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Technical Memorandum 4.1

Digesters Structural Evaluation, Corrosion Protection and Concrete Rehabilitation

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1. EXECUTIVE SUMMARY

This Technical Memorandum (TM) presents the results of the structural evaluation for the existing digesters at the San Jose/Santa Clara Water Pollution Control Plant (WPCP). The purpose of this TM is to determine whether the digesters are capable, either in their existing or modified state, of structurally accommodating steel, concrete, aluminum, or composite material fixed covers, including submerged and non-submerged fixed covers. This TM also summarizes the findings of visual inspections of the interior and exterior of the digesters, estimates the condition and useful life of the digesters, identifies the need for repairs and coating of the existing structures, and identifies and recommends structural modifications required to accommodate new covers.

The structural evaluation was completed on three different digesters (Digesters 1, 4, and 12) at various water surface elevations, internal gas pressures, and sludge temperatures. The evaluation was performed in three different and successive steps with the objective of estimating a loading condition that would maximize digester capacity while minimizing rehabilitation. The first step of the evaluation was to evaluate Digesters 1 and 12 at maximum operating conditions. This loading condition proved to be excessive for the existing digesters and it required extensive concrete rehabilitation. The second step was to perform a qualitative sensitivity analysis on the effects of various loading conditions on the resultant stresses in Digesters 1 and 12. The qualitative sensitivity analysis found that the water surface elevation considerably impacts the structural demand of the digesters. The third and final step was to identify a final water surface elevation, gas pressure, and sludge temperature that would allow increased digester capacity, while minimizing rehabilitation. In step 1 and 2, it was determined that Digester 1, representing Digesters 1 through 11, was not suitable for rehabilitation for increased loading. Therefore, for step 3, Digester 4 was evaluated to be representative of Digesters 4 through 11.

Based on the evaluation, the summary of the findings and digester rehabilitation recommendations are as follows:

- Digesters 1 through 3 do not have any additional capacity to accommodate a new concrete fixed cover or to increase the current water surface elevation. Since these digesters are the oldest and smallest of the digesters and rehabilitation is cost prohibitive, Brown and Caldwell (BC) recommends that these digesters continue to operate at their original design water surface elevation.
- Digester 4 through 11 can accommodate a new submerged or non-submerged fixed cover. The submerged fixed cover requires more rehabilitation than the non-submerged cover because of the higher water surface elevation and weight of the cover.
- Digester 12 through 16 can accommodate a new submerged or non-submerged fixed cover. The submerged fixed cover requires structural rehabilitation; while the non-submerged fixed cover scenario requires no structural rehabilitation.
- The exterior concrete walls of the digesters above grade are in good condition and the tops of the walls appear to be in good structural condition for installing new fixed covers. The interior of the digesters walls need to be coated to increase the life from 15 to 20 years (without coating) to 35 to 40 years (with coating). Flexible coatings, such as polyurethane, are preferred over epoxy coatings because epoxy coatings are brittle and during a seismic event, the walls deform slightly and the epoxy coating will crack. Plastic lining is not recommended for existing digesters walls because the lining is typically attached with epoxy adhesive or mastic to the walls and with the high internal temperature of the sludge in the digesters, the lining tends to de-bond from the wall.

- If the existing steel covers are re-used or if they remain in service for an extended period of time, they should be rehabilitated with an abrasive blast to near white metal and recoated with a high build epoxy coating system.
- The settlement around Digester 4 can be attributed to poor compaction of the 20-foot deep layer of backfill around the digester. Digester 4 does not seem to have settled but only the ground surrounding it. Typical recommendations for this type of settlement include over excavation of the top two feet of soil and recompaction of the soils and installation of flexible joint couplings to all piping connected to the digester wall.
- All digesters are equipped with pressure relief valves in the bottom slab and some of the digesters are also equipped with under drainage systems. The pressure relief valves and the under drainage systems have worked well based on the fact that none of the digesters have been damaged due to groundwater uplift pressures. BC recommends inspecting the pressure relief valves during digester maintenance and unclogging valves as required.
- The existing digesters are equipped with 24-inch diameter access man ways. These man ways are small and present problems to personnel accessing the interior of the digesters. Larger diameter man ways have been successfully installed in other digesters with similar post-tensioning systems, but the process is expensive, requiring either jacking the rods apart or installing new spreader bars to maintain the support of existing post tensioning and installing new man ways. BC recommends that the existing access man ways be replaced with new larger man ways if the digesters are rehabilitated to accommodate the proposed new fixed covers.

2. INTRODUCTION

The purpose of this TM is to discuss the results of the structural evaluation on the existing digesters at the WPCP and to determine whether they are capable, either in their existing or modified state, of structurally accommodating steel, concrete, aluminum, or composite material fixed covers, including submerged and non-submerged fixed covers. Beyaz and Patel, Inc. (B&P), a subconsultant to Brown and Caldwell (BC), reviewed two existing geotechnical investigation reports, conducted a visual inspection of the exterior of the digesters, and completed an initial structural evaluation of the digesters assuming reasonable maximum operating conditions, which are described in Section 5.1. Because many of the digesters have the same or similar designs, not all of the digesters were individually evaluated. Therefore, for evaluation and modeling purposes, the digesters were placed into one of two categories based on their structural characteristics (i.e., age, concrete and rebar strength, and construction methods). Two digesters were selected to represent the 16 digesters. Digester 1 categorized Digesters 1 through 11, and Digester 12 categorized Digesters 12 through 16. The results of B&P's evaluation are presented in Attachment A. As part of the B&P evaluation, a visual corrosion inspection of the interior of five digesters that were not in service at the time was conducted by V&A. A summary of this inspection is included as an attachment to their report.

The B&P report determined that under reasonable maximum operating conditions, significant structural modifications would be required for any of the fixed roof cover options. Therefore, a sensitivity analysis was conducted by BC to optimize the capacity of the digesters with minimal structural rehabilitation for new fixed roof covers on the existing digesters. The results of the sensitivity analysis are provided in Section 5.

The description of existing digesters, existing documents, and references were presented in the B&P report (Attachment A); and therefore, are not repeated in this TM. Structural calculations of the qualitative sensitivity analysis and the final digester evaluations are included in Attachment B.

2.1 Scope of Work

The following subjects are covered in the scope of work:

- Develop up to two structural computer models with seismic loading criteria.
- Group each of the 16 existing digesters into one of the two structural computer models for analysis, based on similar structural design attributes and conditions.
- Identify structural modifications required to accommodate new covers.
- Identify and recommend structural attachments for cover and mixing elements.
- Identify constructability issues.
- Perform a visual inspection of the exterior concrete of the digesters to estimate condition, remaining useful life, and need for repairs and/or coating of the existing structures.
- Assumes that up to five digesters will be inspected and will be representative of the 16 existing digesters.
- Review relevant reports including geotechnical reports, specifications, and drawings regarding the digesters.
- Evaluate damage due to settlement in existing structures.
- Evaluate the need for control of hydrostatic pressure due to high groundwater. Evaluate structural options for adding personnel and cleaning equipment access into existing digesters.
- Include in the TM general recommendations, specific rehabilitation methods, and appropriate materials for corrosion protection. A discussion of alternative concrete coating materials, alternate structural materials and coatings shall be included, along with advantages and disadvantages of each.
- Prepare a draft TM summarizing the evaluations described under Task 4.1 and provide recommendations.

3. REVIEW OF EXISTING GEOTECHNICAL INVESTIGATION REPORTS

B&P reviewed two existing geotechnical investigation reports to obtain general foundation design criteria for the digester evaluation. The two geotechnical reports available for review were the following reports:

1. “Report, Foundation Investigation, Proposed Sewage Treatment Works, Santa Clara County, California, for the City of San Jose”, September 1954, by Dames & Moore.
2. “Geotechnical Report”, November 1974, by Woodward-Lundgren & Associates.

Based on the general recommendations obtained from the geotechnical reports, the basis for the foundation criteria to be used for the digesters evaluation were the following:

- Allowable Net Soil Bearing Pressures (fb) in pounds per square foot (psf):
    - Digesters 1 through 11: fb = 1,500 psf (Dead Load) - Geotechnical Report 1
    - Digesters 1 through 11: fb = 2,000 psf (Total Load) - Geotechnical Report 1
    - Digesters 12 through 16: fb= 3,000 psf (Dead Load) - Geotechnical Report 2
- Soil rigidity in vertical direction was assumed to be 50 pounds per cubic inch (pci) downward.
- Ground water table was at 4 feet below grade.
- Passive resistance to lateral forces by the soil will develop after a slight horizontal movement. The digesters would then bear laterally against the soil, which would prevent further movement. The passive

soil pressure capacity was assumed to be 250 pounds per cubic foot. Soil rigidity in the horizontal direction was assumed to be 40 pounds per cubic foot.

- The site is located in close proximity to active earthquake faults, according to geotechnical reports. The structural evaluation was performed using the site-specific seismic acceleration response spectra coefficients, as required by code, utilizing United States Geological Survey (USGS) maps and the latitude and longitude of the site location, and are listed below.

4. VISUAL INSPECTIONS AND RECOMMENDED REPAIRS

BC contracted with V&A to perform an interior inspection of Digesters 2, 4, 5, 6 and 8 and to review existing coating inspection reports, prepared by other consultants for Digesters 1 and Digesters 3 through 16. V&A conducted the visual inspections on October 27 and 28, 2008. B&P also conducted a visual inspection on October 30, 2008, to assess the condition of accessible exterior areas of each of the 16 digesters. This section presents the findings of the visual corrosion inspection, coating inspection reports, and the visual inspection of the exterior of the digesters. The final digester condition assessment report can be found in Attachment A. Physical evaluations including thickness of the steel cover plates, integrity of welds on the cover, and attic space condition were beyond the scope of V&A's work; and therefore, were not completed.

4.1 Visual Inspection Findings

The key observations and findings of the exterior visual inspection conducted by B&P are summarized below:

- Minor hairline cracks were observed in the exterior gunite wall cover over the post-tensioned hoop steel. Most cracks were multidirectional and spider web type cracks and most of these cracks were the reopening of previously patched cracks.
- There were a few larger horizontal discolored cracks in the gunite cover observed on Digesters 1 through 8.
- There was a major crack and spall in the gunite wall cover where a pipe penetrates the digester wall near grade on Digester 6.
- The top and inside faces of the digester walls above the floating covers where the structural concrete surface is exposed were free of cracks, corrosion stains, and concrete spalling. This area of each digester was of particular interest since it is the only exterior area where the actual concrete surfaces is exposed and this is where a new fixed roof cover would be attached.

The findings of the interior and exterior visual inspection conducted by V&A are summarized below:

- Interior walls of Digesters 2, 4, 5, 6 and 8 have not been adversely affected due to corrosion and can be expected to have an additional 15 to 20 years of life expectancy, which can be extended to 35 to 40 years if the interior walls are coated with a protective coating.
- Exterior walls of Digesters 2, 3, 4, 5 and 8 are in good condition
- Exterior wall of Digester 6 show some stains that may be indicative of corrosion of the steel mesh in the gunite coating. The concrete beneath the coating is believed to be in good condition.
- Underside of interior roof at Digester 2 is severely corroded.
- Underside of interior roof of Digesters 5, 6, and 8 show some surface corrosion.
- Metallic appurtenances in the interior of Digesters 2, 5, 6, and 8 are in good condition with some superficial corrosion.

- Conduits in the interior of Digesters 5 and 8 near the roof show signs of rust staining. Conduits near the floor are in good condition.
- Circulation piping in Digester 2 is in good condition.
- Fractures on the concrete stairway on Digesters 5 and 6 are noted and were most likely caused by the corrosion of the handrailing.
- Handrails at Digesters 6 and 8 show surface corrosion in some locations.
- Minor concrete damage at Digester 8.

4.2 Results, Conclusions, and Recommendations

The overall conclusion from the B&P site visit was that the exterior concrete walls of the digesters above grade are in good condition and the concrete walls should not be adversely affected due to aging. In addition, the tops of the walls appear to be in good structural condition for new fixed roof covers to be installed in the future. V&A investigation also indicates that the digester concrete walls are in good condition, and that the walls and post-tensioning system do not appear to be adversely affected due to aging.

General recommendations and specific recommendations for each individual Digester are listed below. Full recommendations can be found in the B&P and V&A reports in Attachment A.

General Recommendations:

- Interior concrete surfaces of all the digesters to be converted to a fixed roof configuration should be coated with a 100 percent solids polyurethane coating at a minimum dry film thickness of 125 mils to protect against future deterioration of the concrete.
- Ultrasonic thickness testing and a structural analysis should be performed on all of the existing digester floating covers if they are to be re-used or remain in service for an extended period of time.
- If they are to remain in service, steel covers should be rehabilitated with an abrasive blast to near white metal and recoated with a high build epoxy coating system if they are to be re-used or remain in service for an extended period of time.
- All interior piping should be recoated with a 100 percent solids polyurethane or epoxy after being sand blasted to near white metal.
- Interior surfaces of all digester piping should be assessed in order to determine the extent of corrosion.
- The exterior piping should be recoated.

Specific Recommendations:

Digester No. 1

- Digester cover should be coated with 100 percent solids polyurethane or epoxy coating at a minimum dry film thickness of 80 mils if it is re-used or remains in service for an extended period of time.

Digester No. 2

- Hairline cracks should be repaired with a similar acrylic coating.
- Digester cover is severely corroded and should be removed and replaced if it is needed.
- The valves are leaking and should be replaced.

Digester No. 3

- The 2005 digester coating inspections recommended that the underside of the digester cover be recoated in two to four years. If this has not been completed, the cover should be recoated.

Digester No. 4

- Visible hairline cracks should be repaired with a similar acrylic coating.
- The 2005 digester coating inspections recommend that the underside of the digester cover should be recoated before being put back into operation. If this has not been completed, the cover should be recoated.

Digester No. 5

- Hairline cracks should be repaired with a similar acrylic coating.
- A metal thickness and a structural analysis are recommended to be performed on the digester cover.
- Repair handrail concrete fractures on stairways.

Digester No. 6

- Hairline cracks should be repaired with a similar acrylic coating.
- Observed spalls should be repaired with a repair mortar. An acrylic top coat should be applied on top of the repair material.
- Complete coating rehabilitation of the digester cover.
- Repair handrail concrete fractures on stairways.

Digester No. 7

- Coating rehabilitation may be required in three to five years.

Digester No. 8

- Hairline cracks should be repaired with a similar acrylic coating.
- The coating system for the digester cover should be rehabilitated in the next one to two years.
- Spalling on the concrete support base should be cleaned and repaired with a repair mortar. Any exposed reinforcement should be cleaned of rust and coated with a corrosion inhibitor prior to application of the repair mortar.

Digester No. 9

- Digester cover should be re-inspected in the next year.

Digester No. 10

- A complete coating rehabilitation should be done within the next year.

Digester No. 11

- The 2004 digester coating inspection recommended recoating the interior attic surfaces and the skirt area with the next two years. This should be done if it has not been completed to date.

Digester No. 12

- The 2003 digester coating inspection report recommended that the underside of the cover be recoated in five to six years. If this has not been done, the cover should be recoated within the next year.

Digester No. 13

- Prior inspection reports for the digester cover indicate that the bottom of the cover should be recoated between 2008 and 2010. This cover should be re-inspected to determine if rehabilitation is required at this time.

Digester No. 14

- The 2003 inspection report for the digester cover recommended that localized corrosion on the iron frame work in the attic space be touched up. This should be completed if it has not been completed.
- The underside and the attic space should be re-inspected in the next one to two years.

Digester Nos. 15 and 16

- Prior inspection reports for the digester covers recommended that the bottom of the covers be recoated between 2005 and 2006. The covers should be re-inspected to re-assess the existing state of the coating and to determine if rehabilitation is required at this time.

5. DIGESTER STRUCTURAL LOADING CRITERIA AND EVALUATION METHODOLOGY

This section describes the methodology and the structural design loading criteria used to evaluate the digesters. The objective of the evaluations was to determine if the existing digesters could structurally accommodate the proposed fixed covers, including submerged and non-submerged cover scenarios. A qualitative sensitivity analysis was completed with the objective being to determine the structural loading condition that would maximize the digester capacity while minimizing any structural rehabilitation.

5.1 Design Criteria, Methodology and Summary of Results

B&P evaluated Digesters 1 through 16 using two different structural models that were considered representative of the 16 different digesters at the facility. Digester 1 represented Digesters 1 through 11 and Digester 12 represented Digesters 12 through 16. Both digester models evaluated submerged and non-submerged cover scenarios. The submerged fixed cover scenario requires a reinforced concrete cover suitable to resist the internal pressures exerted by the liquid and gas. The non–submerged fixed cover scenario includes steel, concrete, aluminum, and composite cover types. The evaluation was based on the following desirable maximum loading conditions:

- Submerged concrete fixed cover with a water surface elevation of 7 feet above the digester walls.
- Non-submerged fixed cover with water surfaces of 2 and 4.5 feet below the top of the digester walls.
- Thermophilic conditions (sludge temperature of 135 °F) for all scenarios.
- 18-inch water column gas pressure for all scenarios.

The evaluation methodology, results, conclusions, and recommendations were presented in B&P's report (See Attachment A). The structural evaluation results for Digester 1 are presented in Table 8-1 and results for Digester 12 are presented in Table 8-2 of the B&P report. The D/C ratios in the tables represent the demand "D" divided by the capacity "C". The demand is the strength requirement for the specified loading condition based on the analysis and the capacity is the strength capacity calculated using the current code for the structure or structural attribute listed. Since the current codes allow a 10 percent increase in the calculated capacity for the evaluation of existing structures in good condition, the maximum allowable D/C ratio of 1.10 would meet the current code requirements. Structural elements with a D/C ratio less than or equal to 1.10 meet current code requirements for strength; and therefore, are determined to be "acceptable"; those with ratios larger than 1.10 do not have sufficient strength capacity as compared to the strength needed; and therefore, are determined to be "unacceptable".

A summary of the results from the B&P report is presented below:

- Digester 1 has demand over capacity (D/C) ratios in excess of 1.25 for hoop tension stresses in the circumferential prestressing bars under static loading condition for the non-submerged scenario and D/C ratios in excess of 1.63 under static loading condition for the submerged scenario.
- Digester 1 has D/C ratios in excess of 1.10 for shear stresses at the base of the wall under all loading conditions for the submerged scenario and under the static plus seismic loading condition for the non-submerged scenario.
- Digester 1 would experience net uplift of the base during the design seismic event.
- Digester 12 has D/C ratios in excess of 1.10 for hoop tension stresses in the circumferential prestressing bars under all loading conditions for the submerged scenario and under the static plus seismic loading condition for the non-submerged scenario.
- Digester 12 has D/C ratio of 1.14 for shear stresses at the base of the wall under the static plus seismic loading condition for the non-submerged scenario, and a D/C ratio in excess of 1.10 for the submerged scenario.
- Digester 12 has D/C ratios in excess of 1.10 for wall footing soil bearing pressure under all loading conditions for both submerged and non-submerged scenarios.

The results of the evaluation showed that Digester 1 was overstressed on both submerged and non-submerged fixed cover scenarios and would require extensive concrete rehabilitation to accommodate the maximum operating conditions. Digester 12 was also overstressed, but would require less rehabilitation.

5.2 Sensitivity Analysis Design Criteria and Methodology

Following the B&P analysis, BC performed a sensitivity analysis of Digesters 1 and 12 to determine the loading conditions (i.e., water surface elevation, internal gas pressures, and sludge temperatures, or the combination thereof) that would provide a loading condition that minimizes the concrete rehabilitation and maximize the capacity. The scenarios evaluated for the sensitivity analysis are described below:

- Submerged fixed covers under mesophilic conditions (sludge temperature of 100 °F), normal operating water surface elevation of 5 feet above the digester walls, emergency overflow water surface elevation of 7 feet above the digester walls, and 12-, 14-, and 16-inch water column gas pressures.
- Non-submerged fixed covers under mesophilic conditions, normal operating water surface elevation 4 feet below top of digester wall, emergency overflow water surface elevation of 2 feet below the digester walls, and 12-, 14-, and 16-inch water column gas pressures.
- Non-submerged fixed covers under thermophilic conditions (sludge temperature of 135 °F), normal operating water surface elevation 4 feet below top of digester wall, emergency overflow water surface elevation of 2 feet below the digester walls, and 12-, 14- and 16-inch water column gas pressures.

The sensitivity analysis was completed using MathCAD engineering calculations software to obtain shear, bending, and hoop stresses in the digester wall for the different loading conditions. The stresses from the different loading conditions were combined using the appropriate load factors and compared to the capacity of the existing digester walls. The results of the analysis are summarized in Section 5.4.

5.3 Final Digester Design Criteria and Evaluation Methodology

The sensitivity evaluation showed that Digesters 1 through 3 cannot accommodate any new loads without requiring major rehabilitation; therefore, it was decided that Digester 4 would representative Digesters 4 through 11 in subsequent analyses. Digesters 4 through 11 are 110-feet in diameter with 40-foot walls, while

Digesters 1 through 3 are only 100-feet in diameter with 32.5-foot walls. A new computer model for Digesters 4 and 12 and a new loading condition was set for Digesters 4 through 16 that made rehabilitating the digesters feasible. The new evaluation was based on the following loading conditions:

- Submerged fixed covers under mesophilic conditions (sludge temperature of 100 °F), normal operating water surface elevation of 3 feet above the digester walls, emergency overflow water surface elevation of 5 feet above the digester walls, and 16-inch water column gas pressures.
- Non-submerged fixed covers under mesophilic conditions, normal operating water surface elevation 4 feet below top of digester wall, emergency overflow water surface elevation of 2 feet below the digester walls, and 16-inch water column gas pressures.
- Seismic coefficients:
    - Site Class D
    - Fa = 1.0
    - Fv = 1.5
    - SMS = 1.500; SM1 = 0.900
    - SDS = 1.000; SD1 = 0.600
    - Importance Factor I = 1.25
- Ambient Temperature: 40° F (minimum).
- Vacuum Pressure: 5 inches of water column equal to 26 pounds per square foot (psf) downward suction pressure on proposed roof structure.

Digester dimensions and material properties:

- Digesters 4 through 11:
    - Digester diameter: 110 feet
    - Digester wall height: 40 feet
    - Concrete wall thickness: 10 inches
    - Concrete 28-day compressive strength: 3,000 pounds per square inch (psi).
    - Reinforcing steel conforming to ASTM A15, intermediate grade with 40,000 psi minimum tensile yield strength
    - Circumferential post-tensioned steel rods stressed at 55, 000 psi
- Digesters 12 through 16:
    - Digester diameter: 110 feet
    - Digester wall height: 40 feet
    - Concrete wall thickness: 14 inches
    - Concrete 28-day compressive strength: 4,000 psi
    - Reinforcing steel conforming to ASTM A615 with 60,000 psi minimum tensile yield strength.
    - Vertical prestressing bars have 145,000 psi ultimate tensile strength and 125,000 psi minimum yield strength.
    - Circumferential seven-wire strand prestressing with 3/8-inch-diameter strands with a minimum tensile strength of 21,400 lbs. and minimum yield strength is 16,000 lbs.
- A 10 percent overstress is assumed to be acceptable for analyzing and evaluating the digesters.

The new computer models were completed by BC using the structural engineering computer software RISA 3D. The new computer models were similar to the model used for Digester 12 in the B&P report so that external soil loads and live loads could be used for the new evaluation. The hydrodynamic loads due to the design seismic event, based on ACI 350.3, were calculated using MathCAD sheets.

5.4 Final Results of Sensitivity Analysis and Final Evaluation

This section presents the findings of the sensitivity analysis and the results of the final evaluation of Digesters 4 and 12.

5.4.1 Sensitivity Analysis Findings

The findings of the sensitivity analysis are summarized below:

- The water surface elevation considerably impacts the stresses of the digesters.
- The thermophilic sludge temperature increases the bending and hoop stresses in the digesters by approximately 15 percent.
- The internal gas pressure did not affect the results of the digester walls.
- Digesters 1 though 3 do not have any additional capacity to accommodate a new concrete fixed cover or to increase the current water surface elevation.

5.4.2 Digester 4 Evaluation Results

The key findings from the structural evaluation of Digester 4 are presented in Table 5-1.

Table 5-1. Digester 4 Structural Evaluation Results

Item	Static Loading Non-Submerged	Static Loading Submerged	Static + Seismic Loading Non- Submerged	Static + Seismic Loading Submerged
Shear Stress at Base of Wall	Acceptable	Acceptable	Acceptable	Acceptable
Hoop tension Stress in Circumferential Prestress Bars	Acceptable	Unacceptable (D/C = 1.22 from 10’ to 35’ above base)	Unacceptable (D/C = 1.24 from 15’ to 25’ above base)	Unacceptable (D/C = 1.91 from 8’ to 35’ above base)
Footing Soil Bearing Pressure	Acceptable	Acceptable	Unacceptable (D/C = 1.40)	Unacceptable (D/C = 1.55)

5.4.3 Digester 12 Evaluation Results

The key findings from the structural evaluation of Digesters 12 are presented in Table 5-2.

Table 5-2. Digester 12 Structural Evaluation Results

Item	Static Loading Non-Submerged	Static Loading Submerged	Static + Seismic Loading Non- Submerged	Static + Seismic Loading Submerged
Shear Stress at Base of Wall	Acceptable	Acceptable	Acceptable	Acceptable
Hoop tension Stress in Circumferential Prestress Bars	Acceptable	Acceptable	Acceptable	Unacceptable (D/C = 1.36 from 10' to 30' above base)
Footing Soil Bearing Pressure	Acceptable	Acceptable	Unacceptable (D/C = 1.25)	Unacceptable (D/C = 1.40)

5.5 Digester Rehabilitation

The submerged fixed cover alternative requires a concrete cover that is suitable to resist large uplift loads due to internal liquid and gas pressures. The digesters cannot accommodate a clear span concrete cover because of its weight and seismic overturning; therefore, the submerged concrete cover would require at least four columns be installed inside the digester to resist at least 70 percent of the total weight. The rest of the cover weight can be resisted by the digester walls, which were designed to resist the weight of the existing floating covers when resting on the wall corbels. Since the loads from the new columns would likely exceed the soil bearing capacity, the columns would need to be supported by drilled piers and a pile cap.

The digesters that require hoop strengthening can be retrofitted by adding post-tensioning monostrands over the length of the wall requiring strengthening. Two layers of sheathing protect the monostrands, but a layer of shotcrete over the monostrands is recommended for added protection, aesthetics, and insulation value.

The evaluations also revealed that the soil bearing capacity under the digester wall footings will be exceeded for certain loading and cover conditions. One way to mitigate this problem is to underpin the footings using mini piles or drilled piers. The underpinning could be constructed from the inside of the digesters. The soil bearing capacities were obtained from the original geotechnical investigation reports. B&P and BC recommend that a geotechnical consultant be contracted to determine the actual allowable soil bearing capacity of the soil underneath the footings, which would be expected to be higher than the normal loading (dead plus live loads) allowable of 3,000 psf (with a 33 percent increase for seismic loading) used in the evaluations. This is because the subgrade soil has consolidated over the years due to the heavy weight of the digester structure. The need for underpinning may be eliminated if the soil bearing capacity is revised favorably.

Hoop tensile stresses and bending stresses can increase as much as 20 percent due to thermal stresses from high liquid temperatures under the thermophilic condition. These stresses can be minimized by providing insulation on the outside face of the walls. Shotcrete required for covering the post-tensioning monostrands for hoop rehabilitation can be designed to provide insulation to the digester walls.

5.6 Miscellaneous Evaluations

This section covers the evaluation of the settlement around Digester 4, the need for control of hydrostatic pressure due to high groundwater, and structural options for adding personnel and cleaning equipment access into existing digesters.

5.6.1 Settlement in Existing Digesters

The settlement around Digester 4 is characterized by uneven sidewalk surfaces and by the failure of some of the piping connected to the digester. This settlement can be attributed to poor compaction of the 20-foot deep layer of backfill around the digester. Digester 4 does not seem to have settled but only the ground surrounding it. Typical recommendations for this type of settlement include over excavation of the top two feet of soil and recompact it to 95 percent of the maximum relative compaction of the soils and install flexible joint couplings to all piping connected to the digester wall.

5.6.2 Control of Hydrostatic Pressure Due to High Groundwater

All digesters are equipped with pressure relief valves in the bottom slab and some of the digesters are also equipped with under drainage systems. The pressure relief valves and the under drainage systems have worked well since none of the digesters have been damaged due to groundwater uplift pressures. BC recommends inspecting the pressure relief valves during each digester cleaning and maintenance period and unclogging valves as required.

5.6.3 Adding Personnel and Cleaning Equipment Access into Existing Digesters

The existing digesters are equipped with 24-inch diameter access manways. These manways are small and present problems to personnel to access the interior of the digesters. All digesters are post-tensioned with prestressing rods on the outside face of the digesters walls. These prestressing rods present an obstacle for installing a larger manway. However, BC has installed larger manways on similar digesters with prestressing rods. The process requires either jacking apart the rods or installing new spreader bars to maintain the support of existing post tensioning (see Figure 5-1), and installing new manways. This work is generally expensive and is done during a major digester rehabilitation project. BC recommends that the existing access manway be replaced with new larger manways if the digesters are rehabilitated with new fixed covers. The new rehabilitation schemes include strengthening of the digesters using external post-tensioning tendons.

Figure 5-1. In a retrofit of an existing digester, a spreader bar installed to maintain support of digester post-tensioning around the location of the wall penetration.

6. OVERALL PROJECT RECOMMENDATIONS

The existing digesters were divided into groups that are representative of the different structural characteristics (i.e., age, concrete and rebar strength and construction methods) used during the design. The evaluations helped determine whether they could structurally accommodate steel, concrete, aluminum, or composite material fixed covers, including submerged and non-submerged fixed covers. The main conclusions and recommendations derived from the structural evaluations specific for each of the digester groups are summarized in the following sections.

6.1 Digesters 1 through 3

Digesters 1 through 3 were built in 1956 and are100 feet in diameter with 32.5-foot-high walls. The digesters do not have any additional capacity to accommodate a new fixed cover or to increase the current water surface elevation. Since these digesters are the oldest and smallest of the digesters and rehabilitation is cost prohibitive, BC recommends that the digesters continue to operate at the original water surface elevation.

6.2 Digesters 4 through 11

Digester 4 through 11 can accommodate a new submerged or non-submerged fixed cover. The submerged fixed cover requires more rehabilitation than the non-submerged cover because of the different water surface elevation and weight of the cover. The wall base of Digester 4 is approximately 20 feet below grade, while the wall base for Digesters 5 through 11 are only 10 feet below grade; therefore, the construction cost for hoop strengthening for Digester 4 is greater than the other digesters due to the extra excavation required.

The following is recommended for rehabilitation of the submerged fixed cover scenario:

- Provide additional pre-stressing hoop reinforcement around the tank walls from 8 feet above the base of the wall to the top of the tank. This requires excavation 12 feet below the existing ground elevation around Digester 4.
- Insulation is required for the portion of the digester wall above grade for digestion processes using thermophilic conditions.
- Build a new concrete cover supported by four concrete columns, equally spaced inside the digester; the concrete columns will be supported on a new pile cap supported by drilled piers
- Provide underpinning around the interior perimeter of the digester wall, unless a new geotechnical investigation indicates that the soil bearing capacity criterion can be increased from prior reports because of soil compaction.

The following is the recommended rehabilitation for the non-submerged fixed cover scenario:

- Provide additional pre-stressing hoop reinforcement around the tank walls from 5 feet below ground elevation to 10 feet above ground elevation
- Insulation is required for the portion of the digester wall above grade for digester processes using thermophilic conditions.
- Build a new steel cover to be supported on top of the digester wall.

6.3 Digesters 12 through 16

Digester 12 through 16 can accommodate a new submerged or non-submerged fixed cover. The submerged fixed cover requires structural rehabilitation; while the non-submerged fixed cover scenario requires no rehabilitation.

The following is the recommended rehabilitation for the submerged fixed cover scenario:

- Provide additional pre-stressing hoop reinforcement around the tank walls from ground elevation to the top of wall.
- Insulation is required for the portion of the digester wall above grade for digester processes using thermophilic conditions
- Build a new concrete cover supported by four concrete columns, equally spaced inside the digester
- The new concrete cover will be partially supported by four to 36-inch-diameter concrete columns, equally spaced inside the digester; the concrete columns will be supported on a new pile cap supported by drilled piers
- Provide underpinning around the interior perimeter of the digester wall, unless a new geotechnical investigation indicates that the soil bearing capacity criterion can be increased from prior reports because of soil compaction.

The following is the recommended rehabilitation for the non-submerged fixed cover scenario:

- Insulation is required for the portion of the digester wall above grade for digester processes using thermophilic conditions
- Build a new steel cover to be supported on top of the digester wall.

ATTACHMENT A: B&P REPORT

TECHNICAL MEMORANDUM

STRUCTURAL EVALUATIONS OF DIGESTERS #1 TO #16 FOR NEW FIXED ROOF COVERS

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FINAL DRAFT
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1. PURPOSE

The purpose of this Technical Memorandum (TM) is to summarize the results and recommendations from a study involving the structural and seismic evaluations of existing Digesters 1 through 16 (1–16) at the San Jose/Santa Clara Water Pollution Control Plant (WPCP). The evaluations were conducted to determine if the existing digesters could accommodate several types of new fixed roof covers.

The evaluation was performed using two different structural models that were representative of the 16 different digesters at the facility. The types of new roof covers considered included new fixed steel, aluminum, concrete and composite material. Both submerged and unsubmerged roof covers were considered.

2. DESCRIPTION OF EXISTING DIGESTERS

There are 16 anaerobic digesters of varying ages and structural design. All digesters are circular and partially buried. Each digester is constructed with a reinforced concrete core wall which is post-tensioned in hoop compression. The post-tensioning steel is protected from corrosion by shotcrete. The concrete walls vary from 32 to 40 feet tall and are supported by continuous spread footings. The digester floors are slabs on grade which slope downward from the wall footings to the center of the digester. Each digester currently has a floating steel roof cover, and some of these roof covers have been replaced over the years.

The construction dates of the digesters are as follows:

- Digesters 1,2 and 3: 1956
- Digester 4: 1960
- Digesters 5 and 6: 1961
- Digesters 7 and 8: 1966
- Digesters 9,10 and 11: 1970
- Digesters 12,13,14,15 and 16: 1983

The inside diameter is 100’ for digesters 1-3, and 110’ for digesters 4-16.

3. EXISTING DOCUMENTS

Existing documents including structural drawings, specifications and geotechnical reports were provided by the City of San Jose. Specific documents used as design input for the evaluations are listed in other sections of this document. No original structural design calculations for the digesters were available or provided for review. No design documents were provided for digesters 5-8 and 9-11.

It was assumed that the structural design drawings and specifications represented as-built conditions for the existing digesters. This includes attributes such as material properties, dimensions, details and design conditions.

4. SITE VISIT

A site visit was performed by Beyaz & Patel, Inc. (B&P) on 10-30-08. Visual observations were performed to assess the condition of accessible exterior areas of each of the 16 digesters. The key observations and findings for the digester structures were as follows:

- Minor hairline cracks were observed in the exterior gunite wall cover over the post-tensioned hoop steel. Most cracks were multidirectional and spider web type cracks, and most of these cracks were the reopening of previously patched cracks.
- There were a few larger horizontal discolored cracks in the gunite cover observed on Digesters 1-8.
- There was a major crack and spall in the gunite wall cover where a pipe penetrates the digester wall near grade on Digester 6.
- The top and inside faces of the digester walls above the floating covers, where the structural concrete surface is exposed, were free of cracks, corrosion stains, and concrete spalling. This area of each digester was focused upon during the site visit since it is the only exterior area with the actual concrete surfaces exposed and since any new fixed roof covers would typically be attached to the top of the wall and the upper inside face of the structural walls of the existing digesters.

The overall conclusion resulting from the B&P site visit was that the exterior concrete walls of the digesters above grade were in good condition, and that the concrete walls should not be adversely affected due to aging. In addition, the tops of the walls appear to be in good structural condition, should new fixed roof covers be installed in the future.

In addition to the B&P site visit, V&A performed interior and exterior condition assessments of 5 digesters on 10-27 and 10-28-08. Their findings are documented in their report number 08-0294, “B&C San Jose WPCP Digester Inspection”, which is attached. The results of their investigation also indicate that the digester concrete walls were in good condition, and that the walls and post-tensioning system do not appear to be adversely affected due to aging.

5. EVALUATION CRITERIA AND REFERENCES

The following codes, standards and references were utilized for the structural assessment of these digesters:

- American Concrete Institute (ACI) Standard 350-06, "Code Requirements for Environmental Engineering Concrete Structures"
- American Concrete Institute (ACI) Standard 350.3-06, "Seismic Design of Liquid-Containing Concrete Structures"

- American Water Works Association (AWWA) Standard D110-04, "Wire – and Strand-Wound, Circular, Prestressed Concrete Water Tanks"
- "Serviceability of Circular Prestressed Concrete Tanks" by Ghali and Elliot, ACI Journal, June 1992

- Geotechnical Reports:
  - A) "Report, Foundation Investigation, Proposed Sewage Treatment Works, Santa Clara County, California, for the City of San Jose", September 1954, by Dames & Moore.
  - B) "Geotechnical Report", November 1974, by Woodward-Lundgren & Associates

- Foundation Criteria:

  - Allowable Net Soil Bearing Pressures in pounds per square foot (psf):
    - fb = 1,500 psf (Dead Load) - Geotechnical Report A
    - fb = 2,000 psf (Total Load) - Geotechnical Report A
    - fb= 3,000 psf (Dead Load) - Geotechnical Report B

  - Soil rigidity in vertical direction was assumed to be 50 pounds per cubic inch (pci) downward.
  - Ground water table at 4 feet below grade

- Passive resistance to lateral forces by the soil will develop after a slight horizontal movement. The digesters would then bear laterally against the soil, which would prevent further movement. The passive soil pressure capacity was assumed to be 250 pounds per cubic foot. Soil rigidity in the horizontal direction was assumed to be 40 pounds per cubic foot.
- Site is located in close proximity to active earthquake faults, according to geotechnical reports. The structural evaluation was performed using the site-specific seismic acceleration response spectra coefficients, as required by code, utilizing USGS maps and the latitude and longitude of the site location, and are listed below.

Seismic Coefficients:

Site Class D
Fa = 1.0
Fv = 1.5
SMS = 1.500; SM1 = 0.900
SDS = 1.000; SD1 = 0.600
Importance Factor I = 1.25

- Operating Temperature of Sludge: 135^0 F (maximum).
- Ambient Temperature: 40^0 F (minimum).
- Operating Gas Pressure Inside the Digesters: 18 inch of water column; equal to 94 psf upward pressure on proposed roof covers.
- Vacuum Pressure: 5 inches of water column; equal to 26 psf downward suction pressure on proposed roof structure.
- Specifications for Digesters 1, 2 and 3 indicate that the 28-day concrete compressive strength was 3,000 pounds per square inch (psi); reinforcing steel is ASTM A15, intermediate grade, with 40,000 psi minimum tensile yield strength. Circumferential post-tensioned steel rods have an 80,000 psi minimum yield strength and 105,000 psi ultimate tensile strength.
- Digesters 12-16 have a concrete 28-day compressive strength of 4,000 psi; steel reinforcement is ASTM A615, with 60,000 psi minimum tensile yield strength. Vertical prestressing bars have 145,000 psi ultimate tensile strength and 125,000 psi minimum yield strength. Circumferential seven-wire strand prestressing with 3/8-inch diameter strands is specified, with a minimum tensile strength of 21,400 lb. and minimum yield strength is 16,000 lb.
- A 10% overstress is assumed to be acceptable for analysis and evaluation of existing digesters.

6. ASSUMPTIONS

The following assumptions were used in the structural and seismic evaluations.

- No structural degradation is assumed, based on site visit observations of visible accessible areas.
- Existing structural drawings represent as-built conditions and were constructed in accordance with the specifications.
- Geotechnical reports for Digesters 1, 2 and 3, were assumed to apply for all digesters.
- Allowable soil bearing pressure at grade is 3,000 psf (Dead Load + Live Loads) and 4,000 psf (Dead Load + Seismic Loads). Concrete on soil coefficient of friction is 0.25. Unit weight of soil is 130 pcf; the allowable soil bearing pressures at grade can be increased by 130 pcf X the depth of the bottom of the wall footing below grade to determine the allowable bearing pressures for the bottom of the footings.
- It is assumed that thermal conductivity of soil is twice that of concrete.

