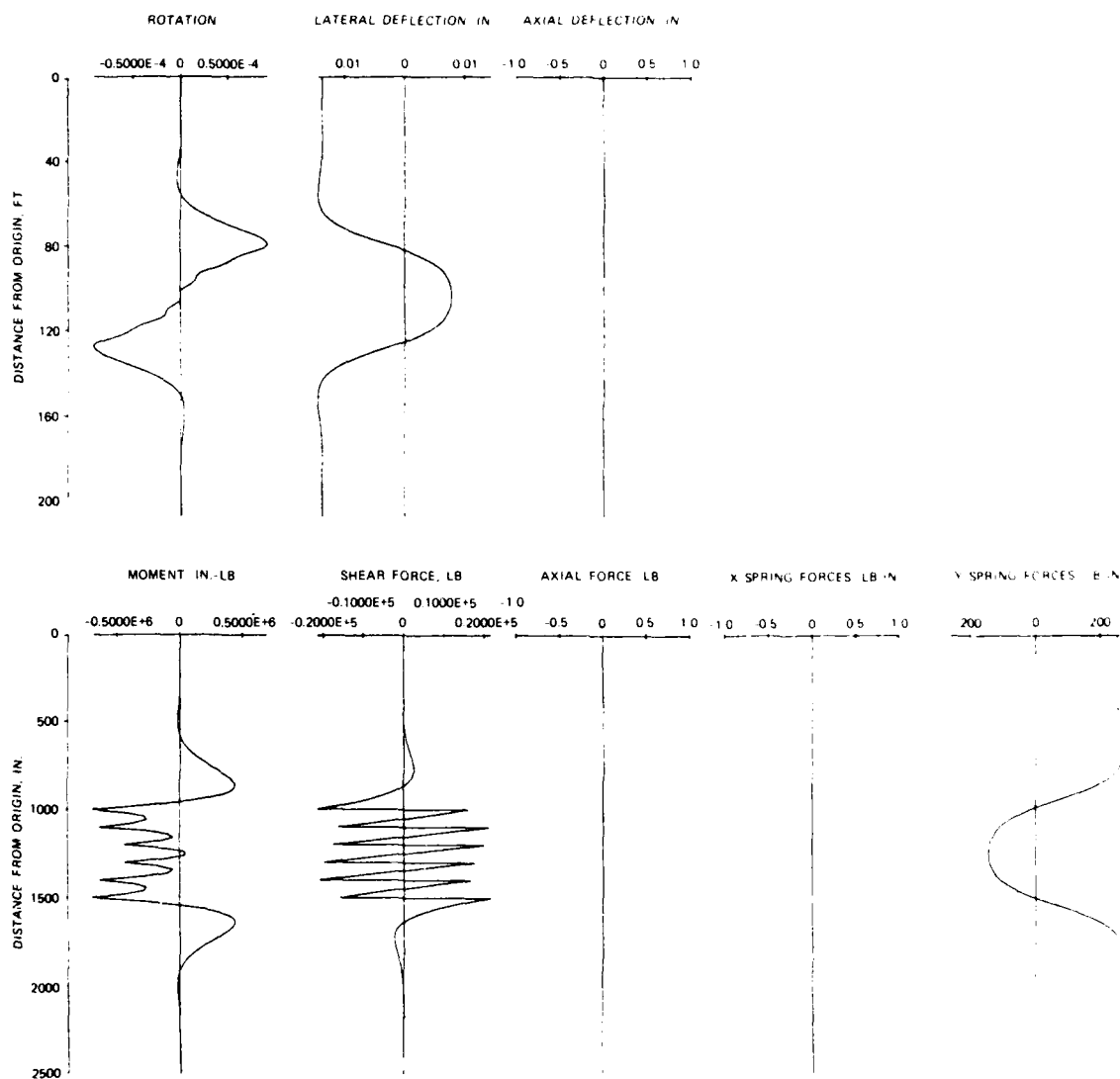


Figure C33. Beam-on-elastic foundation analysis for vertical loading of load case 6 with $K = 175 \text{ lb/in.}^3$

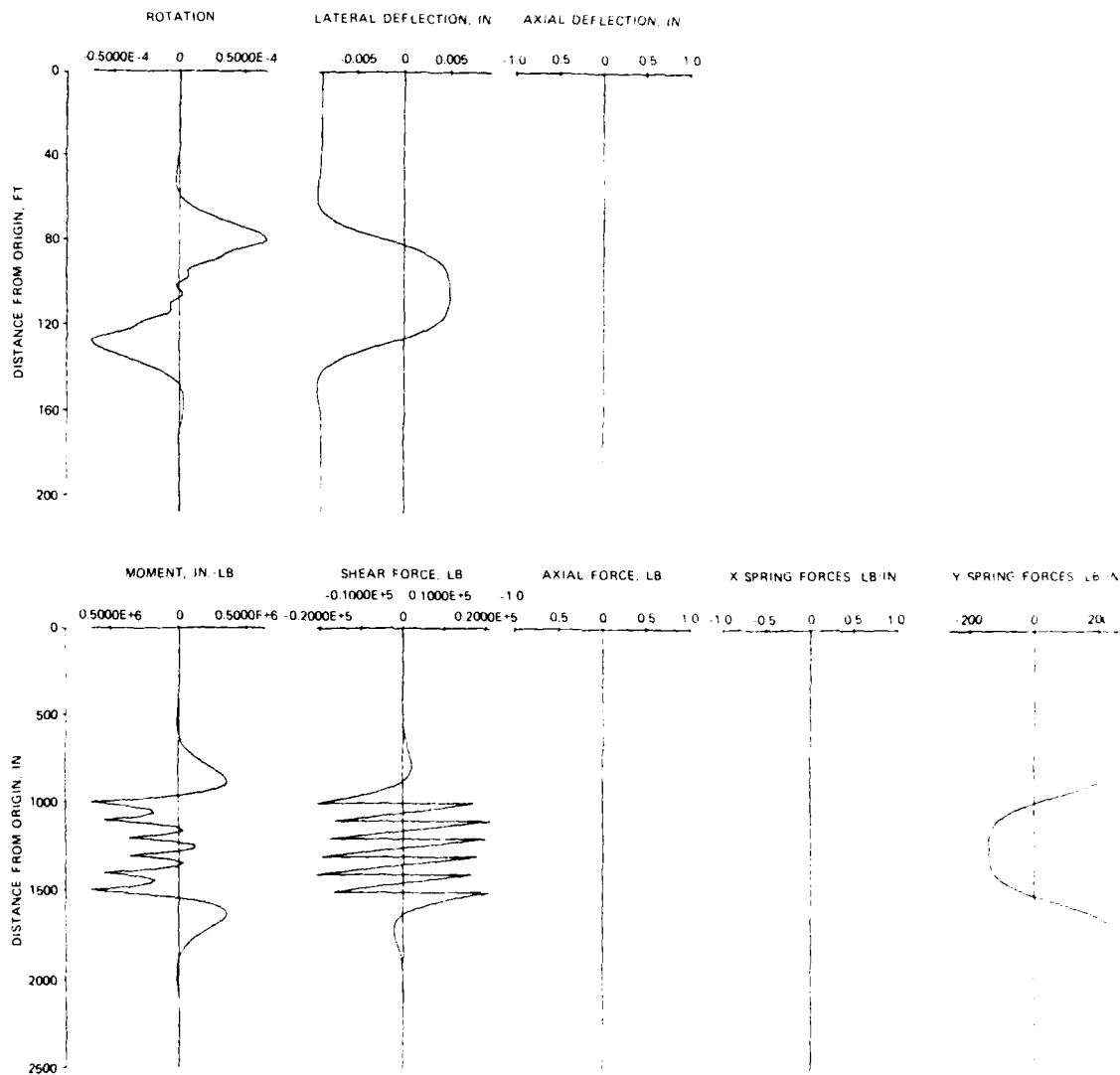


Figure C34. Beam-on-elastic foundation analysis for vertical loading of load case 6 with $K = 271.1 \text{ lb/in.}^3$

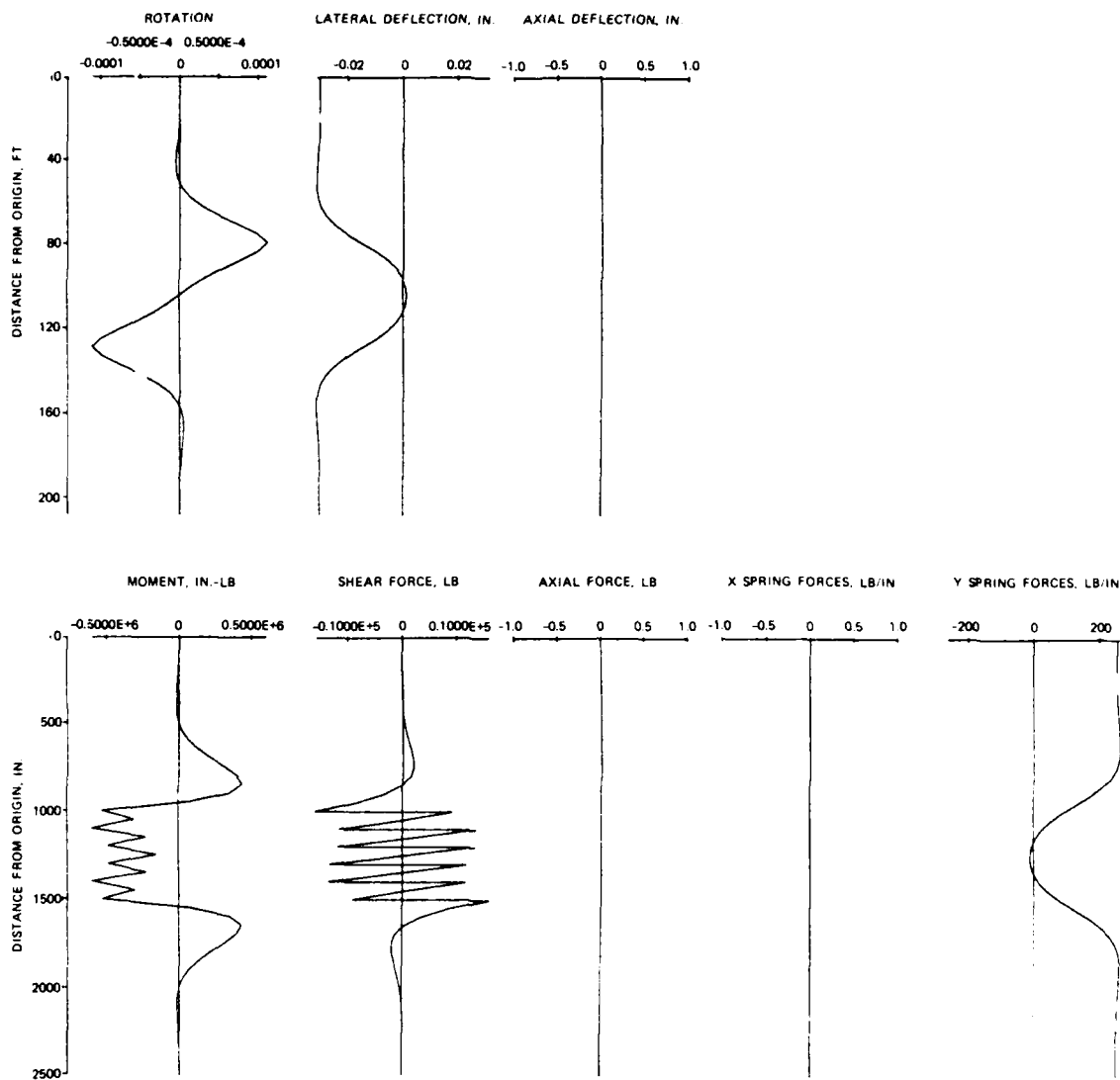


Figure C35. Beam-on-elastic foundation analysis for vertical loading of load case 7 with $K = 79.2 \text{ lb/in.}^3$

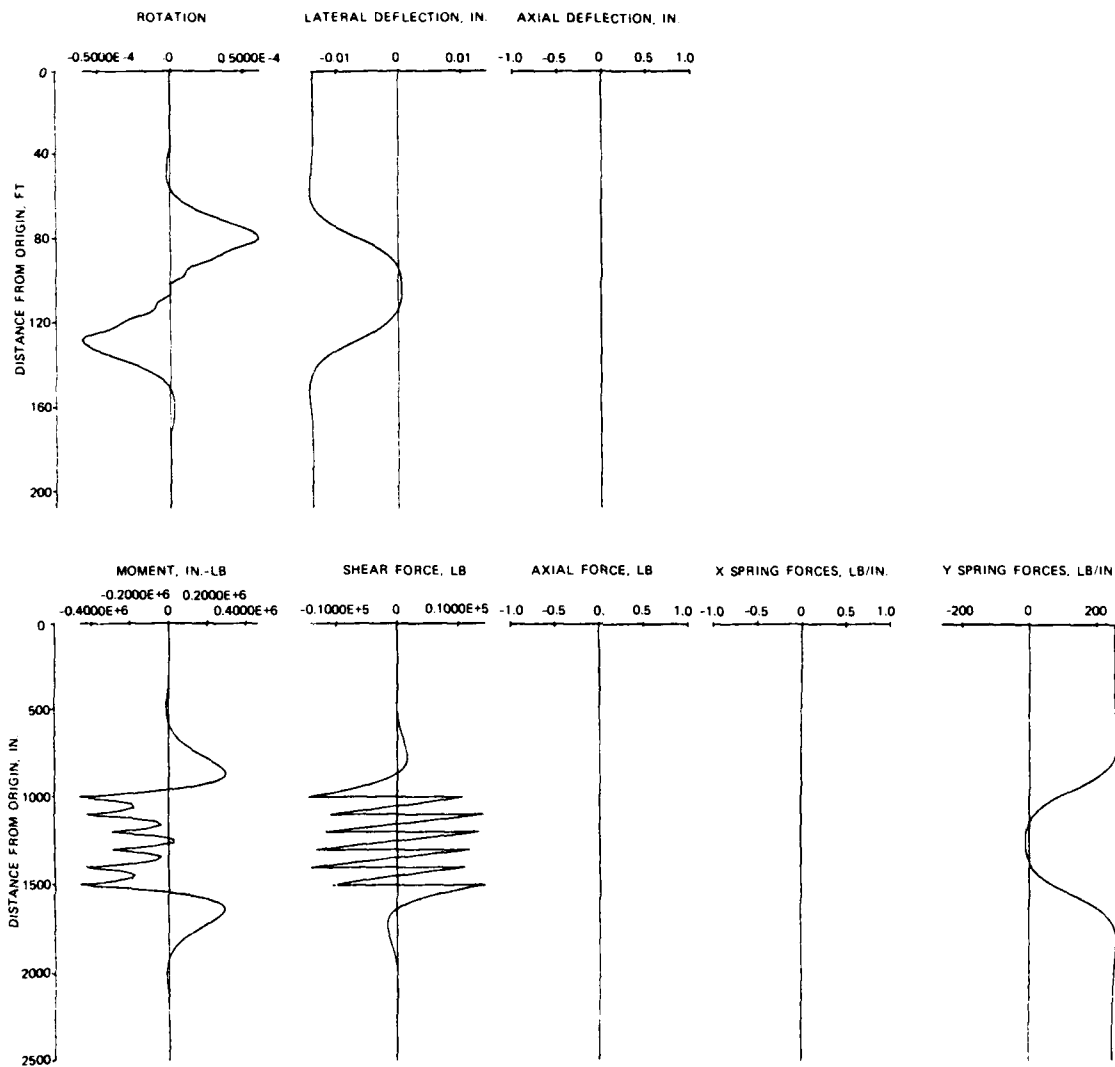


Figure C36. Beam-on-elastic foundation analysis for vertical loading of load case 7 with $K = 175 \text{ lb/in.}^3$

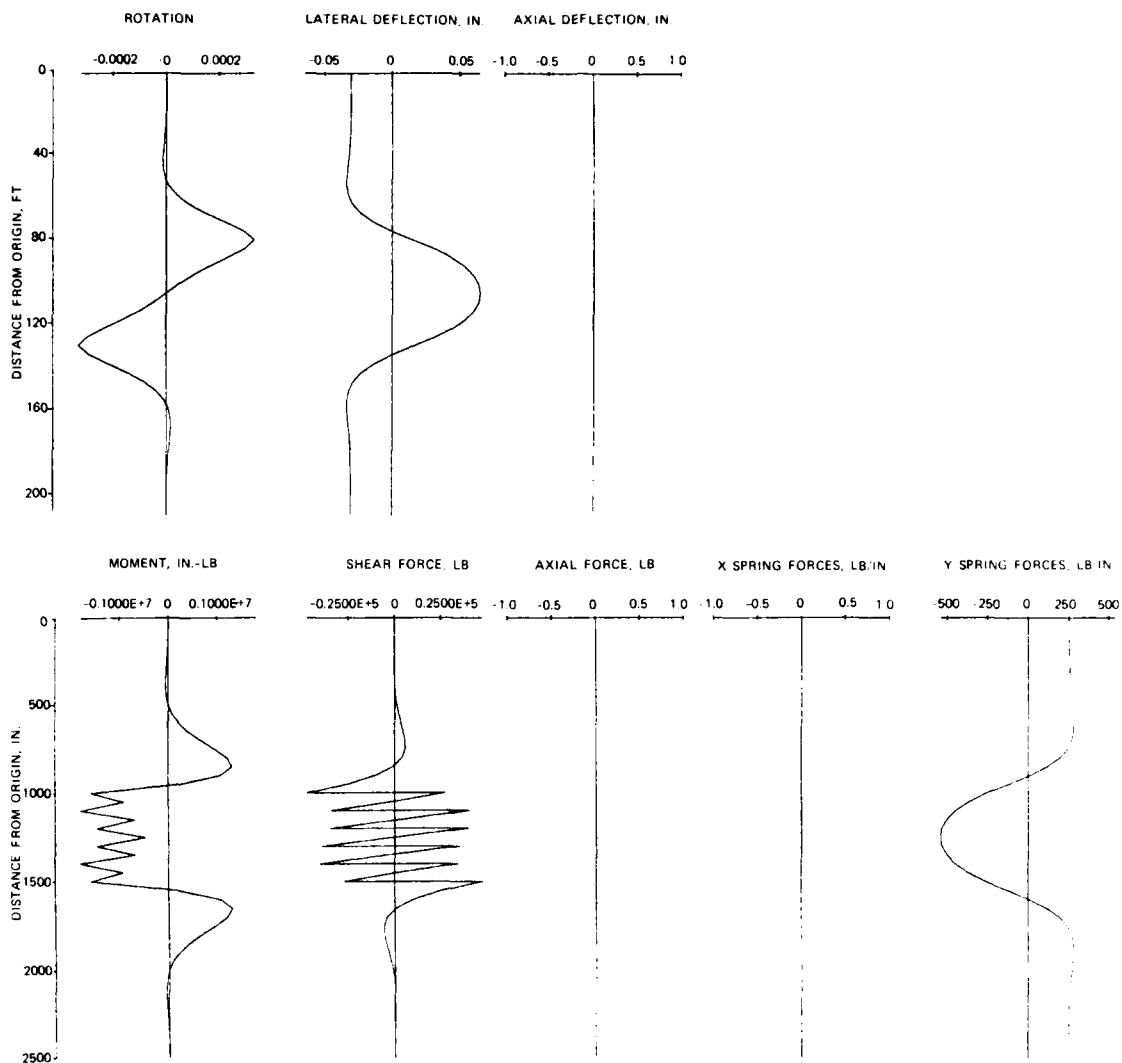


Figure C37. Beam-on-elastic foundation analysis for vertical loading of load case 8 with $K = 79.2 \text{ lb/in.}^3$

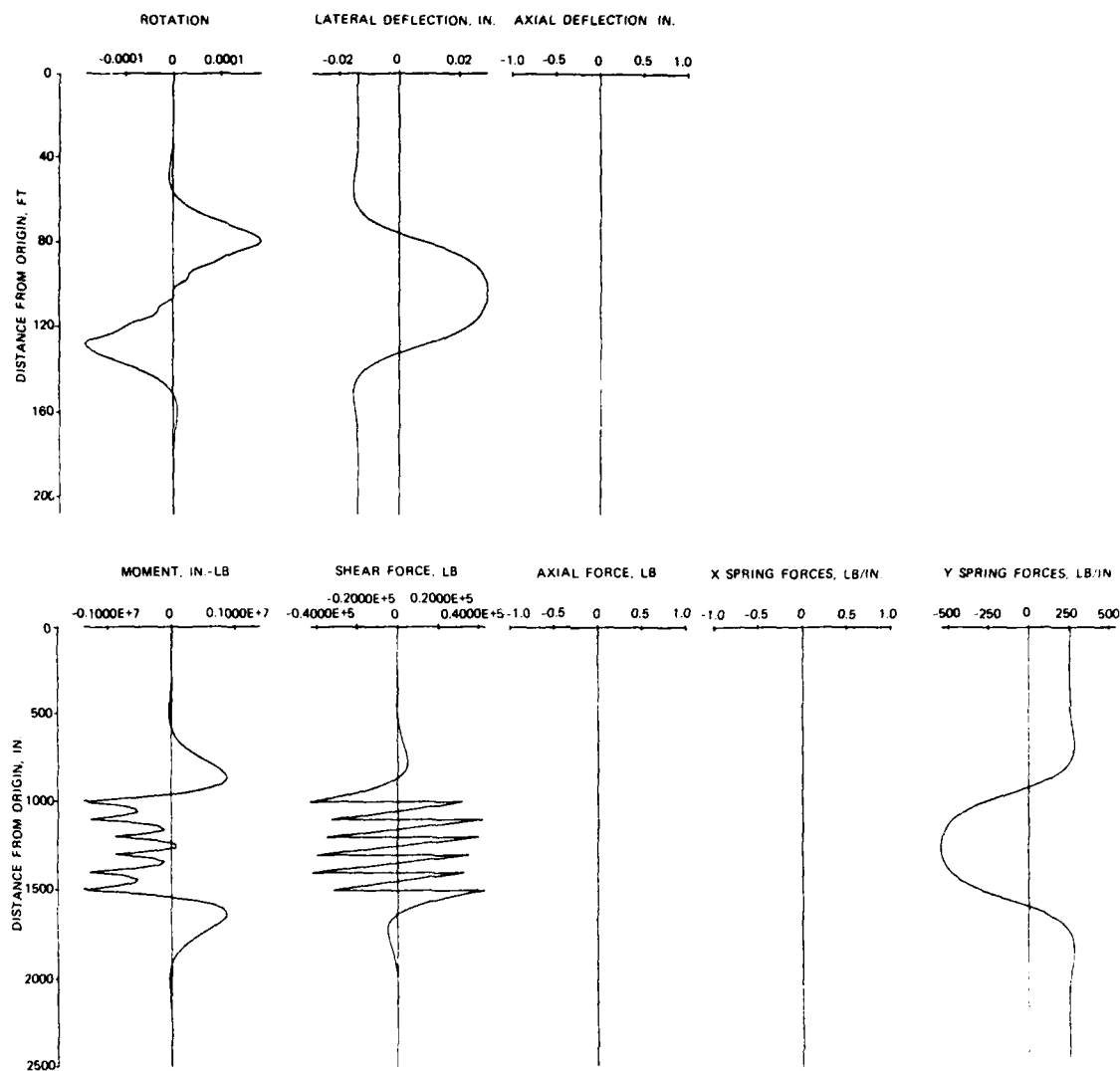


Figure C38. Beam-on-elastic foundation analysis for vertical loading of load case 8 with $K = 175 \text{ lb/in.}^3$

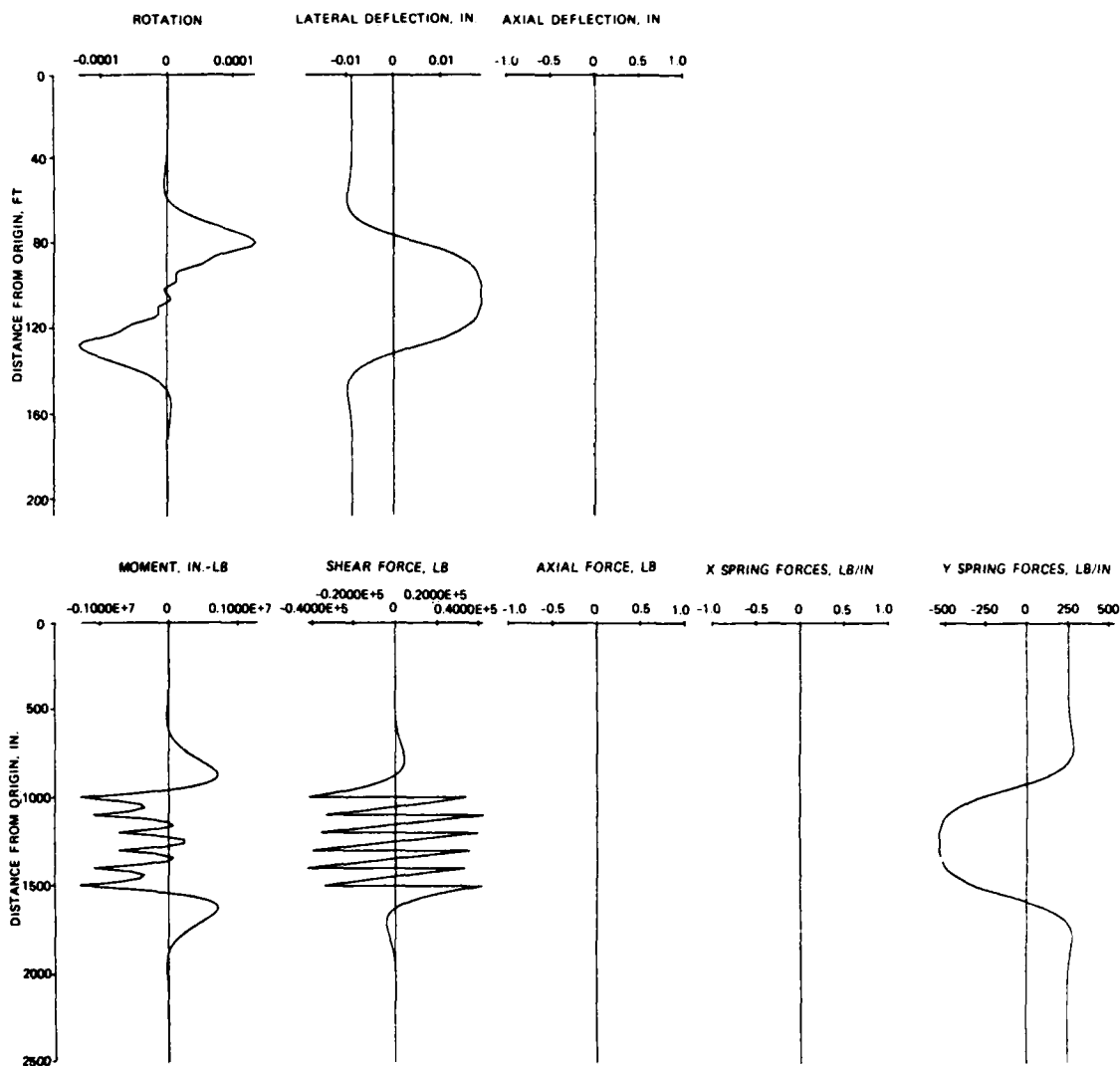


Figure C39. Beam-on-elastic foundation analysis for vertical loading of load case 8 with $K = 271.1 \text{ lb/in.}^3$

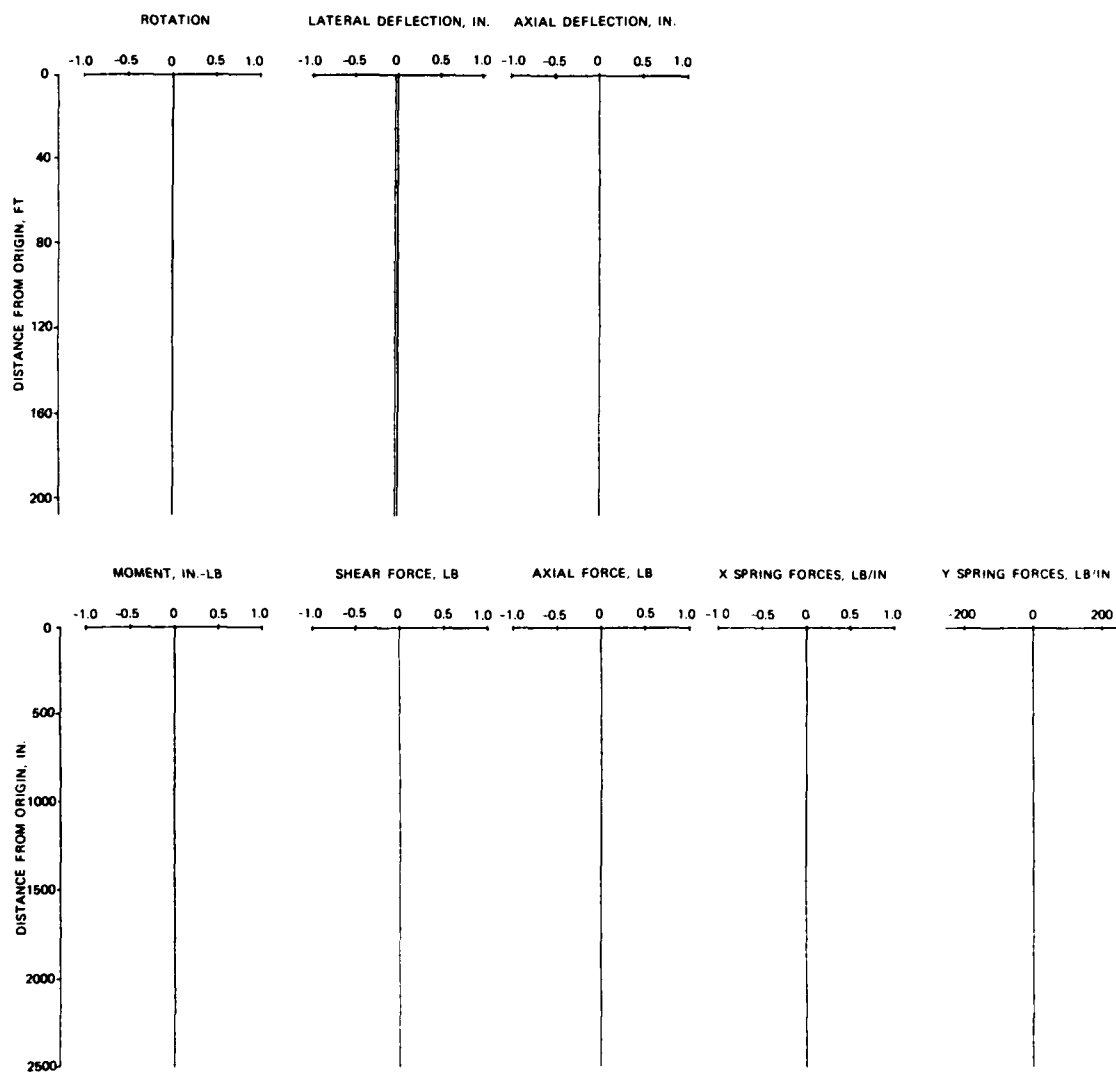


Figure C40. Beam-on-elastic foundation analysis for vertical loading of load case 17 with $K = 79.2 \text{ lb/in.}^3$

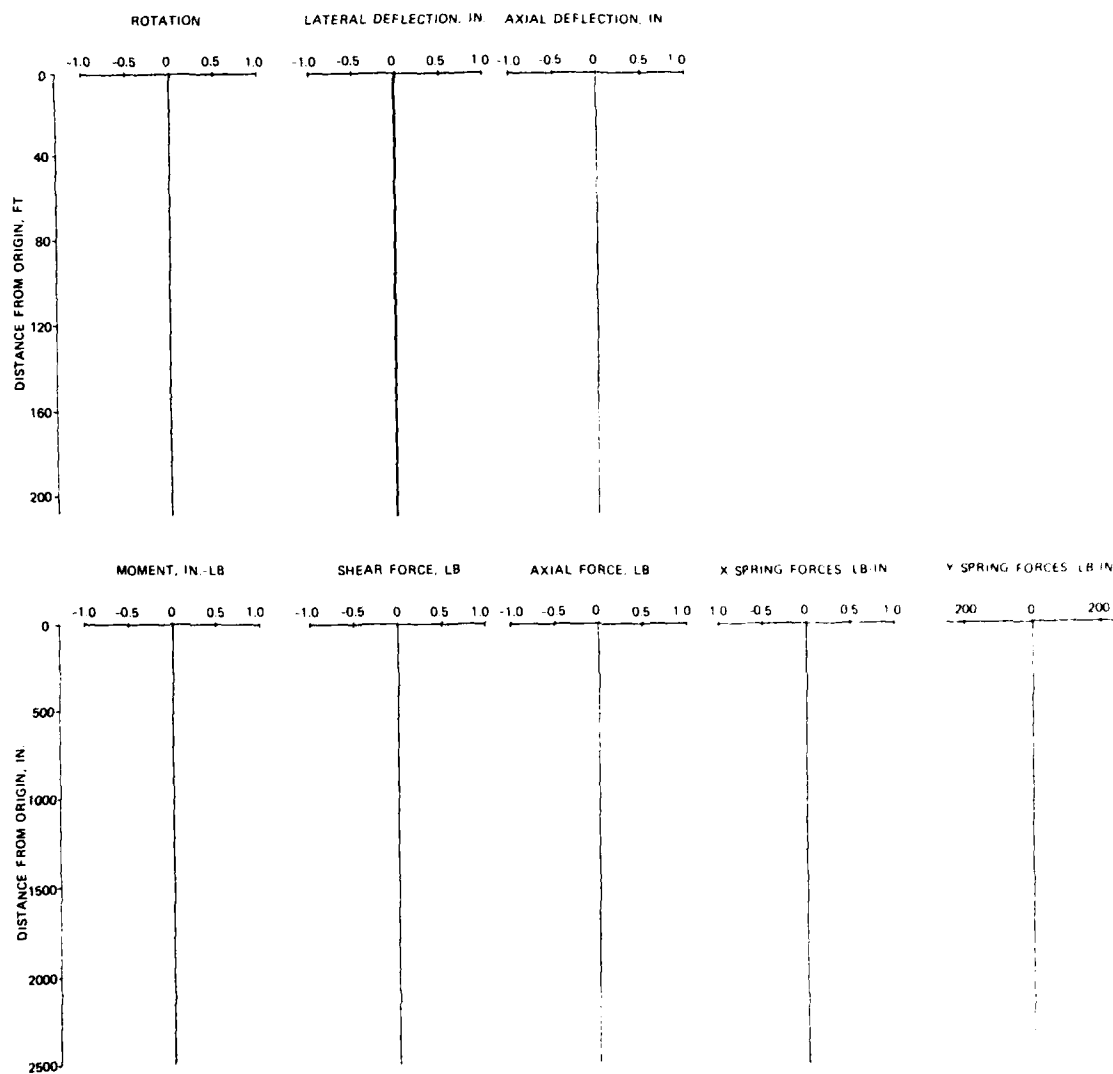


Figure C41. Beam-on-elastic foundation analysis for vertical loading of load case 17 with $K = 175 \text{ lb/in.}^3$

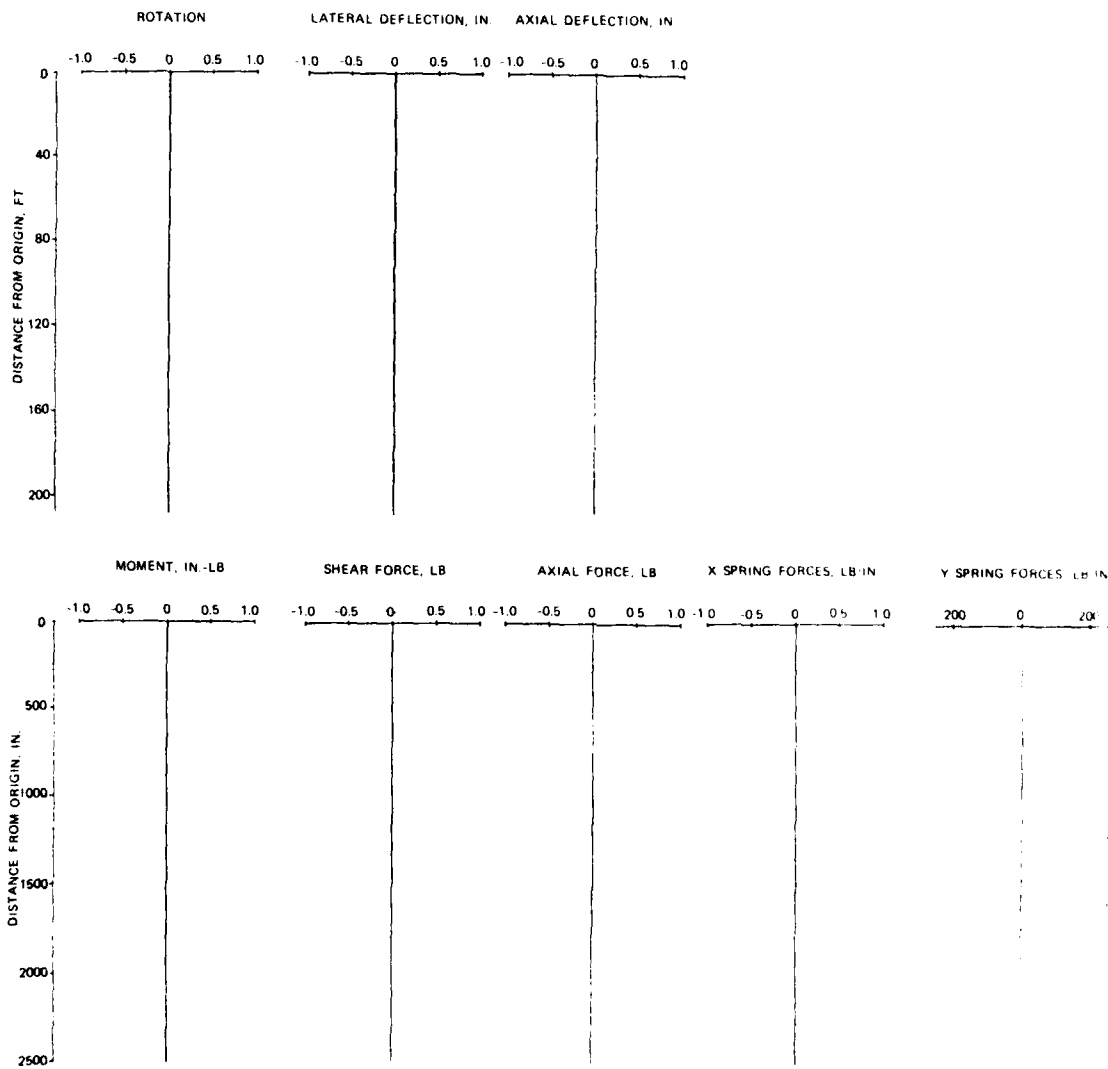


Figure C42. Beam-on-elastic foundation analysis for vertical loading of load case 17 with $K = 271.1 \text{ lb/in.}^3$

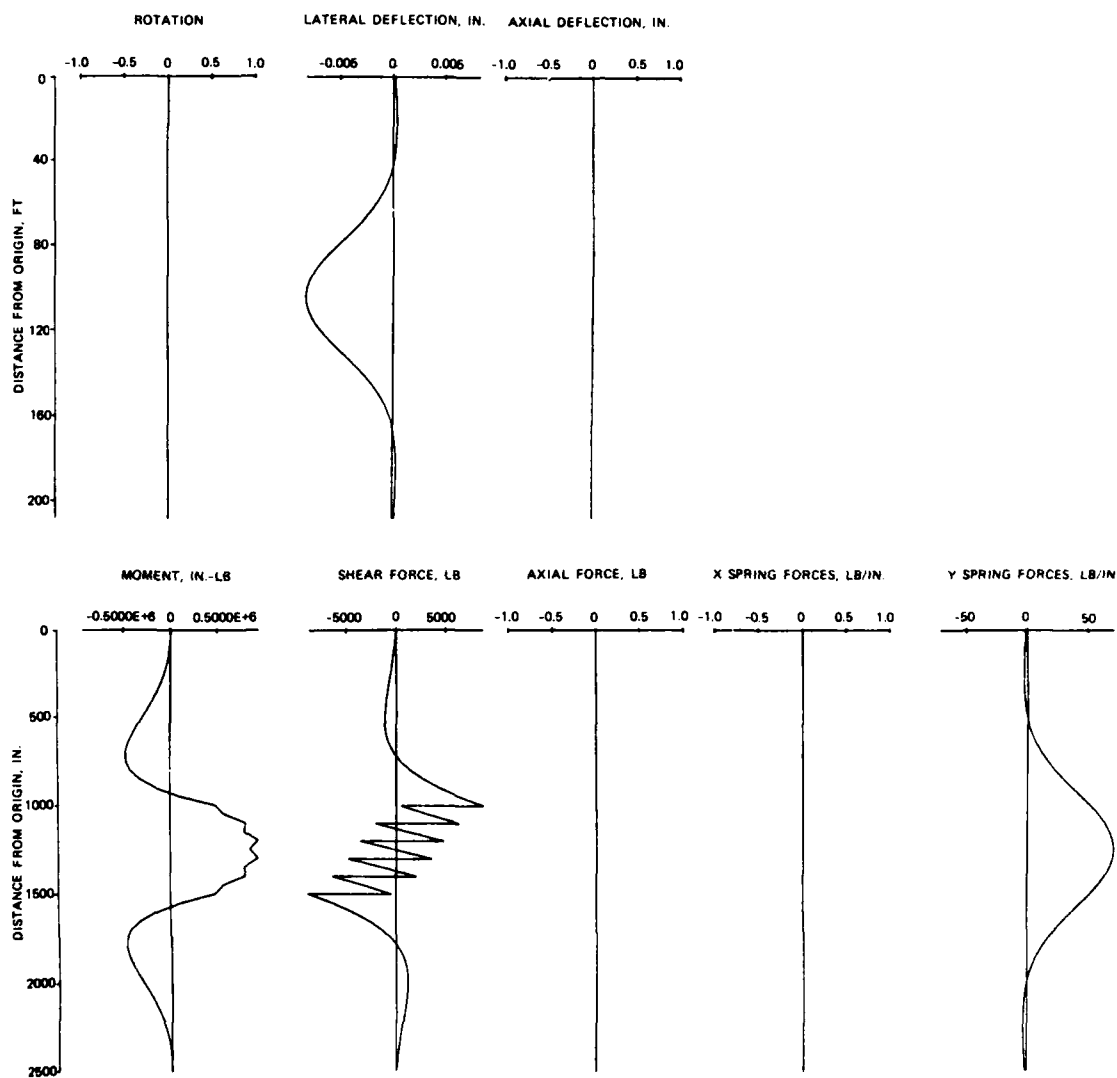


Figure C43. Beam-on-elastic foundation analysis for traverse loadings of load cases 1, 2, 5, and 6 with $K = 79.2 \text{ lb/in.}^3$

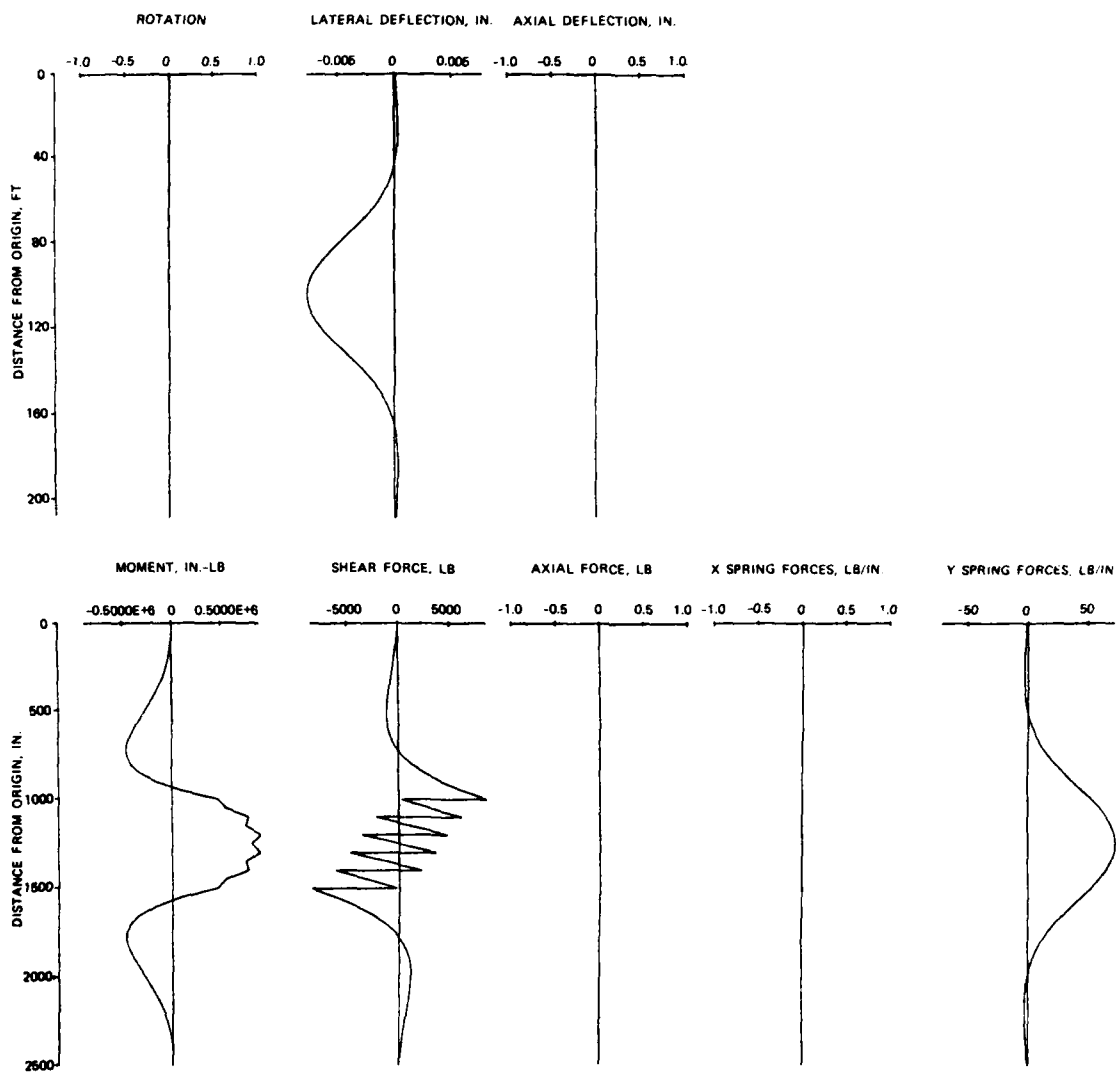


Figure C44. Beam-on-elastic foundation analysis for traverse loadings of load cases 1, 2, 5, and 6 with $K = 175 \text{ lb/in.}^3$

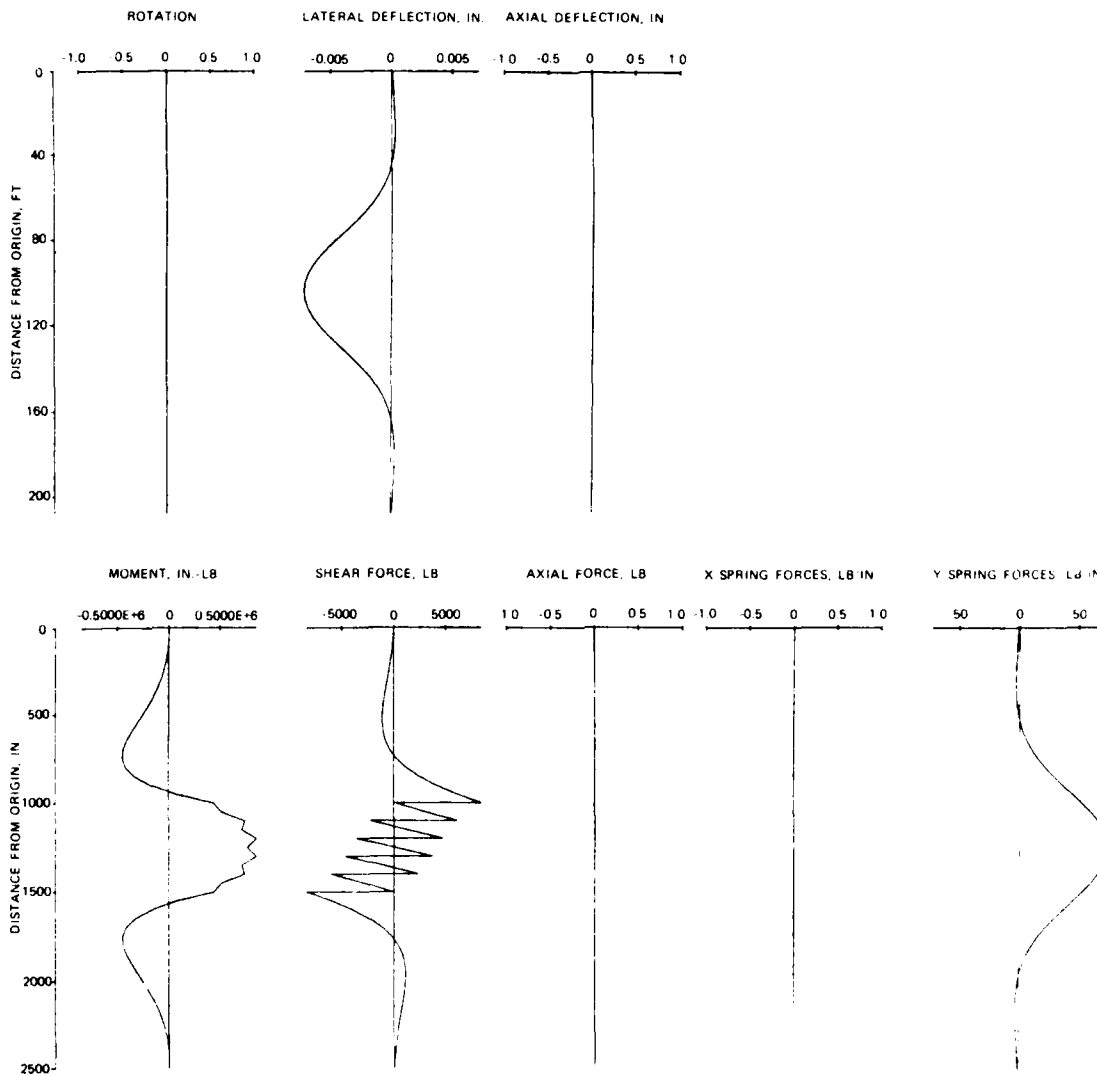


Figure C45. Beam-on-elastic foundation analysis for traverse loadings of load cases 1, 2, 5, and 6 with $K = 271.1 \text{ lb/in.}^3$