7. STRUCTURAL EVALUATION METHODS & MODEL DEVELOPMENT

The loads used to evaluate the digesters were as follows:

- dead load of the digesters
- tributary loads from the proposed roof covers, including dead loads, live loads, gas and vacuum pressures.
- hydrostatic load from the sludge contained in the digesters, which acts radially outward against the walls, and dead load of the sludge, acting on the footing
- thermal effects, which causes bending in the shell wall due to the thermal gradient and radial expansion due to the higher temperature of the sludge.
- impulsive seismic loads, with short periods of vibration acting in both the horizontal and vertical directions
- convective seismic loads with long periods of vibration
- lateral earth and ground water pressures acting laterally on the outside face of the digester walls

Digesters 1 and 12 were selected for structural evaluation. Separate computer math models were developed for each of these two digesters. These two specific digesters were selected because of the availability of original design documents, and the differences in their ages, dimensions and the structural design features. The selection of these two digesters for computer modeling was mutually agreed upon by Brown & Caldwell (BC) and B&P.

Digesters 1-3 are the same design and size, and are the oldest group of the 16 digesters. The walls are 32.5’ high and the wall base varies from 10.5’ to 13’ below grade around the digester periphery. The original maximum operating design sludge level was approximately 2.5’ below the top of the digester walls.

Digesters 12-16 are also the same design and size, and are the newest group of the 16 digesters. The walls are 40’ high and the wall base is approximately 8’ below grade. The original maximum operating design sludge level was approximately 5.5’ below the top of the digester walls.

The 16 digesters were originally designed for a positive gas pressure of +9.5” of water column and a vacuum pressure of -0.86” of water column. The original design sludge temperature was between 95 and 100 degrees F.

The concrete walls of Digesters 1 and 12 were analyzed for all static design loads, including a thermal gradient temperature range from 40 degrees F (ambient temperature) to 135 degrees F (sludge temperature), hydrostatic fluid pressure, design prestress loads (after losses), and tributary roof dead and live loads, using ‘Staad-Pro’ 3D (STAAD) finite element computer models. Effects of seismic and hydrodynamic loads, in combination with static fluid and gravity loads, were evaluated using the procedures and equations in the AWWA D110-04 standard.

Two sludge surface levels were investigated using the STAAD model, unsubmerged and submerged. A unit weight of 70 pounds per cubic foot (pcf) for the sludge was used in the evaluations. In the unsubmerged case, the sludge surface level was assumed to be two feet below the top of the digester wall. In the submerged case, the sludge was assumed to be in contact with the bottom of the proposed concrete roof cover, and the sludge surface level at the central 12-foot diameter opening is six feet above the high point of the sloped slab soffit (or 7' above the top of the wall). Seismic and hydrodynamic loads, using the AWWA D110-04 standard, were considered for the unsubmerged condition; the submerged condition was not specifically evaluated because a review of the unsubmerged condition indicated that the submerged condition was even more critical and therefore unacceptable. The new fixed roof covers were assumed to be supported at the top of the walls.

Digester walls and their footings were modeled as shell elements in STAAD. Element widths were based on a 5 degree spacing, and most elements were 4 feet high. Element nodes at the wall base were released as appropriate to simulate the sliding and/or hinging actions at the joint between the wall and footing. For example, Digester #1 has a non-sliding keyed base that is relatively free to rotate, so wall elements were modeled as hinges at the base nodes. Vertical spring constants were specified at footing support nodes to model the rigidity of the soil.

Most loads in the STAAD computer analysis were modeled as element pressures. Thermal loads were input as temperature ranges for above ground and below ground elements. Tributary loads from the proposed concrete roof structure, including dead, live, gas pressure (for unsubmerged case), and vacuum pressure, were input as vertical point loads at the top of the shell wall. The concrete roof structure was assumed to have four interior columns that support a relatively large portion of the roof loads, with the tributary edge portion supported by the digester wall. Only loads for the proposed concrete roof structure were modeled; the remaining roof cover types were considered to be less critical since their weights are less than that of the concrete roof cover.

8. RESULTS

Key findings from the structural evaluations of the Digesters 1 and 12 walls are presented in Tables 8-1 and 8-2, respectively. The results shown are taken from the calculations for the STAAD computer models, for both the unsubmerged and submerged sludge level cases, and the Mathcad calculations were used to check the AWWA D110-04 requirements for seismic and hydrodynamic loads for the unsubmerged sludge level case.

The maximum operating gas pressure, thermal wall gradient, and maximum sludge operating levels discussed in Section 5 were used for the static load condition. This represented the most critical load condition since these individual loads are all assumed to occur simultaneously for the static load condition; therefore, the results in the tables are maximum upper bound values. If any of the maximum individual design conditions were to decrease, the evaluation results provided in the tables would change, and generally be more favorable in that more items listed may become acceptable, as defined below.

The D/C ratios in the tables represent the Demand “D” divided by the Capacity “C” for each of the various items listed. The Demand is the strength requirement for the specified loading condition based on the analysis, and the Capacity is the strength capacity calculated using the current code for the structure or structural attribute listed. Since the current codes allow for a 10% increase in the calculated capacity for the evaluation of existing structures in good condition, the maximum allowable D/C ratio of 1.10 would be allowed to meet current code requirements. Structural elements with a D/C ratio less than or equal to 1.10 meet current code requirements for strength and are therefore determined to be “acceptable”; those with ratios larger than 1.10 do not have sufficient strength capacity as compared to the strength needed, and are therefore determined to be "unacceptable”. When a table entry “Expected to be …” appears, this conclusion is based on using engineering judgment and experience by extrapolating similar related analytical results from the models evaluated quantatively. For example, for Digester 1, item 5, concerning the footing soil bearing pressure, the D/C = 0.91 for the unsubmerged static load case; based on engineering judgment, the D/C ratio is expected to exceed 1.1 for the submerged static load case due to the significantly larger weight of the contained sludge acting downward on the footing and the increased hydrostatic sludge pressure acting laterally on the walls.

When the entry “Not Applicable” appears in a table, this means that the results do not apply. For example, sliding and overturning of the digester would apply only when seismic loads are combined with static loads, and therefore would not exist or apply under only a static loading condition, submerged or unsubmerged.

TABLE 8-1: DIGESTER #1

STRUCTURAL EVALUATION RESULTS

(See Section 8 for explanation of table terminology)

ITEM	STATIC LOADING		STATIC + SEISMIC LOADING (using AWWA D-110)
	UNSUBMERGED	SUBMERGED	UNSUBMERGED
1. Shear Stress at Base of Wall	Acceptable (D/C = 0.97)	Unacceptable (D/C = 1.19)	Unacceptable (D/C = 1.79)
2. Hoop Tension Stress in Circumferential Prestress Bars	Unacceptable (D/C = 1.25 to 1.89; from top of wall to 5' above wall base)	Unacceptable (D/C = 1.63 to 2.91)	Unacceptable (D/C = 3.91 at 4' above the wall base)
3. Overturning Stability	Not Applicable	Not Applicable	Unacceptable (net uplift of base occurs)
4. Sliding Stability	Not Applicable	Not Applicable	Acceptable (D/C = 0.84)
5. Footing Soil Bearing Pressure	Acceptable (D/C = 0.91)	Expected to be Unacceptable with D/C > 1.1	Acceptable (D/C = 0.80)
6. Sludge Wave Height	Not Applicable	Not Applicable	Unacceptable (Freeboard= 2'; Wave= 4.2') (D/C = 2.1)

TABLE 8-2: DIGESTER #12

STRUCTURAL EVALUATION RESULTS

(See Section 8 for explanation of table terminology)

ITEM	STATIC LOADING		STATIC + SEISMIC LOADING (using AWWA D-110)
	UNSUBMERGED	SUBMERGED	UNSUBMERGED
1. Shear Stress at Base of Wall	Acceptable (D/C = 0.48)	Acceptable (D/C = 0.42)	Unacceptable (D/C = 1.14)
2. Hoop Tension Stress in Circumferential Prestress Strands	Acceptable (D/C = 0.56 to 0.86)	Unacceptable (D/C = 1.20 at 30' above base) (D/C = 1.11 or less elsewhere)	Unacceptable (D/C = 1.35 at wall base)
3. Overturning Stability	Not Applicable	Not Applicable	Acceptable (seismic cables will resist net uplift at the base of the wall)
4. Sliding Stability	Not Applicable	Not Applicable	Acceptable (D/C = 0.77)
5. Footing Soil Bearing Pressure	Unacceptable (D/C = 1.22)	Expected to be Unacceptable with D/C > 1.22	Unacceptable (D/C = 1.31)
6. Sludge Wave Height	Not Applicable	Not Applicable	Unacceptable (Freeboard=2'; Wave=4.45') (D/C = 2.23)

9. CONCLUSIONS AND RECOMMENDATIONS:

The main conclusions and recommendations resulting from the structural evaluation are summarized below.

Digester 1

For the maximum operating conditions considered (gas pressure, thermal gradient and sludge level), it may not be cost effective to strengthen Digester 1 by adding additional prestressing to increase the hoop tension strength. Strengthening would require the addition of a post-tensioning system and shotcrete cover to the exterior face of the digester wall over the upper 25 feet of wall height for the unsubmerged case and full wall height for the submerged case. Strengthening would be required regardless of the type of new fixed roof cover selected.

Due to the net uplift at the wall base resulting from the seismic/hydrodynamic overturning stability analysis, additional anchorage is also needed to secure the wall to the footing. This could be accomplished by the addition of a concrete curb wall with reinforcing bar dowels to the interior face of the existing wall and wall footing. The addition of a curb wall would also increase the shear strength at the base of the wall, which was found to be unacceptable for both the unsubmerged static plus seismic and the submerged static loading cases.

It is our opinion that the conclusions and recommendations for Digester 1 would also apply to Digesters 2 - 8. This opinion is based on a cursory review of available design drawings, the observations during the site visits, the age of the digesters and the overall digester dimensions, indicating that Digesters 1 - 8 are mostly similar types of structures which can be grouped together.

Prior to starting the final design of any structural modifications to Digesters 1 – 8, we recommend that a materials testing lab be consulted to determine the actual concrete compressive strength of the digester walls; the actual strength would be expected to exceed the 3,000 psi design strength as a result of long term curing of the concrete, which could be used to increase the actual wall strength capacity. We also recommend that a geotechnical consultant be contacted to determine the allowable soil bearing capacity of the soil underneath the footings, which would be expected to be higher than the normal loading (dead plus live loads) allowable of 3,000 psf (with a 33% increase for seismic loading) used in the evaluations; this is because the subgrade soil has consolidated over the years due to the heavy weight of the digester structure and sludge contents since the digesters were originally constructed.

Digester 12

For the maximum operating conditions considered, the following structural improvements would be needed for Digester 12:

- For the unsubmerged seismic case, the bottom 12 foot high section of the 40 foot high walls would require strengthening by adding prestressing to increase the hoop tension strength. Strengthening would require the addition of a post-tensioning system and shotcrete cover to the exterior face of the wall. We recommend that estimated cost of this strengthening be determined and compared to the overall long term benefits.
- For the submerged case, significant strengthening of the walls would be required. The strengthening would involve the addition of a post-tensioning system and shotcrete cover for the full height of the digester walls.

The maximum shear stress at the base of the wall for the unsubmerged plus seismic case has a D/C =1.14, which is only slightly higher than a maximum allowed value of 1.10 for existing structures (10% overstress is allowed). Therefore we would recommend further evaluation during the final design, including testing to determine the actual existing concrete strength, which should be higher than the 4,000 psi minimum strength used in our evaluation as part of this study.

It is our opinion that the conclusions and recommendations for Digester 12 would also apply to those digesters remaining in the group of Digesters 9 - 16, which can be grouped together based on similarity. This opinion is based on the same reasons previously mentioned above for grouping Digesters 1 - 8 together in their own group.

ALL DIGESTERS

The sludge wave height during the seismic event exceeds the freeboard provided for Digesters 1 and 12 based on the evaluation results for the unsubmerged case. In our opinion, this would also be expected to apply to all of the remaining digesters based on similarity. The net upward force on any new fixed roof covers around the peripheral digester walls, if any, could be accounted for in their design or the maximum sludge surface operating level could be lowered in elevation from 2.0 feet (used in the evaluation) to approximately 4.5 feet below the top of the walls. This should be evaluated in more detail during the design stage if new fixed roof covers will be installed in the future.

Since the results presented are based on the assumed maximum operating conditions (gas pressure, thermal gradient, and sludge level), we recommend that the option of reducing the operating conditions be considered; additional evaluations using reduced operating conditions would be recommended since the results may indicate that fewer structural modifications or less modification effort would be required than previously discussed.

Based on the unsubmerged static and seismic evaluation results of this study indicating that significant strengthening would be required, even more significant strengthening would be required for the submerged case.

ATTACHMENT A
Digester 1 Calculations

SAN JOSE / SANTA CLARA WATER POLLUTION CONTROL PLANT -- CIRCULAR CONCRETE SLUDGE DIGESTERS #'S 1, 2, 3 -- UNSUBMERGED CASE.

DESIGN DATA AND ASSUMPTIONS

DIMENSIONS

Tank inside diameter $D := 100.0 \cdot ft$

Top of Footing $y_f := 0.0 \cdot ft$

Top of Wall $y_r := 32.5 \cdot ft$

Maximum sludge surface elevation $y_w := 30.5 \cdot ft$

Tank height $Y_r := y_r - y_f$ $Y_r = 33\,ft$

Shell wall thickness, upper $t_{w1} := 10 \cdot in$

Shell wall thickness, lower $t_{w2} := 12 \cdot in$

Wall boundary $y_b := 12.0 \cdot ft$

Wall height upper $Y_{w1} := y_r - y_b$ $Y_{w1} = 21\,ft$

lower $Y_{w2} := y_b - y_f$ $Y_{w2} = 12\,ft$

Footing toe width (outside wall) $b_{fe} := 3.0 \cdot ft$

Footing thickness (floor slab is footing) $t_f := 18.0 \cdot in$

Water table elevation $y_g := 8. \cdot ft$

Maximum water height $H := y_w - y_f$ $H = 31\,ft$

Capacity of tank $Q := \frac{\pi}{4} \cdot D^2 \cdot H$ $Q = 1791932\,gal$

DESIGN LOADS

Dead load

Unit weight of concrete $\gamma_c := 150 \cdot \dfrac{\text{lbf}}{\text{ft}^3}$

Unit weight of soil $\gamma_s := 130 \cdot \dfrac{\text{lbf}}{\text{ft}^3}$

Unit weight of sludge $\gamma_w := 70 \cdot \dfrac{\text{lbf}}{\text{ft}^3}$

Unit dead weight of roof $\sigma_{rd} := 175 \cdot \dfrac{\text{lbf}}{\text{ft}^2}$

Design live load $\sigma_l := 20 \cdot \dfrac{\text{lbf}}{\text{ft}^2}$

REINFORCED CONCRETE PROPERTIES

$\text{kip} := \text{lbf} \cdot 1000$

Reinforcement yield stress $f_y := 40 \cdot \dfrac{\text{kip}}{\text{in}^2}$

Concrete compressive stress $f_c := 3.0 \cdot \dfrac{\text{kip}}{\text{in}^2}$

Concrete Young's Modulus $E_c := 3100 \cdot \dfrac{\text{kip}}{\text{in}^2}$

SEISMIC ACCELERATIONS

$r := \frac{D}{2}$

$C_a := 0.528$ Ref.: UBC, Tables 16-S and 16-Q and UBC-California maps (~ 5km. from Type 'A' fault); assumed Type 'S_D' soil

$I := 1.25$

$S_s := 1.0$

$g = 32 \frac{ft}{s^2}$ gravitational acceleration

$W_w := \gamma_w \cdot Q$ $W_w = 16768\,kip$ weight of contained water

$W_s := \gamma_c \cdot \pi \cdot (t_{w1} \cdot Y_{w1} + t_{w2} \cdot Y_{w2}) \cdot D$ $W_s = 1371\,kip$ weight of shell

$W_r := (\sigma_{rd} \cdot \pi \cdot r^2)$

$W_r = 1374\,kip$ weight of roof

$W_t := (W_s + W_r + W_w)$ $W_t = 19513\,kip$

~~$\alpha_{ca} := 30 \cdot deg$ angle of inclination of steel connection strands used at base~~

~~$A_{ca} := 0.227 \cdot in^2$ area of connection strands, each (0.60-inch dia.)~~

~~$G_{pd} := 135 \cdot \frac{lbf}{in^2}$ shear modulus of bearing pads~~

~~$\lambda_{pd} := 1.0$~~

~~$b_{pd} := 3.0 \cdot in$~~

~~$E_s := 29000 \cdot \frac{kip}{in^2}$ modulus of elasticity of steel strands~~

NA

~~$s_{ca} := 24 \cdot in$ spacing of diagonal strands at base; initial trial~~

~~$L_{sl} := 10 \cdot in$ sleeve length at cables~~

~~$L_{ca} := L_{sl} + 18 \cdot in$ $L_{ca} = 28\,in$~~

~~$t_{pd} := 1.0 \cdot in$~~

Horizontal - impulsive seismic load - AWWA method

Ref.: AWWA, Ch. 4

$$W_i := \frac{\tanh\left(3^{0.5} \cdot \frac{r}{H}\right) \cdot W_w}{\frac{3^{0.5} \cdot r}{H}} \qquad W_i = 5865\,kip$$

weight of water which moves in concert with tank

~~$k_j := 144 \cdot \left(\frac{A_{ca} \cdot E_s \cdot \cos(\alpha_{ca})^2}{L_{ca} \cdot s_{ca}} + \frac{2 \cdot G_{pd} \cdot b_{pd} \cdot \lambda_{pd}}{t_{pd}}\right)$ $k_j = 1175 \frac{kip}{in^2}$~~

NA, DUE TO BASE TYPE

Ref AWWA, Eq. 4-9

$T_i := 0.10$ (SEE BELOW)

$T_i = 0.100$ $\quad T_{ii} := \frac{T_i}{sec}$ period of vibration of tank

$$C_{it} := (1.25 \cdot S_s) / [T_{ii}]^{0.667}$$

$C_{it} := 5.80$ $\quad C_{it} = 6$

$C_i := \min(2.75, C_{it})$ $\quad C_i = 2.75$

$R_i := 2.75$ Ref: AWWA, Table 4 Tank with non-sliding base

$\alpha_i := \frac{C_a \cdot I \cdot C_i}{R_i}$ EQ 4-4

$\alpha_i = 0.660$ Horizontal-impulsive seismic acceleration as proportion of gravitational

$$T_I = 2\pi / \omega_I$$

$$\omega_I = C_L \times \frac{12}{H} \sqrt{\frac{E_c}{\rho_c}}; \quad C_L = C_W \times 10 \sqrt{\frac{t_w}{12r}}$$

$$r/H = 50/20.5 = 1.64$$

$$\rightarrow C_W = 0.143$$

(Fig. 6)

$$C_L = 0.143 \times 10 \sqrt{\frac{11.0 \text{ AVG}}{12 \times 50}}$$

$$C_L = 0.194$$

$$\omega_I = 0.194 \times \frac{12}{30.5} \times \sqrt{\frac{3{,}100 \times 10^3 \text{ lb/in}^2}{4.66 \text{ lb-s}^2/\text{ft}^4}}$$

$$\omega_I = 62.25 \text{ rad/sec}$$

$$T_I = 2\pi / 62.25 \text{ rad/sec} = \underline{0.10 \text{ sec}} < 0.3 \text{ sec}$$

Horizontal - convective seismic load - AWWA method

$$W_c := \tanh\left(3.375^{0.5} \cdot \frac{H}{r}\right) \cdot \frac{3.375^{0.5} \cdot r W_w}{4 \cdot H} \qquad W_c = 10198\,\text{kip}$$

weight of water which moves in waves

$$T_c := \left(\frac{r}{1.5 \cdot \tanh\left(3.375^{0.5} \cdot \frac{H}{r}\right) \cdot ft}\right)^{0.5} \cdot sec$$

$$T_c = 6.42\,s \qquad T_{ci} := \frac{T_c}{sec}$$

period of vibration of water waves

$$C_c := \frac{6 \cdot S_s}{T_{ci}^{\ 2}} \qquad C_c = 0.145$$

$$R_c := 1$$

$$Y_c := H \cdot \left[1 - \left[\frac{\cosh\left(3.375^{0.5} \cdot \frac{H}{r}\right) - 1}{\left(3.375^{0.5} \cdot \frac{H}{r}\right) \cdot \sinh\left(3.375^{0.5} \cdot \frac{H}{r}\right)}\right]\right] \qquad Y_c = 17\,\text{ft}$$

$$\alpha_c := \frac{C_a \cdot I \cdot C_c}{R_c} \qquad \alpha_c = 0.096$$

Horizontal-convective seismic acceleration as proportion of gravitational

Vertical seismic load - AWWA

Ref.: AWWA, Sec. 4.5

$C_v := 2.75$

$R_v := 3.0$

$B := 0.66$ For Zone 4

$\beta := \frac{C_a \cdot I \cdot C_v}{R_v} \cdot B$ $\beta = 0.399$ Vertical seismic acceleration as proportion of gravitational

SHELL WALL

STATIC-LOAD CASE

$D = 100.0\,\text{ft}$ tank diameter

$H = 30.5\,\text{ft}$ water depth

$t_{w1} = 10.0\,\text{in}$ ***wall thickness***

Circumferential compression force in wall, required

$$f_c = 3.0\,\frac{\text{kip}}{\text{in}^2}$$

$$\omega_{sw} := \left(\frac{\gamma_w \cdot D \cdot H}{2}\right) \qquad \omega_{sw} = 107\,\frac{\text{kip}}{\text{ft}}$$

prestress force in circumferential direction required for static loading considerations

$$\omega_{swj} := \left[\frac{\gamma_w \cdot D \cdot \left(H - Y_{w2}\right)}{2}\right]$$

Assumed: that prestress bar stress after all losses is: $f_{pss} := 68 \cdot \frac{\text{kip}}{\text{in}^2}$ *

Required strand area at base is: $A_{psr} := \frac{\omega_{sw}}{f_{pss}}$ $A_{psr} = 1.570\,\frac{\text{in}^2}{\text{ft}}$

$\sigma_{crd} := 200 \cdot \frac{\text{lbf}}{\text{in}^2}$ required minimum residual compression hoop stress in shell, empty tank; Ref.: AWWA D110, Sec. 3.5.2

$\omega_{sd} := \sigma_{crd} \cdot t_{w1}$ $\omega_{sd} = 24\,\frac{\text{kip}}{\text{ft}}$ Provide for ω_{sd} at top of shell and ω_{sw} at bottom of shell

$$* \; f_{pss} = 0.65\,F_u \;(\text{AWWA } 3.4.2.3)$$
$$= 0.65 \times 105\,\text{ksi}$$
$$= 68\,\text{ksi}$$

~~$Y_r = 33\ \text{ft}$ roof height~~

~~$Y_{frp} := y_r - y_w$ $Y_{frp} = 2.00\ \text{ft}$ freeboard height provided~~

~~Define: $\text{hyp}(a,b) := \left(a^2 + b^2\right)^{0.5}$~~

~~$r_i := \frac{r}{ft}$~~

SEE p. 15 FOR
FREEBOARD / WAVE HEIGHT
CHECK

SEISMIC-LOAD CASE

Base shear and overturning moment - AWWA method

$V_i := \alpha_i \cdot (W_t - W_w + W_i)$

$V_i = 5683\,\text{kip}$ impulsive-load base shear

$Y_s := \frac{Y_r}{2}$ $Y_s = 16\,\text{ft}$

$Y_i := 0.375 \cdot H$ $Y_i = 11\,\text{ft}$

$M_i := \alpha_i \cdot (W_s \cdot Y_s + W_r \cdot Y_r + W_i \cdot Y_i)$

$M_i = 88456\,\text{ft} \cdot \text{kip}$ impulsive-load overturning moment at base

$Y_c = 17\,\text{ft}$

$V_c := \alpha_c \cdot W_c$ $V_c = 979\,\text{kip}$ convective-load base shear

$M_c := V_c \cdot Y_c$ $M_c = 16313\,\text{ft} \cdot \text{kip}$ convective-load overturning moment at base

$V_q := \text{hyp}(V_c, V_i)$ $V_q = 5766\,\text{kip}$ total seismically-generated shear at base

$M_q := \text{hyp}(M_c, M_i)$ $M_q = 89948\,\text{ft}\,\text{kip}$ total seismically-generated overturning moment at base

Shear and overturning moment at wall-wall joint - AWWA method

$W_{sj} := \gamma_c \cdot \pi \cdot (t_{w1} \cdot Y_{w1}) \cdot D$ $W_{sj} = 805\,\text{kip}$ weight of portion of shell above wall-wall joint

$$W_{ij} := W_i \cdot \frac{6 \cdot Y_i \cdot Y_{w2} \cdot H + H^3 - 4 \cdot Y_{w2} \cdot H^2 + 3 \cdot Y_{w2}^{\ 2} \cdot H - 6 \cdot Y_i \cdot Y_{w2}^{\ 2}}{H^3}$$

$W_{ij} = 2508\,\text{kip}$

$$W_{cj} := W_c \cdot \frac{H^3 - 4 \cdot H^2 \cdot Y_{w2} + 6 \cdot H \cdot Y_c \cdot Y_{w2} - 6 \cdot Y_c \cdot Y_{w2}^{\ 2} + 3 \cdot H \cdot Y_{w2}^{\ 2}}{H^3}$$

$W_{cj} = 6865\,\text{kip}$

$V_{ij} := \alpha_i \cdot (W_{sj} + W_r + W_{ij})$

$V_{ij} = 3094\,\text{kip}$ impulsive-load shear at w-w joint

$$Y_{sj} := \frac{Y_r - Y_{w2}}{2}$$

$Y_{rj} := Y_r - Y_{w2}$

$Y_{ij} := 0.375 \cdot (H - Y_{w2})$

$M_{ij} := \alpha_i \cdot (W_{sj} \cdot Y_{sj} + W_r \cdot Y_{rj} + W_{ij} \cdot Y_{ij})$

$M_{ij} = 35525\,\text{ft} \cdot \text{kip}$ impulsive-load overturning moment at base (OF UPPER WALL)

$V_{cj} := \alpha_c \cdot W_{cj}$ $V_{cj} = 659\,\text{kip}$ convective-load base shear (OF UPPER WALL AT JOINT)

$$Y_{cj} := \frac{Y_c}{H} \cdot (H - Y_{w2})$$

$M_{cj} := V_{cj} \cdot Y_{cj}$ $M_{cj} = 6661\,\text{ft} \cdot \text{kip}$ convective-load overturning moment at base (OF UPPER WALL)

$V_{qj} := \text{hyp}(V_{cj}, V_{ij})$ $V_{qj} = 3163\,\text{kip}$ total seismically-generated shear at base (OF UPPER WALL)

$M_{qj} := \text{hyp}(M_{cj}, M_{ij})$ $M_{qj} = 36144\,\text{ft}\,\text{kip}$ total seismically-generated overturning moment at base (OF UPPER WALL)

Shell shear capacity - upper portion - AWWA method

$f_{ci} := 1000 f_c \cdot \frac{in^2}{kip}$ $f_{ci} = 3000$

$V_{scq1} := 1.1 \cdot 1.25 \cdot f_{ci}^{0.5} \cdot \frac{lbf}{in^2} \cdot t_{w1} \cdot 2 \cdot D$ Ref.: AWWA D110, Sec. 4.6.1

$V_{scq1} = 1807\,kip$ $\text{if}(V_{scq1} > V_{qj}, 1, 0) = 0$ need wall reinforcement

Provide wall reinforcement : # 6 bars, @ : $s_{wb1a} := 8 \cdot in$

Provide wall reinforcement : # 0 bars, @ : $s_{wb1b} := 1 \cdot in$

$A_{b4i} := 0.44 \cdot in^2$

$A_{b5i} := 0 \cdot in^2$

$A_{wb1} := \frac{A_{b4i}}{s_{wb1a}} + \frac{A_{b5i}}{s_{wb1b}}$ $A_{wb1} = 0.66 \frac{in^2}{ft}$

$f_{sra} := 18 \frac{kip}{in^2}$ allowable reinf. tensile stress; Ref.: AWWA D110, Sec. 3.5.6

$V_{srq1} := f_{sra} \cdot 2 \cdot D \cdot A_{wb1}$ $V_{srq1} = 2376\,kip$ Additional shear capy. due to reinf.

$V_{sq1} := \min(V_{scq1} + V_{srq1}, 5.0 \cdot V_{scq1})$ Ref.: AWWA D110, Sec. 3.4.1

$V_{sq1} = 4183\,kip$ $\text{if}(V_{sq1} > V_{qj}, 1, 0) = 1$ (OK)

Shell shear capacity - lower portion - AWWA method

$$V_{scq2} := 1.1 \cdot 1.25 \cdot f_{ci}^{0.5} \cdot \frac{lbf}{in^2} \cdot t_{w2} \cdot 2 \cdot D$$

$V_{scq2} = 2169\,kip$ $\quad$ $if(V_{scq2} > V_q, 1, 0) = 0$ $\quad$ need wall reinforcement

Provide wall reinforcement : # 6 bars, @ : $\quad s_{wb2a} := 8 \cdot in$

Provide wall reinforcement : # 0 bars, @ : $\quad s_{wb2b} := 1 \cdot in$

$$A_{b8i} := 0 \cdot in^2$$

$$A_{b6i} := 0.44 \cdot in^2$$

$$A_{wb2} := \frac{A_{b6i}}{s_{wb2a}} + \frac{A_{b8i}}{s_{wb2b}} \qquad A_{wb2} = 0.66\,\frac{in^2}{ft}$$

$V_{srq2} := f_{sra} \cdot 2 \cdot D \cdot A_{wb2}$ $\quad$ $\underline{V_{srq2} = 2376\,kip}$ $\quad$ Additional shear capy. due to reinf.

$V_{sq2} := \min(V_{scq2} + V_{srq2}, 5.0 \cdot V_{scq2})$ $\quad$ Ref.: AWWA D110, Sec. 3.4.1

$= 5766^K$

$V_{sq2} = 4545\,kip$ $\quad$ $if(V_{sq2} > V_q, 1, 0) = 0$

$(= 2169^K + 2376^K)$ $\quad$ $\underline{NG}$

$$D/C = \frac{5766^K}{4545^K} = \underline{1.27} \quad \text{(SEISMIC ONLY)}$$

∴ COMBINE w/ STATIC SHEAR FROM 'STAAD' ANALYSIS — SEE p. 20 OF CALCULATIONS

Water waves and freeboard - AWWA method

$Y_{frp} := y_r - y_w$ $Y_{frp} = 2.0\,\text{ft}$

$H_{wq1} := C_a \cdot I \cdot C_c \cdot r$ $H_{wq1} = 4.80\,\text{ft}$

$$H_{wq2} := \frac{\coth\left(3.375^{0.5} \cdot \frac{H}{r}\right) \cdot 3 \cdot r}{\left(\frac{6 \cdot T_{ci}^{\ 2}}{C_a \cdot I \cdot C_c \cdot r_i}\right) - 54^{0.5}} \qquad H_{wq2} = 4.20\,\text{ft}$$

$H_{wq} := \min\left(H_{wq1}, H_{wq2}\right)$ $H_{wq} = 4.20\,\text{ft}$ design seismic water wave height

$\text{if}\left(Y_{frp} > H_{wq}, 1, 0\right) = 0$ waves will hit roof

Seismic hoop forces at base of wall - AWWA method

$$\omega_{nim} := \frac{\alpha_i \left(\frac{W_s}{2} + W_r + W_i \right) \cdot \left(4 - \frac{6 \cdot Y_i}{H} \right)}{\pi \cdot H}$$

$$\omega_{nim} = 96 \frac{kip}{ft}$$

maximum impulsive seismic hoop tension in shell, which occurs at base of tank; Assumed: trapezoidal distribution

$$\omega_{ncn} := \frac{8\alpha_c W_c \cdot \left(4 - \frac{6Y_c}{H} \right)}{9 \cdot \pi \cdot H}$$

$$\omega_{ncn} = 7 \frac{kip}{ft}$$

convective seismic hoop tension in shell occurring at base; Assumed: trapezoidal distribution

$$\omega_{nvm} := \beta \cdot \gamma_w \cdot H \cdot r \qquad \omega_{nvm} = 43 \frac{kip}{ft}$$

maximum vertically-induced seismic hoop tension in shell, which occurs at base of tank; Assumed: triangular distribution of stresses

$$\omega_{qm} := \omega_{sw} + hyp\left(hyp\left(\omega_{nim}, \omega_{ncn}\right), \omega_{nvm}\right)$$

combines statically- and seismically-induced hoop stresses in wall

$$\omega_{qm} = 212 \frac{kip}{ft}$$

maximum circumferential tension at base of shell during earthquake, due to combination of static and earthquake loads; provide at least enough prestress force at base to account for this case, assumed:

$$f_{psq} := 85 \cdot \frac{kip}{in^2}$$

prestress-bar stress developed in earthquake- load case

$$A_{sqr} := \frac{\omega_{qm}}{f_{psq}} \qquad A_{sqr} = 2.489 \frac{in^2}{ft}$$

Note that this amount is more than that required for static loads

Use "virtual" prestress force: $\omega_{qv} := A_{sqr} \cdot f_{pss}$ $\qquad \omega_{qv} = 169 \frac{kip}{ft}$ at base

Seismic hoop forces at wall-wall joint - AWWA method

$$\omega_{nij} := \frac{\alpha_i\left(\frac{W_s}{2} + W_r + W_i\right)\cdot\left[4 - \frac{6\cdot\left(Y_{w2} + Y_i\right)}{H} + \frac{12\cdot Y_i\cdot Y_{w2}}{H^2}\right]}{\pi\cdot H}$$

$$\omega_{nij} = 63\,\frac{kip}{ft}$$

maximum impulsive seismic hoop tension ir shell, which occurs at base of tank; Assumed: trapezoidal distribution

AT JOINT

$$\omega_{ncj} := \frac{8\alpha_c W_c\cdot\left[4 - \frac{6\cdot\left(Y_{w2} + Y_i\right)}{H} + \frac{12\cdot Y_i\cdot Y_{w2}}{H^2}\right]}{9\cdot\pi\cdot H}$$

$$\omega_{ncj} = 11\,\frac{kip}{ft}$$

convective seismic hoop tension in shell occurring at base; AT JOINT
Assumed: trapezoidal distribution

$$\omega_{nvj} := \beta\cdot\gamma_w\cdot\left(H - Y_{w2}\right)\cdot r \qquad \omega_{nvj} = 26\,\frac{kip}{ft}$$

maximum vertically-induced seismic hoop tension in shell, which occurs at base of tank; Assumed: triangular distribution of stresses

AT JOINT

$$\omega_{qj} := \omega_{swj} + hyp\left(hyp\left(\omega_{nij},\omega_{ncj}\right),\omega_{nvj}\right)$$

combines statically- and seismically-induced hoop stresses in wall

$$\underline{\underline{\omega_{qj} = 134\,\frac{kip}{ft}}}$$

maximum circumferential tension at base of shell during earthquake, due to combination of static and earthquake loads; provide at least enough prestress force at base to account for this case, assumed:

$$f_{psq} := 85\cdot\frac{kip}{in^2}$$

prestress-bar stress developed in earthquake- load case

$$A_{sqr} := \frac{\omega_{qj}}{f_{psq}} \qquad A_{sqr} = 1.576\,\frac{in^2}{ft}$$

Note that this amount is more than that required for static loads

Use "virtual" prestress force: $\omega_{qv} := A_{sqr}\cdot f_{pss}$ $\qquad \omega_{qv} = 107\,\frac{kip}{ft}$

AT JOINT

Seismic hoop forces at top of wall - AWWA method

$$\omega_{nin} := \frac{\alpha_i\left(\frac{W_s}{2} + W_r + W_i\right)\cdot\left(\frac{6\cdot Y_i}{H} - 2\right)}{\pi\cdot H}$$

$$\omega_{nin} = 14\frac{kip}{ft}$$

minimum impulsive seismic hoop tension in shell, which occurs at top of wall

$$\omega_{ncm} := \frac{8\alpha_c W_c\cdot\left(\frac{6\cdot Y_c}{H} - 2\right)}{9\cdot\pi H}$$

$$\omega_{ncm} = 12\frac{kip}{ft}$$

maximum convective seismic hoop tension in shell, which occurs at top

$$\omega_{qt} := \omega_{nin} + \omega_{ncm}$$

$$\omega_{qt} = 25\frac{kip}{ft}$$

maximum circumferential tension at top of shell during earthquake; since ω_{sd} is more than this, provide at least that much prestress force at top

Vertical forces at wall-wall joint, seismic-load case - AWWA method

Combine the effects of horizontal and vertical seismic loads by square-root-of-sum-of-squares method; Ref.: ACI, Sec. 4.5

$$\omega_{wj} := \left(Y_{w1} \cdot t_{w1}\right)$$

$$\sigma_g := -94.0 \cdot \frac{lbf}{ft^2}$$ gas upward pressure

$$\omega_{qcj} := \left(\omega_{wj} \cdot \gamma_c + \frac{\sigma_{rd} \cdot r}{2}\right) + hyp\left[\frac{1.273 \cdot M_{qj}}{D^2}, \left(\omega_{wj} \cdot \gamma_c + \frac{\sigma_{rd} \cdot r}{2}\right) \cdot \beta\right]$$

$$\omega_{qcj} = 12.31 \frac{kip}{ft}$$ maximum compression force at base, seismic-load case

AT WALL-TO-WALL CONSTRUCTION JOINT

$$\omega_{qtj} := \left[\omega_{wj} \cdot \gamma_c + \frac{\left(\sigma_{rd} + \sigma_g\right) \cdot r}{2}\right] - hyp\left[\frac{1.273 \cdot M_{qj}}{D^2}, \left(\omega_{wj} \cdot \gamma_c + \frac{\sigma_{rd} \cdot r}{2}\right) \cdot \beta\right]$$

maximum tension (if < 0) or minimum compression (if > 0) force at base, seismic-load case

$$\omega_{qtj} = -0.78 \frac{kip}{ft}$$ **Note that this value is LESS than zero; i.e., net UPLIFT OCCURS at wall-wall joint.**

NOT A PROBLEM — REINFORCING EXTENDS THRU WALL-TO-WALL CONSTRUCTION JOINT

Vertical forces at wall base, seismic-load case - AWWA method

$$\omega_w := \left(Y_{w1} \cdot t_{w1} + Y_{w2} \cdot t_{w2}\right)$$

$$\omega_{qc} := \left(\omega_w \cdot \gamma_c + \frac{\sigma_{rd} \cdot r}{2}\right) + \mathrm{hyp}\left[\frac{1.273 \cdot M_q}{D^2}, \left(\omega_w \cdot \gamma_c + \frac{\sigma_{rd} \cdot r}{2}\right) \cdot \beta\right]$$

$$\omega_{qc} = 20.71 \frac{kip}{ft}$$

$$\omega_{qt} := \left[\omega_w \cdot \gamma_c + \frac{\left(\sigma_{rd} + \sigma_g\right) \cdot r}{2}\right] - \mathrm{hyp}\left[\frac{1.273 \cdot M_q}{D^2}, \left(\omega_w \cdot \gamma_c + \frac{\sigma_{rd} \cdot r}{2}\right) \cdot \beta\right]$$

maximum tension (if < 0) or minimum compression (if > 0) force at base, seismic-load case

$$\omega_{qt} = -5.58 \frac{kip}{ft}$$

Note that this value is LESS than zero; i.e., net UPLIFT OCCURS at ~~wall-wall~~ base joint.

~~Compare with reinforcement capacity at same location~~

~~$\phi_t := 0.90$~~

~~$\omega_{tr2} := f_y \cdot \phi_t \cdot A_{wb2}$~~ ~~$\omega_{tr2} = 23.8 \frac{kip}{ft}$~~

REINFORCING
DOES NOT
EXTEND THRU
WALL BASE JOINT.