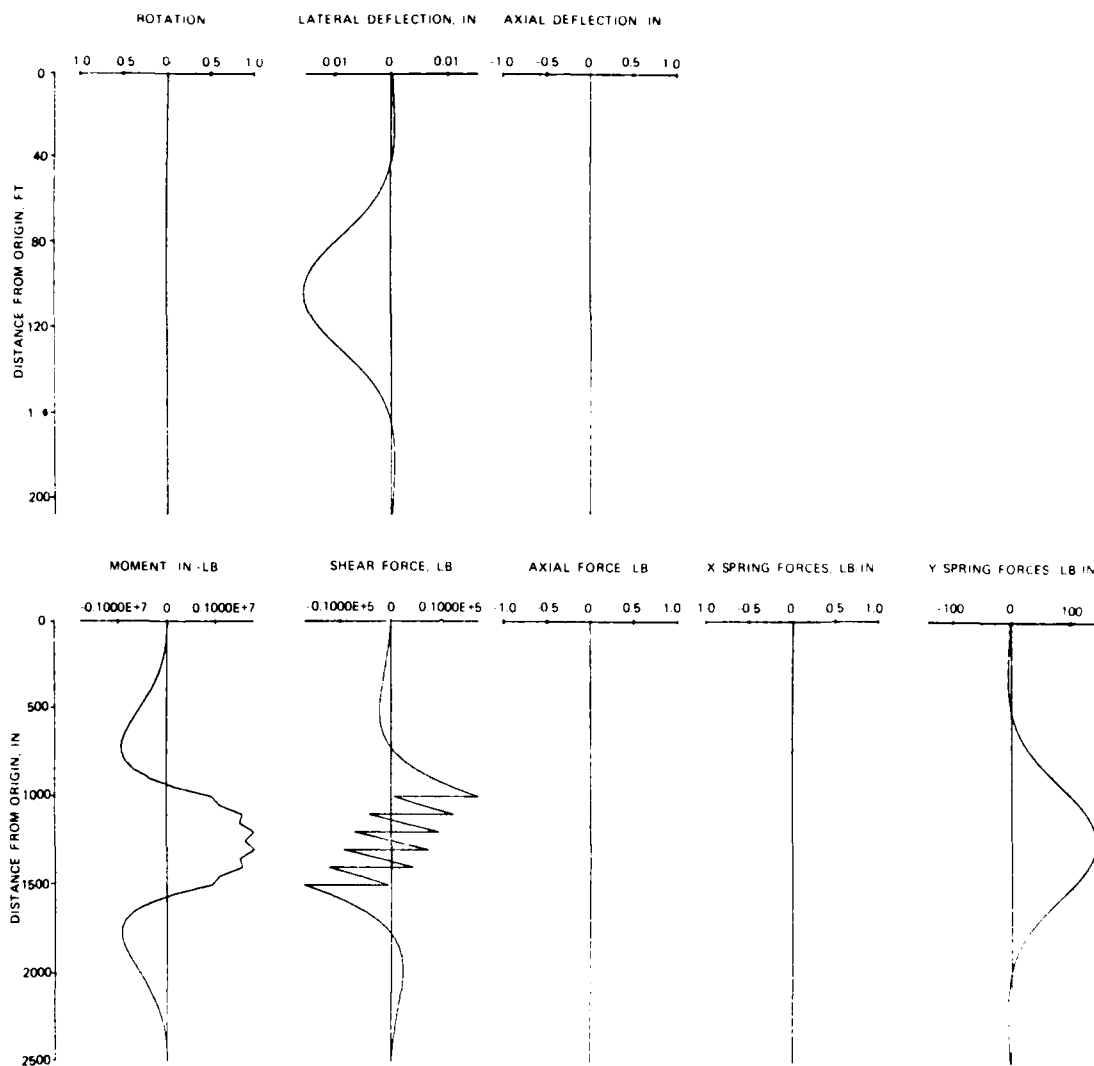


Figure C46. Beam-on-elastic foundation analysis for traverse loadings of load cases 3, 4, 7, and 8 with $K = 79.2 \text{ lb/in.}^3$

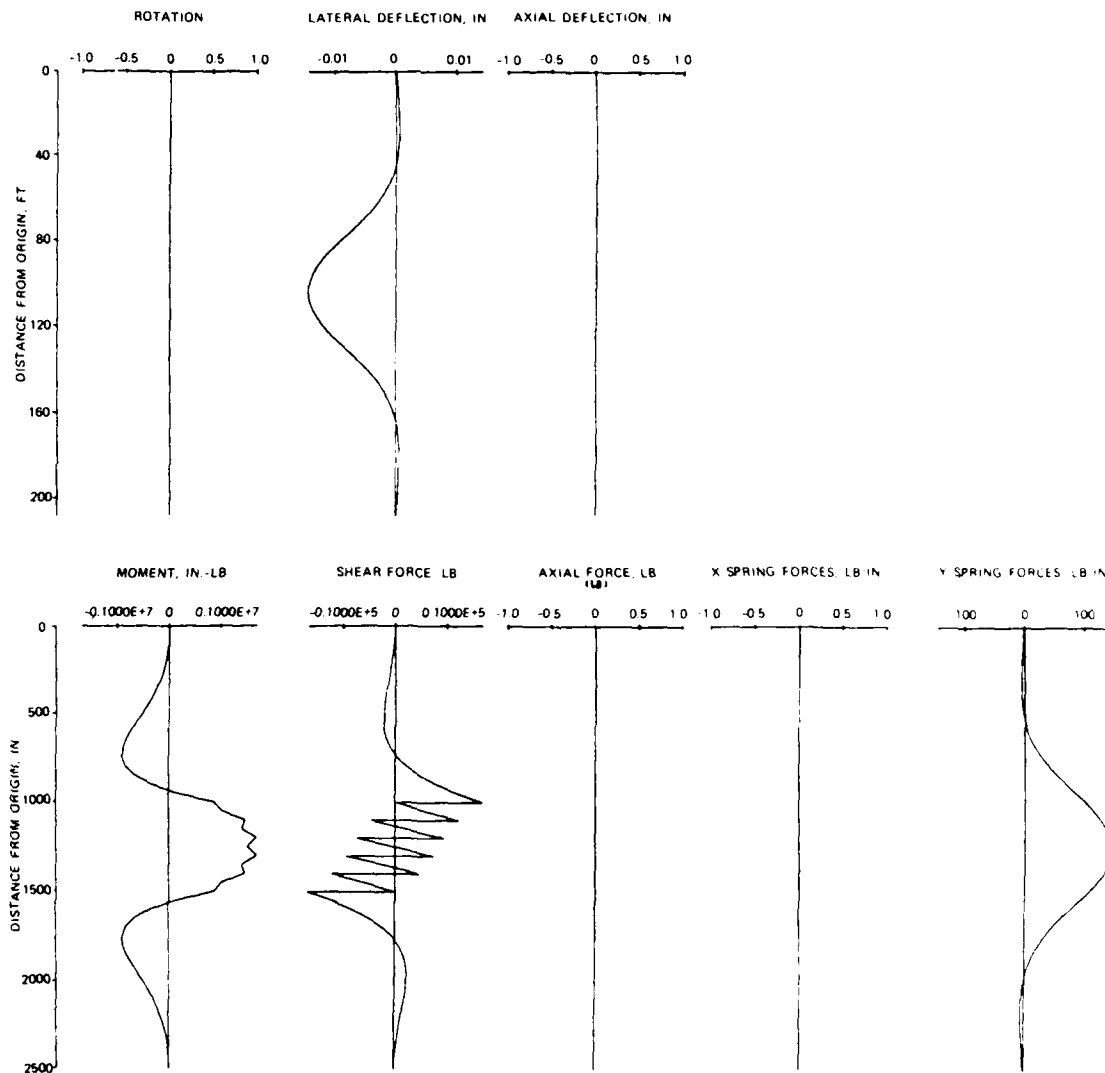


Figure C47. Beam-on-elastic foundation analysis for traverse loadings of load cases 3, 4, 7, and 8 with $K = 175 \text{ lb/in.}^3$

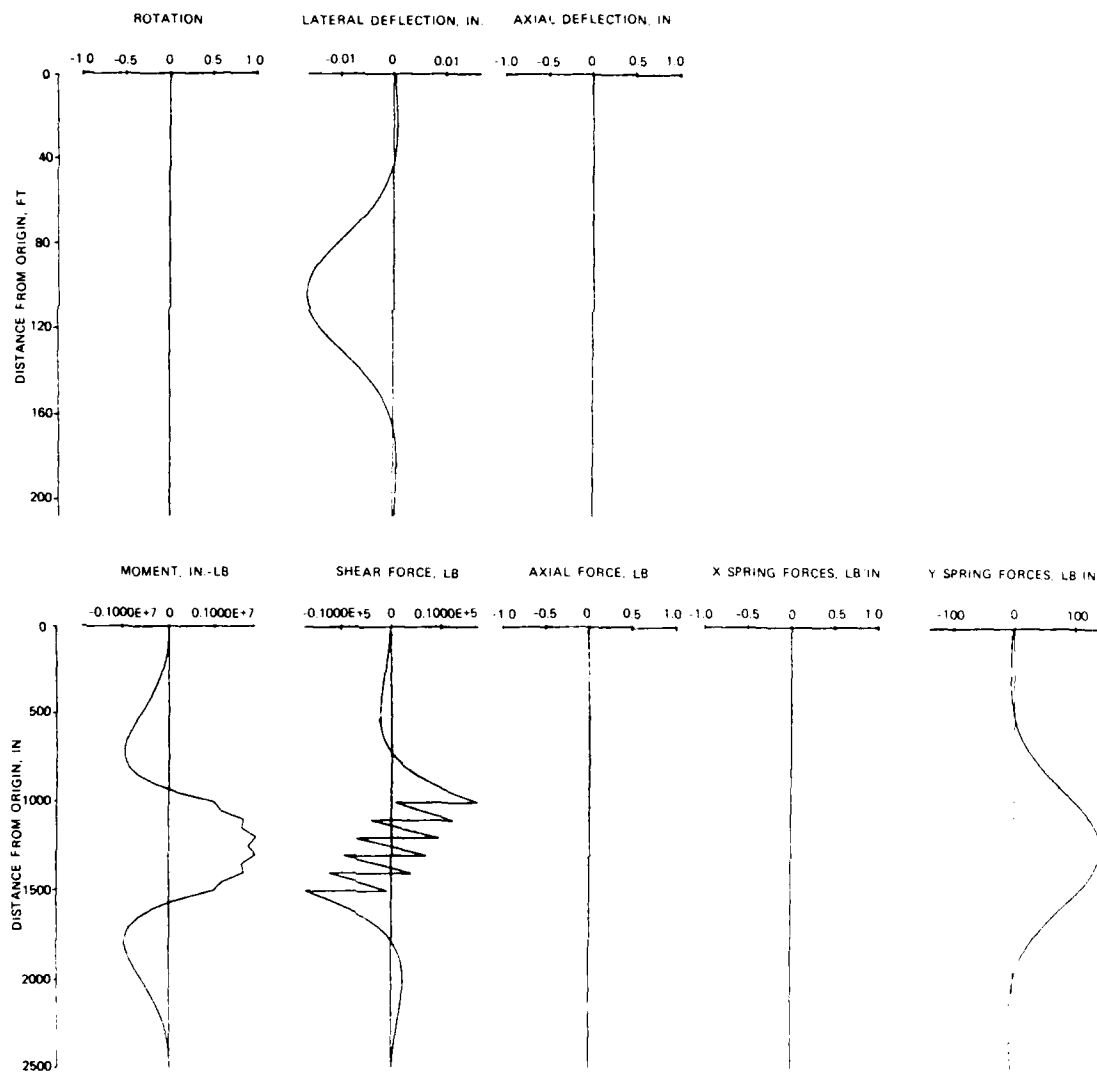


Figure C48. Beam-on-elastic foundation analysis for traverse loadings of load cases 3, 4, 7, and 8 with $K = 271.1 \text{ lb/in.}^3$

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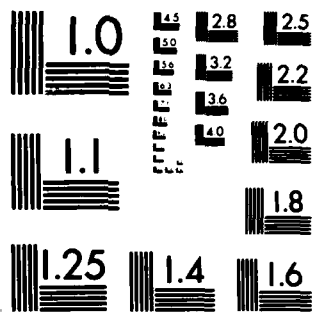
CONDITION EVALUATION OF SUPERSONIC NAVAL ORDNANCE
RESEARCH TRACK (SNORT)(U) ARMY ENGINEER WATERWAYS
EXPERIMENT STATION VICKSBURG MS STRUC..

3/3

UNCLASSIFIED

B R SULLIVAN ET AL. FEB 84 WES/MP/SL-84-1 F/G 13/13 NL

END
DATE
FILMED
5-84
DTIC



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

**APPENDIX D: FINITE-ELEMENT ANALYSIS,
PROPOSED SNORT TRACK**

NORMAL STRESSES FOR LOAD CASE 1 (PSI)

ELEM	SX	SY	SZ	ELEM	SX	SY	SZ	ELEM	SX	SY	SZ	ELEM	SX	SY	SZ
1	0	-19	-4	106	-6	-20	-4	201	-7	-12	-1	306	-4	-13	-1
2	0	-16	-3	107	-6	-19	-3	202	-7	-11	-1	307	-4	-12	-1
3	0	-14	-3	108	-6	-17	-3	203	-7	-9	-1	308	-4	-10	-1
4	0	-12	-3	109	-6	-15	-3	204	-7	-7	-1	309	-4	-8	-1
5	0	-10	-3	110	-6	-13	-3	205	-7	-5	-1	310	-4	-6	-1
6	0	-8	-3	111	-6	-11	-3	206	-7	-3	-1	311	-4	-4	-1
7	0	-6	-3	112	-6	-9	-3	207	-7	-1	-1	312	-4	-2	-1
8	0	-4	-3	113	-6	-7	-3	208	-7	1	-1	313	-4	0	-1
9	0	-2	-3	114	-6	-5	-3	209	-7	3	-1	314	-4	2	-1
10	0	0	-3	115	-6	-3	-3	210	-7	5	-1	315	-4	4	-1
11	0	2	-3	116	-6	-1	-3	211	-7	7	-1	316	-4	6	-1
12	0	4	-3	117	-6	1	-3	212	-7	9	-1	317	-4	8	-1
13	0	6	-3	118	-6	3	-3	213	-7	11	-1	318	-4	10	-1
14	0	8	-3	119	-6	5	-3	214	-7	13	-1	319	-4	12	-1
15	0	10	-3	120	-6	7	-3	215	-7	15	-1	320	-4	14	-1
16	0	12	-3	121	-6	9	-3	216	-7	17	-1	321	-4	16	-1
17	0	14	-3	122	-6	11	-3	217	-7	19	-1	322	-4	18	-1
18	0	16	-3	123	-6	13	-3	218	-7	21	-1	323	-4	20	-1
19	0	18	-3	124	-6	15	-3	219	-7	23	-1	324	-4	22	-1
20	0	20	-3	125	-6	17	-3	220	-7	25	-1	325	-4	24	-1
21	0	22	-3	126	-6	19	-3	221	-7	27	-1	326	-4	26	-1
22	0	24	-3	127	-6	21	-3	222	-7	29	-1	327	-4	28	-1
23	0	26	-3	128	-6	23	-3	223	-7	31	-1	328	-4	30	-1
24	0	28	-3	129	-6	25	-3	224	-7	33	-1	329	-4	32	-1
25	0	30	-3	130	-6	27	-3	225	-7	35	-1	330	-4	34	-1
26	0	32	-3	131	-6	29	-3	226	-7	37	-1	331	-4	36	-1
27	0	34	-3	132	-6	31	-3	227	-7	39	-1	332	-4	38	-1
28	0	36	-3	133	-6	33	-3	228	-7	41	-1	333	-4	40	-1
29	0	38	-3	134	-6	35	-3	229	-7	43	-1	334	-4	42	-1
30	0	40	-3	135	-6	37	-3	230	-7	45	-1	335	-4	44	-1
31	0	42	-3	136	-6	39	-3	231	-7	47	-1	336	-4	46	-1
32	0	44	-3	137	-6	41	-3	232	-7	49	-1	337	-4	48	-1
33	0	46	-3	138	-6	43	-3	233	-7	51	-1	338	-4	50	-1
34	0	48	-3	139	-6	45	-3	234	-7	53	-1	339	-4	52	-1
35	0	50	-3	140	-6	47	-3	235	-7	55	-1	340	-4	54	-1
36	0	52	-3	141	-6	49	-3	236	-7	57	-1	341	-4	56	-1
37	0	54	-3	142	-6	51	-3	237	-7	59	-1	342	-4	58	-1
38	0	56	-3	143	-6	53	-3	238	-7	61	-1	343	-4	60	-1
39	0	58	-3	144	-6	55	-3	239	-7	63	-1	344	-4	62	-1
40	0	60	-3	145	-6	57	-3	240	-7	65	-1	345	-4	64	-1
41	0	62	-3	146	-6	59	-3	241	-7	67	-1	346	-4	66	-1
42	0	64	-3	147	-6	61	-3	242	-7	69	-1	347	-4	68	-1
43	0	66	-3	148	-6	63	-3	243	-7	71	-1	348	-4	70	-1
44	0	68	-3	149	-6	65	-3	244	-7	73	-1	349	-4	72	-1
45	0	70	-3	150	-6	67	-3	245	-7	75	-1	350	-4	74	-1
46	0	72	-3	151	-6	69	-3	246	-7	77	-1	351	-4	76	-1
47	0	74	-3	152	-6	71	-3	247	-7	79	-1	352	-4	78	-1
48	0	76	-3	153	-6	73	-3	248	-7	81	-1	353	-4	80	-1
49	0	78	-3	154	-6	75	-3	249	-7	83	-1	354	-4	82	-1
50	0	80	-3	155	-6	77	-3	250	-7	85	-1	355	-4	84	-1
51	0	82	-3	156	-6	79	-3	251	-7	87	-1	356	-4	86	-1
52	0	84	-3	157	-6	81	-3	252	-7	89	-1	357	-4	88	-1
53	0	86	-3	158	-6	83	-3	253	-7	91	-1	358	-4	90	-1
54	0	88	-3	159	-6	85	-3	254	-7	93	-1	359	-4	92	-1
55	0	90	-3	160	-6	87	-3	255	-7	95	-1	360	-4	94	-1
56	0	92	-3	161	-6	89	-3	256	-7	97	-1	361	-4	96	-1
57	0	94	-3	162	-6	91	-3	257	-7	99	-1	362	-4	98	-1
58	0	96	-3	163	-6	93	-3	258	-7	101	-1	363	-4	100	-1
59	0	98	-3	164	-6	95	-3	259	-7	103	-1	364	-4	102	-1
60	0	100	-3	165	-6	97	-3	260	-7	105	-1	365	-4	104	-1
61	0	102	-3	166	-6	99	-3	261	-7	107	-1	366	-4	106	-1
62	0	104	-3	167	-6	101	-3	262	-7	109	-1	367	-4	108	-1
63	0	106	-3	168	-6	103	-3	263	-7	111	-1	368	-4	110	-1
64	0	108	-3	169	-6	105	-3	264	-7	113	-1	369	-4	112	-1
65	0	110	-3	170	-6	107	-3	265	-7	115	-1	370	-4	114	-1
66	0	112	-3	171	-6	109	-3	266	-7	117	-1	371	-4	116	-1
67	0	114	-3	172	-6	111	-3	267	-7	119	-1	372	-4	118	-1
68	0	116	-3	173	-6	113	-3	268	-7	121	-1	373	-4	120	-1
69	0	118	-3	174	-6	115	-3	269	-7	123	-1	374	-4	122	-1
70	0	120	-3	175	-6	117	-3	270	-7	125	-1	375	-4	124	-1
71	0	122	-3	176	-6	119	-3	271	-7	127	-1	376	-4	126	-1
72	0	124	-3	177	-6	121	-3	272	-7	129	-1	377	-4	128	-1
73	0	126	-3	178	-6	123	-3	273	-7	131	-1	378	-4	130	-1
74	0	128	-3	179	-6	125	-3	274	-7	133	-1	379	-4	132	-1
75	0	130	-3	180	-6	127	-3	275	-7	135	-1	380	-4	134	-1
76	0	132	-3	181	-6	129	-3	276	-7	137	-1	381	-4	136	-1
77	0	134	-3	182	-6	131	-3	277	-7	139	-1	382	-4	138	-1
78	0	136	-3	183	-6	133	-3	278	-7	141	-1	383	-4	140	-1
79	0	138	-3	184	-6	135	-3	279	-7	143	-1	384	-4	142	-1
80	0	140	-3	185	-6	137	-3	280	-7	145	-1	385	-4	144	-1
81	0	142	-3	186	-6	139	-3	281	-7	147	-1	386	-4	146	-1
82	0	144	-3	187	-6	141	-3	282	-7	149	-1	387	-4	148	-1
83	0	146	-3	188	-6	143	-3	283	-7	151	-1	388	-4	150	-1
84	0	148	-3	189	-6	145	-3	284	-7	153	-1	389	-4	152	-1
85	0	150	-3	190	-6	147	-3	285	-7	155	-1	390	-4	154	-1
86	0	152	-3	191	-6	149	-3	286	-7	157	-1	391	-4	156	-1
87	0	154	-3	192	-6	151	-3	287	-7	159	-1	392	-4	158	-1
88	0	156	-3	193	-6	153	-3	288	-7	161	-1	393	-4	160	-1
89	0	158	-3	194	-6	155	-3	289	-7	163	-1	394	-4	162	-1
90	0	160	-3	195	-6	157	-3	290	-7	165	-1	395	-4	164	-1
91	0	162	-3	196	-6	159	-3	291	-7	167	-1	396	-4	166	-1
92	0	164	-3	197	-6	161	-3	292	-7	169	-1	397	-4	168	-1
93	0	166	-3	198	-6	163	-3	293	-7	171	-1	398	-4	170	-1
94	0	168	-3	199	-6	165	-3	294	-7	173	-1	399	-4	172	-1
95	0	170	-3	200	-6	167	-3	295	-7	175	-1	400	-4	174	-1
96	0	172	-3	201	-6	169	-3	296	-7	177	-1	401	-4	176	-1
97	0	174	-3	202	-6	171	-3	297	-7	179	-1	402	-4	178	-1
98	0	176	-3	203	-6	173	-3	298	-7	181	-1	403	-4	180	-1
99	0	178	-3	204	-6	175	-3	299	-7	183	-1	404	-4	182	-1
100	0	180	-3	205	-6	177	-3	300	-7	185	-1	405	-4	184	-1
101	0	182	-3	206	-6	179	-3	301	-7	187	-1	406	-4	186	-1
102	0	184	-3	207	-6	181	-3	302	-7	189	-1	407	-4	188	-1
103	0	186	-3	208	-6	183	-3	303	-7	191	-1	408	-4	190	-1
104	0	188	-3	209	-6	185	-3	304	-7	193	-1	409	-4	192	-1
105	0	190	-3	210	-6	187	-3	305	-7	195	-1	410	-4	194	-1
106	0	192	-3	211	-6	189	-3	306	-7	197	-1	411	-4	196	-1
107	0	194	-3	212	-6	191	-3	307	-7	199	-1	412	-4	198	-1
108	0	196	-3	213	-6	193									

SHEAR STRESSES FOR LOAD CASE 1 (PSI)											
ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX
1	3	-4	-1	2	-4	-3	-1	3	-5	4	-1
7	-1	0	0	8	-2	-1	0	4	-1	0	0
13	-1	-3	0	14	-1	-1	0	10	-1	0	0
19	-1	0	0	20	-1	-1	0	16	-1	0	0
25	0	-3	0	26	0	-2	0	22	0	-1	0
31	-1	-1	0	32	0	-1	0	28	0	0	0
37	0	-2	0	38	0	-1	0	34	0	-1	0
43	0	0	0	44	1	-1	0	40	1	-1	0
49	3	-6	-1	50	-4	-5	0	46	-5	-1	0
55	-1	-4	0	56	-2	-1	0	52	-3	0	0
61	1	-6	0	62	-2	-1	0	58	-3	0	0
67	-2	-4	0	68	-2	-1	0	64	-1	0	0
73	-3	-3	1	74	-2	-1	0	70	-1	0	0
79	-3	-4	1	80	-2	-1	0	76	-1	0	0
85	-1	-2	2	86	0	-1	0	82	-1	0	0
91	-1	-2	2	92	0	-1	0	88	-1	0	0
97	-8	-3	5	98	-6	-2	1	94	-4	-1	0
103	-3	-2	5	104	-6	-2	1	100	-4	-1	0
109	-3	-2	5	110	-6	-2	1	106	-4	-1	0
115	-3	-2	5	116	-6	-2	1	112	-4	-1	0
121	-7	-1	3	122	-5	-1	0	118	-3	0	0
127	0	-1	1	128	-1	-1	0	124	-1	0	0
133	-3	-1	1	134	-1	-1	0	130	-1	0	0
139	-3	-1	1	140	-2	-1	0	136	-1	0	0
145	-7	0	0	146	-6	-2	1	142	-4	-1	0
151	0	0	0	152	0	-1	0	148	-1	0	0
157	0	0	0	158	0	-1	0	154	-1	0	0
163	0	0	0	164	-1	-1	0	160	-1	0	0
169	-3	-1	0	170	-1	-1	0	166	-1	0	0
175	-3	-1	0	176	-1	-1	0	172	-1	0	0
181	0	-3	-1	182	-2	-3	0	178	-2	-1	0
187	-3	-3	-1	188	-2	-3	0	184	-2	-1	0
193	0	-3	-1	194	-2	-3	0	190	-2	-1	0
199	0	0	-1	200	-2	-1	0	196	-2	-1	0
205	0	0	-1	206	-2	-1	0	202	-2	-1	0
211	1	0	-1	212	-1	-1	0	208	-1	-1	0
217	-4	0	0	218	-1	-1	0	214	-1	-1	0
223	-4	0	0	224	-3	-2	0	220	-3	-2	0
229	0	0	0	230	-3	-2	0	226	-3	-2	0
235	0	0	0	236	-3	-2	0	232	-3	-2	0
241	0	0	0	242	-3	-2	0	238	-3	-2	0
247	0	0	0	248	-3	-2	0	244	-3	-2	0
253	0	0	0	254	-3	-2	0	250	-3	-2	0
259	0	0	0	260	-3	-2	0	256	-3	-2	0
265	0	0	0	266	-3	-2	0	262	-3	-2	0
271	0	0	0	272	-3	-2	0	268	-3	-2	0
277	0	0	0	278	-3	-2	0	274	-3	-2	0
283	0	0	0	284	-3	-2	0	280	-3	-2	0
289	0	0	0	290	-3	-2	0	286	-3	-2	0
295	0	0	0	296	-3	-2	0	292	-3	-2	0
301	0	0	0	302	-3	-2	0	298	-3	-2	0
307	0	0	0	308	-3	-2	0	304	-3	-2	0
								310	-3	-2	0
								306	-3	-2	0
								302	-3	-2	0
								298	-3	-2	0
								294	-3	-2	0
								290	-3	-2	0
								286	-3	-2	0
								282	-3	-2	0
								278	-3	-2	0
								274	-3	-2	0
								270	-3	-2	0
								266	-3	-2	0
								262	-3	-2	0
								258	-3	-2	0
								254	-3	-2	0
								250	-3	-2	0
								246	-3	-2	0
								242	-3	-2	0
								238	-3	-2	0
								234	-3	-2	0
								230	-3	-2	0
								226	-3	-2	0
								222	-3	-2	0
								218	-3	-2	0
								214	-3	-2	0
								210	-3	-2	0
								206	-3	-2	0
								202	-3	-2	0
								198	-3	-2	0
								194	-3	-2	0
								190	-3	-2	0
								186	-3	-2	0
								182	-3	-2	0
								178	-3	-2	0
								174	-3	-2	0
								170	-3	-2	0
								166	-3	-2	0
								162	-3	-2	0
								158	-3	-2	0
								154	-3	-2	0
								150	-3	-2	0
								146	-3	-2	0
								142	-3	-2	0
								138	-3	-2	0
								134	-3	-2	0
								130	-3	-2	0
								126	-3	-2	0
								122	-3	-2	0
								118	-3	-2	0
								114	-3	-2	0
								110	-3	-2	0
								106	-3	-2	0
								102	-3	-2	0
								98	-3	-2	0
								94	-3	-2	0
								90	-3	-2	0
								86	-3	-2	0
								82	-3	-2	0
								78	-3	-2	0
								74	-3	-2	0
								70	-3	-2	0
								66	-3	-2	0
								62	-3	-2	0
								58	-3	-2	0
								54	-3	-2	0
								50	-3	-2	0
								46	-3	-2	0
								42	-3	-2	0
								38	-3	-2	0
								34	-3	-2	0
								30	-3	-2	0
								26	-3	-2	0
								22	-3	-2	0
								18	-3	-2	0
								14	-3	-2	0
								10	-3	-2	0
								6	-3	-2	0

Figure D1. (Sheet 4 of 5)

SHEAR STRESSES FOR LOAD CASE 1 (PSI)

ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX
313	1	-3	-2	314	-1	2	-2	315	0	-2	-2	316	-2	2	-2	317	0	-3	-2
319	-2	1	-1	320	-1	0	-1	321	-1	-1	-1	322	-1	-1	-1	323	0	-1	0
325	0	-2	-2	326	1	2	-2	327	1	2	-2	328	2	2	-2	329	3	-2	-2
331	4	-2	-1	332	3	1	0	333	2	0	0	334	1	0	0	335	-1	0	0
337	1	-4	0	338	-2	4	0	339	0	-3	0	340	-3	5	0	341	-1	-2	0
343	-3	4	0	344	-2	2	0	345	-2	1	0	346	-1	0	0	347	-1	0	0
349	-2	-3	1	350	-2	4	1	351	-1	-3	1	352	-3	6	1	353	0	0	1
355	-1	-3	-1	356	-1	4	0	357	-2	-2	0	358	-3	1	0	359	1	0	0
361	1	-5	-1	362	-1	4	0	363	0	-2	0	364	-1	4	0	365	1	1	0
367	0	-8	-1	368	0	3	0	369	1	-2	0	370	1	1	0	371	0	1	0
373	0	-3	0	374	0	3	0	375	1	-2	0	376	1	4	0	377	2	-1	0
379	3	4	0	380	2	2	0	381	1	1	1	382	1	1	0	383	1	0	0

MIN.	ELEM	VXY	ELEM	VYZ	ELEM	VZX
	270	-8	291	-9	265	-4
MAX.	282	4	366	11	97	5

Figure D1. (Sheet 5 of 5)

1/1-0	1/400-0			1/1000-0	1/2011-0	1/2000-0	1/2017-0
1/110-0	1/401-0			1/1001-0	1/2012-0	1/2001-0	1/2018-0
1/200-0	1/700-0	1/200-0	1/1000-0	1/1002-0	1/2013-0	1/2002-0	1/2019-0
1/300-0	1/800-0	1/300-0	1/1001-0	1/1003-0	1/2014-0	1/2003-0	1/2020-0
1/400-0	1/900-0	1/400-0	1/1002-0	1/1004-0	1/2015-0	1/2004-0	1/2021-0
1/500-0	1/000-0	1/500-0	1/1003-0	1/1005-0	1/2016-0	1/2005-0	1/2022-0
1/600-0		1/600-0	1/1004-0	1/1006-0	1/2017-0	1/2006-0	1/2023-0
1/700-0		1/700-0	1/1005-0	1/1007-0	1/2018-0	1/2007-0	1/2024-0
1/800-0		1/800-0	1/1006-0	1/1008-0	1/2019-0	1/2008-0	1/2025-0
1/900-0		1/900-0	1/1007-0	1/1009-0	1/2020-0	1/2009-0	1/2026-0
			1/1008-0	1/1010-0	1/2021-0	1/2010-0	1/2027-0
			1/1009-0	1/1011-0	1/2022-0	1/2011-0	1/2028-0
			1/1010-0	1/1012-0	1/2023-0	1/2012-0	1/2029-0
			1/1011-0	1/1013-0	1/2024-0	1/2013-0	1/2030-0
			1/1012-0	1/1014-0	1/2025-0	1/2014-0	1/2031-0
			1/1013-0	1/1015-0	1/2026-0	1/2015-0	1/2032-0
			1/1014-0	1/1016-0	1/2027-0	1/2016-0	1/2033-0
			1/1015-0	1/1017-0	1/2028-0	1/2017-0	1/2034-0
			1/1016-0	1/1018-0	1/2029-0	1/2018-0	1/2035-0
			1/1017-0	1/1019-0	1/2030-0	1/2019-0	1/2036-0
			1/1018-0	1/1020-0	1/2031-0	1/2020-0	1/2037-0
			1/1019-0	1/1021-0	1/2032-0	1/2021-0	1/2038-0
			1/1020-0	1/1022-0	1/2033-0	1/2022-0	1/2039-0
			1/1021-0	1/1023-0	1/2034-0	1/2023-0	1/2040-0
			1/1022-0	1/1024-0	1/2035-0	1/2024-0	1/2041-0
			1/1023-0	1/1025-0	1/2036-0	1/2025-0	1/2042-0
			1/1024-0	1/1026-0	1/2037-0	1/2026-0	1/2043-0
			1/1025-0	1/1027-0	1/2038-0	1/2027-0	1/2044-0
			1/1026-0	1/1028-0	1/2039-0	1/2028-0	1/2045-0
			1/1027-0	1/1029-0	1/2040-0	1/2029-0	1/2046-0
			1/1028-0	1/1030-0	1/2041-0	1/2030-0	1/2047-0
			1/1029-0	1/1031-0	1/2042-0	1/2031-0	1/2048-0
			1/1030-0	1/1032-0	1/2043-0	1/2032-0	1/2049-0
			1/1031-0	1/1033-0	1/2044-0	1/2033-0	1/2050-0
			1/1032-0	1/1034-0	1/2045-0	1/2034-0	1/2051-0
			1/1033-0	1/1035-0	1/2046-0	1/2035-0	1/2052-0
			1/1034-0	1/1036-0	1/2047-0	1/2036-0	1/2053-0
			1/1035-0	1/1037-0	1/2048-0	1/2037-0	1/2054-0
			1/1036-0	1/1038-0	1/2049-0	1/2038-0	1/2055-0
			1/1037-0	1/1039-0	1/2050-0	1/2039-0	1/2056-0
			1/1038-0	1/1040-0	1/2051-0	1/2040-0	1/2057-0
			1/1039-0	1/1041-0	1/2052-0	1/2041-0	1/2058-0
			1/1040-0	1/1042-0	1/2053-0	1/2042-0	1/2059-0

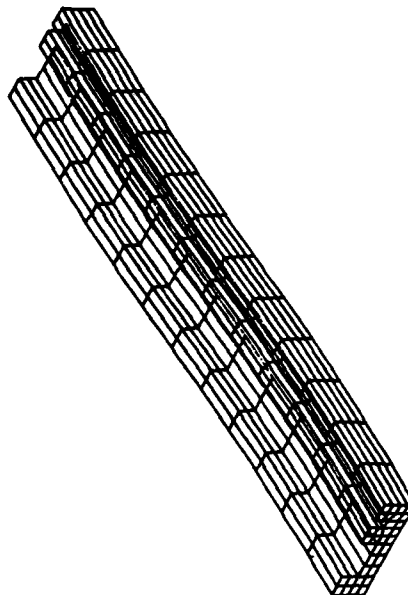
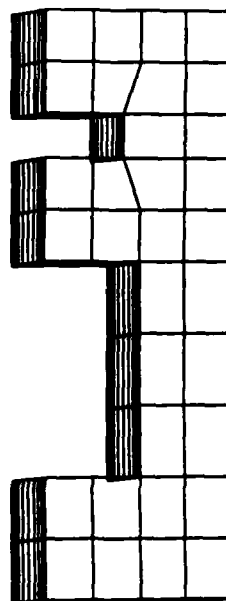


Figure D2. Finite-element analysis for load case 2 with $K = 175 \text{ lb/in.}^3$ (Sheet 1 of 5)

NORMAL STRESSES FOR LOAD CASE 2 (PSI)

ELEM	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360	361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383	384	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399	400	401	402	403	404	405	406	407	408	409	410	411	412	413	414	415	416	417	418	419	420	421	422	423	424	425	426	427	428	429	430	431	432	433	434	435	436	437	438	439	440	441	442	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459	460	461	462	463	464	465	466	467	468	469	470	471	472	473	474	475	476	477	478	479	480	481	482	483	484	485	486	487	488	489	490	491	492	493	494	495	496	497	498	499	500	501	502	503	504	505	506	507	508	509	510	511	512	513	514	515	516	517	518	519	520	521	522	523	524	525	526	527	528	529	530	531	532	533	534	535	536	537	538	539	540	541	542	543	544	545	546	547	548	549	550	551	552	553	554	555	556	557	558	559	560	561	562	563	564	565	566	567	568	569	570	571	572	573	574	575	576	577	578	579	580	581	582	583	584	585	586	587	588	589	590	591	592	593	594	595	596	597	598	599	600	601	602	603	604	605	606	607	608	609	610	611	612	613	614	615	616	617	618	619	620	621	622	623	624	625	626	627	628	629	630	631	632	633	634	635	636	637	638	639	640	641	642	643	644	645	646	647	648	649	650	651	652	653	654	655	656	657	658	659	660	661	662	663	664	665	666	667	668	669	670	671	672	673	674	675	676	677	678	679	680	681	682	683	684	685	686	687	688	689	690	691	692	693	694	695	696	697	698	699	700	701	702	703	704	705	706	707	708	709	710	711	712	713	714	715	716	717	718	719	720	721	722	723	724	725	726	727	728	729	730	731	732	733	734	735	736	737	738	739	740	741	742	743	744	745	746	747	748	749	750	751	752	753	754	755	756	757	758	759	760	761	762	763	764	765	766	767	768	769	770	771	772	773	774	775	776	777	778	779	780	781	782	783	784	785	786	787	788	789	790	791	792	793	794	795	796	797	798	799	800	801	802	803	804	805	806	807	808	809	810	811	812	813	814	815	816	817	818	819	820	821	822	823	824	825	826	827	828	829	830	831	832	833	834	835	836	837	838	839	840	841	842	843	844	845	846	847	848	849	850	851	852	853	854	855	856	857	858	859	860	861	862	863	864	865	866	867	868	869	870	871	872	873	874	875	876	877	878	879	880	881	882	883	884	885	886	887	888	889	890	891	892	893	894	895	896	897	898	899	900	901	902	903	904	905	906	907	908	909	910	911	912	913	914	915	916	917	918	919	920	921	922	923	924	925	926	927	928	929	930	931	932	933	934	935	936	937	938	939	940	941	942	943	944	945	946	947	948	949	950	951	952	953	954	955	956	957	958	959	960	961	962	963	964	965	966	967	968	969	970	971	972	973	974	975	976	977	978	979	980	981	982	983	984	985	986	987	988	989	990	991	992	993	994	995	996	997	998	999	1000	1001	1002	1003	1004	1005	1006	1007	1008	1009	1010	1011	1012	1013	1014	1015	1016	1017	1018	1019	1020	1021	1022	1023	1024	1025	1026	1027	1028	1029	1030	1031	1032	1033	1034	1035	1036	1037	1038	1039	1040	1041	1042	1043	1044	1045	1046	1047	1048	1049	1050	1051	1052	1053	1054	1055	1056	1057	1058	1059	1060	1061	1062	1063	1064	1065	1066	1067	1068	1069	1070	1071	1072	1073	1074	1075	1076	1077	1078	1079	1080	1081	1082	1083	1084	1085	1086	1087	1088	1089	1090	1091	1092	1093	1094	1095	1096	1097	1098	1099	1100	1101	1102	1103	1104	1105	1106	1107	1108	1109	1110	1111	1112	1113	1114	1115	1116	1117	1118	1119	1120	1121	1122	1123	1124	1125	1126	1127	1128	1129	1130	1131	1132	1133	1134	1135	1136	1137	1138	1139	1140	1141	1142	1143	1144	1145	1146	1147	1148	1149	1150	1151	1152	1153	1154	1155	1156	1157	1158	1159	1160	1161	1162	1163	1164	1165	1166	1167	1168	1169	1170	1171	1172	1173	1174	1175	1176	1177	1178	1179	1180	1181	1182	1183	1184	1185	1186	1187	1188	1189	1190	1191	1192	1193	1194	1195	1196	1197	1198	1199	1200	1201	1202	1203	1204	1205	1206	1207	1208	1209	1210	1211	1212	1213	1214	1215	1216	1217	1218	1219	1220	12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SHEAR STRESSES FOR LOAD CASE 2 (PSI)

ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX
1	2	-17	-6	9	2	-18	-6	16	-2	16	-6	1	1	0	0	10	1	0	0	1	1	0	0
13	5	-13	-2	15	1	-14	0	16	0	13	0	17	0	13	0	16	0	13	0	17	0	13	0
25	0	-11	2	27	0	-12	2	28	0	10	2	29	0	-10	2	22	0	-10	2	23	0	-10	2
31	-2	-16	1	33	-1	-10	1	34	-2	0	1	35	-1	-12	1	36	-2	-12	1	37	-1	-12	1
43	1	-9	1	45	-1	-10	1	46	0	-2	0	47	-1	-10	1	48	0	-2	0	49	-1	-10	1
55	-2	-18	1	57	-2	-19	1	58	-1	-10	1	59	-2	-16	1	60	-1	-10	1	61	-2	-16	1
61	5	-13	-2	63	1	-15	-2	64	-2	-10	-2	65	1	-10	-2	66	-2	-10	-2	67	1	-10	-2
73	1	-6	1	75	0	-11	1	76	-1	0	1	77	0	-8	1	78	-1	0	1	79	0	-8	1
85	-5	-8	9	87	-1	-9	1	88	-1	0	9	89	-5	-2	1	90	-1	0	9	91	-5	-2	1
97	-12	-6	12	99	-3	-1	1	100	-1	0	1	101	-12	-1	1	102	-3	-1	1	103	-12	-1	1
103	-5	-5	12	105	-1	-1	1	106	-1	0	1	107	-5	-1	1	108	-1	0	1	109	-5	-1	1
115	-12	-4	5	117	-1	-1	1	118	-1	0	1	119	-12	-1	1	120	-1	0	1	121	-12	-1	1
127	-12	-4	5	129	-1	-1	1	130	-1	0	1	131	-12	-1	1	132	-1	0	1	133	-12	-1	1
139	-12	-4	5	141	-1	-1	1	142	-1	0	1	143	-12	-1	1	144	-1	0	1	145	-12	-1	1
151	-12	-4	5	153	-1	-1	1	154	-1	0	1	155	-12	-1	1	156	-1	0	1	157	-12	-1	1
163	-12	-4	5	165	-1	-1	1	166	-1	0	1	167	-12	-1	1	168	-1	0	1	169	-12	-1	1
175	-12	-4	5	177	-1	-1	1	178	-1	0	1	179	-12	-1	1	180	-1	0	1	181	-12	-1	1
187	-12	-4	5	189	-1	-1	1	190	-1	0	1	191	-12	-1	1	192	-1	0	1	193	-12	-1	1
195	-12	-4	5	197	-1	-1	1	198	-1	0	1	199	-12	-1	1	200	-1	0	1	201	-12	-1	1
203	-12	-4	5	205	-1	-1	1	206	-1	0	1	207	-12	-1	1	208	-1	0	1	209	-12	-1	1
211	-12	-4	5	213	-1	-1	1	214	-1	0	1	215	-12	-1	1	216	-1	0	1	217	-12	-1	1
219	-12	-4	5	221	-1	-1	1	222	-1	0	1	223	-12	-1	1	224	-1	0	1	225	-12	-1	1
227	-12	-4	5	229	-1	-1	1	230	-1	0	1	231	-12	-1	1	232	-1	0	1	233	-12	-1	1
235	-12	-4	5	237	-1	-1	1	238	-1	0	1	239	-12	-1	1	240	-1	0	1	241	-12	-1	1
243	-12	-4	5	245	-1	-1	1	246	-1	0	1	247	-12	-1	1	248	-1	0	1	249	-12	-1	1
251	-12	-4	5	253	-1	-1	1	254	-1	0	1	255	-12	-1	1	256	-1	0	1	257	-12	-1	1
259	-12	-4	5	261	-1	-1	1	262	-1	0	1	263	-12	-1	1	264	-1	0	1	265	-12	-1	1
267	-12	-4	5	269	-1	-1	1	270	-1	0	1	271	-12	-1	1	272	-1	0	1	273	-12	-1	1
275	-12	-4	5	277	-1	-1	1	278	-1	0	1	279	-12	-1	1	280	-1	0	1	281	-12	-1	1
283	-12	-4	5	285	-1	-1	1	286	-1	0	1	287	-12	-1	1	288	-1	0	1	289	-12	-1	1
291	-12	-4	5	293	-1	-1	1	294	-1	0	1	295	-12	-1	1	296	-1	0	1	297	-12	-1	1
299	-12	-4	5	301	-1	-1	1	302	-1	0	1	303	-12	-1	1	304	-1	0	1	305	-12	-1	1
307	-12	-4	5	309	-1	-1	1	310	-1	0	1	311	-12	-1	1	312	-1	0	1	313	-12	-1	1

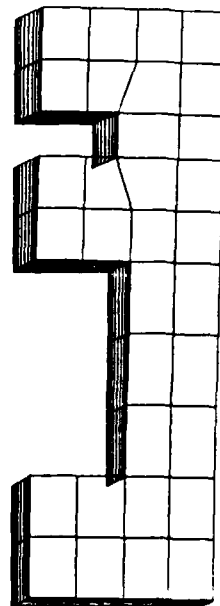
Figure D2. (Sheet 4 of 5)

SHEAR STRESSES FOR LOAD CASE 2 (PSI)

ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX
311	3	-11	-1	314	-1	9	-1	317	2	-10	-2	320	-1	2	-2	323	-1	-10	-2
312	0	7	-1	315	-1	1	-1	318	-3	17	0	321	0	-1	0	324	0	-1	0
313	1	-8	-1	316	-1	1	-1	319	0	-1	0	322	0	13	-2	325	4	13	-2
314	1	5	-2	317	2	1	-1	320	0	0	0	323	0	0	0	326	0	0	0
315	1	5	-2	318	2	1	-1	321	0	0	0	324	0	0	0	327	0	0	0
316	1	5	-2	319	2	1	-1	322	0	0	0	325	0	0	0	328	0	0	0
317	1	5	-2	320	2	1	-1	323	0	0	0	326	0	0	0	329	0	0	0
318	1	5	-2	321	2	1	-1	324	0	0	0	327	0	0	0	330	0	0	0
319	1	5	-2	322	2	1	-1	325	0	0	0	328	0	0	0	331	0	0	0
320	1	5	-2	323	2	1	-1	326	0	0	0	329	0	0	0	332	0	0	0
321	1	5	-2	324	2	1	-1	327	0	0	0	330	0	0	0	333	0	0	0
322	1	5	-2	325	2	1	-1	328	0	0	0	331	0	0	0	334	0	0	0
323	1	5	-2	326	2	1	-1	329	0	0	0	332	0	0	0	335	0	0	0
324	1	5	-2	327	2	1	-1	330	0	0	0	333	0	0	0	336	0	0	0
325	1	5	-2	328	2	1	-1	331	0	0	0	334	0	0	0	337	0	0	0
326	1	5	-2	329	2	1	-1	332	0	0	0	335	0	0	0	338	0	0	0
327	1	5	-2	330	2	1	-1	333	0	0	0	336	0	0	0	339	0	0	0
328	1	5	-2	331	2	1	-1	334	0	0	0	337	0	0	0	340	0	0	0
329	1	5	-2	332	2	1	-1	335	0	0	0	338	0	0	0	341	0	0	0
330	1	5	-2	333	2	1	-1	336	0	0	0	339	0	0	0	342	0	0	0
331	1	5	-2	334	2	1	-1	337	0	0	0	340	0	0	0	343	0	0	0
332	1	5	-2	335	2	1	-1	338	0	0	0	341	0	0	0	344	0	0	0
333	1	5	-2	336	2	1	-1	339	0	0	0	342	0	0	0	345	0	0	0
334	1	5	-2	337	2	1	-1	340	0	0	0	343	0	0	0	346	0	0	0
335	1	5	-2	338	2	1	-1	341	0	0	0	344	0	0	0	347	0	0	0
336	1	5	-2	339	2	1	-1	342	0	0	0	345	0	0	0	348	0	0	0
337	1	5	-2	340	2	1	-1	343	0	0	0	346	0	0	0	349	0	0	0
338	1	5	-2	341	2	1	-1	344	0	0	0	347	0	0	0	350	0	0	0
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341	1	5	-2	344	2	1	-1	347	0	0	0	350	0	0	0	353	0	0	0
342	1	5	-2	345	2	1	-1	348	0	0	0	351	0	0	0	354	0	0	0
343	1	5	-2	346	2	1	-1	349	0	0	0	352	0	0	0	355	0	0	0
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359	1	5	-2	362	2	1	-1	365	0	0	0	368	0	0	0	371	0	0	0
360	1	5	-2	363	2	1	-1	366	0	0	0	369	0	0	0	372	0	0	0
361	1	5	-2	364	2	1	-1	367	0	0	0	370	0	0	0	373	0	0	0
362	1	5	-2	365	2	1	-1	368	0	0	0	371	0	0	0	374	0	0	0
363	1	5	-2	366	2	1	-1	369	0	0	0	372	0	0	0	375	0	0	0
364	1	5	-2	367	2	1	-1	370	0	0	0	373	0	0	0	376	0	0	0
365	1	5	-2	368	2	1	-1	371	0	0	0	374	0	0	0	377	0	0	0
366	1	5	-2	369	2	1	-1	372	0	0	0	375	0	0	0	378	0	0	0
367	1	5	-2	370	2	1	-1	373	0	0	0	376	0	0	0	379	0	0	0
368	1	5	-2	371	2	1	-1	374	0	0	0	377	0	0	0	380	0	0	0
369	1	5	-2	372	2	1	-1	375	0	0	0	378	0	0	0	381	0	0	0
370	1	5	-2	373	2	1	-1	376	0	0	0	379	0	0	0	382	0	0	0
371	1	5	-2	374	2	1	-1	377	0	0	0	380	0	0	0	383	0	0	0
372	1	5	-2	375	2	1	-1	378	0	0	0	381	0	0	0	384	0	0	0
373	1	5	-2	376	2	1	-1	379	0	0	0	382	0	0	0	385	0	0	0
374	1	5	-2	377	2	1	-1	380	0	0	0	383	0	0	0	386	0	0	0
375	1	5	-2	378	2	1	-1	381	0	0	0	384	0	0	0	387	0	0	0
376	1	5	-2	379	2	1	-1	382	0	0	0	385	0	0	0	388	0	0	0
377	1	5	-2	380	2	1	-1	383	0	0	0	386	0	0	0	389	0	0	0
378	1	5	-2	381	2	1	-1	384	0	0	0	387	0	0	0	390	0	0	0
379	1	5	-2	382	2	1	-1	385	0	0	0	388	0	0	0	391	0	0	0
380	1	5	-2	383	2	1	-1	386	0	0	0	389	0	0	0	392	0	0	0
381	1	5	-2	384	2	1	-1	387	0	0	0	390	0	0	0	393	0	0	0
382	1	5	-2	385	2	1	-1	388	0	0	0	391	0	0	0	394	0	0	0
383	1	5	-2	386	2	1	-1	389	0	0	0	392	0	0	0	395	0	0	0
384	1	5	-2	387	2	1	-1	390	0	0	0	393	0	0	0	396	0	0	0
385	1	5	-2	388	2	1	-1	391	0	0	0	394	0	0	0	397	0	0	0
386	1	5	-2	389	2	1	-1	392	0	0	0	395	0	0	0	398	0	0	0
387	1	5	-2	390	2	1	-1	393	0	0	0	396	0	0	0	399	0	0	0
388	1	5	-2	391	2	1	-1	394	0	0	0	397	0	0	0	400	0	0	0
389	1	5	-2	392	2	1	-1	395	0	0	0	398	0	0	0	401	0	0	0
390	1	5	-2	393	2	1	-1	396	0	0	0	399	0	0	0	402	0	0	0
391	1	5	-2	394	2	1	-1	397	0	0	0	400	0	0	0	403	0	0	0
392	1	5	-2	395	2	1	-1	398	0	0	0	401	0	0	0	404	0	0	0
393	1	5	-2	396	2	1	-1	399	0	0	0	402	0	0	0	405	0	0	0
394	1	5	-2	397	2	1	-1	400	0	0	0	403	0	0	0	406	0	0	0
395	1	5	-2	398	2	1	-1	401	0	0	0	404	0	0	0	407	0	0	0
396	1	5	-2	399	2	1	-1	402	0	0	0	405	0	0	0	408	0	0	0
397	1	5	-2	400	2	1	-1	403	0	0	0	406	0	0	0	409	0	0	0
398	1	5	-2	401	2	1	-1	404	0	0	0	407	0	0	0	410	0	0	0
399	1	5	-2	402	2	1	-1	405	0	0	0	408	0	0	0	411	0	0	0
400	1	5	-2	403	2	1	-1	406	0	0	0	409	0	0	0	412	0	0	0
401	1	5</																	

1/1-B	1/10-B	1/100-B	1/237-B	1/200-B	1/337-B
1/13-B	1/61-B	1/181-B	1/229-B	1/301-B	1/349-B
1/25-B	1/73-B	1/145-B	1/183-B	1/241-B	1/313-B
1/37-B	1/85-B	1/121-B	1/153-B	1/205-B	1/261-B
		1/133-B	1/165-B	1/217-B	1/283-B
		1/109-B	1/137-B	1/189-B	1/251-B

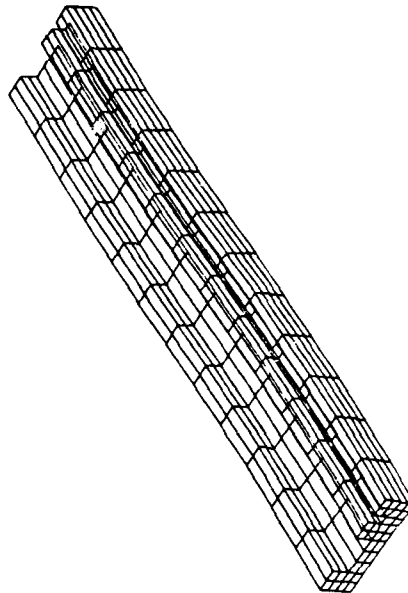
FINITE-ELEMENT ANALYSIS OF PROPOSED 'SHORT' STRUCTURE, AUG 82
UNDEFORMED GRID
SHORT STRUCTURE: 156 NODES, 284 ELEMENTS



FINITE-ELEMENT ANALYSIS OF PROPOSED 'SHORT' STRUCTURE, AUG 82
LOAD CASE NO-3
SHORT STRUCTURE: 156 NODES, 284 ELEMENTS



FINITE-ELEMENT ANALYSIS OF PROPOSED 'SHORT' STRUCTURE, AUG 82
LOAD CASE NO-3



FINITE-ELEMENT ANALYSIS OF PROPOSED 'SHORT' STRUCTURE, AUG 82
LOAD CASE NO-3

Figure D3. Finite-element analysis for load case 3 with $K = 175 \text{ lb/in.}^3$ (Sheet 1 of 5)

NORMAL STRESSES FOR LOAD CASE 3 (PSI)											
ELEM	SX	SY	SZ	ELEM	SX	SY	SZ	ELEM	SX	SY	SZ
1	0	-38	-9	101	-1	-40	-9	201	1	10	-9
2	1	-37	-6	102	0	-39	-5	202	0	0	-5
3	0	-32	-6	103	0	-28	-1	203	0	-1	-1
4	0	-29	-5	104	0	-27	-1	204	0	-1	-1
5	0	-26	-5	105	0	-20	-1	205	0	-1	-1
6	0	-24	-5	106	0	-16	-1	206	0	-1	-1
7	0	-22	-5	107	0	-12	-1	207	0	-1	-1
8	0	-20	-5	108	0	-9	-1	208	0	-1	-1
9	0	-18	-5	109	0	-6	-1	209	0	-1	-1
10	0	-16	-5	110	0	-3	-1	210	0	-1	-1
11	0	-14	-5	111	0	0	-1	211	0	-1	-1
12	0	-12	-5	112	0	0	-1	212	0	-1	-1
13	0	-10	-5	113	0	0	-1	213	0	-1	-1
14	0	-8	-5	114	0	0	-1	214	0	-1	-1
15	0	-6	-5	115	0	0	-1	215	0	-1	-1
16	0	-4	-5	116	0	0	-1	216	0	-1	-1
17	0	-2	-5	117	0	0	-1	217	0	-1	-1
18	0	0	-5	118	0	0	-1	218	0	-1	-1
19	0	0	-5	119	0	0	-1	219	0	-1	-1
20	0	0	-5	120	0	0	-1	220	0	-1	-1
21	0	0	-5	121	0	0	-1	221	0	-1	-1
22	0	0	-5	122	0	0	-1	222	0	-1	-1
23	0	0	-5	123	0	0	-1	223	0	-1	-1
24	0	0	-5	124	0	0	-1	224	0	-1	-1
25	0	0	-5	125	0	0	-1	225	0	-1	-1
26	0	0	-5	126	0	0	-1	226	0	-1	-1
27	0	0	-5	127	0	0	-1	227	0	-1	-1
28	0	0	-5	128	0	0	-1	228	0	-1	-1
29	0	0	-5	129	0	0	-1	229	0	-1	-1
30	0	0	-5	130	0	0	-1	230	0	-1	-1
31	0	0	-5	131	0	0	-1	231	0	-1	-1
32	0	0	-5	132	0	0	-1	232	0	-1	-1
33	0	0	-5	133	0	0	-1	233	0	-1	-1
34	0	0	-5	134	0	0	-1	234	0	-1	-1
35	0	0	-5	135	0	0	-1	235	0	-1	-1
36	0	0	-5	136	0	0	-1	236	0	-1	-1
37	0	0	-5	137	0	0	-1	237	0	-1	-1
38	0	0	-5	138	0	0	-1	238	0	-1	-1
39	0	0	-5	139	0	0	-1	239	0	-1	-1
40	0	0	-5	140	0	0	-1	240	0	-1	-1
41	0	0	-5	141	0	0	-1	241	0	-1	-1
42	0	0	-5	142	0	0	-1	242	0	-1	-1
43	0	0	-5	143	0	0	-1	243	0	-1	-1
44	0	0	-5	144	0	0	-1	244	0	-1	-1
45	0	0	-5	145	0	0	-1	245	0	-1	-1
46	0	0	-5	146	0	0	-1	246	0	-1	-1
47	0	0	-5	147	0	0	-1	247	0	-1	-1
48	0	0	-5	148	0	0	-1	248	0	-1	-1
49	0	0	-5	149	0	0	-1	249	0	-1	-1
50	0	0	-5	150	0	0	-1	250	0	-1	-1
51	0	0	-5	151	0	0	-1	251	0	-1	-1
52	0	0	-5	152	0	0	-1	252	0	-1	-1
53	0	0	-5	153	0	0	-1	253	0	-1	-1
54	0	0	-5	154	0	0	-1	254	0	-1	-1
55	0	0	-5	155	0	0	-1	255	0	-1	-1
56	0	0	-5	156	0	0	-1	256	0	-1	-1
57	0	0	-5	157	0	0	-1	257	0	-1	-1
58	0	0	-5	158	0	0	-1	258	0	-1	-1
59	0	0	-5	159	0	0	-1	259	0	-1	-1
60	0	0	-5	160	0	0	-1	260	0	-1	-1
61	0	0	-5	161	0	0	-1	261	0	-1	-1
62	0	0	-5	162	0	0	-1	262	0	-1	-1
63	0	0	-5	163	0	0	-1	263	0	-1	-1
64	0	0	-5	164	0	0	-1	264	0	-1	-1
65	0	0	-5	165	0	0	-1	265	0	-1	-1
66	0	0	-5	166	0	0	-1	266	0	-1	-1
67	0	0	-5	167	0	0	-1	267	0	-1	-1
68	0	0	-5	168	0	0	-1	268	0	-1	-1
69	0	0	-5	169	0	0	-1	269	0	-1	-1
70	0	0	-5	170	0	0	-1	270	0	-1	-1
71	0	0	-5	171	0	0	-1	271	0	-1	-1
72	0	0	-5	172	0	0	-1	272	0	-1	-1
73	0	0	-5	173	0	0	-1	273	0	-1	-1
74	0	0	-5	174	0	0	-1	274	0	-1	-1
75	0	0	-5	175	0	0	-1	275	0	-1	-1
76	0	0	-5	176	0	0	-1	276	0	-1	-1
77	0	0	-5	177	0	0	-1	277	0	-1	-1
78	0	0	-5	178	0	0	-1	278	0	-1	-1
79	0	0	-5	179	0	0	-1	279	0	-1	-1
80	0	0	-5	180	0	0	-1	280	0	-1	-1
81	0	0	-5	181	0	0	-1	281	0	-1	-1
82	0	0	-5	182	0	0	-1	282	0	-1	-1
83	0	0	-5	183	0	0	-1	283	0	-1	-1
84	0	0	-5	184	0	0	-1	284	0	-1	-1
85	0	0	-5	185	0	0	-1	285	0	-1	-1
86	0	0	-5	186	0	0	-1	286	0	-1	-1
87	0	0	-5	187	0	0	-1	287	0	-1	-1
88	0	0	-5	188	0	0	-1	288	0	-1	-1
89	0	0	-5	189	0	0	-1	289	0	-1	-1
90	0	0	-5	190	0	0	-1	290	0	-1	-1
91	0	0	-5	191	0	0	-1	291	0	-1	-1
92	0	0	-5	192	0	0	-1	292	0	-1	-1
93	0	0	-5	193	0	0	-1	293	0	-1	-1
94	0	0	-5	194	0	0	-1	294	0	-1	-1
95	0	0	-5	195	0	0	-1	295	0	-1	-1
96	0	0	-5	196	0	0	-1	296	0	-1	-1
97	0	0	-5	197	0	0	-1	297	0	-1	-1
98	0	0	-5	198	0	0	-1	298	0	-1	-1
99	0	0	-5	199	0	0	-1	299	0	-1	-1
100	0	0	-5	200	0	0	-1	300	0	-1	-1
101	0	0	-5	201	0	0	-1	301	0	-1	-1
102	0	0	-5	202	0	0	-1	302	0	-1	-1
103	0	0	-5	203	0	0	-1	303	0	-1	-1
104	0	0	-5	204	0	0	-1	304	0	-1	-1
105	0	0	-5	205	0	0	-1	305	0	-1	-1
106	0	0	-5	206	0	0	-1	306	0	-1	-1
107	0	0	-5	207	0	0	-1	307	0	-1	-1
108	0	0	-5	208	0	0	-1	308	0	-1	-1
109	0	0	-5	209	0	0	-1	309	0	-1	-1
110	0	0	-5	210	0	0	-1	310	0	-1	-1
111	0	0	-5	211	0	0	-1	311	0	-1	-1
112	0	0	-5	212	0	0	-1	312	0	-1	-1
113	0	0	-5	213	0	0	-1				
114	0	0	-5	214	0	0	-1				
115	0	0	-5	215	0	0	-1				
116	0	0	-5	216	0	0	-1				
117	0	0	-5	217	0	0	-1				
118	0	0	-5	218	0	0	-1				
119	0	0	-5	219	0	0	-1				
120	0	0	-5	220	0	0	-1				
121	0	0	-5	221	0	0	-1				
122	0	0	-5	222	0	0	-1				
123	0	0	-5	223	0	0	-1				
124	0	0	-5	224	0	0	-1				
125	0	0	-5	225	0	0	-1				
126	0	0	-5	226	0	0	-1				
127	0	0	-5	227	0	0	-1				
128	0	0	-5	228	0	0	-1				
129	0	0	-5	229	0	0	-1				
130	0	0	-5	230	0	0	-1				
131	0	0	-5	231	0	0	-1				
132	0	0	-5	232	0	0	-1				
133	0	0	-5	233	0	0	-1				
134	0	0	-5	234	0	0	-1				
135	0	0	-5	235	0	0	-1				
136	0	0	-5	236	0	0	-1				
137	0	0	-5	237	0	0	-1				
138	0	0	-5	238	0	0	-1				
139	0	0	-5	239	0	0	-1				
140	0	0	-5	240	0	0	-1				
141	0	0	-5	241	0	0	-1				
142	0	0	-5	242	0	0	-1				
143	0	0	-5	243	0	0	-1				
144	0	0	-5	244	0	0	-1				
145	0	0	-5	245	0	0	-1				
146	0	0	-5	246	0	0	-1				
147	0	0	-5	247	0	0	-1				
148	0	0	-5	248	0	0	-1				
149	0	0	-5	249	0	0	-1				
150	0	0	-5	250	0	0	-1				
151	0	0</									

NORMAL STRESSES FOR LOAD CASE 3 (PSI)											
ELEM	SX	SY	SZ	ELEM	SX	SY	SZ	ELEM	SX	SY	SZ
313	4	20	-11	315	4	19	-11	317	4	16	-11
314	0	6	-1	316	0	18	-2	318	0	20	-11
315	0	26	-1	317	0	18	-2	319	0	20	-11
323	7	29	-6	321	0	11	-6	323	0	20	-11
324	-7	16	-4	322	-3	11	-6	324	-5	20	-11
331	-6	-16	-4	333	-3	-4	-3	335	-2	20	-11
332	-1	9	-1	334	-1	0	-1	336	-1	20	-11
343	1	17	-1	345	0	6	-1	347	0	20	-11
344	0	16	-7	346	0	12	-2	348	0	20	-11
349	1	-3	-3	351	0	10	-2	353	0	20	-11
355	1	-3	-10	357	0	23	-3	359	1	22	-9
361	0	26	-4	363	0	24	-3	365	0	22	-9
367	-1	-10	-4	369	-3	37	-9	371	-2	35	-8
373	-3	25	-9	375	-3	37	-9	377	-2	35	-8
379	-3	-18	-5	381	-2	-38	-3	382	-1	-40	-3

MIN.	ELEM	SX	SY	ELEM	SZ
157	157	-29	-41	294	-32
MAX.	145	27	39	295	8

Figure D3. (Sheet 3 of 5)

SHEAR STRESSES FOR LOAD CASE 3 (PSI)											
ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX
1	0	0	0	101	0	0	0	201	0	0	0
2	0	0	0	102	0	0	0	202	0	0	0
3	0	0	0	103	0	0	0	203	0	0	0
4	0	0	0	104	0	0	0	204	0	0	0
5	0	0	0	105	0	0	0	205	0	0	0
6	0	0	0	106	0	0	0	206	0	0	0
7	0	0	0	107	0	0	0	207	0	0	0
8	0	0	0	108	0	0	0	208	0	0	0
9	0	0	0	109	0	0	0	209	0	0	0
10	0	0	0	110	0	0	0	210	0	0	0
11	0	0	0	111	0	0	0	211	0	0	0
12	0	0	0	112	0	0	0	212	0	0	0
13	0	0	0	113	0	0	0	213	0	0	0
14	0	0	0	114	0	0	0	214	0	0	0
15	0	0	0	115	0	0	0	215	0	0	0
16	0	0	0	116	0	0	0	216	0	0	0
17	0	0	0	117	0	0	0	217	0	0	0
18	0	0	0	118	0	0	0	218	0	0	0
19	0	0	0	119	0	0	0	219	0	0	0
20	0	0	0	120	0	0	0	220	0	0	0
21	0	0	0	121	0	0	0	221	0	0	0
22	0	0	0	122	0	0	0	222	0	0	0
23	0	0	0	123	0	0	0	223	0	0	0
24	0	0	0	124	0	0	0	224	0	0	0
25	0	0	0	125	0	0	0	225	0	0	0
26	0	0	0	126	0	0	0	226	0	0	0
27	0	0	0	127	0	0	0	227	0	0	0
28	0	0	0	128	0	0	0	228	0	0	0
29	0	0	0	129	0	0	0	229	0	0	0
30	0	0	0	130	0	0	0	230	0	0	0
31	0	0	0	131	0	0	0	231	0	0	0
32	0	0	0	132	0	0	0	232	0	0	0
33	0	0	0	133	0	0	0	233	0	0	0
34	0	0	0	134	0	0	0	234	0	0	0
35	0	0	0	135	0	0	0	235	0	0	0
36	0	0	0	136	0	0	0	236	0	0	0
37	0	0	0	137	0	0	0	237	0	0	0
38	0	0	0	138	0	0	0	238	0	0	0
39	0	0	0	139	0	0	0	239	0	0	0
40	0	0	0	140	0	0	0	240	0	0	0
41	0	0	0	141	0	0	0	241	0	0	0
42	0	0	0	142	0	0	0	242	0	0	0
43	0	0	0	143	0	0	0	243	0	0	0
44	0	0	0	144	0	0	0	244	0	0	0
45	0	0	0	145	0	0	0	245	0	0	0
46	0	0	0	146	0	0	0	246	0	0	0
47	0	0	0	147	0	0	0	247	0	0	0
48	0	0	0	148	0	0	0	248	0	0	0
49	0	0	0	149	0	0	0	249	0	0	0
50	0	0	0	150	0	0	0	250	0	0	0
51	0	0	0	151	0	0	0	251	0	0	0
52	0	0	0	152	0	0	0	252	0	0	0
53	0	0	0	153	0	0	0	253	0	0	0
54	0	0	0	154	0	0	0	254	0	0	0
55	0	0	0	155	0	0	0	255	0	0	0
56	0	0	0	156	0	0	0	256	0	0	0
57	0	0	0	157	0	0	0	257	0	0	0
58	0	0	0	158	0	0	0	258	0	0	0
59	0	0	0	159	0	0	0	259	0	0	0
60	0	0	0	160	0	0	0	260	0	0	0
61	0	0	0	161	0	0	0	261	0	0	0
62	0	0	0	162	0	0	0	262	0	0	0
63	0	0	0	163	0	0	0	263	0	0	0
64	0	0	0	164	0	0	0	264	0	0	0
65	0	0	0	165	0	0	0	265	0	0	0
66	0	0	0	166	0	0	0	266	0	0	0
67	0	0	0	167	0	0	0	267	0	0	0
68	0	0	0	168	0	0	0	268	0	0	0
69	0	0	0	169	0	0	0	269	0	0	0
70	0	0	0	170	0	0	0	270	0	0	0
71	0	0	0	171	0	0	0	271	0	0	0
72	0	0	0	172	0	0	0	272	0	0	0
73	0	0	0	173	0	0	0	273	0	0	0
74	0	0	0	174	0	0	0	274	0	0	0
75	0	0	0	175	0	0	0	275	0	0	0
76	0	0	0	176	0	0	0	276	0	0	0
77	0	0	0	177	0	0	0	277	0	0	0
78	0	0	0	178	0	0	0	278	0	0	0
79	0	0	0	179	0	0	0	279	0	0	0
80	0	0	0	180	0	0	0	280	0	0	0
81	0	0	0	181	0	0	0	281	0	0	0
82	0	0	0	182	0	0	0	282	0	0	0
83	0	0	0	183	0	0	0	283	0	0	0
84	0	0	0	184	0	0	0	284	0	0	0
85	0	0	0	185	0	0	0	285	0	0	0
86	0	0	0	186	0	0	0	286	0	0	0
87	0	0	0	187	0	0	0	287	0	0	0
88	0	0	0	188	0	0	0	288	0	0	0
89	0	0	0	189	0	0	0	289	0	0	0
90	0	0	0	190	0	0	0	290	0	0	0
91	0	0	0	191	0	0	0	291	0	0	0
92	0	0	0	192	0	0	0	292	0	0	0
93	0	0	0	193	0	0	0	293	0	0	0
94	0	0	0	194	0	0	0	294	0	0	0
95	0	0	0	195	0	0	0	295	0	0	0
96	0	0	0	196	0	0	0	296	0	0	0
97	0	0	0	197	0	0	0	297	0	0	0
98	0	0	0	198	0	0	0	298	0	0	0
99	0	0	0	199	0	0	0	299	0	0	0
100	0	0	0	200	0	0	0	300	0	0	0

Figure D3. (Sheet 4 of 5)

SHEAR STRESSES FOR LOAD CASE 3 (PSI)																	
ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX	ELEM	VXY
313	2	-6	-4	315	1	-7	-4	316	-4	5	-3	317	-1	-6	-3	318	-5
319	-3	3	-2	321	-2	-1	-1	322	-1	-2	-1	323	-1	-1	-1	324	0
325	1	-5	-3	327	3	-3	-3	328	-4	5	-3	329	-6	-3	-3	330	0
331	6	4	-1	333	4	0	0	334	3	0	0	335	2	0	0	336	8
337	3	-7	1	339	1	-6	1	340	-7	9	1	341	-2	-3	1	342	1
343	-7	7	0	345	-3	2	0	346	-2	1	0	347	-1	0	0	348	0
349	4	-7	3	351	3	-5	3	352	-5	11	3	353	3	1	0	354	21
355	-2	14	-1	357	-1	4	0	358	-1	2	0	359	0	1	0	360	0
361	3	-6	-2	363	3	-4	0	364	-3	11	0	365	3	1	1	366	-2
367	0	15	-2	369	0	5	-1	370	0	2	0	371	0	1	0	372	0
373	1	-6	0	375	2	-5	0	376	2	8	0	377	4	-2	0	378	5
379	5	9	-1	381	3	2	0	382	2	1	0	383	1	0	0	384	0

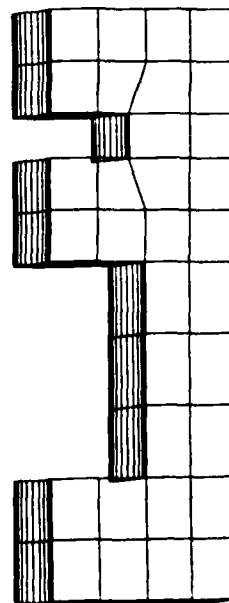
ELEM	VXY	ELEM	VYZ	ELEM	VZX
270	-16	291	-18	265	-7
282	8	366	22	54	11

MIN.
MAX.

Figure D3. (Sheet 5 of 5)

1/1-0	1/40-0		1/100-0	1/217-0	1/200-0	1/137-0
1/13-0	1/81-0		1/101-0	1/229-0	1/201-0	1/249-0
1/25-0	1/73-0	1/21-0	1/133-0	1/241-0	1/203-0	1/213-0
1/37-0	1/65-0	1/109-0	1/137-0	1/253-0	1/217-0	1/273-0

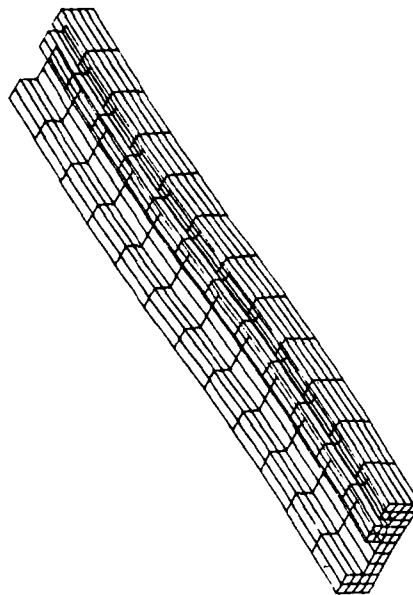
FINITE-ELEMENT ANALYSIS OF PROPOSED 'SNORT' STRUCTURE, AUG 82
UNDEFORMED GRID
SNORT STRUCTURE (700 MODELS, 304 ELEMENTS)



FINITE-ELEMENT ANALYSIS OF PROPOSED 'SNORT' STRUCTURE, AUG 82
LOAD CASE NO-4
SNORT STRUCTURE (700 MODELS, 304 ELEMENTS)



FINITE-ELEMENT ANALYSIS OF PROPOSED 'SNORT' STRUCTURE, AUG 82
LOAD CASE NO-4



FINITE-ELEMENT ANALYSIS OF PROPOSED 'SNORT' STRUCTURE, AUG 82
LOAD CASE NO-4

Figure D4. Finite-element analysis for load case 4 with $K = 175 \text{ lb/in.}^3$ (Sheet 1 of 5)

NORMAL STRESSES FOR LOAD CASE 4 (PSI)

ELEM	SX	SY	SZ	ELEM	SX	SY	SZ	ELEM	SX	SY	SZ	ELEM	SX	SY	SZ	ELEM	SX	SY	SZ
1	-7	-8	-34	10	0	-10	-35	101	-44	31	-12	106	-44	31	-12	107	-37	33	5
2	14	-22	-31	11	0	-56	-30	102	100	41	5	108	-29	17	-2	108	-29	17	-2
3	20	-24	-28	12	0	-51	-26	103	112	-5	31	109	-1	-19	6	109	-1	-19	6
4	22	-27	-27	13	0	-48	-22	104	118	73	-3	110	-49	21	-16	110	-49	21	-16
5	23	-28	-24	14	0	-47	-18	105	124	6	-3	111	-10	-35	-3	111	-10	-35	-3
6	24	-29	-21	15	0	-46	-15	106	130	6	-3	112	-77	19	-2	112	-77	19	-2
7	25	-30	-19	16	0	-45	-12	107	136	-73	-11	113	-13	-20	-5	113	-13	-20	-5
8	26	-31	-17	17	0	-44	-9	108	142	83	-28	114	-49	21	-16	114	-49	21	-16
9	27	-32	-15	18	0	-43	-6	109	148	8	-9	115	-159	-6	-18	115	-159	-6	-18
10	28	-33	-13	19	0	-42	-3	110	154	6	-3	116	-166	-7	-11	116	-166	-7	-11
11	29	-34	-11	20	0	-41	0	111	160	-81	-34	117	-172	-1	-1	117	-172	-1	-1
12	30	-35	-9	21	0	-40	3	112	166	-1	-1	118	-178	0	0	118	-178	0	0
13	31	-36	-7	22	0	-39	6	113	172	0	0	119	-184	38	2	119	-184	38	2
14	32	-37	-5	23	0	-38	9	114	178	32	23	120	-190	31	-12	120	-190	31	-12
15	33	-38	-3	24	0	-37	12	115	184	29	1	121	-196	24	-15	121	-196	24	-15
16	34	-39	-1	25	0	-36	15	116	190	-67	-15	122	-202	17	-18	122	-202	17	-18
17	35	-40	1	26	0	-35	18	117	196	2	-16	123	-208	10	-21	123	-208	10	-21
18	36	-41	3	27	0	-34	21	118	202	-2	-17	124	-214	3	-24	124	-214	3	-24
19	37	-42	5	28	0	-33	24	119	208	0	-18	125	-220	-3	-27	125	-220	-3	-27
20	38	-43	7	29	0	-32	27	120	214	29	-19	126	-226	4	-30	126	-226	4	-30
21	39	-44	9	30	0	-31	30	121	220	-60	-20	127	-232	11	-33	127	-232	11	-33
22	40	-45	11	31	0	-30	33	122	226	1	-21	128	-238	18	-36	128	-238	18	-36
23	41	-46	13	32	0	-29	36	123	232	26	-22	129	-244	25	-39	129	-244	25	-39
24	42	-47	15	33	0	-28	39	124	238	36	-23	130	-250	32	-42	130	-250	32	-42
25	43	-48	17	34	0	-27	42	125	244	46	-24	131	-256	39	-45	131	-256	39	-45
26	44	-49	19	35	0	-26	45	126	250	56	-25	132	-262	46	-48	132	-262	46	-48
27	45	-50	21	36	0	-25	48	127	256	66	-26	133	-268	53	-51	133	-268	53	-51
28	46	-51	23	37	0	-24	51	128	262	76	-27	134	-274	60	-54	134	-274	60	-54
29	47	-52	25	38	0	-23	54	129	268	86	-28	135	-280	67	-57	135	-280	67	-57
30	48	-53	27	39	0	-22	57	130	274	96	-29	136	-286	76	-60	136	-286	76	-60
31	49	-54	29	40	0	-21	60	131	280	106	-30	137	-292	83	-63	137	-292	83	-63
32	50	-55	31	41	0	-20	63	132	286	116	-31	138	-298	93	-66	138	-298	93	-66
33	51	-56	33	42	0	-19	66	133	292	126	-32	139	-304	103	-69	139	-304	103	-69
34	52	-57	35	43	0	-18	69	134	298	136	-33	140	-310	113	-72	140	-310	113	-72
35	53	-58	37	44	0	-17	72	135	304	146	-34	141	-316	123	-75	141	-316	123	-75
36	54	-59	39	45	0	-16	75	136	310	156	-35	142	-322	133	-78	142	-322	133	-78
37	55	-60	41	46	0	-15	78	137	316	166	-36	143	-328	143	-81	143	-328	143	-81
38	56	-61	43	47	0	-14	81	138	322	176	-37	144	-334	153	-84	144	-334	153	-84
39	57	-62	45	48	0	-13	84	139	328	186	-38	145	-340	163	-87	145	-340	163	-87
40	58	-63	47	49	0	-12	87	140	334	196	-39	146	-346	173	-90	146	-346	173	-90
41	59	-64	49	50	0	-11	90	141	340	206	-40	147	-352	183	-93	147	-352	183	-93
42	60	-65	51	51	0	-10	93	142	346	216	-41	148	-358	193	-96	148	-358	193	-96
43	61	-66	53	52	0	-9	96	143	352	226	-42	149	-364	203	-99	149	-364	203	-99
44	62	-67	55	53	0	-8	99	144	358	236	-43	150	-370	213	-102	150	-370	213	-102
45	63	-68	57	54	0	-7	102	145	364	246	-44	151	-376	223	-105	151	-376	223	-105
46	64	-69	59	55	0	-6	105	146	370	256	-45	152	-382	233	-108	152	-382	233	-108
47	65	-70	61	56	0	-5	108	147	376	266	-46	153	-388	243	-111	153	-388	243	-111
48	66	-71	63	57	0	-4	111	148	382	276	-47	154	-394	253	-114	154	-394	253	-114
49	67	-72	65	58	0	-3	114	149	388	286	-48	155	-400	263	-117	155	-400	263	-117
50	68	-73	67	59	0	-2	117	150	394	296	-49	156	-406	273	-120	156	-406	273	-120
51	69	-74	69	60	0	-1	120	151	400	306	-50	157	-412	283	-123	157	-412	283	-123
52	70	-75	71	61	0	0	123	152	406	316	-51	158	-418	293	-126	158	-418	293	-126
53	71	-76	73	62	0	0	126	153	412	326	-52	159	-424	303	-129	159	-424	303	-129
54	72	-77	75	63	0	0	129	154	418	336	-53	160	-430	313	-132	160	-430	313	-132
55	73	-78	77	64	0	0	132	155	424	346	-54	161	-436	323	-135	161	-436	323	-135
56	74	-79	79	65	0	0	135	156	430	356	-55	162	-442	333	-138	162	-442	333	-138
57	75	-80	81	66	0	0	138	157	436	366	-56	163	-448	343	-141	163	-448	343	-141
58	76	-81	83	67	0	0	141	158	442	376	-57	164	-454	353	-144	164	-454	353	-144
59	77	-82	85	68	0	0	144	159	448	386	-58	165	-460	363	-147	165	-460	363	-147
60	78	-83	87	69	0	0	147	160	454	396	-59	166	-466	373	-150	166	-466	373	-150
61	79	-84	89	70	0	0	150	161	460	406	-60	167	-472	383	-153	167	-472	383	-153
62	80	-85	91	71	0	0	153	162	466	416	-61	168	-478	393	-156	168	-478	393	-156
63	81	-86	93	72	0	0	156	163	472	426	-62	169	-484	403	-159	169	-484	403	-159
64	82	-87	95	73	0	0	159	164	478	436	-63	170	-490	413	-162	170	-490	413	-162
65	83	-88	97	74	0	0	162	165	484	446	-64	171	-496	423	-165	171	-496	423	-165
66	84	-89	99	75	0	0	165	166	490	456	-65	172	-502	433	-168	172	-502	433	-168
67	85	-90	101	76	0	0	168	167	496	466	-66	173	-508	443	-171	173	-508	443	-171
68	86	-91	103	77	0	0	171	168	502	476	-67	174	-514	453	-174	174	-514	453	-174
69	87	-92	105	78	0	0	174	169	508	486	-68	175	-520	463	-177	175	-520	463	-177
70	88	-93	107	79	0	0	177	170	514	496	-69	176	-526	473	-180	176	-526	473	-180
71	89	-94	109	80	0	0	180	171	520	506	-70	177	-532	483	-183	177	-532	483	-183
72	90	-95	111	81	0	0	183	172	526	516	-71	178	-538	493	-186	178	-538	493	-186
73	91	-96	113	82	0	0	186	173	532	526	-72	179	-544	503	-189	179	-544	503	-189
74	92	-97	115	83	0	0	189	174	538	536	-73	180	-550	513	-192	180	-550	513	-192
75	93	-98	117	84	0	0	192	175	544	546	-74	181	-556	523	-195	181	-556	523	-195
76	94	-99	119	85	0	0	195	176	550	556	-75	182	-562	533	-198	182	-562	533	-198
77	95	-100	121	86	0	0	198	177	556	566	-76	183	-568	543	-201	183	-568	543	-201
78	96	-101	123	87	0	0	201	178	562	576	-77	184	-574	553	-204	184	-574	553	-204
79	97	-102	125	88	0	0	204	179	568	586	-78	185	-580	563	-207	185	-580	563	-207
80	98	-103	127	89	0	0	207	180	574	596	-79	186	-586	573	-210	186	-586	573	-210
81	99	-104	129</																

NORMAL STRESSES FOR LOAD CASE 4 (PSI)											
ELEM	SX	SY	SZ	ELEM	SX	SY	SZ	ELEM	SX	SY	SZ
313	7	18	-4	316	7	17	-39	317	6	13	-5
319	-1	-12	-4	322	0	-25	-2	323	0	-25	-1
323	-1	-49	-22	328	0	66	-19	329	4	62	-6
325	-1	-40	-2	334	-2	-66	-2	335	-1	-59	2
331	-1	-22	-2	340	1	-55	2	341	0	-56	0
333	2	35	-5	346	0	44	0	347	0	31	0
339	-5	1	-5	352	-5	-13	-4	353	-6	-16	-1
349	3	14	-5	358	0	30	-13	359	0	25	-1
355	1	29	-15	364	1	-34	-13	365	0	-33	-1
361	-1	-18	-5	370	0	-71	-16	371	2	-66	-2
367	-1	55	-19	376	1	-71	-12	377	-1		
373	0	-43	-6	382	1	-71	-2	383			
379	-6										

MIN.	ELEM	SX	SY	ELEM	SZ
	157	-91	-106	294	-117
MAX.	145	89	98	295	28

Figure D4. (Sheet 3 of 5)

SHEAR STRESSES FOR LOAD CASE 4 (PSI)

ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX
1	4	-35	-13	2	-4	31	-13	3	3	-36	-13	4	-3	33	-13	5	8	-26	-11	6	5	46	-17
7	10	-26	-4	8	3	8	-2	9	1	-28	-4	10	0	2	-4	11	0	-2	12	0	0	-1	
13	-2	-26	-4	14	2	22	-4	15	2	0	-4	16	2	26	-4	17	3	-14	18	2	54	-6	
19	0	-21	4	20	-1	11	4	21	0	-23	4	22	0	0	0	23	4	-3	24	0	-1	0	
25	-1	-21	4	26	1	17	4	27	-1	1	4	28	-1	21	3	29	-4	-10	30	-4	51	1	
31	-5	-31	3	32	-3	10	4	33	-1	-20	4	34	0	18	1	35	0	-3	36	0	-1	0	
37	1	-19	4	38	-1	15	4	39	0	-20	3	40	-4	18	3	41	-6	-12	42	-15	36	1	
43	-13	-36	3	44	-7	6	2	45	-3	3	0	46	-1	32	1	47	7	-34	48	0	-1	0	
49	55	9	21	50	5	33	2	51	4	-39	2	52	-2	0	21	53	0	-19	54	6	36	27	
55	9	-26	11	56	4	21	1	57	1	-30	3	58	3	3	0	59	0	-3	60	0	-1	0	
61	6	-12	19	62	-3	11	1	63	3	-30	12	64	-3	21	12	65	2	-25	66	-3	36	17	
67	-1	-12	19	68	-1	0	-4	69	0	-21	18	70	0	-5	10	71	0	-4	72	0	-1	0	
73	-1	-19	17	74	0	14	19	75	81	-21	16	76	-3	15	17	77	-5	-15	78	-11	33	13	
79	-10	-16	17	80	-6	13	17	81	-2	-18	3	82	-8	13	2	83	0	-3	84	0	24	11	
85	-3	-16	17	86	-1	12	5	87	1	-18	1	88	-8	13	15	89	-1	-13	90	-26	0	0	
91	-24	-11	24	92	-13	0	8	93	-5	-13	24	94	-2	8	23	95	0	-10	96	0	19	21	
97	-1	-11	24	98	-10	8	0	99	0	-12	23	100	-2	-3	7	101	-4	-10	102	-10	0	0	
103	-9	-10	24	104	-5	7	23	105	-2	-12	23	106	0	-3	7	107	0	-8	108	-26	0	0	
109	-3	-8	9	110	-12	1	9	111	-5	-5	9	112	-9	-3	1	113	-9	-2	114	-6	10	17	
115	-20	-3	9	116	-12	1	9	117	-3	-5	9	118	-4	-3	1	119	0	-2	120	-6	10	17	
121	-4	-7	13	122	-5	1	13	123	0	-1	13	124	-3	-2	1	125	-2	-2	126	-6	10	17	
127	-10	-7	13	128	-9	1	13	129	-5	-5	13	130	-3	-2	1	131	-2	-2	132	-18	10	10	
133	-5	-7	13	134	-6	-2	1	135	-5	-2	4	136	-2	-2	4	137	-1	-2	138	-6	7	13	
139	-5	-7	13	140	-2	-2	-1	141	-5	-3	-6	142	-5	-3	-6	143	-5	-3	144	-6	7	13	
145	-5	-7	13	146	-2	-2	-1	147	-5	-3	-6	148	-5	-3	-6	149	-5	-3	150	-6	7	13	
147	-5	-7	13	152	-2	-2	-1	153	-5	-3	-6	154	-5	-3	-6	155	-5	-3	156	-6	7	13	
157	-5	-7	13	158	-2	-2	-1	159	-5	-3	-6	160	-5	-3	-6	161	-5	-3	162	-6	7	13	
163	-5	-7	13	164	-2	-2	-1	165	-5	-3	-6	166	-5	-3	-6	167	-5	-3	168	-6	7	13	
169	-5	-7	13	170	-2	-2	-1	171	-5	-3	-6	172	-5	-3	-6	173	-5	-3	174	-6	7	13	
175	-5	-7	13	176	-2	-2	-1	177	-5	-3	-6	178	-5	-3	-6	179	-5	-3	180	-6	7	13	
181	-5	-7	13	182	-2	-2	-1	183	-5	-3	-6	184	-5	-3	-6	185	-5	-3	186	-6	7	13	
187	-5	-7	13	188	-2	-2	-1	189	-5	-3	-6	190	-5	-3	-6	191	-5	-3	192	-6	7	13	
189	-5	-7	13	190	-2	-2	-1	191	-5	-3	-6	192	-5	-3	-6	193	-5	-3	194	-6	7	13	
195	-5	-7	13	196	-2	-2	-1	197	-5	-3	-6	198	-5	-3	-6	199	-5	-3	200	-6	7	13	
201	-5	-7	13	202	-2	-2	-1	203	-5	-3	-6	204	-5	-3	-6	205	-5	-3	206	-6	7	13	
207	-5	-7	13	208	-2	-2	-1	209	-5	-3	-6	210	-5	-3	-6	211	-5	-3	212	-6	7	13	
213	-5	-7	13	214	-2	-2	-1	215	-5	-3	-6	216	-5	-3	-6	217	-5	-3	218	-6	7	13	
219	-5	-7	13	220	-2	-2	-1	221	-5	-3	-6	222	-5	-3	-6	223	-5	-3	224	-6	7	13	
225	-5	-7	13	226	-2	-2	-1	227	-5	-3	-6	228	-5	-3	-6	229	-5	-3	230	-6	7	13	
231	-5	-7	13	232	-2	-2	-1	233	-5	-3	-6	234	-5	-3	-6	235	-5	-3	236	-6	7	13	
237	-5	-7	13	238	-2	-2	-1	239	-5	-3	-6	240	-5	-3	-6	241	-5	-3	242	-6	7	13	
243	-5	-7	13	244	-2	-2	-1	245	-5	-3	-6	246	-5	-3	-6	247	-5	-3	248	-6	7	13	
249	-5	-7	13	250	-2	-2	-1	251	-5	-3	-6	252	-5	-3	-6	253	-5	-3	254	-6	7	13	
255	-5	-7	13	256	-2	-2	-1	257	-5	-3	-6	258	-5	-3	-6	259	-5	-3	260	-6	7	13	
261	-5	-7	13	262	-2	-2	-1	263	-5	-3	-6	264	-5	-3	-6	265	-5	-3	266	-6	7	13	
267	-5	-7	13	268	-2	-2	-1	269	-5	-3	-6	270	-5	-3	-6	271	-5	-3	272	-6	7	13	
273	-5	-7	13	274	-2	-2	-1	275	-5	-3	-6	276	-5	-3	-6	277	-5	-3	278	-6	7	13	
279	-5	-7	13	280	-2	-2	-1	281	-5	-3	-6	282	-5	-3	-6	283	-5	-3	284	-6	7	13	
285	-5	-7	13	286	-2	-2	-1	287	-5	-3	-6	288	-5	-3	-6	289	-5	-3	290	-6	7	13	
291	-5	-7	13	292	-2	-2	-1	293	-5	-3	-6	294	-5	-3	-6	295	-5	-3	296	-6	7	13	
297	-5	-7	13	298	-2	-2	-1	299	-5	-3	-6	300	-5	-3	-6	301	-5	-3	302	-6	7	13	

Figure D4. (Sheet 4 of 5)

SHEAR STRESSES FOR LOAD CASE 4 (PSI)

ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX
313	5	-22	-5	314	-7	18	-5	315	4	-25	-5	316	-7	19	-4	317	4	-20	-4
319	0	13	-5	320	-2	2	-2	321	-2	-2	-1	322	-2	-4	-1	323	-1	-3	0
325	1	-16	-6	326	-1	14	-5	327	2	-18	-5	328	0	15	-5	329	6	-13	-4
331	10	11	-3	332	4	2	-1	333	1	-1	-1	334	0	-2	0	335	0	-2	0
337	-9	-18	-7	338	8	15	-7	339	-10	-19	-7	340	7	17	-7	341	-12	-12	-7
343	-9	12	2	344	-3	16	0	345	-2	0	0	346	-1	-2	0	347	-1	-2	0
349	6	-20	6	350	-7	16	6	351	6	-21	1	352	-1	20	6	353	6	-10	5
355	-2	24	-7	356	-1	19	1	357	-1	1	0	358	-1	-2	0	359	0	-2	0
361	7	-20	7	362	-7	16	7	363	7	-21	7	364	-7	20	7	365	7	-10	8
367	1	26	-4	368	0	18	-1	369	0	1	-1	370	0	-2	0	371	0	-2	0
373	4	-18	3	374	-3	16	3	375	4	-19	3	376	-2	18	3	377	6	-13	3
379	7	15	-2	380	3	5	-1	381	1	1	0	382	0	-2	0	383	0	-2	0

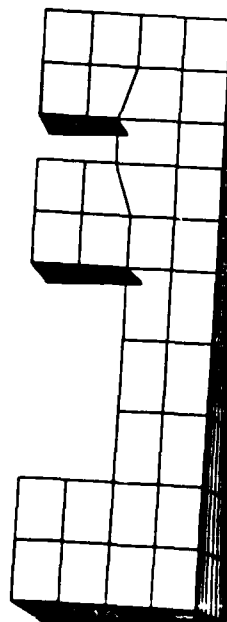
ELEM	VXY	ELEM	VYZ	ELEM	VZX
90	-26	291	-61	285	-32
282	11	18	54	54	27

MIN.
MAX.

Figure D4. (Sheet 5 of 5)

1/1-0	1/6-0		1/100-0	1/217-0	1/200-0	1/237-0
1/13-0	1/61-0		1/101-0	1/200-0	1/201-0	1/200-0
1/20-0	1/73-0	1/97-0	1/133-0	1/201-0	1/203-0	1/201-0
1/37-0	1/60-0	1/100-0	1/133-0	1/203-0	1/203-0	1/203-0

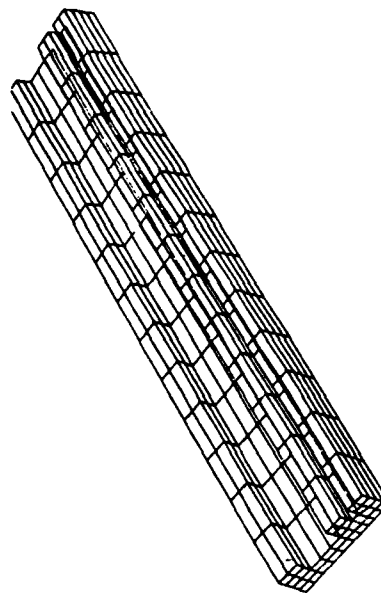
FINITE-ELEMENT ANALYSIS OF PROPOSED 'SHORT' STRUCTURE. AUG 82
 UNDEFORMED GRID
 SHORT STRUCTURE 1700 NILES 1.00 ELEMENTS



FINITE-ELEMENT ANALYSIS OF PROPOSED 'SHORT' STRUCTURE. AUG 82
 LOAD CASE NO. 5
 SHORT STRUCTURE 1700 NILES 1.00 ELEMENTS



FINITE-ELEMENT ANALYSIS OF PROPOSED 'SHORT' STRUCTURE. AUG 82
 LOAD CASE NO. 5



FINITE-ELEMENT ANALYSIS OF PROPOSED 'SHORT' STRUCTURE. AUG 82
 LOAD CASE NO. 5

Figure D5. Finite-element analysis for load case 5 with $K = 175 \text{ lb/in.}^3$ (Sheet 1 of 5)

NORMAL STRESSES FOR LOAD CASE 5 (PSI)

ELEM	SX	SY	SZ	ELEM	SX	SY	SZ	ELEM	SX	SY	SZ	ELEM	SX	SY	SZ
1	2	-6	3	4	2	0	4	5	2	0	4	6	2	0	4
2	-2	-2	3	5	0	-5	3	7	0	-5	3	8	0	-5	3
3	-2	-2	3	6	0	-5	3	9	0	-5	3	10	0	-5	3
4	0	-1	4	11	0	-1	4	12	0	-1	4	13	0	-1	4
5	0	-1	4	14	0	-1	4	15	0	-1	4	16	0	-1	4
6	0	-1	4	17	0	-1	4	18	0	-1	4	19	0	-1	4
7	0	-1	4	20	0	-1	4	21	0	-1	4	22	0	-1	4
8	0	-1	4	23	0	-1	4	24	0	-1	4	25	0	-1	4
9	0	-1	4	26	0	-1	4	27	0	-1	4	28	0	-1	4
10	0	-1	4	29	0	-1	4	30	0	-1	4	31	0	-1	4
11	0	-1	4	32	0	-1	4	33	0	-1	4	34	0	-1	4
12	0	-1	4	35	0	-1	4	36	0	-1	4	37	0	-1	4
13	0	-1	4	38	0	-1	4	39	0	-1	4	40	0	-1	4
14	0	-1	4	41	0	-1	4	42	0	-1	4	43	0	-1	4
15	0	-1	4	44	0	-1	4	45	0	-1	4	46	0	-1	4
16	0	-1	4	47	0	-1	4	48	0	-1	4	49	0	-1	4
17	0	-1	4	50	0	-1	4	51	0	-1	4	52	0	-1	4
18	0	-1	4	53	0	-1	4	54	0	-1	4	55	0	-1	4
19	0	-1	4	56	0	-1	4	57	0	-1	4	58	0	-1	4
20	0	-1	4	59	0	-1	4	60	0	-1	4	61	0	-1	4
21	0	-1	4	62	0	-1	4	63	0	-1	4	64	0	-1	4
22	0	-1	4	65	0	-1	4	66	0	-1	4	67	0	-1	4
23	0	-1	4	68	0	-1	4	69	0	-1	4	70	0	-1	4
24	0	-1	4	71	0	-1	4	72	0	-1	4	73	0	-1	4
25	0	-1	4	74	0	-1	4	75	0	-1	4	76	0	-1	4
26	0	-1	4	77	0	-1	4	78	0	-1	4	79	0	-1	4
27	0	-1	4	80	0	-1	4	81	0	-1	4	82	0	-1	4
28	0	-1	4	83	0	-1	4	84	0	-1	4	85	0	-1	4
29	0	-1	4	86	0	-1	4	87	0	-1	4	88	0	-1	4
30	0	-1	4	89	0	-1	4	90	0	-1	4	91	0	-1	4
31	0	-1	4	92	0	-1	4	93	0	-1	4	94	0	-1	4
32	0	-1	4	95	0	-1	4	96	0	-1	4	97	0	-1	4
33	0	-1	4	98	0	-1	4	99	0	-1	4	100	0	-1	4
34	0	-1	4	101	0	-1	4	102	0	-1	4	103	0	-1	4
35	0	-1	4	104	0	-1	4	105	0	-1	4	106	0	-1	4
36	0	-1	4	107	0	-1	4	108	0	-1	4	109	0	-1	4
37	0	-1	4	110	0	-1	4	111	0	-1	4	112	0	-1	4
38	0	-1	4	113	0	-1	4	114	0	-1	4	115	0	-1	4
39	0	-1	4	116	0	-1	4	117	0	-1	4	118	0	-1	4
40	0	-1	4	119	0	-1	4	120	0	-1	4	121	0	-1	4
41	0	-1	4	122	0	-1	4	123	0	-1	4	124	0	-1	4
42	0	-1	4	125	0	-1	4	126	0	-1	4	127	0	-1	4
43	0	-1	4	128	0	-1	4	129	0	-1	4	130	0	-1	4
44	0	-1	4	131	0	-1	4	132	0	-1	4	133	0	-1	4
45	0	-1	4	134	0	-1	4	135	0	-1	4	136	0	-1	4
46	0	-1	4	137	0	-1	4	138	0	-1	4	139	0	-1	4
47	0	-1	4	140	0	-1	4	141	0	-1	4	142	0	-1	4
48	0	-1	4	143	0	-1	4	144	0	-1	4	145	0	-1	4
49	0	-1	4	146	0	-1	4	147	0	-1	4	148	0	-1	4
50	0	-1	4	149	0	-1	4	150	0	-1	4	151	0	-1	4
51	0	-1	4	152	0	-1	4	153	0	-1	4	154	0	-1	4
52	0	-1	4	155	0	-1	4	156	0	-1	4	157	0	-1	4
53	0	-1	4	158	0	-1	4	159	0	-1	4	160	0	-1	4
54	0	-1	4	161	0	-1	4	162	0	-1	4	163	0	-1	4
55	0	-1	4	164	0	-1	4	165	0	-1	4	166	0	-1	4
56	0	-1	4	167	0	-1	4	168	0	-1	4	169	0	-1	4
57	0	-1	4	170	0	-1	4	171	0	-1	4	172	0	-1	4
58	0	-1	4	173	0	-1	4	174	0	-1	4	175	0	-1	4
59	0	-1	4	176	0	-1	4	177	0	-1	4	178	0	-1	4
60	0	-1	4	179	0	-1	4	180	0	-1	4	181	0	-1	4
61	0	-1	4	182	0	-1	4	183	0	-1	4	184	0	-1	4
62	0	-1	4	185	0	-1	4	186	0	-1	4	187	0	-1	4
63	0	-1	4	188	0	-1	4	189	0	-1	4	190	0	-1	4
64	0	-1	4	191	0	-1	4	192	0	-1	4	193	0	-1	4
65	0	-1	4	194	0	-1	4	195	0	-1	4	196	0	-1	4
66	0	-1	4	197	0	-1	4	198	0	-1	4	199	0	-1	4
67	0	-1	4	200	0	-1	4	201	0	-1	4	202	0	-1	4
68	0	-1	4	203	0	-1	4	204	0	-1	4	205	0	-1	4
69	0	-1	4	206	0	-1	4	207	0	-1	4	208	0	-1	4
70	0	-1	4	209	0	-1	4	210	0	-1	4	211	0	-1	4
71	0	-1	4	212	0	-1	4	213	0	-1	4	214	0	-1	4
72	0	-1	4	215	0	-1	4	216	0	-1	4	217	0	-1	4
73	0	-1	4	218	0	-1	4	219	0	-1	4	220	0	-1	4
74	0	-1	4	221	0	-1	4	222	0	-1	4	223	0	-1	4
75	0	-1	4	224	0	-1	4	225	0	-1	4	226	0	-1	4
76	0	-1	4	227	0	-1	4	228	0	-1	4	229	0	-1	4
77	0	-1	4	230	0	-1	4	231	0	-1	4	232	0	-1	4
78	0	-1	4	233	0	-1	4	234	0	-1	4	235	0	-1	4
79	0	-1	4	236	0	-1	4	237	0	-1	4	238	0	-1	4
80	0	-1	4	239	0	-1	4	240	0	-1	4	241	0	-1	4
81	0	-1	4	242	0	-1	4	243	0	-1	4	244	0	-1	4
82	0	-1	4	245	0	-1	4	246	0	-1	4	247	0	-1	4
83	0	-1	4	248	0	-1	4	249	0	-1	4	250	0	-1	4
84	0	-1	4	251	0	-1	4	252	0	-1	4	253	0	-1	4
85	0	-1	4	254	0	-1	4	255	0	-1	4	256	0	-1	4
86	0	-1	4	257	0	-1	4	258	0	-1	4	259	0	-1	4
87	0	-1	4	260	0	-1	4	261	0	-1	4	262	0	-1	4
88	0	-1	4	263	0	-1	4	264	0	-1	4	265	0	-1	4
89	0	-1	4	266	0	-1	4	267	0	-1	4	268	0	-1	4
90	0	-1	4	269	0	-1	4	270	0	-1	4	271	0	-1	4
91	0	-1	4	272	0	-1	4	273	0	-1	4	274	0	-1	4
92	0	-1	4	275	0	-1	4	276	0	-1	4	277	0	-1	4
93	0	-1	4	278	0	-1	4	279	0	-1	4	280	0	-1	4
94	0	-1	4	281	0	-1	4	282	0	-1	4	283	0	-1	4
95	0	-1	4	284	0	-1	4	285	0	-1	4	286	0	-1	4
96	0	-1	4	287	0	-1	4	288	0	-1	4	289	0	-1	4
97	0	-1	4	290	0	-1	4	291	0	-1	4	292	0	-1	4
98	0	-1	4	293	0	-1	4	294	0	-1	4	295	0	-1	4
99	0	-1	4	296	0	-1	4	297	0	-1	4	298	0	-1	4
100	0	-1	4	299	0	-1	4	300	0	-1	4	301	0	-1	4
101	0	-1	4	302	0	-1	4	303	0	-1	4	304	0	-1	4
102	0	-1	4	305	0	-1	4	306	0	-1	4	307	0	-1	4
103	0	-1	4	308	0	-1	4	309	0	-1	4	310	0	-1	4
104	0	-1	4	311	0	-1	4	312	0	-1	4	313	0	-1	4
105	0	-1	4	314	0	-1	4	315	0	-1	4	316	0	-1	4
106	0	-1	4	317	0	-1	4	318	0	-1	4	319	0	-1	4
107	0	-1	4	320	0	-1	4	321	0	-1	4	322	0	-1	4
108	0	-1	4	323	0	-1	4	324	0	-1	4	325	0	-1	4
109	0	-1	4	326	0	-1	4	327	0	-1	4	328	0	-1	4
110	0	-1	4	329	0	-1	4	330	0	-1	4	331	0	-1	4
111	0	-1	4	332	0	-1	4	333	0	-1	4	334	0	-1	4
112	0	-1	4	335	0	-1	4	336	0	-1	4	337	0	-1	4
113	0	-1	4	338	0	-1	4	339	0	-1	4	340	0	-1	4
114	0	-1	4	341	0	-1	4	342	0	-1	4	343			