Vertical forces at top of wall, seismic-load case

$$\omega_{qct} := \left(\frac{\sigma_{rd} \cdot r}{2}\right) + \left(\frac{\sigma_{rd} \cdot r}{2}\right) \cdot \beta$$

$$\omega_{qct} = 6.12 \frac{kip}{ft}$$

$$\omega_{qtt} := \left[\frac{(\sigma_{rd} + \sigma_g) \cdot r}{2}\right] - \left[\left(\frac{\sigma_{rd} \cdot r}{2}\right) \cdot \beta\right]$$

maximum tension (if < 0) or minimum compression (if > 0) force at base, seismic-load case

$\omega_{qtt} = 0.28 \frac{kip}{ft}$ **>0, No net uplift**

Compare with reinforcement capacity at same location

$\omega_{trl} := f_y \cdot \phi_t \cdot A_{wbl}$ $\omega_{trl} = 23.8 \frac{kip}{ft}$

Vertical forces at top of wall, normal-load case

$\omega_{nct} := \left(\frac{\sigma_{rd} \cdot r}{2}\right)$ $\omega_{nct} = 4.38\,\frac{kip}{ft}$

$\omega_{ntt} := \left[\frac{\left(\sigma_{rd} + \sigma_g\right) \cdot r}{2}\right]$

$\omega_{ntt} = 2.03\,\frac{kip}{ft}$ **>0, no net uplift.**

$\sigma_{ntt} := \frac{\omega_{ntt}}{t_{w1}}$ $\sigma_{ntt} = 16.9\,\frac{lbf}{in^2}$

EMPTY-TANK CASE

Residual concrete compressive hoop stress at base due to prestressing, empty-tank case:

$f_{cer} := \frac{\omega_{qv}}{t_{w2}}$ $\qquad$ $f_{cer} = 744\,\frac{lbf}{in^2}$

Concrete compressive hoop stress at base due to soil active pressure:

$\gamma_{sa} := 65 \cdot \frac{lbf}{ft^3}$ $\qquad$ active pressure fluid equiv.

$Y_e := 12 \cdot ft$ $\qquad$ soil embedment depth

$Y_g := y_g - y_f$ $\qquad$ $Y_g = 8\,ft$ $\qquad$ vertical distance from highest possible water table to base of wall

$f_{cs} := \frac{(\gamma_{sa} \cdot Y_e + \gamma_w \cdot Y_g) \cdot r}{t_{w2}}$ $\qquad$ $f_{cs} = 465\,\frac{lbf}{in^2}$

Any compression force due to soil loading will lead to a corresponding relaxation of prestress strands; therefore, the two types of loads do not act in superposition.

Maximum compressive hoop stress:

$f_{ce} := \max(f_{cs}, f_{cer})$ $\qquad$ $f_{ce} = 744\,\frac{lbf}{in^2}$

Concrete allowable compr. stress: $\qquad$ $f_{cr} := 0.45 \cdot f_c$

$f_{cr} = 1350\,\frac{lbf}{in^2}$ $\qquad$ $\text{if}(f_{cr} > f_{ce}, 1, 0) = 1$ $\qquad$ (OK)

Provide wall thickness: $\qquad$ $t_{w2} = 12\,in$

RING FOUNDATION

STATIC-LOAD SOIL BEARING

$b_{fe} = 3.0\,ft$ Use $b_f := 4 \cdot ft$ $b_f = 4.0\,ft$

$$\sigma_t := \frac{W_t}{\pi \cdot (r + b_{fe})^2} \qquad \sigma_t = 2.21\,\frac{kip}{ft^2}$$

$$\omega_{fd} := \left[(\omega_w + b_f \cdot t_f) \cdot \gamma_c + \frac{\sigma_{rd} \cdot r}{2} \right] \qquad \omega_{fd} = 9.6\,\frac{kip}{ft}$$

dead weight of tank carried by ring footing, per unit length of wall

$$b_{fn} := \left(b_f - \frac{t_{w2}}{2} \right) \qquad b_{fn} = 3.50\,ft$$

portion of footing width inside tank wall

$$\omega_{ws} := H \cdot \gamma_w \cdot b_{fn} \qquad \omega_{ws} = 7.5\,\frac{kip}{ft}$$

weight of water carried by ring footing, per unit length of wall

$$x_{fd} := \left[\left(Y_r \cdot t_{w2} \cdot b_{fn} + b_f \cdot t_f \cdot \frac{b_f}{2} \right) \cdot \gamma_c + \frac{\sigma_{rd} \cdot \left(b_{fn} + \frac{t_{w2}}{2} \right) \cdot r}{2} \right] \cdot \frac{1}{\omega_{fd}}$$

$x_{fd} = 3.77\,ft$ location of centroid of concrete dead load on footing

$$x_{ws} := \frac{b_{fn}}{2} \qquad x_{ws} = 1.75\,ft$$

location of centroid of water bearing on footing

$$\omega_{fl} := \sigma_l \cdot b_f \qquad \omega_{fl} = 0.1\,\frac{kip}{ft}$$

$$x_{fl} := \left(\frac{b_{fn}}{2} \right) \qquad x_{fl} = 1.75\,ft$$

$$x_{fl} := \frac{\omega_{fd} \cdot x_{fd} + \omega_{ws} \cdot x_{ws} + \omega_{fl} \cdot x_{fl}}{\omega_{fd} + \omega_{ws} + \omega_{fl}} \qquad x_{fl} = 2.88\,\text{ft}$$

location of net centroid

$y_{sa} := 13.5 \cdot \text{ft}$ (SOIL DEPTH TO BOTTOM OF FOOTING)

$$\sigma_{ssa} := \cancel{2.00}\,3.0 \cdot \frac{\text{kip}}{\text{ft}^2} + y_{sa} \cdot \gamma_s \qquad \sigma_{ssa} = \cancel{3.8}\,4.75\,\frac{\text{kip}}{\text{ft}^2}$$

allowable soil bearing stress

Since ring-foundation is rigidly connected to rest of foundation, ignore eccentricity in considering soil-bearing pressure; however, consider transferred bending moment in design of floor slab.

$$\sigma_{ss} := \frac{\omega_{fd} + \omega_{ws} + \omega_{fl}}{b_f} \qquad \sigma_{ss} = 4.30\,\frac{\text{kip}}{\text{ft}^2}$$

$\text{if}(\sigma_{ssa} > \sigma_{ss}, 1, 0) = 1$ (OK)

4.75 > 4.30 ✓

$D/C = \frac{4.30}{4.75} = \underline{\underline{0.91}}$

$$m_{ss} := (\omega_{fd} + \omega_{ws} + \omega_{fl}) \cdot \left(\frac{\frac{b_f}{2} - x_{fl}}{2} \right) \qquad m_{ss} = -7.6\,\frac{\text{kip} \cdot \text{ft}}{\text{ft}}$$

$m_{ssu} := 1.7 \cdot m_{ss}$ bending moment to be transferred to rest of floor slab

Use $d_{fb} := t_f - 8.7\text{in}$ $\quad d_{fb} = 9\,\text{in}$

$$\xi := 0.85 \cdot \frac{f_c}{f_y} \qquad \xi = 0.063750$$

$$\Phi_f := 0.90$$

$$\psi := \frac{2 \cdot 1.3 \cdot 0.85 f_c}{\Phi_f f_y^{\,2}} \qquad \psi = 0.004604\,\frac{\text{in}^2}{\text{kip}}$$

factor ***1.3*** is for reinforcement in water resources structures; Ref: ACI 350, Sect. 2.6.5

Required reinforcement ratio as a function of moment per unit width and of effective depth

$$\rho(M_a, d_j, b_s) := \xi - \frac{\left[(\xi \cdot d_j)^2 - \psi \cdot \frac{M_a}{b_s} \right]^{0.5}}{d_j}$$

$$\rho_{ssu} := \xi - \frac{\left[\left(\xi \cdot d_{fb}\right)^2 - \psi \cdot m_{ssu}\right]^{0.5}}{d_{fb}} \qquad \rho_{ssu} = -0.00518$$

$A_{sfssr} := \rho_{ssu} \cdot d_{fb}$ $\qquad A_{sfssr} = -0.578\,\frac{in^2}{ft}$

Provide: # 5 bars, each way, bottom face; $\quad A_{b7i} := 0.31 in^2$

space at: $\quad s_{bf} := 15 \cdot in$ radially

reinf. area provided: $\quad A_{sfbp} := \frac{A_{b7i}}{s_{bf}} \qquad A_{sfbp} = 0.248\,\frac{in^2}{ft}$

$\text{if}\left(A_{sfbp} > A_{sfssr}, 1, 0\right) = 1$ (OK)

SEISMIC-LOAD CASE

Soil bearing

4.75k/ft² (p.25)

$$\sigma_{sqa} := \frac{4 \cdot \sigma_{ssa}}{3} \qquad \sigma_{sqa} = \overset{6.3}{\cancel{5.0}}\,\frac{kip}{ft^2}$$

allowable soil bearing pressure, seismic-load case

$$\omega_{fq} := \omega_{qc} + b_f \cdot t_f \cdot \gamma_c \cdot (1 + \beta) \qquad \omega_{fq} = 21.97\,\frac{kip}{ft}$$

Note that "SRSS" was not used here; value is slightly exaggerated

$$\omega_{wq} := (H + H_{wq}) \cdot \gamma_w \cdot b_{fn} \cdot (1 + \beta) \qquad \omega_{wq} = 11.89\,\frac{kip}{ft}$$

$$x_{wq} := \frac{\dfrac{H \cdot b_{fn}}{2} + \dfrac{H_{wq} \cdot b_{fn}}{2}}{H + H_{wq}} \qquad x_{wq} = 1.75\,ft$$

$$x_{fq} := \frac{\omega_{fq} \cdot x_{fd} + \omega_{wq} \cdot x_{wq}}{\omega_{fq} + \omega_{wq}} \qquad x_{fq} = 3.06\,ft$$

$$\sigma_{sqm} := \frac{\omega_{fq} + \omega_{wq}}{b_f} \cdot \left(1 + 6 \cdot \frac{\dfrac{b_f}{2} - x_{fq}}{b_f}\right) \qquad \sigma_{sqm} = -5.02\,\frac{kip}{ft^2}$$

calculated "actual" soil bearing pressure, seismic-load case

$$\mathrm{if}(\sigma_{sqa} > \sigma_{sqm}, 1, 0) = 1$$

(OK)

$$D/C = \frac{5.02}{6.3}$$

$$D/C = \underline{0.80}$$

Provide ring footing width: $b_f = 4\,ft$

Flexure in ring beam, radial plane

Note that load of water is carried directly through footing, therefore does not contribute to bending in footing.

$$\sigma_{sqmn} := \frac{\omega_{fq}}{b_f} \cdot \left(1 + 6 \cdot \frac{\dfrac{b_f}{2} - x_{fq}}{b_f}\right) \qquad \sigma_{sqmn} = -3.26\,\frac{kip}{ft^2}$$

$$\gamma_{sq} := \frac{12 \cdot \omega_{fq} \cdot \left(\frac{b_f}{2} - x_{fq}\right)}{b_f^{\,3}} \qquad \gamma_{sq} = -4.376\,\frac{\text{kip}}{\text{ft}^3}$$

$$m_{sq} := \frac{\sigma_{sqmn} \cdot b_{fn}^{\,2}}{2} - \frac{\gamma_{sq} \cdot b_{fn}^{\,3}}{6} \qquad m_{sq} = 11\,\frac{\text{ft} \cdot \text{kip}}{\text{ft}}$$

$$d_{fl} := t_f - 4 \cdot \text{in} \qquad d_{fl} = 14\,\text{in}$$

Resistance to seismically-induced lateral sliding on soil

Soil passive fluid equivalent is given by: $\gamma_{sp} := 250 \cdot \frac{\text{lbf}}{\text{ft}^3}$

Coefficient of friction, concrete on soil: $\nu := 0.25$ (Ref.: SR, p. 12)

Soil embedment depth: $h_s := 12 \cdot \text{ft}$

Soil lateral resistance capacity is given by:

$$V_{sr} := \left(W_w + W_r + W_f\right) \cdot \nu \qquad V_{sr} = 5032\,\text{kip}$$

using friction alone $\rightarrow$ $D/C = \frac{5,766^k}{5,032^k} = 1.15$

$$\text{if}\left(V_{sr} > V_q, 1, 0\right) = 0$$

$V_q = 5,766^K > V_{sr} = 5,032^K$
(FRICTION)

∴ BY INSPECTION, INCLUSION
OF PASSIVE PRESSURE
RESISTANCE WILL GIVE TOTAL
RESISTANCE > V_q

OK

PASSIVE RESISTANCE $= \frac{250pcf \times 12'}{2} \times 12' \times 102' = \underline{1,836^K}$

COMBINED FRICTION/PASSIVE RESISTANCE:

$D/C = 5,766^K / (5,032^K + 1,836^K) = \underline{0.84}$ OK

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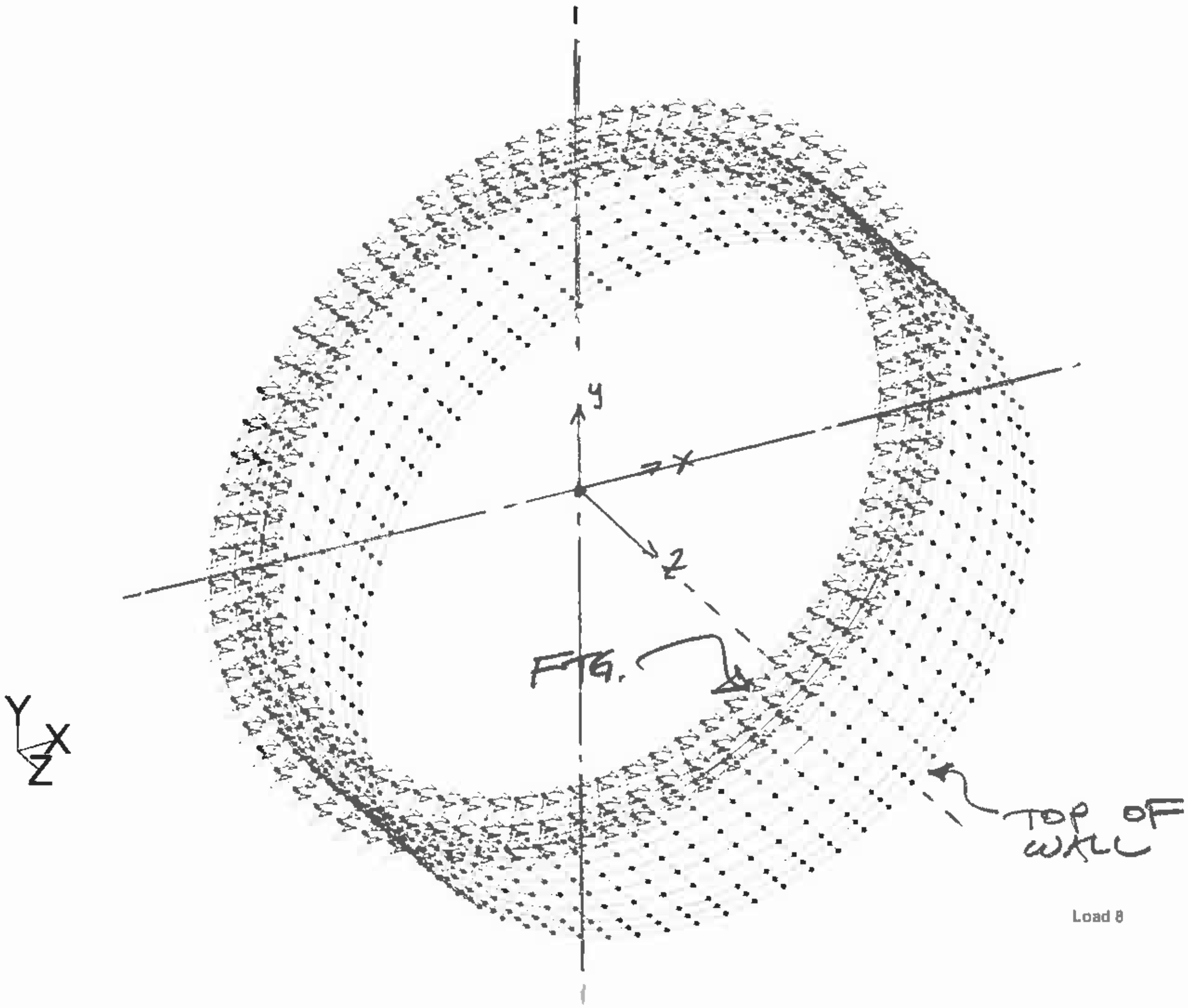
Job No	Sheet No 1	Rev	
Part			
Ref			
By GGH	Date 25-Nov-08	Chd	
File Structure1.std	Date/Time 03-Dec-2008 10:05		

Job Title SAN JOSE DIGESTER #1
'STAAD' MODEL GEOMETRY

Client



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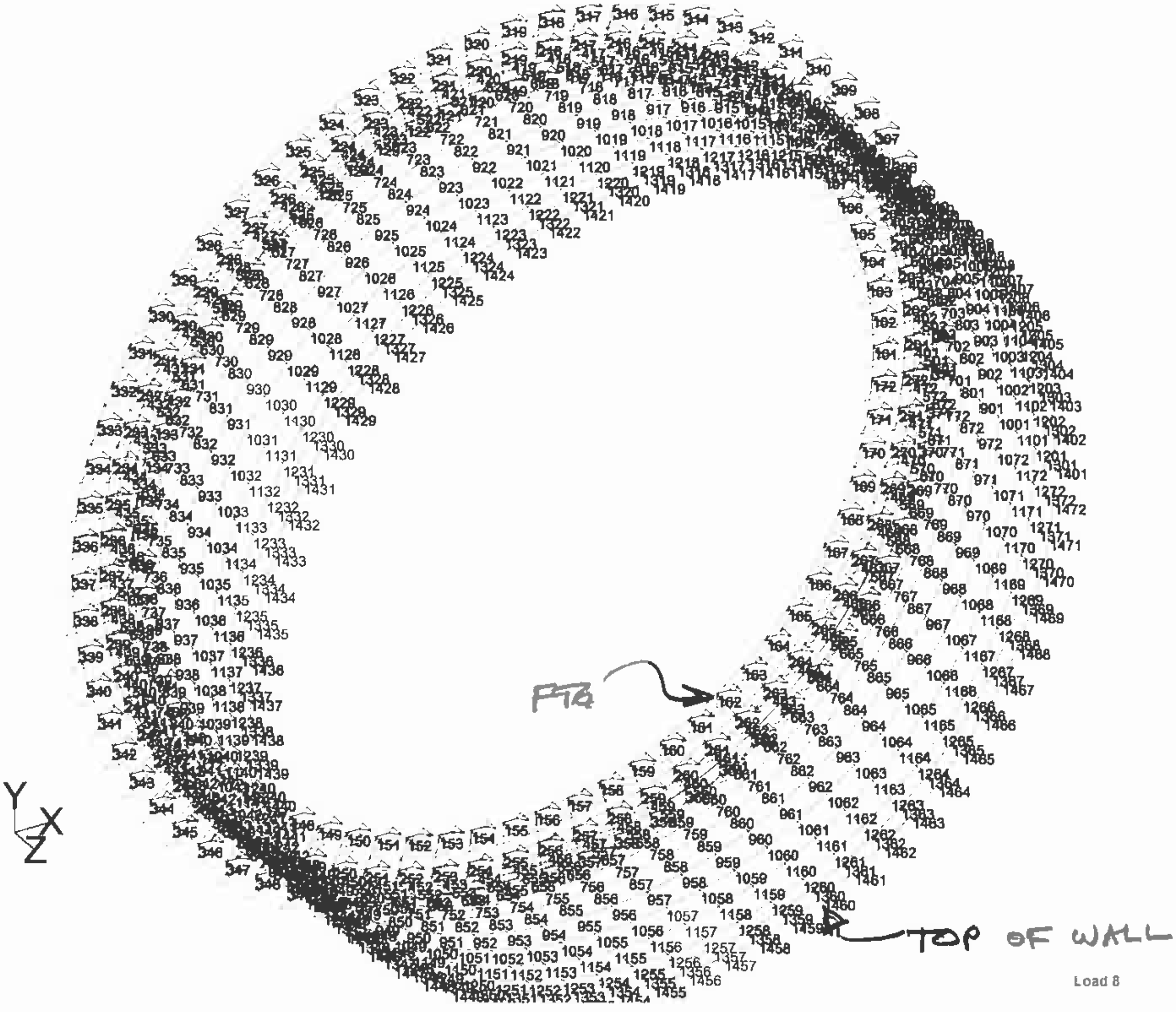
Job No	Sheet No 1	Rev	
Part			
Ref			
By GGH	Date 25-Nov-08	Chd	
File Structure1.std	Date/Time 03-Dec-2008 10:05		

Job Title SAN JOSE DIGESTER #1
'STAAD' JOINT NUMBERS

Client



JOINT NUMBERS

Print Time/Date: 03/12/2008 10:23

STAAD.Pro for Windows Release 2006

Print Run 1 of 1

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Job No

Sheet No 1

Rev

Part

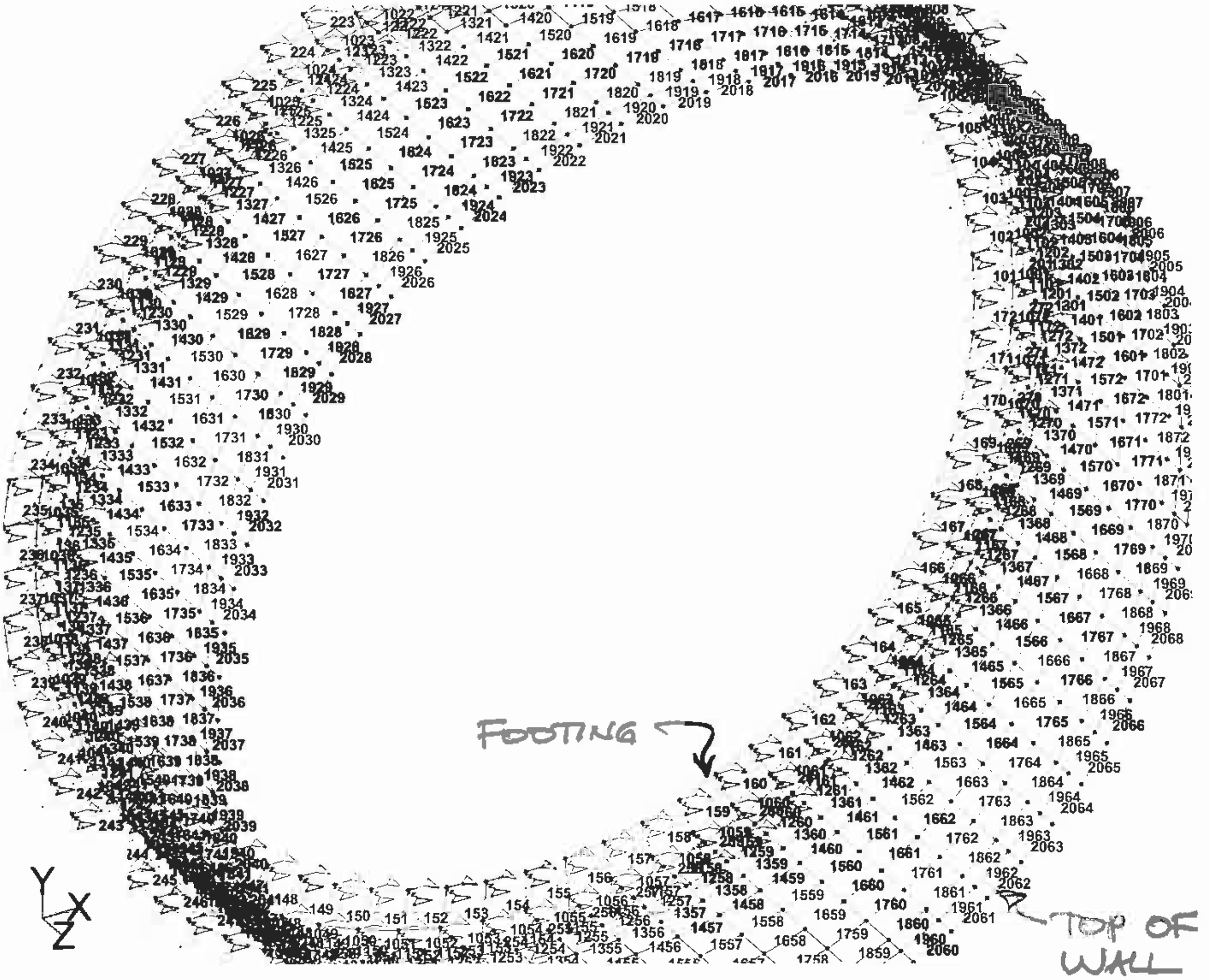
Job Title SAN JOSE DIGESTER #1
ELEMENT NUMBERS

Ref

By GGH Date 25-Nov-08 Chd

Client

File Structure1.sld Date/Time 03-Dec-2008 10:05



FOOTING

TOP OF WALL

ELEMENT NUMBERS

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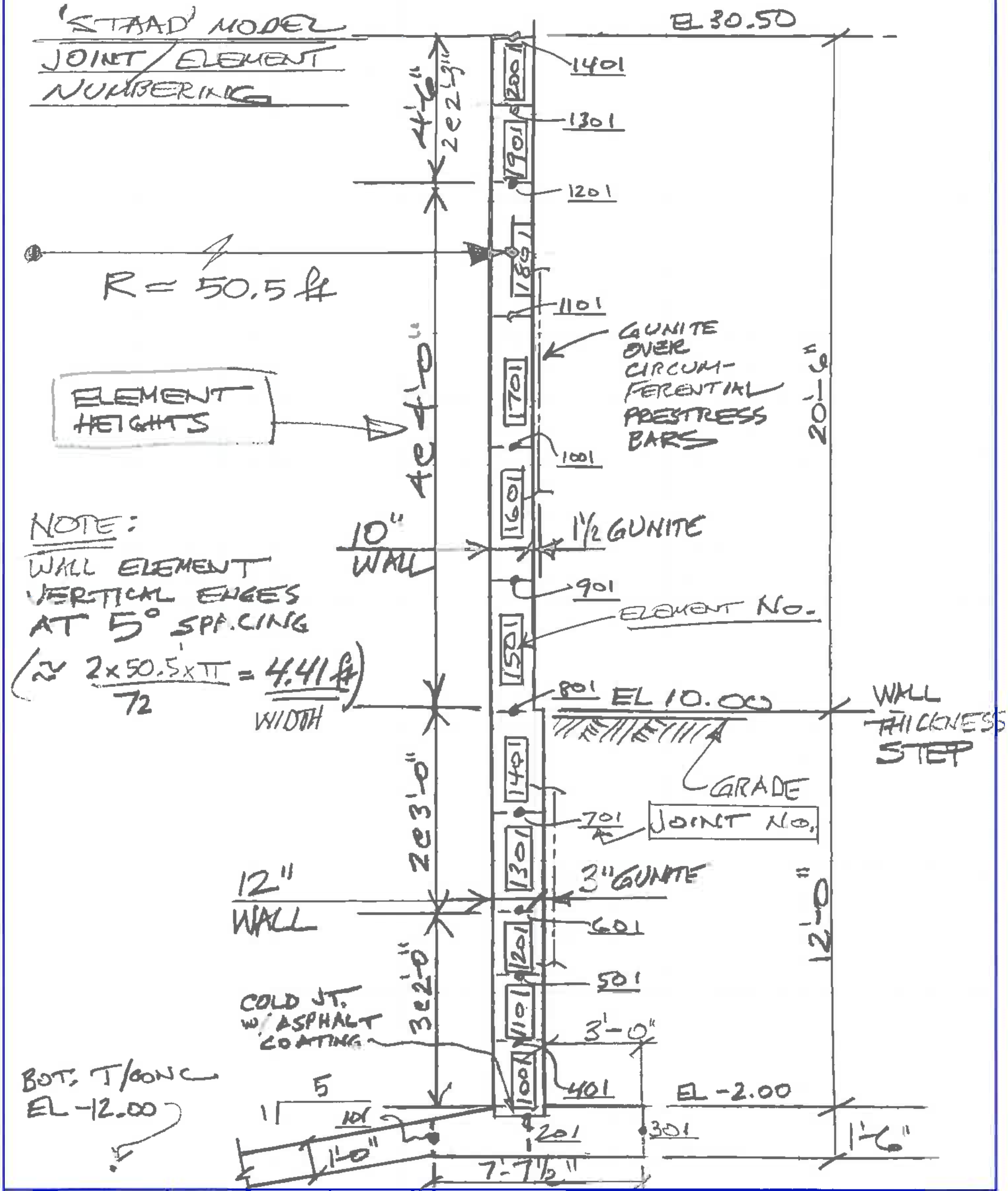
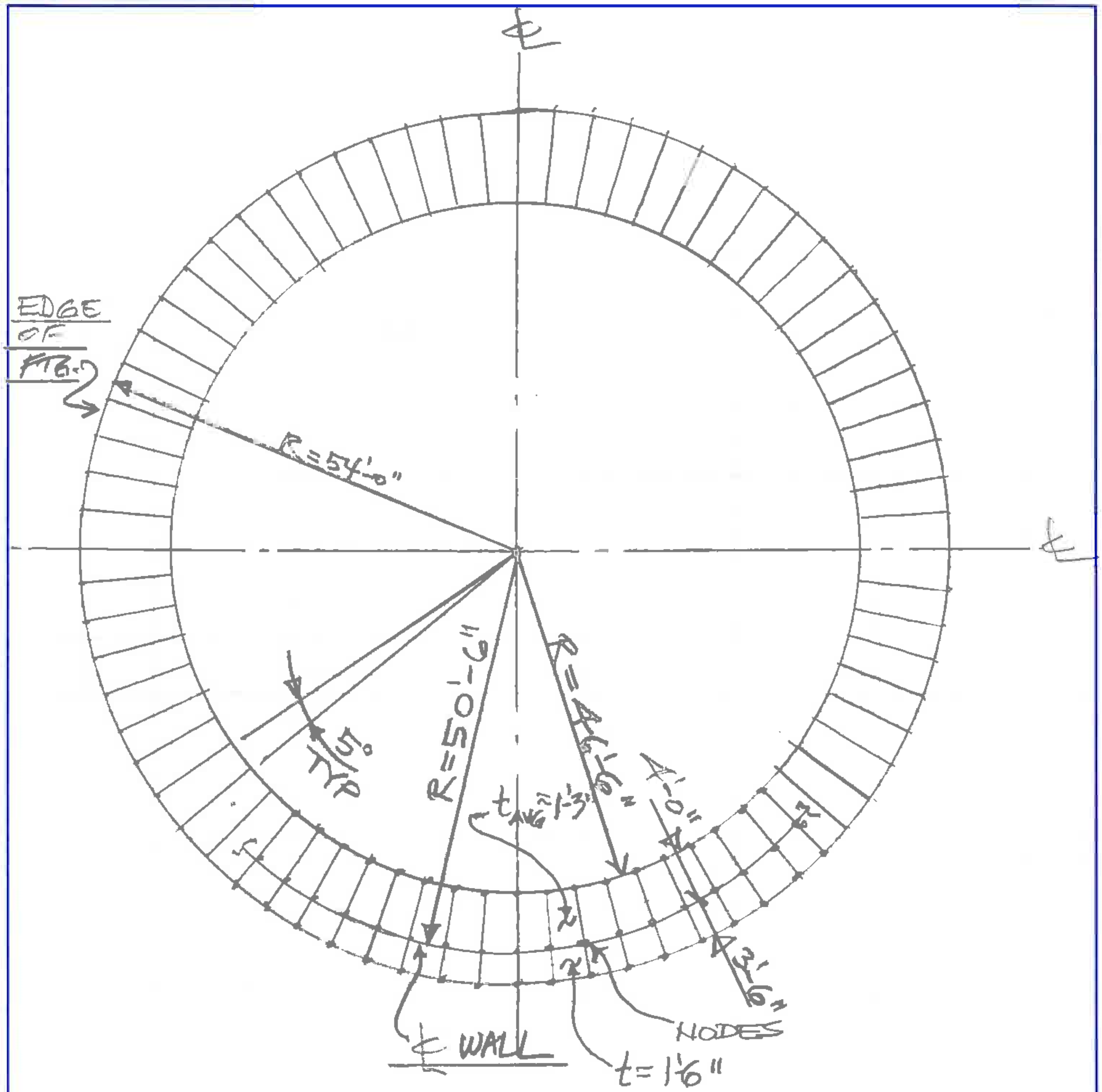


BY: GGH	11-18-08	W0803	PROJECT	SAN JOSE DIGESTERS	1
CHKD:		PROJECT NO.	SUBJECT	#1 WALL / ELEMENTS	SHEET NO.



FOOTING ELEMENTS

NTS

BY: GGH	11-20-08	W0803	PROJECT	SAN JOSE DIGESTERS	2
CHKD:		PROJECT NO.	SUBJECT	#1 — FOOTING ELEMENTS	SHEET NO.

DIGESTER #1

EXISTING CIRCUMFERENTIAL PRESTRESS BARS

3/4"ϕ AND 1"ϕ BARS — $f_y = 80$ ksi } PER EXISTING
$f_{pu} = 105$ ksi } DWG 147 NOTES.

ALLOWABLE STRESS:

① ALLOWABLE PRESTRESS DESIGN STRESS, AFTER LOSSES, FOR ALL SIMULTANEOUSLY ACTING LOADS EXCEPT SEISMIC

$= 0.65 f_{pu}$ (PER AWWA, SECT. 3.4.2.3)
$= 0.65 \times 105$ Ksi
$= \underline{\underline{68 \text{ Ksi}}}$

② ALLOWABLE PRESTRESS DESIGN STRESS FOR ALL LOADS INCLUDING SEISMIC

$= 1.25 \times 0.65 f_{pu}$ (PER AWWA, SECT. 3.4)
$= 1.25 \times 68$ Ksi
$= \underline{\underline{85 \text{ Ksi}}}$

BY: GGH | 12-12-08 | W0803 | PROJECT: SAN JOSE DIGESTERS
CHKD: | | PROJECT NO. | SUBJECT: DIG-#1 - ALLOW. PRESTRESS

AWWA 3.4.2.3

- ALLOWABLE PRESTRESS DESIGN STRESS, AFTER LOSSES:

$= 0.65 f_{pu}$

$= 0.65 \times 105$ ksi (AT DIGESTER #1)

$= \underline{\underline{68.\text{ ksi}}}$ (ALL LOADS, EXCEPT SEISMIC) SIMULTANEOUSLY ACTING

AWWA 4.6.1

- ALLOWABLE STRESSES FOR COMBINATION OF SEISMIC AND ALL OTHER LOADS THAT CAN ACT SIMULTANEOUSLY, SHALL NOT EXCEED 1.25 TIMES ALLOWABLE STRESSES OF SEC. 3.4.

ALLOWABLE STRESS IN CIRCUMFERENTIAL RAKS:

$= 1.25 \times 0.C5 \times f_{pu}$

$= 1.25 \times 0.65 \times 105$ ksi

$= \underline{\underline{85\text{ ksi}}}$ (SEISMIC + ALL OTHER SIMULTANEOUS LOADS)

BY: GGH	12·12·08	W0803	PROJECT	SAN JOSE DIGESTERS	4	
CHKD:		PROJECT NO.	SUBJECT	DIG. #1 — PRESTRESS		SHEET NO.

DIGESTER #1 PRESTRESS

EXISTING CIRCUMFERENTIAL PRE-STRESS BARS PER DWG. 147. 1"φ IN 12" WALL; 3/4"φ IN 10" WALL. SPAC'G VARIES PER DWG.

PRESTRESS = 30 KSI (PER DWG.)

INITIAL PRESTRESS FORCES —

RADIUS R = 50.5 ft TO WALL ℄

12" WALL:

- BOTTOM 2'-9"
  1"φ @ 5 1/2" OC
  $0.79 \text{ in}^2 \times 30 \frac{k}{\text{in}^2} \times \frac{12 \text{ in/ft}}{5\frac{1}{2} \text{ in}} = \underline{51.7 \text{ k/ft}}$ OF HT.
- NEXT 3'-0"
  1"φ @ 6" OC
  $0.79 \times 30 \times \frac{12}{6} = \underline{47.4 \text{ k/ft}}$
- NEXT 3'-3"
  1"φ @ 6 1/2" OC
  $0.79 \times 30 \times \frac{12}{6\frac{1}{2}} = \underline{43.8 \text{ k/ft}}$
- NEXT 2'-11"
  1"φ @ 7" OC
  $0.79 \times 30 \times 12/7 = \underline{40.6 \text{ k/ft}}$

10" WALL:

- BOTTOM 2'-9 3/4"
  3/4"φ @ 3 3/4 OC
  $0.44 \times 30 \times 12/3.75 = \underline{42.2 \text{ k/ft}}$
- NEXT 3'-0"
  3/4 @ 4.5" OC $\underline{35.2 \text{ k/ft}}$
- NEXT 2'-11"
  3/4"φ @ 5" OC $\underline{31.7 \text{ k/ft}}$
- NEXT 3'-0"
  3/4"φ @ 6" OC $\underline{26.4 \text{ k/ft}}$
- NEXT 3'-4"
  3/4"φ @ 8" OC $\underline{19.8 \text{ k/ft}}$
- NEXT 4'0" 3/4"φ @ 12" OC $\underline{13.2 \text{ k/ft}}$

BY: GGH 12-2-08
CHKD:
W0803 PROJECT NO.
PROJECT SAN JOSE DIGESTERS
SUBJECT DIGESTER #1 – PRESTRESS LOAD
5 SHEET NO.

DIGESTER #1 PRESTRESS (CONT.)

- NO PRESTRESS IN TOP 1'-3" OF WALL

PRESTRESS BARS:
80 ksi YIELD
105 ksi STRENGTH

RADIAL WALL PRESSURES (INWARD) CORRESPONDING TO PRESTRESS TENSION FORCES ON PREVIOUS PAGE:

RADIUS = 50.5 ft

12" WALL

- BOTTOM 2'-9" — $\sigma = \frac{51.7\ k/ft}{50.5\ ft} = 1.02\ ksf$
- NEXT 3'-0" $\sigma = 47.4/50.5 =$ 0.93 ksf
- NEXT 3'-3" 0.86 ksf
- NEXT 2'-11" 0.81 ksf

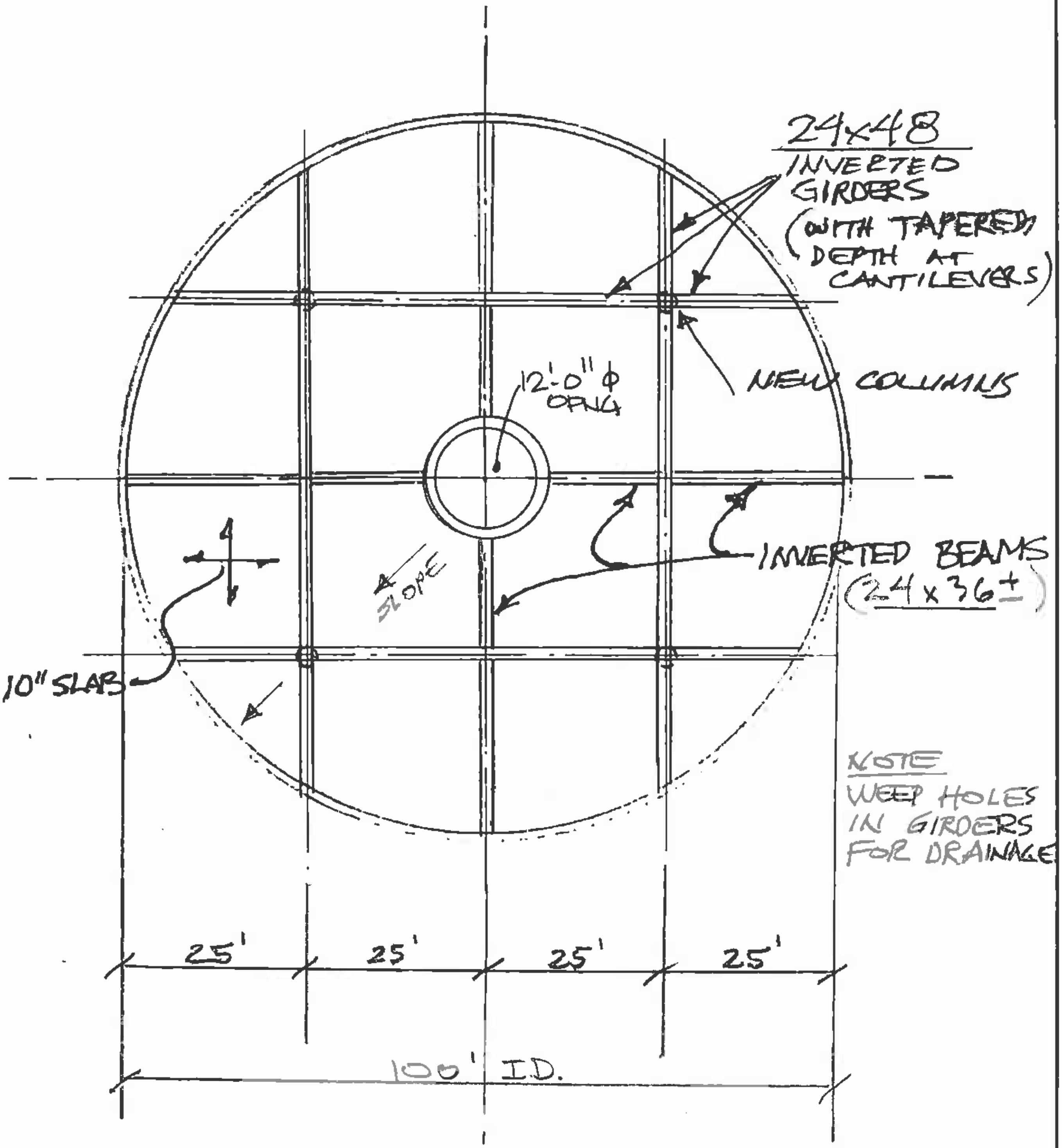
10" WALL

- BOTTOM 2'-9 3/4" — $\sigma = \frac{42.2\ k/ft}{50.5\ ft} =$ 0.84 ksf
- NEXT 3'-0" 0.70 ksf
- " 2'-11" 0.62 ksf
- " 3'-0" 0.52 ksf
- " 3'-4" 0.39 ksf
- " 4'-0" 0.26 ksf

- 'STAAD' MODEL RADIAL PRESTRESS ELEMENT LOADS

1001 TO 1072 — 1.02 ksf
1101 TO 1172 — 0.96
1201 TO 1272 — 0.93
1301 TO 1372 — 0.86
1401 TO 1472 — 0.81
1501 TO 1572 — 0.80
1601 TO 1672 — 0.66
1701 TO 1772 — 0.53
1801 TO 1872 — 0.36 ksf
1901 TO 1972 — 0.26
2001 TO 2072 — 0.10

BY: GGH	12-2-08	W0803	PROJECT	SAN JOSE DIGESTERS	6
CHKD:		PROJECT NO.	SUBJECT	DIGESTER #1 – PRESTRESS LOAD	SHEET NO



NOTE
WEEP HOLES
IN GIRDERS
FOR DRAINAGE

CONCRETE ROOF STRUCTURE PLAN

BY: REM	11.13.08	W0803	PROJECT	SAN JOSE DIGESTER ANALYSIS	7
CHKD:		PROJECT NO.	SUBJECT	DIGESTER PLAN - PRELIMINARY	SHEET NO.