NORMAL STRESSES FOR LOAD CASE 5 (PSI)											
ELEM	SX	SY	SZ	ELEM	SX	SY	SZ	ELEM	SX	SY	SZ
313	1	11	3	315	1	9	3	316	1	8	3
319	0	-2	-1	321	0	-7	-1	322	0	-9	-1
325	-5	8	-1	327	-5	6	-1	328	-5	4	-1
331	-1	-1	-2	333	-1	-6	-2	334	-1	-8	-2
337	-1	14	-2	339	-1	13	-2	340	-1	12	-2
343	0	-6	0	345	0	-13	0	346	0	-14	0
349	2	13	-5	351	2	12	-5	352	2	10	-5
355	0	-4	-1	357	0	-11	-1	358	0	-13	-1
361	0	12	-4	363	0	10	-4	364	0	8	-4
367	-2	-3	-2	369	-2	-10	-2	370	-2	-12	-2
373	-1	11	-2	381	-1	-8	-2	382	-1	-6	-2
379	-1	12	-2	383	-1	-10	-2	384	-1	-10	-2

MIN.	ELEM	SX	ELEM	SY	ELEM	SZ
97	38	-9	38	-17	354	-5 (COMPRESSIVE)
MAX.	305	7	47	17	294	10 (TENSILE)

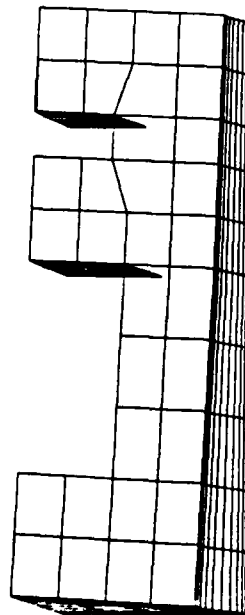
Figure D5. (Sheet 3 of 5)

SHEAR STRESSES FOR LOAD CASE 5 (PSI)											
ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX
1	4	4	1	103	99	1	1	201	201	2	2
2	5	4	1	104	-7	2	1	202	202	3	3
3	-2	-3	1	105	-6	1	1	203	203	4	4
4	-1	-4	1	106	-4	1	1	204	204	5	5
5	-3	-3	1	107	-2	1	1	205	205	6	6
6	-1	-4	1	108	-1	1	1	206	206	7	7
7	0	-3	1	109	1	1	1	207	207	8	8
8	-2	-3	1	110	1	1	1	208	208	9	9
9	-1	-4	1	111	1	1	1	209	209	10	10
10	0	-3	1	112	1	1	1	210	210	11	11
11	-2	-3	1	113	1	1	1	211	211	12	12
12	-1	-4	1	114	1	1	1	212	212	13	13
13	0	-3	1	115	1	1	1	213	213	14	14
14	-2	-3	1	116	1	1	1	214	214	15	15
15	-1	-4	1	117	1	1	1	215	215	16	16
16	0	-3	1	118	1	1	1	216	216	17	17
17	-2	-3	1	119	1	1	1	217	217	18	18
18	-1	-4	1	120	1	1	1	218	218	19	19
19	0	-3	1	121	1	1	1	219	219	20	20
20	-2	-3	1	122	1	1	1	220	220	21	21
21	-1	-4	1	123	1	1	1	221	221	22	22
22	0	-3	1	124	1	1	1	222	222	23	23
23	-2	-3	1	125	1	1	1	223	223	24	24
24	-1	-4	1	126	1	1	1	224	224	25	25
25	0	-3	1	127	1	1	1	225	225	26	26
26	-2	-3	1	128	1	1	1	226	226	27	27
27	-1	-4	1	129	1	1	1	227	227	28	28
28	0	-3	1	130	1	1	1	228	228	29	29
29	-2	-3	1	131	1	1	1	229	229	30	30
30	-1	-4	1	132	1	1	1	230	230	31	31
31	0	-3	1	133	1	1	1	231	231	32	32
32	-2	-3	1	134	1	1	1	232	232	33	33
33	-1	-4	1	135	1	1	1	233	233	34	34
34	0	-3	1	136	1	1	1	234	234	35	35
35	-2	-3	1	137	1	1	1	235	235	36	36
36	-1	-4	1	138	1	1	1	236	236	37	37
37	0	-3	1	139	1	1	1	237	237	38	38
38	-2	-3	1	140	1	1	1	238	238	39	39
39	-1	-4	1	141	1	1	1	239	239	40	40
40	0	-3	1	142	1	1	1	240	240	41	41
41	-2	-3	1	143	1	1	1	241	241	42	42
42	-1	-4	1	144	1	1	1	242	242	43	43
43	0	-3	1	145	1	1	1	243	243	44	44
44	-2	-3	1	146	1	1	1	244	244	45	45
45	-1	-4	1	147	1	1	1	245	245	46	46
46	0	-3	1	148	1	1	1	246	246	47	47
47	-2	-3	1	149	1	1	1	247	247	48	48
48	-1	-4	1	150	1	1	1	248	248	49	49
49	0	-3	1	151	1	1	1	249	249	50	50
50	-2	-3	1	152	1	1	1	250	250	51	51
51	-1	-4	1	153	1	1	1	251	251	52	52
52	0	-3	1	154	1	1	1	252	252	53	53
53	-2	-3	1	155	1	1	1	253	253	54	54
54	-1	-4	1	156	1	1	1	254	254	55	55
55	0	-3	1	157	1	1	1	255	255	56	56
56	-2	-3	1	158	1	1	1	256	256	57	57
57	-1	-4	1	159	1	1	1	257	257	58	58
58	0	-3	1	160	1	1	1	258	258	59	59
59	-2	-3	1	161	1	1	1	259	259	60	60
60	-1	-4	1	162	1	1	1	260	260	61	61
61	0	-3	1	163	1	1	1	261	261	62	62
62	-2	-3	1	164	1	1	1	262	262	63	63
63	-1	-4	1	165	1	1	1	263	263	64	64
64	0	-3	1	166	1	1	1	264	264	65	65
65	-2	-3	1	167	1	1	1	265	265	66	66
66	-1	-4	1	168	1	1	1	266	266	67	67
67	0	-3	1	169	1	1	1	267	267	68	68
68	-2	-3	1	170	1	1	1	268	268	69	69
69	-1	-4	1	171	1	1	1	269	269	70	70
70	0	-3	1	172	1	1	1	270	270	71	71
71	-2	-3	1	173	1	1	1	271	271	72	72
72	-1	-4	1	174	1	1	1	272	272	73	73
73	0	-3	1	175	1	1	1	273	273	74	74
74	-2	-3	1	176	1	1	1	274	274	75	75
75	-1	-4	1	177	1	1	1	275	275	76	76
76	0	-3	1	178	1	1	1	276	276	77	77
77	-2	-3	1	179	1	1	1	277	277	78	78
78	-1	-4	1	180	1	1	1	278	278	79	79
79	0	-3	1	181	1	1	1	279	279	80	80
80	-2	-3	1	182	1	1	1	280	280	81	81
81	-1	-4	1	183	1	1	1	281	281	82	82
82	0	-3	1	184	1	1	1	282	282	83	83
83	-2	-3	1	185	1	1	1	283	283	84	84
84	-1	-4	1	186	1	1	1	284	284	85	85
85	0	-3	1	187	1	1	1	285	285	86	86
86	-2	-3	1	188	1	1	1	286	286	87	87
87	-1	-4	1	189	1	1	1	287	287	88	88
88	0	-3	1	190	1	1	1	288	288	89	89
89	-2	-3	1	191	1	1	1	289	289	90	90
90	-1	-4	1	192	1	1	1	290	290	91	91
91	0	-3	1	193	1	1	1	291	291	92	92
92	-2	-3	1	194	1	1	1	292	292	93	93
93	-1	-4	1	195	1	1	1	293	293	94	94
94	0	-3	1	196	1	1	1	294	294	95	95
95	-2	-3	1	197	1	1	1	295	295	96	96
96	-1	-4	1	198	1	1	1	296	296	97	97
97	0	-3	1	199	1	1	1	297	297	98	98
98	-2	-3	1	200	1	1	1	298	298	99	99
99	-1	-4	1	201	1	1	1	299	299	100	100
100	0	-3	1	202	1	1	1	300	300		
101	-2	-3	1	203	1	1	1	301	301		
102	-1	-4	1	204	1	1	1	302	302		
103	0	-3	1	205	1	1	1	303	303		
104	-2	-3	1	206	1	1	1	304	304		
105	-1	-4	1	207	1	1	1	305	305		
106	0	-3	1	208	1	1	1	306	306		
107	-2	-3	1	209	1	1	1	307	307		
108	-1	-4	1	210	1	1	1				
109	0	-3	1	211	1	1	1				
110	-2	-3	1	212	1	1	1				
111	-1	-4	1	213	1	1	1				
112	0	-3	1	214	1	1	1				
113	-2	-3	1	215	1	1	1				
114	-1	-4	1	216	1	1	1				
115	0	-3	1	217	1	1	1				
116	-2	-3	1	218	1	1	1				
117	-1	-4	1	219	1	1	1				
118	0	-3	1	220	1	1	1				
119	-2	-3	1	221	1	1	1				
120	-1	-4	1	222	1	1	1				
121	0	-3	1	223	1	1	1				
122	-2	-3	1	224	1	1	1				
123	-1	-4	1	225	1	1	1				
124	0	-3	1	226	1	1	1				
125	-2	-3	1	227	1	1	1				
126	-1	-4	1	228	1	1	1				
127	0	-3	1	229	1	1	1				
128	-2	-3	1	230	1	1	1				
129	-1	-4	1	231	1	1	1				
130	0	-3	1	232	1	1	1				
131	-2	-3	1	233	1	1	1				
132	-1	-4	1	234	1	1	1				
133	0	-3	1	235	1	1	1				
134	-2	-3	1	236	1	1	1				
135	-1	-4	1	237	1	1	1				
136	0	-3	1	238	1	1	1				
137	-2	-3	1	239	1	1	1				
138	-1	-4	1	240	1	1	1				
139	0	-3	1	241	1	1	1				
140	-2	-3	1	242	1	1	1				
141	-1	-4	1	243	1	1	1				
142	0	-3	1	244	1	1	1				
143	-2	-3	1	245	1	1	1				
144	-1	-4	1	246	1	1	1				
145	0	-3	1	247	1	1	1				
146	-2	-3	1	248	1	1	1				
147	-1	-4	1	249	1	1	1				
148	0	-3	1	250	1	1	1				
149	-2	-3									

SHEAR STRESSES FOR LOAD CASE 5 (PSI)															
ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX
313	0	2	-2	314	0	-2	-2	315	-1	2	-2	316	-2	1	-2
314	-2	-2	0	315	-2	-1	0	316	-1	0	-2	317	0	0	-1
315	0	1	-1	316	-2	-1	-1	317	-1	2	-1	318	0	0	-1
316	0	0	0	317	3	0	0	318	3	2	0	319	0	0	-1
317	3	0	0	318	3	0	0	319	3	2	0	320	0	0	0
318	3	0	0	319	3	0	0	320	3	2	0	321	0	0	0
319	3	0	0	320	3	0	0	321	3	2	0	322	0	0	0
320	3	0	0	321	3	0	0	322	3	2	0	323	0	0	0
321	3	0	0	322	3	0	0	323	3	2	0	324	0	0	0
322	3	0	0	323	3	0	0	324	3	2	0	325	0	0	0
323	3	0	0	324	3	0	0	325	3	2	0	326	0	0	0
324	3	0	0	325	3	0	0	326	3	2	0	327	0	0	0
325	3	0	0	326	3	0	0	327	3	2	0	328	0	0	0
326	3	0	0	327	3	0	0	328	3	2	0	329	0	0	0
327	3	0	0	328	3	0	0	329	3	2	0	330	0	0	0
328	3	0	0	329	3	0	0	330	3	2	0	331	0	0	0
329	3	0	0	330	3	0	0	331	3	2	0	332	0	0	0
330	3	0	0	331	3	0	0	332	3	2	0	333	0	0	0
331	3	0	0	332	3	0	0	333	3	2	0	334	0	0	0
332	3	0	0	333	3	0	0	334	3	2	0	335	0	0	0
333	3	0	0	334	3	0	0	335	3	2	0	336	0	0	0
334	3	0	0	335	3	0	0	336	3	2	0	337	0	0	0
335	3	0	0	336	3	0	0	337	3	2	0	338	0	0	0
336	3	0	0	337	3	0	0	338	3	2	0	339	0	0	0
337	3	0	0	338	3	0	0	339	3	2	0	340	0	0	0
338	3	0	0	339	3	0	0	340	3	2	0	341	0	0	0
339	3	0	0	340	3	0	0	341	3	2	0	342	0	0	0
340	3	0	0	341	3	0	0	342	3	2	0	343	0	0	0
341	3	0	0	342	3	0	0	343	3	2	0	344	0	0	0
342	3	0	0	343	3	0	0	344	3	2	0	345	0	0	0
343	3	0	0	344	3	0	0	345	3	2	0	346	0	0	0
344	3	0	0	345	3	0	0	346	3	2	0	347	0	0	0
345	3	0	0	346	3	0	0	347	3	2	0	348	0	0	0
346	3	0	0	347	3	0	0	348	3	2	0	349	0	0	0
347	3	0	0	348	3	0	0	349	3	2	0	350	0	0	0
348	3	0	0	349	3	0	0	350	3	2	0	351	0	0	0
349	3	0	0	350	3	0	0	351	3	2	0	352	0	0	0
350	3	0	0	351	3	0	0	352	3	2	0	353	0	0	0
351	3	0	0	352	3	0	0	353	3	2	0	354	0	0	0
352	3	0	0	353	3	0	0	354	3	2	0	355	0	0	0
353	3	0	0	354	3	0	0	355	3	2	0	356	0	0	0
354	3	0	0	355	3	0	0	356	3	2	0	357	0	0	0
355	3	0	0	356	3	0	0	357	3	2	0	358	0	0	0
356	3	0	0	357	3	0	0	358	3	2	0	359	0	0	0
357	3	0	0	358	3	0	0	359	3	2	0	360	0	0	0
358	3	0	0	359	3	0	0	360	3	2	0	361	0	0	0
359	3	0	0	360	3	0	0	361	3	2	0	362	0	0	0
360	3	0	0	361	3	0	0	362	3	2	0	363	0	0	0
361	3	0	0	362	3	0	0	363	3	2	0	364	0	0	0
362	3	0	0	363	3	0	0	364	3	2	0	365	0	0	0
363	3	0	0	364	3	0	0	365	3	2	0	366	0	0	0
364	3	0	0	365	3	0	0	366	3	2	0	367	0	0	0
365	3	0	0	366	3	0	0	367	3	2	0	368	0	0	0
366	3	0	0	367	3	0	0	368	3	2	0	369	0	0	0
367	3	0	0	368	3	0	0	369	3	2	0	370	0	0	0
368	3	0	0	369	3	0	0	370	3	2	0	371	0	0	0
369	3	0	0	370	3	0	0	371	3	2	0	372	0	0	0
370	3	0	0	371	3	0	0	372	3	2	0	373	0	0	0
371	3	0	0	372	3	0	0	373	3	2	0	374	0	0	0
372	3	0	0	373	3	0	0	374	3	2	0	375	0	0	0
373	3	0	0	374	3	0	0	375	3	2	0	376	0	0	0
374	3	0	0	375	3	0	0	376	3	2	0	377	0	0	0
375	3	0	0	376	3	0	0	377	3	2	0	378	0	0	0
376	3	0	0	377	3	0	0	378	3	2	0	379	0	0	0
377	3	0	0	378	3	0	0	379	3	2	0	380	0	0	0
378	3	0	0	379	3	0	0	380	3	2	0	381	0	0	0
379	3	0	0	380	3	0	0	381	3	2	0	382	0	0	0
380	3	0	0	381	3	0	0	382	3	2	0	383	0	0	0
381	3	0	0	382	3	0	0	383	3	2	0	384	0	0	0
382	3	0	0	383	3	0	0	384	3	2	0	385	0	0	0
383	3	0	0	384	3	0	0	385	3	2	0	386	0	0	0
384	3	0	0	385	3	0	0	386	3	2	0	387	0	0	0
385	3	0	0	386	3	0	0	387	3	2	0	388	0	0	0
386	3	0	0	387	3	0	0	388	3	2	0	389	0	0	0
387	3	0	0	388	3	0	0	389	3	2	0	390	0	0	0
388	3	0	0	389	3	0	0	390	3	2	0	391	0	0	0
389	3	0	0	390	3	0	0	391	3	2	0	392	0	0	0
390	3	0	0	391	3	0	0	392	3	2	0	393	0	0	0
391	3	0	0	392	3	0	0	393	3	2	0	394	0	0	0
392	3	0	0	393	3	0	0	394	3	2	0	395	0	0	0
393	3	0	0	394	3	0	0	395	3	2	0	396	0	0	0
394	3	0	0	395	3	0	0	396	3	2	0	397	0	0	0
395	3	0	0	396	3	0	0	397	3	2	0	398	0	0	0
396	3	0	0	397	3	0	0	398	3	2	0	399	0	0	0
397	3	0	0	398	3	0	0	399	3	2	0	400	0	0	0
398	3	0	0	399	3	0	0	400	3	2	0	401	0	0	0
399	3	0	0	400	3	0	0	401	3	2	0	402	0	0	0
400	3	0	0	401	3	0	0	402	3	2	0	403	0	0	0
401	3	0	0	402	3	0	0	403	3	2	0	404	0	0	0
402	3	0	0	403	3	0	0	404	3	2	0	405	0	0	0
403	3	0	0	404	3	0	0	405	3	2	0	406	0	0	0
404	3	0	0	405	3	0	0	406	3	2	0	407	0	0	0
405	3	0	0	406	3	0	0	407	3	2	0	408	0	0	0
406	3	0	0	407	3	0	0	408	3	2	0	409	0	0	0
407	3	0	0	408	3	0	0	409	3	2	0	410	0	0	0
408	3	0	0	409	3	0	0	410	3	2	0	411	0	0	0
409	3	0	0	410	3	0	0	411	3	2	0	412	0	0	0
410	3	0	0	411	3	0	0	412	3	2	0	413	0	0	0
411	3	0	0	412	3	0	0	413	3	2	0	414	0	0	0
412	3	0	0	413	3	0	0	414	3	2	0	415	0	0	0
413	3	0	0	414	3	0	0	415	3	2	0	416	0	0	0
414	3	0	0	415	3	0	0	416	3	2	0	417	0	0	0
415	3	0	0	416	3	0	0	417	3	2	0	418	0	0	0
416	3	0	0	417	3	0	0	418	3	2	0	419	0	0	0
417	3	0	0	418	3	0	0	419	3	2	0	420	0	0	0
418	3	0	0	419	3	0	0	420	3	2	0	421	0	0	0
419	3	0	0	420	3	0	0	421	3	2	0	422	0	0	0
420	3	0	0	421	3	0	0	422	3	2	0	423	0	0	0
421	3	0	0	422	3	0	0	423	3	2	0	424	0	0	0
422	3	0	0	423	3	0	0	424	3	2	0	425	0	0	0

1/11-B	1/48-B	1/103-B	1/217-B	1/289-B	1/337-B
1/13-B	1/61-B	1/113-B	1/228-B	1/301-B	1/347-B
1/25-B	1/73-B	1/133-B	1/281-B	1/353-B	1/391-B
1/31-B	1/85-B	1/153-B	1/337-B	1/429-B	1/471-B

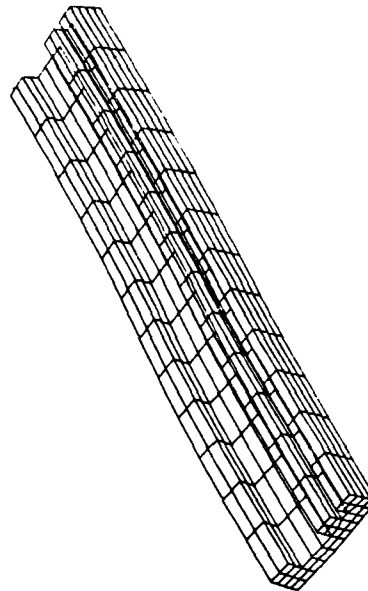
FINITE-ELEMENT ANALYSIS OF PROPOSED 'SHORT' STRUCTURE, AUG 82
UNDEFORMED GRID
 SHORT STRUCTURE: 156 NODES, 394 ELEMENTS



FINITE-ELEMENT ANALYSIS OF PROPOSED 'SHORT' STRUCTURE, AUG 82
LOAD CASE NO-6
 SHORT STRUCTURE: 156 NODES, 394 ELEMENTS



FINITE-ELEMENT ANALYSIS OF PROPOSED 'SHORT' STRUCTURE, AUG 82
LOAD CASE NO-6



FINITE-ELEMENT ANALYSIS OF PROPOSED 'SHORT' STRUCTURE, AUG 82
LOAD CASE NO-6

Figure D6. Finite-element analysis for load case 6 with $K = 175 \text{ lb/in.}^3$ (Sheet 1 of 5)

NORMAL STRESSES FOR LOAD CASE 6 (PST)

ELEM	SX	SY	SZ	ELEM	SX	SY	SZ	ELEM	SX	SY	SZ	ELEM	SX	SY	SZ
1	2	3	4	101	10	11	12	201	20	21	22	301	30	31	32
13	14	15	16	102	11	12	13	202	21	22	23	302	31	32	33
17	18	19	20	103	12	13	14	203	22	23	24	303	32	33	34
21	22	23	24	104	13	14	15	204	23	24	25	304	33	34	35
25	26	27	28	105	14	15	16	205	24	25	26	305	34	35	36
29	30	31	32	106	15	16	17	206	25	26	27	306	35	36	37
33	34	35	36	107	16	17	18	207	26	27	28	307	36	37	38
37	38	39	40	108	17	18	19	208	27	28	29	308	37	38	39
41	42	43	44	109	18	19	20	209	28	29	30	309	38	39	40
45	46	47	48	110	19	20	21	210	29	30	31	310	39	40	41
49	50	51	52	111	20	21	22	211	30	31	32	311	40	41	42
53	54	55	56	112	21	22	23	212	31	32	33	312	41	42	43
57	58	59	60	113	22	23	24	213	32	33	34	313	42	43	44
61	62	63	64	114	23	24	25	214	33	34	35	314	43	44	45
65	66	67	68	115	24	25	26	215	34	35	36	315	44	45	46
69	70	71	72	116	25	26	27	216	35	36	37	316	45	46	47
73	74	75	76	117	26	27	28	217	36	37	38	317	46	47	48
77	78	79	80	118	27	28	29	218	37	38	39	318	47	48	49
81	82	83	84	119	28	29	30	219	38	39	40	319	48	49	50
85	86	87	88	120	29	30	31	220	39	40	41	320	49	50	51
89	90	91	92	121	30	31	32	221	40	41	42	321	50	51	52
93	94	95	96	122	31	32	33	222	41	42	43	322	51	52	53
97	98	99	100	123	32	33	34	223	42	43	44	323	52	53	54
101	102	103	104	124	33	34	35	224	43	44	45	324	53	54	55
105	106	107	108	125	34	35	36	225	44	45	46	325	54	55	56
109	110	111	112	126	35	36	37	226	45	46	47	326	55	56	57
113	114	115	116	127	36	37	38	227	46	47	48	327	56	57	58
117	118	119	120	128	37	38	39	228	47	48	49	328	57	58	59
121	122	123	124	129	38	39	40	229	48	49	50	329	58	59	60
125	126	127	128	130	39	40	41	230	49	50	51	330	59	60	61
129	130	131	132	131	40	41	42	231	50	51	52	331	60	61	62
133	134	135	136	132	41	42	43	232	51	52	53	332	61	62	63
137	138	139	140	133	42	43	44	233	52	53	54	333	62	63	64
141	142	143	144	134	43	44	45	234	53	54	55	334	63	64	65
145	146	147	148	135	44	45	46	235	54	55	56	335	64	65	66
149	150	151	152	136	45	46	47	236	55	56	57	336	65	66	67
153	154	155	156	137	46	47	48	237	56	57	58	337	66	67	68
157	158	159	160	138	47	48	49	238	57	58	59	338	67	68	69
161	162	163	164	139	48	49	50	239	58	59	60	339	68	69	70
165	166	167	168	140	49	50	51	240	59	60	61	340	69	70	71
169	170	171	172	141	50	51	52	241	60	61	62	341	70	71	72
173	174	175	176	142	51	52	53	242	61	62	63	342	71	72	73
177	178	179	180	143	52	53	54	243	62	63	64	343	72	73	74
181	182	183	184	144	53	54	55	244	63	64	65	344	73	74	75
185	186	187	188	145	54	55	56	245	64	65	66	345	74	75	76
189	190	191	192	146	55	56	57	246	65	66	67	346	75	76	77
193	194	195	196	147	56	57	58	247	66	67	68	347	76	77	78
197	198	199	200	148	57	58	59	248	67	68	69	348	77	78	79
201	202	203	204	149	58	59	60	249	68	69	70	349	78	79	80
205	206	207	208	150	59	60	61	250	69	70	71	350	79	80	81
209	210	211	212	151	60	61	62	251	70	71	72	351	80	81	82
213	214	215	216	152	61	62	63	252	71	72	73	352	81	82	83
217	218	219	220	153	62	63	64	253	72	73	74	353	82	83	84
221	222	223	224	154	63	64	65	254	73	74	75	354	83	84	85
225	226	227	228	155	64	65	66	255	74	75	76	355	84	85	86
229	230	231	232	156	65	66	67	256	75	76	77	356	85	86	87
233	234	235	236	157	66	67	68	257	76	77	78	357	86	87	88
237	238	239	240	158	67	68	69	258	77	78	79	358	87	88	89
241	242	243	244	159	68	69	70	259	78	79	80	359	88	89	90
245	246	247	248	160	69	70	71	260	79	80	81	360	89	90	91
249	250	251	252	161	70	71	72	261	80	81	82	361	90	91	92
253	254	255	256	162	71	72	73	262	81	82	83	362	91	92	93
257	258	259	260	163	72	73	74	263	82	83	84	363	92	93	94
261	262	263	264	164	73	74	75	264	83	84	85	364	93	94	95
265	266	267	268	165	74	75	76	265	84	85	86	365	94	95	96
269	270	271	272	166	75	76	77	266	85	86	87	366	95	96	97
273	274	275	276	167	76	77	78	267	86	87	88	367	96	97	98
277	278	279	280	168	77	78	79	268	87	88	89	368	97	98	99
281	282	283	284	169	78	79	80	269	88	89	90	369	98	99	100
285	286	287	288	170	79	80	81	270	89	90	91	370	99	100	101
289	290	291	292	171	80	81	82	271	90	91	92	371	100	101	102
293	294	295	296	172	81	82	83	272	91	92	93	372	101	102	103
297	298	299	300	173	82	83	84	273	92	93	94	373	102	103	104
301	302	303	304	174	83	84	85	274	93	94	95	374	103	104	105
305	306	307	308	175	84	85	86	275	94	95	96	375	104	105	106
309	310	311	312	176	85	86	87	276	95	96	97	376	105	106	107
313	314	315	316	177	86	87	88	277	96	97	98	377	106	107	108
317	318	319	320	178	87	88	89	278	97	98	99	378	107	108	109
321	322	323	324	179	88	89	90	279	98	99	100	379	108	109	110
325	326	327	328	180	89	90	91	280	99	100	101	380	109	110	111
329	330	331	332	181	90	91	92	281	100	101	102	381	110	111	112
333	334	335	336	182	91	92	93	282	101	102	103	382	111	112	113
337	338	339	340	183	92	93	94	283	102	103	104	383	112	113	114
341	342	343	344	184	93	94	95	284	103	104	105	384	113	114	115
345	346	347	348	185	94	95	96	285	104	105	106	385	114	115	116
349	350	351	352	186	95	96	97	286	105	106	107	386	115	116	117
353	354	355	356	187	96	97	98	287	106	107	108	387	116	117	118
357	358	359	360	188	97	98	99	288	107	108	109	388	117	118	119
361	362	363	364	189	98	99	100	289	108	109	110	389	118	119	120
365	366	367	368	190	99	100	101	290	109	110	111	390	119	120	121
369	370	371	372	191	100	101	102	291	110	111	112	391	120	121	122
373	374	375	376	192	101	102	103	292	111	112	113	392	121	122	123
377	378	379	380	193	102	103	104	293	112	113	114	393	122	123	124
381	382	383	384	194	103	104	105	294	113	114	115	394	123	124	125
385	386	387	388	195	104	105	106	295	114	115	116	395	124	125	126
389	390	391	392	196	105	106	107	296	115	116	117	396	125	126	127
393	394	395	396	197	106	107	108	297	116	117	118	397	126	127	128
397	398	399	400	198	107	108	109	298	117	118	119				

NORMAL STRESSES FOR LOAD CASE 6 (PSI)

ELEM	SX	SY	SZ	ELEM	SX	SY	SZ	ELEM	SX	SY	SZ	ELEM	SX	SY	SZ
313	0	11	10	315	0	9	9	316	0	8	8	317	0	8	8
319	0	0	-2	321	0	-6	-1	322	0	-8	-1	323	0	-6	-1
325	-6	4	-2	327	-6	-1	-2	328	-7	-4	-2	329	-7	-6	-2
331	-2	4	-2	333	-2	2	-1	334	-1	-1	-2	335	-1	-5	-2
337	0	21	-3	339	-2	23	-3	340	-1	-2	-3	341	-1	-1	-3
343	0	-12	-3	345	0	-24	-5	346	0	-24	-6	347	0	-23	-6
349	3	16	-5	351	3	16	-1	352	3	15	-1	353	3	-17	-4
355	-1	-6	-3	357	0	-9	-3	358	0	-7	-3	359	0	-12	-4
361	0	11	-1	363	0	9	-2	364	0	-10	-2	365	0	-12	-2
367	-3	-7	-1	369	-3	-8	-1	370	-3	-10	-1	371	-3	-9	-1
373	0	7	-1	375	-1	2	-2	376	-1	-3	-2	377	-1	-6	-3
379	0	4	-1	381	-1	0	-2	382	-1	-3	-3	383	-1	-6	-3

MIN.	ELEM	SX	ELEM	SY	ELEM	SZ
121	40	-20	285	294	29	(COMPRESSIVE)
133	45	19	294	29	29	(TENSILE)

Figure D6. (Sheet 3 of 5)

SHEAR STRESSES FOR LOAD CASE 6 (PSI)											
ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX
313	-1	6	-1	316	0	-5	-2	317	-3	4	-2
314	-3	-4	0	317	-1	0	-1	318	0	0	-1
315	0	-4	0	318	2	5	0	319	0	-5	-1
316	3	-2	0	319	3	1	0	320	3	0	-1
317	7	-2	0	320	3	5	0	321	2	4	0
318	-2	1	-1	321	3	1	0	322	3	1	0
319	-1	3	0	322	3	1	0	323	2	1	0
320	-1	3	0	323	3	1	0	324	2	1	0
321	-1	3	0	324	3	1	0	325	2	1	0
322	-1	3	0	325	3	1	0	326	2	1	0
323	-1	3	0	326	3	1	0	327	2	1	0
324	-1	3	0	327	3	1	0	328	2	1	0
325	-1	3	0	328	3	1	0	329	2	1	0
326	-1	3	0	329	3	1	0	330	2	1	0
327	-1	3	0	330	3	1	0	331	2	1	0
328	-1	3	0	331	3	1	0	332	2	1	0
329	-1	3	0	332	3	1	0	333	2	1	0
330	-1	3	0	333	3	1	0	334	2	1	0
331	-1	3	0	334	3	1	0	335	2	1	0
332	-1	3	0	335	3	1	0	336	2	1	0
333	-1	3	0	336	3	1	0	337	2	1	0
334	-1	3	0	337	3	1	0	338	2	1	0
335	-1	3	0	338	3	1	0	339	2	1	0
336	-1	3	0	339	3	1	0	340	2	1	0
337	-1	3	0	340	3	1	0	341	2	1	0
338	-1	3	0	341	3	1	0	342	2	1	0
339	-1	3	0	342	3	1	0	343	2	1	0
340	-1	3	0	343	3	1	0	344	2	1	0
341	-1	3	0	344	3	1	0	345	2	1	0
342	-1	3	0	345	3	1	0	346	2	1	0
343	-1	3	0	346	3	1	0	347	2	1	0
344	-1	3	0	347	3	1	0	348	2	1	0
345	-1	3	0	348	3	1	0	349	2	1	0
346	-1	3	0	349	3	1	0	350	2	1	0
347	-1	3	0	350	3	1	0	351	2	1	0
348	-1	3	0	351	3	1	0	352	2	1	0
349	-1	3	0	352	3	1	0	353	2	1	0
350	-1	3	0	353	3	1	0	354	2	1	0
351	-1	3	0	354	3	1	0	355	2	1	0
352	-1	3	0	355	3	1	0	356	2	1	0
353	-1	3	0	356	3	1	0	357	2	1	0
354	-1	3	0	357	3	1	0	358	2	1	0
355	-1	3	0	358	3	1	0	359	2	1	0
356	-1	3	0	359	3	1	0	360	2	1	0
357	-1	3	0	360	3	1	0	361	2	1	0
358	-1	3	0	361	3	1	0	362	2	1	0
359	-1	3	0	362	3	1	0	363	2	1	0
360	-1	3	0	363	3	1	0	364	2	1	0
361	-1	3	0	364	3	1	0	365	2	1	0
362	-1	3	0	365	3	1	0	366	2	1	0
363	-1	3	0	366	3	1	0	367	2	1	0
364	-1	3	0	367	3	1	0	368	2	1	0
365	-1	3	0	368	3	1	0	369	2	1	0
366	-1	3	0	369	3	1	0	370	2	1	0
367	-1	3	0	370	3	1	0	371	2	1	0
368	-1	3	0	371	3	1	0	372	2	1	0
369	-1	3	0	372	3	1	0	373	2	1	0
370	-1	3	0	373	3	1	0	374	2	1	0
371	-1	3	0	374	3	1	0	375	2	1	0
372	-1	3	0	375	3	1	0	376	2	1	0
373	-1	3	0	376	3	1	0	377	2	1	0
374	-1	3	0	377	3	1	0	378	2	1	0
375	-1	3	0	378	3	1	0	379	2	1	0
376	-1	3	0	379	3	1	0	380	2	1	0
377	-1	3	0	380	3	1	0	381	2	1	0
378	-1	3	0	381	3	1	0	382	2	1	0
379	-1	3	0	382	3	1	0	383	2	1	0
380	-1	3	0	383	3	1	0	384	2	1	0
381	-1	3	0	384	3	1	0	385	2	1	0
382	-1	3	0	385	3	1	0	386	2	1	0
383	-1	3	0	386	3	1	0	387	2	1	0
384	-1	3	0	387	3	1	0	388	2	1	0
385	-1	3	0	388	3	1	0	389	2	1	0
386	-1	3	0	389	3	1	0	390	2	1	0
387	-1	3	0	390	3	1	0	391	2	1	0
388	-1	3	0	391	3	1	0	392	2	1	0
389	-1	3	0	392	3	1	0	393	2	1	0
390	-1	3	0	393	3	1	0	394	2	1	0
391	-1	3	0	394	3	1	0	395	2	1	0
392	-1	3	0	395	3	1	0	396	2	1	0
393	-1	3	0	396	3	1	0	397	2	1	0
394	-1	3	0	397	3	1	0	398	2	1	0
395	-1	3	0	398	3	1	0	399	2	1	0
396	-1	3	0	399	3	1	0	400	2	1	0
397	-1	3	0	400	3	1	0	401	2	1	0
398	-1	3	0	401	3	1	0	402	2	1	0
399	-1	3	0	402	3	1	0	403	2	1	0
400	-1	3	0	403	3	1	0	404	2	1	0
401	-1	3	0	404	3	1	0	405	2	1	0
402	-1	3	0	405	3	1	0	406	2	1	0
403	-1	3	0	406	3	1	0	407	2	1	0
404	-1	3	0	407	3	1	0	408	2	1	0
405	-1	3	0	408	3	1	0	409	2	1	0
406	-1	3	0	409	3	1	0	410	2	1	0
407	-1	3	0	410	3	1	0	411	2	1	0
408	-1	3	0	411	3	1	0	412	2	1	0
409	-1	3	0	412	3	1	0	413	2	1	0
410	-1	3	0	413	3	1	0	414	2	1	0
411	-1	3	0	414	3	1	0	415	2	1	0
412	-1	3	0	415	3	1	0	416	2	1	0
413	-1	3	0	416	3	1	0	417	2	1	0
414	-1	3	0	417	3	1	0	418	2	1	0
415	-1	3	0	418	3	1	0	419	2	1	0
416	-1	3	0	419	3	1	0	420	2	1	0
417	-1	3	0	420	3	1	0	421	2	1	0
418	-1	3	0	421	3	1	0	422	2	1	0
419	-1	3	0	422	3	1	0	423	2	1	0
420	-1	3	0	423	3	1	0	424	2	1	0
421	-1	3	0	424	3	1	0	425	2	1	0
422	-1	3	0	425	3	1	0	426	2	1	0
423	-1	3	0	426	3	1	0	427	2	1	0
424	-1	3	0	427	3	1	0	428	2	1	0
425	-1	3	0	428	3	1	0	429	2	1	0
426	-1	3	0	429	3	1	0	430	2	1	0
427	-1	3	0	430	3	1	0	431	2	1	0
428	-1	3	0	431	3	1	0	432	2	1	0
429	-1	3	0	432	3	1	0	433	2	1	0
430	-1	3	0	433	3	1	0	434	2	1	0
431	-1	3	0	434	3	1	0	435	2	1	0
432	-1	3	0	435	3	1	0	436	2	1	0
433	-1	3	0	436	3	1	0	437	2	1	0
434	-1	3	0	437	3	1	0	438	2	1	0
435	-1	3	0	438	3	1	0	439	2	1	0
436	-1	3	0	439	3	1	0	440	2	1	0
437	-1	3	0	440	3	1	0	441	2	1	0
438	-1	3	0	441	3	1	0	442	2	1	0
439	-1	3	0	442	3	1	0	443	2	1	0
440	-1	3	0	443	3	1	0	444	2	1	0
441	-1	3	0	444	3	1	0	445	2	1	0
442	-1	3	0	445	3	1	0	446	2	1	0
443	-1	3	0	446	3	1	0	447	2	1	0
444	-1	3	0	447	3	1	0	448	2	1	0
445	-1	3	0	448	3	1	0	449	2	1	0
446	-1	3	0	449	3	1	0	450	2	1	0
447	-1	3	0	450	3	1	0	451	2	1	0
448	-1	3	0	451	3	1	0	452	2	1	0
449	-1	3	0	452	3	1	0	453	2	1	0
450	-1	3	0	453	3	1	0	454	2	1	0
451	-1	3	0	454	3	1	0	455	2	1	0
452	-1	3	0	455	3	1	0	456	2	1	0
453	-1	3	0	456	3	1	0	457	2	1	0
454	-1	3	0	457	3	1	0	458	2	1	0
455	-1	3	0	458	3	1	0	459	2	1	0
456	-1	3	0	459	3	1	0	460	2	1	0
457	-1	3	0	460	3	1	0	461	2	1	0
458	-1	3	0	461	3	1	0	462	2	1	0
459	-1	3	0	462</							

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Figure D7. (Sheet 2 of 5)

NORMAL STRESSES FOR LOAD CASE 7 (PSI)

ELEM	SX	SY	SZ	ELEM	SX	SY	SZ	ELEM	SX	SY	SZ	ELEM	SX	SY	SZ	ELEM	SX	SY	SZ
313	2	22	-2	316	2	19	7	319	2	16	-1	322	2	14	-1	325	2	11	-1
315	1	3	-2	320	-1	-14	-1	323	1	-17	0	326	-1	-17	0	329	1	-10	-1
318	-10	16	0	321	-10	15	0	324	-10	12	0	327	-10	8	0	330	-10	5	0
321	-2	1	-2	322	-2	12	-2	325	-2	11	-2	328	-2	8	-2	331	-2	5	-2
324	-2	-1	-4	323	-2	11	-4	326	-2	10	-4	329	-2	7	-4	332	-2	4	-4
327	-2	-1	-4	324	-2	10	-4	327	-2	9	-4	330	-2	6	-4	333	-2	3	-4
330	-2	-1	-4	325	-2	9	-4	328	-2	8	-4	331	-2	5	-4	334	-2	2	-4
333	-2	-1	-4	326	-2	8	-4	329	-2	7	-4	332	-2	4	-4	335	-2	1	-4
336	-2	-1	-4	327	-2	7	-4	330	-2	6	-4	333	-2	3	-4	336	-2	0	-4
339	-2	-1	-4	328	-2	6	-4	331	-2	5	-4	334	-2	2	-4	337	-2	0	-4
342	-2	-1	-4	329	-2	5	-4	332	-2	4	-4	335	-2	1	-4	338	-2	0	-4
345	-2	-1	-4	330	-2	4	-4	333	-2	3	-4	336	-2	0	-4	339	-2	0	-4
348	-2	-1	-4	331	-2	3	-4	334	-2	2	-4	337	-2	0	-4	340	-2	0	-4
351	-2	-1	-4	332	-2	2	-4	335	-2	1	-4	338	-2	0	-4	341	-2	0	-4
354	-2	-1	-4	333	-2	1	-4	336	-2	0	-4	339	-2	0	-4	342	-2	0	-4
357	-2	-1	-4	334	-2	0	-4	337	-2	0	-4	340	-2	0	-4	343	-2	0	-4
360	-2	-1	-4	335	-2	0	-4	338	-2	0	-4	341	-2	0	-4	344	-2	0	-4
363	-2	-1	-4	336	-2	0	-4	339	-2	0	-4	342	-2	0	-4	345	-2	0	-4
366	-2	-1	-4	337	-2	0	-4	340	-2	0	-4	343	-2	0	-4	346	-2	0	-4
369	-2	-1	-4	338	-2	0	-4	341	-2	0	-4	344	-2	0	-4	347	-2	0	-4
372	-2	-1	-4	339	-2	0	-4	342	-2	0	-4	345	-2	0	-4	348	-2	0	-4
375	-2	-1	-4	340	-2	0	-4	343	-2	0	-4	346	-2	0	-4	349	-2	0	-4
378	-2	-1	-4	341	-2	0	-4	344	-2	0	-4	347	-2	0	-4	350	-2	0	-4
381	-2	-1	-4	342	-2	0	-4	345	-2	0	-4	348	-2	0	-4	351	-2	0	-4
384	-2	-1	-4	343	-2	0	-4	346	-2	0	-4	349	-2	0	-4	352	-2	0	-4
387	-2	-1	-4	344	-2	0	-4	347	-2	0	-4	350	-2	0	-4	353	-2	0	-4
390	-2	-1	-4	345	-2	0	-4	348	-2	0	-4	351	-2	0	-4	354	-2	0	-4
393	-2	-1	-4	346	-2	0	-4	349	-2	0	-4	352	-2	0	-4	355	-2	0	-4
396	-2	-1	-4	347	-2	0	-4	350	-2	0	-4	353	-2	0	-4	356	-2	0	-4
399	-2	-1	-4	348	-2	0	-4	351	-2	0	-4	354	-2	0	-4	357	-2	0	-4
402	-2	-1	-4	349	-2	0	-4	352	-2	0	-4	355	-2	0	-4	358	-2	0	-4
405	-2	-1	-4	350	-2	0	-4	353	-2	0	-4	356	-2	0	-4	359	-2	0	-4
408	-2	-1	-4	351	-2	0	-4	354	-2	0	-4	357	-2	0	-4	360	-2	0	-4
411	-2	-1	-4	352	-2	0	-4	355	-2	0	-4	358	-2	0	-4	361	-2	0	-4
414	-2	-1	-4	353	-2	0	-4	356	-2	0	-4	359	-2	0	-4	362	-2	0	-4
417	-2	-1	-4	354	-2	0	-4	357	-2	0	-4	360	-2	0	-4	363	-2	0	-4
420	-2	-1	-4	355	-2	0	-4	358	-2	0	-4	361	-2	0	-4	364	-2	0	-4
423	-2	-1	-4	356	-2	0	-4	359	-2	0	-4	362	-2	0	-4	365	-2	0	-4
426	-2	-1	-4	357	-2	0	-4	360	-2	0	-4	363	-2	0	-4	366	-2	0	-4
429	-2	-1	-4	358	-2	0	-4	361	-2	0	-4	364	-2	0	-4	367	-2	0	-4
432	-2	-1	-4	359	-2	0	-4	362	-2	0	-4	365	-2	0	-4	368	-2	0	-4
435	-2	-1	-4	360	-2	0	-4	363	-2	0	-4	366	-2	0	-4	369	-2	0	-4
438	-2	-1	-4	361	-2	0	-4	364	-2	0	-4	367	-2	0	-4	370	-2	0	-4
441	-2	-1	-4	362	-2	0	-4	365	-2	0	-4	368	-2	0	-4	371	-2	0	-4
444	-2	-1	-4	363	-2	0	-4	366	-2	0	-4	369	-2	0	-4	372	-2	0	-4
447	-2	-1	-4	364	-2	0	-4	367	-2	0	-4	370	-2	0	-4	373	-2	0	-4
450	-2	-1	-4	365	-2	0	-4	371	-2	0	-4	372	-2	0	-4	374	-2	0	-4
453	-2	-1	-4	366	-2	0	-4	372	-2	0	-4	373	-2	0	-4	375	-2	0	-4
456	-2	-1	-4	367	-2	0	-4	373	-2	0	-4	374	-2	0	-4	376	-2	0	-4
459	-2	-1	-4	368	-2	0	-4	374	-2	0	-4	375	-2	0	-4	377	-2	0	-4
462	-2	-1	-4	369	-2	0	-4	375	-2	0	-4	376	-2	0	-4	378	-2	0	-4
465	-2	-1	-4	370	-2	0	-4	376	-2	0	-4	377	-2	0	-4	379	-2	0	-4
468	-2	-1	-4	371	-2	0	-4	377	-2	0	-4	378	-2	0	-4	380	-2	0	-4
471	-2	-1	-4	372	-2	0	-4	378	-2	0	-4	379	-2	0	-4	381	-2	0	-4
474	-2	-1	-4	373	-2	0	-4	379	-2	0	-4	380	-2	0	-4	382	-2	0	-4
477	-2	-1	-4	374	-2	0	-4	380	-2	0	-4	381	-2	0	-4	383	-2	0	-4
480	-2	-1	-4	375	-2	0	-4	381	-2	0	-4	382	-2	0	-4	384	-2	0	-4
483	-2	-1	-4	376	-2	0	-4	382	-2	0	-4	383	-2	0	-4	385	-2	0	-4
486	-2	-1	-4	377	-2	0	-4	383	-2	0	-4	384	-2	0	-4	386	-2	0	-4
489	-2	-1	-4	378	-2	0	-4	384	-2	0	-4	385	-2	0	-4	387	-2	0	-4
492	-2	-1	-4	379	-2	0	-4	385	-2	0	-4	386	-2	0	-4	388	-2	0	-4
495	-2	-1	-4	380	-2	0	-4	386	-2	0	-4	387	-2	0	-4	389	-2	0	-4
498	-2	-1	-4	381	-2	0	-4	387	-2	0	-4	388	-2	0	-4	390	-2	0	-4
501	-2	-1	-4	382	-2	0	-4	388	-2	0	-4	389	-2	0	-4	391	-2	0	-4
504	-2	-1	-4	383	-2	0	-4	389	-2	0	-4	390	-2	0	-4	392	-2	0	-4
507	-2	-1	-4	384	-2	0	-4	390	-2	0	-4	391	-2	0	-4	393	-2	0	-4
510	-2	-1	-4	385	-2	0	-4	391	-2	0	-4	392	-2	0	-4	394	-2	0	-4
513	-2	-1	-4	386	-2	0	-4	392	-2	0	-4	393	-2	0	-4	395	-2	0	-4
516	-2	-1	-4	387	-2	0	-4	393	-2	0	-4	394	-2	0	-4	396	-2	0	-4
519	-2	-1	-4	388	-2	0	-4	394	-2	0	-4	395	-2	0	-4	397	-2	0	-4
522	-2	-1	-4	389	-2	0	-4	395	-2	0	-4	396	-2	0	-4	398	-2	0	-4
525	-2	-1	-4	390	-2	0	-4	396	-2	0	-4	397	-2	0	-4	399	-2	0	-4
528	-2	-1	-4	391	-2	0	-4	397	-2	0	-4	398	-2	0	-4	400	-2	0	-4
531	-2	-1	-4	392	-2	0	-4	398	-2	0	-4	399	-2	0	-4	401	-2	0	-4
534	-2	-1	-4	393	-2	0	-4	399	-2	0	-4	400	-2	0	-4	402	-2	0	-4
537	-2	-1	-4	394	-2	0	-4	400	-2	0	-4	401	-2	0	-4	403	-2	0	-4
540	-2	-1	-4	395	-2	0	-4	401	-2	0	-4	402	-2	0	-4	404	-2	0	-4
543	-2	-1	-4	396	-2	0	-4	402	-2	0	-4	403	-2	0	-4	405	-2	0	-4
546	-2	-1	-4	397	-2	0	-4	403	-2	0	-4	404	-2	0	-4	406	-2	0	-4
549	-2	-1	-4	398	-2	0	-4	404	-2	0	-4	405	-2	0	-4	407	-2	0	-4
552	-2	-1	-4	399	-2	0	-4	405	-2	0	-4	406	-2	0	-4	408	-2	0	-4
555	-2	-1	-4	400	-2	0	-4	406	-2	0	-4	407	-2	0	-4	409	-2	0	-4
558	-2	-1	-4	401	-2	0	-4	407	-2	0	-4	408	-2	0	-4	410	-2	0	-4
561	-2	-1	-4	402	-2	0	-4	408	-2	0	-4	409	-2	0	-4	411	-2	0	-4
564	-2	-1	-4	403	-2	0	-4	409	-2	0	-4	410	-2	0	-4	412	-2	0	-4
567	-2	-1	-4	404	-2	0	-4	410	-2	0	-4	411	-2	0	-4	413	-2	0	-4
570	-2	-1	-4	405	-2	0	-4	411	-2	0	-4	412	-2	0	-4	414	-2	0	-4
573	-2	-1	-4	406	-2	0	-4	412	-2	0	-4	413	-2	0	-4	415	-2	0	-4
576	-2	-1	-4	407	-2	0	-4	413	-2	0	-4	414	-2	0	-4	416	-2	0	-4
579	-2	-1	-4	408	-2														