PRELIMINARY ROOF STRUCTURE DESIGN
TO DETERMINE TRIBUTARY LOADS TO WALL

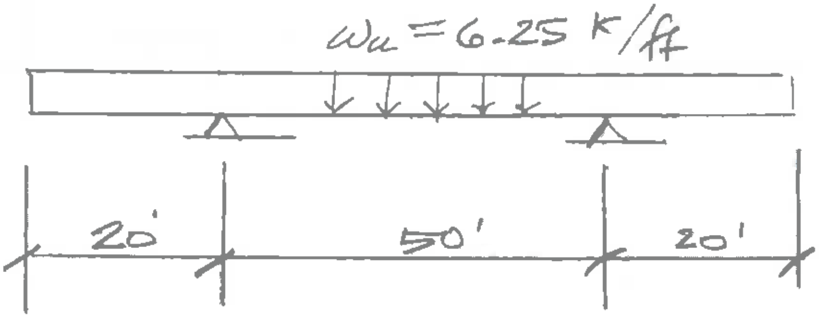
DL :

10" SLAB (WARPED)	125 psf
GIRDERS/BEAMS	50
	DL = 175 psf

LL ——————— LL = 20 psf

$$U = 1.2D + 1.6L$$
$$U = 1.2 \times 175 + 1.6 \times 50$$
$$U = 242 \rightarrow \underline{250\,psf}$$

GIRDERS $w_u = 25' \times 250\,psf$



$$M_- = \frac{W_u \times 20^2}{2} = \frac{6.25 \times 20^2}{2} = \underline{1{,}250\ K/ft}$$

24x48 GIRDER (TAPER TOWARD END OF CANTILEVERS)

$b = 24,\ d = 45$

$$\rho_- = \frac{0.85 \times 4}{60}\left[1 - \sqrt{1 - \frac{31{,}370 \times 1{,}250}{24 \times 45^2 \times 4{,}000}}\right]$$

$$\rho_- = 0.0060\ ✓$$

$$A_{s-} = 0.0060 \times 24 \times 45 = 6.52 \rightarrow \underline{(7)\#9\ TOP}$$

USE 24 × 48 GIRDER

PREL. ROOF STRUCTURE (CONT.)

M – GOVERNS

24×36 BEAMS

∴ AVG BEAM/GIRDER DL = 53psf ≈ 50psf ASSUMED

OK

TRIB. LOADS TO WALL

$$b \approx \frac{\overset{\text{AT 1/4 PT. 2}}{18'} + \overset{\text{AT ℄}}{25'}}{2} \times \frac{1}{2} = \underline{10.75'} \longrightarrow \underline{\text{USE 11 ft}}$$

$\omega_{DL} = 175\text{psf} \times 11\text{ ft} = \underline{1.93^{k}/\text{ft}}$ ↓ (UNFACTORED)

$\omega_{LL} = 20\text{psf} \times 11\text{ ft} = \underline{0.22^{k}/\text{ft}}$ ↓

$\omega_{VACUUM} = 26\text{psf} \times 11\text{ ft} = \underline{0.29^{k}/\text{ft}}$ ↓

$\omega_{GAS\ PRESSURE} = 94\text{psf} \times 11\text{ ft} = \underline{1.04^{k}/\text{ft}}$ ↑

JOINT LOADS AT TOP OF WALL (FOR 'STAAD' MODEL)

(BASED ON 5° JT. SPCG → 4.41 ft ELEMENT WIDTH)

DL — $FZ = 1.93^{k}/\text{ft} \times 4.41\text{ ft} = -\underline{8.51}^{k}$ ↓

LL — $FZ = 0.22 \times 4.41 = -\underline{0.97}^{k}$ ↓

VACUUM — $FZ = 0.29 \times 4.41 = -\underline{1.28}^{k}$ ↓

GAS — $FZ = 1.04 \times 4.41 = \underline{4.59^{k}}$ ↑

BY: GGH	11-26-08	W0803	PROJECT		9
CHKD:		PROJECT NO.	SUBJECT	DIGESTER #1 – ROOF LOADS TO WALL	SHEET NO.

FOUNDATION SPRING CONSTANTS — DIGESTER #1

- DETERMINE APPROXIMATE SPRING CONSTANT FOR FOUNDATION SUPPORT JOINTS IN 'STAAD' MODEL

— FROM GEOTECH. REPORT BY WOODWARD-LUNDGREN, p.16, 1,500 psf OF NET PRESSURE SHOULD RESULT IN A SETTLEMENT OF 3½ in.

$$K \approx \frac{1{,}500\,psf}{3\tfrac{1}{2}\,in} \times 144\,in^2/SF \times \frac{1\,K}{1{,}000\,lb}$$

$$K = 61.7 \rightarrow \underline{62\,K/in} \quad (\text{PER SF OF AREA})$$

— FOR FOUNDATION SUPPORT JOINTS IN MODEL:

- JT. 101 TO 172:

$$A_1 = 4.15' \times 2.0' = \underline{8.3\,ft^2}$$

$$K_1 = K \times A = \frac{62\,K/in}{ft^2} \times 8.3\,ft^2 = \underline{\underline{515\,K/in}}$$

- JT. 201 TO 272:

$$A_2 = 4.4' \times 3.75' = \underline{16.50\,ft^2}$$

$$K_2 = \frac{16.5}{8.3} \times 515 = \underline{\underline{1{,}025\,K/in}}$$

- JT 301 TO 372:

$$A_3 = 4.63' \times 1.75' = 8.1\,ft^2 \approx 8.3\,ft^2$$

$$K_3 = K_1 = \underline{\underline{515\,K/in}}$$

PASSIVE PRESSURE LATERAL SPRING CONSTANTS

- ASSUME PASSIVE PRESSURE RESISTANCE IN X-DIRECTION IS EFFECTIVE OVER PROJECTED WIDTH OF WALL AREA EQUAL TO 88 ft (i.e, TO JT AT 30° ANGLE FROM PERPENDICULAR Y-AXIS)

∴ EFFECTIVE AREA FROM JT. 401–412 AND 461 TO 472
JT. 501–512 561 TO 572
JT. 601–612 661 TO 672
JT 701–712 761 TO 772

AVERAGE ELEMENT WIDTH TRIBUTARY TO EFFECTIVE JOINTS

$$\frac{88\ ft}{24} = \underline{\underline{3.67\ ft}}\ \pm$$

[STIFFNESS = 40pci
PASSIVE PRESS = 250pcf × H]

JT. SERIES	SOIL DEPTH (FT)	AVG. EFFECTIVE A (SF)	PASSIVE PRESSURE (KSF)	PASSIVE REACTION R AT JT. (K)	K (K/in)
401→	10.0	7.33	2.50	18.33	42.2
501→	8.0	7.33	2.00	14.67	42.2
601→	6.0	9.18	1.50	13.77	52.9
701→	3.0	11.01	0.75	8.26	63.4

$$K = 40pci \times A(ft^2) \times 144\frac{in^2}{ft^2} \times \frac{1k}{1,000lb}$$

$$K = 5.76 \times A\ (k/in)$$

BY: GGH		W0803	PROJECT	SAN JOSE DIGESTERS	11
CHKD:		PROJECT NO.	SUBJECT		SHEET NO.

DIGESTER #1

PERIOD CALC, PER AWWA

TANK BASE IS SIMILAR TO "NON-SLIDING BASE", FIG. 5A OF AWWA.

∴ USE EQ (4-9) FOR PERIOD CALC

$$T_I = 2\pi / \omega_I$$

$$\omega_I = C_L \times \frac{12}{H}\sqrt{\frac{E_c}{\rho_c}}$$

$$C_L = C_w \times 10\sqrt{\frac{t_w}{12r}}$$

$$r/H = 50./30.5 = 1.64$$

$$\rightarrow C_w = 0.143 \quad (\text{Fig. } 6)$$

$$C_L = 0.143 \times 10\sqrt{\frac{11.0 \text{ -AVG}}{12 \times 50.}} = 0.194$$

$$\omega_I = 0.194 \times \frac{12}{30.5} \times \sqrt{\frac{3{,}100 \times 10^3 \ lb/in^2}{4.66 \ \frac{lb\text{-}s^2}{ft^4}}}$$

$$\omega_I = 62.25 \ rad/sec$$

$$T_I = 2\pi / 62.25 \frac{rad}{sec} = \underline{0.10 \ sec} < 0.3 \ sec$$

BY: GGH	12-11-08	N0803	PROJECT	SAN JOSE DIGESTERS	12
CHKD:		PROJECT NO.	SUBJECT	DIGESTER #1 – PERIOD	SHEET NO.

SUMMARY OF 'STAAD' OUTPUT MAXIMUM VALUES
DIGESTER #1

UNSUBMERGED CASE

MAXIMUM HORIZ. Δ
(RADIAL DIRECTION):

$\Delta_{MAX} = \Delta_x = \underline{0.205''}$
(JOINT 701, LC8)

BASE REACTIONS:

HORIZ: $R_{x_{MAX}} = \underline{-33.61^K} \leftarrow$
(JOINT 201, LC8)

VERT: $R_{z_{MAX}} = \underline{18.92^K} \uparrow$

SUBMERGED CASE

$\Delta_{MAX} = \Delta_x = \underline{0.239''}$
(JOINT 801, LC8)

$R_{x_{MAX}} = \underline{-41.34^K} \leftarrow$
(JOINT 201, LC8)

$R_{z_{MAX}} = \underline{21.68^K} \uparrow$

ELEMENT FORCES
SEE FOLLOWING CALCS

BY: GGH	12-5-08	W0803	PROJECT	SAN JOSE DIGESTERS	13
CHKD:		PROJECT NO.	SUBJECT	STAAD RESULTS SUMMARY – #1	SHEET NO.

STAAD RESULTS (CONT.)

SUBMERGED CASE

- CHECK SHEAR AT BASE OF WALL

$V_{MAX} = 41.34^k$ (UNFACTORED)

LC8 INCLUDES FLUID, TEMP., & PRESTRESS LOADS
(AXIAL LOADS HAVE SMALL CONTRIBUTION TO HORIZ SHEAR)

$V_u = 1.2(F + T + PRESTRESS)$

$V_u = 1.2(41.34) = \underline{49.61^k}$

EXIST. 12" WALL:

$\phi V_c = 0.75 \times 2\sqrt{3{,}000} \times \overset{b}{52.9} \times \overset{d}{9.6}$

$\phi V_c = 41.7^k < V_u = 49.61^k$

$D/C = \frac{49.61^k}{41.7^k} = \underline{\underline{1.19}}$ $\underline{\underline{NG}}$

BY: GGH	12·8·08	W0803	PROJECT	SAN JOSE DIGESTERS	14
CHKD:		PROJECT NO.	SUBJECT	STAAD RESULTS – WALL SHEAR – #1	SHEET NO.

'STAAD' RESULTS (CONT.)

UNSUBMERGED CASE

- CHECK SHEAR AT BASE OF WALL

$$V = 33.61^{k} \quad \text{(UNFACTORED)} \quad \text{(LC8 — INCLUDES FLUID, TEMP, AND PRESTRESS LOADS)}$$

$$V_u = 1.2(\underset{\uparrow}{D} + F + T) + \underbrace{1.6(L + H) + 0.5(L_R)}$$

AXIAL LOADS TO TOP OF WALL; VERY SMALL EFFECT ON WALL BASE V

CASE $V_u \approx 1.2(\underset{\text{FLUID}}{F} + \underset{\text{TEMP}}{T} + \text{PRESTR.})$

$$V_u \approx 1.2 \times 33.61^{k} = \underline{\underline{40.33^{k}}}$$

EXIST. 12" CONC WALL:

$f'_c = 3{,}000\,psi \qquad d = 12'' - 2'' - \frac{0.75''}{2} = 9.6''$

$b = 52.9''$

$$\phi V_c = 0.75 \times 2\sqrt{3{,}000} \times 52.9 \times 9.6$$

$$\phi V_c = \underline{\underline{41.7^{k}}} > V_u = 40.33^{k} \quad \underline{\underline{OK}}$$

∴ WALL SHEAR STRESS OK
FOR UNSUBMERGED CASE

$$D/C = \frac{40.33^{k}}{41.7^{k}} = \underline{0.97} \quad \underline{\underline{OK}}$$

(SEE p. 20 FOR COMBINED STATIC + SEISMIC)

SUMMARY OF 'STAAD' RESULTS (CONT.)

ELEMENT FORCES – SUBMERGED CASE

- CALCULATE HORIZONTAL FORCE-PER-INCH OF WALL HEIGHT, BASED ON 'STAAD' ELEMENT JOINT FORCES FY (NOTE: ELEMENTS IN OUTPUT ARE IN VERTICAL STRIP AT $\theta = 0°$)

ELEMENT 1401 (LC8)

JT 701 309^{K}
JT 801 305^{K}

$$F = \frac{309^{K} + 305^{K}}{36\,in} = 17.06^{K}/in \text{ OF WALL HT}$$

EXIST. CIRCUMFERENTIAL PRESTRESS BARS:
1"ϕ @ 7"OC

BAR TENSION STRESS:

$$f_t = \frac{17.06^{K}/in \times 7.0\,in}{0.79\,in^2} = \underline{151.2\,Ksi} > 0.65 \times F_u$$
$$= 0.65 \times 105\,Ksi$$
$$= 68\,Ksi$$

NG

ELEMENT 1501 (LC8)

JT. 801 300^{K}
JT. 901 286^{K}

$$F = \frac{300^{k} + 286^{k}}{48\,in} = 12.2\,k/in$$

3/4"ϕ @ 4" (AVG.)

$$f_t = \frac{12.2\,k/in \times 4.0\,in}{0.44\,in^2} = \underline{110.9\,Ksi} > 68\,Ksi \quad \underline{\underline{NG}}$$

OTHER ELEMENTS:

10" WALL 3/4"ϕ BARS
1601 – 3/4"ϕ @ 4 3/4" AVG – f_t = 113.5 Ksi
1801 – 3/4"ϕ @ 8 1/2" AVG – f_t 173.3 Ksi

12" WALL 1"ϕ BARS
1301 – 1"ϕ @ 6 1/2" – f_t = 138.9 Ksi
1201 – 1"ϕ @ 6" – f_t = 112.0 Ksi

SEE TABLE ON NEXT PAGE

SUMMARY OF PRESTRESS BAR STRESSES
(FOR LC8) — SUBMERGED CASE

ELEMENT No.	PRESTRESS BARS	BAR TENSION f_t (KSI)	D/C RATIO*
1201	1"φ @ 6"	112.0 KSI	1.65
1301	1"φ @ 6½"	138.9	2.04
1401	1"φ @ 7"	151.2	2.22
1501	3/4"φ @ 4"	110.9	1.63 (MIN. D/C)
1601	3/4"φ @ 4¾" AVG.	113.5	1.67
1701	3/4"φ @ 5½"	120.6	1.77
1801	3/4"φ @ 8½" AVG	173.3	2.55
1901	3/4"φ @ 12"	198.3	2.91 (MAX. D/C)
(2001	(2) 3/4"φ @12 PRESTRESS +(3) 3/4" GR.40 HORIZ IN TOP OF WALL	65.7 KSI 43.8 KSI) — APPROX.	

(NOTE: FOR EXISTING PRESTRESS BARS,
$F_y = 80$ KSI ; $F_u = 105$ KSI)

∴ EXISTING PRESTRESS BARS
ARE OVERSTRESSED IN TENSION

* $C = 0.65 \times F_u = 0.65 \times 105$ KSI
$C = 68$ KSI

AT ELEMENT 1901, $D/C = 198.3/68 = \underline{2.91} > 1.10$ NG

BY: GGH | 12-10-08 | W0803 | PROJECT: SAN JOSE DIGESTERS | 17
CHKD: | | PROJECT NO. | SUBJECT: DIGESTER #1 — PRESTRESS BAR STRESSES | SHEET NO.

SUMMARY OF 'STAAD' RESULTS (CONT.)

ELEMENT FORCES — UNSUBMERGED CASE

- CALCULATE HORIZONTAL TENSION FORCE PER INCH OF WALL HEIGHT, BASED ON 'STAAD' ELEMENT JOINT FORCES FY (NOTE: ELEMENTS IN OUTPUT ARE IN A VERTICAL STRIP AT $\theta = 0°$ — FX IS VERY SMALL COMPARED TO FY — SRSS WILL GIVE F ESSENTIALLY EQUAL TO FY)
- SAMPLE CALC:

<u>ELEMENT 1401</u> (LC8)

JT 701 256^K

JT 801 251^K

$$F = \frac{256^K + 251^K}{36\,in} = 14.08\,{}^K/_{in} \text{ of HT}$$

ELEMENT HT

EXIST. CIRCUMFERENTIAL PRESTRESS BARS:
$1''\phi @ 7''oc$

BAR TENSION STRESS:

AWWA SECTION 3.4.2.3

$$f_t = \frac{14.08\,{}^k/_{in} \times 7.0_{in}}{0.79\,in^2} = \underline{124.8\,ksi} > 0.65F_u = 0.65 \times 105\,ksi = 68\,ksi$$

<u>NG</u>

- SUMMARY OF PRESTRESS BAR TENSION STRESSES ON NEXT PAGE
- DEMAND/CAPACITY RATIOS (D/C):

ELEMENT 1101 — D/C = 70 ksi/68 ksi = 1.03 < 1.10 <u>OK</u>
ELEMENT 1201 — D/C = 96.3 ksi/68 ksi = <u>1.42</u> NG

ELEMENT 1601 — D/C = 84.8 ksi/68 ksi = <u>1.25</u> NG
(SMALLEST D/C THAT IS GREATER THAN 1.10)

ELEMENT 1901 - D/C = 128.7 ksi/68 ksi = <u>1.89</u> NG
(LARGEST D/C RATIO)

SUMMARY OF 'STAAD' RESULTS (CONT.)

SUMMARY OF PRESTRESS BAR STRESSES (LC8)
UNSUBMERGED CASE

ELEMENT No.	PRESTRESS BAR SIZE/SPCG	BAR TENSION f_t (KSI)	D/C RATIO
1001	1"ϕ @ 5½"	30. KSI	
1101	1"ϕ @ 5¾" AVG.	70. —	D/C = 1.03
1201	1"ϕ @ 6"	96.3 —	D/C = 1.42
1301	1"ϕ @ 6½"	117.6	
1401	1"ϕ @ 7"	124.8	
1501	3/4"ϕ @ 4"	87.1	
1601	3/4"ϕ @ 4¾" AVG.	84.8	D/C = 1.25
1701	3/4"ϕ @ 5½"	88.3	
1801	3/4"ϕ @ 8½" AVG	124.5	
1901	3/4"ϕ @ 12"	128.7	D/C = 1.89
2001	(2) 3/4"@ 12 PRESTRESS + (3) 3/4"ϕ GR.40 IN TOP 1 FT OF WALL	26 ksi 17 ksi	APPROX.

∴ RANGE OF D/C = 1.25 TO 1.89 AT ELEMENTS EXCEEDING 1.10 LIMIT (ELEMENTS FROM 1201 TO 1901)

↳ ℄ ELEMENT AT 5 ft ABOVE WALL BASE

BY: GGH 12·208 W0803
CHKD:
PROJECT NO.
PROJECT: SAN JOSE DIGESTERS
SUBJECT: DIGESTER #1 – PRESTRESS BAR TENSIONS
SHEET NO. 19

AWWA ANALYSIS SUMMARY (CONT.)

- HOOP TENSION AT BASE (UNSUBMERGED CASE)

$F_1 = 212\ k/ft$ (p. 16 OF MATHCAD CALCS; SEISMIC + STATIC LOAD (NOT INCL. THERMAL))

$$F_2 = \frac{324+303\ k/ft}{2\ ft}$$

(THERMAL LOAD CASE '6' FROM 'STAAD' OUTPUT — ELEMENTS 1101 & 1201, AT JT. 501 (i.e, CRITICAL AT 4 ft ABOVE BASE — CONSERV.))

$F_2 = 313.5\ k/ft$

TOTAL HOOP TENSION:

$$F = 212 + 313.5 = \underline{\underline{525.5\ k/ft}}$$

CAPACITY (1"φ @ 6" BARS):

$$0.79\ in^2 \times 2\ BARS/ft \times 85\ ksi = \underline{\underline{134.3\ k/ft}}$$

↳ ALLOWABLE STRESS INCL. SEISMIC (INCLUDES INCR. IN ALLOWABLE) SEE p. 3

$D/C = \underline{3.91}$ $\underline{\underline{NG}}$

- SEISMIC SHEAR AT BASE (UNSUBMERGED)

$$D/C = \frac{5{,}766^k}{4{,}545^k} = \underline{\underline{1.27}} \quad \underline{\underline{NG}}$$

(p. 14 OF AWWA ANALYSIS (MATHCAD))

- COMBINED STATIC + SEISMIC BASE SHEAR:

$$D/C \approx \frac{(\overset{p.15}{0.97} + 1.27)}{1.25} = \underline{\underline{1.79}} \quad \underline{\underline{NG}}$$

INCREASE ALLOWED BY AWWA FOR COMBINED STATIC + SEISMIC

BY: GGH	1/09	W0803	PROJECT	SAN JOSE DIGESTERS	20
CHKD:		PROJECT NO.	SUBJECT	DIG. #1 – RESULTS SUMMARY	SHEET NO.

```
          ****************************************************
          *                                                  *
          *           STAAD.Pro                              *
          *           Version  2006    Bld 1001.US           *
          *           Proprietary Program of                 *
          *           Research Engineers,  Intl.             *
          *           Date=    DEC  9, 2008                  *
          *           Time=     8:48:54                      *
          *                                                  *
          *      USER ID: Beyaz _Patel, Inc.                 *
          ****************************************************



     1. STAAD SPACE SAN JOSE DIGESTER #1 - UNSUBMERGED CASE
INPUT FILE: Structure1.STD
     2. START JOB INFORMATION
     3. ENGINEER DATE 8-DEC-08
     4. END JOB INFORMATION
     5. INPUT WIDTH 79
     6. *BY: GLENN HUDSON
     7. *LOADS ARE FOR UNSUBMERGED CASE WITH SURFACE AT 2 FT BELOW
     8. *TOP OF WALL
     9. *
    10. UNIT KIP FEET
    11. *
    12. JOINT COORDINATES CYLINDRICAL
    13. *
    14. *FOLLOWING JOINTS ARE FOR WALL FOOTING
    15. *
    16. 101   46.50  0.  0.
    17. REPEAT  71  0  5  0
    18. 201  50.50  0.  0.
    19. REPEAT  71  0  5  0
    20. 301  54.00  0.  0.
    21. REPEAT  71  0  5  0
    22. *
    23. *FOLLOWING JOINTS ARE FOR WALL
    24. *
    25. 401  50.50  0.  2.0
    26. REPEAT  71  0  5  0
    27. 501  50.50  0.  4.0
    28. REPEAT  71  0  5  0
    29. 601  50.50  0  6.0
    30. REPEAT  71  0  5  0
    31. 701  50.50  0.  9.0
    32. REPEAT  71  0  5  0
    33. 801  50.50  0.  12.0
    34. REPEAT  71  0  5  0
    35. 901  50.50  0.  16.0
    36. REPEAT  71  0  5  0
    37. 1001  50.50  0.  20.0
    38. REPEAT  71  0  5  0
    39. 1101  50.50  0.  24.0
    40. REPEAT  71  0  5  0
```

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41. 1201  50.50  0.  28.0
42. REPEAT  71  0  5  0
43. 1301  50.50  0.  30.25
44. REPEAT  71  0  5  0
45. 1401  50.50  0.  32.50
46. REPEAT  71  0  5  0
47. *
48. ELEMENT INCIDENCES SHELL
49. *
50. *ELEMENTS WITH NUMBERS BELOW 1000 ARE FOR FOOTING
51. *ELEMENTS WITH NUMBERS ABOVE 1000 ARE FOR WALL
52. *
53. *FOOTING ELEMENTS
54. 101  101  102  202  201  TO  171  1  1
55. 172  172  101  201  272
56. 201  201  202  302  301  TO  271  1  1
57. 272  272  201  301  372
58. *
59. *WALL ELEMENTS
60. 1001  201  401  402  202  TO  1071  1  1
61. 1072  272  472  401  201
62. 1101  401  501  502  402  TO  1171  1  1
63. 1172  472  572  501  401
64. 1201  501  601  602  502  TO  1271  1  1
65. 1272  572  672  601  501
66. 1301  601  701  702  602  TO  1371  1  1
67. 1372  672  772  701  601
68. 1401  701  801  802  702  TO  1471  1  1
69. 1472  772  872  801  701
70. 1501  801  901  902  802  TO  1571  1  1
71. 1572  872  972  901  801
72. 1601  901  1001  1002  902  TO  1671  1  1
73. 1672  972  1072  1001  901
74. 1701  1001  1101  1102  1002  TO  1771  1  1
75. 1772  1072  1172  1101  1001
76. 1801  1101  1201  1202  1102  TO  1871  1  1
77. 1872  1172  1272  1201  1101
78. 1901  1201  1301  1302  1202  TO  1971  1  1
79. 1972  1272  1372  1301  1201
80. 2001  1301  1401  1402  1302  TO  2071  1  1
81. 2072  1372  1472  1401  1301
82. UNIT KIP INCH
83. *
84. ELEMENT PROPERTY
85. *
86. *FOLLOWING ARE FOOTING ELEMENT THICKNESSES (101 TO 172 USE
87. *AVERAGE THICKNESS)
88. 101 TO 172 THICKNESS 15
89. 201 TO 272 THICKNESS 18
90. *
91. *FOLLOWING ARE WALL ELEMENTS
92. 1001 TO 1072  1101 TO 1172  1201 TO 1272  1301 TO 1372  1401 TO 1472 -
93. THICKNESS 12
94. 1501 TO 1572  1601 TO 1672  1701 TO 1772  1801 TO 1872  1901 TO 1972 -
95. 2001 TO 2072  THICKNESS 10
96. *
```

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  97. *JOINTS AT THE BOTTOM OF WALL ELEMENTS ARE RELEASED WITH RESPECT TO
  98. *MOMENT SINCE THERE IS NO REINFORCING THROUGH THE WALL TO FOOTING JOINT
  99. ELEMENT RELEASE
 100. 1001 TO 1072  J1  MX
 101. 1001 TO 1072  J4  MX
 102. *
 103. SUPPORTS
 104. *
 105. *SUPPORT JOINTS AT FOOTINGS HAVE VERTICAL SPRING CONSTANTS
 106. *TO MODEL SOIL RIGIDITY AND GIVE VERTICAL DEFLECTION OUTPUT
 107. *THAT IS INDICATION OF PREDICTED VERTICAL SETTLEMENT
 108. *
 109. 101 TO 172 FIXED BUT MX MY MZ  KFZ 515
 110. 201 TO 272 FIXED BUT MX MY MZ  KFZ 1225
 111. 301 TO 372 FIXED BUT MX MY MZ  KFZ 515
 112. *
 113. *SUPPORT JOINTS AT WALLS HAVE HORIZONTAL SPRING CONSTANTS IN
 114. *THE X-DIRECTION THAT MODEL SOIL PASSIVE PRESSURE
 115. *RESISTANCE ON THE BURIED PORTION OF THE WALL (FOR SEISMIC LOAD
 116. *CASES ONLY)
 117. *401 TO 412 461 TO 472 FIXED BUT  FY FZ MX MY MZ KFX 42
 118. *501 TO 512 561 TO 572 FIXED BUT  FY FZ MX MY MZ KFX 42
 119. *601 TO 612 661 TO 672 FIXED BUT  FY FZ MX MY MZ KFX 53
 120. *701 TO 712 761 TO 772 FIXED BUT  FY FZ MX MY MZ KFX 63
 121. *
 122. UNIT KIP INCH
 123. *
 124. CONSTANTS
 125. *FOLLOWING ARE CONCRETE ELEMENTS
 126. E 3100  MEMB 101 TO 172  201 TO 272  1001 TO 1072  1101 TO 1172 -
 127. 1201 TO 1272  1301 TO 1372  1401 TO 1472  1501 TO 1572  1601 TO 1672 -
 128. 1701 TO 1772  1801 TO 1872  1901 TO 1972  2001 TO 2072
 129. *
 130. POISSON 0.17 ALL
 131. *
 132. ALPHA CONCRETE ALL
 133. *
 134. UNIT KIP FEET
 135. *
 136. DENSITY 0.150 ALL
 137. *
 138. *LOADS
 139. *
 140. LOAD 1 DEAD LOAD
 141. SELFWEIGHT Z -1.0
 142. *REACTIONS FROM TRIBUTARY PORTION OF ROOF STRUCTURE ARE APPLIED AS VERTICAL
 143. *JOINT LOADS ON TOP OF WALL
 144. JOINT LOAD
 145. 1401 TO 1472  FZ -8.51
 146. *
 147. LOAD 2 TRIBUTARY ROOF LIVE LOAD
 148. JOINT LOAD
 149. 1401 TO 1472 FZ -0.97
 150. *
 151. LOAD 3 TRIBUTARY ROOF VACUUM PRESSURE
 152. JOINT LOAD
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153. 1401 TO 1472 FZ -1.28
154. *
155. LOAD 4 TRIBUTARY ROOF GAS UPLIFT PRESSURE
156. JOINT LOAD
157. 1401 TO 1472 FZ 4.59
158. *
159. LOAD 5 FLUID STATIC LOAD
160. *FOLLOWING IS FLUID STATIC LOAD ON WALL BASED ON SLUDGE DENSITY OF 70 PCF.
161. *NOTE THAT FOR UNSUBMERGED CASE, SURFACE IS AT 2 FT BELOW TOP OF WALL.  PRESSUR
162. *WALL IS 30.5 FT.
163. *
164. ELEMENT LOAD
165. 1001 TO 1072  PR -2.07
166. 1101 TO 1172  PR -1.93
167. 1201 TO 1272  PR -1.79
168. 1301 TO 1372  PR -1.61
169. 1401 TO 1472  PR -1.40
170. 1501 TO 1572  PR -1.16
171. 1601 TO 1672  PR -0.88
172. 1701 TO 1772  PR -0.60
173. 1801 TO 1872  PR -0.32
174. 1901 TO 1972  PR -0.10
175. 2001 TO 2072  PR  0.
176. *
177. LOAD 6 TEMPERATURE LOAD
178. *
179. *FIRST TEMPERATURE LOAD VALUE SPECIFIED IS THE AVERAGE RISE, AS MEASURED FROM
180. *THE STRUCTURE AVERAGE START TEMPERATURE.  SECOND TEMPERATURE LOAD VALUE
181. *SPECIFIED IS THE THRU-WALL TEMPERATURE DIFFERENTIAL
182. *
183. *ASSUMED TEMPERATURE VALUES FOR SITE (SAN JOSE) ARE:
184. *AIR AMBIENT LOW TEMPERATURE (JANUARY) = 40 DEG. F.
185. *STRUCTURE START TEMPERATURE (ANNUAL AVERAGE TEMP.) = 60 DEG. F.
186. *SOIL AMBIENT TEMPERATURE (INFLUENCED BY DIGESTER) = 80 DEG. F.
187. *DIGESTER INTERIOR TEMPERATURE = 135 DEG. F.
188. *
189. TEMPERATURE LOAD
190. *ABOVE GRADE ELEMENTS:
191. *FIRST TEMP LOAD VALUE = ((135-60)+(40-60))/2 = 27.5,  USE 28
192. *SECOND TEMP LOAD VALUE = 40 - 135 = -95
193. 1501 TO 1572  1601 TO 1672  1701 TO 1772  1801 TO 1872  1901 TO 1972 -
194. 2001 TO 2072  TEMP  28  -95
195. *BELOW GRADE ELEMENTS:
196. *FIRST TEMP LOAD VALUE = ((135-60)+(80-60))/2 = 48
197. *SECOND TEMP LOAD VALUE = 80 - 135 = -55
198. 1001 TO 1072  1101 TO 1172  1201 TO 1272  1301 TO 1372  1401 TO 1472 -
199. TEMP  48  -55
200. *
201. LOAD 7 PRESTRESS LOAD
202. *BASED ON 30 KSI INITIAL PRESTRESS IN CIRCUMFERENTIAL PRETRESS BARS,
203. *PER EXISTING DWGS.
204. *
205. ELEMENT LOAD
206. 1001 TO 1072  PR 1.02
207. 1101 TO 1172  PR 0.96
208. 1201 TO 1272  PR 0.93
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209. 1301 TO 1372  PR 0.86
210. 1401 TO 1472  PR 0.81
211. 1501 TO 1572  PR 0.80
212. 1601 TO 1672  PR 0.66
213. 1701 TO 1772  PR 0.53
214. 1801 TO 1872  PR 0.36
215. 1901 TO 1972  PR 0.26
216. 2001 TO 2072  PR 0.10
217. *
218. *FOLLOWING LOAD COMBINATION COMBINES TRIBUTARY ROOF VERTICAL DL,LL,VACUUM
219. *AND GAS PRESSURE LOADS; AND STATIC FLUID, TEMPERATURE AND PRESTRESS
220. *LATERAL LOADS ON SHELL WALL
221. *
222. LOAD COMB 8 TRIB. ROOF LOADS + FLUID STATIC + TEMP + PRESTRESS
223. 1 1.0  2 1.0  3 1.0  4 1.0  5 1.0  6 1.0  7 1.0
224. *
225. UNIT KIP INCH
226. *
227. PERFORM ANALYSIS


         P R O B L E M   S T A T I S T I C S
         -----------------------------------

   NUMBER OF JOINTS/MEMBER+ELEMENTS/SUPPORTS =  1008/   936/   216
   ORIGINAL/FINAL BAND-WIDTH=   215/    46/    282 DOF
   TOTAL PRIMARY LOAD CASES =    7, TOTAL DEGREES OF FREEDOM =   6048
   SIZE OF STIFFNESS MATRIX =     1706 DOUBLE  KILO-WORDS
   REQRD/AVAIL. DISK SPACE  =     35.6/  69191.8 MB



228. *
229. LOAD LIST 1 TO 8
230. *DISPLACEMENTS AT FOOTING AND FROM BOTTOM TO TOP OF WALL:
231. PRINT JOINT DISPLACEMENTS LIST 101 201 301   401 501 601 701 801 901 1001 1101
```

```
  JOINT DISPLACEMENT (INCH RADIANS)    STRUCTURE TYPE = SPACE
  ------------------

 JOINT  LOAD   X-TRANS   Y-TRANS   Z-TRANS   X-ROTAN   Y-ROTAN   Z-ROTAN


   101    1    0.00000   0.00000  -0.01293   0.00000   0.00012   0.00000
          2    0.00000   0.00000  -0.00036   0.00000   0.00000   0.00000
          3    0.00000   0.00000  -0.00047   0.00000   0.00001   0.00000
          4    0.00000   0.00000   0.00168   0.00000  -0.00002   0.00000
          5    0.00000   0.00000   0.00001   0.00000   0.00000   0.00000
          6    0.00000   0.00000   0.00090   0.00000   0.00001   0.00000
          7    0.00000   0.00000  -0.00001   0.00000   0.00000   0.00000
          8    0.00000   0.00000  -0.01116   0.00000   0.00013   0.00000
   201    1    0.00000   0.00000  -0.01660   0.00000  -0.00001   0.00000
          2    0.00000   0.00000  -0.00048   0.00000   0.00000   0.00000
          3    0.00000   0.00000  -0.00063   0.00000   0.00000   0.00000
          4    0.00000   0.00000   0.00226   0.00000   0.00000   0.00000
          5    0.00000   0.00000   0.00000   0.00000   0.00000   0.00000
          6    0.00000   0.00000   0.00001   0.00000   0.00003   0.00000
          7    0.00000   0.00000   0.00000   0.00000   0.00000   0.00000
          8    0.00000   0.00000  -0.01544   0.00000   0.00002   0.00000
   301    1    0.00000   0.00000  -0.01454   0.00000  -0.00007   0.00000
          2    0.00000   0.00000  -0.00039   0.00000   0.00000   0.00000
          3    0.00000   0.00000  -0.00052   0.00000   0.00000   0.00000
          4    0.00000   0.00000   0.00187   0.00000   0.00001   0.00000
          5    0.00000   0.00000  -0.00001   0.00000   0.00000   0.00000
          6    0.00000   0.00000  -0.00092   0.00000   0.00002   0.00000
          7    0.00000   0.00000   0.00001   0.00000   0.00000   0.00000
          8    0.00000   0.00000  -0.01452   0.00000  -0.00004   0.00000
   401    1    0.00044   0.00000  -0.01693   0.00000   0.00002   0.00000
          2    0.00002   0.00000  -0.00049   0.00000   0.00000   0.00000
          3    0.00002   0.00000  -0.00065   0.00000   0.00000   0.00000
          4   -0.00009   0.00000   0.00231   0.00000   0.00000   0.00000
          5    0.04207   0.00000  -0.00073   0.00000   0.00160   0.00000
          6    0.07039   0.00000   0.00627   0.00000   0.00249   0.00000
          7   -0.02218   0.00000   0.00039   0.00000  -0.00085   0.00000
          8    0.09067   0.00000  -0.00983   0.00000   0.00325   0.00000
   501    1    0.00079   0.00000  -0.01724   0.00000   0.00001   0.00000
          2    0.00003   0.00000  -0.00050   0.00000   0.00000   0.00000
          3    0.00004   0.00000  -0.00066   0.00000   0.00000   0.00000
          4   -0.00016   0.00000   0.00237   0.00000   0.00000   0.00000
          5    0.07522   0.00000  -0.00096   0.00000   0.00113   0.00000
          6    0.11898   0.00000   0.01339   0.00000   0.00157   0.00000
          7   -0.04014   0.00000   0.00052   0.00000  -0.00063   0.00000
          8    0.15477   0.00000  -0.00308   0.00000   0.00208   0.00000
   601    1    0.00103   0.00000  -0.01754   0.00000   0.00001   0.00000
          2    0.00004   0.00000  -0.00051   0.00000   0.00000   0.00000
          3    0.00006   0.00000  -0.00068   0.00000   0.00000   0.00000
          4   -0.00021   0.00000   0.00242   0.00000   0.00000   0.00000
          5    0.09630   0.00000  -0.00135   0.00000   0.00063   0.00000
          6    0.14639   0.00000   0.02021   0.00000   0.00076   0.00000
          7   -0.05245   0.00000   0.00074   0.00000  -0.00040   0.00000
          8    0.19116   0.00000   0.00330   0.00000   0.00100   0.00000
```

```
  JOINT DISPLACEMENT (INCH RADIANS)    STRUCTURE TYPE = SPACE
  ------------------

 JOINT  LOAD   X-TRANS   Y-TRANS   Z-TRANS   X-ROTAN   Y-ROTAN   Z-ROTAN


   701    1    0.00121   0.00000  -0.01795   0.00000   0.00000   0.00000
          2    0.00005   0.00000  -0.00053   0.00000   0.00000   0.00000
          3    0.00007   0.00000  -0.00070   0.00000   0.00000   0.00000
          4   -0.00026   0.00000   0.00251   0.00000   0.00000   0.00000
          5    0.10861   0.00000  -0.00219   0.00000   0.00009   0.00000
          6    0.15681   0.00000   0.03010   0.00000  -0.00009   0.00000
          7   -0.06203   0.00000   0.00123   0.00000  -0.00015   0.00000
          8    0.20447   0.00000   0.01247   0.00000  -0.00015   0.00000
   801    1    0.00125   0.00000  -0.01833   0.00000   0.00000   0.00000
          2    0.00006   0.00000  -0.00055   0.00000   0.00000   0.00000
          3    0.00008   0.00000  -0.00072   0.00000   0.00000   0.00000
          4   -0.00028   0.00000   0.00259   0.00000   0.00000   0.00000
          5    0.10569   0.00000  -0.00316   0.00000  -0.00022   0.00000
          6    0.14572   0.00000   0.03981   0.00000  -0.00043   0.00000
          7   -0.06457   0.00000   0.00182   0.00000   0.00000   0.00000
          8    0.18794   0.00000   0.02146   0.00000  -0.00065   0.00000
   901    1    0.00114   0.00000  -0.01888   0.00000   0.00000   0.00000
          2    0.00006   0.00000  -0.00058   0.00000   0.00000   0.00000
          3    0.00008   0.00000  -0.00076   0.00000   0.00000   0.00000
          4   -0.00029   0.00000   0.00273   0.00000   0.00000   0.00000
          5    0.08797   0.00000  -0.00438   0.00000  -0.00047   0.00000
          6    0.12134   0.00000   0.04667   0.00000  -0.00044   0.00000
          7   -0.06027   0.00000   0.00261   0.00000   0.00017   0.00000
          8    0.15004   0.00000   0.02740   0.00000  -0.00075   0.00000
  1001    1    0.00095   0.00000  -0.01936   0.00000   0.00000   0.00000
          2    0.00006   0.00000  -0.00060   0.00000   0.00000   0.00000
          3    0.00007   0.00000  -0.00080   0.00000   0.00000   0.00000
          4   -0.00027   0.00000   0.00286   0.00000   0.00000   0.00000
          5    0.06354   0.00000  -0.00539   0.00000  -0.00052   0.00000
          6    0.11031   0.00000   0.05361   0.00000  -0.00002   0.00000
          7   -0.04999   0.00000   0.00332   0.00000   0.00025   0.00000
          8    0.12467   0.00000   0.03364   0.00000  -0.00029   0.00000
  1101    1    0.00075   0.00000  -0.01978   0.00000   0.00000   0.00000
          2    0.00005   0.00000  -0.00063   0.00000   0.00000   0.00000
          3    0.00007   0.00000  -0.00083   0.00000   0.00000   0.00000
          4   -0.00024   0.00000   0.00299   0.00000   0.00000   0.00000
          5    0.03931   0.00000  -0.00609   0.00000  -0.00048   0.00000
          6    0.11340   0.00000   0.06073   0.00000   0.00005   0.00000
          7   -0.03726   0.00000   0.00390   0.00000   0.00027   0.00000
          8    0.11609   0.00000   0.04029   0.00000  -0.00015   0.00000


  ************** END OF LATEST ANALYSIS RESULT **************
```

JOINT 701

$\Delta x_{MAX} = 0.205"$

(LC8)

```
 232. *REACTIONS AT WALL BASE _FOOTING:
 233. PRINT SUPPORT REACTIONS LIST 101 201 301
```

```
 SUPPORT REACTIONS -UNIT KIP  INCH    STRUCTURE TYPE = SPACE
 -----------------

JOINT  LOAD   FORCE-X   FORCE-Y   FORCE-Z     MOM-X     MOM-Y     MOM Z


  101    1      0.00      0.00      6.66      0.00      0.00      0.00
         2      0.00      0.00      0.18      0.00      0.00      0.00
         3      0.00      0.00      0.24      0.00      0.00      0.00
         4      0.00      0.00     -0.87      0.00      0.00      0.00
         5      0.00      0.00     -0.01      0.00      0.00      0.00
         6      0.00      0.00     -0.46      0.00      0.00      0.00
         7      0.00      0.00      0.00      0.00      0.00      0.00
         8      0.00      0.00      5.75      0.00      0.00      0.00
  201    1     -0.24      0.00     20.34      0.00      0.00      0.00
         2     -0.01      0.00      0.58      0.00      0.00      0.00
         3     -0.01      0.00      0.77      0.00      0.00      0.00
         4      0.04      0.00     -2.76      0.00      0.00      0.00
         5    -26.09      0.00      0.00      0.00      0.00      0.00
         6    -19.82      0.00     -0.01      0.00      0.00      0.00
         7     12.51      0.00      0.00      0.00      0.00      0.00
         8    -33.61      0.00     18.92      0.00      0.00      0.00
  301    1      0.00      0.00      7.49      0.00      0.00      0.00
         2      0.00      0.00      0.20      0.00      0.00      0.00
         3      0.00      0.00      0.27      0.00      0.00      0.00
         4      0.00      0.00     -0.96      0.00      0.00      0.00
         5      0.00      0.00      0.01      0.00      0.00      0.00
         6      0.00      0.00      0.48      0.00      0.00      0.00
         7      0.00      0.00      0.00      0.00      0.00      0.00
         8      0.00      0.00      7.48      0.00      0.00      0.00


 ************** END OF LATEST ANALYSIS RESULT **************


 234. *ELEMENT STRESSES IN STRIP FROM TOP TO BOTTOM OF WALL:
 235. PRINT ELEMENT STRESSES LIST 2001 1901 1801 1701 1601 1501 1401 1301 1201 -
 236. 1101 1001
```

SHEAR AT WALL BASE;

$R_{x_{MAX}} = -33.61^K$

(JOINT 201, LC8)

$R_Z = 18.92^K$ VERT.

```
ELEMENT STRESSES    FORCE,LENGTH UNITS= KIP  INCH
----------------

         STRESS = FORCE/UNIT WIDTH/THICK, MOMENT = FORCE-LENGTH/UNIT WIDTH

ELEMENT  LOAD        SQX        SQY          MX          MY            MXY
                     VONT       VONB         SX          SY            SXY
                     TRESCAT    TRESCAB


 2001      1         0.00       0.00         0.06        0.01          0.00
                     0.01       0.02        -0.02        0.00          0.00
                     0.02       0.02
     TOP :  SMAX=      0.00  SMIN=    -0.01  TMAX=      0.01  ANGLE=  90.0
     BOTT:  SMAX=      0.00  SMIN=    -0.02  TMAX=      0.01  ANGLE=  90.0
           2         0.00       0.00         0.01        0.00          0.00
                     0.00       0.00         0.00        0.00          0.00
                     0.00       0.00
     TOP :  SMAX=      0.00  SMIN=     0.00  TMAX=      0.00  ANGLE=  90.0
     BOTT:  SMAX=      0.00  SMIN=     0.00  TMAX=      0.00  ANGLE=  90.0
           3         0.00       0.00         0.01        0.00          0.00
                     0.00       0.00         0.00        0.00          0.00
                     0.00       0.00
     TOP :  SMAX=      0.00  SMIN=     0.00  TMAX=      0.00  ANGLE=  90.0
     BOTT:  SMAX=      0.00  SMIN=     0.00  TMAX=      0.00  ANGLE=  90.0
           4         0.00       0.00        -0.03       -0.01          0.00
                     0.01       0.01         0.01        0.00          0.00
                     0.01       0.01
     TOP :  SMAX=      0.01  SMIN=     0.00  TMAX=      0.00  ANGLE=  90.0
     BOTT:  SMAX=      0.01  SMIN=     0.00  TMAX=      0.01  ANGLE=  90.0
           5         0.00       0.00         0.02        0.00          0.00
                     0.00       0.00         0.00        0.00          0.00
                     0.00       0.00
     TOP :  SMAX=      0.00  SMIN=     0.00  TMAX=      0.00  ANGLE=  90.0
     BOTT:  SMAX=      0.00  SMIN=     0.00  TMAX=      0.00  ANGLE=  90.0
           6        -0.01       0.00         0.89       13.65          0.00
                     0.45       1.14         0.00       -0.35          0.00
                     0.47       1.16
     TOP :  SMAX=      0.47  SMIN=     0.05  TMAX=      0.21  ANGLE=   0.0
     BOTT:  SMAX=     -0.05  SMIN=    -1.16  TMAX=      0.56  ANGLE=   0.0
           7         0.00       0.00        -0.01        0.00          0.00
                     0.07       0.07         0.00       -0.07          0.00
                     0.07       0.07
     TOP :  SMAX=      0.00  SMIN=    -0.07  TMAX=      0.03  ANGLE=  90.0
     BOTT:  SMAX=      0.00  SMIN=    -0.07  TMAX=      0.03  ANGLE=  90.0
           8        -0.01       0.00         0.94       13.66          0.00
                     0.39       1.19        -0.01       -0.41          0.00
                     0.41       1.23
     TOP :  SMAX=      0.41  SMIN=     0.04  TMAX=      0.18  ANGLE=   0.0
     BOTT:  SMAX=     -0.07  SMIN=    -1.23  TMAX=      0.58  ANGLE=   0.0

 1901      1         0.00       0.00         0.05        0.01          0.00
                     0.02       0.02        -0.02        0.00          0.00
                     0.02       0.02
     TOP :  SMAX=      0.00  SMIN=    -0.02  TMAX=      0.01  ANGLE=  90.0
     BOTT:  SMAX=      0.00  SMIN=    -0.02  TMAX=      0.01  ANGLE=  90.0
```

```
 ELEMENT STRESSES    FORCE,LENGTH UNITS= KIP  INCH
 ----------------

         STRESS = FORCE/UNIT WIDTH/THICK, MOMENT = FORCE-LENGTH/UNIT WIDTH

ELEMENT  LOAD        SQX         SQY          MX          MY           MXY
                     VONT        VONB         SX          SY           SXY
                     TRESCAT     TRESCAB

           2         0.00        0.00         0.01        0.00         0.00
                     0.00        0.00         0.00        0.00         0.00
                     0.00        0.00
      TOP :  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
      BOTT:  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
           3         0.00        0.00         0.01        0.00         0.00
                     0.00        0.00         0.00        0.00         0.00
                     0.00        0.00
      TOP :  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
      BOTT:  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
           4         0.00        0.00        -0.02        0.00         0.00
                     0.01        0.01         0.01        0.00         0.00
                     0.01        0.01
      TOP :  SMAX=     0.01  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
      BOTT:  SMAX=     0.01  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
           5         0.00        0.00         0.06        0.01         0.00
                     0.06        0.06         0.00        0.06         0.00
                     0.06        0.06
      TOP :  SMAX=     0.06  SMIN=     0.00  TMAX=     0.03  ANGLE=  90.0
      BOTT:  SMAX=     0.06  SMIN=     0.00  TMAX=     0.03  ANGLE=  90.0
           6        -0.02        0.00         4.77       14.31         0.00
                     0.70        0.81         0.00       -0.06         0.00
                     0.80        0.92
      TOP :  SMAX=     0.80  SMIN=     0.29  TMAX=     0.26  ANGLE=   0.0
      BOTT:  SMAX=    -0.29  SMIN=    -0.92  TMAX=     0.32  ANGLE=   0.0
           7         0.00        0.00         0.11        0.02         0.00
                     0.11        0.10         0.00       -0.10         0.00
                     0.11        0.11
      TOP :  SMAX=     0.01  SMIN=    -0.10  TMAX=     0.06  ANGLE=   0.0
      BOTT:  SMAX=    -0.01  SMIN=    -0.11  TMAX=     0.05  ANGLE=  90.0
           8        -0.02        0.00         4.98       14.34         0.00
                     0.66        0.85        -0.02       -0.10         0.00
                     0.76        0.96
      TOP :  SMAX=     0.76  SMIN=     0.28  TMAX=     0.24  ANGLE=   0.0
      BOTT:  SMAX=    -0.31  SMIN=    -0.96  TMAX=     0.32  ANGLE=   0.0

 1801      1         0.00        0.00         0.03        0.00         0.00
                     0.02        0.02        -0.02        0.00         0.00
                     0.02        0.02
      TOP :  SMAX=     0.00  SMIN=    -0.02  TMAX=     0.01  ANGLE=  90.0
      BOTT:  SMAX=     0.00  SMIN=    -0.02  TMAX=     0.01  ANGLE=  90.0
           2         0.00        0.00         0.00        0.00         0.00
                     0.00        0.00         0.00        0.00         0.00
                     0.00        0.00
      TOP :  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
      BOTT:  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
```

```
 ELEMENT STRESSES    FORCE,LENGTH UNITS= KIP  INCH
 ----------------

         STRESS = FORCE/UNIT WIDTH/THICK, MOMENT = FORCE-LENGTH/UNIT WIDTH

ELEMENT  LOAD       SQX        SQY          MX          MY            MXY
                    VONT       VONB         SX          SY            SXY
                    TRESCAT    TRESCAB

           3        0.00       0.00        0.00        0.00          0.00
                    0.00       0.00        0.00        0.00          0.00
                    0.00       0.00
      TOP :  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
      BOTT:  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
           4        0.00       0.00       -0.01        0.00          0.00
                    0.01       0.01        0.01        0.00          0.00
                    0.01       0.01
      TOP :  SMAX=     0.01  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
      BOTT:  SMAX=     0.01  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
           5        0.00       0.00        0.29        0.05          0.00
                    0.14       0.15        0.00        0.14          0.00
                    0.15       0.16
      TOP :  SMAX=     0.15  SMIN=     0.02  TMAX=     0.06  ANGLE=   0.0
      BOTT:  SMAX=     0.14  SMIN=    -0.02  TMAX=     0.08  ANGLE=   0.0
           6       -0.02       0.00       11.12       15.39          0.00
                    0.89       0.77        0.00        0.08          0.00
                    1.01       0.84
      TOP :  SMAX=     1.01  SMIN=     0.67  TMAX=     0.17  ANGLE=   0.0
      BOTT:  SMAX=    -0.67  SMIN=    -0.84  TMAX=     0.09  ANGLE=   0.0
           7        0.00       0.00       -0.02        0.00          0.00
                    0.16       0.16        0.00       -0.16          0.00
                    0.16       0.16
      TOP :  SMAX=     0.00  SMIN=    -0.16  TMAX=     0.08  ANGLE=   0.0
      BOTT:  SMAX=     0.00  SMIN=    -0.16  TMAX=     0.08  ANGLE=   0.0
           8       -0.02       0.00       11.40       15.44          0.00
                    0.88       0.79       -0.02        0.07          0.00
                    1.00       0.86
      TOP :  SMAX=     1.00  SMIN=     0.67  TMAX=     0.17  ANGLE=   0.0
      BOTT:  SMAX=    -0.70  SMIN=    -0.86  TMAX=     0.08  ANGLE=   0.0

 1701      1        0.00       0.00        0.01        0.00          0.00
                    0.03       0.03       -0.03        0.00          0.00
                    0.03       0.03
      TOP :  SMAX=     0.00  SMIN=    -0.03  TMAX=     0.01  ANGLE=  90.0
      BOTT:  SMAX=     0.00  SMIN=    -0.03  TMAX=     0.01  ANGLE=  90.0
           2        0.00       0.00        0.00        0.00          0.00
                    0.00       0.00        0.00        0.00          0.00
                    0.00       0.00
      TOP :  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
      BOTT:  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
           3        0.00       0.00        0.00        0.00          0.00
                    0.00       0.00        0.00        0.00          0.00
                    0.00       0.00
      TOP :  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
      BOTT:  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
```

```
 ELEMENT STRESSES    FORCE,LENGTH UNITS= KIP  INCH
 ----------------

          STRESS = FORCE/UNIT WIDTH/THICK, MOMENT = FORCE-LENGTH/UNIT WIDTH

ELEMENT  LOAD       SQX        SQY          MX          MY          MXY
                    VONT       VONB         SX          SY          SXY
                    TRESCAT    TRESCAB

           4        0.00       0.00        0.00        0.00         0.00
                    0.01       0.01        0.01        0.00         0.00
                    0.01       0.01
     TOP :  SMAX=     0.01  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
     BOTT:  SMAX=     0.01  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
           5        0.00       0.00        0.22        0.04         0.00
                    0.26       0.27        0.00        0.26         0.00
                    0.26       0.27
     TOP :  SMAX=     0.26  SMIN=     0.01  TMAX=     0.13  ANGLE=   0.0
     BOTT:  SMAX=     0.26  SMIN=    -0.01  TMAX=     0.14  ANGLE=   0.0
           6       -0.01       0.00       16.67       16.33         0.00
                    1.04       0.95        0.00        0.09         0.00
                    1.07       1.00
     TOP :  SMAX=     1.07  SMIN=     1.00  TMAX=     0.04  ANGLE=  90.0
     BOTT:  SMAX=    -0.89  SMIN=    -1.00  TMAX=     0.06  ANGLE=   0.0
           7        0.00       0.00        0.13        0.02         0.00
                    0.23       0.22        0.00       -0.22         0.00
                    0.23       0.23
     TOP :  SMAX=     0.01  SMIN=    -0.22  TMAX=     0.12  ANGLE=   0.0
     BOTT:  SMAX=    -0.01  SMIN=    -0.23  TMAX=     0.11  ANGLE=   0.0
           8       -0.01       0.00       17.03       16.39         0.00
                    1.06       0.96       -0.02        0.13         0.00
                    1.12       1.04
     TOP :  SMAX=     1.12  SMIN=     1.00  TMAX=     0.06  ANGLE=   0.0
     BOTT:  SMAX=    -0.85  SMIN=    -1.04  TMAX=     0.10  ANGLE=   0.0

 1601      1        0.00       0.00        0.00        0.00         0.00
                    0.03       0.03       -0.03        0.00         0.00
                    0.03       0.03
     TOP :  SMAX=     0.00  SMIN=    -0.03  TMAX=     0.02  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=    -0.03  TMAX=     0.02  ANGLE=  90.0
           2        0.00       0.00        0.00        0.00         0.00
                    0.00       0.00        0.00        0.00         0.00
                    0.00       0.00
     TOP :  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
           3        0.00       0.00        0.00        0.00         0.00
                    0.00       0.00        0.00        0.00         0.00
                    0.00       0.00
     TOP :  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
           4        0.00       0.00        0.00        0.00         0.00
                    0.01       0.01        0.01        0.00         0.00
                    0.01       0.01
     TOP :  SMAX=     0.01  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
     BOTT:  SMAX=     0.01  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
```

```
 ELEMENT STRESSES    FORCE,LENGTH UNITS= KIP  INCH
 ----------------

          STRESS = FORCE/UNIT WIDTH/THICK, MOMENT = FORCE-LENGTH/UNIT WIDTH

ELEMENT  LOAD        SQX         SQY           MX           MY            MXY
                     VONT        VONB          SX           SY            SXY
                     TRESCAT     TRESCAB

          5          0.00        0.00        -0.25        -0.04          0.00
                     0.39        0.38         0.00         0.39          0.00
                     0.40        0.39
     TOP :  SMAX=     0.39  SMIN=    -0.02  TMAX=     0.20  ANGLE=   0.0
     BOTT:  SMAX=     0.39  SMIN=     0.02  TMAX=     0.19  ANGLE=   0.0
          6          0.00        0.00        18.61        16.66          0.00
                     1.11        1.02         0.00         0.11          0.00
                     1.12        1.12
     TOP :  SMAX=     1.12  SMIN=     1.11  TMAX=     0.01  ANGLE=  90.0
     BOTT:  SMAX=    -0.89  SMIN=    -1.12  TMAX=     0.11  ANGLE=   0.0
          7          0.00        0.00         0.46         0.08          0.00
                     0.29        0.28         0.00        -0.28          0.00
                     0.31        0.29
     TOP :  SMAX=     0.03  SMIN=    -0.28  TMAX=     0.15  ANGLE=   0.0
     BOTT:  SMAX=    -0.03  SMIN=    -0.29  TMAX=     0.13  ANGLE=   0.0
          8          0.00        0.00        18.81        16.70          0.00
                     1.16        1.02        -0.03         0.21          0.00
                     1.21        1.16
     TOP :  SMAX=     1.21  SMIN=     1.10  TMAX=     0.06  ANGLE=   0.0
     BOTT:  SMAX=    -0.79  SMIN=    -1.16  TMAX=     0.18  ANGLE=   0.0

 1501     1          0.00        0.00        -0.02         0.00          0.00
                     0.04        0.03        -0.04         0.00          0.00
                     0.04        0.03
     TOP :  SMAX=     0.00  SMIN=    -0.04  TMAX=     0.02  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=    -0.03  TMAX=     0.02  ANGLE=  90.0
          2          0.00        0.00         0.00         0.00          0.00
                     0.00        0.00         0.00         0.00          0.00
                     0.00        0.00
     TOP :  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
          3          0.00        0.00         0.00         0.00          0.00
                     0.00        0.00         0.00         0.00          0.00
                     0.00        0.00
     TOP :  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
          4          0.00        0.00         0.00         0.00          0.00
                     0.01        0.01         0.01         0.00          0.00
                     0.01        0.01
     TOP :  SMAX=     0.01  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
     BOTT:  SMAX=     0.01  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
          5          0.00        0.00        -1.39        -0.24          0.00
                     0.53        0.48         0.00         0.50          0.00
                     0.57        0.51
     TOP :  SMAX=     0.49  SMIN=    -0.08  TMAX=     0.28  ANGLE=   0.0
     BOTT:  SMAX=     0.51  SMIN=     0.08  TMAX=     0.22  ANGLE=   0.0
```

```
ELEMENT STRESSES     FORCE,LENGTH UNITS= KIP  INCH
----------------

         STRESS = FORCE/UNIT WIDTH/THICK, MOMENT = FORCE-LENGTH/UNIT WIDTH

ELEMENT  LOAD       SQX        SQY          MX          MY           MXY
                    VONT       VONB         SX          SY           SXY
                    TRESCAT    TRESCAB

          6         0.01       0.00       16.18       16.25          0.00
                    1.09       0.89        0.00        0.21          0.00
                    1.18       0.97
     TOP :  SMAX=     1.18  SMIN=     0.97  TMAX=     0.11  ANGLE=    0.0
     BOTT:  SMAX=    -0.77  SMIN=    -0.97  TMAX=     0.10  ANGLE=    0.0
          7         0.00       0.00        0.92        0.16          0.00
                    0.34       0.31        0.00       -0.32          0.00
                    0.37       0.33
     TOP :  SMAX=     0.05  SMIN=    -0.31  TMAX=     0.18  ANGLE=    0.0
     BOTT:  SMAX=    -0.05  SMIN=    -0.33  TMAX=     0.14  ANGLE=    0.0
          8         0.01       0.00       15.69       16.16          0.00
                    1.20       0.85       -0.03        0.38          0.00
                    1.35       0.97
     TOP :  SMAX=     1.35  SMIN=     0.91  TMAX=     0.22  ANGLE=    0.0
     BOTT:  SMAX=    -0.59  SMIN=    -0.97  TMAX=     0.19  ANGLE=    0.0

 1401     1         0.00       0.00       -0.04       -0.01          0.00
                    0.03       0.03       -0.03        0.00          0.00
                    0.03       0.03
     TOP :  SMAX=     0.00  SMIN=    -0.03  TMAX=     0.02  ANGLE=   90.0
     BOTT:  SMAX=     0.00  SMIN=    -0.03  TMAX=     0.02  ANGLE=   90.0
          2         0.00       0.00        0.00        0.00          0.00
                    0.00       0.00        0.00        0.00          0.00
                    0.00       0.00
     TOP :  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=   90.0
     BOTT:  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=   90.0
          3         0.00       0.00        0.00        0.00          0.00
                    0.00       0.00        0.00        0.00          0.00
                    0.00       0.00
     TOP :  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=   90.0
     BOTT:  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=   90.0
          4         0.00       0.00        0.01        0.00          0.00
                    0.01       0.01        0.01        0.00          0.00
                    0.01       0.01
     TOP :  SMAX=     0.01  SMIN=     0.00  TMAX=     0.00  ANGLE=   90.0
     BOTT:  SMAX=     0.01  SMIN=     0.00  TMAX=     0.00  ANGLE=   90.0
          5         0.01       0.00       -4.00       -0.68          0.00
                    0.62       0.52        0.00        0.55          0.00
                    0.69       0.58
     TOP :  SMAX=     0.52  SMIN=    -0.17  TMAX=     0.35  ANGLE=    0.0
     BOTT:  SMAX=     0.58  SMIN=     0.17  TMAX=     0.21  ANGLE=    0.0
          6         0.02       0.00        9.23       12.82          0.00
                    0.45       0.51        0.00       -0.04          0.00
                    0.49       0.57
     TOP :  SMAX=     0.49  SMIN=     0.38  TMAX=     0.06  ANGLE=    0.0
     BOTT:  SMAX=    -0.38  SMIN=    -0.57  TMAX=     0.09  ANGLE=    0.0
```

MAX. ELEMENT
HORIZ. TENSION
STRESS
ELEM. 1301, LC8
$\sigma_{x_{MAX}} = 1.35 ksi$
$\sigma_{x_{MIN}} = -0.59 ksi$

```
ELEMENT STRESSES    FORCE,LENGTH UNITS= KIP  INCH
----------------

         STRESS = FORCE/UNIT WIDTH/THICK, MOMENT = FORCE-LENGTH/UNIT WIDTH

ELEMENT  LOAD       SQX         SQY          MX          MY           MXY
                    VONT        VONB         SX          SY           SXY
                    TRESCAT     TRESCAB

           7        0.00        0.00        1.95        0.33         0.00
                    0.36        0.31        0.00       -0.33         0.00
                    0.39        0.34
     TOP :  SMAX=     0.08  SMIN=    -0.31  TMAX=     0.20  ANGLE=   0.0
     BOTT:  SMAX=    -0.08  SMIN=    -0.34  TMAX=     0.13  ANGLE=   0.0
           8        0.02        0.00        7.14       12.47         0.00
                    0.62        0.33       -0.03        0.19         0.00
                    0.71        0.33
     TOP :  SMAX=     0.71  SMIN=     0.27  TMAX=     0.22  ANGLE=   0.0
     BOTT:  SMAX=    -0.33  SMIN=    -0.33  TMAX=     0.00  ANGLE=  90.0

 1301      1        0.00        0.00       -0.07       -0.01         0.00
                    0.04        0.03       -0.04        0.00         0.00
                    0.04        0.03
     TOP :  SMAX=     0.00  SMIN=    -0.04  TMAX=     0.02  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=    -0.03  TMAX=     0.02  ANGLE=  90.0
           2        0.00        0.00        0.00        0.00         0.00
                    0.00        0.00        0.00        0.00         0.00
                    0.00        0.00
     TOP :  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
           3        0.00        0.00        0.00        0.00         0.00
                    0.00        0.00        0.00        0.00         0.00
                    0.00        0.00
     TOP :  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
           4        0.00        0.00        0.01        0.00         0.00
                    0.01        0.01        0.01        0.00         0.00
                    0.01        0.01
     TOP :  SMAX=     0.01  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
     BOTT:  SMAX=     0.01  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
           5        0.01        0.00       -6.89       -1.17         0.00
                    0.67        0.50        0.00        0.53         0.00
                    0.77        0.58
     TOP :  SMAX=     0.48  SMIN=    -0.29  TMAX=     0.39  ANGLE=   0.0
     BOTT:  SMAX=     0.58  SMIN=     0.29  TMAX=     0.15  ANGLE=   0.0
           6        0.01        0.00        2.76       11.72         0.00
                    0.41        0.47        0.00       -0.03         0.00
                    0.46        0.52
     TOP :  SMAX=     0.46  SMIN=     0.11  TMAX=     0.17  ANGLE=   0.0
     BOTT:  SMAX=    -0.11  SMIN=    -0.52  TMAX=     0.20  ANGLE=   0.0
           7        0.00        0.00        3.14        0.53         0.00
                    0.36        0.28        0.00       -0.30         0.00
                    0.41        0.32
     TOP :  SMAX=     0.13  SMIN=    -0.27  TMAX=     0.20  ANGLE=   0.0
     BOTT:  SMAX=    -0.13  SMIN=    -0.32  TMAX=     0.09  ANGLE=   0.0
```

```
 SAN JOSE DIGESTER #1 - UNSUBMERGED CASE                    -- PAGE NO.   17


 ELEMENT STRESSES    FORCE,LENGTH UNITS= KIP  INCH
 ----------------

         STRESS = FORCE/UNIT WIDTH/THICK, MOMENT = FORCE-LENGTH/UNIT WIDTH

ELEMENT  LOAD       SQX        SQY          MX          MY           MXY
                    VONT       VONB         SX          SY           SXY
                    TRESCAT    TRESCAB

           8        0.02       0.00        -1.05       11.07          0.00
                    0.71       0.26        -0.03        0.21          0.00
                    0.74       0.27
     TOP :  SMAX=     0.67  SMIN=    -0.08  TMAX=     0.37  ANGLE=   0.0
     BOTT:  SMAX=     0.01  SMIN=    -0.26  TMAX=     0.13  ANGLE=   0.0

 1201      1        0.00       0.00        -0.09       -0.01          0.00
                    0.04       0.03        -0.04        0.00          0.00
                    0.04       0.03
     TOP :  SMAX=     0.00  SMIN=    -0.04  TMAX=     0.02  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=    -0.03  TMAX=     0.02  ANGLE=  90.0
           2        0.00       0.00         0.00        0.00          0.00
                    0.00       0.00         0.00        0.00          0.00
                    0.00       0.00
     TOP :  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
           3        0.00       0.00         0.00        0.00          0.00
                    0.00       0.00         0.00        0.00          0.00
                    0.00       0.00
     TOP :  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
           4        0.00       0.00         0.01        0.00          0.00
                    0.01       0.01         0.01        0.00          0.00
                    0.01       0.01
     TOP :  SMAX=     0.01  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
     BOTT:  SMAX=     0.01  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
           5        0.00       0.00        -9.55       -1.62          0.00
                    0.67       0.47         0.00        0.44          0.00
                    0.77       0.51
     TOP :  SMAX=     0.38  SMIN=    -0.40  TMAX=     0.39  ANGLE=   0.0
     BOTT:  SMAX=     0.51  SMIN=     0.40  TMAX=     0.06  ANGLE=   0.0
           6        0.01       0.00        -1.97       10.92          0.00
                    0.37       0.63         0.00       -0.13          0.00
                    0.41       0.67
     TOP :  SMAX=     0.32  SMIN=    -0.08  TMAX=     0.20  ANGLE=   0.0
     BOTT:  SMAX=     0.08  SMIN=    -0.59  TMAX=     0.33  ANGLE=   0.0
           7        0.00       0.00         4.45        0.76          0.00
                    0.34       0.24         0.00       -0.24          0.00
                    0.39       0.27
     TOP :  SMAX=     0.19  SMIN=    -0.21  TMAX=     0.20  ANGLE=   0.0
     BOTT:  SMAX=    -0.19  SMIN=    -0.27  TMAX=     0.04  ANGLE=  90.0
           8        0.01       0.00        -7.14       10.04          0.00
                    0.72       0.53        -0.03        0.07          0.00
                    0.82       0.61
     TOP :  SMAX=     0.49  SMIN=    -0.33  TMAX=     0.41  ANGLE=   0.0
     BOTT:  SMAX=     0.26  SMIN=    -0.35  TMAX=     0.30  ANGLE=   0.0
```

```
   SAN JOSE DIGESTER #1 - UNSUBMERGED CASE                     -- PAGE NO.   18


  ELEMENT STRESSES    FORCE,LENGTH UNITS= KIP  INCH
  ----------------

         STRESS = FORCE/UNIT WIDTH/THICK, MOMENT = FORCE-LENGTH/UNIT WIDTH

 ELEMENT  LOAD       SQX         SQY          MX          MY           MXY
                     VONT        VONB         SX          SY           SXY
                     TRESCAT     TRESCAB


  1101      1        0.00        0.00        -0.08       -0.01          0.00
                     0.04        0.04        -0.04        0.00          0.00
                     0.04        0.04
     TOP :  SMAX=      0.00  SMIN=    -0.04  TMAX=     0.02  ANGLE=  90.0
     BOTT:  SMAX=      0.00  SMIN=    -0.04  TMAX=     0.02  ANGLE=  90.0
            2        0.00        0.00         0.00        0.00          0.00
                     0.00        0.00         0.00        0.00          0.00
                     0.00        0.00
     TOP :  SMAX=      0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
     BOTT:  SMAX=      0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
            3        0.00        0.00         0.00        0.00          0.00
                     0.00        0.00         0.00        0.00          0.00
                     0.00        0.00
     TOP :  SMAX=      0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
     BOTT:  SMAX=      0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
            4        0.00        0.00         0.01        0.00          0.00
                     0.01        0.01         0.01        0.00          0.00
                     0.01        0.01
     TOP :  SMAX=      0.01  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
     BOTT:  SMAX=      0.01  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
            5       -0.01        0.00        -8.90       -1.51          0.00
                     0.53        0.37         0.00        0.30          0.00
                     0.61        0.37
     TOP :  SMAX=      0.24  SMIN=    -0.37  TMAX=     0.31  ANGLE=   0.0
     BOTT:  SMAX=      0.37  SMIN=     0.37  TMAX=     0.00  ANGLE=  90.0
            6        0.00        0.00        -4.06       10.56          0.00
                     0.25        0.86         0.00       -0.32          0.00
                     0.28        0.93
     TOP :  SMAX=      0.12  SMIN=    -0.17  TMAX=     0.14  ANGLE=   0.0
     BOTT:  SMAX=      0.17  SMIN=    -0.76  TMAX=     0.47  ANGLE=   0.0
            7        0.00        0.00         4.19        0.71          0.00
                     0.27        0.18         0.00       -0.16          0.00
                     0.31        0.19
     TOP :  SMAX=      0.17  SMIN=    -0.13  TMAX=     0.15  ANGLE=   0.0
     BOTT:  SMAX=     -0.17  SMIN=    -0.19  TMAX=     0.01  ANGLE=  90.0
            8        0.00        0.00        -8.85        9.75          0.00
                     0.55        0.81        -0.04       -0.18          0.00
                     0.63        0.92
     TOP :  SMAX=      0.22  SMIN=    -0.41  TMAX=     0.31  ANGLE=   0.0
     BOTT:  SMAX=      0.33  SMIN=    -0.59  TMAX=     0.46  ANGLE=   0.0

  1001      1        0.00        0.00        -0.03       -0.01          0.00
                     0.04        0.04        -0.04       -0.01          0.00
                     0.04        0.04
     TOP :  SMAX=     -0.01  SMIN=    -0.04  TMAX=     0.02  ANGLE=  90.0
     BOTT:  SMAX=     -0.01  SMIN=    -0.04  TMAX=     0.02  ANGLE=  90.0
```

```
 ELEMENT STRESSES    FORCE,LENGTH UNITS= KIP  INCH
 ----------------

         STRESS = FORCE/UNIT WIDTH/THICK, MOMENT = FORCE-LENGTH/UNIT WIDTH

ELEMENT  LOAD         SQX        SQY          MX          MY           MXY
                      VONT       VONB         SX          SY           SXY
                      TRESCAT    TRESCAB

           2          0.00       0.00         0.00        0.00         0.00
                      0.00       0.00         0.00        0.00         0.00
                      0.00       0.00
     TOP :  SMAX=     0.00  SMIN=    0.00  TMAX=     0.00  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=    0.00  TMAX=     0.00  ANGLE=  90.0
           3          0.00       0.00         0.00        0.00         0.00
                      0.00       0.00         0.00        0.00         0.00
                      0.00       0.00
     TOP :  SMAX=     0.00  SMIN=    0.00  TMAX=     0.00  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=    0.00  TMAX=     0.00  ANGLE=  90.0
           4          0.00       0.00         0.01        0.00         0.00
                      0.01       0.01         0.01        0.00         0.00
                      0.01       0.01
     TOP :  SMAX=     0.01  SMIN=    0.00  TMAX=     0.00  ANGLE=  90.0
     BOTT:  SMAX=     0.01  SMIN=    0.00  TMAX=     0.00  ANGLE=  90.0
           5         -0.03       0.00        -3.92       -0.67         0.00
                      0.20       0.15         0.00        0.09         0.00
                      0.23       0.16
     TOP :  SMAX=     0.06  SMIN=   -0.16  TMAX=     0.11  ANGLE=   0.0
     BOTT:  SMAX=     0.16  SMIN=    0.12  TMAX=     0.02  ANGLE=  90.0
           6         -0.08       0.00         2.30       11.64         0.00
                      0.24       1.10         0.00       -0.66         0.00
                      0.27       1.15
     TOP :  SMAX=     0.10  SMIN=   -0.18  TMAX=     0.14  ANGLE=   0.0
     BOTT:  SMAX=    -0.10  SMIN=   -1.15  TMAX=     0.53  ANGLE=   0.0
           7          0.01       0.00         1.86        0.32         0.00
                      0.10       0.07         0.00       -0.05         0.00
                      0.11       0.08
     TOP :  SMAX=     0.08  SMIN=   -0.03  TMAX=     0.06  ANGLE=   0.0
     BOTT:  SMAX=    -0.06  SMIN=   -0.08  TMAX=     0.01  ANGLE=  90.0
           8         -0.09       0.00         0.20       11.29         0.00
                      0.14       1.07        -0.04       -0.63         0.00
                      0.16       1.10
     TOP :  SMAX=    -0.03  SMIN=   -0.16  TMAX=     0.06  ANGLE=   0.0
     BOTT:  SMAX=    -0.05  SMIN=   -1.10  TMAX=     0.52  ANGLE=   0.0
```

```
        **** MAXIMUM STRESSES AMONG SELECTED PLATES AND CASES ****
           MAXIMUM       MINIMUM       MAXIMUM       MAXIMUM       MAXIMUM
          PRINCIPAL     PRINCIPAL       SHEAR       VONMISES       TRESCA
           STRESS        STRESS        STRESS        STRESS        STRESS

        1.353828E+00 -1.227103E+00  5.787945E-01  1.195443E+00  1.353828E+00
PLATE NO.     1501          2001          2001          1501          1501
CASE  NO.        8             8             8             8             8


  ********************END OF ELEMENT FORCES********************


  237. PRINT ELEMENT FORCES LIST 2001 1901 1801 1701 1601 1501 1401 1301 1201 -
  238. 1101 1001
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   SAN JOSE DIGESTER #1 - UNSUBMERGED CASE                    -- PAGE NO.   21


  ELEMENT FORCES    FORCE,LENGTH UNITS= KIP  INCH
  --------------

  **NOTE- IF A COMBINATION INCLUDES A DYNAMIC CASE OR IS AN SRSS OR ABS COMBINATION
          THEN RESULTS CANNOT BE COMPUTED PROPERLY.
    GLOBAL CORNER FORCES
JOINT     FX          FY          FZ          MX          MY          MZ

             ELE.NO.   2001 FOR LOAD CASE     1
 1301  2.1674E-02 -2.1895E-01  4.5647E+00  4.1399E+01  3.2958E-01  2.1060E-02
 1401 -2.4323E-07 -2.7745E-01 -4.5648E+00 -4.1342E+01  2.7441E-06  2.6371E-01
 1402 -2.4182E-02  2.7641E-01 -4.5648E+00  4.1185E+01  3.6032E+00 -2.6370E-01
 1302  2.5086E-03  2.2000E-01  4.5648E+00 -4.1271E+01 -3.2799E+00 -2.1069E-02
             ELE.NO.   2001 FOR LOAD CASE     2
 1301  1.7259E-03 -1.6203E-02  4.8500E-01  4.3694E+00  2.7800E-02  5.1288E-03
 1401 -1.4575E-08 -2.3326E-02 -4.8500E-01 -4.3625E+00 -4.1593E-08  2.5529E-02
 1402 -2.0330E-03  2.3238E-02 -4.8500E-01  4.3459E+00  3.8022E-01 -2.5528E-02
 1302  3.0711E-04  1.6292E-02  4.8500E-01 -4.3552E+00 -3.5313E-01 -5.1297E-03
             ELE.NO.   2001 FOR LOAD CASE     3
 1301  2.2775E-03 -2.1381E-02  6.4000E-01  5.7658E+00  3.6685E-02  6.7680E-03
 1401  6.9190E-09 -3.0782E-02 -6.4000E-01 -5.7567E+00 -1.2644E-07  3.3687E-02
 1402 -2.6827E-03  3.0664E-02 -6.4000E-01  5.7348E+00  5.0173E-01 -3.3686E-02
 1302  4.0522E-04  2.1499E-02  6.4000E-01 -5.7471E+00 -4.6598E-01 -6.7693E-03
             ELE.NO.   2001 FOR LOAD CASE     4
 1301 -8.1670E-03  7.6673E-02 -2.2950E+00 -2.0676E+01 -1.3155E-01 -2.4270E-02
 1401  4.3610E-08  1.1038E-01  2.2950E+00  2.0643E+01 -5.5783E-07 -1.2080E-01
 1402  9.6202E-03 -1.0996E-01  2.2950E+00 -2.0565E+01 -1.7992E+00  1.2080E-01
 1302 -1.4532E-03 -7.7094E-02 -2.2950E+00  2.0609E+01  1.6710E+00  2.4273E-02
             ELE.NO.   2001 FOR LOAD CASE     5
 1301  2.7950E-02 -1.5327E+00  3.0405E-06  3.2061E-01 -1.1524E+00  4.4593E-01
 1401 -1.3754E-08  8.9247E-01 -6.1076E-07 -2.6160E+00  5.8088E-07 -3.3458E-01
 1402  7.7783E-02 -8.8908E-01  1.7849E-06  2.6060E+00  2.2803E-01  3.3455E-01
 1302 -1.0573E-01  1.5293E+00 -4.2146E-06 -2.1896E-01 -1.1758E+00 -4.4584E-01
             ELE.NO.   2001 FOR LOAD CASE     6
 1301 -6.8155E-01 -3.9121E+01 -1.5204E+02 -1.2245E+03  3.2106E+02 -1.1353E+01
 1401  3.3870E+00 -2.2844E+01  1.5204E+02  1.2088E+03 -3.8627E+02 -5.9217E+01
 1402  1.3831E+00  2.3052E+01  1.5204E+02 -1.1705E+03 -4.9016E+02  5.9216E+01
 1302 -4.0886E+00  3.8913E+01 -1.5204E+02  1.1919E+03  4.2657E+02  1.1353E+01
             ELE.NO.   2001 FOR LOAD CASE     7
 1301 -5.2962E-01  9.7141E+00 -3.3604E-06 -3.9307E+01 -2.7818E+00  1.0252E+00
 1401 -2.4758E-01  8.0866E+00  3.3102E-06  4.0828E+01  2.0614E-06 -1.0877E+00
 1402  4.5816E-01 -8.0774E+00  3.2774E-06 -4.0672E+01 -3.5584E+00  1.0875E+00
 1302  3.1904E-01 -9.7233E+00 -3.2271E-06  3.9400E+01  6.5451E-01 -1.0254E+00
             ELE.NO.   2001 FOR LOAD CASE     8
 1301 -1.1657E+00 -3.1120E+01 -1.4864E+02 -1.2327E+03  3.1739E+02 -9.8735E+00
 1401  3.1395E+00 -1.4086E+01  1.4864E+02  1.2162E+03 -3.8627E+02 -6.0437E+01
 1402  1.8998E+00  1.4306E+01  1.4864E+02 -1.1779E+03 -4.9080E+02  6.0436E+01
 1302 -3.8736E+00  3.0900E+01 -1.4864E+02  1.2003E+03  4.2362E+02  9.8727E+00

             ELE.NO.   1901 FOR LOAD CASE     1
 1201  2.7204E-02 -5.1186E-02  5.1843E+00  4.5993E+01  1.0049E+00 -1.3380E-01
 1301 -2.1674E-02 -7.5490E-02 -5.1843E+00 -4.5966E+01 -3.2958E-01  3.6632E-01
 1302 -2.8171E-02  7.3326E-02 -5.1843E+00  4.5820E+01  3.6779E+00 -3.6631E-01
 1202  2.2640E-02  5.3350E-02  5.1843E+00 -4.5905E+01 -3.0075E+00  1.3381E-01
             ELE.NO.   1901 FOR LOAD CASE     2
 1201  1.9739E-03 -1.0415E-03  4.8500E-01  4.2897E+00  8.0028E-02 -7.7497E-03
 1301 -1.7259E-03 -4.6380E-03 -4.8500E-01 -4.2861E+00 -2.7800E-02  3.0875E-02
 1302 -2.1236E-03  4.4702E-03 -4.8500E-01  4.2722E+00  3.4586E-01 -3.0875E-02
 1202  1.8756E-03  1.2093E-03  4.8500E-01 -4.2804E+00 -2.9416E-01  7.7503E-03
```