SHEAR STRESSES FOR LOAD CASE 7 (PSI)

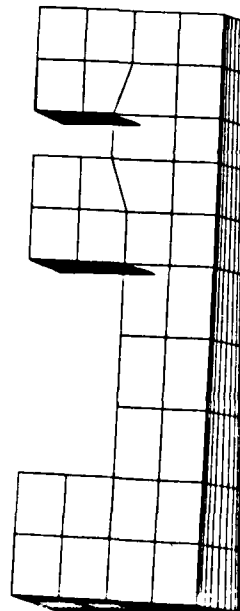
ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX
313	0	4	-3	316	-1	-4	-3	319	-3	-7	-3	322	-1	-4	-3	325	-5	-7	-3
319	-5	-3	0	320	-3	-1	0	323	-1	0	-1	326	0	0	-1	329	0	0	-1
325	0	3	-2	321	-2	-1	0	324	0	0	-2	327	0	0	-2	330	0	0	-2
331	7	0	0	327	4	3	-2	328	4	-2	0	331	3	1	0	334	1	0	0
337	10	0	0	333	6	1	0	334	6	1	0	336	3	0	0	339	3	0	0
343	-6	4	0	336	-12	3	5	340	-15	4	5	343	5	2	0	346	-16	5	6
349	-2	1	-1	346	-5	3	0	347	-3	2	0	350	-2	2	0	353	-1	1	0
355	-2	8	0	350	-3	3	1	352	-4	6	1	355	-1	3	0	358	-5	6	1
361	0	2	-4	352	-2	2	0	356	-1	5	0	359	0	0	0	362	0	0	0
367	0	6	0	363	0	6	-4	364	0	6	-4	367	0	0	0	370	0	0	0
373	-1	2	-2	369	0	7	0	370	0	5	0	373	0	0	0	376	0	0	0
379	4	4	0	375	1	4	-2	376	5	2	-2	379	3	5	-3	382	6	1	-3
				381	3	4	0	382	3	3	0	385	2	2	0	388	1	1	0

MIN.	ELEM	VXY	ELEM	VYZ	ELEM	VZX
	150	-20	18	-24	85	-5
MAX.	90	12	65	14	265	8

Figure D7. (Sheet 5 of 5)

1/1	1/100		1/1000	1/2000	1/3000
1/10	1/100		1/1000	1/2000	1/3000
1/100	1/1000		1/10000	1/20000	1/30000
1/1000	1/10000		1/100000	1/200000	1/300000
1/10000	1/100000		1/1000000	1/2000000	1/3000000

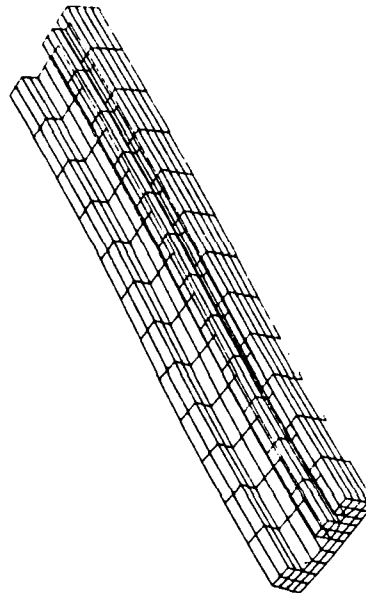
FINITE-ELEMENT ANALYSIS OF PROPOSED 'SHORT' STRUCTURE, AUG 82
UNDEFORMED GRID
SHORT STRUCTURE: 100, 200, 300 ELEMENTS



FINITE-ELEMENT ANALYSIS OF PROPOSED 'SHORT' STRUCTURE, AUG 82
LOAD CASE NO. 8
SHORT STRUCTURE: 100, 200, 300 ELEMENTS



FINITE-ELEMENT ANALYSIS OF PROPOSED 'SHORT' STRUCTURE, AUG 82
LOAD CASE NO. 8



FINITE-ELEMENT ANALYSIS OF PROPOSED 'SHORT' STRUCTURE, AUG 82
LOAD CASE NO. 8

Figure D8. Finite-element analysis for load case 8 with $K = 175 \text{ lb/in.}^3$ (Sheet 1 of 5)

NORMAL STRESSES FOR LOAD CASE 8 (PSI)

ELEM	SX	SY	SZ	ELEM	SX	SY	SZ	ELEM	SX	SY	SZ	ELEM	SX	SY	SZ	ELEM	SX	SY	SZ	ELEM	SX	SY	SZ
1	7	-4	19	19	12	-28	19	4	7	-1	19	11	10	-1	19	10	10	-1	19	10	10	-1	
13	19	-12	22	21	-7	-1	21	16	0	-7	21	17	17	-1	21	17	17	-1	21	17	17	-1	
25	3	-3	19	18	0	-3	18	28	0	-3	18	29	29	-2	18	35	35	-2	18	35	35	-2	
37	4	-4	11	11	0	-4	11	40	0	-4	11	41	41	0	11	47	47	0	11	47	47	0	
49	4	-4	15	15	0	-4	15	52	0	-4	15	53	53	0	15	59	59	0	15	59	59	0	
61	6	-6	11	11	0	-6	11	64	0	-6	11	65	65	0	11	71	71	0	11	71	71	0	
73	7	-7	11	11	0	-7	11	76	0	-7	11	77	77	0	11	83	83	0	11	83	83	0	
85	8	-8	9	9	0	-8	9	88	0	-8	9	89	89	0	9	95	95	0	9	95	95	0	
97	9	-9	10	10	0	-9	10	100	0	-9	10	101	101	0	10	107	107	0	10	107	107	0	
109	10	-10	10	10	0	-10	10	102	0	-10	10	103	103	0	10	109	109	0	10	109	109	0	
121	11	-11	10	10	0	-11	10	104	0	-11	10	105	105	0	10	111	111	0	10	111	111	0	
133	12	-12	10	10	0	-12	10	106	0	-12	10	107	107	0	10	113	113	0	10	113	113	0	
145	13	-13	10	10	0	-13	10	108	0	-13	10	109	109	0	10	115	115	0	10	115	115	0	
157	14	-14	10	10	0	-14	10	110	0	-14	10	111	111	0	10	117	117	0	10	117	117	0	
169	15	-15	10	10	0	-15	10	112	0	-15	10	113	113	0	10	119	119	0	10	119	119	0	
181	16	-16	10	10	0	-16	10	114	0	-16	10	115	115	0	10	121	121	0	10	121	121	0	
193	17	-17	10	10	0	-17	10	116	0	-17	10	117	117	0	10	123	123	0	10	123	123	0	
205	18	-18	10	10	0	-18	10	118	0	-18	10	119	119	0	10	125	125	0	10	125	125	0	
217	19	-19	10	10	0	-19	10	119	0	-19	10	121	121	0	10	127	127	0	10	127	127	0	
229	20	-20	10	10	0	-20	10	120	0	-20	10	122	122	0	10	129	129	0	10	129	129	0	
241	21	-21	10	10	0	-21	10	121	0	-21	10	123	123	0	10	131	131	0	10	131	131	0	
253	22	-22	10	10	0	-22	10	122	0	-22	10	124	124	0	10	133	133	0	10	133	133	0	
265	23	-23	10	10	0	-23	10	123	0	-23	10	125	125	0	10	135	135	0	10	135	135	0	
277	24	-24	10	10	0	-24	10	124	0	-24	10	126	126	0	10	137	137	0	10	137	137	0	
289	25	-25	10	10	0	-25	10	125	0	-25	10	127	127	0	10	139	139	0	10	139	139	0	
301	26	-26	10	10	0	-26	10	126	0	-26	10	128	128	0	10	141	141	0	10	141	141	0	
313	27	-27	10	10	0	-27	10	127	0	-27	10	129	129	0	10	143	143	0	10	143	143	0	
325	28	-28	10	10	0	-28	10	128	0	-28	10	130	130	0	10	145	145	0	10	145	145	0	
337	29	-29	10	10	0	-29	10	129	0	-29	10	131	131	0	10	147	147	0	10	147	147	0	
349	30	-30	10	10	0	-30	10	130	0	-30	10	132	132	0	10	149	149	0	10	149	149	0	
361	31	-31	10	10	0	-31	10	131	0	-31	10	133	133	0	10	151	151	0	10	151	151	0	
373	32	-32	10	10	0	-32	10	132	0	-32	10	134	134	0	10	153	153	0	10	153	153	0	
385	33	-33	10	10	0	-33	10	133	0	-33	10	135	135	0	10	155	155	0	10	155	155	0	
397	34	-34	10	10	0	-34	10	134	0	-34	10	136	136	0	10	157	157	0	10	157	157	0	
409	35	-35	10	10	0	-35	10	135	0	-35	10	137	137	0	10	159	159	0	10	159	159	0	
421	36	-36	10	10	0	-36	10	136	0	-36	10	138	138	0	10	161	161	0	10	161	161	0	
433	37	-37	10	10	0	-37	10	137	0	-37	10	139	139	0	10	163	163	0	10	163	163	0	
445	38	-38	10	10	0	-38	10	138	0	-38	10	140	140	0	10	165	165	0	10	165	165	0	
457	39	-39	10	10	0	-39	10	139	0	-39	10	141	141	0	10	167	167	0	10	167	167	0	
469	40	-40	10	10	0	-40	10	140	0	-40	10	142	142	0	10	169	169	0	10	169	169	0	
481	41	-41	10	10	0	-41	10	141	0	-41	10	143	143	0	10	171	171	0	10	171	171	0	
493	42	-42	10	10	0	-42	10	142	0	-42	10	144	144	0	10	173	173	0	10	173	173	0	
505	43	-43	10	10	0	-43	10	143	0	-43	10	145	145	0	10	175	175	0	10	175	175	0	
517	44	-44	10	10	0	-44	10	144	0	-44	10	146	146	0	10	177	177	0	10	177	177	0	
529	45	-45	10	10	0	-45	10	145	0	-45	10	147	147	0	10	179	179	0	10	179	179	0	
541	46	-46	10	10	0	-46	10	146	0	-46	10	148	148	0	10	181	181	0	10	181	181	0	
553	47	-47	10	10	0	-47	10	147	0	-47	10	149	149	0	10	183	183	0	10	183	183	0	
565	48	-48	10	10	0	-48	10	148	0	-48	10	150	150	0	10	185	185	0	10	185	185	0	
577	49	-49	10	10	0	-49	10	149	0	-49	10	151	151	0	10	187	187	0	10	187	187	0	
589	50	-50	10	10	0	-50	10	150	0	-50	10	152	152	0	10	189	189	0	10	189	189	0	
601	51	-51	10	10	0	-51	10	151	0	-51	10	153	153	0	10	191	191	0	10	191	191	0	
613	52	-52	10	10	0	-52	10	152	0	-52	10	154	154	0	10	193	193	0	10	193	193	0	
625	53	-53	10	10	0	-53	10	153	0	-53	10	155	155	0	10	195	195	0	10	195	195	0	
637	54	-54	10	10	0	-54	10	154	0	-54	10	156	156	0	10	197	197	0	10	197	197	0	
649	55	-55	10	10	0	-55	10	155	0	-55	10	157	157	0	10	199	199	0	10	199	199	0	
661	56	-56	10	10	0	-56	10	156	0	-56	10	158	158	0	10	201	201	0	10	201	201	0	
673	57	-57	10	10	0	-57	10	157	0	-57	10	159	159	0	10	203	203	0	10	203	203	0	
685	58	-58	10	10	0	-58	10	158	0	-58	10	160	160	0	10	205	205	0	10	205	205	0	
697	59	-59	10	10	0	-59	10	159	0	-59	10	161	161	0	10	207	207	0	10	207	207	0	
709	60	-60	10	10	0	-60	10	160	0	-60	10	162	162	0	10	209	209	0	10	209	209	0	
721	61	-61	10	10	0	-61	10	161	0	-61	10	163	163	0	10	211	211	0	10	211	211	0	
733	62	-62	10	10	0	-62	10	162	0	-62	10	164	164	0	10	213	213	0	10	213	213	0	
745	63	-63	10	10	0	-63	10	163	0	-63	10	165	165	0	10	215	215	0	10	215	215	0	
757	64	-64	10	10	0	-64	10	164	0	-64	10	166	166	0	10	217	217	0	10	217	217	0	
769	65	-65	10	10	0	-65	10	165	0	-65	10	167	167	0	10	219	219	0	10	219	219	0	
781	66	-66	10	10	0	-66	10	166	0	-66	10	168	168	0	10	221	221	0	10	221	221	0	
793	67	-67	10	10	0	-67	10	167	0	-67	10	169	169	0	10	223	223	0	10	223	223	0	
805	68	-68	10	10	0	-68	10	168	0	-68	10	170	170	0	10	225	225	0	10	225	225	0	
817	69	-69	10	10	0	-69	10	169	0	-69	10	171	171	0	10	227	227	0	10	227	227	0	
829	70	-70	10	10	0	-70	10	170	0	-70	10	172	172	0	10	229	229	0	10	229	229	0	
841	71	-71	10	10	0	-71	10	171	0	-71	10	173	173	0	10	231	231	0	10	231	231	0	
853	72	-72	10	10	0	-72	10	172	0	-72	10	174	174	0	10	233	233	0	10	233	233	0	
865	73	-73	10	10	0	-73	10	173	0	-73													

NORMAL STRESSES FOR LOAD CASE 8 (PSI)

ELEM	SX	SY	SZ	ELEM	SX	SY	SZ	ELEM	SX	SY	SZ	ELEM	SX	SY	SZ
313	1	23	21	315	1	19	20	316	1	15	20	317	2	1	19
319	1	0	-3	321	0	-11	-1	322	0	-15	-1	323	0	-18	-2
325	-12	8	6	327	-12	-1	6	328	-13	-8	5	329	-13	-12	5
331	0	0	-1	333	-3	5	-5	334	-3	-1	-5	335	-3	7	-3
337	-3	41	0	339	0	46	-5	340	0	46	-5	341	-3	39	-5
343	0	-24	-5	345	0	-42	-10	346	6	30	-10	347	0	-34	-11
349	5	33	-10	351	5	32	-1	352	6	-34	-1	353	6	-34	-2
355	-1	-12	-4	357	0	-31	-4	358	0	-13	-5	359	0	-8	-6
361	0	23	-1	363	0	-15	-2	364	0	-20	-2	365	1	-23	-3
367	0	-2	-1	369	-6	11	-1	370	0	-6	-3	371	0	-5	-3
373	-6	14	1	375	-6	11	-2	376	-6	-1	0	377	-6	-12	-3
379	0	8	0	381	-1	1	-2	382	-1	-6	-3	383	-1	-12	-3

ELEM	SX	SY	SZ	ELEM	SX	SY	SZ
321	-44	295	-14	329	1	15	20
333	41	294	58	337	2	1	19

Figure D8. (Sheet 3 of 5)

SHEAR STRESSES FOR LOAD CASE 8 (PSI)											
ELEM	VXY	VZ	ELEM	VXY	VZ	ELEM	VXY	VZ	ELEM	VXY	VZ
1	-15	8	2	-11	-20	3	-8	18	4	-17	-24
7	-14	-3	8	-11	-19	9	-4	12	5	-5	0
13	-5	-14	14	-6	-17	15	-4	4	10	-7	0
19	-5	-30	20	-2	-17	21	-2	0	16	-1	0
25	11	-11	26	-2	-13	27	-2	-4	22	-1	0
31	11	-10	32	-2	-16	33	1	-4	28	0	0
37	-11	-10	38	1	-11	39	7	-4	34	0	0
43	-15	-17	44	10	-19	45	4	-4	40	-8	-5
49	-18	-15	50	-12	-11	51	-8	20	46	-17	0
55	-16	12	56	-11	-6	57	-1	0	52	-5	0
61	-9	13	62	-5	-3	63	-1	20	58	-5	0
67	-9	13	68	-6	-3	69	-1	12	64	-4	1
73	-1	-1	74	-2	-4	75	-2	-1	70	-3	1
79	-1	-1	80	-2	-4	81	-2	8	76	-3	1
85	-2	-5	86	15	-1	87	9	-1	82	11	-10
91	-2	-5	92	-18	-4	93	-10	-5	88	-14	-10
97	-2	-5	98	-18	-4	99	-10	-5	94	-14	-4
103	-2	-5	104	-18	-4	105	-10	-5	100	-14	-4
109	-12	-2	110	-2	-2	111	1	5	106	-6	2
115	-12	-2	116	-2	-2	117	1	5	112	-6	2
121	-12	-2	122	-16	-1	123	-2	2	118	-2	1
127	-12	-2	128	-16	-1	129	-2	2	124	-2	1
133	-12	-2	134	-19	-2	135	-2	2	130	-2	1
139	-12	-2	140	-19	-2	141	-2	2	136	-2	1
145	-12	-2	146	-19	-2	147	-2	2	142	-2	1
151	-12	-2	152	-19	-2	153	-2	2	148	-2	1
157	-12	-2	158	-19	-2	159	-2	2	154	-2	1
163	-12	-2	164	-19	-2	165	-2	2	160	-2	1
169	-12	-2	170	-19	-2	171	-2	2	166	-2	1
175	-12	-2	176	-19	-2	177	-2	2	172	-2	1
181	-12	-2	182	-19	-2	183	-2	2	178	-2	1
187	-12	-2	188	-19	-2	189	-2	2	184	-2	1
193	-12	-2	194	-19	-2	195	-2	2	190	-2	1
199	-12	-2	200	-19	-2	201	-2	2	196	-2	1
205	-12	-2	206	-19	-2	207	-2	2	202	-2	1
211	-12	-2	212	-19	-2	213	-2	2	208	-2	1
217	-12	-2	218	-19	-2	219	-2	2	214	-2	1
223	-12	-2	224	-19	-2	225	-2	2	220	-2	1
229	-12	-2	230	-19	-2	231	-2	2	226	-2	1
235	-12	-2	236	-19	-2	237	-2	2	232	-2	1
241	-12	-2	242	-19	-2	243	-2	2	238	-2	1
247	-12	-2	248	-19	-2	249	-2	2	244	-2	1
253	-12	-2	254	-19	-2	255	-2	2	250	-2	1
259	-12	-2	260	-19	-2	261	-2	2	256	-2	1
265	-12	-2	266	-19	-2	267	-2	2	262	-2	1
271	-12	-2	272	-19	-2	273	-2	2	268	-2	1
277	-12	-2	278	-19	-2	279	-2	2	274	-2	1
283	-12	-2	284	-19	-2	285	-2	2	280	-2	1
289	-12	-2	290	-19	-2	291	-2	2	286	-2	1
295	-12	-2	296	-19	-2	297	-2	2	292	-2	1
301	-12	-2	302	-19	-2	303	-2	2	298	-2	1
307	-12	-2	308	-19	-2	309	-2	2	304	-2	1
313	-12	-2	314	-19	-2	315	-2	2	310	-2	1
319	-12	-2	320	-19	-2	321	-2	2	316	-2	1
325	-12	-2	326	-19	-2	327	-2	2	322	-2	1
331	-12	-2	332	-19	-2	333	-2	2	328	-2	1
337	-12	-2	338	-19	-2	339	-2	2	334	-2	1
343	-12	-2	344	-19	-2	345	-2	2	340	-2	1
349	-12	-2	350	-19	-2	351	-2	2	346	-2	1
355	-12	-2	356	-19	-2	357	-2	2	352	-2	1
361	-12	-2	362	-19	-2	363	-2	2	358	-2	1
367	-12	-2	368	-19	-2	369	-2	2	364	-2	1
373	-12	-2	374	-19	-2	375	-2	2	370	-2	1
379	-12	-2	380	-19	-2	381	-2	2	376	-2	1
385	-12	-2	386	-19	-2	387	-2	2	382	-2	1
391	-12	-2	392	-19	-2	393	-2	2	388	-2	1
397	-12	-2	398	-19	-2	399	-2	2	394	-2	1
403	-12	-2	404	-19	-2	405	-2	2	400	-2	1
409	-12	-2	410	-19	-2	411	-2	2	406	-2	1
415	-12	-2	416	-19	-2	417	-2	2	412	-2	1
421	-12	-2	422	-19	-2	423	-2	2	418	-2	1
427	-12	-2	428	-19	-2	429	-2	2	424	-2	1
433	-12	-2	434	-19	-2	435	-2	2	430	-2	1
439	-12	-2	440	-19	-2	441	-2	2	436	-2	1
445	-12	-2	446	-19	-2	447	-2	2	442	-2	1
451	-12	-2	452	-19	-2	453	-2	2	448	-2	1
457	-12	-2	458	-19	-2	459	-2	2	454	-2	1
463	-12	-2	464	-19	-2	465	-2	2	460	-2	1
469	-12	-2	470	-19	-2	471	-2	2	466	-2	1
475	-12	-2	476	-19	-2	477	-2	2	472	-2	1
481	-12	-2	482	-19	-2	483	-2	2	478	-2	1
487	-12	-2	488	-19	-2	489	-2	2	484	-2	1
493	-12	-2	494	-19	-2	495	-2	2	490	-2	1
499	-12	-2	500	-19	-2	501	-2	2	496	-2	1
505	-12	-2	506	-19	-2	507	-2	2	502	-2	1
511	-12	-2	512	-19	-2	513	-2	2	508	-2	1
517	-12	-2	518	-19	-2	519	-2	2	514	-2	1
523	-12	-2	524	-19	-2	525	-2	2	520	-2	1
529	-12	-2	530	-19	-2	531	-2	2	526	-2	1
535	-12	-2	536	-19	-2	537	-2	2	532	-2	1
541	-12	-2	542	-19	-2	543	-2	2	538	-2	1
547	-12	-2	548	-19	-2	549	-2	2	544	-2	1
553	-12	-2	554	-19	-2	555	-2	2	550	-2	1
559	-12	-2	560	-19	-2	561	-2	2	556	-2	1
565	-12	-2	566	-19	-2	567	-2	2	562	-2	1
571	-12	-2	572	-19	-2	573	-2	2	568	-2	1
577	-12	-2	578	-19	-2	579	-2	2	574	-2	1
583	-12	-2	584	-19	-2	585	-2	2	580	-2	1
589	-12	-2	590	-19	-2	591	-2	2	586	-2	1
595	-12	-2	596	-19	-2	597	-2	2	592	-2	1
601	-12	-2	602	-19	-2	603	-2	2	598	-2	1
607	-12	-2	608	-19	-2	609	-2	2	604	-2	1
613	-12	-2	614	-19	-2	615	-2	2	610	-2	1
619	-12	-2	620	-19	-2	621	-2	2	616	-2	1
625	-12	-2	626	-19	-2	627	-2	2	622	-2	1
631	-12	-2	632	-19	-2	633	-2	2	628	-2	1
637	-12	-2	638	-19	-2	639	-2	2	634	-2	1
643	-12	-2	644	-19	-2	645	-2	2	640	-2	1
649	-12	-2	650	-19	-2	651	-2	2	646	-2	1
655	-12	-2	656	-19	-2	657	-2	2	652	-2	1
661	-12	-2	662	-19	-2	663	-2	2	658	-2	1
667	-12	-2	668	-19	-2	669	-2	2	664	-2	1
673	-12	-2	674	-19	-2	675	-2	2	670	-2	1
679	-12	-2	680	-19	-2	681	-2	2	676	-2	1
685	-12	-2	686	-19	-2	687	-2	2	682	-2	1
691	-12	-2	692	-19	-2	693	-2	2	688	-2	1
697	-12	-2	698	-19	-2	699	-2	2	694	-2	1
703	-12	-2	704	-19	-2	705	-2	2	700	-2	1
709	-12	-2	710	-19	-2	711	-2	2	706	-2	1
715	-12	-2	716	-19	-2	717	-2	2	712	-2	1
721	-12	-2	722	-19	-2	723	-2	2	718	-2	1
727	-12	-2	728	-19	-2	729	-2	2	724	-2	1
733	-12	-2	734	-19	-2	735	-2	2	730	-2	1
739	-12	-2	740	-19	-2	741	-2	2	736	-2	1
745	-12	-2	746	-19	-2	747	-2	2	742	-2	1
751	-12	-2	752	-19	-2	753	-2	2	748	-2	1
757	-12	-2	758	-19	-2	759	-2	2	754	-2	1
763	-12	-2	764	-19	-2	765	-2	2	760	-2	1
769	-12	-2	770	-19	-2	771	-2	2	766	-2	1
775	-12	-2	776	-19	-2	777	-2	2	772	-2	1
781	-12	-2	782	-19	-2	783	-2	2	778	-2	1
787	-12	-2	788	-19	-2	789	-2	2	784	-2	1
793	-12	-2	794	-19	-2	795	-2	2	790	-2	1
799	-12	-2	800	-19	-2	801	-2	2	796	-2	1
805	-12	-2	806	-19	-2	807	-2	2	802	-2	1
811	-12	-2	812	-19	-2	813	-2	2	808	-2	1
817	-12	-2	818	-19	-2	819	-2	2	814	-2	1
823	-12	-2	824	-19	-2	825	-2	2	820	-2	1
829	-12	-2	830	-19	-2	831	-2	2	826	-2	1
835	-12	-2	836	-19	-2	837	-2	2	832	-2	1
841	-12	-2	842	-							

SHEAR STRESSES FOR LOAD CASE 0.000000											
ELEM	VX	VY	VZ	ELEM	VX	VY	VZ	ELEM	VX	VY	VZ
313	-1	10	-2	315	-1	12	-2	316	-1	-1	-1
314	1	-10	2	317	1	-12	2	318	1	1	1
315	-4	-2	0	319	-4	-2	0	320	-4	-2	0
316	4	2	0	321	4	2	0	322	4	2	0
317	0	0	0	323	0	0	0	324	0	0	0
318	0	0	0	325	0	0	0	326	0	0	0
319	-1	1	0	327	-1	1	0	328	-1	1	0
320	1	-1	0	329	1	-1	0	330	1	-1	0
321	-4	-2	0	331	-4	-2	0	332	-4	-2	0
322	4	2	0	333	4	2	0	334	4	2	0
323	0	0	0	335	0	0	0	336	0	0	0
324	0	0	0	337	0	0	0	338	0	0	0
325	-1	1	0	339	-1	1	0	340	-1	1	0
326	1	-1	0	341	1	-1	0	342	1	-1	0
327	-4	-2	0	343	-4	-2	0	344	-4	-2	0
328	4	2	0	345	4	2	0	346	4	2	0
329	0	0	0	347	0	0	0	348	0	0	0
330	0	0	0	349	0	0	0	350	0	0	0
331	-1	1	0	351	-1	1	0	352	-1	1	0
332	1	-1	0	353	1	-1	0	354	1	-1	0
333	-4	-2	0	355	-4	-2	0	356	-4	-2	0
334	4	2	0	357	4	2	0	358	4	2	0
335	0	0	0	359	0	0	0	360	0	0	0
336	0	0	0	361	0	0	0	362	0	0	0
337	-1	1	0	363	-1	1	0	364	-1	1	0
338	1	-1	0	365	1	-1	0	366	1	-1	0
339	-4	-2	0	367	-4	-2	0	368	-4	-2	0
340	4	2	0	369	4	2	0	370	4	2	0
341	0	0	0	371	0	0	0	372	0	0	0
342	0	0	0	373	0	0	0	374	0	0	0
343	-1	1	0	375	-1	1	0	376	-1	1	0
344	1	-1	0	377	1	-1	0	378	1	-1	0
345	-4	-2	0	379	-4	-2	0	380	-4	-2	0
346	4	2	0		4	2	0		4	2	0
347	0	0	0		0	0	0		0	0	0
348	0	0	0		0	0	0		0	0	0
349	-1	1	0		-1	1	0		-1	1	0
350	1	-1	0		1	-1	0		1	-1	0
351	-4	-2	0		-4	-2	0		-4	-2	0
352	4	2	0		4	2	0		4	2	0
353	0	0	0		0	0	0		0	0	0
354	0	0	0								

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1/1-a	1/4-a	1/185-a	1/237-a
1/2-a	1/61-a	1/181-a	1/243-a
1/3-a	1/73-a	1/105-a	1/253-a
1/4-a	1/85-a	1/129-a	1/271-a
1/5-a	1/97-a	1/153-a	1/285-a
1/6-a	1/109-a	1/177-a	1/299-a
1/7-a	1/121-a	1/201-a	1/313-a
1/8-a	1/133-a	1/225-a	1/327-a
1/9-a	1/145-a	1/249-a	1/341-a
1/10-a	1/157-a	1/273-a	1/355-a
1/11-a	1/169-a	1/297-a	1/369-a
1/12-a	1/181-a	1/321-a	1/383-a
1/13-a	1/193-a	1/345-a	1/397-a
1/14-a	1/205-a	1/369-a	1/411-a
1/15-a	1/217-a	1/393-a	1/425-a
1/16-a	1/229-a	1/417-a	1/439-a
1/17-a	1/241-a	1/441-a	1/453-a
1/18-a	1/253-a	1/465-a	1/467-a
1/19-a	1/265-a	1/489-a	1/481-a
1/20-a	1/277-a	1/513-a	1/495-a
1/21-a	1/289-a	1/537-a	1/509-a
1/22-a	1/301-a	1/561-a	1/523-a
1/23-a	1/313-a	1/585-a	1/537-a
1/24-a	1/325-a	1/609-a	1/551-a
1/25-a	1/337-a	1/633-a	1/565-a
1/26-a	1/349-a	1/657-a	1/579-a
1/27-a	1/361-a	1/681-a	1/593-a
1/28-a	1/373-a	1/705-a	1/607-a
1/29-a	1/385-a	1/729-a	1/621-a
1/30-a	1/397-a	1/753-a	1/635-a
1/31-a	1/409-a	1/777-a	1/649-a
1/32-a	1/421-a	1/801-a	1/663-a
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NORMAL STRESSES FOR LOAD CASE 9 (PSI)

ELEM	SX	SY	SZ	ELEM	SX	SY	SZ	ELEM	SX	SY	SZ	ELEM	SX	SY	SZ	ELEM	SX	SY	SZ
1	0	-12	0	101	0	13	0	106	0	13	0	201	0	13	0	206	0	13	0
2	0	12	0	102	0	13	0	107	0	13	0	202	0	13	0	207	0	13	0
3	0	12	0	103	0	13	0	108	0	13	0	203	0	13	0	208	0	13	0
4	0	12	0	104	0	13	0	109	0	13	0	204	0	13	0	209	0	13	0
5	0	12	0	105	0	13	0	110	0	13	0	205	0	13	0	210	0	13	0
6	0	12	0	106	0	13	0	111	0	13	0	206	0	13	0	211	0	13	0
7	0	12	0	107	0	13	0	112	0	13	0	207	0	13	0	212	0	13	0
8	0	12	0	108	0	13	0	113	0	13	0	208	0	13	0	213	0	13	0
9	0	12	0	109	0	13	0	114	0	13	0	209	0	13	0	214	0	13	0
10	0	12	0	110	0	13	0	115	0	13	0	210	0	13	0	215	0	13	0
11	0	12	0	111	0	13	0	116	0	13	0	211	0	13	0	216	0	13	0
12	0	12	0	112	0	13	0	117	0	13	0	212	0	13	0	217	0	13	0
13	0	12	0	113	0	13	0	118	0	13	0	213	0	13	0	218	0	13	0
14	0	12	0	114	0	13	0	119	0	13	0	214	0	13	0	219	0	13	0
15	0	12	0	115	0	13	0	120	0	13	0	215	0	13	0	220	0	13	0
16	0	12	0	116	0	13	0	121	0	13	0	216	0	13	0	221	0	13	0
17	0	12	0	117	0	13	0	122	0	13	0	217	0	13	0	222	0	13	0
18	0	12	0	118	0	13	0	123	0	13	0	218	0	13	0	223	0	13	0
19	0	12	0	119	0	13	0	124	0	13	0	219	0	13	0	224	0	13	0
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28	0	12	0	128	0	13	0	133	0	13	0	228	0	13	0	233	0	13	0
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56	0	12	0	156	0	13	0	161	0	13	0	256	0	13	0	261	0	13	0
57	0	12	0	157	0	13	0	162	0	13	0	257	0	13	0	262	0	13	0
58	0	12	0	158	0	13	0	163	0	13	0	258	0	13	0	263	0	13	0
59	0	12	0	159	0	13	0	164	0	13	0	259	0	13	0	264	0	13	0
60	0	12	0	160	0	13	0	165	0	13	0	260	0	13	0	265	0	13	0
61	0	12	0	161	0	13	0	166	0	13	0	261	0	13	0	266	0	13	0
62	0	12	0	162	0	13	0	167	0	13	0	262	0	13	0	267	0	13	0
63	0	12	0	163	0	13	0	168	0	13	0	263	0	13	0	268	0	13	0
64	0	12	0	164	0	13	0	169	0	13	0	264	0	13	0	269	0	13	0
65	0	12	0	165	0	13	0	170	0	13	0	265	0	13	0	270	0	13	0
66	0	12	0	166	0	13	0	171	0	13	0	266	0	13	0	271	0	13	0
67	0	12	0	167	0	13	0	172	0	13	0	267	0	13	0	272	0	13	0
68	0	12	0	168	0	13	0	173	0	13	0	268	0	13	0	273	0	13	0
69	0	12	0	169	0	13	0	174	0	13	0	269	0	13	0	274	0	13	0
70	0	12	0	170	0	13	0	175	0	13	0	270	0	13	0	275	0	13	0
71	0	12	0	171	0	13	0	176	0	13	0	271	0	13	0	276	0	13	0
72	0	12	0	172	0	13	0	177	0	13	0	272	0	13	0	277	0	13	0
73	0	12	0	173	0	13	0	178	0	13	0	273	0	13	0	278	0	13	0
74	0	12	0	174	0	13	0	179	0	13	0	274	0	13	0	279	0	13	0
75	0	12	0	175	0	13	0	180	0	13	0	275	0	13	0	280	0	13	0
76	0	12	0	176	0	13	0	181	0	13	0	276	0	13	0	281	0	13	0
77	0	12	0	177	0	13	0	182	0	13	0	277	0	13	0	282	0	13	0
78	0	12	0	178	0	13	0	183	0	13	0	278	0	13	0	283	0	13	0
79	0	12	0	179	0	13	0	184	0	13	0	279	0	13	0	284	0	13	0
80	0	12	0	180	0	13	0	185	0	13	0	280	0	13	0	285	0	13	0
81	0	12	0	181	0	13	0	186	0	13	0	281	0	13	0	286	0	13	0
82	0	12	0	182	0	13	0	187	0	13	0	282	0	13	0	287	0	13	0
83	0	12	0	183	0	13	0	188	0	13	0	283	0	13	0	288	0	13	0
84	0	12	0	184	0	13	0	189	0	13	0	284	0	13	0	289	0	13	0
85	0	12	0	185	0	13	0	190	0	13	0	285	0	13	0	290	0	13	0
86	0	12	0	186	0	13	0	191	0	13	0	286	0	13	0	291	0	13	0
87	0	12	0	187	0	13	0	192	0	13	0	287	0	13	0	292	0	13	0
88	0	12	0	188	0	13	0	193	0	13	0	288	0						

NORMAL STRESSES FOR LOAD CASE 9 (PSI)											
ELEM	SX	SY	SZ	ELEM	SX	SY	SZ	ELEM	SX	SY	SZ
313	2	27	-4	314	3	24	-3	315	2	17	-3
319	0	-9	-1	320	0	-11	-1	321	0	5	-1
325	-4	9	-6	326	-3	44	-6	327	-3	-12	-1
331	-3	-20	-3	332	-2	-20	-3	333	-2	0	-5
337	-3	-9	-7	338	-3	-8	-7	339	-5	-17	-2
343	0	6	-1	344	0	1	-1	345	0	12	-1
349	2	15	-11	350	2	13	-11	351	3	-8	-1
355	0	-4	-2	356	0	-7	-2	357	0	-12	-2
361	0	36	-10	362	0	33	-10	363	1	-15	-4
367	0	-14	-3	368	0	-15	-3	369	0	-16	-2
373	-2	58	-8	374	-2	52	-8	375	-1	-21	-6
379	-1	-23	-3	380	-1	-23	-3	381	-1	-20	-3
386	0	0	0	387	0	0	0	388	0	0	0
392	0	0	0	393	0	0	0	394	0	0	0
398	0	0	0	399	0	0	0	400	0	0	0
406	0	0	0	407	0	0	0	408	0	0	0
412	0	0	0	413	0	0	0	414	0	0	0
418	0	0	0	419	0	0	0	420	0	0	0
424	0	0	0	425	0	0	0	426	0	0	0
430	0	0	0	431	0	0	0	432	0	0	0
436	0	0	0	437	0	0	0	438	0	0	0
442	0	0	0	443	0	0	0	444	0	0	0
448	0	0	0	449	0	0	0	450	0	0	0
454	0	0	0	455	0	0	0	456	0	0	0
460	0	0	0	461	0	0	0	462	0	0	0
466	0	0	0	467	0	0	0	468	0	0	0
472	0	0	0	473	0	0	0	474	0	0	0
478	0	0	0	479	0	0	0	480	0	0	0
484	0	0	0	485	0	0	0	486	0	0	0
490	0	0	0	491	0	0	0	492	0	0	0
496	0	0	0	497	0	0	0	498	0	0	0
502	0	0	0	503	0	0	0	504	0	0	0
508	0	0	0	509	0	0	0	510	0	0	0
514	0	0	0	515	0	0	0	516	0	0	0
520	0	0	0	521	0	0	0	522	0	0	0
526	0	0	0	527	0	0	0	528	0	0	0
532	0	0	0	533	0	0	0	534	0	0	0
538	0	0	0	539	0	0	0	540	0	0	0
544	0	0	0	545	0	0	0	546	0	0	0
550	0	0	0	551	0	0	0	552	0	0	0
556	0	0	0	557	0	0	0	558	0	0	0
562	0	0	0	563	0	0	0	564	0	0	0
568	0	0	0	569	0	0	0	570	0	0	0
574	0	0	0	575	0	0	0	576	0	0	0
580	0	0	0	581	0	0	0	582	0	0	0
586	0	0	0	587	0	0	0	588	0	0	0
592	0	0	0	593	0	0	0	594	0	0	0
598	0	0	0	599	0	0	0	600	0	0	0
604	0	0	0	605	0	0	0	606	0	0	0
610	0	0	0	611	0	0	0	612	0	0	0
616	0	0	0	617	0	0	0	618	0	0	0
622	0	0	0	623	0	0	0	624	0	0	0
628	0	0	0	629	0	0	0	630	0	0	0
634	0	0	0	635	0	0	0	636	0	0	0
640	0	0	0	641	0	0	0	642	0	0	0
646	0	0	0	647	0	0	0	648	0	0	0
652	0	0	0	653	0	0	0	654	0	0	0
658	0	0	0	659	0	0	0	660	0	0	0
664	0	0	0	665	0	0	0	666	0	0	0
670	0	0	0	671	0	0	0	672	0	0	0
676	0	0	0	677	0	0	0	678	0	0	0
682	0	0	0	683	0	0	0	684	0	0	0
688	0	0	0	689	0	0	0	690	0	0	0
694	0	0	0	695	0	0	0	696	0	0	0
700	0	0	0	701	0	0	0	702	0	0	0
706	0	0	0	707	0	0	0	708	0	0	0
712	0	0	0	713	0	0	0	714	0	0	0
718	0	0	0	719	0	0	0	720	0	0	0
724	0	0	0	725	0	0	0	726	0	0	0
730	0	0	0	731	0	0	0	732	0	0	0
736	0	0	0	737	0	0	0	738	0	0	0
742	0	0	0	743	0	0	0	744	0	0	0
748	0	0	0	749	0	0	0	750	0	0	0
754	0	0	0	755	0	0	0	756	0	0	0
760	0	0	0	761	0	0	0	762	0	0	0
766	0	0	0	767	0	0	0	768	0	0	0
772	0	0	0	773	0	0	0	774	0	0	0
778	0	0	0	779	0	0	0	780	0	0	0
784	0	0	0	785	0	0	0	786	0	0	0
790	0	0	0	791	0	0	0	792	0	0	0
796	0	0	0	797	0	0	0	798	0	0	0
802	0	0	0	803	0	0	0	804	0	0	0
808	0	0	0	809	0	0	0	810	0	0	0
814	0	0	0	815	0	0	0	816	0	0	0
820	0	0	0	821	0	0	0	822	0	0	0
826	0	0	0	827	0	0	0	828	0	0	0
832	0	0	0	833	0	0	0	834	0	0	0
838	0	0	0	839	0	0	0	840	0	0	0
844	0	0	0	845	0	0	0	846	0	0	0
850	0	0	0	851	0	0	0	852	0	0	0
856	0	0	0	857	0	0	0	858	0	0	0
862	0	0	0	863	0	0	0	864	0	0	0
868	0	0	0	869	0	0	0	870	0	0	0
874	0	0	0	875	0	0	0	876	0	0	0
880	0	0	0	881	0	0	0	882	0	0	0
886	0	0	0	887	0	0	0	888	0	0	0
892	0	0	0	893	0	0	0	894	0	0	0
898	0	0	0	899	0	0	0	900	0	0	0
904	0	0	0	905	0	0	0	906	0	0	0
910	0	0	0	911	0	0	0	912	0	0	0
916	0	0	0	917	0	0	0	918	0	0	0
922	0	0	0	923	0	0	0	924	0	0	0
928	0	0	0	929	0	0	0	930	0	0	0
934	0	0	0	935	0	0	0	936	0	0	0
940	0	0	0	941	0	0	0	942	0	0	0
946	0	0	0	947	0	0	0	948	0	0	0
952	0	0	0	953	0	0	0	954	0	0	0
958	0	0	0	959	0	0	0	960	0	0	0
964	0	0	0	965	0	0	0	966	0	0	0
970	0	0	0	971	0	0	0	972	0	0	0
976	0	0	0	977	0	0	0	978	0	0	0
982	0	0	0	983	0	0	0	984	0	0	0
988	0	0	0	989	0	0	0	990	0	0	0
994	0	0	0	995	0	0	0	996	0	0	0
998	0	0	0	999	0	0	0	1000	0	0	0

MIN.			
ELEM	SX	SY	SZ
133	-15	-32	-16
145	24	58	2
MAX.			