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  ELEMENT FORCES    FORCE,LENGTH UNITS= KIP  INCH
  --------------
    GLOBAL CORNER FORCES
JOINT      FX           FY           FZ           MX           MY           MZ
               ELE.NO.   1901 FOR LOAD CASE     3
 1201  2.6047E-03 -1.3740E-03  6.4000E-01  5.6607E+00  1.0560E-01 -1.0226E-02
 1301 -2.2775E-03 -6.1203E-03 -6.4000E-01 -5.6558E+00 -3.6685E-02  4.0743E-02
 1302 -2.8022E-03  5.8984E-03 -6.4000E-01  5.6375E+00  4.5640E-01 -4.0742E-02
 1202  2.4750E-03  1.5960E-03  6.4000E-01 -5.6484E+00 -3.8816E-01  1.0227E-02
               ELE.NO.   1901 FOR LOAD CASE     4
 1201 -9.3403E-03  4.9272E-03 -2.2950E+00 -2.0299E+01 -3.7869E-01  3.6671E-02
 1301  8.1670E-03  2.1947E-02  2.2950E+00  2.0282E+01  1.3155E-01 -1.4610E-01
 1302  1.0049E-02 -2.1151E-02  2.2950E+00 -2.0216E+01 -1.6366E+00  1.4610E-01
 1202 -8.8752E-03 -5.7231E-03 -2.2950E+00  2.0255E+01  1.3919E+00 -3.6674E-02
               ELE.NO.   1901 FOR LOAD CASE     5
 1201  4.9030E-01 -9.3598E+00  4.4693E-06  3.5504E+01  9.5116E-01 -6.6991E-01
 1301  2.1963E-01 -6.9002E+00  7.2121E-07 -3.7814E+01  1.1523E+00  9.6535E-01
 1302 -3.8261E-01  6.8931E+00 -4.4999E-06  3.7570E+01  4.4438E+00 -9.6533E-01
 1202 -3.2732E-01  9.3669E+00 -6.9059E-07 -3.5452E+01 -2.1467E+00  6.7013E-01
               ELE.NO.   1901 FOR LOAD CASE     6
 1201 -1.3794E+00 -7.3674E+01 -1.5204E+02 -1.0427E+03  1.9660E+02  1.9645E+01
 1301  7.4556E+00 -6.5492E+01  1.5204E+02  1.0343E+03 -3.2106E+02 -7.2413E+01
 1302  1.7192E+00  6.5893E+01  1.5204E+02 -1.0024E+03 -4.0999E+02  7.2413E+01
 1202 -7.7954E+00  7.3274E+01 -1.5204E+02  1.0216E+03  2.8673E+02 -1.9645E+01
               ELE.NO.   1901 FOR LOAD CASE     7
 1201 -8.6887E-01  1.4895E+01 -3.1335E-07 -6.2544E+01 -8.6175E+00  2.4431E+00
 1301 -3.6166E-01  1.3289E+01 -3.1975E-06  6.4028E+01  2.7818E+00 -1.9340E+00
 1302  7.9790E-01 -1.3270E+01  2.7829E-07 -6.4027E+01 -2.8092E+00  1.9338E+00
 1202  4.3263E-01 -1.4914E+01  3.2326E-06  6.3057E+01 -3.1337E+00 -2.4434E+00
               ELE.NO.   1901 FOR LOAD CASE     8
 1201 -1.7356E+00 -6.8188E+01 -1.4803E+02 -1.0341E+03  1.8975E+02  2.1304E+01
 1301  7.2961E+00 -5.9168E+01  1.4803E+02  1.0249E+03 -3.1739E+02 -7.3090E+01
 1302  2.1115E+00  5.9579E+01  1.4803E+02 -9.9331E+02 -4.0551E+02  7.3090E+01
 1202 -7.6720E+00  6.7777E+01 -1.4803E+02  1.0136E+03  2.7915E+02 -2.1304E+01

               ELE.NO.   1801 FOR LOAD CASE     1
 1101  2.1391E-02  5.5261E-02  6.0448E+00  5.2720E+01  2.1485E+00 -1.7308E-01
 1201 -2.7204E-02  7.7892E-02 -6.0448E+00 -5.2698E+01 -1.0049E+00  3.9657E-01
 1202 -2.0312E-02 -7.9966E-02 -6.0448E+00  5.2586E+01  3.5919E+00 -3.9657E-01
 1102  2.6125E-02 -5.3187E-02  6.0448E+00 -5.2707E+01 -2.4546E+00  1.7307E-01
               ELE.NO.   1801 FOR LOAD CASE     2
 1101  1.1259E-03  1.0850E-02  4.8500E-01  4.1978E+00  1.5710E-01 -9.1829E-03
 1201 -1.9739E-03  8.5731E-03 -4.8500E-01 -4.1911E+00 -8.0028E-02  2.9097E-02
 1202 -1.2192E-03 -8.7125E-03 -4.8500E-01  4.1822E+00  2.8556E-01 -2.9097E-02
 1102  2.0672E-03 -1.0710E-02  4.8500E-01 -4.1955E+00 -2.0936E-01  9.1827E-03
               ELE.NO.   1801 FOR LOAD CASE     3
 1101  1.4857E-03  1.4317E-02  6.4000E-01  5.5393E+00  2.0730E-01 -1.2118E-02
 1201 -2.6047E-03  1.1313E-02 -6.4000E-01 -5.5306E+00 -1.0560E-01  3.8396E-02
 1202 -1.6088E-03 -1.1497E-02 -6.4000E-01  5.5187E+00  3.7682E-01 -3.8396E-02
 1102  2.7278E-03 -1.4133E-02  6.4000E-01 -5.5363E+00 -2.7627E-01  1.2117E-02
               ELE.NO.   1801 FOR LOAD CASE     4
 1101 -5.3275E-03 -5.1340E-02 -2.2950E+00 -1.9864E+01 -7.4338E-01  4.3453E-02
 1201  9.3403E-03 -4.0567E-02  2.2950E+00  1.9832E+01  3.7869E-01 -1.3769E-01
 1202  5.7691E-03  4.1227E-02  2.2950E+00 -1.9790E+01 -1.3513E+00  1.3769E-01
 1102 -9.7819E-03  5.0680E-02 -2.2950E+00  1.9853E+01  9.9070E-01 -4.3452E-02
```

```
 ELEMENT FORCES    FORCE,LENGTH UNITS= KIP  INCH
 --------------
   GLOBAL CORNER FORCES
JOINT      FX           FY           FZ           MX           MY           MZ
                ELE.NO.   1801 FOR LOAD CASE     5
 1101  1.8548E+00 -3.8847E+01  1.8232E-05  2.7143E+02  8.0770E+00 -7.2916E-01
 1201  1.1657E+00 -3.0334E+01 -8.1667E-06 -2.8268E+02 -9.5117E-01  3.0684E+00
 1202 -1.4825E+00  3.0320E+01 -1.0665E-05  2.8169E+02  2.3690E+01 -3.0680E+00
 1102 -1.5380E+00  3.8861E+01  5.9954E-07 -2.7110E+02 -1.5610E+01  7.2995E-01
                ELE.NO.   1801 FOR LOAD CASE     6
 1101  2.9874E+00 -1.6059E+02 -1.5204E+02 -9.0618E+01  3.5632E+01  2.7157E+01
 1201  1.0788E+01 -1.5491E+02  1.5204E+02  7.3952E+01 -2.2953E+02 -6.9153E+01
 1202 -2.7544E+00  1.5526E+02  1.5204E+02 -5.3666E+01 -2.3510E+02  6.9153E+01
 1102 -1.1021E+01  1.6024E+02 -1.5204E+02  8.7168E+01  4.3395E+01 -2.7156E+01
                ELE.NO.   1801 FOR LOAD CASE     7
 1101 -1.9262E+00  4.0191E+01 -8.9317E-06 -2.9772E+02 -1.6556E+01  1.9648E+00
 1201 -1.3593E+00  3.5059E+01  4.8496E-06  3.0433E+02  8.6175E+00 -2.1371E+00
 1202  1.7015E+00 -3.5044E+01  9.3547E-06 -3.0393E+02 -1.7940E+01  2.1366E+00
 1102  1.5840E+00 -4.0206E+01 -5.2726E-06  2.9803E+02  9.4546E+00 -1.9656E+00
                ELE.NO.   1801 FOR LOAD CASE     8
 1101  2.9346E+00 -1.5922E+02 -1.4716E+02 -7.4314E+01  2.8922E+01  2.8241E+01
 1201  1.0572E+01 -1.5013E+02  1.4716E+02  5.3018E+01 -2.2268E+02 -6.7896E+01
 1202 -2.5528E+00  1.5048E+02  1.4716E+02 -3.3409E+01 -2.2645E+02  6.7896E+01
 1102 -1.0954E+01  1.5887E+02 -1.4716E+02  7.1510E+01  3.5289E+01 -2.8241E+01

                ELE.NO.   1701 FOR LOAD CASE     1
 1001  1.5617E-02  2.7881E-02  7.1462E+00  6.2351E+01  2.9536E+00 -1.7480E-01
 1101 -2.1391E-02  1.0435E-01 -7.1462E+00 -6.2418E+01 -2.1484E+00  2.2808E-01
 1102 -1.2214E-02 -1.0582E-01 -7.1462E+00  6.2367E+01  3.2998E+00 -2.2808E-01
 1002  1.7988E-02 -2.6415E-02  7.1462E+00 -6.2371E+01 -2.4919E+00  1.7479E-01
                ELE.NO.   1701 FOR LOAD CASE     2
 1001  3.8105E-04  7.5295E-03  4.8500E-01  4.2009E+00  1.9112E-01 -7.0538E-03
 1101 -1.1259E-03  9.5295E-03 -4.8500E-01 -4.2021E+00 -1.5710E-01  9.9328E-03
 1102 -2.9103E-04 -9.5914E-03 -4.8500E-01  4.1998E+00  2.0974E-01 -9.9329E-03
 1002  1.0358E-03 -7.4677E-03  4.8500E-01 -4.2016E+00 -1.7575E-01  7.0537E-03
                ELE.NO.   1701 FOR LOAD CASE     3
 1001  5.0284E-04  9.9357E-03  6.4000E-01  5.5435E+00  2.5220E-01 -9.3081E-03
 1101 -1.4857E-03  1.2575E-02 -6.4000E-01 -5.5450E+00 -2.0730E-01  1.3107E-02
 1102 -3.8404E-04 -1.2657E-02 -6.4000E-01  5.5420E+00  2.7677E-01 -1.3107E-02
 1002  1.3669E-03 -9.8541E-03  6.4000E-01 -5.5444E+00 -2.3191E-01  9.3079E-03
                ELE.NO.   1701 FOR LOAD CASE     4
 1001 -1.8031E-03 -3.5630E-02 -2.2950E+00 -1.9879E+01 -9.0436E-01  3.3378E-02
 1101  5.3276E-03 -4.5094E-02  2.2950E+00  1.9884E+01  7.4338E-01 -4.7001E-02
 1102  1.3771E-03  4.5386E-02  2.2950E+00 -1.9873E+01 -9.9247E-01  4.7002E-02
 1002 -4.9016E-03  3.5337E-02 -2.2950E+00  1.9882E+01  8.3163E-01 -3.3378E-02
                ELE.NO.   1701 FOR LOAD CASE     5
 1001  3.2966E+00 -6.7616E+01  2.9003E-05  4.9725E+02  2.4078E+01 -3.2108E+00
 1101  2.1945E+00 -5.8149E+01 -1.6726E-05 -5.0939E+02 -8.0770E+00  5.0308E+00
 1102 -2.8819E+00  5.8119E+01 -2.4158E-05  5.0815E+02  3.6350E+01 -5.0300E+00
 1002 -2.6091E+00  6.7646E+01  1.1881E-05 -4.9746E+02 -1.9352E+01  3.2122E+00
                ELE.NO.   1701 FOR LOAD CASE     6
 1001  4.9413E+00 -1.5962E+02 -1.5204E+02 -5.6931E+01 -6.1827E+01  2.5912E+01
 1101  9.0555E+00 -1.6096E+02  1.5204E+02  5.4256E+01 -3.5632E+01 -2.2621E+01
 1102 -5.0073E+00  1.6113E+02  1.5204E+02 -5.0944E+01 -4.0225E+01  2.2621E+01
 1002 -8.9895E+00  1.5944E+02 -1.5204E+02  6.2103E+01 -5.6630E+01 -2.5911E+01
```

```
 ELEMENT FORCES    FORCE,LENGTH UNITS= KIP  INCH
 --------------
   GLOBAL CORNER FORCES
JOINT     FX          FY          FZ          MX          MY          MZ
               ELE.NO.  1701 FOR LOAD CASE    7
 1001 -2.6917E+00  5.6116E+01 -1.2948E-05 -4.2573E+02 -2.7882E+01  3.4300E+00
 1101 -1.9910E+00  5.1137E+01  1.0396E-05  4.3198E+02  1.6556E+01 -2.3530E+00
 1102  2.4734E+00 -5.1116E+01  1.4196E-05 -4.3178E+02 -2.1157E+01  2.3522E+00
 1002  2.2093E+00 -5.6137E+01 -1.1645E-05  4.2654E+02  9.3286E+00 -3.4311E+00
               ELE.NO.  1701 FOR LOAD CASE    8
 1001  5.5608E+00 -1.7111E+02 -1.4606E+02  6.6803E+01 -6.3139E+01  2.5973E+01
 1101  9.2402E+00 -1.6789E+02  1.4606E+02 -7.5430E+01 -2.8922E+01 -1.9739E+01
 1102 -5.4273E+00  1.6805E+02  1.4606E+02  7.7664E+01 -2.2238E+01  1.9739E+01
 1002 -9.3737E+00  1.7094E+02 -1.4606E+02 -6.1046E+01 -6.8721E+01 -2.5972E+01

               ELE.NO.  1601 FOR LOAD CASE    1
  901  1.6873E-02 -5.3535E-02  8.2475E+00  7.2673E+01  3.6481E+00 -1.9339E-01
 1001 -1.5617E-02  2.4766E-02 -8.2475E+00 -7.2748E+01 -2.9536E+00  1.5448E-01
 1002 -1.3399E-02 -2.6031E-02 -8.2475E+00  7.2728E+01  3.3981E+00 -1.5447E-01
  902  1.2143E-02  5.4801E-02  8.2475E+00 -7.2715E+01 -2.6998E+00  1.9339E-01
               ELE.NO.  1601 FOR LOAD CASE    2
  901  1.8803E-04  1.3926E-03  4.8500E-01  4.2503E+00  2.0299E-01 -4.7419E-03
 1001 -3.8105E-04  3.0283E-03 -4.8500E-01 -4.2520E+00 -1.9112E-01  1.2130E-03
 1002 -1.1567E-04 -3.0500E-03 -4.8500E-01  4.2525E+00  1.8020E-01 -1.2130E-03
  902  3.0869E-04 -1.3709E-03  4.8500E-01 -4.2518E+00 -1.6823E-01  4.7420E-03
               ELE.NO.  1601 FOR LOAD CASE    3
  901  2.4812E-04  1.8377E-03  6.4000E-01  5.6086E+00  2.6786E-01 -6.2575E-03
 1001 -5.0284E-04  3.9962E-03 -6.4000E-01 -5.6109E+00 -2.5220E-01  1.6007E-03
 1002 -1.5263E-04 -4.0248E-03 -6.4000E-01  5.6115E+00  2.3779E-01 -1.6008E-03
  902  4.0735E-04 -1.8091E-03  6.4000E-01 -5.6107E+00 -2.2199E-01  6.2574E-03
               ELE.NO.  1601 FOR LOAD CASE    4
  901 -8.8976E-04 -6.5893E-03 -2.2950E+00 -2.0112E+01 -9.6053E-01  2.2438E-02
 1001  1.8031E-03 -1.4330E-02  2.2950E+00  2.0120E+01  9.0436E-01 -5.7402E-03
 1002  5.4733E-04  1.4432E-02  2.2950E+00 -2.0122E+01 -8.5268E-01  5.7397E-03
  902 -1.4607E-03  6.4869E-03 -2.2950E+00  2.0119E+01  7.9603E-01 -2.2439E-02
               ELE.NO.  1601 FOR LOAD CASE    5
  901  4.9162E+00 -9.7927E+01  3.0128E-05  7.3906E+02  5.4318E+01 -8.6936E+00
 1001  3.2174E+00 -8.8363E+01 -2.4905E-05 -7.5068E+02 -2.4078E+01  6.6360E+00
 1002 -4.4961E+00  8.8307E+01 -3.5577E-05  7.4992E+02  4.1440E+01 -6.6346E+00
  902 -3.6375E+00  9.7983E+01  3.0355E-05 -7.4099E+02 -1.0302E+01  8.6954E+00
               ELE.NO.  1601 FOR LOAD CASE    6
  901  7.1698E+00 -1.6558E+02 -1.5204E+02 -3.1180E+01 -6.4952E+01  1.0299E+01
 1001  7.1016E+00 -1.6129E+02  1.5204E+02  2.5193E+01  6.1827E+01  8.8714E+00
 1002 -6.9825E+00  1.6129E+02  1.5204E+02 -3.0486E+01  5.9396E+01 -8.8709E+00
  902 -7.2889E+00  1.6558E+02 -1.5204E+02  3.6722E+01 -6.1987E+01 -1.0299E+01
               ELE.NO.  1601 FOR LOAD CASE    7
  901 -3.3946E+00  7.0044E+01 -1.3777E-05 -5.4134E+02 -4.3820E+01  5.8920E+00
 1001 -2.5459E+00  6.6015E+01  1.1207E-05  5.4608E+02  2.7882E+01 -2.1574E+00
 1002  3.2173E+00 -6.5985E+01  2.2706E-05 -5.4643E+02 -1.9818E+01  2.1563E+00
  902  2.7231E+00 -7.0074E+01 -2.0136E-05  5.4309E+02  3.5268E+00 -5.8933E+00
               ELE.NO.  1601 FOR LOAD CASE    8
  901  8.7079E+00 -1.9352E+02 -1.4496E+02  2.2897E+02 -5.1296E+01  7.3156E+00
 1001  7.7584E+00 -1.8362E+02  1.4496E+02 -2.4189E+02  6.3139E+01  1.3502E+01
 1002 -8.2744E+00  1.8359E+02  1.4496E+02  2.3547E+02  8.3981E+01 -1.3501E+01
  902 -8.1919E+00  1.9354E+02 -1.4496E+02 -2.2363E+02 -7.1057E+01 -7.3146E+00
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  ELEMENT FORCES     FORCE,LENGTH UNITS= KIP  INCH
  --------------
    GLOBAL CORNER FORCES
JOINT      FX          FY          FZ          MX          MY          MZ
              ELE.NO.   1501 FOR LOAD CASE     1
  801  2.0538E-02 -6.2971E-02  9.3489E+00  8.2602E+01  4.5012E+00 -2.8498E-01
  901 -1.6873E-02 -2.0977E-02 -9.3489E+00 -8.2620E+01 -3.6481E+00  1.4074E-01
  902 -1.8637E-02  1.9428E-02 -9.3489E+00  8.2624E+01  3.5667E+00 -1.4074E-01
  802  1.4972E-02  6.4521E-02  9.3489E+00 -8.2680E+01 -2.7153E+00  2.8498E-01
              ELE.NO.   1501 FOR LOAD CASE     2
  801  1.7811E-04  3.5605E-04  4.8500E-01  4.2680E+00  2.1233E-01 -5.6073E-03
  901 -1.8803E-04 -1.2908E-04 -4.8500E-01 -4.2669E+00 -2.0299E-01 -9.7274E-04
  902 -1.9856E-04  1.1220E-04 -4.8500E-01  4.2684E+00  1.6967E-01  9.7283E-04
  802  2.0847E-04 -3.3917E-04  4.8500E-01 -4.2703E+00 -1.6046E-01  5.6074E-03
              ELE.NO.   1501 FOR LOAD CASE     3
  801  2.3503E-04  4.6996E-04  6.4000E-01  5.6320E+00  2.8019E-01 -7.3994E-03
  901 -2.4812E-04 -1.7020E-04 -6.4000E-01 -5.6306E+00 -2.6786E-01 -1.2837E-03
  902 -2.6201E-04  1.4793E-04 -6.4000E-01  5.6325E+00  2.2390E-01  1.2836E-03
  802  2.7510E-04 -4.4769E-04  6.4000E-01 -5.6350E+00 -2.1174E-01  7.3994E-03
              ELE.NO.   1501 FOR LOAD CASE     4
  801 -8.4280E-04 -1.6853E-03 -2.2950E+00 -2.0196E+01 -1.0047E+00  2.6534E-02
  901  8.8975E-04  6.1025E-04  2.2950E+00  2.0191E+01  9.6053E-01  4.6031E-03
  902  9.3954E-04 -5.3040E-04  2.2950E+00 -2.0198E+01 -8.0290E-01 -4.6034E-03
  802 -9.8648E-04  1.6055E-03 -2.2950E+00  2.0207E+01  7.5930E-01 -2.6534E-02
              ELE.NO.   1501 FOR LOAD CASE     5
  801  6.4166E+00 -1.2349E+02  2.3318E-05  9.5483E+02  1.0319E+02 -1.7953E+01
  901  4.0626E+00 -1.1652E+02 -2.5391E-05 -9.6206E+02 -5.4318E+01  6.5714E+00
  902 -6.1082E+00  1.1643E+02 -4.8184E-05  9.6313E+02  2.9738E+01 -6.5695E+00
  802 -4.3710E+00  1.2358E+02  5.0257E-05 -9.6019E+02  1.9579E+01  1.7954E+01
              ELE.NO.   1501 FOR LOAD CASE     6
  801  1.1483E+01 -1.9215E+02 -1.5204E+02  1.5676E+02  8.3236E+01 -3.7343E+01
  901  4.8730E+00 -1.8245E+02  1.5204E+02 -1.6312E+02  6.4952E+01  3.6678E+01
  902 -1.1047E+01  1.8218E+02  1.5204E+02  1.5684E+02  7.8922E+01 -3.6677E+01
  802 -5.3082E+00  1.9242E+02 -1.5204E+02 -1.6342E+02  6.9256E+01  3.7344E+01
              ELE.NO.   1501 FOR LOAD CASE     7
  801 -3.7252E+00  7.8224E+01 -1.0263E-05 -6.1714E+02 -5.8624E+01  7.4457E+00
  901 -3.0314E+00  7.6529E+01  1.5596E-05  6.1876E+02  4.3820E+01  2.9623E-02
  902  3.6500E+00 -7.6502E+01  2.5765E-05 -6.2023E+02 -1.0275E+01 -3.0918E-02
  802  3.1066E+00 -7.8251E+01 -3.1099E-05  6.1990E+02 -4.6134E+00 -7.4469E+00
              ELE.NO.   1501 FOR LOAD CASE     8
  801  1.4194E+01 -2.3748E+02 -1.4386E+02  5.6676E+02  1.3179E+02 -4.8122E+01
  901  5.8877E+00 -2.2246E+02  1.4386E+02 -5.7874E+02  5.1296E+01  4.3422E+01
  902 -1.3524E+01  2.2213E+02  1.4386E+02  5.7207E+02  1.0154E+02 -4.3421E+01
  802 -6.5581E+00  2.3782E+02 -1.4386E+02 -5.7609E+02  8.1894E+01  4.8123E+01

              ELE.NO.   1401 FOR LOAD CASE     1
  701  3.5092E-02 -1.6058E-01  1.0395E+01  9.2475E+01  5.5130E+00 -4.1560E-01
  801 -2.0538E-02 -1.7276E-01 -1.0395E+01 -9.2454E+01 -4.5012E+00  1.9125E-01
  802 -3.5517E-02  1.7031E-01 -1.0395E+01  9.2495E+01  3.5739E+00 -1.9124E-01
  702  2.0963E-02  1.6303E-01  1.0395E+01 -9.2604E+01 -2.5678E+00  4.1560E-01
              ELE.NO.   1401 FOR LOAD CASE     2
  701  8.0210E-04 -6.2181E-03  4.8500E-01  4.3119E+00  2.3153E-01 -9.6332E-03
  801 -1.7811E-04 -8.0737E-03 -4.8500E-01 -4.3096E+00 -2.1233E-01  1.8336E-03
  802 -8.8109E-04  8.0274E-03 -4.8500E-01  4.3117E+00  1.6408E-01 -1.8335E-03
  702  2.5710E-04  6.2644E-03  4.8500E-01 -4.3156E+00 -1.4515E-01  9.6333E-03
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 ELEMENT FORCES    FORCE,LENGTH UNITS= KIP  INCH
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   GLOBAL CORNER FORCES
JOINT      FX          FY          FZ          MX          MY          MZ
             ELE.NO.   1401 FOR LOAD CASE     3
  701  1.0584E-03 -8.2053E-03  6.4000E-01  5.6899E+00  3.0553E-01 -1.2712E-02
  801 -2.3502E-04 -1.0654E-02 -6.4000E-01 -5.6869E+00 -2.8019E-01  2.4195E-03
  802 -1.1627E-03  1.0593E-02 -6.4000E-01  5.6897E+00  2.1652E-01 -2.4194E-03
  702  3.3926E-04  8.2664E-03  6.4000E-01 -5.6949E+00 -1.9154E-01  1.2712E-02
             ELE.NO.   1401 FOR LOAD CASE     4
  701 -3.7955E-03  2.9424E-02 -2.2950E+00 -2.0404E+01 -1.0956E+00  4.5584E-02
  801  8.4279E-04  3.8204E-02  2.2950E+00  2.0393E+01  1.0047E+00 -8.6765E-03
  802  4.1693E-03 -3.7985E-02  2.2950E+00 -2.0403E+01 -7.7644E-01  8.6759E-03
  702 -1.2166E-03 -2.9643E-02 -2.2950E+00  2.0421E+01  6.8687E-01 -4.5584E-02
             ELE.NO.   1401 FOR LOAD CASE     5
  701  7.1089E+00 -1.1983E+02  1.5388E-05  7.1095E+02  1.7073E+02 -3.2527E+01
  801  3.3105E+00 -1.1881E+02 -2.5658E-05 -7.1167E+02 -1.0319E+02  8.0330E+00
  802 -7.0571E+00  1.1865E+02 -7.1046E-05  7.1795E+02 -4.0772E+01 -8.0309E+00
  702 -3.3623E+00  1.2000E+02  8.1316E-05 -7.2312E+02  1.0811E+02  3.2529E+01
             ELE.NO.   1401 FOR LOAD CASE     6
  701  1.4009E+01 -2.0622E+02 -3.1277E+02 -1.5342E+03  1.3765E+02 -6.7329E+01
  801  3.8291E+00 -2.0234E+02  3.1277E+02  1.5309E+03  4.2395E+01  4.0835E+01
  802 -1.3820E+01  2.0190E+02  3.1277E+02 -1.5288E+03 -9.1195E+01 -4.0835E+01
  702 -4.0176E+00  2.0665E+02 -3.1277E+02  1.5163E+03  2.7084E+02  6.7329E+01
             ELE.NO.   1401 FOR LOAD CASE     7
  701 -3.6762E+00  6.9942E+01 -6.7708E-06 -4.2064E+02 -8.1082E+01  1.2683E+01
  801 -2.4697E+00  7.0822E+01  8.4363E-06  4.1946E+02  5.8624E+01 -7.6807E-01
  802  3.7122E+00 -7.0767E+01  3.3544E-05 -4.2297E+02  2.1843E+01  7.6688E-01
  702  2.4337E+00 -6.9997E+01 -3.5209E-05  4.2610E+02 -4.4113E+01 -1.2684E+01
             ELE.NO.   1401 FOR LOAD CASE     8
  701  1.7475E+01 -2.5625E+02 -3.0354E+02 -1.1618E+03  2.3225E+02 -8.7566E+01
  801  4.6497E+00 -2.5048E+02  3.0354E+02  1.1566E+03 -6.1611E+00  4.8286E+01
  802 -1.7199E+01  2.4993E+02  3.0354E+02 -1.1517E+03 -1.0695E+02 -4.8286E+01
  702 -4.9259E+00  2.5680E+02 -3.0354E+02  1.1371E+03  3.3262E+02  8.7566E+01

             ELE.NO.   1301 FOR LOAD CASE     1
  601  2.9961E-02  8.9830E-02  1.1386E+01  9.9843E+01  6.7363E+00 -5.7048E-01
  701 -3.5093E-02  2.7717E-02 -1.1386E+01 -9.9762E+01 -5.5130E+00  1.6174E-01
  702 -3.2544E-02 -3.0656E-02 -1.1386E+01  9.9863E+01  3.2029E+00 -1.6174E-01
  602  3.7676E-02 -8.6891E-02  1.1386E+01 -1.0005E+02 -1.9913E+00  5.7048E-01
             ELE.NO.   1301 FOR LOAD CASE     2
  601  6.9603E-04  2.9965E-03  4.8500E-01  4.2616E+00  2.6149E-01 -1.5936E-02
  701 -8.0211E-04 -5.6696E-04 -4.8500E-01 -4.2572E+00 -2.3153E-01  1.9327E-03
  702 -8.4846E-04  4.9483E-04 -4.8500E-01  4.2612E+00  1.4039E-01 -1.9327E-03
  602  9.5454E-04 -2.9243E-03  4.8500E-01 -4.2682E+00 -1.1093E-01  1.5936E-02
             ELE.NO.   1301 FOR LOAD CASE     3
  601  9.1849E-04  3.9538E-03  6.4000E-01  5.6235E+00  3.4506E-01 -2.1029E-02
  701 -1.0584E-03 -7.4843E-04 -6.4000E-01 -5.6178E+00 -3.0553E-01  2.5504E-03
  702 -1.1196E-03  6.5325E-04 -6.4000E-01  5.6230E+00  1.8526E-01 -2.5504E-03
  602  1.2596E-03 -3.8586E-03  6.4000E-01 -5.6322E+00 -1.4638E-01  2.1029E-02
             ELE.NO.   1301 FOR LOAD CASE     4
  601 -3.2936E-03 -1.4178E-02 -2.2950E+00 -2.0166E+01 -1.2374E+00  7.5409E-02
  701  3.7955E-03  2.6838E-03  2.2950E+00  2.0145E+01  1.0956E+00 -9.1461E-03
  702  4.0149E-03 -2.3424E-03  2.2950E+00 -2.0164E+01 -6.6433E-01  9.1455E-03
  602 -4.5168E-03  1.3837E-02 -2.2950E+00  2.0197E+01  5.2490E-01 -7.5410E-02
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  ELEMENT FORCES    FORCE,LENGTH UNITS= KIP  INCH
  --------------
    GLOBAL CORNER FORCES
JOINT      FX           FY           FZ           MX           MY           MZ
              ELE.NO.   1301 FOR LOAD CASE      5
  601  7.2049E+00 -1.1276E+02 -1.0316E-05  6.8414E+02  2.5311E+02 -4.5724E+01
  701  2.8272E+00 -1.1702E+02 -8.3456E-06 -6.7862E+02 -1.7073E+02  3.5879E+00
  702 -7.3822E+00  1.1682E+02 -8.1752E-05  6.9092E+02 -1.1093E+02 -3.5859E+00
  602 -2.6499E+00  1.1295E+02  1.0041E-04 -7.0360E+02  1.9252E+02  4.5725E+01
              ELE.NO.   1301 FOR LOAD CASE      6
  601  1.3445E+01 -2.0453E+02 -3.1277E+02 -1.5250E+03  3.0044E+02 -8.1837E+01
  701  4.5715E+00 -2.0812E+02  3.1277E+02  1.5304E+03 -1.3765E+02  1.5743E+01
  702 -1.3585E+01  2.0773E+02  3.1277E+02 -1.5125E+03 -2.7051E+02 -1.5743E+01
  602 -4.4317E+00  2.0492E+02 -3.1277E+02  1.4931E+03  4.3221E+02  8.1837E+01
              ELE.NO.   1301 FOR LOAD CASE      7
  601 -3.7523E+00  6.2343E+01  1.2154E-05 -3.8245E+02 -1.1836E+02  2.0745E+01
  701 -1.8365E+00  6.5663E+01  4.4660E-06  3.7834E+02  8.1082E+01 -1.5219E+00
  702  3.8934E+00 -6.5574E+01  3.0326E-05 -3.8397E+02  4.7800E+01  1.5208E+00
  602  1.6955E+00 -6.2433E+01 -4.6946E-05  3.9131E+02 -8.4572E+01 -2.0746E+01
              ELE.NO.   1301 FOR LOAD CASE      8
  601  1.6926E+01 -2.5486E+02 -3.0255E+02 -1.1338E+03  4.4130E+02 -1.0735E+02
  701  5.5290E+00 -2.5945E+02  3.0255E+02  1.1406E+03 -2.3225E+02  1.7966E+01
  702 -1.7105E+01  2.5894E+02  3.0255E+02 -1.1160E+03 -3.3077E+02 -1.7966E+01
  602 -5.3507E+00  2.5536E+02 -3.0255E+02  1.0910E+03  5.3844E+02  1.0735E+02

              ELE.NO.   1201 FOR LOAD CASE      1
  501  6.9924E-03  2.9110E-01  1.2213E+01  1.0637E+02  7.2110E+00 -3.7236E-01
  601 -2.9960E-02  2.3496E-01 -1.2213E+01 -1.0633E+02 -6.7363E+00  1.3018E-02
  602 -9.3687E-03 -2.3666E-01 -1.2212E+01  1.0651E+02  2.5565E+00 -1.3026E-02
  502  3.2337E-02 -2.8939E-01  1.2212E+01 -1.0660E+02 -2.0874E+00  3.7236E-01
              ELE.NO.   1201 FOR LOAD CASE      2
  501 -7.4366E-05  1.0096E-02  4.8500E-01  4.2315E+00  2.7038E-01 -9.8467E-03
  601 -6.9602E-04  7.5484E-03 -4.8500E-01 -4.2294E+00 -2.6149E-01 -2.6786E-03
  602 -3.5483E-05 -7.5805E-03 -4.8500E-01  4.2361E+00  1.0813E-01  2.6784E-03
  502  8.0587E-04 -1.0064E-02  4.8500E-01 -4.2390E+00 -9.9457E-02  9.8465E-03
              ELE.NO.   1201 FOR LOAD CASE      3
  501 -9.8124E-05  1.3323E-02  6.4000E-01  5.5839E+00  3.5679E-01 -1.2994E-02
  601 -9.1849E-04  9.9613E-03 -6.4000E-01 -5.5811E+00 -3.4506E-01 -3.5346E-03
  602 -4.6834E-05 -1.0003E-02 -6.4000E-01  5.5900E+00  1.4268E-01  3.5343E-03
  502  1.0635E-03 -1.3281E-02  6.4000E-01 -5.5937E+00 -1.3124E-01  1.2993E-02
              ELE.NO.   1201 FOR LOAD CASE      4
  501  3.5187E-04 -4.7776E-02 -2.2950E+00 -2.0023E+01 -1.2794E+00  4.6594E-02
  601  3.2936E-03 -3.5720E-02  2.2950E+00  2.0014E+01  1.2374E+00  1.2675E-02
  602  1.6787E-04  3.5871E-02  2.2950E+00 -2.0045E+01 -5.1166E-01 -1.2674E-02
  502 -3.8134E-03  4.7625E-02 -2.2950E+00  2.0059E+01  4.7063E-01 -4.6594E-02
              ELE.NO.   1201 FOR LOAD CASE      5
  501  3.5263E+00 -6.1419E+01 -2.8570E-05  2.4636E+02  2.7356E+02 -2.7742E+01
  601  2.0490E+00 -6.6276E+01  7.2423E-06 -2.4240E+02 -2.5311E+02 -1.1219E+01
  602 -3.7352E+00  6.6202E+01 -6.9287E-05  2.6354E+02 -2.3102E+02  1.1220E+01
  502 -1.8401E+00  6.1493E+01  9.0615E-05 -2.6926E+02  2.5105E+02  2.7743E+01
              ELE.NO.   1201 FOR LOAD CASE      6
  501  8.6984E+00 -1.1977E+02 -3.1277E+02 -2.2770E+03  3.5293E+02 -6.5595E+01
  601  2.0383E+00 -1.2614E+02  3.1277E+02  2.2816E+03 -2.6947E+02  2.2614E+00
  602 -8.9631E+00  1.2583E+02  3.1277E+02 -2.2494E+03 -4.6730E+02 -2.2615E+00
  502 -1.7736E+00  1.2007E+02 -3.1277E+02  2.2376E+03  5.5004E+02  6.5595E+01
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 ELEMENT FORCES    FORCE,LENGTH UNITS= KIP  INCH
 --------------
   GLOBAL CORNER FORCES
JOINT      FX             FY             FZ            MX             MY             MZ
               ELE.NO.   1201 FOR LOAD CASE      7
  501 -1.8718E+00  3.2996E+01  1.8699E-05 -1.3368E+02 -1.2881E+02  1.3299E+01
  601 -1.1332E+00  3.5831E+01 -1.0780E-05  1.3136E+02  1.1836E+02  4.8647E+00
  602  1.9940E+00 -3.5793E+01  2.6270E-05 -1.4117E+02  1.0646E+02 -4.8653E+00
  502  1.0111E+00 -3.3033E+01 -3.4189E-05  1.4440E+02 -1.1666E+02 -1.3300E+01
               ELE.NO.   1201 FOR LOAD CASE      8
  501  1.0360E+01 -1.4793E+02 -3.0172E+02 -2.0682E+03  5.0424E+02 -8.0386E+01
  601  2.9258E+00 -1.5636E+02  3.0172E+02  2.0744E+03 -4.1033E+02 -4.0739E+00
  602 -1.0714E+01  1.5602E+02  3.0172E+02 -2.0308E+03 -5.8957E+02  4.0738E+00
  502 -2.5722E+00  1.4827E+02 -3.0172E+02  2.0163E+03  6.8257E+02  8.0386E+01