Figure D9. (Sheet 3 of 5)

SHEAR STRESSES FOR LOAD CASE 9 (PSI)

ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX
1	-3	-5	-1	101	-2	-1	0	102	-16	1	0	103	-12	-7	0	104	-10	-6	0
2	-8	-10	0	105	-9	0	0	106	-23	6	1	107	-20	5	1	108	-16	1	0
3	-2	-5	0	109	-5	4	0	110	-4	3	0	111	-4	3	0	112	-4	3	0
4	-10	-10	0	113	-20	1	0	114	-22	4	0	115	-19	2	0	116	-15	0	0
5	-10	-10	0	117	-20	1	0	118	-22	4	0	119	-19	2	0	120	-15	0	0
6	-10	-10	0	121	-20	1	0	122	-22	4	0	123	-19	2	0	124	-15	0	0
7	-10	-10	0	125	-20	1	0	126	-22	4	0	127	-19	2	0	128	-15	0	0
8	-10	-10	0	129	-20	1	0	130	-22	4	0	131	-19	2	0	132	-15	0	0
9	-10	-10	0	133	-20	1	0	134	-22	4	0	135	-19	2	0	136	-15	0	0
10	-10	-10	0	137	-20	1	0	138	-22	4	0	139	-19	2	0	140	-15	0	0
11	-10	-10	0	141	-20	1	0	142	-22	4	0	143	-19	2	0	144	-15	0	0
12	-10	-10	0	145	-20	1	0	146	-22	4	0	147	-19	2	0	148	-15	0	0
13	-10	-10	0	149	-20	1	0	150	-22	4	0	151	-19	2	0	152	-15	0	0
14	-10	-10	0	153	-20	1	0	154	-22	4	0	155	-19	2	0	156	-15	0	0
15	-10	-10	0	157	-20	1	0	158	-22	4	0	159	-19	2	0	160	-15	0	0
16	-10	-10	0	161	-20	1	0	162	-22	4	0	163	-19	2	0	164	-15	0	0
17	-10	-10	0	165	-20	1	0	166	-22	4	0	167	-19	2	0	168	-15	0	0
18	-10	-10	0	169	-20	1	0	170	-22	4	0	171	-19	2	0	172	-15	0	0
19	-10	-10	0	173	-20	1	0	174	-22	4	0	175	-19	2	0	176	-15	0	0
20	-10	-10	0	177	-20	1	0	178	-22	4	0	179	-19	2	0	180	-15	0	0
21	-10	-10	0	181	-20	1	0	182	-22	4	0	183	-19	2	0	184	-15	0	0
22	-10	-10	0	185	-20	1	0	186	-22	4	0	187	-19	2	0	188	-15	0	0
23	-10	-10	0	189	-20	1	0	190	-22	4	0	191	-19	2	0	192	-15	0	0
24	-10	-10	0	193	-20	1	0	194	-22	4	0	195	-19	2	0	196	-15	0	0
25	-10	-10	0	197	-20	1	0	198	-22	4	0	199	-19	2	0	200	-15	0	0
26	-10	-10	0	201	-20	1	0	202	-22	4	0	203	-19	2	0	204	-15	0	0
27	-10	-10	0	205	-20	1	0	206	-22	4	0	207	-19	2	0	208	-15	0	0
28	-10	-10	0	209	-20	1	0	210	-22	4	0	211	-19	2	0	212	-15	0	0
29	-10	-10	0	213	-20	1	0	214	-22	4	0	215	-19	2	0	216	-15	0	0
30	-10	-10	0	217	-20	1	0	218	-22	4	0	219	-19	2	0	220	-15	0	0
31	-10	-10	0	221	-20	1	0	222	-22	4	0	223	-19	2	0	224	-15	0	0
32	-10	-10	0	225	-20	1	0	226	-22	4	0	227	-19	2	0	228	-15	0	0
33	-10	-10	0	229	-20	1	0	230	-22	4	0	231	-19	2	0	232	-15	0	0
34	-10	-10	0	233	-20	1	0	234	-22	4	0	235	-19	2	0	236	-15	0	0
35	-10	-10	0	237	-20	1	0	238	-22	4	0	239	-19	2	0	240	-15	0	0
36	-10	-10	0	241	-20	1	0	242	-22	4	0	243	-19	2	0	244	-15	0	0
37	-10	-10	0	245	-20	1	0	246	-22	4	0	247	-19	2	0	248	-15	0	0
38	-10	-10	0	249	-20	1	0	250	-22	4	0	251	-19	2	0	252	-15	0	0
39	-10	-10	0	253	-20	1	0	254	-22	4	0	255	-19	2	0	256	-15	0	0
40	-10	-10	0	257	-20	1	0	258	-22	4	0	259	-19	2	0	260	-15	0	0
41	-10	-10	0	261	-20	1	0	262	-22	4	0	263	-19	2	0	264	-15	0	0
42	-10	-10	0	265	-20	1	0	266	-22	4	0	267	-19	2	0	268	-15	0	0
43	-10	-10	0	269	-20	1	0	270	-22	4	0	271	-19	2	0	272	-15	0	0
44	-10	-10	0	273	-20	1	0	274	-22	4	0	275	-19	2	0	276	-15	0	0
45	-10	-10	0	277	-20	1	0	278	-22	4	0	279	-19	2	0	280	-15	0	0
46	-10	-10	0	281	-20	1	0	282	-22	4	0	283	-19	2	0	284	-15	0	0
47	-10	-10	0	285	-20	1	0	286	-22	4	0	287	-19	2	0	288	-15	0	0
48	-10	-10	0	289	-20	1	0	290	-22	4	0	291	-19	2	0	292	-15	0	0
49	-10	-10	0	293	-20	1	0	294	-22	4	0	295	-19	2	0	296	-15	0	0
50	-10	-10	0	297	-20	1	0	298	-22	4	0	299	-19	2	0	300	-15	0	0
51	-10	-10	0	301	-20	1	0	302	-22	4	0	303	-19	2	0	304	-15	0	0
52	-10	-10	0	305	-20	1	0	306	-22	4	0	307	-19	2	0	308	-15	0	0
53	-10	-10	0	309	-20	1	0	310	-22	4	0	311	-19	2	0	312	-15	0	0

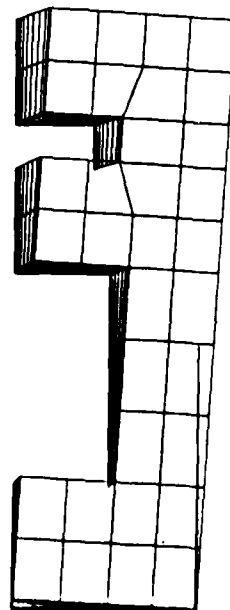
Figure D9. (Sheet 4 of 5)

SHEAR STRESSES FOR LOAD CASE 9 (PSI)

ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX
313	-2	4	-2	315	-5	7	-2	317	-3	0	-1	319	-3	-1	-1	321	-1	0	-1
319	-2	-2	-1	321	-1	-1	-1	323	0	-1	-1	325	0	-1	-1	327	0	-1	-1
325	4	4	-1	327	19	0	-1	329	18	3	-1	331	15	0	0	333	15	0	0
331	11	1	0	333	6	0	0	335	-2	0	0	337	1	0	0	339	1	0	0
337	-11	11	0	335	-20	21	7	341	-11	9	1	343	-9	6	0	345	-9	6	0
343	-7	11	0	345	-3	2	0	347	-1	1	0	349	-2	13	0	351	-2	13	0
349	-5	11	0	347	-7	32	2	353	-3	18	0	355	-2	13	0	357	-2	13	0
355	-2	10	0	351	-1	3	0	353	0	2	0	355	0	1	0	357	0	1	0
361	-1	10	-1	353	0	31	-1	355	1	19	-1	357	1	14	-1	359	1	14	-1
367	1	7	-1	355	1	19	-1	357	0	2	0	359	0	1	0	361	0	1	0
373	2	7	-1	357	11	4	-1	363	11	10	0	365	11	10	0	367	11	10	0
379	7	5	0	361	4	2	0	365	11	10	0	367	11	10	0	369	11	10	0
				363	11	4	0	367	11	10	0	369	11	10	0	371	11	10	0
				365	11	4	0	369	11	10	0	371	11	10	0	373	11	10	0
				367	11	4	0	371	11	10	0	373	11	10	0	375	11	10	0
				369	11	4	0	373	11	10	0	375	11	10	0	377	11	10	0
				371	11	4	0	375	11	10	0	377	11	10	0	379	11	10	0
				373	11	4	0	377	11	10	0	379	11	10	0	381	11	10	0
				375	11	4	0	379	11	10	0	381	11	10	0	383	11	10	0
				377	11	4	0	381	11	10	0	383	11	10	0	385	11	10	0
				379	11	4	0	383	11	10	0	385	11	10	0	387	11	10	0
				381	11	4	0	385	11	10	0	387	11	10	0	389	11	10	0
				383	11	4	0	387	11	10	0	389	11	10	0	391	11	10	0
				385	11	4	0	389	11	10	0	391	11	10	0	393	11	10	0
				387	11	4	0	391	11	10	0	393	11	10	0	395	11	10	0
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				393	11	4	0	397	11	10	0	399	11	10	0	401	11	10	0
				395	11	4	0	399	11	10	0	401	11	10	0	403	11	10	0
				397	11	4	0	401	11	10	0	403	11	10	0	405	11	10	0
				399	11	4	0	403	11	10	0	405	11	10	0	407	11	10	0
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				403	11	4	0	407	11	10	0	409	11	10	0	411	11	10	0
				405	11	4	0	409	11	10	0	411	11	10	0	413	11	10	0
				407	11	4	0	411	11	10	0	413	11	10	0	415	11	10	0
				409	11	4	0	413	11	10	0	415	11	10	0	417	11	10	0
				411	11	4	0	415	11	10	0	417	11	10	0	419	11	10	0
				413	11	4	0	417	11	10	0	419	11	10	0	421	11	10	0
				415	11	4	0	419	11	10	0	421	11	10	0	423	11	10	0
				417	11	4	0	421	11	10	0	423	11	10	0	425	11	10	0
				419	11	4	0	423	11	10	0	425	11	10	0	427	11	10	0
				421	11	4	0	425	11	10	0	427	11	10	0	429	11	10	0
				423	11	4	0	427	11	10	0	429	11	10	0	431	11	10	0
				425	11	4	0	429	11	10	0	431	11	10	0	433	11	10	0
				427	11	4	0	431	11	10	0	433	11	10	0	435	11	10	0
				429	11	4	0	433	11	10	0	435	11	10	0	437	11	10	0
				431	11	4	0	435	11	10	0	437	11	10	0	439	11	10	0
				433	11	4	0	437	11	10	0	439	11	10	0	441	11	10	0
				435	11	4	0	439	11	10	0	441	11	10	0	443	11	10	0
				437	11	4	0	441	11	10	0	443	11	10	0	445	11	10	0
				439	11	4	0	443	11	10	0	445	11	10	0	447	11	10	0
				441	11	4	0	445	11	10	0	447	11	10	0	449	11	10	0
				443	11	4	0	447	11	10	0	449	11	10	0	451	11	10	0
				445	11	4	0	449	11	10	0	451	11	10	0	453	11	10	0
				447	11	4	0	451	11	10	0	453	11	10	0	455	11	10	0
				449	11	4	0	453	11	10	0	455	11	10	0	457	11	10	0
				451	11	4	0	455	11	10	0	457	11	10	0	459	11	10	0
				453	11	4	0	457	11	10	0	459	11	10	0	461	11	10	0
				455	11	4	0	459	11	10	0	461	11	10	0	463	11	10	0
				457	11	4	0	461	11	10	0	463	11	10	0	465	11	10	0
				459	11	4	0	463	11	10	0	465	11	10	0	467	11	10	0
				461	11	4	0	465	11	10	0	467	11	10	0	469	11	10	0
				463	11	4	0	467	11	10	0	469	11	10	0	471	11	10	0
				465	11	4	0	469	11	10	0	471	11	10	0	473	11	10	0
				467	11	4	0	471	11	10	0	473	11	10	0	475	11	10	0
				469	11	4	0	473	11	10	0	475	11	10	0	477	11	10	0
				471	11	4	0	475	11	10	0	477	11	10	0	479	11	10	0
				473	11	4	0	477	11	10	0	479	11	10	0	481	11	10	0
				475	11	4	0	479	11	10	0	481	11	10	0	483	11	10	0
				477	11	4	0	481	11	10	0	483	11	10	0	485	11	10	0
				479	11	4	0	483	11	10	0	485	11	10	0	487	11	10	0
				481	11	4	0	485	11	10	0	487	11	10	0	489	11	10	0
				483	11	4	0	487	11	10	0	489	11	10	0	491	11	10	0
				485	11	4	0	489	11	10	0	491	11	10	0	493	11	10	0
				487	11	4	0	491	11	10	0	493	11	10	0	495	11	10	0
				489	11	4	0	493	11	10	0	495	11	10	0	497	11	10	0
				491	11	4	0	495	11	10	0	497	11	10	0	499	11	10	0
				493	11	4	0	497	11	10	0	499	11	10	0	501	11	10	0
				495	11	4	0	499	11	10	0	501	11	10	0	503	11	10	0
				497	11	4	0	501	11	10	0	503	11	10	0	505	11	10	0
				499	11	4	0	503	11	10	0	505	11	10	0	507	11	10	0
				501	11	4	0	505	11	10	0	507	11	10	0	509	11	10	0
				503	11	4	0	507	11	10	0	509	11	10	0	511	11	10	0
				505	11	4	0	509	11	10	0	511	11	10	0	513	11	10	0
				507	11	4	0	511	11	10	0	513	11	10	0	515	11	10	0
				509	11	4	0	513	11	10	0	515	11	10	0	517	11	10	0
				511	11	4	0	515	11	10	0	517	11	10	0	519	11	10	0
				513	11	4	0	517	11	10	0	519	11	10	0	521	11	10	0
				515	11	4	0	519	11	10	0	521	11	10	0	523	11	10	0
				517	11	4	0	521	11	10	0	523	11	10	0	525	11	10	0
				519	11	4	0	523	11	10	0	525	11	10	0	527	11	10	0

1/11-0	1/10-0	1/10-0	1/217-0	1/200-0	1/237-0
1/11-0	1/10-0	1/10-0	1/220-0	1/201-0	1/240-0
1/25-0	1/73-0	1/121-0	1/133-0	1/201-0	1/201-0
1/37-0	1/100-0	1/133-0	1/137-0	1/205-0	1/231-0
				1/205-0	1/231-0

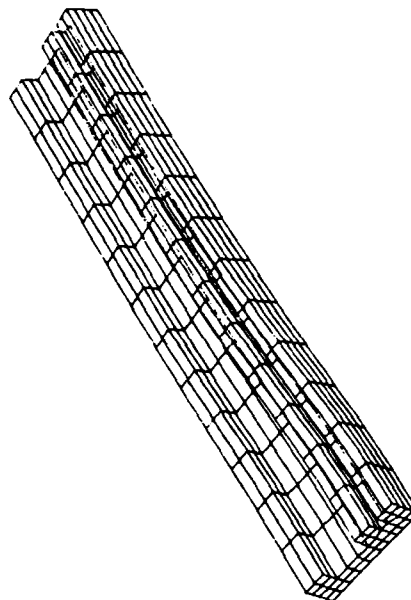
FINITE-ELEMENT ANALYSIS OF PROPOSED 'SNORT' STRUCTURE. AUG 82
UNDEFORMED GRID
SNORT STRUCTURE HAS 8000 1250 ELEMENTS



FINITE-ELEMENT ANALYSIS OF PROPOSED 'SNORT' STRUCTURE. AUG 82
LOAD CASE NO-10
SNORT STRUCTURE HAS 8000 1250 ELEMENTS



FINITE-ELEMENT ANALYSIS OF PROPOSED 'SNORT' STRUCTURE. AUG 82
LOAD CASE NO-10



FINITE-ELEMENT ANALYSIS OF PROPOSED 'SNORT' STRUCTURE. AUG 82
LOAD CASE NO-10

Figure D10. Finite-element analysis for load case 10 with $K = 175 \text{ lb/in.}^3$ (Sheet 1 of 5)

NORMAL STRESSES FOR LOAD CASE 10 (PSI)

ELEM	1	13	25	31	33	43	49	55	61	67	73	79	85	91	97	103	109	115	121	127	133	139	145	151	157	163	169	175	181	187	193	205	211	217	223	229	235	241	247	253	259	265	271	277	283	289	295	301	307			
SX	1	0	-1	0	-2	0	-1	0	-3	1	-1	2	-2	1	-4	3	-3	1	-2	1	-2	3	-3	1	-1	1	-1	0	-1	3	-3	1	5	-5	1	-1	4	-4	3	-3	1	-1	8	-8	1	1	-1	1	-1	2	-2	
SZ	-1	-10	-10	-10	-3	1	-2	1	-5	9	-5	0	-3	-12	7	-3	-3	-21	11	-3	-7	14	-14	3	-3	-7	-16	-4	16	-16	3	19	-19	15	-15	10	-10	12	-12	15	-15	27	-27	1	1	-1	1	-1	1	-1	1	-1
ELEM	2	8	14	20	26	32	38	44	50	56	62	68	74	80	86	92	98	104	110	116	122	128	134	140	146	152	158	164	170	176	182	188	194	200	206	212	218	224	230	236	242	248	254	260	266	272	278	284	290	296	302	308
SX	1	0	-1	0	-2	0	-1	0	-3	1	-1	2	-2	1	-4	3	-3	1	-2	1	-2	3	-3	1	-1	1	-1	0	-1	3	-3	1	5	-5	1	-1	4	-4	3	-3	1	-1	8	-8	1	1	-1	1	-1	2	-2	
SZ	-1	-10	-10	-10	-3	1	-2	1	-5	9	-5	0	-3	-12	7	-3	-3	-21	11	-3	-7	14	-14	3	-3	-7	-16	-4	16	-16	3	19	-19	15	-15	10	-10	12	-12	15	-15	27	-27	1	1	-1	1	-1	1	-1	1	-1
ELEM	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96	102	108	114	120	126	132	138	144	150	156	162	168	174	180	186	192	198	204	210	216	222	228	234	240	246	252	258	264	270	276	282	288	294	300	306	312
SX	0	0	-1	0	0	1	0	0	0	-3	2	-2	1	-5	3	-3	-2	1	2	7	2	-10	-1	15	-18	-5	-18	0	0	9	3	2	-13	-6	0	7	3	4	-14	-5	8	3	-14	-5	1	0	6	2				
SZ	1	0	1	1	1	1	1	0	-1	-5	3	-3	-3	-3	-1	-3	-2	-3	-1	-1	0	-3	-3	-1	2	-1	-1	-1	0	1	1	-1	-1	-7	-2	-5	-1	-9	-3	-9	-3	0	-9	-2	0	-2	0	-2	0			
ELEM	17	17	23	29	35	41	47	53	59	65	71	77	83	89	95	101	107	113	119	125	131	137	143	149	155	161	167	173	179	185	191	197	203	209	215	221	227	233	239	245	251	257	263	269	275	281	287	293	299	305	311	
SX	0	0	-1	0	0	1	0	0	-2	2	-2	1	-5	3	-3	-2	1	2	3	9	2	-14	-1	17	-22	-6	-22	0	0	11	4	7	-27	-2	0	9	3	4	-2	-15	-8	3	-14	-5	1	0	7	2				
SZ	0	0	-1	0	0	1	0	0	-2	2	-2	1	-5	3	-3	-2	1	2	3	9	2	-14	-1	17	-22	-6	-22	0	0	11	4	7	-27	-2	0	9	3	4	-2	-15	-8	3	-14	-5	1	0	7	2				
ELEM	17	17	23	29	35	41	47	53	59	65	71	77	83	89	95	101	107	113	119	125	131	137	143	149	155	161	167	173	179	185	191	197	203	209	215	221	227	233	239	245	251	257	263	269	275	281	287	293	299	305	311	
SX	0	0	-1	0	0	1	0	0	-2	2	-2	1	-5	3	-3	-2	1	2	3	9	2	-14	-1	17	-22	-6	-22	0	0	11	4	7	-27	-2	0	9	3	4	-2	-15	-8	3	-14	-5	1	0	7	2				
SZ	0	0	-1	0	0	1	0	0	-2	2	-2	1	-5	3	-3	-2	1	2	3	9	2	-14	-1	17	-22	-6	-22	0	0	11	4	7	-27	-2	0	9	3	4	-2	-15	-8	3	-14	-5	1	0	7	2				
ELEM	17	17	23	29	35	41	47	53	59	65	71	77	83	89	95	101	107	113	119	125	131	137	143	149	155	161	167	173	179	185	191	197	203	209	215	221	227	233	239	245	251	257	263	269	275	281	287	293	299	305	311	
SX	0	0	-1	0	0	1	0	0	-2	2	-2	1	-5	3	-3	-2	1	2	3	9	2	-14	-1	17	-22	-6	-22	0	0	11	4	7	-27	-2	0	9	3	4	-2	-15	-8	3	-14	-5	1	0	7	2				
SZ	0	0	-1	0	0	1	0	0	-2	2	-2	1	-5	3	-3	-2	1	2	3	9	2	-14	-1	17	-22	-6	-22	0	0	11	4	7	-27	-2	0	9	3	4	-2	-15	-8	3	-14	-5	1	0	7	2				
ELEM	17	17	23	29	35	41	47	53	59	65	71	77	83	89	95	101	107	113	119	125	131	137	143	149	155	161	167	173	179	185	191	197	203	209	215	221	227	233	239	245	251	257	263	269	275	281	287	293	299	305	311	
SX	0	0	-1	0	0	1	0	0	-2	2	-2	1	-5	3	-3	-2	1	2	3	9	2	-14	-1	17	-22	-6	-22	0	0	11	4	7	-27	-2	0	9	3	4	-2	-15	-8	3	-14	-5	1	0	7	2				
SZ	0	0	-1	0	0	1	0	0	-2	2	-2	1	-5	3	-3	-2	1	2	3	9	2	-14	-1	17	-22	-6	-22	0	0	11	4	7	-27	-2	0	9	3	4	-2	-15	-8	3	-14	-5	1	0	7	2				
ELEM	17	17	23	29	35	41	47	53	59	65	71	77	83	89	95	101	107	113	119	125	131	137	143	149	155	161	167	173	179	185	191	197	203	209	215	221	227	233	239	245	251	257	263	269	275	281	287	293	299	305	311	
SX	0	0	-1	0	0	1	0	0	-2	2	-2	1	-5	3	-3	-2	1	2	3	9	2	-14	-1	17	-22	-6	-22	0	0	11	4	7	-27	-2	0	9	3	4	-2	-15	-8	3	-14	-5	1	0	7	2				
SZ	0	0	-1	0	0	1	0	0	-2	2	-2	1	-5	3	-3	-2	1	2	3	9	2	-14	-1	17	-22	-6	-22	0	0	11	4	7	-27	-2	0	9	3	4	-2	-15	-8	3	-14	-5	1	0	7	2				
ELEM	17	17	23	29	35	41	47	53	59	65	71	77	83	89	95	101	107	113	119	125	131	137	143	149	155	161	167	173	179	185	191	197	203	209	215	221	227	233	239	245	251	257	263	269	275	281	287	293	299	305	311	
SX	0	0	-1	0	0	1	0	0	-2	2	-2	1	-5	3	-3	-2	1	2	3	9	2	-14	-1	17	-22	-6	-22	0	0	11	4	7	-27	-2	0	9	3	4	-2	-15	-8	3	-14	-5	1	0	7	2				
SZ	0	0	-1	0	0	1	0	0	-2	2	-2	1	-5	3	-3	-2	1	2	3	9	2	-14	-1	17	-22	-6	-22	0	0	11	4	7	-27	-2	0	9	3	4	-2	-15	-8	3	-14	-5	1	0	7	2				
ELEM	17	17	23	29	35	41	47	53	59	65	71	77	83	89	95	101	107	113	119	125	131	137	143	149	155	161	167	173	179	185	191	197	203	209	215	221	227	233	239	245	251	257	263	269	275	281	287	293	299	305	311	
SX	0	0	-1	0	0	1	0	0	-2	2	-2	1	-5	3	-3	-2	1	2	3	9	2	-14	-1	17	-22	-6	-22	0	0	11	4	7	-27	-2	0	9	3	4	-2	-15	-8	3	-14	-5	1	0	7	2				
SZ	0	0	-1	0	0	1	0	0	-2	2	-2	1	-5	3	-3	-2	1	2	3	9	2	-14	-1	17	-22	-6	-22	0	0	11	4	7	-27	-2	0	9	3	4	-2	-15	-8	3	-14	-5	1	0	7	2				
ELEM	17	17	23	29	35	41	47	53	59	65	71	77	83	89	95	101	107	113	119	125	131	137	143	149	155	161	167	173	179	185	191	197	203	209	215	221	227	233	239	245	251	257	263	269	275	281	287	293	299	305	311	
SX	0	0	-1	0	0	1	0	0	-2	2	-2	1	-5	3	-3	-2	1	2	3	9	2	-14	-1	17	-22	-6	-22	0	0	11	4	7	-27	-2	0	9	3	4	-2	-15	-8	3	-14	-5	1	0	7	2				
SZ	0	0	-1	0	0	1	0	0	-2	2	-2	1	-5	3	-3	-2	1	2	3	9	2	-14	-1	17	-22	-6	-22	0	0	11	4	7	-27	-2	0	9	3	4	-2	-15	-8	3	-14	-5	1	0	7	2				
ELEM	17	17	23	29	35	41	47	53	59	65	71	77	83	89	95	101	107	113	119	125	131	137	143	149	155	161	167	173	179	185	191	197	203	209	215	221	227	233	239	245	251	257	263	269	275	281	287	293	299	305	311	
SX	0	0	-1	0	0	1	0	0	-2	2	-2	1	-5	3	-3	-2	1	2	3	9	2	-14	-1	17	-22	-6	-22	0	0	11	4	7	-27	-2	0	9	3	4	-2	-15	-8	3	-14	-5	1	0	7	2				
SZ	0	0	-1	0	0	1	0	0	-2	2	-2	1	-5	3	-3	-2	1	2	3	9	2	-14	-1	17	-22	-6	-22	0	0	11	4	7	-27	-2	0	9	3	4	-2	-15	-8											

NORMAL STRESSES FOR LOAD CASE 10 (PSI)

ELEM	SX	SY	SZ	ELEM	SX	SY	SZ	ELEM	SX	SY	SZ	ELEM	SX	SY	SZ	ELEM	SX	SY	SZ
313	1	49	-27	314	2	44	-25	315	3	30	-25	316	0	0	-6	317	1	-33	-5
319	1	-20	-2	320	1	-20	-1	321	1	-19	-1	322	1	-18	-1	323	1	-17	-5
325	10	169	-24	326	10	150	-22	327	7	96	-18	328	-8	-20	-15	329	-9	-68	-10
331	-8	-74	-5	332	-6	-61	-4	333	-5	-48	-3	334	-4	-37	-3	335	-3	-30	-2
337	-9	-150	-29	338	-9	-131	-27	339	-13	-80	-39	340	6	36	9	341	1	77	-3
343	1	67	-1	344	1	46	-1	345	0	26	-1	346	0	10	-1	347	0	-1	-1
349	1	-31	-27	350	1	-27	-26	351	6	-10	-32	352	-1	13	-2	353	2	26	-8
355	1	14	-5	356	1	69	-4	357	1	-2	-3	358	0	-8	-3	359	0	-23	-2
361	0	77	-27	362	0	31	-5	363	2	47	-27	364	-2	-10	-10	365	0	-31	-11
367	1	136	-24	368	1	165	-24	369	0	-28	-4	370	0	-26	-3	371	-4	-24	-3
373	1	186	-26	374	1	186	-24	375	4	107	-20	376	-5	-20	-17	377	-4	-73	-13
379	-3	-80	-7	380	-2	-68	-5	381	-2	-54	-4	382	-1	-43	-3	383	-1	-35	-3

ELEM	SX	SY	SZ
MIN.	109	-39	-62 (COMPRESSIVE)
MAX.	97	46	15 (TENSILE)

Figure D10. (Sheet 3 of 5)

SHEAR STRESSES FOR LOAD CASE 10 (PSI)

ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX
318	-3	23	1	314	-1	-14	1	315	-7	45	0	316	-6	22	-2	317	-5	3	-3	318	-5	-4	-2
319	-4	-7	-2	320	-3	-7	-2	321	-2	-6	-1	322	2	4	-1	323	-1	3	-1	324	0	-1	-1
325	17	22	2	326	51	7	0	327	76	45	2	328	85	26	-2	329	76	12	-2	330	61	5	-2
331	46	1	-1	332	34	0	-1	333	24	-1	-1	334	16	1	-1	335	9	-1	-1	336	3	0	-1
337	-22	45	1	338	-21	-5	12	339	-51	84	18	340	-48	51	-4	341	-41	39	2	342	-33	25	1
343	-25	16	1	344	-18	10	1	345	-13	124	7	346	-8	4	-4	347	-5	76	0	348	-8	1	0
349	-8	46	7	350	0	27	6	351	-18	124	8	352	-12	102	-2	353	-10	76	0	354	0	2	0
355	-6	33	0	356	-4	24	4	357	-3	16	0	358	-2	10	0	359	-1	76	-2	360	6	54	-2
361	-2	41	5	362	8	34	4	363	4	123	3	364	8	106	-1	365	7	4	-1	366	0	2	-1
367	4	31	-2	368	3	25	-2	369	2	17	-1	370	2	11	-1	371	43	41	-1	372	35	28	-1
373	9	30	-2	374	29	11	2	375	43	77	8	376	49	60	-1	377	43	41	-1	378	35	28	-1
379	2	19	-1	380	19	12	-1	381	14	7	-1	382	9	5	-1	383	5	41	-1	384	2	1	-1

MIN. ELEM VXY ELEM VYZ ELEM VZX
 268 -79 185 -70 145 -18
 MAX. 280 98 351 124 219 18

Figure D10. (Sheet 5 of 5)

NORMAL STRESSES FOR LOAD CASE 11 (PSI)

ELEM	SX	SY	SZ	ELEM	SX	SY	SZ	ELEM	SX	SY	SZ	ELEM	SX	SY	SZ	ELEM	SX	SY	SZ
1	0	-5	-2	101	10	-15	0	102	0	0	0	201	0	-15	0	202	0	0	0
2	0	-5	-2	103	10	-15	0	104	0	0	0	203	0	-15	0	204	0	0	0
3	0	-5	-2	105	10	-15	0	106	0	0	0	205	0	-15	0	206	0	0	0
4	0	-5	-2	107	10	-15	0	108	0	0	0	207	0	-15	0	208	0	0	0
5	0	-5	-2	109	10	-15	0	110	0	0	0	209	0	-15	0	210	0	0	0
6	0	-5	-2	111	10	-15	0	112	0	0	0	211	0	-15	0	212	0	0	0
7	0	-5	-2	113	10	-15	0	114	0	0	0	213	0	-15	0	214	0	0	0
8	0	-5	-2	115	10	-15	0	116	0	0	0	215	0	-15	0	216	0	0	0
9	0	-5	-2	117	10	-15	0	118	0	0	0	217	0	-15	0	218	0	0	0
10	0	-5	-2	119	10	-15	0	120	0	0	0	219	0	-15	0	220	0	0	0
11	0	-5	-2	121	10	-15	0	122	0	0	0	221	0	-15	0	222	0	0	0
12	0	-5	-2	123	10	-15	0	124	0	0	0	223	0	-15	0	224	0	0	0
13	0	-5	-2	125	10	-15	0	126	0	0	0	225	0	-15	0	226	0	0	0
14	0	-5	-2	127	10	-15	0	128	0	0	0	227	0	-15	0	228	0	0	0
15	0	-5	-2	129	10	-15	0	130	0	0	0	229	0	-15	0	230	0	0	0
16	0	-5	-2	131	10	-15	0	132	0	0	0	231	0	-15	0	232	0	0	0
17	0	-5	-2	133	10	-15	0	134	0	0	0	233	0	-15	0	234	0	0	0
18	0	-5	-2	135	10	-15	0	136	0	0	0	235	0	-15	0	236	0	0	0
19	0	-5	-2	137	10	-15	0	138	0	0	0	237	0	-15	0	238	0	0	0
20	0	-5	-2	139	10	-15	0	140	0	0	0	239	0	-15	0	240	0	0	0
21	0	-5	-2	141	10	-15	0	142	0	0	0	241	0	-15	0	242	0	0	0
22	0	-5	-2	143	10	-15	0	144	0	0	0	243	0	-15	0	244	0	0	0
23	0	-5	-2	145	10	-15	0	146	0	0	0	245	0	-15	0	246	0	0	0
24	0	-5	-2	147	10	-15	0	148	0	0	0	247	0	-15	0	248	0	0	0
25	0	-5	-2	149	10	-15	0	150	0	0	0	249	0	-15	0	250	0	0	0
26	0	-5	-2	151	10	-15	0	152	0	0	0	251	0	-15	0	252	0	0	0
27	0	-5	-2	153	10	-15	0	154	0	0	0	253	0	-15	0	254	0	0	0
28	0	-5	-2	155	10	-15	0	156	0	0	0	255	0	-15	0	256	0	0	0
29	0	-5	-2	157	10	-15	0	158	0	0	0	257	0	-15	0	258	0	0	0
30	0	-5	-2	159	10	-15	0	160	0	0	0	259	0	-15	0	260	0	0	0
31	0	-5	-2	161	10	-15	0	162	0	0	0	261	0	-15	0	262	0	0	0
32	0	-5	-2	163	10	-15	0	164	0	0	0	263	0	-15	0	264	0	0	0
33	0	-5	-2	165	10	-15	0	166	0	0	0	265	0	-15	0	266	0	0	0
34	0	-5	-2	167	10	-15	0	168	0	0	0	267	0	-15	0	268	0	0	0
35	0	-5	-2	169	10	-15	0	170	0	0	0	269	0	-15	0	270	0	0	0
36	0	-5	-2	171	10	-15	0	172	0	0	0	271	0	-15	0	272	0	0	0
37	0	-5	-2	173	10	-15	0	174	0	0	0	273	0	-15	0	274	0	0	0
38	0	-5	-2	175	10	-15	0	176	0	0	0	275	0	-15	0	276	0	0	0
39	0	-5	-2	177	10	-15	0	178	0	0	0	277	0	-15	0	278	0	0	0
40	0	-5	-2	179	10	-15	0	180	0	0	0	279	0	-15	0	280	0	0	0
41	0	-5	-2	181	10	-15	0	182	0	0	0	281	0	-15	0	282	0	0	0
42	0	-5	-2	183	10	-15	0	184	0	0	0	283	0	-15	0	284	0	0	0
43	0	-5	-2	185	10	-15	0	186	0	0	0	285	0	-15	0	286	0	0	0
44	0	-5	-2	187	10	-15	0	188	0	0	0	287	0	-15	0	288	0	0	0
45	0	-5	-2	189	10	-15	0	190	0	0	0	289	0	-15	0	290	0	0	0
46	0	-5	-2	191	10	-15	0	192	0	0	0	291	0	-15	0	292	0	0	0
47	0	-5	-2	193	10	-15	0	194	0	0	0	293	0	-15	0	294	0	0	0
48	0	-5	-2	195	10	-15	0	196	0	0	0	295	0	-15	0	296	0	0	0
49	0	-5	-2	197	10	-15	0	198	0	0	0	297	0	-15	0	298	0	0	0
50	0	-5	-2	199	10	-15	0	200	0	0	0	299	0	-15	0	300	0	0	0
51	0	-5	-2	201	10	-15	0	202	0	0	0	301	0	-15	0	302	0	0	0
52	0	-5	-2	203	10	-15	0	204	0	0	0	303	0	-15	0	304	0	0	0
53	0	-5	-2	205	10	-15	0	206	0	0	0	305	0	-15	0	306	0	0	0
54	0	-5	-2	207	10	-15	0	208	0	0	0	307	0	-15	0	308	0	0	0
55	0	-5	-2	209	10	-15	0	210	0	0	0	309	0	-15	0	310	0	0	0
56	0	-5	-2	211	10	-15	0	212	0	0	0	311	0	-15	0	312	0	0	0
57	0	-5	-2	213	10	-15	0	214	0	0	0	313	0	-15	0	314	0	0	0
58	0	-5	-2	215	10	-15	0	216	0	0	0	315	0	-15	0	316	0	0	0
59	0	-5	-2	217	10	-15	0	218	0	0	0	317	0	-15	0	318	0	0	0
60	0	-5	-2	219	10	-15	0	220	0	0	0	319	0	-15	0	320	0	0	0
61	0	-5	-2	221	10	-15	0	222	0	0	0	321	0	-15	0	322	0	0	0
62	0	-5	-2	223	10	-15	0	224	0	0	0	323	0	-15	0	324	0	0	0
63	0	-5	-2	225	10	-15	0	226	0	0	0	325	0	-15	0	326	0	0	0
64	0	-5	-2	227	10	-15	0	228	0	0	0	327	0	-15	0	328	0	0	0
65	0	-5	-2	229	10	-15	0	230	0	0	0	329	0	-15	0	330	0	0	0
66	0	-5	-2	231	10	-15	0	232	0	0	0	331	0	-15	0	332	0	0	0
67	0	-5	-2	233	10	-15	0	234	0	0	0	333	0	-15	0	334	0	0	0
68	0	-5	-2	235	10	-15	0	236	0	0	0	335	0	-15	0	336	0	0	0
69	0	-5	-2	237	10	-15	0	238	0	0	0	337	0	-15	0	338	0	0	0
70	0	-5	-2	239	10	-15	0	240	0	0	0	339	0	-15	0	340	0	0	0
71	0	-5	-2	241	10	-15	0	242	0	0	0	341	0	-15	0	342	0	0	0
72	0	-5	-2	243	10	-15	0	244	0	0	0	343	0	-15	0	344	0	0	0
73	0	-5	-2	245	10	-15	0	246	0	0	0	345	0	-15	0	346	0	0	0
74	0	-5	-2	247	10	-15	0	248	0	0	0	347	0	-15	0	348	0	0	0
75	0	-5	-2	249	10	-15	0	250	0	0	0	349	0	-15	0	350	0	0	0
76	0	-5	-2	251	10	-15	0	252	0	0	0	351	0	-15	0	352	0	0	0
77	0	-5	-2	253	10	-15	0	254	0	0	0	353	0	-15	0	354	0	0	0
78	0	-5	-2	255	10	-15	0	256	0	0	0	355	0	-15	0	356	0	0	0
79	0	-5	-2	257	10	-15	0	258	0	0	0	357	0	-15	0	358	0	0	0
80	0	-5	-2	259	10	-15	0	260	0	0	0	359	0	-15	0	360	0	0	0
81	0	-5	-2	261	10	-15	0	262	0	0	0	361	0	-15	0	362	0	0	0
82	0	-5	-2	263	10	-15	0	264	0	0	0	363	0	-15	0	364	0	0	0
83	0	-5	-2	265	10	-15	0	266	0	0	0	365	0	-15	0	366	0	0	0
84	0	-5	-2	267	10	-15	0	268	0	0	0	367	0	-15	0	368	0	0	0
85	0	-5	-2	269	10	-15	0	270	0	0	0	369	0	-15	0	370	0	0	0
86	0	-5	-2	271	10	-15	0	272	0	0	0	371	0	-15	0	372	0	0	0
87	0	-5	-2	273	10	-15	0	274	0	0	0	373	0	-15	0	374	0	0	0
88	0	-5	-2	275	10	-15	0	276	0	0	0	375	0	-15	0	376	0	0	0
89	0	-5	-2	277	10	-15	0	278	0	0	0	377	0	-15	0	378	0	0	

SHEAR STRESSES FOR LOAD CASE 11 (PSI)											
ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX
1	-5	-3	-1	16	-15	-8	-1	31	-22	-12	0
7	-15	-10	0	17	-14	-8	0	32	-25	-14	0
13	-2	-16	0	18	-11	-7	0	33	-28	-28	0
19	-4	-20	0	19	-16	-24	0	34	-18	-8	0
25	2	-24	5	20	-16	-24	0	35	-22	-27	0
31	2	-20	0	21	-15	-24	0	36	-1	-27	0
37	4	-23	0	22	-12	-24	0	37	18	18	0
43	14	-19	0	23	-11	-24	0	38	-23	-15	0
49	-5	-18	-1	24	-18	-15	0	39	-25	-17	0
55	-15	18	-5	25	-22	15	0	40	-23	17	0
61	-6	23	0	26	-18	33	0	41	-25	33	0
67	-9	23	0	27	-19	33	0	42	-18	34	0
73	-3	6	0	28	-16	33	0	43	-16	34	0
79	-3	6	0	29	-10	33	0	44	-7	11	0
85	-3	6	0	30	-11	33	0	45	-26	5	0
91	20	0	0	31	-21	33	0	46	-25	0	0
97	20	0	0	32	-21	33	0	47	-25	0	0
103	-24	6	5	33	-22	33	0	48	-23	16	0
109	12	1	5	34	-18	33	0	49	-16	13	0
115	12	1	5	35	-19	33	0	50	-12	28	0
121	2	0	1	36	-16	33	0	51	-7	11	0
127	-2	-1	1	37	-16	33	0	52	-7	11	0
133	2	-1	1	38	-16	33	0	53	-7	11	0
139	8	-1	1	39	-16	33	0	54	-7	11	0
145	-10	-3	1	40	-16	33	0	55	-7	11	0
151	-27	-3	1	41	-16	33	0	56	-7	11	0
157	4	-3	1	42	-16	33	0	57	-7	11	0
163	11	-3	1	43	-16	33	0	58	-7	11	0
169	-21	-12	0	44	-16	33	0	59	-7	11	0
175	-14	-12	0	45	-16	33	0	60	-7	11	0
181	-10	-12	0	46	-16	33	0	61	-7	11	0
187	-12	-12	0	47	-16	33	0	62	-7	11	0
193	-3	-12	0	48	-16	33	0	63	-7	11	0
199	-6	-12	0	49	-16	33	0	64	-7	11	0
205	7	-12	0	50	-16	33	0	65	-7	11	0
211	19	-3	1	51	-16	33	0	66	-7	11	0
217	24	-3	1	52	-16	33	0	67	-7	11	0
223	-15	10	1	53	-16	33	0	68	-7	11	0
229	-15	10	1	54	-16	33	0	69	-7	11	0
235	-15	10	1	55	-16	33	0	70	-7	11	0
241	-4	9	0	56	-16	33	0	71	-7	11	0
247	5	2	0	57	-16	33	0	72	-7	11	0
253	22	-2	0	58	-16	33	0	73	-7	11	0
259	22	-2	0	59	-16	33	0	74	-7	11	0
265	22	-2	0	60	-16	33	0	75	-7	11	0
271	22	-2	0	61	-16	33	0	76	-7	11	0
277	22	-2	0	62	-16	33	0	77	-7	11	0
283	22	-2	0	63	-16	33	0	78	-7	11	0
289	22	-2	0	64	-16	33	0	79	-7	11	0
295	22	-2	0	65	-16	33	0	80	-7	11	0
301	22	-2	0	66	-16	33	0	81	-7	11	0
307	22	-2	0	67	-16	33	0	82	-7	11	0
313	22	-2	0	68	-16	33	0	83	-7	11	0
319	22	-2	0	69	-16	33	0	84	-7	11	0
325	22	-2	0	70	-16	33	0	85	-7	11	0
331	22	-2	0	71	-16	33	0	86	-7	11	0
337	22	-2	0	72	-16	33	0	87	-7	11	0
343	22	-2	0	73	-16	33	0	88	-7	11	0
349	22	-2	0	74	-16	33	0	89	-7	11	0
355	22	-2	0	75	-16	33	0	90	-7	11	0
361	22	-2	0	76	-16	33	0	91	-7	11	0
367	22	-2	0	77	-16	33	0	92	-7	11	0
373	22	-2	0	78	-16	33	0	93	-7	11	0
379	22	-2	0	79	-16	33	0	94	-7	11	0
385	22	-2	0	80	-16	33	0	95	-7	11	0
391	22	-2	0	81	-16	33	0	96	-7	11	0
397	22	-2	0	82	-16	33	0	97	-7	11	0
403	22	-2	0	83	-16	33	0	98	-7	11	0
409	22	-2	0	84	-16	33	0	99	-7	11	0
415	22	-2	0	85	-16	33	0	100	-7	11	0
421	22	-2	0	86	-16	33	0	101	-7	11	0
427	22	-2	0	87	-16	33	0	102	-7	11	0
433	22	-2	0	88	-16	33	0	103	-7	11	0
439	22	-2	0	89	-16	33	0	104	-7	11	0
445	22	-2	0	90	-16	33	0	105	-7	11	0
451	22	-2	0	91	-16	33	0	106	-7	11	0
457	22	-2	0	92	-16	33	0	107	-7	11	0
463	22	-2	0	93	-16	33	0	108	-7	11	0
469	22	-2	0	94	-16	33	0	109	-7	11	0
475	22	-2	0	95	-16	33	0	110	-7	11	0
481	22	-2	0	96	-16	33	0	111	-7	11	0
487	22	-2	0	97	-16	33	0	112	-7	11	0
493	22	-2	0	98	-16	33	0	113	-7	11	0
499	22	-2	0	99	-16	33	0	114	-7	11	0
505	22	-2	0	100	-16	33	0	115	-7	11	0
511	22	-2	0	101	-16	33	0	116	-7	11	0
517	22	-2	0	102	-16	33	0	117	-7	11	0
523	22	-2	0	103	-16	33	0	118	-7	11	0
529	22	-2	0	104	-16	33	0	119	-7	11	0
535	22	-2	0	105	-16	33	0	120	-7	11	0
541	22	-2	0	106	-16	33	0	121	-7	11	0
547	22	-2	0	107	-16	33	0	122	-7	11	0
553	22	-2	0	108	-16	33	0	123	-7	11	0
559	22	-2	0	109	-16	33	0	124	-7	11	0
565	22	-2	0	110	-16	33	0	125	-7	11	0
571	22	-2	0	111	-16	33	0	126	-7	11	0
577	22	-2	0	112	-16	33	0	127	-7	11	0
583	22	-2	0	113	-16	33	0	128	-7	11	0
589	22	-2	0	114	-16	33	0	129	-7	11	0
595	22	-2	0	115	-16	33	0	130	-7	11	0
601	22	-2	0	116	-16	33	0	131	-7	11	0
607	22	-2	0	117	-16	33	0	132	-7	11	0
613	22	-2	0	118	-16	33	0	133	-7	11	0
619	22	-2	0	119	-16	33	0	134	-7	11	0
625	22	-2	0	120	-16	33	0	135	-7	11	0
631	22	-2	0	121	-16	33	0	136	-7	11	0
637	22	-2	0	122	-16	33	0	137	-7	11	0
643	22	-2	0	123	-16	33	0	138	-7	11	0
649	22	-2	0	124	-16	33	0	139	-7	11	0
655	22	-2	0	125	-16	33	0	140	-7	11	0
661	22	-2	0	126	-16	33	0	141	-7	11	0
667	22	-2	0	127	-16	33	0	142	-7	11	0
673	22	-2	0	128	-16	33	0	143	-7	11	0
679	22	-2	0	129	-16	33	0	144	-7	11	0
685	22	-2	0	130	-16	33	0	145	-7	11	0
691	22	-2	0	131	-16	33	0	146	-7	11	0
697	22	-2	0	132	-16	33	0	147	-7	11	0
703	22	-2	0	133	-16	33	0	148	-7	11	0
709	22	-2	0	134	-16	33	0	149	-7	11	0
715	22	-2	0	135	-16	33	0	150	-7	11	0
721	22	-2	0	136	-16	33	0	151	-7	11	0
727	22	-2	0	137	-16	33	0	152	-7	11	0
733	22	-2	0	138	-16	33	0	153	-7	11	0
739	22	-2	0	139	-16	33	0	154	-7	11	0
745	22	-2	0	140	-16	33	0	155	-7	11	0
751	22	-2	0	141	-16	33	0	156	-7	11	0
757	22	-2	0	142	-16	33	0	157	-7	11	0
763	22	-2	0	143	-16	33	0	158	-7	11	0
769	22	-2	0	144	-16	33	0	159	-7	11	0
775	22	-2	0	145	-16	33	0	160	-7	11	0
781	22	-2	0	146	-16	33	0	161	-7	11	0
787	22	-2	0	147	-16	33	0	162	-7	11	0
793	22	-2	0	148	-16	33	0	163	-7	11	0
799	22	-2	0	149	-16	33	0	164	-7	11	0
805	22	-2	0	150	-16	33	0	165	-7	11	0
811	22	-2	0	151	-16	33	0	166	-7	11	0
817	22	-2	0	152	-16	33	0	167	-7	11	0
823	22	-2	0	153	-16	33	0	168	-7	11	0
829	22	-2	0	154	-16	33	0	169	-7	11	0
835	22	-2	0	155	-16	33	0	170	-7	11	0
841	22	-2	0	156	-16	33	0	171	-7	11	0
847	22	-2	0	157	-16						

SHEAR STRESSES FOR LOAD CASE 11 (PSI)

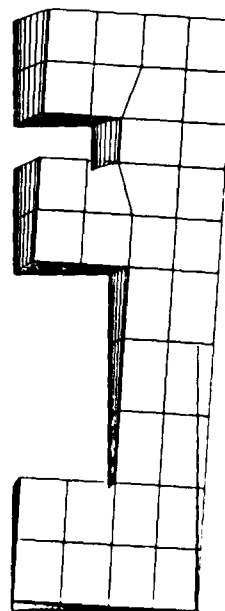
ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX
313	-4	8	-4	314	-2	-6	-4	315	-10	14	-3	316	-9	6	-3	317	-6	-1	-2
319	-4	-4	-1	320	-3	-3	-1	321	-2	-3	-1	322	-1	-2	-1	323	-1	-1	-1
325	8	9	-2	326	25	-2	-2	327	37	18	-1	328	41	11	-1	329	37	5	-1
331	22	1	-1	332	17	0	-1	333	12	0	0	334	8	0	0	335	5	0	0
337	-22	2	11	338	1	-3	10	339	-40	42	14	340	-26	26	-2	341	-22	19	0
343	-15	9	0	344	-10	6	4	345	-7	4	0	346	-5	3	0	347	-5	1	0
349	-9	23	4	350	-4	13	4	351	-15	63	5	352	-7	52	-1	353	-6	37	0
355	-4	19	0	356	-3	13	0	357	-1	9	0	358	-1	6	0	359	-1	3	0
361	-2	20	-2	362	4	17	-2	363	-1	62	-2	364	2	54	-1	365	3	33	-1
367	2	20	-1	368	1	14	-1	369	1	10	-1	370	1	6	-1	371	0	3	-1
373	5	15	-2	374	14	6	-2	375	22	33	-2	376	25	30	0	377	21	21	-1
379	13	10	0	380	10	7	0	381	7	5	0	382	5	3	0	383	3	-2	0

MIN. 263 -54 184 -44 193 -9
MAX. 320 46 351 63 219 16

Figure D11. (Sheet 5 of 5)

1/13-m	1/49-m	1/168-m	1/217-m	1/289-m	1/337-m
1/13-m	1/41-m	1/168-m	1/225-m	1/301-m	1/349-m
1/25-m	1/73-m	1/121-m	1/145-m	1/181-m	1/201-m
1/31-m	1/85-m	1/137-m	1/169-m	1/213-m	1/253-m

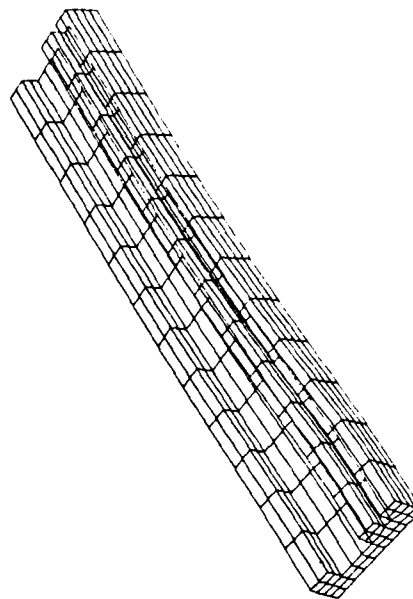
FINITE-ELEMENT ANALYSIS OF PROPOSED 'SHORT' STRUCTURE. AUG 82
UNDEFORMED GRID
SHORT STRUCTURE (56 MODELS, 394 ELEMENTS)



FINITE-ELEMENT ANALYSIS OF PROPOSED 'SHORT' STRUCTURE. AUG 82
LOAD CASE NO-12
SHORT STRUCTURE (56 MODELS, 394 ELEMENTS)



FINITE-ELEMENT ANALYSIS OF PROPOSED 'SHORT' STRUCTURE. AUG 82
LOAD CASE NO-12



FINITE-ELEMENT ANALYSIS OF PROPOSED 'SHORT' STRUCTURE. AUG 82
LOAD CASE NO-12

Figure D12. Finite-element analysis for load case 12 with $K = 175 \text{ lb/in.}^3$ (Sheet 1 of 5)

NORMAL STRESSES FOR LOAD CASE 12 (PSI)

ELEM	SX	SY	SZ	ELEM	SX	SY	SZ	ELEM	SX	SY	SZ	ELEM	SX	SY	SZ	ELEM	SX	SY	SZ
1	1	0	0	101	1	0	0	191	1	0	0	281	1	0	0	371	1	0	0
2	0	0	0	102	0	0	0	192	0	0	0	282	0	0	0	372	0	0	0
3	0	0	0	103	0	0	0	193	0	0	0	283	0	0	0	373	0	0	0
4	0	0	0	104	0	0	0	194	0	0	0	284	0	0	0	374	0	0	0
5	0	0	0	105	0	0	0	195	0	0	0	285	0	0	0	375	0	0	0
6	0	0	0	106	0	0	0	196	0	0	0	286	0	0	0	376	0	0	0
7	0	0	0	107	0	0	0	197	0	0	0	287	0	0	0	377	0	0	0
8	0	0	0	108	0	0	0	198	0	0	0	288	0	0	0	378	0	0	0
9	0	0	0	109	0	0	0	199	0	0	0	289	0	0	0	379	0	0	0
10	0	0	0	110	0	0	0	200	0	0	0	290	0	0	0	380	0	0	0
11	0	0	0	111	0	0	0	201	0	0	0	291	0	0	0	381	0	0	0
12	0	0	0	112	0	0	0	202	0	0	0	292	0	0	0	382	0	0	0
13	0	0	0	113	0	0	0	203	0	0	0	293	0	0	0	383	0	0	0
14	0	0	0	114	0	0	0	204	0	0	0	294	0	0	0	384	0	0	0
15	0	0	0	115	0	0	0	205	0	0	0	295	0	0	0	385	0	0	0
16	0	0	0	116	0	0	0	206	0	0	0	296	0	0	0	386	0	0	0
17	0	0	0	117	0	0	0	207	0	0	0	297	0	0	0	387	0	0	0
18	0	0	0	118	0	0	0	208	0	0	0	298	0	0	0	388	0	0	0
19	0	0	0	119	0	0	0	209	0	0	0	299	0	0	0	389	0	0	0
20	0	0	0	120	0	0	0	210	0	0	0	300	0	0	0	390	0	0	0
21	0	0	0	121	0	0	0	211	0	0	0	301	0	0	0	391	0	0	0
22	0	0	0	122	0	0	0	212	0	0	0	302	0	0	0	392	0	0	0
23	0	0	0	123	0	0	0	213	0	0	0	303	0	0	0	393	0	0	0
24	0	0	0	124	0	0	0	214	0	0	0	304	0	0	0	394	0	0	0
25	0	0	0	125	0	0	0	215	0	0	0	305	0	0	0	395	0	0	0
26	0	0	0	126	0	0	0	216	0	0	0	306	0	0	0	396	0	0	0
27	0	0	0	127	0	0	0	217	0	0	0	307	0	0	0	397	0	0	0
28	0	0	0	128	0	0	0	218	0	0	0	308	0	0	0	398	0	0	0
29	0	0	0	129	0	0	0	219	0	0	0	309	0	0	0	399	0	0	0
30	0	0	0	130	0	0	0	220	0	0	0	310	0	0	0	400	0	0	0
31	0	0	0	131	0	0	0	221	0	0	0	311	0	0	0	401	0	0	0
32	0	0	0	132	0	0	0	222	0	0	0	312	0	0	0	402	0	0	0
33	0	0	0	133	0	0	0	223	0	0	0	313	0	0	0	403	0	0	0
34	0	0	0	134	0	0	0	224	0	0	0	314	0	0	0	404	0	0	0
35	0	0	0	135	0	0	0	225	0	0	0	315	0	0	0	405	0	0	0
36	0	0	0	136	0	0	0	226	0	0	0	316	0	0	0	406	0	0	0
37	0	0	0	137	0	0	0	227	0	0	0	317	0	0	0	407	0	0	0
38	0	0	0	138	0	0	0	228	0	0	0	318	0	0	0	408	0	0	0
39	0	0	0	139	0	0	0	229	0	0	0	319	0	0	0	409	0	0	0
40	0	0	0	140	0	0	0	230	0	0	0	320	0	0	0	410	0	0	0
41	0	0	0	141	0	0	0	231	0	0	0	321	0	0	0	411	0	0	0
42	0	0	0	142	0	0	0	232	0	0	0	322	0	0	0	412	0	0	0
43	0	0	0	143	0	0	0	233	0	0	0	323	0	0	0	413	0	0	0
44	0	0	0	144	0	0	0	234	0	0	0	324	0	0	0	414	0	0	0
45	0	0	0	145	0	0	0	235	0	0	0	325	0	0	0	415	0	0	0
46	0	0	0	146	0	0	0	236	0	0	0	326	0	0	0	416	0	0	0
47	0	0	0	147	0	0	0	237	0	0	0	327	0	0	0	417	0	0	0
48	0	0	0	148	0	0	0	238	0	0	0	328	0	0	0	418	0	0	0
49	0	0	0	149	0	0	0	239	0	0	0	329	0	0	0	419	0	0	0
50	0	0	0	150	0	0	0	240	0	0	0	330	0	0	0	420	0	0	0
51	0	0	0	151	0	0	0	241	0	0	0	331	0	0	0	421	0	0	0
52	0	0	0	152	0	0	0	242	0	0	0	332	0	0	0	422	0	0	0
53	0	0	0	153	0	0	0	243	0	0	0	333	0	0	0	423	0	0	0
54	0	0	0	154	0	0	0	244	0	0	0	334	0	0	0	424	0	0	0
55	0	0	0	155	0	0	0	245	0	0	0	335	0	0	0	425	0	0	0
56	0	0	0	156	0	0	0	246	0	0	0	336	0	0	0	426	0	0	0
57	0	0	0	157	0	0	0	247	0	0	0	337	0	0	0	427	0	0	0
58	0	0	0	158	0	0	0	248	0	0	0	338	0	0	0	428	0	0	0
59	0	0	0	159	0	0	0	249	0	0	0	339	0	0	0	429	0	0	0
60	0	0	0	160	0	0	0	250	0	0	0	340	0	0	0	430	0	0	0
61	0	0	0	161	0	0	0	251	0	0	0	341	0	0	0	431	0	0	0
62	0	0	0	162	0	0	0	252	0	0	0	342	0	0	0	432	0	0	0
63	0	0	0	163	0	0	0	253	0	0	0	343	0	0	0	433	0	0	0
64	0	0	0	164	0	0	0	254	0	0	0	344	0	0	0	434	0	0	0
65	0	0	0	165	0	0	0	255	0	0	0	345	0	0	0	435	0	0	0
66	0	0	0	166	0	0	0	256	0	0	0	346	0	0	0	436	0	0	0
67	0	0	0	167	0	0	0	257	0	0	0	347	0	0	0	437	0	0	0
68	0	0	0	168	0	0	0	258	0	0	0	348	0	0	0	438	0	0	0
69	0	0	0	169	0	0	0	259	0	0	0	349	0	0	0	439	0	0	0
70	0	0	0	170	0	0	0	260	0	0	0	350	0	0	0	440	0	0	0
71	0	0	0	171	0	0	0	261	0	0	0	351	0	0	0	441	0	0	0
72	0	0	0	172	0	0	0	262	0	0	0	352	0	0	0	442	0	0	0
73	0	0	0	173	0	0	0	263	0	0	0	353	0	0	0	443	0	0	0
74	0	0	0	174	0	0	0	264	0	0	0	354	0	0	0	444	0	0	0
75	0	0	0	175	0	0	0	265	0	0	0	355	0	0	0	445	0	0	0
76	0	0	0	176	0	0	0	266	0	0	0	356	0	0	0	446	0	0	0
77	0	0	0	177	0	0	0	267	0	0	0	357	0	0	0	447	0	0	0
78	0	0	0	178	0	0	0	268	0	0	0	358	0	0	0	448	0	0	0
79	0	0	0	179	0	0	0	269	0	0	0	359	0	0	0	449	0	0	0
80	0	0	0	180	0	0	0	270	0	0	0	360	0	0	0	450	0	0	0
81	0	0	0	181	0	0	0	271	0	0	0	361	0	0	0	451	0	0	0
82	0	0	0	182	0	0	0	272	0	0	0	362	0	0	0	452	0	0	0
83	0	0	0	183	0	0	0	273	0	0	0	363	0	0	0	453	0	0	0
84	0	0	0	184	0	0	0	274	0	0	0	364	0	0	0	454	0	0	0
85	0	0	0	185	0	0	0	275	0	0	0	365	0	0	0	455	0	0	0
86	0	0	0	186	0	0	0	276	0	0	0	366	0	0	0	456	0	0	0
87	0	0	0	187	0	0	0	277	0	0	0	367	0	0	0	457	0	0	0
88	0	0	0	188	0	0	0	278	0	0	0	368	0	0	0	458	0	0	0
89	0	0	0	189	0	0	0	279	0	0	0	369	0	0	0	459	0	0	0
90	0	0	0	190	0	0	0	280	0	0	0	370	0	0	0	460	0	0	0
91	0	0	0	191	0	0	0	281	0	0	0	371	0	0	0	461	0	0	

NORMAL STRESSES FOR LOAD CASE 12 (PSI)

ELEM	SX	SY	SZ	ELEM	SX	SY	SZ	ELEM	SX	SY	SZ	ELEM	SX	SY	SZ	ELEM	SX	SY	SZ
313	4	96	-51	314	4	80	-36	315	6	56	-35	316	1	2	-10	317	1	-23	-4
319	1	-27	-2	320	1	-36	-1	321	6	-35	-1	322	1	-33	0	323	1	-31	0
325	20	330	-41	326	5	263	-7	327	1	158	-9	328	-16	-41	-24	329	-17	-126	-11
331	-13	-121	-7	332	-11	-109	-5	333	-8	-86	-4	334	-7	-67	-3	335	-5	-47	-2
337	-19	-255	-57	338	-18	-229	-59	339	-21	-125	-82	340	11	75	18	341	1	142	-1
343	1	117	-2	344	1	80	-2	345	17	49	-2	346	0	15	-1	347	0	-4	-1
349	6	-62	-52	350	11	-46	-58	351	17	-5	-70	352	-2	28	-2	353	4	49	-9
355	2	27	-7	356	1	10	-6	357	4	-5	-5	358	1	-17	-4	359	1	-25	-3
361	1	150	-50	362	1	123	-52	363	4	82	-5	364	-3	-4	-17	365	-1	-41	-13
367	0	-58	-10	368	0	-56	-7	369	0	172	-3	370	0	-48	-5	371	0	-45	-4
373	7	303	-45	374	1	293	-44	375	3	178	-3	376	-10	-41	-29	377	-7	-132	-15
379	-5	-143	-10	380	-4	-121	-7	381	-3	-98	-6	382	-2	-78	-4	383	-2	-57	-4

MIN.	ELEM	SX	ELEM	SY	ELEM	SZ
	109	-71	289	-357	217	-100
MAX.	97	86	373	363	292	21

Figure D12. (Sheet 3 of 5)

SHEAR STRESSES FOR LOAD CASE 12 (PSI)

ELPH	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX
1	-20	-10	-5	2	-57	-28	-4	3	-83	-42	-2	4	-91	-49	0	5	-81	-49	1
7	-51	-38	1	8	-38	-30	1	9	-27	-22	1	10	-18	-15	1	11	-19	-9	1
13	-5	-22	1	14	-16	-60	1	15	-23	-85	1	16	-24	-101	1	17	-10	-9	1
19	-10	-73	1	20	-7	-58	0	21	-5	-43	0	22	-12	-99	0	23	14	-17	0
25	3	-21	14	26	7	-58	12	27	10	-87	8	28	12	-99	3	29	14	-17	0
31	11	-72	1	32	9	-56	-2	33	7	-42	-2	34	4	-51	-2	35	3	-17	-1
37	15	-11	13	38	49	-29	11	39	72	-44	-2	40	79	-51	-1	41	76	-10	-1
43	51	-35	-3	44	39	-30	-2	45	28	-23	-2	46	19	-15	-1	47	11	-9	-1
49	-20	16	-3	50	-57	45	-2	51	-82	63	-1	52	-90	68	0	53	-80	5	1
55	-12	31	17	56	-36	88	-15	57	-27	15	-1	58	-18	10	1	59	-10	5	1
61	-27	66	5	62	-19	47	15	63	-53	12	-8	64	-56	14	0	65	-48	11	5
67	73	11	21	68	12	32	19	69	-14	44	14	70	-19	46	3	71	-5	37	2
79	27	16	3	80	0	10	-1	81	0	6	15	82	11	3	-1	83	0	2	-1
85	27	3	23	86	74	9	20	87	107	12	-1	88	119	11	1	89	117	7	-1
91	75	-1	-10	92	-84	-2	-7	93	-123	44	-1	94	-29	-2	-1	95	-17	-1	-1
97	-29	18	5	98	59	31	8	99	-34	19	6	100	-33	46	5	101	-17	37	13
103	-28	15	2	104	-49	13	3	105	-34	19	6	106	-22	5	5	107	-13	37	13
109	-21	3	8	110	54	13	1	111	81	19	5	112	85	18	4	113	82	12	10
115	56	3	14	116	-70	4	-1	117	-105	15	-4	118	-121	10	4	119	-96	3	10
121	-61	-7	-9	122	45	-4	-14	123	-72	16	-5	124	-21	11	5	125	-12	-1	5
127	-22	-4	-11	128	49	5	-27	129	-113	-2	-18	130	16	11	6	131	70	9	-2
133	67	-1	-33	134	32	-3	-9	135	-41	-17	8	136	-125	-1	5	137	-114	-2	11
139	-25	-5	-11	140	-57	-35	-10	141	-101	5	-17	142	-27	-12	7	143	-15	-7	-2
151	51	15	-29	152	65	-8	6	153	-41	-20	3	154	108	15	0	155	-15	-6	3
157	51	-11	7	158	39	-10	-6	159	106	27	-8	160	18	-6	4	161	10	-3	4
169	-44	-46	-16	170	-39	-33	-20	171	-101	5	-17	172	-91	-18	4	173	-77	-9	-10
175	-45	-46	-1	176	-34	-35	1	177	-24	-26	0	178	-16	-54	7	179	-9	-10	-1
181	-17	12	-17	182	-26	-155	-10	183	-60	-69	-11	184	-63	-119	13	185	-54	-127	10
187	-35	-66	9	188	-34	-105	17	189	-19	-55	6	190	-12	-23	-5	191	-7	-21	4
193	-1	25	-27	194	-5	-37	-17	195	-11	9	-16	196	-13	-23	-3	197	-13	-41	-3
199	-12	-39	0	200	-9	-32	0	201	-17	-44	-13	202	-5	-17	-6	203	-3	-10	-4
205	40	25	-21	206	92	-13	-15	207	142	34	-13	208	149	11	0	209	129	-4	-4
211	77	-11	-1	212	56	-11	-1	213	39	-8	4	214	26	-6	-9	215	15	-4	0
217	-45	95	25	218	-42	0	32	219	-107	19	44	220	-94	86	1	221	-80	71	5
223	-40	52	2	224	-35	21	14	225	-25	14	19	226	-16	12	-5	227	-77	128	10
229	-31	93	11	230	-45	66	15	231	-96	24	9	232	-92	18	0	233	-9	130	1
235	-66	64	0	236	-34	43	0	237	-24	91	2	238	-18	59	0	239	-13	30	2
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247	-9	5	10	248	-6	0	-4	249	-5	47	-2	250	163	18	-2	251	147	1	1
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271	-34	43	-3	272	-59	-9	-2	273	-163	59	0	274	32	24	8	275	-74	-9	0
277	39	63	-13	278	69	-6	-1	279	-109	18	-26	280	-86	-15	-1	281	-74	-9	0
283	96	-5	-13	284	-13	-5	-9	285	-109	18	-26	286	-86	-15	-1	287	-74	-9	0
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295	-43	-62	-7	296	-13	-5	-9	297	-109	18	-26	298	-86	-15	-1	299	-74	-9	0
301	-42	-74	-3	302	-31	-39	3	303	-75	-15	-10	304	-75	-15	-10	305	-67	-8	-17
307	-42	-74	-3	308	-31	-39	3	309	-22	-44	-2	310	-15	-30	2	311	-8	-8	-17

Figure D12. (Sheet 4 of 5)

SHEAR STRESSES FOR LOAD CASE 12 (PSI)

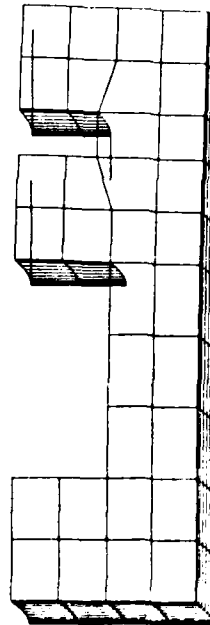
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320	-10	63	0	323	-4	-13	-3	335	-2	-5	-1	336	-1	-2	-1
321	-3	86	-3	324	-6	-13	-3	337	-2	-5	-1	338	-1	-2	-1
322	8	66	-3	325	-4	-13	-3	339	-2	-5	-1	339	-1	-2	-1
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				372	-6	-13	-3								
				373	-4	-13	-3								
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				381	-4	-13	-3								
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				383	-4	-13	-3								
				384	-6	-13	-3								

MIN. 268 -145
MAX. 280 176

Figure D12. (Sheet 5 of 5)

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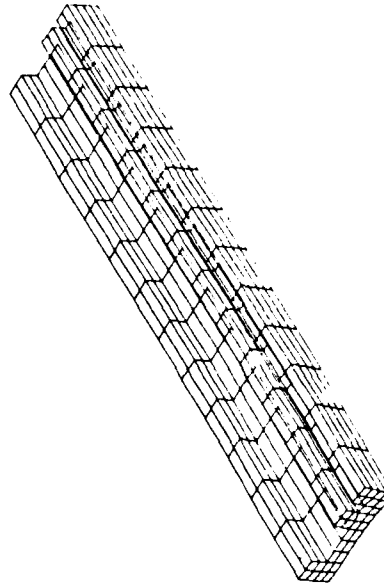
FINITE-ELEMENT ANALYSIS OF PROPOSED 'SHORT' STRUCTURE, AUG 82
UNIFORMED GRID
SHORT STRUCTURE 100 NODES, 394 ELEMENTS



FINITE-ELEMENT ANALYSIS OF PROPOSED 'SHORT' STRUCTURE, AUG 82
LOAD CASE NO-13
SHORT STRUCTURE 100 NODES, 394 ELEMENTS



FINITE-ELEMENT ANALYSIS OF PROPOSED 'SHORT' STRUCTURE, AUG 82
LOAD CASE NO-13



FINITE-ELEMENT ANALYSIS OF PROPOSED 'SHORT' STRUCTURE, AUG 82
LOAD CASE NO-13

Figure D13. Finite element analysis for load case 13 with $K = 175 \text{ lb/in.}^3$ (Sheet 1 of 5)

NORMAL STRESSES FOR LOAD CASE 13 (PSI)

ELEM	SX	SY	SZ	ELEM	SX	SY	SZ	ELEM	SX	SY	SZ	ELEM	SX	SY	SZ	ELEM	SX	SY	SZ	ELEM	SX	SY	SZ
1	0	-14	0	5	0	-12	0	9	0	-9	0	10	0	-10	0	11	0	-11	0	12	0	-12	0
2	0	-22	0	10	0	-19	0	15	0	-15	0	16	0	-16	0	-19	0	-19	0	17	0	-17	0
3	0	-26	0	15	0	-21	0	21	0	-21	0	22	0	-22	0	-18	0	-18	0	23	0	-23	0
4	0	-35	0	20	0	-28	0	27	0	-28	0	28	0	-28	0	-13	0	-13	0	29	0	-29	0
5	0	-44	0	25	0	-35	0	33	0	-35	0	34	0	-35	0	-8	0	-8	0	35	0	-35	0
6	0	-53	0	30	0	-42	0	39	0	-42	0	40	0	-42	0	-7	0	-7	0	41	0	-41	0
7	0	-62	0	35	0	-49	0	45	0	-49	0	46	0	-49	0	-6	0	-6	0	47	0	-47	0
8	0	-71	0	40	0	-56	0	51	0	-56	0	52	0	-56	0	-5	0	-5	0	48	0	-48	0
9	0	-80	0	45	0	-63	0	57	0	-63	0	58	0	-63	0	-4	0	-4	0	49	0	-49	0
10	0	-89	0	50	0	-70	0	62	0	-70	0	63	0	-70	0	-3	0	-3	0	51	0	-51	0
11	0	-98	0	55	0	-77	0	67	0	-77	0	68	0	-77	0	-2	0	-2	0	52	0	-52	0
12	0	-107	0	60	0	-84	0	72	0	-84	0	73	0	-84	0	-1	0	-1	0	53	0	-53	0
13	0	-116	0	65	0	-91	0	77	0	-91	0	78	0	-91	0	0	0	0	0	54	0	-54	0
14	0	-125	0	70	0	-98	0	82	0	-98	0	83	0	-98	0	0	0	0	0	55	0	-55	0
15	0	-134	0	75	0	-105	0	87	0	-105	0	88	0	-105	0	0	0	0	0	56	0	-56	0
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25	0	-224	0	125	0	-175	0	137	0	-175	0	138	0	-175	0	0	0	0	0	66	0	-66	0
26	0	-233	0	130	0	-182	0	142	0	-182	0	143	0	-182	0	0	0	0	0	67	0	-67	0
27	0	-242	0	135	0	-189	0	147	0	-189	0	148	0	-189	0	0	0	0	0	68	0	-68	0
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32	0	-287	0	160	0	-224	0	172	0	-224	0	173	0	-224	0	0	0	0	0	73	0	-73	0
33	0	-296	0	165	0	-231	0	177	0	-231	0	178	0	-231	0	0	0	0	0	74	0	-74	0
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36	0	-323	0	180	0	-252	0	192	0	-252	0	193	0	-252	0	0	0	0	0	77	0	-77	0
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38	0	-341	0	190	0	-266	0	202	0	-266	0	203	0	-266	0	0	0	0	0	79	0	-79	0
39	0	-350	0	195	0	-273	0	207	0	-273	0	208	0	-273	0	0	0	0	0	80	0	-80	0
40	0	-359	0	200	0	-280	0	212	0	-280	0	213	0	-280	0	0	0	0	0	81	0	-81	0
41	0	-368	0	205	0	-287	0	217	0	-287	0	218	0	-287	0	0	0	0	0	82	0	-82	0
42	0	-377	0	210	0	-294	0	222	0	-294	0	223	0	-294	0	0	0	0	0	83	0	-83	0
43	0	-386	0	215	0	-301	0	227	0	-301	0	228	0	-301	0	0	0	0	0	84	0	-84	0
44	0	-395	0	220	0	-308	0	232	0	-308	0	233	0	-308	0	0	0	0	0	85	0	-85	0
45	0	-404	0	225	0	-315	0	237	0	-315	0	238	0	-315	0	0	0	0	0	86	0	-86	0
46	0	-413	0	230	0	-322	0	242	0	-322	0	243	0	-322	0	0	0	0	0	87	0	-87	0
47	0	-422	0	235	0	-329	0	247	0	-329	0	248	0	-329	0	0	0	0	0	88	0	-88	0
48	0	-431	0	240	0	-336	0	252	0	-336	0	253	0	-336	0	0	0	0	0	89	0	-89	0
49	0	-440	0	245	0	-343	0	257	0	-343	0	258	0	-343	0	0	0	0	0	90	0	-90	0
50	0	-449	0	250	0	-350	0	262	0	-350	0	263	0	-350	0	0	0	0	0	91	0	-91	0
51	0	-458	0	255	0	-357	0	267	0	-357	0	268	0	-357	0	0	0	0	0	92	0	-92	0
52	0	-467	0	260	0	-364	0	272	0	-364	0	273	0	-364	0	0	0	0	0	93	0	-93	0
53	0	-476	0	265	0	-371	0	277	0	-371	0	278	0	-371	0	0	0	0	0	94	0	-94	0
54	0	-485	0	270	0	-378	0	282	0	-378	0	283	0	-378	0	0	0	0	0	95	0	-95	0
55	0	-494	0	275	0	-385	0	287	0	-385	0	288	0	-385	0	0	0	0	0	96	0	-96	0
56	0	-503	0	280	0	-392	0	292	0	-392	0	293	0	-392	0	0	0	0	0	97	0	-97	0
57	0	-512	0	285	0	-399	0	297	0	-399	0	298	0	-399	0	0	0	0	0	98	0	-98	0
58	0	-521	0	290	0	-406	0	302	0	-406	0	303	0	-406	0	0	0	0	0	99	0	-99	0
59	0	-530	0	295	0	-413	0	307	0	-413	0	308	0	-413	0	0	0	0	0	100	0	-100	0
60	0	-539	0	300	0	-420	0	312	0	-420	0	313	0	-420	0	0	0	0	0	101	0	-101	0
61	0	-548	0	305	0	-427	0	317	0	-427	0	318	0	-427	0	0	0	0	0	102	0	-102	0
62	0	-557	0	310	0	-434	0	322	0	-434	0	323	0	-434	0	0	0	0	0	103	0	-103	0
63	0	-566	0	315	0	-441	0	327	0	-441	0	328	0	-441	0	0	0	0	0	104	0	-104	0
64	0	-575	0	320	0	-448	0	332	0	-448	0	333	0	-448	0	0	0	0	0	105	0	-105	0
65	0	-584	0	325	0	-455	0	337	0	-455	0	338	0	-455	0	0	0	0	0	106	0	-106	0
66	0	-593	0	330	0	-462	0	342	0	-462	0	343	0	-462	0	0	0	0	0	107	0	-107	0
67	0	-602	0	335	0	-469	0	347	0	-469	0	348	0	-469	0	0	0	0	0	108	0	-108	0
68	0	-611	0	340	0	-476	0	352	0	-476	0	353	0	-476	0	0	0	0	0	109	0	-109	0
69	0	-620	0	345	0	-483	0	357	0	-483	0	358	0	-483	0	0	0	0	0	110	0	-110	0
70	0	-629	0	350	0	-490	0	362	0	-490	0	363	0	-490	0	0	0	0	0	111	0	-111	0
71	0	-638	0	355	0	-497	0	367	0	-497	0	368	0	-497	0	0	0	0	0	112	0	-112	0
72	0	-647	0	360	0	-504	0	372	0	-504	0	373	0	-504	0	0	0	0	0	113	0	-113	0
73	0	-656	0	365	0	-511	0	377	0	-511	0	378	0	-511	0	0	0	0	0	114	0	-114	0
74	0	-665	0	370	0	-518	0	382	0	-518	0	383	0	-518	0								

NORMAL STRESSES FOR LOAD CASE 13 (PSI)																	
ELEM	SX	SY	SZ	ELEM	SX	SY	SZ	ELEM	SX	SY	SZ	ELEM	SX	SY	SZ	ELEM	SX
313	3	20	3	315	2	13	4	316	1	7	-2	317	0	1	-1	318	0
319	0	-6	-1	321	0	-9	-1	322	0	-10	-1	323	0	-11	-1	324	0
325	-8	12	-1	327	-7	8	-1	328	-3	-7	-2	329	-2	3	-2	330	-2
331	-1	-4	-2	333	-1	-7	-2	334	-1	-10	-2	335	-1	-11	-2	336	-1
337	-1	34	-1	339	-2	22	-2	340	1	-5	-1	341	0	-4	0	342	0
343	0	-12	0	345	0	-14	0	346	0	-13	0	347	0	-13	0	348	0
349	2	-28	-6	351	2	-19	-5	352	0	6	-2	353	0	-2	-1	354	0
355	0	-20	-1	357	0	-13	-1	358	0	-13	-1	359	0	-13	-1	360	0
361	0	24	-5	363	0	-16	-5	364	0	17	-2	365	0	0	-2	366	0
367	0	-8	-2	369	-3	-12	-2	370	-2	-13	-2	371	-1	-14	-2	372	-1
373	-3	19	-3	375	-3	-13	-2	376	-2	-13	-2	377	-1	-14	-2	378	-1
379	-1	-6	-2	381	0	-11	-2	382	0	-13	-2	383	0	-14	-2	384	0

ELEM	SX	SY	SZ	ELEM	SX	SY	SZ
157	-15	37	-36	183	-6	10	-6
145	25	337	34				

Figure D13. (Sheet 3 of 5)

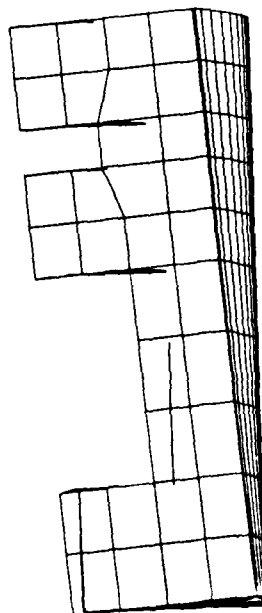
SHEAR STRESSES FOR LOAD CASE 13 (PSI)

ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX
1	0	0	0	101	-1	-1	0	102	-1	-1	0	103	-1	-1	0	104	-1	-1	0	105	-1	-1	0
2	0	0	0	106	-1	-1	0	107	-1	-1	0	108	-1	-1	0	109	-1	-1	0	110	-1	-1	0
3	0	0	0	111	-1	-1	0	112	-1	-1	0	113	-1	-1	0	114	-1	-1	0	115	-1	-1	0
4	0	0	0	116	-1	-1	0	117	-1	-1	0	118	-1	-1	0	119	-1	-1	0	120	-1	-1	0
5	0	0	0	121	-1	-1	0	122	-1	-1	0	123	-1	-1	0	124	-1	-1	0	125	-1	-1	0
6	0	0	0	126	-1	-1	0	127	-1	-1	0	128	-1	-1	0	129	-1	-1	0	130	-1	-1	0
7	0	0	0	131	-1	-1	0	132	-1	-1	0	133	-1	-1	0	134	-1	-1	0	135	-1	-1	0
8	0	0	0	136	-1	-1	0	137	-1	-1	0	138	-1	-1	0	139	-1	-1	0	140	-1	-1	0
9	0	0	0	141	-1	-1	0	142	-1	-1	0	143	-1	-1	0	144	-1	-1	0	145	-1	-1	0
10	0	0	0	146	-1	-1	0	147	-1	-1	0	148	-1	-1	0	149	-1	-1	0	150	-1	-1	0
11	0	0	0	151	-1	-1	0	152	-1	-1	0	153	-1	-1	0	154	-1	-1	0	155	-1	-1	0
12	0	0	0	156	-1	-1	0	157	-1	-1	0	158	-1	-1	0	159	-1	-1	0	160	-1	-1	0
13	0	0	0	161	-1	-1	0	162	-1	-1	0	163	-1	-1	0	164	-1	-1	0	165	-1	-1	0
14	0	0	0	166	-1	-1	0	167	-1	-1	0	168	-1	-1	0	169	-1	-1	0	170	-1	-1	0
15	0	0	0	171	-1	-1	0	172	-1	-1	0	173	-1	-1	0	174	-1	-1	0	175	-1	-1	0
16	0	0	0	176	-1	-1	0	177	-1	-1	0	178	-1	-1	0	179	-1	-1	0	180	-1	-1	0
17	0	0	0	181	-1	-1	0	182	-1	-1	0	183	-1	-1	0	184	-1	-1	0	185	-1	-1	0
18	0	0	0	186	-1	-1	0	187	-1	-1	0	188	-1	-1	0	189	-1	-1	0	190	-1	-1	0
19	0	0	0	191	-1	-1	0	192	-1	-1	0	193	-1	-1	0	194	-1	-1	0	195	-1	-1	0
20	0	0	0	196	-1	-1	0	197	-1	-1	0	198	-1	-1	0	199	-1	-1	0	200	-1	-1	0
21	0	0	0	201	-1	-1	0	202	-1	-1	0	203	-1	-1	0	204	-1	-1	0	205	-1	-1	0
22	0	0	0	206	-1	-1	0	207	-1	-1	0	208	-1	-1	0	209	-1	-1	0	210	-1	-1	0
23	0	0	0	211	-1	-1	0	212	-1	-1	0	213	-1	-1	0	214	-1	-1	0	215	-1	-1	0
24	0	0	0	216	-1	-1	0	217	-1	-1	0	218	-1	-1	0	219	-1	-1	0	220	-1	-1	0
25	0	0	0	221	-1	-1	0	222	-1	-1	0	223	-1	-1	0	224	-1	-1	0	225	-1	-1	0
26	0	0	0	226	-1	-1	0	227	-1	-1	0	228	-1	-1	0	229	-1	-1	0	230	-1	-1	0
27	0	0	0	231	-1	-1	0	232	-1	-1	0	233	-1	-1	0	234	-1	-1	0	235	-1	-1	0
28	0	0	0	236	-1	-1	0	237	-1	-1	0	238	-1	-1	0	239	-1	-1	0	240	-1	-1	0
29	0	0	0	241	-1	-1	0	242	-1	-1	0	243	-1	-1	0	244	-1	-1	0	245	-1	-1	0
30	0	0	0	246	-1	-1	0	247	-1	-1	0	248	-1	-1	0	249	-1	-1	0	250	-1	-1	0
31	0	0	0	251	-1	-1	0	252	-1	-1	0	253	-1	-1	0	254	-1	-1	0	255	-1	-1	0
32	0	0	0	256	-1	-1	0	257	-1	-1	0	258	-1	-1	0	259	-1	-1	0	260	-1	-1	0
33	0	0	0	261	-1	-1	0	262	-1	-1	0	263	-1	-1	0	264	-1	-1	0	265	-1	-1	0
34	0	0	0	266	-1	-1	0	267	-1	-1	0	268	-1	-1	0	269	-1	-1	0	270	-1	-1	0
35	0	0	0	271	-1	-1	0	272	-1	-1	0	273	-1	-1	0	274	-1	-1	0	275	-1	-1	0
36	0	0	0	276	-1	-1	0	277	-1	-1	0	278	-1	-1	0	279	-1	-1	0	280	-1	-1	0
37	0	0	0	281	-1	-1	0	282	-1	-1	0	283	-1	-1	0	284	-1	-1	0	285	-1	-1	0
38	0	0	0	286	-1	-1	0	287	-1	-1	0	288	-1	-1	0	289	-1	-1	0	290	-1	-1	0
39	0	0	0	291	-1	-1	0	292	-1	-1	0	293	-1	-1	0	294	-1	-1	0	295	-1	-1	0
40	0	0	0	296	-1	-1	0	297	-1	-1	0	298	-1	-1	0	299	-1	-1	0	300	-1	-1	0
41	0	0	0	301	-1	-1	0	302	-1	-1	0	303	-1	-1	0	304	-1	-1	0	305	-1	-1	0
42	0	0	0	306	-1	-1	0	307	-1	-1	0	308	-1	-1	0	309	-1	-1	0	310	-1	-1	0
43	0	0	0	311	-1	-1	0	312	-1	-1	0	313	-1	-1	0	314	-1	-1	0	315	-1	-1	0
44	0	0	0	316	-1	-1	0	317	-1	-1	0	318	-1	-1	0	319	-1	-1	0	320	-1	-1	0
45	0	0	0	321	-1	-1	0	322	-1	-1	0	323	-1	-1	0	324	-1	-1	0	325	-1	-1	0
46	0	0	0	326	-1	-1	0	327	-1	-1	0	328	-1	-1	0	329	-1	-1	0	330	-1	-1	0
47	0	0	0	331	-1	-1	0	332	-1	-1	0	333	-1	-1	0	334	-1	-1	0	335	-1	-1	0
48	0	0	0	336	-1	-1	0	337	-1	-1	0	338	-1	-1	0	339	-1	-1	0	340	-1	-1	0
49	0	0	0	341	-1	-1	0	342	-1	-1	0	343	-1	-1	0	344	-1	-1	0	345	-1	-1	0
50	0	0	0	346	-1	-1	0	347	-1	-1	0	348	-1	-1	0	349	-1	-1	0	350	-1	-1	0
51	0	0	0	351	-1	-1	0	352	-1	-1	0	353	-1	-1	0	354	-1	-1	0	355	-1	-1	0
52	0	0	0	356	-1	-1	0	357	-1	-1	0	358	-1	-1	0	359	-1	-1	0	360	-1	-1	0
53	0	0	0	361	-1	-1	0	362	-1	-1	0	363	-1	-1	0	364	-1	-1	0	365	-1	-1	0
54	0	0	0	366	-1	-1	0	367	-1	-1	0	368	-1	-1	0	369	-1	-1	0	370	-1	-1	0
55	0	0	0	371	-1	-1	0	372	-1	-1	0	373	-1	-1	0	374	-1	-1	0	375	-1	-1	0
56	0	0	0	376	-1	-1	0	377	-1	-1	0	378	-1	-1	0	379	-1	-1	0	380	-1	-1	0
57	0	0	0	381	-1	-1	0	382	-1	-1	0	383	-1	-1	0	384	-1	-1	0	385	-1	-1	0
58	0	0	0	386	-1	-1	0	387	-1	-1	0	388	-1	-1	0	389	-1	-1	0	390	-1	-1	0
59	0	0	0	391	-1	-1	0	392	-1	-1	0	393	-1	-1	0	394	-1	-1	0	395	-1	-1	0
60	0	0	0	396	-1	-1	0	397	-1	-1	0	398	-1	-1	0	399	-1	-1	0	400	-1	-1	0
61	0	0	0	401	-1	-1	0	402	-1	-1	0	403	-1	-1	0	404	-1	-1	0	405	-1	-1	0
62	0	0	0	406	-1	-1	0	407	-1	-1	0	408	-1	-1	0	409	-1	-1	0	410	-1	-1	0
63	0	0	0	411	-1	-1	0	412	-1	-1	0	413	-1	-1	0	414	-1	-1	0	415	-1	-1	0
64	0	0	0	416	-1	-1	0	417	-1	-1	0	418	-1	-1	0	419	-1	-1	0	420	-1	-1	0
65	0	0	0	421	-1	-1	0	422	-1	-1	0	423	-1	-1	0	424	-1	-1	0	425	-1	-1	0
66	0	0	0	426	-1	-1	0	427	-1	-1	0	428	-1	-1	0	429	-1	-1	0	430	-1	-1	0
67	0	0	0	431	-1	-1	0	432	-1	-1	0	433	-1	-1	0	434	-1	-1	0	435	-1	-1	0
68	0	0	0	436	-1	-1	0	437	-1	-1	0	438	-1	-1	0	439	-1	-1	0	440	-1	-1	0
69	0	0	0	441	-1	-1	0	442	-1	-1	0	443	-1	-1	0	444	-1	-1	0	445	-1	-1	0
70	0	0	0	446	-1	-1	0	447	-1	-1	0	448	-1	-1	0	449	-1	-1	0	450	-1	-1	0
71	0	0	0	451	-1	-1	0	452	-1	-1	0	453	-1	-1	0	454	-1	-1	0	455	-1	-1	0
72	0	0	0	456	-1	-1	0	457	-1	-1	0	458	-1	-1	0	459	-1	-1	0	460	-1	-1	0
73	0	0	0	461	-1	-1	0	462	-1	-1	0	463	-1	-1	0	464	-1	-1	0	465	-1	-1	0
74	0	0	0	466	-1	-1	0	467	-1	-1	0	468	-1	-1	0	469	-1	-1	0	470	-1	-1	0
75	0	0	0	471	-1	-1	0	472	-1	-1	0	473	-1	-1	0	474	-1	-1	0	475	-1	-1	0
76	0	0	0	476	-1	-1	0	477	-1	-1	0	478	-1	-1	0	479	-1	-1	0	480	-1	-1	0

SHEAR STRESSES FOR LOAD CASE 13 (PSI)											
ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX
313	-2	-2	-3	314	-1	0	-3	315	-5	-5	-2
319	-1	0	0	320	-1	0	0	321	0	0	0
325	0	-1	-2	326	0	0	-2	327	1	-2	-2
331	0	0	0	332	0	0	0	333	0	0	0
337	-9	1	3	338	7	-1	3	339	-1	2	4
343	-1	1	0	344	-1	1	0	345	-4	1	0
349	-3	1	0	350	2	0	1	351	-4	1	0
355	0	1	-3	356	0	1	-3	357	0	2	0
361	-1	0	0	362	0	0	0	363	-2	1	-2
367	0	1	0	368	0	0	0	369	0	1	0
373	0	0	-2	374	0	0	-2	375	1	1	1
379	0	1	0	380	0	0	0	381	0	0	0

1/1.0	1/4.0	1/16.0	1/217.0	1/200.0	1/237.0
1/1.0	1/6.0	1/18.0	1/220.0	1/201.0	1/243.0
1/2.0	1/3.0	1/13.0	1/165.0	1/255.0	1/261.0
1/3.0	1/2.0	1/10.0	1/132.0	1/264.0	1/272.0
1/4.0	1/1.5	1/8.0	1/110.0	1/273.0	1/282.0
1/5.0	1/1.0	1/6.0	1/90.0	1/282.0	1/292.0
1/6.0	1/0.8	1/5.0	1/75.0	1/292.0	1/302.0
1/7.0	1/0.7	1/4.0	1/63.0	1/302.0	1/312.0
1/8.0	1/0.6	1/3.0	1/54.0	1/312.0	1/322.0
1/9.0	1/0.5	1/2.0	1/45.0	1/322.0	1/332.0
1/10.0	1/0.4	1/1.0	1/36.0	1/332.0	1/342.0
1/11.0	1/0.3	1/0.8	1/27.0	1/342.0	1/352.0
1/12.0	1/0.2	1/0.6	1/18.0	1/352.0	1/362.0
1/13.0	1/0.1	1/0.4	1/9.0	1/362.0	1/372.0
1/14.0	1/0.0	1/0.2	1/4.0	1/372.0	1/382.0
1/15.0	1/0.0	1/0.1	1/2.0	1/382.0	1/392.0
1/16.0	1/0.0	1/0.0	1/1.0	1/392.0	1/402.0
1/17.0	1/0.0	1/0.0	1/0.8	1/402.0	1/412.0
1/18.0	1/0.0	1/0.0	1/0.6	1/412.0	1/422.0
1/19.0	1/0.0	1/0.0	1/0.4	1/422.0	1/432.0
1/20.0	1/0.0	1/0.0	1/0.2	1/432.0	1/442.0
1/21.0	1/0.0	1/0.0	1/0.1	1/442.0	1/452.0
1/22.0	1/0.0	1/0.0	1/0.0	1/452.0	1/462.0
1/23.0	1/0.0	1/0.0	1/0.0	1/462.0	1/472.0
1/24.0	1/0.0	1/0.0	1/0.0	1/472.0	1/482.0
1/25.0	1/0.0	1/0.0	1/0.0	1/482.0	1/492.0
1/26.0	1/0.0	1/0.0	1/0.0	1/492.0	1/502.0
1/27.0	1/0.0	1/0.0	1/0.0	1/502.0	1/512.0
1/28.0	1/0.0	1/0.0	1/0.0	1/512.0	1/522.0
1/29.0	1/0.0	1/0.0	1/0.0	1/522.0	1/532.0
1/30.0	1/0.0	1/0.0	1/0.0	1/532.0	1/542.0
1/31.0	1/0.0	1/0.0	1/0.0	1/542.0	1/552.0
1/32.0	1/0.0	1/0.0	1/0.0	1/552.0	1/562.0
1/33.0	1/0.0	1/0.0	1/0.0	1/562.0	1/572.0
1/34.0	1/0.0	1/0.0	1/0.0	1/572.0	1/582.0
1/35.0	1/0.0	1/0.0	1/0.0	1/582.0	1/592.0
1/36.0	1/0.0	1/0.0	1/0.0	1/592.0	1/602.0
1/37.0	1/0.0	1/0.0	1/0.0	1/602.0	1/612.0
1/38.0	1/0.0	1/0.0	1/0.0	1/612.0	1/622.0
1/39.0	1/0.0	1/0.0	1/0.0	1/622.0	1/632.0
1/40.0	1/0.0	1/0.0	1/0.0	1/632.0	1/642.0
1/41.0	1/0.0	1/0.0	1/0.0	1/642.0	1/652.0
1/42.0	1/0.0	1/0.0	1/0.0	1/652.0	1/662.0
1/43.0	1/0.0	1/0.0	1/0.0	1/662.0	1/672.0
1/44.0	1/0.0	1/0.0	1/0.0	1/672.0	1/682.0
1/45.0	1/0.0	1/0.0	1/0.0	1/682.0	1/692.0
1/46.0	1/0.0	1/0.0	1/0.0	1/692.0	1/702.0
1/47.0	1/0.0	1/0.0	1/0.0	1/702.0	1/712.0
1/48.0	1/0.0	1/0.0	1/0.0	1/712.0	1/722.0
1/49.0	1/0.0	1/0.0	1/0.0	1/722.0	1/732.0
1/50.0	1/0.0	1/0.0	1/0.0	1/732.0	1/742.0
1/51.0	1/0.0	1/0.0	1/0.0	1/742.0	1/752.0
1/52.0	1/0.0	1/0.0	1/0.0	1/752.0	1/762.0
1/53.0	1/0.0	1/0.0	1/0.0	1/762.0	1/772.0
1/54.0	1/0.0	1/0.0	1/0.0	1/772.0	1/782.0
1/55.0	1/0.0	1/0.0	1/0.0	1/782.0	1/792.0
1/56.0	1/0.0	1/0.0	1/0.0	1/792.0	1/802.0
1/57.0	1/0.0	1/0.0	1/0.0	1/802.0	1/812.0
1/58.0	1/0.0	1/0.0	1/0.0	1/812.0	1/822.0
1/59.0	1/0.0	1/0.0	1/0.0	1/822.0	1/832.0
1/60.0	1/0.0	1/0.0	1/0.0	1/832.0	1/842.0
1/61.0	1/0.0	1/0.0	1/0.0	1/842.0	1/852.0
1/62.0	1/0.0	1/0.0	1/0.0	1/852.0	1/862.0
1/63.0	1/0.0	1/0.0	1/0.0	1/862.0	1/872.0
1/64.0	1/0.0	1/0.0	1/0.0	1/872.0	1/882.0
1/65.0	1/0.0	1/0.0	1/0.0	1/882.0	1/892.0
1/66.0	1/0.0	1/0.0	1/0.0	1/892.0	1/902.0
1/67.0	1/0.0	1/0.0	1/0.0	1/902.0	1/912.0
1/68.0	1/0.0	1/0.0	1/0.0	1/912.0	1/922.0
1/69.0	1/0.0	1/0.0	1/0.0	1/922.0	1/932.0
1/70.0	1/0.0	1/0.0	1/0.0	1/932.0	1/942.0
1/71.0	1/0.0	1/0.0	1/0.0	1/942.0	1/952.0
1/72.0	1/0.0	1/0.0	1/0.0	1/952.0	1/962.0
1/73.0	1/0.0	1/0.0	1/0.0	1/962.0	1/972.0
1/74.0	1/0.0	1/0.0	1/0.0	1/972.0	1/982.0
1/75.0	1/0.0	1/0.0	1/0.0	1/982.0	1/992.0
1/76.0	1/0.0	1/0.0	1/0.0	1/992.0	1/1000.0

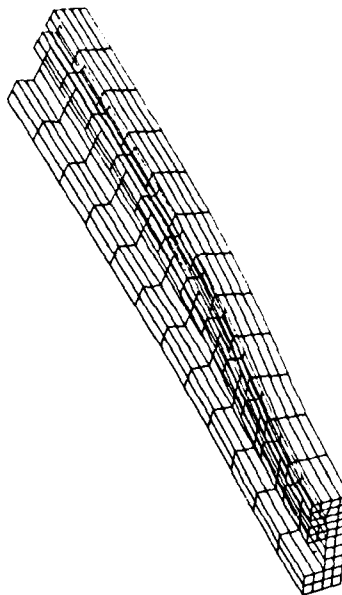
FINITE-ELEMENT ANALYSIS OF PROPOSED 'SHORT' STRUCTURE, AUG 82
UNIFORMED GRID
SHORT STRUCTURE/200 5000.000 ELEMENTS



FINITE-ELEMENT ANALYSIS OF PROPOSED 'SHORT' STRUCTURE, AUG 82
LOAD CASE NO-14
SHORT STRUCTURE/200 5000.000 ELEMENTS



FINITE-ELEMENT ANALYSIS OF PROPOSED 'SHORT' STRUCTURE, AUG 82
LOAD CASE NO-14



FINITE-ELEMENT ANALYSIS OF PROPOSED 'SHORT' STRUCTURE, AUG 82
LOAD CASE NO-14

Figure D14. Finite-element analysis for load case 14 with $K = 175 \text{ lb/in.}^3$ (Sheet 1 of 5)

NORMAL STRESSES FOR LOAD CASE 14 (PSI)

SZ	1	0	2	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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Figure D14. (Sheet 2 of 5)

NORMAL STRESSES FOR LOAD CASE 14 (PSI)

ELEM	SX	SY	SZ	ELEM	SX	SY	SZ	ELEM	SX	SY	SZ	ELEM	SX	SY	SZ
313	3	10	14	315	2	8	14	317	-1	6	0	319	0	2	0
319	0	-1	-1	321	-11	-6	-2	323	0	-9	-2	325	0	-9	-2
325	-14	-41	-7	327	0	-21	-5	329	0	27	1	331	1	26	0
331	1	20	-1	333	33	5	-2	335	0	-5	-2	337	0	-7	-2
337	1	56	9	339	2	56	13	341	0	-1	-3	343	0	-40	0
343	0	-39	0	345	0	-27	0	347	0	-17	0	349	0	-15	0
349	2	-49	1	351	1	29	4	353	0	-11	-1	355	0	-13	0
355	0	-19	1	357	0	-17	-1	359	0	-14	-1	361	0	15	-1
361	0	6	2	363	0	5	3	365	0	-10	-2	367	0	-11	-1
367	0	1	0	369	-5	-18	-4	371	0	28	-2	373	0	-26	-2
373	-5	-38	-1	375	0	3	-2	377	0	-7	-2	379	0	-8	-2
379	0	19	-1	381	0	0	0	383	0	0	0				

MIN.	ELEM	SX	ELEM	SY	ELEM	SZ
205	205	-22	37	-44	292	-7 (COMPRESSIVE)
MAX.	145	25	289	101	291	31 (TENSILE)

Figure D14. (Sheet 3 of 5)

SHEAR STRESSES FOR LOAD CASE 14 (PSI)											
ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX
1	8	1	0	101	11	1	0	201	11	1	0
2	16	1	0	102	12	1	0	202	12	1	0
3	15	1	0	103	13	1	0	203	13	1	0
4	15	1	0	104	14	1	0	204	14	1	0
5	15	1	0	105	15	1	0	205	15	1	0
6	15	1	0	106	16	1	0	206	16	1	0
7	15	1	0	107	17	1	0	207	17	1	0
8	15	1	0	108	18	1	0	208	18	1	0
9	15	1	0	109	19	1	0	209	19	1	0
10	15	1	0	110	20	1	0	210	20	1	0
11	15	1	0	111	21	1	0	211	21	1	0
12	15	1	0	112	22	1	0	212	22	1	0
13	15	1	0	113	23	1	0	213	23	1	0
14	15	1	0	114	24	1	0	214	24	1	0
15	15	1	0	115	25	1	0	215	25	1	0
16	15	1	0	116	26	1	0	216	26	1	0
17	15	1	0	117	27	1	0	217	27	1	0
18	15	1	0	118	28	1	0	218	28	1	0
19	15	1	0	119	29	1	0	219	29	1	0
20	15	1	0	120	30	1	0	220	30	1	0
21	15	1	0	121	31	1	0	221	31	1	0
22	15	1	0	122	32	1	0	222	32	1	0
23	15	1	0	123	33	1	0	223	33	1	0
24	15	1	0	124	34	1	0	224	34	1	0
25	15	1	0	125	35	1	0	225	35	1	0
26	15	1	0	126	36	1	0	226	36	1	0
27	15	1	0	127	37	1	0	227	37	1	0
28	15	1	0	128	38	1	0	228	38	1	0
29	15	1	0	129	39	1	0	229	39	1	0
30	15	1	0	130	40	1	0	230	40	1	0
31	15	1	0	131	41	1	0	231	41	1	0
32	15	1	0	132	42	1	0	232	42	1	0
33	15	1	0	133	43	1	0	233	43	1	0
34	15	1	0	134	44	1	0	234	44	1	0
35	15	1	0	135	45	1	0	235	45	1	0
36	15	1	0	136	46	1	0	236	46	1	0
37	15	1	0	137	47	1	0	237	47	1	0
38	15	1	0	138	48	1	0	238	48	1	0
39	15	1	0	139	49	1	0	239	49	1	0
40	15	1	0	140	50	1	0	240	50	1	0
41	15	1	0	141	51	1	0	241	51	1	0
42	15	1	0	142	52	1	0	242	52	1	0
43	15	1	0	143	53	1	0	243	53	1	0
44	15	1	0	144	54	1	0	244	54	1	0
45	15	1	0	145	55	1	0	245	55	1	0
46	15	1	0	146	56	1	0	246	56	1	0
47	15	1	0	147	57	1	0	247	57	1	0
48	15	1	0	148	58	1	0	248	58	1	0
49	15	1	0	149	59	1	0	249	59	1	0
50	15	1	0	150	60	1	0	250	60	1	0
51	15	1	0	151	61	1	0	251	61	1	0
52	15	1	0	152	62	1	0	252	62	1	0
53	15	1	0	153	63	1	0	253	63	1	0
54	15	1	0	154	64	1	0	254	64	1	0
55	15	1	0	155	65	1	0	255	65	1	0
56	15	1	0	156	66	1	0	256	66	1	0
57	15	1	0	157	67	1	0	257	67	1	0
58	15	1	0	158	68	1	0	258	68	1	0
59	15	1	0	159	69	1	0	259	69	1	0
60	15	1	0	160	70	1	0	260	70	1	0
61	15	1	0	161	71	1	0	261	71	1	0
62	15	1	0	162	72	1	0	262	72	1	0
63	15	1	0	163	73	1	0	263	73	1	0
64	15	1	0	164	74	1	0	264	74	1	0
65	15	1	0	165	75	1	0	265	75	1	0
66	15	1	0	166	76	1	0	266	76	1	0
67	15	1	0	167	77	1	0	267	77	1	0
68	15	1	0	168	78	1	0	268	78	1	0
69	15	1	0	169	79	1	0	269	79	1	0
70	15	1	0	170	80	1	0	270	80	1	0
71	15	1	0	171	81	1	0	271	81	1	0
72	15	1	0	172	82	1	0	272	82	1	0
73	15	1	0	173	83	1	0	273	83	1	0
74	15	1	0	174	84	1	0	274	84	1	0
75	15	1	0	175	85	1	0	275	85	1	0
76	15	1	0	176	86	1	0	276	86	1	0
77	15	1	0	177	87	1	0	277	87	1	0
78	15	1	0	178	88	1	0	278	88	1	0
79	15	1	0	179	89	1	0	279	89	1	0
80	15	1	0	180	90	1	0	280	90	1	0
81	15	1	0	181	91	1	0	281	91	1	0
82	15	1	0	182	92	1	0	282	92	1	0
83	15	1	0	183	93	1	0	283	93	1	0
84	15	1	0	184	94	1	0	284	94	1	0
85	15	1	0	185	95	1	0	285	95	1	0
86	15	1	0	186	96	1	0	286	96	1	0
87	15	1	0	187	97	1	0	287	97	1	0
88	15	1	0	188	98	1	0	288	98	1	0
89	15	1	0	189	99	1	0	289	99	1	0
90	15	1	0	190	100	1	0	290	100	1	0
91	15	1	0	191	101	1	0	291	101	1	0
92	15	1	0	192	102	1	0	292	102	1	0
93	15	1	0	193	103	1	0	293	103	1	0
94	15	1	0	194	104	1	0	294	104	1	0
95	15	1	0	195	105	1	0	295	105	1	0
96	15	1	0	196	106	1	0	296	106	1	0
97	15	1	0	197	107	1	0	297	107	1	0
98	15	1	0	198	108	1	0	298	108	1	0
99	15	1	0	199	109	1	0	299	109	1	0
100	15	1	0	200	110	1	0	300	110	1	0
101	15	1	0	201	111	1	0	301	111	1	0
102	15	1	0	202	112	1	0	302	112	1	0
103	15	1	0	203	113	1	0	303	113	1	0
104	15	1	0	204	114	1	0	304	114	1	0
105	15	1	0	205	115	1	0	305	115	1	0
106	15	1	0	206	116	1	0	306	116	1	0
107	15	1	0	207	117	1	0	307	117	1	0
108	15	1	0	208	118	1	0	308	118	1	0
109	15	1	0	209	119	1	0	309	119	1	0
110	15	1	0	210	120	1	0	310	120	1	0
111	15	1	0	211	121	1	0	311	121	1	0
112	15	1	0	212	122	1	0	312	122	1	0
113	15	1	0	213	123	1	0				
114	15	1	0	214	124	1	0				
115	15	1	0	215	125	1	0				
116	15	1	0	216	126	1	0				
117	15	1	0	217	127	1	0				
118	15	1	0	218	128	1	0				
119	15	1	0	219	129	1	0				
120	15	1	0	220	130	1	0				
121	15	1	0	221	131	1	0				
122	15	1	0	222	132	1	0				
123	15	1	0	223	133	1	0				
124	15	1	0	224	134	1	0				
125	15	1	0	225	135	1	0				
126	15	1	0	226	136	1	0				
127	15	1	0	227	137	1	0				
128	15	1	0	228	138	1	0				
129	15	1	0	229	139	1	0				
130	15	1	0	230	140	1	0				
131	15	1	0	231	141	1	0				
132	15	1	0	232	142	1	0				
133	15	1	0	233	143	1	0				
134	15	1	0	234	144	1	0				
135	15	1	0	235	145	1	0				
136	15	1	0	236	146	1	0				
137	15	1	0	237	147	1	0				
138	15	1	0	238	148	1	0				
139	15	1	0	239	149	1	0				
140	15	1	0	240	150	1	0				
141	15	1	0	241	151	1	0				
142	15	1	0	242	152	1	0				
143	15	1	0	243	153	1	0				
144	15	1	0	244	154	1	0				
145	15	1	0	245	155	1	0				
146	15	1	0	246	156	1	0				