               ELE.NO.   1101 FOR LOAD CASE      1
  401 -3.9666E-02  5.7488E-01  1.2873E+01  1.1112E+02  6.8646E+00 -2.6203E-02
  501 -6.9917E-03  4.9377E-01 -1.2873E+01 -1.1105E+02 -7.2110E+00 -3.1114E-01
  502  3.6070E-02 -4.9250E-01 -1.2873E+01  1.1126E+02  2.4953E+00  3.1113E-01
  402  1.0588E-02 -5.7615E-01  1.2873E+01 -1.1130E+02 -2.8467E+00  2.6194E-02
               ELE.NO.   1101 FOR LOAD CASE      2
  401 -1.6835E-03  2.0140E-02  4.8500E-01  4.1938E+00  2.5122E-01  1.8692E-03
  501  7.4357E-05  1.6714E-02 -4.8500E-01 -4.1907E+00 -2.7038E-01 -1.3860E-02
  502  1.5308E-03 -1.6644E-02 -4.8500E-01  4.1983E+00  9.5895E-02  1.3860E-02
  402  7.8275E-05 -2.0210E-02  4.8500E-01 -4.1997E+00 -1.1526E-01 -1.8694E-03
               ELE.NO.   1101 FOR LOAD CASE      3
  401 -2.2215E-03  2.6576E-02  6.4000E-01  5.5341E+00  3.3150E-01  2.4667E-03
  501  9.8124E-05  2.2056E-02 -6.4000E-01 -5.5299E+00 -3.5679E-01 -1.8290E-02
  502  2.0200E-03 -2.1963E-02 -6.4000E-01  5.5400E+00  1.2654E-01  1.8289E-02
  402  1.0328E-04 -2.6669E-02  6.4000E-01 -5.5419E+00 -1.5209E-01 -2.4671E-03
               ELE.NO.   1101 FOR LOAD CASE      4
  401  7.9661E-03 -9.5302E-02 -2.2950E+00 -1.9845E+01 -1.1887E+00 -8.8452E-03
  501 -3.5192E-04 -7.9091E-02  2.2950E+00  1.9830E+01  1.2794E+00  6.5586E-02
  502 -7.2438E-03  7.8760E-02  2.2950E+00 -1.9866E+01 -4.5377E-01 -6.5583E-02
  402 -3.7033E-04  9.5633E-02 -2.2950E+00  1.9873E+01  5.4539E-01  8.8467E-03
               ELE.NO.   1101 FOR LOAD CASE      5
  401 -8.3199E-01 -4.0066E+01 -1.4614E-05  1.6867E+02  2.1192E+02  7.0865E+00
  501  4.6603E+00 -4.7616E+01  2.6476E-05 -1.6153E+02 -2.7356E+02 -4.3405E+01
  502  4.9250E-01  4.7841E+01 -3.7899E-05  1.8476E+02 -2.5844E+02  4.3407E+01
  402 -4.3208E+00  3.9841E+01  2.6038E-05 -1.8650E+02  1.9641E+02 -7.0859E+00
               ELE.NO.   1101 FOR LOAD CASE      6
  401  4.6202E+00 -8.9567E+01 -3.1277E+02 -2.3882E+03  3.7037E+02 -4.2879E+01
  501  3.6885E+00 -1.0073E+02  3.1277E+02  2.3976E+03 -3.5293E+02 -2.8999E+01
  502 -5.1050E+00  1.0067E+02  3.1277E+02 -2.3577E+03 -5.6055E+02  2.8998E+01
  402 -3.2037E+00  8.9629E+01 -3.1277E+02  2.3468E+03  5.7710E+02  4.2879E+01
               ELE.NO.   1101 FOR LOAD CASE      7
  401  2.5702E-01  2.1204E+01  1.3044E-05 -9.0086E+01 -1.0059E+02 -3.0220E+00
  501 -2.2874E+00  2.5300E+01 -1.7646E-05  8.6271E+01  1.2881E+02  2.0115E+01
  502 -7.3664E-02 -2.5404E+01  9.2558E-06 -9.7169E+01  1.2080E+02 -2.0115E+01
  402  2.1041E+00 -2.1101E+01 -4.6539E-06  9.8510E+01 -9.2351E+01  3.0217E+00
               ELE.NO.   1101 FOR LOAD CASE      8
  401  4.0096E+00 -1.0790E+02 -3.0106E+02 -2.2086E+03  4.8796E+02 -3.8845E+01
  501  6.0542E+00 -1.2259E+02  3.0106E+02  2.2214E+03 -5.0424E+02 -5.2568E+01
  502 -4.6538E+00  1.2266E+02  3.0106E+02 -2.1690E+03 -6.9593E+02  5.2568E+01
  402 -5.4100E+00  1.0784E+02 -3.0106E+02  2.1577E+03  6.7860E+02  3.8845E+01
```

```
 ELEMENT FORCES    FORCE,LENGTH UNITS= KIP  INCH
 --------------
   GLOBAL CORNER FORCES
JOINT      FX          FY          FZ          MX          MY          MZ
              ELE.NO.   1001 FOR LOAD CASE     1
  201 -1.1976E-01  1.0346E+00  1.3534E+01  1.1464E+02  5.0051E+00  6.6048E-01
  401  3.9666E-02  7.9983E-01 -1.3534E+01 -1.1623E+02 -6.8647E+00 -7.9851E-01
  402  1.0923E-01 -7.9333E-01 -1.3534E+01  1.1638E+02  3.2913E+00  7.9850E-01
  202 -2.9133E-02 -1.0411E+00  1.3534E+01 -1.1464E+02 -5.0051E+00 -6.6049E-01
              ELE.NO.   1001 FOR LOAD CASE     2
  201 -4.5177E-03  3.7754E-02  4.8500E-01  4.0995E+00  1.7899E-01  2.5408E-02
  401  1.6835E-03  2.7160E-02 -4.8500E-01 -4.1765E+00 -2.5122E-01 -3.0718E-02
  402  4.0442E-03 -2.6910E-02 -4.8500E-01  4.1825E+00  1.1375E-01  3.0717E-02
  202 -1.2100E-03 -3.8004E-02  4.8500E-01 -4.0995E+00 -1.7899E-01 -2.5408E-02
              ELE.NO.   1001 FOR LOAD CASE     3
  201 -5.9614E-03  4.9819E-02  6.4000E-01  5.4096E+00  2.3619E-01  3.3528E-02
  401  2.2215E-03  3.5840E-02 -6.4000E-01 -5.5113E+00 -3.3150E-01 -4.0535E-02
  402  5.3367E-03 -3.5510E-02 -6.4000E-01  5.5192E+00  1.5010E-01  4.0534E-02
  202 -1.5967E-03 -5.0149E-02  6.4000E-01 -5.4096E+00 -2.3619E-01 -3.3528E-02
              ELE.NO.   1001 FOR LOAD CASE     4
  201  2.1377E-02 -1.7865E-01 -2.2950E+00 -1.9399E+01 -8.4697E-01 -1.2023E-01
  401 -7.9660E-03 -1.2852E-01  2.2950E+00  1.9763E+01  1.1887E+00  1.4535E-01
  402 -1.9137E-02  1.2734E-01  2.2950E+00 -1.9792E+01 -5.3827E-01 -1.4535E-01
  202  5.7257E-03  1.7983E-01 -2.2950E+00  1.9399E+01  8.4697E-01  1.2023E-01
              ELE.NO.   1001 FOR LOAD CASE     5
  201 -8.4884E+00 -3.5039E+00  5.8292E-05 -7.6812E+00 -3.3537E-01  7.6521E+01
  401  9.6347E+00 -2.2750E+01  1.3949E-05 -1.0366E+02 -2.1192E+02 -9.2511E+01
  402  7.6152E+00  2.3503E+01  1.0390E-05  1.2174E+02 -2.0208E+02  9.2512E+01
  202 -8.7615E+00  2.7509E+00 -8.2631E-05  7.6808E+00  3.3536E-01 -7.6521E+01
              ELE.NO.   1001 FOR LOAD CASE     6
  201 -2.3503E+01 -3.0306E+01 -3.1277E+02 -2.6738E+03 -1.1674E+02  2.1984E+02
  401  2.7554E+01 -6.2474E+01  3.1277E+02  2.4875E+03 -4.8722E+02 -2.6578E+02
  402  2.2004E+01  6.4637E+01  3.1277E+02 -2.4356E+03 -7.0217E+02  2.6578E+02
  202 -2.6055E+01  2.8142E+01 -3.1277E+02  2.6738E+03  1.1674E+02 -2.1984E+02
              ELE.NO.   1001 FOR LOAD CASE     7
  201  4.0112E+00  1.8371E+00 -2.2323E-05  3.8188E+00  1.6673E-01 -3.6230E+01
  401 -4.6144E+00  1.1978E+01 -1.3196E-05  5.4802E+01  1.0059E+02  4.3801E+01
  402 -3.5528E+00 -1.2335E+01 -1.6940E-05 -6.3360E+01  9.5427E+01 -4.3801E+01
  202  4.1560E+00 -1.4806E+00  5.2459E-05 -3.8186E+00 -1.6673E-01  3.6230E+01
              ELE.NO.   1001 FOR LOAD CASE     8
  201 -2.8089E+01 -3.1029E+01 -3.0040E+02 -2.5729E+03 -1.1233E+02  2.6073E+02
  401  3.2610E+01 -7.2511E+01  3.0040E+02  2.3325E+03 -6.0481E+02 -3.1521E+02
  402  2.6166E+01  7.5077E+01  3.0040E+02 -2.2709E+03 -8.0580E+02  3.1521E+02
  202 -3.0687E+01  2.8463E+01 -3.0040E+02  2.5729E+03  1.1233E+02 -2.6073E+02
  239. *
  240. FINISH
```

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          ****************************************************
          *                                                  *
          *           STAAD.Pro                              *
          *           Version  2006    Bld 1001.US           *
          *           Proprietary Program of                 *
          *           Research Engineers,  Intl.             *
          *           Date=    DEC  8, 2008                  *
          *           Time=     8:54: 3                      *
          *                                                  *
          *      USER ID: Beyaz _Patel, Inc.                 *
          ****************************************************



     1. STAAD SPACE SAN JOSE DIGESTER #1 - SUBMERGED CASE
INPUT FILE: Structure1.STD
     2. START JOB INFORMATION
     3. ENGINEER DATE 5-DEC-08
     4. END JOB INFORMATION
     5. INPUT WIDTH 79
     6. *BY: GLENN HUDSON
     7. *LOADS ARE FOR SUBMERGED CASE WITH 6-FOOT HYDROSTATIC HEAD ABOVE
     8. *BOTTOM OF CONCRETE ROOF SLAB (AT HIGH POINT OF SLOPE)
     9. *
    10. UNIT KIP FEET
    11. *
    12. JOINT COORDINATES CYLINDRICAL
    13. *
    14. *FOLLOWING JOINTS ARE FOR WALL FOOTING
    15. *
    16. 101   46.50  0.  0.
    17. REPEAT  71  0  5  0
    18. 201  50.50  0.  0.
    19. REPEAT  71  0  5  0
    20. 301  54.00  0.  0.
    21. REPEAT  71  0  5  0
    22. *
    23. *FOLLOWING JOINTS ARE FOR WALL
    24. *
    25. 401  50.50  0.  2.0
    26. REPEAT  71  0  5  0
    27. 501  50.50  0.  4.0
    28. REPEAT  71  0  5  0
    29. 601  50.50  0  6.0
    30. REPEAT  71  0  5  0
    31. 701  50.50  0.  9.0
    32. REPEAT  71  0  5  0
    33. 801  50.50  0.  12.0
    34. REPEAT  71  0  5  0
    35. 901  50.50  0.  16.0
    36. REPEAT  71  0  5  0
    37. 1001  50.50  0.  20.0
    38. REPEAT  71  0  5  0
    39. 1101  50.50  0.  24.0
    40. REPEAT  71  0  5  0
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41. 1201  50.50  0.  28.0
42. REPEAT  71  0  5  0
43. 1301  50.50  0.  30.25
44. REPEAT  71  0  5  0
45. 1401  50.50  0.  32.50
46. REPEAT  71  0  5  0
47. *
48. ELEMENT INCIDENCES SHELL
49. *
50. *ELEMENTS WITH NUMBERS BELOW 1000 ARE FOR FOOTING
51. *ELEMENTS WITH NUMBERS ABOVE 1000 ARE FOR WALL
52. *
53. *FOOTING ELEMENTS
54. 101  101  102  202  201  TO  171  1  1
55. 172  172  101  201  272
56. 201  201  202  302  301  TO  271  1  1
57. 272  272  201  301  372
58. *
59. *WALL ELEMENTS
60. 1001  201  401  402  202  TO  1071  1  1
61. 1072  272  472  401  201
62. 1101  401  501  502  402  TO  1171  1  1
63. 1172  472  572  501  401
64. 1201  501  601  602  502  TO  1271  1  1
65. 1272  572  672  601  501
66. 1301  601  701  702  602  TO  1371  1  1
67. 1372  672  772  701  601
68. 1401  701  801  802  702  TO  1471  1  1
69. 1472  772  872  801  701
70. 1501  801  901  902  802  TO  1571  1  1
71. 1572  872  972  901  801
72. 1601  901  1001  1002  902  TO  1671  1  1
73. 1672  972  1072  1001  901
74. 1701  1001  1101  1102  1002  TO  1771  1  1
75. 1772  1072  1172  1101  1001
76. 1801  1101  1201  1202  1102  TO  1871  1  1
77. 1872  1172  1272  1201  1101
78. 1901  1201  1301  1302  1202  TO  1971  1  1
79. 1972  1272  1372  1301  1201
80. 2001  1301  1401  1402  1302  TO  2071  1  1
81. 2072  1372  1472  1401  1301
82. UNIT KIP INCH
83. *
84. ELEMENT PROPERTY
85. *
86. *FOLLOWING ARE FOOTING ELEMENT THICKNESSES (101 TO 172 USE
87. *AVERAGE THICKNESS)
88. 101 TO 172 THICKNESS 15
89. 201 TO 272 THICKNESS 18
90. *
91. *FOLLOWING ARE WALL ELEMENTS
92. 1001 TO 1072  1101 TO 1172  1201 TO 1272  1301 TO 1372  1401 TO 1472 -
93. THICKNESS 12
94. 1501 TO 1572  1601 TO 1672  1701 TO 1772  1801 TO 1872  1901 TO 1972 -
95. 2001 TO 2072  THICKNESS 10
96. *
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 97. *JOINTS AT THE BOTTOM OF WALL ELEMENTS ARE RELEASED WITH RESPECT TO
 98. *MOMENT SINCE THERE IS NO REINFORCING THROUGH THE WALL TO FOOTING JOINT
 99. ELEMENT RELEASE
100. 1001 TO 1072  J1  MX
101. 1001 TO 1072  J4  MX
102. *
103. SUPPORTS
104. *
105. *SUPPORT JOINTS AT FOOTINGS HAVE VERTICAL SPRING CONSTANTS
106. *TO MODEL SOIL RIGIDITY AND GIVE VERTICAL DEFLECTION OUTPUT
107. *THAT IS INDICATION OF PREDICTED VERTICAL SETTLEMENT
108. *
109. 101 TO 172 FIXED BUT MX MY MZ  KFZ 515
110. 201 TO 272 FIXED BUT MX MY MZ  KFZ 1225
111. 301 TO 372 FIXED BUT MX MY MZ  KFZ 515
112. *
113. *SUPPORT JOINTS AT WALLS HAVE HORIZONTAL SPRING CONSTANTS IN
114. *THE X-DIRECTION THAT MODEL SOIL PASSIVE PRESSURE
115. *RESISTANCE ON THE BURIED PORTION OF THE WALL (FOR SEISMIC LOAD
116. *CASES ONLY)
117. *401 TO 412 461 TO 472 FIXED BUT  FY FZ MX MY MZ KFX 42
118. *501 TO 512 561 TO 572 FIXED BUT  FY FZ MX MY MZ KFX 42
119. *601 TO 612 661 TO 672 FIXED BUT  FY FZ MX MY MZ KFX 53
120. *701 TO 712 761 TO 772 FIXED BUT  FY FZ MX MY MZ KFX 63
121. *
122. UNIT KIP INCH
123. *
124. CONSTANTS
125. *FOLLOWING ARE CONCRETE ELEMENTS
126. E 3100  MEMB 101 TO 172  201 TO 272  1001 TO 1072  1101 TO 1172 -
127. 1201 TO 1272  1301 TO 1372  1401 TO 1472  1501 TO 1572  1601 TO 1672 -
128. 1701 TO 1772  1801 TO 1872  1901 TO 1972  2001 TO 2072
129. *
130. POISSON 0.17 ALL
131. *
132. ALPHA CONCRETE ALL
133. *
134. UNIT KIP FEET
135. *
136. DENSITY 0.150 ALL
137. *
138. *LOADS
139. *
140. LOAD 1 DEAD LOAD
141. SELFWEIGHT Z -1.0
142. *REACTIONS FROM TRIBUTARY PORTION OF ROOF STRUCTURE ARE APPLIED AS VERTICAL
143. *JOINT LOADS ON TOP OF WALL
144. JOINT LOAD
145. 1401 TO 1472  FZ -8.51
146. *
147. LOAD 2 TRIBUTARY ROOF LIVE LOAD
148. JOINT LOAD
149. 1401 TO 1472 FZ -0.97
150. *
151. LOAD 3 TRIBUTARY ROOF VACUUM PRESSURE
152. JOINT LOAD
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153. 1401 TO 1472 FZ -1.28
154. *
155. *NOTE:  GAS UPLIFT PRESSURE DOES NOT APPLY FOR SUBMERGED CASE
156. *
157. *LOAD 4 TRIBUTARY ROOF GAS UPLIFT PRESSURE
158. *JOINT LOAD
159. *1401 TO 1472 FZ 4.59
160. *
161. LOAD 5 FLUID STATIC LOAD
162. *FOLLOWING IS FLUID STATIC LOAD ON WALL BASED ON SLUDGE DENSITY OF 70 PCF.
163. *NOTE THAT FOR "SUBMERGED" CASE THERE IS A 7.0 FOOT PRESSURE HEAD AT TOP OF
164. *WALL (6.0 FEET PLUS 1.0 FOOT ROOF SLAB SLOPE).  PRESSURE HEAD AT BASE OF
165. *WALL IS 32.5 FT + 7.0 FT = 39.5 FT.
166. *
167. ELEMENT LOAD
168. 1001 TO 1072  PR -2.70
169. 1101 TO 1172  PR -2.56
170. 1201 TO 1272  PR -2.42
171. 1301 TO 1372  PR -2.24
172. 1401 TO 1472  PR -2.03
173. 1501 TO 1572  PR -1.79
174. 1601 TO 1672  PR -1.51
175. 1701 TO 1772  PR -1.23
176. 1801 TO 1872  PR -0.91
177. 1901 TO 1972  PR -0.73
178. 2001 TO 2072  PR -0.57
179. *
180. LOAD 6 TEMPERATURE LOAD
181. *
182. *FIRST TEMPERATURE LOAD VALUE SPECIFIED IS THE AVERAGE RISE, AS MEASURED FROM
183. *THE STRUCTURE AVERAGE START TEMPERATURE.  SECOND TEMPERATURE LOAD VALUE
184. *SPECIFIED IS THE THRU-WALL TEMPERATURE DIFFERENTIAL
185. *
186. *ASSUMED TEMPERATURE VALUES FOR SITE (SAN JOSE) ARE:
187. *AIR AMBIENT LOW TEMPERATURE (JANUARY) = 40 DEG. F.
188. *STRUCTURE START TEMPERATURE (ANNUAL AVERAGE TEMP.) = 60 DEG. F.
189. *SOIL AMBIENT TEMPERATURE (INFLUENCED BY DIGESTER) = 80 DEG. F.
190. *DIGESTER INTERIOR TEMPERATURE = 135 DEG. F.
191. *
192. TEMPERATURE LOAD
193. *ABOVE GRADE ELEMENTS:
194. *FIRST TEMP LOAD VALUE = ((135-60)+(40-60))/2 = 27.5,  USE 28
195. *SECOND TEMP LOAD VALUE = 40 - 135 = -95
196. 1501 TO 1572  1601 TO 1672  1701 TO 1772  1801 TO 1872  1901 TO 1972 -
197. 2001 TO 2072  TEMP  28  -95
198. *BELOW GRADE ELEMENTS:
199. *FIRST TEMP LOAD VALUE = ((135-60)+(80-60))/2 = 48
200. *SECOND TEMP LOAD VALUE = 80 - 135 = -55
201. 1001 TO 1072  1101 TO 1172  1201 TO 1272  1301 TO 1372  1401 TO 1472 -
202. TEMP  48  -55
203. *
204. LOAD 7 PRESTRESS LOAD
205. *BASED ON 30 KSI INITIAL PRESTRESS IN CIRCUMFERENTIAL PRETRESS BARS,
206. *PER EXISTING DWGS.
207. *
208. ELEMENT LOAD
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 209. 1001 TO 1072  PR 1.02
 210. 1101 TO 1172  PR 0.96
 211. 1201 TO 1272  PR 0.93
 212. 1301 TO 1372  PR 0.86
 213. 1401 TO 1472  PR 0.81
 214. 1501 TO 1572  PR 0.80
 215. 1601 TO 1672  PR 0.66
 216. 1701 TO 1772  PR 0.53
 217. 1801 TO 1872  PR 0.36
 218. 1901 TO 1972  PR 0.26
 219. 2001 TO 2072  PR 0.10
 220. *
 221. *FOLLOWING LOAD COMBINATION COMBINES TRIBUTARY ROOF DL,LL,VACUUM LOADS,
 222. *AND STATIC FLUID,TEMPERATURE AND PRESTRESS LOADS ON SHELL WALL
 223. *
 224. LOAD COMB 8 TRIB. ROOF LOADS + FLUID STATIC + TEMP + PRESTRESS
 225. 1 1.0  2 1.0  3 1.0   5 1.0  6 1.0  7 1.0
 226. *
 227. UNIT KIP INCH
 228. *
 229. PERFORM ANALYSIS


          P R O B L E M   S T A T I S T I C S
          -----------------------------------

  NUMBER OF JOINTS/MEMBER+ELEMENTS/SUPPORTS =  1008/   936/   216
  ORIGINAL/FINAL BAND-WIDTH=  215/    46/    282 DOF
  TOTAL PRIMARY LOAD CASES =    6, TOTAL DEGREES OF FREEDOM =   6048
  SIZE OF STIFFNESS MATRIX =     1706 DOUBLE  KILO-WORDS
  REQRD/AVAIL. DISK SPACE  =     35.6/  69270.4 MB



 230. *
 231. LOAD LIST 1 TO 3  5 TO 8
 232. *DISPLACEMENTS AT FOOTING AND FROM BOTTOM TO TOP OF WALL:
 233. PRINT JOINT DISPLACEMENTS LIST 101 201 301   401 501 601 701 801 901 1001 1101
```

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  JOINT DISPLACEMENT (INCH RADIANS)    STRUCTURE TYPE = SPACE
  ------------------

JOINT  LOAD   X-TRANS    Y-TRANS    Z-TRANS    X-ROTAN    Y-ROTAN    Z-ROTAN


   101    1    0.00000    0.00000   -0.01293    0.00000    0.00012    0.00000
          2    0.00000    0.00000   -0.00036    0.00000    0.00000    0.00000
          3    0.00000    0.00000   -0.00047    0.00000    0.00001    0.00000
          5    0.00000    0.00000    0.00002    0.00000    0.00000    0.00000
          6    0.00000    0.00000    0.00090    0.00000    0.00001    0.00000
          7    0.00000    0.00000   -0.00001    0.00000    0.00000    0.00000
          8    0.00000    0.00000   -0.01284    0.00000    0.00015    0.00000
   201    1    0.00000    0.00000   -0.01660    0.00000   -0.00001    0.00000
          2    0.00000    0.00000   -0.00048    0.00000    0.00000    0.00000
          3    0.00000    0.00000   -0.00063    0.00000    0.00000    0.00000
          5    0.00000    0.00000    0.00000    0.00000    0.00000    0.00000
          6    0.00000    0.00000    0.00001    0.00000    0.00003    0.00000
          7    0.00000    0.00000    0.00000    0.00000    0.00000    0.00000
          8    0.00000    0.00000   -0.01770    0.00000    0.00002    0.00000
   301    1    0.00000    0.00000   -0.01454    0.00000   -0.00007    0.00000
          2    0.00000    0.00000   -0.00039    0.00000    0.00000    0.00000
          3    0.00000    0.00000   -0.00052    0.00000    0.00000    0.00000
          5    0.00000    0.00000   -0.00002    0.00000    0.00000    0.00000
          6    0.00000    0.00000   -0.00092    0.00000    0.00002    0.00000
          7    0.00000    0.00000    0.00001    0.00000    0.00000    0.00000
          8    0.00000    0.00000   -0.01639    0.00000   -0.00005    0.00000
   401    1    0.00044    0.00000   -0.01693    0.00000    0.00002    0.00000
          2    0.00002    0.00000   -0.00049    0.00000    0.00000    0.00000
          3    0.00002    0.00000   -0.00065    0.00000    0.00000    0.00000
          5    0.05743    0.00000   -0.00101    0.00000    0.00219    0.00000
          6    0.07039    0.00000    0.00627    0.00000    0.00249    0.00000
          7   -0.02218    0.00000    0.00039    0.00000   -0.00085    0.00000
          8    0.10612    0.00000   -0.01241    0.00000    0.00385    0.00000
   501    1    0.00079    0.00000   -0.01724    0.00000    0.00001    0.00000
          2    0.00003    0.00000   -0.00050    0.00000    0.00000    0.00000
          3    0.00004    0.00000   -0.00066    0.00000    0.00000    0.00000
          5    0.10336    0.00000   -0.00133    0.00000    0.00159    0.00000
          6    0.11898    0.00000    0.01339    0.00000    0.00157    0.00000
          7   -0.04014    0.00000    0.00052    0.00000   -0.00063    0.00000
          8    0.18306    0.00000   -0.00582    0.00000    0.00254    0.00000
   601    1    0.00103    0.00000   -0.01754    0.00000    0.00001    0.00000
          2    0.00004    0.00000   -0.00051    0.00000    0.00000    0.00000
          3    0.00006    0.00000   -0.00068    0.00000    0.00000    0.00000
          5    0.13375    0.00000   -0.00189    0.00000    0.00095    0.00000
          6    0.14639    0.00000    0.02021    0.00000    0.00076    0.00000
          7   -0.05245    0.00000    0.00074    0.00000   -0.00040    0.00000
          8    0.22882    0.00000    0.00034    0.00000    0.00132    0.00000
   701    1    0.00121    0.00000   -0.01795    0.00000    0.00000    0.00000
          2    0.00005    0.00000   -0.00053    0.00000    0.00000    0.00000
          3    0.00007    0.00000   -0.00070    0.00000    0.00000    0.00000
          5    0.15459    0.00000   -0.00310    0.00000    0.00026    0.00000
          6    0.15681    0.00000    0.03010    0.00000   -0.00009    0.00000
          7   -0.06203    0.00000    0.00123    0.00000   -0.00015    0.00000
```

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 JOINT DISPLACEMENT (INCH RADIANS)    STRUCTURE TYPE = SPACE
 ------------------

JOINT  LOAD   X-TRANS   Y-TRANS   Z-TRANS   X-ROTAN   Y-ROTAN   Z-ROTAN


         8    0.25071   0.00000   0.00906   0.00000   0.00002   0.00000
  801    1    0.00125   0.00000  -0.01833   0.00000   0.00000   0.00000
         2    0.00006   0.00000  -0.00055   0.00000   0.00000   0.00000
         3    0.00008   0.00000  -0.00072   0.00000   0.00000   0.00000
         5    0.15603   0.00000  -0.00452   0.00000  -0.00014   0.00000
         6    0.14572   0.00000   0.03981   0.00000  -0.00043   0.00000
         7   -0.06457   0.00000   0.00182   0.00000   0.00000   0.00000
         8    0.23856   0.00000   0.01751   0.00000  -0.00057   0.00000
  901    1    0.00114   0.00000  -0.01888   0.00000   0.00000   0.00000
         2    0.00006   0.00000  -0.00058   0.00000   0.00000   0.00000
         3    0.00008   0.00000  -0.00076   0.00000   0.00000   0.00000
         5    0.14019   0.00000  -0.00641   0.00000  -0.00047   0.00000
         6    0.12134   0.00000   0.04667   0.00000  -0.00044   0.00000
         7   -0.06027   0.00000   0.00261   0.00000   0.00017   0.00000
         8    0.20254   0.00000   0.02265   0.00000  -0.00075   0.00000
 1001    1    0.00095   0.00000  -0.01936   0.00000   0.00000   0.00000
         2    0.00006   0.00000  -0.00060   0.00000   0.00000   0.00000
         3    0.00007   0.00000  -0.00080   0.00000   0.00000   0.00000
         5    0.11495   0.00000  -0.00810   0.00000  -0.00055   0.00000
         6    0.11031   0.00000   0.05361   0.00000  -0.00002   0.00000
         7   -0.04999   0.00000   0.00332   0.00000   0.00025   0.00000
         8    0.17635   0.00000   0.02807   0.00000  -0.00032   0.00000
 1101    1    0.00075   0.00000  -0.01978   0.00000   0.00000   0.00000
         2    0.00005   0.00000  -0.00063   0.00000   0.00000   0.00000
         3    0.00007   0.00000  -0.00083   0.00000   0.00000   0.00000
         5    0.08910   0.00000  -0.00949   0.00000  -0.00050   0.00000
         6    0.11340   0.00000   0.06073   0.00000   0.00005   0.00000
         7   -0.03726   0.00000   0.00390   0.00000   0.00027   0.00000
         8    0.16612   0.00000   0.03390   0.00000  -0.00018   0.00000


 ************** END OF LATEST ANALYSIS RESULT **************


 234. *REACTIONS AT WALL BASE _FOOTING:
 235. PRINT SUPPORT REACTIONS LIST 101 201 301
```

LC5 = FLUID STATIC
LC6 = TEMP.
LC7 = PRESTRESS INITIAL
LC8 = COMBINED 1 TO 7

JOINT 801

$\Delta x_{MAX} = \underline{0.239''}$

(LC8)

```
  SUPPORT REACTIONS -UNIT KIP  INCH    STRUCTURE TYPE = SPACE
  -----------------

JOINT  LOAD   FORCE-X   FORCE-Y   FORCE-Z     MOM-X     MOM-Y     MOM Z


   101    1      0.00      0.00      6.66      0.00      0.00      0.00
          2      0.00      0.00      0.18      0.00      0.00      0.00
          3      0.00      0.00      0.24      0.00      0.00      0.00
          5      0.00      0.00     -0.01      0.00      0.00      0.00
          6      0.00      0.00     -0.46      0.00      0.00      0.00
          7      0.00      0.00      0.00      0.00      0.00      0.00
          8      0.00      0.00      6.61      0.00      0.00      0.00
   201    1     -0.24      0.00     20.34      0.00      0.00      0.00
          2     -0.01      0.00      0.58      0.00      0.00      0.00
          3     -0.01      0.00      0.77      0.00      0.00      0.00
          5    -33.77      0.00      0.00      0.00      0.00      0.00
          6    -19.82      0.00     -0.01      0.00      0.00      0.00
          7     12.51      0.00      0.00      0.00      0.00      0.00
          8    -41.34      0.00     21.68      0.00      0.00      0.00
   301    1      0.00      0.00      7.49      0.00      0.00      0.00
          2      0.00      0.00      0.20      0.00      0.00      0.00
          3      0.00      0.00      0.27      0.00      0.00      0.00
          5      0.00      0.00      0.01      0.00      0.00      0.00
          6      0.00      0.00      0.48      0.00      0.00      0.00
          7      0.00      0.00      0.00      0.00      0.00      0.00
          8      0.00      0.00      8.44      0.00      0.00      0.00


  ************** END OF LATEST ANALYSIS RESULT **************

  236. *ELEMENT STRESSES IN STRIP FROM TOP TO BOTTOM OF WALL:
  237. PRINT ELEMENT STRESSES LIST 2001 1901 1801 1701 1601 1501 1401 1301 1201 -
  238. 1101 1001
```

SHEAR AT WALL BASE:

$R_{x_{MAX}} = \underline{-41.34^{K}}$

(JOINT 201, LC8)