SHEAR STRESSES FOR LOAD CASE 14 (PSI)

ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX
313	-1	-11	-5	314	-1	5	-4	315	-4	-21	-3	316	-3	-11	-1	317	-1	-1	0
319	0	2	0	320	0	3	0	321	0	-17	-3	322	0	-10	0	323	0	-4	0
325	-6	-9	-4	326	-17	3	-4	327	-25	-17	-3	328	-28	-10	0	329	-25	-4	0
331	-15	0	0	332	-12	1	0	333	-7	1	0	334	-5	1	0	335	3	0	0
337	-6	-14	0	338	17	-3	0	339	3	-26	-1	340	13	-15	1	341	11	-13	0
343	7	-5	0	344	5	-3	0	345	4	-1	0	346	2	-1	0	347	1	0	0
349	-1	-15	-2	350	3	-9	-1	351	1	-38	-2	352	2	-31	0	353	2	-23	0
355	-1	-10	0	356	1	-6	0	357	1	-4	0	358	0	-2	0	359	0	-1	0
361	-1	-14	-5	362	-2	-11	-5	363	-1	-38	-4	364	-4	-32	0	365	-3	-23	0
367	-2	-11	0	368	-1	-7	0	369	-1	-4	0	370	-1	-2	0	371	0	-1	0
373	-5	-10	-3	374	-9	-3	-3	375	-13	-24	-2	376	-15	-18	0	377	-13	-13	0
379	-8	5	0	380	-6	-3	0	381	-4	-2	0	382	-3	-1	0	383	-1	-1	0
384																			

ELEM	VXY	ELEM	VYZ	ELEM	VZX
MIN.	208	363	361		
MAX.	290	21	181		15

Figure D14. (Sheet 5 of 5)

1/11.0	1/48.0			1/188.0	1/217.0	1/231.0
1/13.0	1/61.0			1/181.0	1/228.0	1/248.0
1/25.0	1/79.0	1/121.0	1/145.0	1/193.0	1/241.0	1/255.0
1/31.0	1/95.0	1/133.0	1/157.0	1/205.0	1/258.0	1/277.0
						1/282.0
						1/287.0
						1/292.0
						1/297.0
						1/302.0
						1/307.0
						1/312.0
						1/317.0
						1/322.0
						1/327.0
						1/332.0
						1/337.0
						1/342.0
						1/347.0
						1/352.0
						1/357.0
						1/362.0
						1/367.0
						1/372.0
						1/377.0
						1/382.0
						1/387.0
						1/392.0
						1/397.0
						1/402.0
						1/407.0
						1/412.0
						1/417.0
						1/422.0
						1/427.0
						1/432.0
						1/437.0
						1/442.0
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						1/597.0
						1/602.0
						1/607.0
						1/612.0
						1/617.0
						1/622.0
						1/627.0
						1/632.0
						1/637.0
						1/642.0
						1/647.0
						1/652.0
						1/657.0
						1/662.0
						1/667.0
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						1/677.0
						1/682.0
						1/687.0
						1/692.0
						1/697.0
						1/702.0
						1/707.0
						1/712.0
						1/717.0
						1/722.0
						1/727.0
						1/732.0
						1/737.0
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						1/747.0
						1/752.0
						1/757.0
						1/762.0
						1/767.0
						1/772.0
						1/777.0
						1/782.0
						1/787.0
						1/792.0
						1/797.0
						1/802.0
						1/807.0
						1/812.0
						1/817.0
						1/822.0
						1/827.0
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						1/1012.0
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						1/1667.0
						1/1672.0
						1/1677.0
						1/1682.0
						1/1687.0
						1/1692.0
	</					

NORMAL STRESSES FOR LOAD CASE 15 (PSI)

ELEM	SX	SY	SZ	ELEM	SX	SY	SZ	ELEM	SX	SY	SZ	ELEM	SX	SY	SZ	ELEM	SX	SY	SZ
313	5	41	8	314	6	37	8	315	4	27	9	316	1	14	-2	317	-1	-2	-1
319	0	-12	-1	320	0	-16	-1	321	0	-19	-1	322	0	-20	-1	323	0	-21	-2
325	-15	-25	1	326	-14	-22	1	327	-13	-17	0	328	-6	-14	-1	329	-4	-6	-2
331	-2	-7	-2	332	-2	-13	-2	333	-1	-17	-2	334	-1	-20	-2	335	-1	-22	-2
337	-3	69	-1	338	-2	60	-1	339	-4	44	1	340	1	9	0	341	0	-7	0
343	0	-25	-10	344	0	-27	-10	345	0	-27	0	346	0	-27	0	347	0	-6	0
349	4	58	-1	350	4	51	-1	351	4	38	-9	352	0	12	-3	353	0	-3	-1
355	0	-20	-1	356	0	-23	-1	357	0	-25	-1	358	0	-26	-1	359	0	-27	-1
361	1	47	-8	362	1	43	-8	363	1	32	-7	364	0	14	-2	365	-1	1	-2
367	0	-15	-2	368	0	-20	-2	369	0	-24	-2	370	0	-26	-2	371	0	-27	-2
373	-6	37	-3	374	-6	35	-3	375	-5	27	-3	376	-3	16	-2	377	-2	5	-2
379	-1	-11	-2	380	-1	-17	-2	381	-1	-22	-2	382	-1	-25	-2	383	0	-27	-2

MIN. ELEM SX ELEM SY ELEM SZ
 205 -28 337 -72 369 -10 (COMPRESSIVE)
 MAX. 145 46 183 22 (TENSILE)

Figure D15. (Sheet 3 of 5)

SHEAR STRESSES FOR LOAD CASE 15 (PSI)

ELEM	VXY	VZ	VZX	ELEM	VXY	VZ	VZX	ELEM	VXY	VZ	VZX	ELEM	VXY	VZ	VZX	ELEM	VXY	VZ	VZX
1	1	0	0	101	1	0	0	201	1	0	0	301	1	0	0	401	1	0	0
2	2	0	0	102	2	0	0	202	2	0	0	302	2	0	0	402	2	0	0
3	3	0	0	103	3	0	0	203	3	0	0	303	3	0	0	403	3	0	0
4	4	0	0	104	4	0	0	204	4	0	0	304	4	0	0	404	4	0	0
5	5	0	0	105	5	0	0	205	5	0	0	305	5	0	0	405	5	0	0
6	6	0	0	106	6	0	0	206	6	0	0	306	6	0	0	406	6	0	0
7	7	0	0	107	7	0	0	207	7	0	0	307	7	0	0	407	7	0	0
8	8	0	0	108	8	0	0	208	8	0	0	308	8	0	0	408	8	0	0
9	9	0	0	109	9	0	0	209	9	0	0	309	9	0	0	409	9	0	0
10	10	0	0	110	10	0	0	210	10	0	0	310	10	0	0	410	10	0	0
11	11	0	0	111	11	0	0	211	11	0	0	311	11	0	0	411	11	0	0
12	12	0	0	112	12	0	0	212	12	0	0	312	12	0	0	412	12	0	0
13	13	0	0	113	13	0	0	213	13	0	0	313	13	0	0	413	13	0	0
14	14	0	0	114	14	0	0	214	14	0	0	314	14	0	0	414	14	0	0
15	15	0	0	115	15	0	0	215	15	0	0	315	15	0	0	415	15	0	0
16	16	0	0	116	16	0	0	216	16	0	0	316	16	0	0	416	16	0	0
17	17	0	0	117	17	0	0	217	17	0	0	317	17	0	0	417	17	0	0
18	18	0	0	118	18	0	0	218	18	0	0	318	18	0	0	418	18	0	0
19	19	0	0	119	19	0	0	219	19	0	0	319	19	0	0	419	19	0	0
20	20	0	0	120	20	0	0	220	20	0	0	320	20	0	0	420	20	0	0
21	21	0	0	121	21	0	0	221	21	0	0	321	21	0	0	421	21	0	0
22	22	0	0	122	22	0	0	222	22	0	0	322	22	0	0	422	22	0	0
23	23	0	0	123	23	0	0	223	23	0	0	323	23	0	0	423	23	0	0
24	24	0	0	124	24	0	0	224	24	0	0	324	24	0	0	424	24	0	0
25	25	0	0	125	25	0	0	225	25	0	0	325	25	0	0	425	25	0	0
26	26	0	0	126	26	0	0	226	26	0	0	326	26	0	0	426	26	0	0
27	27	0	0	127	27	0	0	227	27	0	0	327	27	0	0	427	27	0	0
28	28	0	0	128	28	0	0	228	28	0	0	328	28	0	0	428	28	0	0
29	29	0	0	129	29	0	0	229	29	0	0	329	29	0	0	429	29	0	0
30	30	0	0	130	30	0	0	230	30	0	0	330	30	0	0	430	30	0	0
31	31	0	0	131	31	0	0	231	31	0	0	331	31	0	0	431	31	0	0
32	32	0	0	132	32	0	0	232	32	0	0	332	32	0	0	432	32	0	0
33	33	0	0	133	33	0	0	233	33	0	0	333	33	0	0	433	33	0	0
34	34	0	0	134	34	0	0	234	34	0	0	334	34	0	0	434	34	0	0
35	35	0	0	135	35	0	0	235	35	0	0	335	35	0	0	435	35	0	0
36	36	0	0	136	36	0	0	236	36	0	0	336	36	0	0	436	36	0	0
37	37	0	0	137	37	0	0	237	37	0	0	337	37	0	0	437	37	0	0
38	38	0	0	138	38	0	0	238	38	0	0	338	38	0	0	438	38	0	0
39	39	0	0	139	39	0	0	239	39	0	0	339	39	0	0	439	39	0	0
40	40	0	0	140	40	0	0	240	40	0	0	340	40	0	0	440	40	0	0
41	41	0	0	141	41	0	0	241	41	0	0	341	41	0	0	441	41	0	0
42	42	0	0	142	42	0	0	242	42	0	0	342	42	0	0	442	42	0	0
43	43	0	0	143	43	0	0	243	43	0	0	343	43	0	0	443	43	0	0
44	44	0	0	144	44	0	0	244	44	0	0	344	44	0	0	444	44	0	0
45	45	0	0	145	45	0	0	245	45	0	0	345	45	0	0	445	45	0	0
46	46	0	0	146	46	0	0	246	46	0	0	346	46	0	0	446	46	0	0
47	47	0	0	147	47	0	0	247	47	0	0	347	47	0	0	447	47	0	0
48	48	0	0	148	48	0	0	248	48	0	0	348	48	0	0	448	48	0	0
49	49	0	0	149	49	0	0	249	49	0	0	349	49	0	0	449	49	0	0
50	50	0	0	150	50	0	0	250	50	0	0	350	50	0	0	450	50	0	0
51	51	0	0	151	51	0	0	251	51	0	0	351	51	0	0	451	51	0	0
52	52	0	0	152	52	0	0	252	52	0	0	352	52	0	0	452	52	0	0
53	53	0	0	153	53	0	0	253	53	0	0	353	53	0	0	453	53	0	0
54	54	0	0	154	54	0	0	254	54	0	0	354	54	0	0	454	54	0	0
55	55	0	0	155	55	0	0	255	55	0	0	355	55	0	0	455	55	0	0
56	56	0	0	156	56	0	0	256	56	0	0	356	56	0	0	456	56	0	0
57	57	0	0	157	57	0	0	257	57	0	0	357	57	0	0	457	57	0	0
58	58	0	0	158	58	0	0	258	58	0	0	358	58	0	0	458	58	0	0
59	59	0	0	159	59	0	0	259	59	0	0	359	59	0	0	459	59	0	0
60	60	0	0	160	60	0	0	260	60	0	0	360	60	0	0	460	60	0	0
61	61	0	0	161	61	0	0	261	61	0	0	361	61	0	0	461	61	0	0
62	62	0	0	162	62	0	0	262	62	0	0	362	62	0	0	462	62	0	0
63	63	0	0	163	63	0	0	263	63	0	0	363	63	0	0	463	63	0	0
64	64	0	0	164	64	0	0	264	64	0	0	364	64	0	0	464	64	0	0
65	65	0	0	165	65	0	0	265	65	0	0	365	65	0	0	465	65	0	0
66	66	0	0	166	66	0	0	266	66	0	0	366	66	0	0	466	66	0	0
67	67	0	0	167	67	0	0	267	67	0	0	367	67	0	0	467	67	0	0
68	68	0	0	168	68	0	0	268	68	0	0	368	68	0	0	468	68	0	0
69	69	0	0	169	69	0	0	269	69	0	0	369	69	0	0	469	69	0	0
70	70	0	0	170	70	0	0	270	70	0	0	370	70	0	0	470	70	0	0
71	71	0	0	171	71	0	0	271	71	0	0	371	71	0	0	471	71	0	0
72	72	0	0	172	72	0	0	272	72	0	0	372	72	0	0	472	72	0	0
73	73	0	0	173	73	0	0	273	73	0	0	373	73	0	0	473	73	0	0
74	74	0	0	174	74	0	0	274	74	0	0	374	74	0	0	474	74	0	0
75	75	0	0	175	75	0	0	275	75	0	0	375	75	0	0	475	75	0	0
76	76	0	0	176	76	0	0	276	76	0	0	376	76	0	0	476	76	0	0
77	77	0	0	177	77	0	0	277	77	0	0	377	77	0	0	477	77	0	0
78	78	0	0	178	78	0	0	278	78	0	0	378	78	0	0	478	78	0	0
79	79	0	0	179	79	0	0	279	79	0	0	379	79	0	0	479	79	0	0
80	80	0	0	180	80	0	0	280	80	0	0	380	80	0	0	480	80	0	0
81	81	0	0	181	81	0	0	281	81	0	0	381	81	0	0	481	81	0	0
82	82	0	0	182	82	0	0	282	82	0	0	382	82	0	0	482	82	0	0
83	83	0	0	183	83	0	0	283	83	0	0	383	83	0	0	483	83	0	0
84	84	0	0	184	84	0	0	284	84	0	0	384	84	0	0	484	84	0	0
85	85	0	0	185	85	0	0	285	85	0	0	385	85	0	0	485	85	0	0
86	86	0	0	186	86	0	0	286	86	0	0	386	86	0	0	486	86	0	0
87	87	0	0	187	87	0	0	287	87	0	0	387	87	0	0	487	87	0	0
88	88	0	0	188	88	0	0	288	88	0	0	388	88	0	0	488	88	0	0

ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX
313	-3	-4	-6	316	-2	-1	-4	319	-2	1	-5	322	-1	-1	-4	325	-1	-1	-4	328	-1	-1	-4	331	-2	-1	-4	334	-3	-1	-4
319	-2	-1	-4	320	1	0	-4	321	1	0	-4	322	1	0	-4	323	1	0	-4	324	1	0	-4	325	1	0	-4	326	1	0	-4
325	-1	-1	-4	327	1	1	-4	328	1	1	-4	329	1	1	-4	330	1	1	-4	331	1	1	-4	332	1	1	-4	333	1	1	-4
331	-1	1	0	332	1	1	0	333	1	1	0	334	1	1	0	335	1	1	0	336	1	1	0	337	1	1	0	338	1	1	0
337	-1	1	0	338	1	1	0	339	1	1	0	340	1	1	0	341	1	1	0	342	1	1	0	343	1	1	0	344	1	1	0
343	-2	1	0	345	-2	1	0	346	-2	1	0	347	-2	1	0	348	-2	1	0	349	-2	1	0	350	-2	1	0	351	-2	1	0
349	-2	1	0	352	-2	1	0	353	-2	1	0	354	-2	1	0	355	-2	1	0	356	-2	1	0	357	-2	1	0	358	-2	1	0
355	-2	1	0	356	-2	1	0	357	-2	1	0	358	-2	1	0	359	-2	1	0	360	-2	1	0	361	-2	1	0	362	-2	1	0
361	-2	1	0	363	-2	1	0	364	-2	1	0	365	-2	1	0	366	-2	1	0	367	-2	1	0	368	-2	1	0	369	-2	1	0
367	-2	1	0	370	-2	1	0	371	-2	1	0	372	-2	1	0	373	-2	1	0	374	-2	1	0	375	-2	1	0	376	-2	1	0
373	-2	1	0	377	-2	1	0	378	-2	1	0	379	-2	1	0	380	-2	1	0	381	-2	1	0	382	-2	1	0	383	-2	1	0
379	-2	1	0	384	-2	1	0	385	-2	1	0	386	-2	1	0	387	-2	1	0	388	-2	1	0	389	-2	1	0	390	-2	1	0

MIN.	ELEM	VXY	ELEM	VYZ	ELEM	VZX
	148	-24	183	-24	313	-6
MAX.	290	15	170	8	181	18

Figure D15. (Sheet 5 of 5)

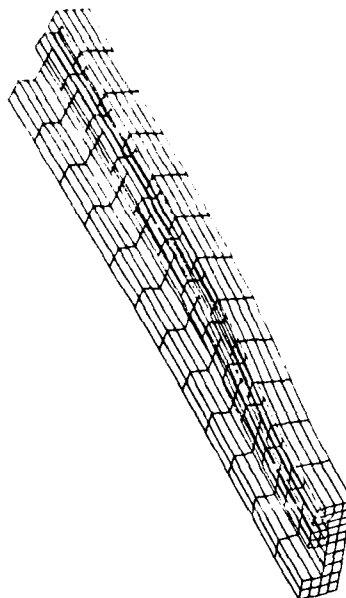
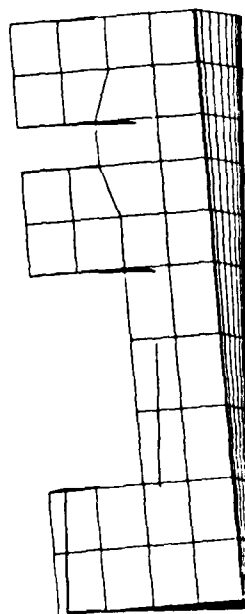
[illegible]

Figure D16. Finite-element analysis for load case 16 with $K = 175 \text{ lb/in.}^3$ (Sheet 1 of 5)

NORMAL STRESSES FOR LOAD CASE 16 (PSI)

ELEM	SX	SY	SZ	ELEM	SX	SY	SZ	ELEM	SX	SY	SZ	ELEM	SX	SY	SZ	ELEM	SX	SY	SZ	ELEM	SX	SY	SZ	ELEM	SX	SY	SZ	ELEM	SX	SY	SZ
1	0	0	0	101	0	0	0	102	0	0	0	103	0	0	0	104	0	0	0	105	0	0	0	106	0	0	0	107	0	0	0
2	0	0	0	108	0	0	0	109	0	0	0	110	0	0	0	111	0	0	0	112	0	0	0	113	0	0	0	114	0	0	0
3	0	0	0	115	0	0	0	116	0	0	0	117	0	0	0	118	0	0	0	119	0	0	0	120	0	0	0	121	0	0	0
4	0	0	0	122	0	0	0	123	0	0	0	124	0	0	0	125	0	0	0	126	0	0	0	127	0	0	0	128	0	0	0
5	0	0	0	129	0	0	0	130	0	0	0	131	0	0	0	132	0	0	0	133	0	0	0	134	0	0	0	135	0	0	0
6	0	0	0	136	0	0	0	137	0	0	0	138	0	0	0	139	0	0	0	140	0	0	0	141	0	0	0	142	0	0	0
7	0	0	0	143	0	0	0	144	0	0	0	145	0	0	0	146	0	0	0	147	0	0	0	148	0	0	0	149	0	0	0
8	0	0	0	150	0	0	0	151	0	0	0	152	0	0	0	153	0	0	0	154	0	0	0	155	0	0	0	156	0	0	0
9	0	0	0	157	0	0	0	158	0	0	0	159	0	0	0	160	0	0	0	161	0	0	0	162	0	0	0	163	0	0	0
10	0	0	0	164	0	0	0	165	0	0	0	166	0	0	0	167	0	0	0	168	0	0	0	169	0	0	0	170	0	0	0
11	0	0	0	171	0	0	0	172	0	0	0	173	0	0	0	174	0	0	0	175	0	0	0	176	0	0	0	177	0	0	0
12	0	0	0	178	0	0	0	179	0	0	0	180	0	0	0	181	0	0	0	182	0	0	0	183	0	0	0	184	0	0	0
13	0	0	0	185	0	0	0	186	0	0	0	187	0	0	0	188	0	0	0	189	0	0	0	190	0	0	0	191	0	0	0
14	0	0	0	192	0	0	0	193	0	0	0	194	0	0	0	195	0	0	0	196	0	0	0	197	0	0	0	198	0	0	0
15	0	0	0	199	0	0	0	200	0	0	0	201	0	0	0	202	0	0	0	203	0	0	0	204	0	0	0	205	0	0	0
16	0	0	0	206	0	0	0	207	0	0	0	208	0	0	0	209	0	0	0	210	0	0	0	211	0	0	0	212	0	0	0
17	0	0	0	213	0	0	0	214	0	0	0	215	0	0	0	216	0	0	0	217	0	0	0	218	0	0	0	219	0	0	0
18	0	0	0	220	0	0	0	221	0	0	0	222	0	0	0	223	0	0	0	224	0	0	0	225	0	0	0	226	0	0	0
19	0	0	0	227	0	0	0	228	0	0	0	229	0	0	0	230	0	0	0	231	0	0	0	232	0	0	0	233	0	0	0
20	0	0	0	234	0	0	0	235	0	0	0	236	0	0	0	237	0	0	0	238	0	0	0	239	0	0	0	240	0	0	0
21	0	0	0	241	0	0	0	242	0	0	0	243	0	0	0	244	0	0	0	245	0	0	0	246	0	0	0	247	0	0	0
22	0	0	0	248	0	0	0	249	0	0	0	250	0	0	0	251	0	0	0	252	0	0	0	253	0	0	0	254	0	0	0
23	0	0	0	255	0	0	0	256	0	0	0	257	0	0	0	258	0	0	0	259	0	0	0	260	0	0	0	261	0	0	0
24	0	0	0	262	0	0	0	263	0	0	0	264	0	0	0	265	0	0	0	266	0	0	0	267	0	0	0	268	0	0	0
25	0	0	0	269	0	0	0	270	0	0	0	271	0	0	0	272	0	0	0	273	0	0	0	274	0	0	0	275	0	0	0
26	0	0	0	276	0	0	0	277	0	0	0	278	0	0	0	279	0	0	0	280	0	0	0	281	0	0	0	282	0	0	0
27	0	0	0	283	0	0	0	284	0	0	0	285	0	0	0	286	0	0	0	287	0	0	0	288	0	0	0	289	0	0	0
28	0	0	0	290	0	0	0	291	0	0	0	292	0	0	0	293	0	0	0	294	0	0	0	295	0	0	0	296	0	0	0
29	0	0	0	297	0	0	0	298	0	0	0	299	0	0	0	300	0	0	0	301	0	0	0	302	0	0	0	303	0	0	0
30	0	0	0	304	0	0	0	305	0	0	0	306	0	0	0	307	0	0	0	308	0	0	0	309	0	0	0	310	0	0	0
31	0	0	0	311	0	0	0	312	0	0	0	313	0	0	0	314	0	0	0	315	0	0	0	316	0	0	0	317	0	0	0
32	0	0	0	318	0	0	0	319	0	0	0	320	0	0	0	321	0	0	0	322	0	0	0	323	0	0	0	324	0	0	0
33	0	0	0	325	0	0	0	326	0	0	0	327	0	0	0	328	0	0	0	329	0	0	0	330	0	0	0	331	0	0	0
34	0	0	0	332	0	0	0	333	0	0	0	334	0	0	0	335	0	0	0	336	0	0	0	337	0	0	0	338	0	0	0
35	0	0	0	339	0	0	0	340	0	0	0	341	0	0	0	342	0	0	0	343	0	0	0	344	0	0	0	345	0	0	0
36	0	0	0	346	0	0	0	347	0	0	0	348	0	0	0	349	0	0	0	350	0	0	0	351	0	0	0	352	0	0	0
37	0	0	0	353	0	0	0	354	0	0	0	355	0	0	0	356	0	0	0	357	0	0	0	358	0	0	0	359	0	0	0
38	0	0	0	360	0	0	0	361	0	0	0	362	0	0	0	363	0	0	0	364	0	0	0	365	0	0	0	366	0	0	0
39	0	0	0	367	0	0	0	368	0	0	0	369	0	0	0	370	0	0	0	371	0	0	0	372	0	0	0	373	0	0	0
40	0	0	0	374	0	0	0	375	0	0	0	376	0	0	0	377	0	0	0	378	0	0	0	379	0	0	0	380	0	0	0
41	0	0	0	381	0	0	0	382	0	0	0	383	0	0	0	384	0	0	0	385	0	0	0	386	0	0	0	387	0	0	0
42	0	0	0	388	0	0	0	389	0	0	0	390	0	0	0	391	0	0	0	392	0	0	0	393	0	0	0	394	0	0	0
43	0	0	0	395	0	0	0	396	0	0	0	397	0	0	0	398	0	0	0	399	0	0	0	400	0	0	0	401	0	0	0
44	0	0	0	402	0	0	0	403	0	0	0	404	0	0	0	405	0	0	0	406	0	0	0	407	0	0	0	408	0	0	0
45	0	0	0	409	0	0	0	410	0	0	0	411	0	0	0	412	0	0	0	413	0	0	0	414	0	0	0	415	0	0	0
46	0	0	0	416	0	0	0	417	0	0	0	418	0	0	0	419	0	0	0	420	0	0	0	421	0	0	0	422	0	0	0
47	0	0	0	423	0	0	0	424	0	0	0	425	0	0	0	426	0	0	0	427	0	0	0	428	0	0	0	429	0	0	0
48	0	0	0	430	0	0	0	431	0	0	0	432	0	0	0	433	0	0	0	434	0	0	0	435	0	0	0	436	0	0	0
49	0	0	0	437	0	0	0	438	0	0	0	439	0	0	0	440	0	0	0	441	0	0	0	442	0	0	0	443	0	0	0
50	0	0	0	444	0	0	0	445	0	0	0	446	0	0	0	447	0	0	0	448	0	0	0	449	0	0	0	450	0	0	0
51	0	0	0	451	0	0	0	452	0	0	0	453	0	0	0	454	0	0	0	455	0	0	0	456	0	0	0	457	0	0	0
52	0	0	0	458	0	0	0	459	0	0	0	460	0	0	0	461	0	0	0	462	0	0	0	463	0	0	0	464	0	0	0
53	0	0	0	465	0	0	0	466	0	0	0	467	0	0	0	468	0	0	0	469	0	0	0	470	0	0	0	471	0	0	0
54	0	0	0	472	0	0	0	473	0	0	0	474	0	0	0	475	0	0	0	476	0	0	0	477	0	0	0	478	0	0	0
55	0	0	0	479	0	0	0	480	0	0	0	481	0	0	0	482	0	0	0	483	0	0	0	484	0	0	0	485	0	0	0
56	0	0	0	486	0	0	0	487	0	0	0	488	0	0	0	489	0	0	0	490	0	0	0	491	0	0	0	492	0	0	0
57	0	0	0	493	0	0	0	494	0	0	0	495	0	0	0	496	0	0	0	497	0	0	0	498	0	0	0	499	0	0	0
58	0	0	0																												

NORMAL STRESSES FOR LOAD CASE 16 (PSI)

ELEM	SX	SY	SZ	ELEM	SX	SY	SZ	ELEM	SX	SY	SZ	ELEM	SX	SY	SZ	ELEM	SX	SY	SZ
313	6	21	29	314	7	19	28	315	3	15	18	316	2	18	1	317	-2	12	2
319	-1	-2	-1	320	-1	-8	-2	321	3	-12	-15	322	0	-15	1	323	0	-17	-2
325	-27	-31	16	326	-26	-71	15	327	-22	-42	32	328	-3	32	4	329	1	55	4
331	2	40	0	332	1	24	-1	333	4	10	-2	334	1	-2	-2	335	1	-9	2
337	3	192	18	338	3	168	16	339	4	113	-9	340	-2	-43	0	341	-1	-62	2
343	-1	-78	0	344	0	-67	0	345	0	-54	0	346	0	-47	3	347	0	-35	0
349	3	98	4	350	4	87	3	351	1	57	9	352	1	30	0	353	-1	-22	3
355	-1	-37	1	356	0	-36	0	357	0	-33	0	358	0	-21	3	359	0	-27	0
361	1	11	7	362	1	11	6	363	0	11	8	364	1	21	5	365	-1	17	5
367	0	1	1	368	0	-7	0	369	0	-13	0	370	0	-17	-1	371	0	-20	-1
373	-11	-75	13	374	-10	-65	12	375	-10	-36	9	376	-1	34	8	377	-1	56	5
379	0	39	1	380	0	23	0	381	0	7	-1	382	0	-5	-2	383	0	-13	-2

MIN.	ELEM	SX	SY	SZ	ELEM	SX	SY	SZ
205	205	-43	-88	-16	292	-16	(COMPRESSIVE)	
MAX.	195	47	289	62	291	62	(TENSILE)	

Figure D16. (Sheet 3 of 5)

SHEAR STRESSES FOR LOAD CASE 16 (PSI)											
ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX
1	1	1	1	101	1	1	1	201	1	1	1
2	2	2	2	102	2	2	2	202	2	2	2
3	3	3	3	103	3	3	3	203	3	3	3
4	4	4	4	104	4	4	4	204	4	4	4
5	5	5	5	105	5	5	5	205	5	5	5
6	6	6	6	106	6	6	6	206	6	6	6
7	7	7	7	107	7	7	7	207	7	7	7
8	8	8	8	108	8	8	8	208	8	8	8
9	9	9	9	109	9	9	9	209	9	9	9
10	10	10	10	110	10	10	10	210	10	10	10
11	11	11	11	111	11	11	11	211	11	11	11
12	12	12	12	112	12	12	12	212	12	12	12
13	13	13	13	113	13	13	13	213	13	13	13
14	14	14	14	114	14	14	14	214	14	14	14
15	15	15	15	115	15	15	15	215	15	15	15
16	16	16	16	116	16	16	16	216	16	16	16
17	17	17	17	117	17	17	17	217	17	17	17
18	18	18	18	118	18	18	18	218	18	18	18
19	19	19	19	119	19	19	19	219	19	19	19
20	20	20	20	120	20	20	20	220	20	20	20
21	21	21	21	121	21	21	21	221	21	21	21
22	22	22	22	122	22	22	22	222	22	22	22
23	23	23	23	123	23	23	23	223	23	23	23
24	24	24	24	124	24	24	24	224	24	24	24
25	25	25	25	125	25	25	25	225	25	25	25
26	26	26	26	126	26	26	26	226	26	26	26
27	27	27	27	127	27	27	27	227	27	27	27
28	28	28	28	128	28	28	28	228	28	28	28
29	29	29	29	129	29	29	29	229	29	29	29
30	30	30	30	130	30	30	30	230	30	30	30
31	31	31	31	131	31	31	31	231	31	31	31
32	32	32	32	132	32	32	32	232	32	32	32
33	33	33	33	133	33	33	33	233	33	33	33
34	34	34	34	134	34	34	34	234	34	34	34
35	35	35	35	135	35	35	35	235	35	35	35
36	36	36	36	136	36	36	36	236	36	36	36
37	37	37	37	137	37	37	37	237	37	37	37
38	38	38	38	138	38	38	38	238	38	38	38
39	39	39	39	139	39	39	39	239	39	39	39
40	40	40	40	140	40	40	40	240	40	40	40
41	41	41	41	141	41	41	41	241	41	41	41
42	42	42	42	142	42	42	42	242	42	42	42
43	43	43	43	143	43	43	43	243	43	43	43
44	44	44	44	144	44	44	44	244	44	44	44
45	45	45	45	145	45	45	45	245	45	45	45
46	46	46	46	146	46	46	46	246	46	46	46
47	47	47	47	147	47	47	47	247	47	47	47
48	48	48	48	148	48	48	48	248	48	48	48
49	49	49	49	149	49	49	49	249	49	49	49
50	50	50	50	150	50	50	50	250	50	50	50
51	51	51	51	151	51	51	51	251	51	51	51
52	52	52	52	152	52	52	52	252	52	52	52
53	53	53	53	153	53	53	53	253	53	53	53
54	54	54	54	154	54	54	54	254	54	54	54
55	55	55	55	155	55	55	55	255	55	55	55
56	56	56	56	156	56	56	56	256	56	56	56
57	57	57	57	157	57	57	57	257	57	57	57
58	58	58	58	158	58	58	58	258	58	58	58
59	59	59	59	159	59	59	59	259	59	59	59
60	60	60	60	160	60	60	60	260	60	60	60
61	61	61	61	161	61	61	61	261	61	61	61
62	62	62	62	162	62	62	62	262	62	62	62
63	63	63	63	163	63	63	63	263	63	63	63
64	64	64	64	164	64	64	64	264	64	64	64
65	65	65	65	165	65	65	65	265	65	65	65
66	66	66	66	166	66	66	66	266	66	66	66
67	67	67	67	167	67	67	67	267	67	67	67
68	68	68	68	168	68	68	68	268	68	68	68
69	69	69	69	169	69	69	69	269	69	69	69
70	70	70	70	170	70	70	70	270	70	70	70
71	71	71	71	171	71	71	71	271	71	71	71
72	72	72	72	172	72	72	72	272	72	72	72
73	73	73	73	173	73	73	73	273	73	73	73
74	74	74	74	174	74	74	74	274	74	74	74
75	75	75	75	175	75	75	75	275	75	75	75
76	76	76	76	176	76	76	76	276	76	76	76
77	77	77	77	177	77	77	77	277	77	77	77
78	78	78	78	178	78	78	78	278	78	78	78
79	79	79	79	179	79	79	79	279	79	79	79
80	80	80	80	180	80	80	80	280	80	80	80
81	81	81	81	181	81	81	81	281	81	81	81
82	82	82	82	182	82	82	82	282	82	82	82
83	83	83	83	183	83	83	83	283	83	83	83
84	84	84	84	184	84	84	84	284	84	84	84
85	85	85	85	185	85	85	85	285	85	85	85
86	86	86	86	186	86	86	86	286	86	86	86
87	87	87	87	187	87	87	87	287	87	87	87
88	88	88	88	188	88	88	88	288	88	88	88
89	89	89	89	189	89	89	89	289	89	89	89
90	90	90	90	190	90	90	90	290	90	90	90
91	91	91	91	191	91	91	91	291	91	91	91
92	92	92	92	192	92	92	92	292	92	92	92
93	93	93	93	193	93	93	93	293	93	93	93
94	94	94	94	194	94	94	94	294	94	94	94
95	95	95	95	195	95	95	95	295	95	95	95
96	96	96	96	196	96	96	96	296	96	96	96
97	97	97	97	197	97	97	97	297	97	97	97
98	98	98	98	198	98	98	98	298	98	98	98
99	99	99	99	199	99	99	99	299	99	99	99
100	100	100	100	200	100	100	100	300	100	100	100
101	101	101	101	201	101	101	101	301	101	101	101
102	102	102	102	202	102	102	102	302	102	102	102
103	103	103	103	203	103	103	103	303	103	103	103
104	104	104	104	204	104	104	104	304	104	104	104
105	105	105	105	205	105	105	105	305	105	105	105
106	106	106	106	206	106	106	106	306	106	106	106
107	107	107	107	207	107	107	107	307	107	107	107
108	108	108	108	208	108	108	108	308	108	108	108
109	109	109	109	209	109	109	109	309	109	109	109
110	110	110	110	210	110	110	110	310	110	110	110
111	111	111	111	211	111	111	111	311	111	111	111
112	112	112	112	212	112	112	112	312	112	112	112
113	113	113	113	213	113	113	113				
114	114	114	114	214	114	114	114				
115	115	115	115	215	115	115	115				
116	116	116	116	216	116	116	116				
117	117	117	117	217	117	117	117				
118	118	118	118	218	118	118	118				
119	119	119	119	219	119	119	119				
120	120	120	120	220	120	120	120				
121	121	121	121	221	121	121	121				
122	122	122	122	222	122	122	122				
123	123	123	123	223	123	123	123				
124	124	124	124	224	124	124	124				
125	125	125	125	225	125	125	125				
126	126	126	126	226	126	126	126				
127	127	127	127	227	127	127	127				
128	128	128	128	228	128	128	128				
129	129	129	129	229	129	129	129				
130	130	130	130	230	130	130	130				
131	131	131	131	231	131	131	131				
132	132	132	132	232	132	132	132				
133	133	133	133	233	133	133	133				
134	134	134	134	234	134	134	134				
135	135	135	135	235	135						

SHEAR STRESSES FOR LOAD CASE 16 (PSI)

ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX
313	-2	-21	-9	314	-1	10	-8	315	-8	-42	-6	316	-6	-22	-2	317	-3	-6	0
319	0	-14	1	320	0	5	0	321	-50	-35	-5	322	-55	-19	0	323	0	-2	0
325	-12	-18	-7	326	-35	6	-7	327	-15	1	0	328	-10	1	0	329	-50	-9	1
331	-13	-29	0	332	-22	1	1	333	-6	-52	-2	334	-26	-31	0	335	-5	1	0
337	-13	-29	0	338	33	2	1	339	7	-5	0	340	5	-2	2	341	23	-25	-1
343	-13	-29	0	344	10	-5	0	345	1	-76	-4	346	5	-2	0	347	3	-1	0
349	-13	-29	-3	350	2	-18	-2	351	1	-8	-9	352	1	-5	1	353	5	-46	-1
355	-13	-29	-10	356	-4	-13	-10	357	-6	-76	-9	358	-7	-5	0	359	1	-2	0
361	-13	-29	-10	362	-4	-13	-10	363	-6	-76	-9	364	-7	-5	-1	365	-6	-47	1
367	-13	-29	-10	368	-3	-13	-10	369	-2	-8	-1	370	-30	-17	0	371	-1	-3	0
373	-13	-29	-10	374	-19	-7	-6	375	-26	-49	-5	376	-30	-17	0	377	-27	-25	1
379	-17	-10	1	380	-12	-6	1	381	-8	-4	0	382	-5	-2	0	383	-3	-1	0

MIN. 208 -69
MAX. 290 35
ELEM VXY ELEM VYZ
208 -69 363 -76
290 35 290 42
361 -10
381 30

Figure D16. (Sheet 5 of 5)

NORMAL STRESSES FOR LOAD CASE 17 (PSI)											
ELEM	SX	SY	SZ	ELEM	SX	SY	SZ	ELEM	SX	SY	SZ
1	0	0	0	11	0	0	0				
2	0	0	0	12	0	0	0				
3	0	0	0	13	0	0	0				
4	0	0	0	14	0	0	0				
5	0	0	0	15	0	0	0				
6	0	0	0	16	0	0	0				
7	0	0	0	17	0	0	0				
8	0	0	0	18	0	0	0				
9	0	0	0	19	0	0	0				
10	0	0	0	20	0	0	0				
11	0	0	0	21	0	0	0				
12	0	0	0	22	0	0	0				
13	0	0	0	23	0	0	0				
14	0	0	0	24	0	0	0				
15	0	0	0	25	0	0	0				
16	0	0	0	26	0	0	0				
17	0	0	0	27	0	0	0				
18	0	0	0	28	0	0	0				
19	0	0	0	29	0	0	0				
20	0	0	0	30	0	0	0				
21	0	0	0	31	0	0	0				
22	0	0	0	32	0	0	0				
23	0	0	0	33	0	0	0				
24	0	0	0	34	0	0	0				
25	0	0	0	35	0	0	0				
26	0	0	0	36	0	0	0				
27	0	0	0	37	0	0	0				
28	0	0	0	38	0	0	0				
29	0	0	0	39	0	0	0				
30	0	0	0	40	0	0	0				
31	0	0	0	41	0	0	0				
32	0	0	0	42	0	0	0				
33	0	0	0	43	0	0	0				
34	0	0	0	44	0	0	0				
35	0	0	0	45	0	0	0				
36	0	0	0	46	0	0	0				
37	0	0	0	47	0	0	0				
38	0	0	0	48	0	0	0				
39	0	0	0	49	0	0	0				
40	0	0	0	50	0	0	0				
41	0	0	0	51	0	0	0				
42	0	0	0	52	0	0	0				
43	0	0	0	53	0	0	0				
44	0	0	0	54	0	0	0				
45	0	0	0	55	0	0	0				
46	0	0	0	56	0	0	0				
47	0	0	0	57	0	0	0				
48	0	0	0	58	0	0	0				
49	0	0	0	59	0	0	0				
50	0	0	0	60	0	0	0				
51	0	0	0	61	0	0	0				
52	0	0	0	62	0	0	0				
53	0	0	0	63	0	0	0				
54	0	0	0	64	0	0	0				
55	0	0	0	65	0	0	0				
56	0	0	0	66	0	0	0				
57	0	0	0	67	0	0	0				
58	0	0	0	68	0	0	0				
59	0	0	0	69	0	0	0				
60	0	0	0	70	0	0	0				
61	0	0	0	71	0	0	0				
62	0	0	0	72	0	0	0				
63	0	0	0	73	0	0	0				
64	0	0	0	74	0	0	0				
65	0	0	0	75	0	0	0				
66	0	0	0	76	0	0	0				
67	0	0	0	77	0	0	0				
68	0	0	0	78	0	0	0				
69	0	0	0	79	0	0	0				
70	0	0	0	80	0	0	0				
71	0	0	0	81	0	0	0				
72	0	0	0	82	0	0	0				
73	0	0	0	83	0	0	0				
74	0	0	0	84	0	0	0				
75	0	0	0	85	0	0	0				
76	0	0	0	86	0	0	0				
77	0	0	0	87	0	0	0				
78	0	0	0	88	0	0	0				
79	0	0	0	89	0	0	0				
80	0	0	0	90	0	0	0				
81	0	0	0	91	0	0	0				
82	0	0	0	92	0	0	0				
83	0	0	0	93	0	0	0				
84	0	0	0	94	0	0	0				
85	0	0	0	95	0	0	0				
86	0	0	0	96	0	0	0				
87	0	0	0	97	0	0	0				
88	0	0	0	98	0	0	0				
89	0	0	0	99	0	0	0				
90	0	0	0	100	0	0	0				
91	0	0	0	101	0	0	0				
92	0	0	0	102	0	0	0				
93	0	0	0	103	0	0	0				
94	0	0	0	104	0	0	0				
95	0	0	0	105	0	0	0				
96	0	0	0	106	0	0	0				
97	0	0	0	107	0	0	0				
98	0	0	0	108	0	0	0				
99	0	0	0	109	0	0	0				
100	0	0	0	110	0	0	0				
101	0	0	0	111	0	0	0				
102	0	0	0	112	0	0	0				
103	0	0	0	113	0	0	0				
104	0	0	0	114	0	0	0				
105	0	0	0	115	0	0	0				
106	0	0	0	116	0	0	0				
107	0	0	0	117	0	0	0				
108	0	0	0	118	0	0	0				
109	0	0	0	119	0	0	0				
110	0	0	0	120	0	0	0				
111	0	0	0	121	0	0	0				
112	0	0	0	122	0	0	0				
113	0	0	0	123	0	0	0				
114	0	0	0	124	0	0	0				
115	0	0	0	125	0	0	0				
116	0	0	0	126	0	0	0				
117	0	0	0	127	0	0	0				
118	0	0	0	128	0	0	0				
119	0	0	0	129	0	0	0				
120	0	0	0	130	0	0	0				
121	0	0	0	131	0	0	0				
122	0	0	0	132	0	0	0				
123	0	0	0	133	0	0	0				
124	0	0	0	134	0	0	0				
125	0	0	0	135	0	0	0				
126	0	0	0	136	0	0	0				
127	0	0	0	137	0	0	0				
128	0	0	0	138	0	0	0				
129	0	0	0	139	0	0	0				
130	0	0	0	140	0	0	0				
131	0	0	0	141	0	0	0				
132	0	0	0	142	0	0	0				
133	0	0	0	143	0	0	0				
134	0	0	0	144	0	0	0				
135	0	0	0	145	0	0	0				
136	0	0	0	146	0	0	0				
137	0	0	0	147	0	0	0				
138	0	0	0	148	0	0	0				
139	0	0	0	149	0	0	0				
140	0	0	0	150	0	0	0				
141	0	0	0	151	0	0	0				
142	0	0	0	152	0	0	0				
143	0	0	0	153	0	0	0				
144	0	0	0	154	0	0	0				
145	0	0	0	155	0	0	0				
146	0	0	0	156	0	0	0				
147	0	0	0	157	0	0	0				
148	0	0	0	158	0	0	0				
149	0	0	0	159	0	0	0				
150	0	0	0	160	0	0	0				
151	0	0	0	161	0	0	0				
152	0	0	0	162	0	0	0				
153	0	0	0	163	0	0	0				
154	0	0	0	164	0	0	0				
155	0	0	0	165	0	0	0				
156	0	0	0	166	0	0	0				
157	0	0	0	167	0	0	0				
158	0	0	0	168	0	0	0				
159	0	0	0	169	0	0	0				
160	0	0	0	170	0	0	0				
161	0	0	0	171	0	0	0				
162	0	0	0	172	0	0	0				
163	0	0	0	173	0	0	0				
164	0	0	0	174	0	0	0				
165	0	0	0	175	0	0	0				
166	0	0	0	176	0	0	0				
167	0	0	0	177	0	0	0				
168	0	0	0	178	0	0	0				
169	0	0	0	179	0	0	0				
170	0	0	0	180	0	0	0				
171	0	0	0	181	0	0	0				
172	0	0	0	182	0	0	0				
173	0	0	0	183	0	0	0				
174	0	0	0	184	0	0	0				
175	0	0	0	185	0	0	0				
176	0	0	0	186	0	0	0				
177	0	0	0	187	0	0	0				
178	0	0	0	188	0	0	0				
179	0	0	0	189	0	0	0				
180	0	0	0	190	0	0	0				
181	0	0	0	191	0	0	0				
182	0	0	0	192	0	0	0				
183	0	0	0	193	0	0	0				
184	0	0	0	194	0	0	0				
185	0	0	0	195	0	0	0				
186	0	0	0	196	0	0	0				
187	0	0	0	197	0	0	0				
188	0	0	0	198	0	0	0				
189	0	0	0	199	0	0	0				
190	0	0	0	200	0	0	0				
191	0	0	0	201	0	0	0				
192	0	0	0	202	0	0	0				
193	0	0	0	203	0	0	0				
194	0	0	0	204	0	0	0				
195	0	0	0	205	0	0	0				
196	0	0	0	206	0	0	0				
197	0	0	0	207	0	0	0				
198	0	0	0	208	0	0	0				
199	0	0	0	209	0	0	0				
200	0	0	0	210	0	0	0				
201	0	0	0	211	0	0	0				
202	0	0	0	212	0	0	0				
203	0	0	0	213	0	0	0				
204	0	0	0	214	0	0	0				
205	0	0	0	215	0	0	0				
206	0	0	0	216	0	0	0				
207	0	0	0	217	0	0	0				
208	0	0	0	218	0	0	0				
209	0	0	0	219	0	0	0				
210	0	0	0	220	0	0	0				
211	0	0	0	221	0	0	0				
212	0	0	0	222	0	0	0				
213	0	0	0	223	0	0	0				
214	0	0	0	224	0	0	0				
215	0	0	0	225	0	0	0				
216	0	0	0	226	0	0	0				
217	0	0	0	227	0	0	0				
218	0	0	0	228	0	0					

	ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX
	313	0	0	0	314	0	0	0	315	0	0	0	316	0	0	0
	319	0	0	0	320	0	0	0	321	0	0	0	322	0	0	0
	325	0	0	0	326	0	0	0	327	0	0	0	328	0	0	0
	331	0	0	0	332	0	0	0	333	0	0	0	334	0	0	0
	337	0	0	0	338	0	0	0	339	0	0	0	340	0	0	0
	343	0	0	0	344	0	0	0	345	0	0	0	346	0	0	0
	349	0	0	0	350	0	0	0	351	0	0	0	352	0	0	0
	355	0	0	0	356	0	0	0	357	0	0	0	358	0	0	0
	361	0	0	0	362	0	0	0	363	0	0	0	364	0	0	0
	367	0	0	0	368	0	0	0	369	0	0	0	370	0	0	0
	373	0	0	0	374	0	0	0	375	0	0	0	376	0	0	0
	379	0	0	0	380	0	0	0	381	0	0	0	382	0	0	0

	ELEM	VXY	ELEM	VYZ	ELEM	VZX
MIN.	98	0	193	0	204	-1
MAX.		0	204	84	1	

Figure D17. (Sheet 3 of 5)

SHEAR STRESSES FOR LOAD CASE 17 (PSI)															
ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX
313	0	0	0	315	0	0	0	316	0	0	0	317	0	0	0
314	0	0	0	321	0	0	0	322	0	0	0	323	0	0	0
319	0	0	0	327	0	0	0	328	0	0	0	329	0	0	0
325	0	0	0	333	0	0	0	334	0	0	0	335	0	0	0
331	0	0	0	339	0	0	0	340	0	0	0	341	0	0	0
337	0	0	0	345	0	0	0	346	0	0	0	347	0	0	0
343	0	0	0	351	0	0	0	352	0	0	0	353	0	0	0
349	0	0	0	357	0	0	0	358	0	0	0	359	0	0	0
355	0	0	0	363	0	0	0	364	0	0	0	365	0	0	0
361	0	0	0	369	0	0	0	370	0	0	0	371	0	0	0
367	0	0	0	375	0	0	0	376	0	0	0	377	0	0	0
373	0	0	0	381	0	0	0	382	0	0	0	383	0	0	0
379	0	0	0												
ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX	ELEM	VXY	VYZ	VZX
107	0	193	-1	204	0	204	-1	204	0	204	0	204	0	204	0
98	0	84	1	84	0	84	1	84	0	84	0	84	0	84	0
MIN.															
MAX.															

ELEM	VXY	VYZ	VZX
107	0	193	0
98	0	204	0
		84	0
			84
			-1
			1

MIN.
MAX.

Figure D17. (Sheet 5 of 5)

END

DATE
FILMED

5-84

DTIC