$R_{z} = \underline{21.68^{K}}$

VERT

```
 ELEMENT STRESSES    FORCE,LENGTH UNITS= KIP  INCH
 ----------------

         STRESS = FORCE/UNIT WIDTH/THICK, MOMENT = FORCE-LENGTH/UNIT WIDTH

ELEMENT  LOAD        SQX        SQY          MX          MY          MXY
                     VONT       VONB         SX          SY          SXY
                     TRESCAT    TRESCAB


 2001      1         0.00       0.00        0.06        0.01        0.00
                     0.01       0.02       -0.02        0.00        0.00
                     0.02       0.02
     TOP :  SMAX=     0.00  SMIN=    -0.01  TMAX=     0.01  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=    -0.02  TMAX=     0.01  ANGLE=  90.0
           2         0.00       0.00        0.01        0.00        0.00
                     0.00       0.00        0.00        0.00        0.00
                     0.00       0.00
     TOP :  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
           3         0.00       0.00        0.01        0.00        0.00
                     0.00       0.00        0.00        0.00        0.00
                     0.00       0.00
     TOP :  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
           5         0.00       0.00        0.22        0.04        0.00
                     0.26       0.27        0.00        0.26        0.00
                     0.26       0.27
     TOP :  SMAX=     0.26  SMIN=     0.01  TMAX=     0.13  ANGLE=   0.0
     BOTT:  SMAX=     0.26  SMIN=    -0.01  TMAX=     0.14  ANGLE=   0.0
           6        -0.01       0.00        0.89       13.65        0.00
                     0.45       1.14        0.00       -0.35        0.00
                     0.47       1.16
     TOP :  SMAX=     0.47  SMIN=     0.05  TMAX=     0.21  ANGLE=   0.0
     BOTT:  SMAX=    -0.05  SMIN=    -1.16  TMAX=     0.56  ANGLE=   0.0
           7         0.00       0.00       -0.01        0.00        0.00
                     0.07       0.07        0.00       -0.07        0.00
                     0.07       0.07
     TOP :  SMAX=     0.00  SMIN=    -0.07  TMAX=     0.03  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=    -0.07  TMAX=     0.03  ANGLE=  90.0
           8        -0.01       0.00        1.17       13.70        0.00
                     0.65       0.93       -0.02       -0.15        0.00
                     0.68       0.97
     TOP :  SMAX=     0.68  SMIN=     0.05  TMAX=     0.31  ANGLE=   0.0
     BOTT:  SMAX=    -0.09  SMIN=    -0.97  TMAX=     0.44  ANGLE=   0.0

 1901      1         0.00       0.00        0.05        0.01        0.00
                     0.02       0.02       -0.02        0.00        0.00
                     0.02       0.02
     TOP :  SMAX=     0.00  SMIN=    -0.02  TMAX=     0.01  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=    -0.02  TMAX=     0.01  ANGLE=  90.0
           2         0.00       0.00        0.01        0.00        0.00
                     0.00       0.00        0.00        0.00        0.00
                     0.00       0.00
     TOP :  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
```

```
 ELEMENT STRESSES    FORCE,LENGTH UNITS= KIP  INCH
 ----------------

          STRESS = FORCE/UNIT WIDTH/THICK, MOMENT = FORCE-LENGTH/UNIT WIDTH

ELEMENT  LOAD        SQX         SQY          MX          MY           MXY
                     VONT        VONB         SX          SY           SXY
                     TRESCAT     TRESCAB

           3         0.00        0.00         0.01        0.00         0.00
                     0.00        0.00         0.00        0.00         0.00
                     0.00        0.00
     TOP :  SMAX=      0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
     BOTT:  SMAX=      0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
           5         0.00        0.00         0.09        0.02         0.00
                     0.31        0.32         0.00        0.32         0.00
                     0.32        0.32
     TOP :  SMAX=      0.32  SMIN=     0.01  TMAX=     0.16  ANGLE=   0.0
     BOTT:  SMAX=      0.31  SMIN=    -0.01  TMAX=     0.16  ANGLE=   0.0
           6        -0.02        0.00         4.77       14.31         0.00
                     0.70        0.81         0.00       -0.06         0.00
                     0.80        0.92
     TOP :  SMAX=      0.80  SMIN=     0.29  TMAX=     0.26  ANGLE=   0.0
     BOTT:  SMAX=     -0.29  SMIN=    -0.92  TMAX=     0.32  ANGLE=   0.0
           7         0.00        0.00         0.11        0.02         0.00
                     0.11        0.10         0.00       -0.10         0.00
                     0.11        0.11
     TOP :  SMAX=      0.01  SMIN=    -0.10  TMAX=     0.06  ANGLE=   0.0
     BOTT:  SMAX=     -0.01  SMIN=    -0.11  TMAX=     0.05  ANGLE=  90.0
           8        -0.02        0.00         5.03       14.35         0.00
                     0.91        0.61        -0.02        0.15         0.00
                     1.01        0.71
     TOP :  SMAX=      1.01  SMIN=     0.28  TMAX=     0.37  ANGLE=   0.0
     BOTT:  SMAX=     -0.33  SMIN=    -0.71  TMAX=     0.19  ANGLE=   0.0

 1801      1         0.00        0.00         0.03        0.00         0.00
                     0.02        0.02        -0.02        0.00         0.00
                     0.02        0.02
     TOP :  SMAX=      0.00  SMIN=    -0.02  TMAX=     0.01  ANGLE=  90.0
     BOTT:  SMAX=      0.00  SMIN=    -0.02  TMAX=     0.01  ANGLE=  90.0
           2         0.00        0.00         0.00        0.00         0.00
                     0.00        0.00         0.00        0.00         0.00
                     0.00        0.00
     TOP :  SMAX=      0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
     BOTT:  SMAX=      0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
           3         0.00        0.00         0.00        0.00         0.00
                     0.00        0.00         0.00        0.00         0.00
                     0.00        0.00
     TOP :  SMAX=      0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
     BOTT:  SMAX=      0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
           5         0.00        0.00         0.60        0.10         0.00
                     0.39        0.41         0.00        0.40         0.00
                     0.40        0.43
     TOP :  SMAX=      0.40  SMIN=     0.04  TMAX=     0.18  ANGLE=   0.0
     BOTT:  SMAX=      0.39  SMIN=    -0.04  TMAX=     0.21  ANGLE=   0.0
```

```
 ELEMENT STRESSES    FORCE,LENGTH UNITS= KIP  INCH
 ----------------

         STRESS = FORCE/UNIT WIDTH/THICK, MOMENT = FORCE-LENGTH/UNIT WIDTH

ELEMENT  LOAD       SQX        SQY          MX          MY           MXY
                    VONT       VONB         SX          SY           SXY
                    TRESCAT    TRESCAB

           6       -0.02       0.00       11.12       15.39          0.00
                    0.89       0.77        0.00        0.08          0.00
                    1.01       0.84
     TOP :  SMAX=     1.01  SMIN=     0.67  TMAX=     0.17  ANGLE=   0.0
     BOTT:  SMAX=    -0.67  SMIN=    -0.84  TMAX=     0.09  ANGLE=   0.0
           7        0.00       0.00       -0.02        0.00          0.00
                    0.16       0.16        0.00       -0.16          0.00
                    0.16       0.16
     TOP :  SMAX=     0.00  SMIN=    -0.16  TMAX=     0.08  ANGLE=   0.0
     BOTT:  SMAX=     0.00  SMIN=    -0.16  TMAX=     0.08  ANGLE=   0.0
           8       -0.01       0.00       11.73       15.49          0.00
                    1.09       0.68       -0.03        0.32          0.00
                    1.25       0.73
     TOP :  SMAX=     1.25  SMIN=     0.68  TMAX=     0.29  ANGLE=   0.0
     BOTT:  SMAX=    -0.61  SMIN=    -0.73  TMAX=     0.06  ANGLE=   0.0

 1701      1        0.00       0.00        0.01        0.00          0.00
                    0.03       0.03       -0.03        0.00          0.00
                    0.03       0.03
     TOP :  SMAX=     0.00  SMIN=    -0.03  TMAX=     0.01  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=    -0.03  TMAX=     0.01  ANGLE=  90.0
           2        0.00       0.00        0.00        0.00          0.00
                    0.00       0.00        0.00        0.00          0.00
                    0.00       0.00
     TOP :  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
           3        0.00       0.00        0.00        0.00          0.00
                    0.00       0.00        0.00        0.00          0.00
                    0.00       0.00
     TOP :  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
           5        0.00       0.00        0.25        0.04          0.00
                    0.52       0.53        0.00        0.52          0.00
                    0.52       0.53
     TOP :  SMAX=     0.52  SMIN=     0.01  TMAX=     0.25  ANGLE=   0.0
     BOTT:  SMAX=     0.52  SMIN=    -0.01  TMAX=     0.27  ANGLE=   0.0
           6       -0.01       0.00       16.67       16.33          0.00
                    1.04       0.95        0.00        0.09          0.00
                    1.07       1.00
     TOP :  SMAX=     1.07  SMIN=     1.00  TMAX=     0.04  ANGLE=  90.0
     BOTT:  SMAX=    -0.89  SMIN=    -1.00  TMAX=     0.06  ANGLE=   0.0
           7        0.00       0.00        0.13        0.02          0.00
                    0.23       0.22        0.00       -0.22          0.00
                    0.23       0.23
     TOP :  SMAX=     0.01  SMIN=    -0.22  TMAX=     0.12  ANGLE=   0.0
     BOTT:  SMAX=    -0.01  SMIN=    -0.23  TMAX=     0.11  ANGLE=   0.0
```

```
 ELEMENT STRESSES    FORCE,LENGTH UNITS= KIP  INCH
 ----------------

         STRESS = FORCE/UNIT WIDTH/THICK, MOMENT = FORCE-LENGTH/UNIT WIDTH

ELEMENT  LOAD        SQX        SQY          MX          MY            MXY
                     VONT       VONB         SX          SY            SXY
                     TRESCAT    TRESCAB

           8        -0.01       0.00        17.05       16.40          0.00
                     1.23       0.92        -0.03        0.39          0.00
                     1.37       1.05
       TOP :  SMAX=     1.37  SMIN=     0.99  TMAX=     0.19  ANGLE=   0.0
       BOTT:  SMAX=    -0.59  SMIN=    -1.05  TMAX=     0.23  ANGLE=   0.0

 1601      1         0.00       0.00         0.00        0.00          0.00
                     0.03       0.03        -0.03        0.00          0.00
                     0.03       0.03
       TOP :  SMAX=     0.00  SMIN=    -0.03  TMAX=     0.02  ANGLE=  90.0
       BOTT:  SMAX=     0.00  SMIN=    -0.03  TMAX=     0.02  ANGLE=  90.0
           2         0.00       0.00         0.00        0.00          0.00
                     0.00       0.00         0.00        0.00          0.00
                     0.00       0.00
       TOP :  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
       BOTT:  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
           3         0.00       0.00         0.00        0.00          0.00
                     0.00       0.00         0.00        0.00          0.00
                     0.00       0.00
       TOP :  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
       BOTT:  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
           5         0.00       0.00        -0.45       -0.08          0.00
                     0.66       0.65         0.00        0.65          0.00
                     0.68       0.66
       TOP :  SMAX=     0.65  SMIN=    -0.03  TMAX=     0.34  ANGLE=   0.0
       BOTT:  SMAX=     0.66  SMIN=     0.03  TMAX=     0.32  ANGLE=   0.0
           6         0.00       0.00        18.61       16.66          0.00
                     1.11       1.02         0.00        0.11          0.00
                     1.12       1.12
       TOP :  SMAX=     1.12  SMIN=     1.11  TMAX=     0.01  ANGLE=  90.0
       BOTT:  SMAX=    -0.89  SMIN=    -1.12  TMAX=     0.11  ANGLE=   0.0
           7         0.00       0.00         0.46        0.08          0.00
                     0.29       0.28         0.00       -0.28          0.00
                     0.31       0.29
       TOP :  SMAX=     0.03  SMIN=    -0.28  TMAX=     0.15  ANGLE=   0.0
       BOTT:  SMAX=    -0.03  SMIN=    -0.29  TMAX=     0.13  ANGLE=   0.0
           8         0.00       0.00        18.61       16.66          0.00
                     1.32       1.00        -0.04        0.48          0.00
                     1.48       1.15
       TOP :  SMAX=     1.48  SMIN=     1.08  TMAX=     0.20  ANGLE=   0.0
       BOTT:  SMAX=    -0.52  SMIN=    -1.15  TMAX=     0.31  ANGLE=   0.0

 1501      1         0.00       0.00        -0.02        0.00          0.00
                     0.04       0.03        -0.04        0.00          0.00
                     0.04       0.03
       TOP :  SMAX=     0.00  SMIN=    -0.04  TMAX=     0.02  ANGLE=  90.0
       BOTT:  SMAX=     0.00  SMIN=    -0.03  TMAX=     0.02  ANGLE=  90.0
```

```
 ELEMENT STRESSES    FORCE,LENGTH UNITS= KIP  INCH
 ----------------

         STRESS = FORCE/UNIT WIDTH/THICK, MOMENT = FORCE-LENGTH/UNIT WIDTH

ELEMENT  LOAD       SQX        SQY          MX          MY           MXY
                    VONT       VONB         SX          SY           SXY
                    TRESCAT    TRESCAB

          2         0.00       0.00        0.00        0.00         0.00
                    0.00       0.00        0.00        0.00         0.00
                    0.00       0.00
     TOP :  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
          3         0.00       0.00        0.00        0.00         0.00
                    0.00       0.00        0.00        0.00         0.00
                    0.00       0.00
     TOP :  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
          5         0.00       0.00       -1.82       -0.31         0.00
                    0.81       0.73        0.00        0.76         0.00
                    0.86       0.78
     TOP :  SMAX=     0.75  SMIN=    -0.11  TMAX=     0.43  ANGLE=   0.0
     BOTT:  SMAX=     0.78  SMIN=     0.11  TMAX=     0.34  ANGLE=   0.0
          6         0.01       0.00       16.18       16.25         0.00
                    1.09       0.89        0.00        0.21         0.00
                    1.18       0.97
     TOP :  SMAX=     1.18  SMIN=     0.97  TMAX=     0.11  ANGLE=   0.0
     BOTT:  SMAX=    -0.77  SMIN=    -0.97  TMAX=     0.10  ANGLE=   0.0
          7         0.00       0.00        0.92        0.16         0.00
                    0.34       0.31        0.00       -0.32         0.00
                    0.37       0.33
     TOP :  SMAX=     0.05  SMIN=    -0.31  TMAX=     0.18  ANGLE=   0.0
     BOTT:  SMAX=    -0.05  SMIN=    -0.33  TMAX=     0.14  ANGLE=   0.0
          8         0.01       0.00       15.26       16.09         0.00
                    1.40       0.84       -0.04        0.65         0.00
                    1.61       0.95
     TOP :  SMAX=     1.61  SMIN=     0.88  TMAX=     0.37  ANGLE=   0.0
     BOTT:  SMAX=    -0.32  SMIN=    -0.95  TMAX=     0.32  ANGLE=   0.0

  1401    1         0.00       0.00       -0.04       -0.01         0.00
                    0.03       0.03       -0.03        0.00         0.00
                    0.03       0.03
     TOP :  SMAX=     0.00  SMIN=    -0.03  TMAX=     0.02  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=    -0.03  TMAX=     0.02  ANGLE=  90.0
          2         0.00       0.00        0.00        0.00         0.00
                    0.00       0.00        0.00        0.00         0.00
                    0.00       0.00
     TOP :  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
          3         0.00       0.00        0.00        0.00         0.00
                    0.00       0.00        0.00        0.00         0.00
                    0.00       0.00
     TOP :  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
```

ELEMENT 1301

σx_{MAX} = 1.61ksi

(LC8)

(NOTE: CLOSE TO SAME ELEVATION AS Δ_{MAX})

```
 ELEMENT STRESSES    FORCE,LENGTH UNITS= KIP  INCH
 ----------------

          STRESS = FORCE/UNIT WIDTH/THICK, MOMENT = FORCE-LENGTH/UNIT WIDTH

ELEMENT  LOAD          SQX         SQY          MX          MY          MXY
                       VONT        VONB         SX          SY          SXY
                       TRESCAT     TRESCAB

          5            0.01        0.00       -5.13       -0.87         0.00
                       0.89        0.75        0.00        0.80         0.00
                       0.98        0.84
      TOP :   SMAX=     0.76  SMIN=    -0.21  TMAX=      0.49  ANGLE=   0.0
      BOTT:   SMAX=     0.84  SMIN=     0.21  TMAX=      0.31  ANGLE=   0.0
          6            0.02        0.00        9.23       12.82         0.00
                       0.45        0.51        0.00       -0.04         0.00
                       0.49        0.57
      TOP :   SMAX=     0.49  SMIN=     0.38  TMAX=      0.06  ANGLE=   0.0
      BOTT:   SMAX=    -0.38  SMIN=    -0.57  TMAX=      0.09  ANGLE=   0.0
          7            0.00        0.00        1.95        0.33         0.00
                       0.36        0.31        0.00       -0.33         0.00
                       0.39        0.34
      TOP :   SMAX=     0.08  SMIN=    -0.31  TMAX=      0.20  ANGLE=   0.0
      BOTT:   SMAX=    -0.08  SMIN=    -0.34  TMAX=      0.13  ANGLE=   0.0
          8            0.02        0.00        6.01       12.27         0.00
                       0.86        0.26       -0.04        0.44         0.00
                       0.95        0.29
      TOP :   SMAX=     0.95  SMIN=     0.21  TMAX=      0.37  ANGLE=   0.0
      BOTT:   SMAX=    -0.08  SMIN=    -0.29  TMAX=      0.11  ANGLE=   0.0

   1301   1            0.00        0.00       -0.07       -0.01         0.00
                       0.04        0.03       -0.04        0.00         0.00
                       0.04        0.03
      TOP :   SMAX=     0.00  SMIN=    -0.04  TMAX=      0.02  ANGLE=  90.0
      BOTT:   SMAX=     0.00  SMIN=    -0.03  TMAX=      0.02  ANGLE=  90.0
          2            0.00        0.00        0.00        0.00         0.00
                       0.00        0.00        0.00        0.00         0.00
                       0.00        0.00
      TOP :   SMAX=     0.00  SMIN=     0.00  TMAX=      0.00  ANGLE=  90.0
      BOTT:   SMAX=     0.00  SMIN=     0.00  TMAX=      0.00  ANGLE=  90.0
          3            0.00        0.00        0.00        0.00         0.00
                       0.00        0.00        0.00        0.00         0.00
                       0.00        0.00
      TOP :   SMAX=     0.00  SMIN=     0.00  TMAX=      0.00  ANGLE=  90.0
      BOTT:   SMAX=     0.00  SMIN=     0.00  TMAX=      0.00  ANGLE=  90.0
          5            0.01        0.00       -8.78       -1.49         0.00
                       0.92        0.70        0.00        0.75         0.00
                       1.05        0.81
      TOP :   SMAX=     0.69  SMIN=    -0.37  TMAX=      0.53  ANGLE=   0.0
      BOTT:   SMAX=     0.81  SMIN=     0.37  TMAX=      0.22  ANGLE=   0.0
          6            0.01        0.00        2.76       11.72         0.00
                       0.41        0.47        0.00       -0.03         0.00
                       0.46        0.52
      TOP :   SMAX=     0.46  SMIN=     0.11  TMAX=      0.17  ANGLE=   0.0
      BOTT:   SMAX=    -0.11  SMIN=    -0.52  TMAX=      0.20  ANGLE=   0.0
```

```
 ELEMENT STRESSES    FORCE,LENGTH UNITS= KIP  INCH
 ----------------

         STRESS = FORCE/UNIT WIDTH/THICK, MOMENT = FORCE-LENGTH/UNIT WIDTH

ELEMENT  LOAD        SQX         SQY          MX          MY           MXY
                     VONT        VONB         SX          SY           SXY
                     TRESCAT     TRESCAB

           7         0.00        0.00         3.14        0.53         0.00
                     0.36        0.28         0.00       -0.30         0.00
                     0.41        0.32
      TOP :  SMAX=     0.13  SMIN=    -0.27  TMAX=     0.20  ANGLE=   0.0
      BOTT:  SMAX=    -0.13  SMIN=    -0.32  TMAX=     0.09  ANGLE=   0.0
           8         0.02        0.00        -2.95       10.75         0.00
                     0.96        0.10        -0.04        0.42         0.00
                     1.03        0.11
      TOP :  SMAX=     0.87  SMIN=    -0.16  TMAX=     0.52  ANGLE=   0.0
      BOTT:  SMAX=     0.08  SMIN=    -0.03  TMAX=     0.06  ANGLE=   0.0

  1201     1         0.00        0.00        -0.09       -0.01         0.00
                     0.04        0.03        -0.04        0.00         0.00
                     0.04        0.03
      TOP :  SMAX=     0.00  SMIN=    -0.04  TMAX=     0.02  ANGLE=  90.0
      BOTT:  SMAX=     0.00  SMIN=    -0.03  TMAX=     0.02  ANGLE=  90.0
           2         0.00        0.00         0.00        0.00         0.00
                     0.00        0.00         0.00        0.00         0.00
                     0.00        0.00
      TOP :  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
      BOTT:  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
           3         0.00        0.00         0.00        0.00         0.00
                     0.00        0.00         0.00        0.00         0.00
                     0.00        0.00
      TOP :  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
      BOTT:  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
           5         0.00        0.00       -12.29       -2.09         0.00
                     0.90        0.63         0.00        0.61         0.00
                     1.04        0.70
      TOP :  SMAX=     0.53  SMIN=    -0.51  TMAX=     0.52  ANGLE=   0.0
      BOTT:  SMAX=     0.70  SMIN=     0.51  TMAX=     0.09  ANGLE=   0.0
           6         0.01        0.00        -1.97       10.92         0.00
                     0.37        0.63         0.00       -0.13         0.00
                     0.41        0.67
      TOP :  SMAX=     0.32  SMIN=    -0.08  TMAX=     0.20  ANGLE=   0.0
      BOTT:  SMAX=     0.08  SMIN=    -0.59  TMAX=     0.33  ANGLE=   0.0
           7         0.00        0.00         4.45        0.76         0.00
                     0.34        0.24         0.00       -0.24         0.00
                     0.39        0.27
      TOP :  SMAX=     0.19  SMIN=    -0.21  TMAX=     0.20  ANGLE=   0.0
      BOTT:  SMAX=    -0.19  SMIN=    -0.27  TMAX=     0.04  ANGLE=  90.0
           8         0.01        0.00        -9.90        9.57         0.00
                     0.95        0.47        -0.04        0.24         0.00
                     1.09        0.53
      TOP :  SMAX=     0.64  SMIN=    -0.45  TMAX=     0.55  ANGLE=   0.0
      BOTT:  SMAX=     0.37  SMIN=    -0.16  TMAX=     0.26  ANGLE=   0.0
```

```
 ELEMENT STRESSES    FORCE,LENGTH UNITS= KIP  INCH
 ----------------

        STRESS = FORCE/UNIT WIDTH/THICK, MOMENT = FORCE-LENGTH/UNIT WIDTH

ELEMENT  LOAD        SQX        SQY          MX          MY          MXY
                     VONT       VONB         SX          SY          SXY
                     TRESCAT    TRESCAB


 1101      1         0.00       0.00       -0.08       -0.01         0.00
                     0.04       0.04       -0.04        0.00         0.00
                     0.04       0.04
     TOP :  SMAX=      0.00  SMIN=    -0.04  TMAX=     0.02  ANGLE=  90.0
     BOTT:  SMAX=      0.00  SMIN=    -0.04  TMAX=     0.02  ANGLE=  90.0
           2         0.00       0.00        0.00        0.00         0.00
                     0.00       0.00        0.00        0.00         0.00
                     0.00       0.00
     TOP :  SMAX=      0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
     BOTT:  SMAX=      0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
           3         0.00       0.00        0.00        0.00         0.00
                     0.00       0.00        0.00        0.00         0.00
                     0.00       0.00
     TOP :  SMAX=      0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
     BOTT:  SMAX=      0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
           5        -0.01       0.00      -11.47       -1.95         0.00
                     0.71       0.49        0.00        0.42         0.00
                     0.81       0.50
     TOP :  SMAX=      0.34  SMIN=    -0.48  TMAX=     0.41  ANGLE=   0.0
     BOTT:  SMAX=      0.50  SMIN=     0.48  TMAX=     0.01  ANGLE=  90.0
           6         0.00       0.00       -4.06       10.56         0.00
                     0.25       0.86        0.00       -0.32         0.00
                     0.28       0.93
     TOP :  SMAX=      0.12  SMIN=    -0.17  TMAX=     0.14  ANGLE=   0.0
     BOTT:  SMAX=      0.17  SMIN=    -0.76  TMAX=     0.47  ANGLE=   0.0
           7         0.00       0.00        4.19        0.71         0.00
                     0.27       0.18        0.00       -0.16         0.00
                     0.31       0.19
     TOP :  SMAX=      0.17  SMIN=    -0.13  TMAX=     0.15  ANGLE=   0.0
     BOTT:  SMAX=     -0.17  SMIN=    -0.19  TMAX=     0.01  ANGLE=  90.0
           8         0.00       0.00      -11.43        9.31         0.00
                     0.73       0.77       -0.04       -0.07         0.00
                     0.84       0.89
     TOP :  SMAX=      0.32  SMIN=    -0.52  TMAX=     0.42  ANGLE=   0.0
     BOTT:  SMAX=      0.43  SMIN=    -0.46  TMAX=     0.45  ANGLE=   0.0

 1001      1         0.00       0.00       -0.03       -0.01         0.00
                     0.04       0.04       -0.04       -0.01         0.00
                     0.04       0.04
     TOP :  SMAX=     -0.01  SMIN=    -0.04  TMAX=     0.02  ANGLE=  90.0
     BOTT:  SMAX=     -0.01  SMIN=    -0.04  TMAX=     0.02  ANGLE=  90.0
           2         0.00       0.00        0.00        0.00         0.00
                     0.00       0.00        0.00        0.00         0.00
                     0.00       0.00
     TOP :  SMAX=      0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
     BOTT:  SMAX=      0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
```

```
ELEMENT STRESSES    FORCE,LENGTH UNITS= KIP  INCH
----------------

         STRESS = FORCE/UNIT WIDTH/THICK, MOMENT = FORCE-LENGTH/UNIT WIDTH

ELEMENT  LOAD       SQX         SQY          MX          MY            MXY
                    VONT        VONB         SX          SY            SXY
                    TRESCAT     TRESCAB

          3         0.00        0.00        0.00        0.00          0.00
                    0.00        0.00        0.00        0.00          0.00
                    0.00        0.00
     TOP :  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
          5        -0.04        0.00       -5.06       -0.86          0.00
                    0.27        0.19        0.00        0.12          0.00
                    0.30        0.21
     TOP :  SMAX=     0.09  SMIN=    -0.21  TMAX=     0.15  ANGLE=   0.0
     BOTT:  SMAX=     0.21  SMIN=     0.16  TMAX=     0.03  ANGLE=  90.0
          6        -0.08        0.00        2.30       11.64          0.00
                    0.24        1.10        0.00       -0.66          0.00
                    0.27        1.15
     TOP :  SMAX=     0.10  SMIN=    -0.18  TMAX=     0.14  ANGLE=   0.0
     BOTT:  SMAX=    -0.10  SMIN=    -1.15  TMAX=     0.53  ANGLE=   0.0
          7         0.01        0.00        1.86        0.32          0.00
                    0.10        0.07        0.00       -0.05          0.00
                    0.11        0.08
     TOP :  SMAX=     0.08  SMIN=    -0.03  TMAX=     0.06  ANGLE=   0.0
     BOTT:  SMAX=    -0.06  SMIN=    -0.08  TMAX=     0.01  ANGLE=  90.0
          8        -0.10        0.00       -0.94       11.09          0.00
                    0.12        1.05       -0.05       -0.59          0.00
                    0.13        1.06
     TOP :  SMAX=    -0.09  SMIN=    -0.13  TMAX=     0.02  ANGLE=  90.0
     BOTT:  SMAX=    -0.01  SMIN=    -1.06  TMAX=     0.52  ANGLE=   0.0


        **** MAXIMUM STRESSES AMONG SELECTED PLATES AND CASES ****
           MAXIMUM       MINIMUM       MAXIMUM       MAXIMUM       MAXIMUM
          PRINCIPAL     PRINCIPAL       SHEAR       VONMISES       TRESCA
           STRESS        STRESS        STRESS        STRESS        STRESS

        1.613312E+00 -1.164395E+00  5.555590E-01  1.398876E+00  1.613312E+00
PLATE NO.    1501          2001          2001          1501          1501
CASE  NO.       8             6             6             8             8


 ********************END OF ELEMENT FORCES********************


 239. PRINT ELEMENT FORCES LIST 2001 1901 1801 1701 1601 1501 1401 1301 1201 -
 240. 1101 1001
```

```
 ELEMENT FORCES    FORCE,LENGTH UNITS= KIP  INCH
 --------------

 **NOTE- IF A COMBINATION INCLUDES A DYNAMIC CASE OR IS AN SRSS OR ABS COMBINATION
         THEN RESULTS CANNOT BE COMPUTED PROPERLY.
   GLOBAL CORNER FORCES
JOINT      FX           FY           FZ           MX           MY           MZ

              ELE.NO.   2001 FOR LOAD CASE      1
 1301  2.1674E-02 -2.1895E-01  4.5647E+00  4.1399E+01  3.2958E-01  2.1060E-02
 1401 -2.4323E-07 -2.7745E-01 -4.5648E+00 -4.1342E+01  2.7441E-06  2.6371E-01
 1402 -2.4182E-02  2.7641E-01 -4.5648E+00  4.1185E+01  3.6032E+00 -2.6370E-01
 1302  2.5086E-03  2.2000E-01  4.5648E+00 -4.1271E+01 -3.2799E+00 -2.1069E-02
              ELE.NO.   2001 FOR LOAD CASE      2
 1301  1.7259E-03 -1.6203E-02  4.8500E-01  4.3694E+00  2.7800E-02  5.1288E-03
 1401 -1.4575E-08 -2.3326E-02 -4.8500E-01 -4.3625E+00 -4.1593E-08  2.5529E-02
 1402 -2.0330E-03  2.3238E-02 -4.8500E-01  4.3459E+00  3.8022E-01 -2.5528E-02
 1302  3.0711E-04  1.6292E-02  4.8500E-01 -4.3552E+00 -3.5313E-01 -5.1297E-03
              ELE.NO.   2001 FOR LOAD CASE      3
 1301  2.2775E-03 -2.1381E-02  6.4000E-01  5.7658E+00  3.6685E-02  6.7680E-03
 1401  6.9190E-09 -3.0782E-02 -6.4000E-01 -5.7567E+00 -1.2644E-07  3.3687E-02
 1402 -2.6827E-03  3.0664E-02 -6.4000E-01  5.7348E+00  5.0173E-01 -3.3686E-02
 1302  4.0522E-04  2.1499E-02  6.4000E-01 -5.7471E+00 -4.6598E-01 -6.7693E-03
```

LC1 to LC3
VERT. LOADS TO
TOP OF WALL

```
              ELE.NO.   2001 FOR LOAD CASE      5
 1301  1.6802E+00 -3.6498E+01  7.0117E-06  1.5854E+02  2.2502E+00 -3.6079E-01
 1401  1.4112E+00 -3.4306E+01 -5.3673E-06 -1.6059E+02  3.0975E-05  1.3751E+00
 1402 -1.5842E+00  3.4299E+01 -6.8530E-06  1.5998E+02  1.3997E+01 -1.3746E+00
 1302 -1.5072E+00  3.6506E+01  5.2086E-06 -1.5813E+02 -1.1576E+01  3.6151E-01
```

LC5 – FLUID
STATIC PRESSURE

```
              ELE.NO.   2001 FOR LOAD CASE      6
 1301 -6.8155E-01 -3.9121E+01 -1.5204E+02 -1.2245E+03  3.2106E+02 -1.1353E+01
 1401  3.3870E+00 -2.2844E+01  1.5204E+02  1.2088E+03 -3.8627E+02 -5.9217E+01
 1402  1.3831E+00  2.3052E+01  1.5204E+02 -1.1705E+03 -4.9016E+02  5.9216E+01
 1302 -4.0886E+00  3.8913E+01 -1.5204E+02  1.1919E+03  4.2657E+02  1.1353E+01
```

LC6 – TEMP.

```
              ELE.NO.   2001 FOR LOAD CASE      7
 1301 -5.2962E-01  9.7141E+00 -3.3604E-06 -3.9307E+01 -2.7818E+00  1.0252E+00
 1401 -2.4758E-01  8.0866E+00  3.3102E-06  4.0828E+01  2.0614E-06 -1.0877E+00
 1402  4.5816E-01 -8.0774E+00  3.2774E-06 -4.0672E+01 -3.5584E+00  1.0875E+00
 1302  3.1904E-01 -9.7233E+00 -3.2271E-06  3.9400E+01  6.5451E-01 -1.0254E+00
```

LC7 – PRESTRESS

```
              ELE.NO.   2001 FOR LOAD CASE      8
 1301  4.9474E-01 -6.6162E+01 -1.4635E+02 -1.0538E+03  3.2093E+02 -1.0656E+01
 1401  4.5506E+00 -4.9395E+01  1.4635E+02  1.0376E+03 -3.8627E+02 -5.8606E+01
 1402  2.2820E-01  4.9604E+01  1.4635E+02 -9.9996E+02 -4.7523E+02  5.8606E+01
 1302 -5.2736E+00  6.5953E+01 -1.4635E+02  1.0218E+03  4.1155E+02  1.0656E+01
```

LC8 – COMBINED
LOADING
LC1 TO LC7

```
              ELE.NO.   1901 FOR LOAD CASE      1
 1201  2.7204E-02 -5.1186E-02  5.1843E+00  4.5993E+01  1.0049E+00 -1.3380E-01
 1301 -2.1674E-02 -7.5490E-02 -5.1843E+00 -4.5966E+01 -3.2958E-01  3.6632E-01
 1302 -2.8171E-02  7.3326E-02 -5.1843E+00  4.5820E+01  3.6779E+00 -3.6631E-01
 1202  2.2640E-02  5.3350E-02  5.1843E+00 -4.5905E+01 -3.0075E+00  1.3381E-01
              ELE.NO.   1901 FOR LOAD CASE      2
 1201  1.9739E-03 -1.0415E-03  4.8500E-01  4.2897E+00  8.0028E-02 -7.7497E-03
 1301 -1.7259E-03 -4.6380E-03 -4.8500E-01 -4.2861E+00 -2.7800E-02  3.0875E-02
 1302 -2.1236E-03  4.4702E-03 -4.8500E-01  4.2722E+00  3.4586E-01 -3.0875E-02
 1202  1.8756E-03  1.2093E-03  4.8500E-01 -4.2804E+00 -2.9416E-01  7.7503E-03
              ELE.NO.   1901 FOR LOAD CASE      3
 1201  2.6047E-03 -1.3740E-03  6.4000E-01  5.6607E+00  1.0560E-01 -1.0226E-02
 1301 -2.2775E-03 -6.1203E-03 -6.4000E-01 -5.6558E+00 -3.6685E-02  4.0743E-02
 1302 -2.8022E-03  5.8984E-03 -6.4000E-01  5.6375E+00  4.5640E-01 -4.0742E-02
 1202  2.4750E-03  1.5960E-03  6.4000E-01 -5.6484E+00 -3.8816E-01  1.0227E-02
```

```
  ELEMENT FORCES    FORCE,LENGTH UNITS= KIP  INCH
  --------------
    GLOBAL CORNER FORCES
JOINT      FX          FY          FZ          MX          MY          MZ
               ELE.NO.   1901 FOR LOAD CASE     5
 1201  2.1819E+00 -4.3752E+01 -6.0535E-06  1.9076E+02  9.4914E+00 -2.5026E+00
 1301  1.5383E+00 -4.1454E+01  1.1236E-05 -1.9289E+02 -2.2502E+00  2.9381E+00
 1302 -2.0805E+00  4.1430E+01  1.5513E-05  1.9235E+02  1.4570E+01 -2.9374E+00
 1202 -1.6396E+00  4.3775E+01 -2.0695E-05 -1.9086E+02 -7.1701E+00  2.5035E+00
               ELE.NO.   1901 FOR LOAD CASE     6
 1201 -1.3794E+00 -7.3674E+01 -1.5204E+02 -1.0427E+03  1.9660E+02  1.9645E+01
 1301  7.4556E+00 -6.5492E+01  1.5204E+02  1.0343E+03 -3.2106E+02 -7.2413E+01
 1302  1.7192E+00  6.5893E+01  1.5204E+02 -1.0024E+03 -4.0999E+02  7.2413E+01
 1202 -7.7954E+00  7.3274E+01 -1.5204E+02  1.0216E+03  2.8673E+02 -1.9645E+01
               ELE.NO.   1901 FOR LOAD CASE     7
 1201 -8.6887E-01  1.4895E+01 -3.1335E-07 -6.2544E+01 -8.6175E+00  2.4431E+00
 1301 -3.6166E-01  1.3289E+01 -3.1975E-06  6.4028E+01  2.7818E+00 -1.9340E+00
 1302  7.9790E-01 -1.3270E+01  2.7829E-07 -6.4027E+01 -2.8092E+00  1.9338E+00
 1202  4.3263E-01 -1.4914E+01  3.2326E-06  6.3057E+01 -3.1337E+00 -2.4434E+00
               ELE.NO.   1901 FOR LOAD CASE     8
 1201 -3.4684E-02 -1.0258E+02 -1.4573E+02 -8.5854E+02  1.9866E+02  1.9434E+01
 1301  8.6066E+00 -9.3744E+01  1.4573E+02  8.4952E+02 -3.2093E+02 -7.0972E+01
 1302  4.0352E-01  9.4137E+01  1.4573E+02 -8.1832E+02 -3.9375E+02  7.0972E+01
 1202 -8.9755E+00  1.0219E+02 -1.4573E+02  8.3796E+02  2.7274E+02 -1.9434E+01

               ELE.NO.   1801 FOR LOAD CASE     1
 1101  2.1391E-02  5.5261E-02  6.0448E+00  5.2720E+01  2.1485E+00 -1.7308E-01
 1201 -2.7204E-02  7.7892E-02 -6.0448E+00 -5.2698E+01 -1.0049E+00  3.9657E-01
 1202 -2.0312E-02 -7.9966E-02 -6.0448E+00  5.2586E+01  3.5919E+00 -3.9657E-01
 1102  2.6125E-02 -5.3187E-02  6.0448E+00 -5.2707E+01 -2.4546E+00  1.7307E-01
               ELE.NO.   1801 FOR LOAD CASE     2
 1101  1.1259E-03  1.0850E-02  4.8500E-01  4.1978E+00  1.5710E-01 -9.1829E-03
 1201 -1.9739E-03  8.5731E-03 -4.8500E-01 -4.1911E+00 -8.0028E-02  2.9097E-02
 1202 -1.2192E-03 -8.7125E-03 -4.8500E-01  4.1822E+00  2.8556E-01 -2.9097E-02
 1102  2.0672E-03 -1.0710E-02  4.8500E-01 -4.1955E+00 -2.0936E-01  9.1827E-03
               ELE.NO.   1801 FOR LOAD CASE     3
 1101  1.4857E-03  1.4317E-02  6.4000E-01  5.5393E+00  2.0730E-01 -1.2118E-02
 1201 -2.6047E-03  1.1313E-02 -6.4000E-01 -5.5306E+00 -1.0560E-01  3.8396E-02
 1202 -1.6088E-03 -1.1497E-02 -6.4000E-01  5.5187E+00  3.7682E-01 -3.8396E-02
 1102  2.7278E-03 -1.4133E-02  6.4000E-01 -5.5363E+00 -2.7627E-01  1.2117E-02
               ELE.NO.   1801 FOR LOAD CASE     5
 1101  4.6877E+00 -9.9561E+01  2.1303E-05  7.5730E+02  2.5370E+01 -1.6291E+00
 1201  3.6307E+00 -9.0961E+01 -1.2573E-05 -7.6826E+02 -9.4915E+00  6.5262E+00
 1202 -4.3109E+00  9.0931E+01 -1.8356E-05  7.6617E+02  5.7503E+01 -6.5249E+00
 1102 -4.0075E+00  9.9591E+01  9.6262E-06 -7.5663E+02 -4.0729E+01  1.6311E+00
               ELE.NO.   1801 FOR LOAD CASE     6
 1101  2.9874E+00 -1.6059E+02 -1.5204E+02 -9.0618E+01  3.5632E+01  2.7157E+01
 1201  1.0788E+01 -1.5491E+02  1.5204E+02  7.3952E+01 -2.2953E+02 -6.9153E+01
 1202 -2.7544E+00  1.5526E+02  1.5204E+02 -5.3666E+01 -2.3510E+02  6.9153E+01
 1102 -1.1021E+01  1.6024E+02 -1.5204E+02  8.7168E+01  4.3395E+01 -2.7156E+01
               ELE.NO.   1801 FOR LOAD CASE     7
 1101 -1.9262E+00  4.0191E+01 -8.9317E-06 -2.9772E+02 -1.6556E+01  1.9648E+00
 1201 -1.3593E+00  3.5059E+01  4.8496E-06  3.0433E+02  8.6175E+00 -2.1371E+00
 1202  1.7015E+00 -3.5044E+01  9.3547E-06 -3.0393E+02 -1.7940E+01  2.1366E+00
 1102  1.5840E+00 -4.0206E+01 -5.2726E-06  2.9803E+02  9.4546E+00 -1.9656E+00
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 ELEMENT FORCES    FORCE,LENGTH UNITS= KIP  INCH
 --------------
   GLOBAL CORNER FORCES
JOINT      FX          FY          FZ          MX          MY          MZ
               ELE.NO.   1801 FOR LOAD CASE      8
 1101  5.7729E+00 -2.1988E+02 -1.4487E+02  4.3142E+02  4.6959E+01  2.7298E+01
 1201  1.3027E+01 -2.1071E+02  1.4487E+02 -4.5240E+02 -2.3159E+02 -6.4300E+01
 1202 -5.3871E+00  2.1105E+02  1.4487E+02  4.7086E+02 -1.9128E+02  6.4301E+01
 1102 -1.3413E+01  2.1955E+02 -1.4487E+02 -4.3387E+02  9.1804E+00 -2.7296E+01

               ELE.NO.   1701 FOR LOAD CASE      1
 1001  1.5617E-02  2.7881E-02  7.1462E+00  6.2351E+01  2.9536E+00 -1.7480E-01
 1101 -2.1391E-02  1.0435E-01 -7.1462E+00 -6.2418E+01 -2.1484E+00  2.2808E-01
 1102 -1.2214E-02 -1.0582E-01 -7.1462E+00  6.2367E+01  3.2998E+00 -2.2808E-01
 1002  1.7988E-02 -2.6415E-02  7.1462E+00 -6.2371E+01 -2.4919E+00  1.7479E-01
               ELE.NO.   1701 FOR LOAD CASE      2
 1001  3.8105E-04  7.5295E-03  4.8500E-01  4.2009E+00  1.9112E-01 -7.0538E-03
 1101 -1.1259E-03  9.5295E-03 -4.8500E-01 -4.2021E+00 -1.5710E-01  9.9328E-03
 1102 -2.9103E-04 -9.5914E-03 -4.8500E-01  4.1998E+00  2.0974E-01 -9.9329E-03
 1002  1.0358E-03 -7.4677E-03  4.8500E-01 -4.2016E+00 -1.7575E-01  7.0537E-03
               ELE.NO.   1701 FOR LOAD CASE      3
 1001  5.0284E-04  9.9357E-03  6.4000E-01  5.5435E+00  2.5220E-01 -9.3081E-03
 1101 -1.4857E-03  1.2575E-02 -6.4000E-01 -5.5450E+00 -2.0730E-01  1.3107E-02
 1102 -3.8404E-04 -1.2657E-02 -6.4000E-01  5.5420E+00  2.7677E-01 -1.3107E-02
 1002  1.3669E-03 -9.8541E-03  6.4000E-01 -5.5444E+00 -2.3191E-01  9.3079E-03
               ELE.NO.   1701 FOR LOAD CASE      5
 1001  6.1775E+00 -1.2998E+02  3.0594E-05  9.9335E+02  4.8936E+01 -5.0098E+00
 1101  4.7312E+00 -1.1987E+02 -3.2567E-05 -1.0060E+03 -2.5370E+01  7.0147E+00
 1102 -5.7342E+00  1.1983E+02 -1.9922E-05  1.0044E+03  6.2406E+01 -7.0127E+00
 1002 -5.1745E+00  1.3002E+02  2.1895E-05 -9.9384E+02 -3.7826E+01  5.0123E+00
               ELE.NO.   1701 FOR LOAD CASE      6
 1001  4.9413E+00 -1.5962E+02 -1.5204E+02 -5.6931E+01 -6.1827E+01  2.5912E+01
 1101  9.0555E+00 -1.6096E+02  1.5204E+02  5.4256E+01 -3.5632E+01 -2.2621E+01
 1102 -5.0073E+00  1.6113E+02  1.5204E+02 -5.0944E+01 -4.0225E+01  2.2621E+01
 1002 -8.9895E+00  1.5944E+02 -1.5204E+02  6.2103E+01 -5.6630E+01 -2.5911E+01
               ELE.NO.   1701 FOR LOAD CASE      7
 1001 -2.6917E+00  5.6116E+01 -1.2948E-05 -4.2573E+02 -2.7882E+01  3.4300E+00
 1101 -1.9910E+00  5.1137E+01  1.0396E-05  4.3198E+02  1.6556E+01 -2.3530E+00
 1102  2.4734E+00 -5.1116E+01  1.4196E-05 -4.3178E+02 -2.1157E+01  2.3522E+00
 1002  2.2093E+00 -5.6137E+01 -1.1645E-05  4.2654E+02  9.3286E+00 -3.4311E+00
               ELE.NO.   1701 FOR LOAD CASE      8
 1001  8.4435E+00 -2.3344E+02 -1.4377E+02  5.8278E+02 -3.7377E+01  2.4141E+01
 1101  1.1772E+01 -2.2956E+02  1.4377E+02 -5.9194E+02 -4.6959E+01 -1.7708E+01
 1102 -8.2809E+00  2.2972E+02  1.4377E+02  5.9378E+02  4.8102E+00  1.7709E+01
 1002 -1.1934E+01  2.3329E+02 -1.4377E+02 -5.7731E+02 -8.8027E+01 -2.4139E+01

               ELE.NO.   1601 FOR LOAD CASE      1
  901  1.6873E-02 -5.3535E-02  8.2475E+00  7.2673E+01  3.6481E+00 -1.9339E-01
 1001 -1.5617E-02  2.4766E-02 -8.2475E+00 -7.2748E+01 -2.9536E+00  1.5448E-01
 1002 -1.3399E-02 -2.6031E-02 -8.2475E+00  7.2728E+01  3.3981E+00 -1.5447E-01
  902  1.2143E-02  5.4801E-02  8.2475E+00 -7.2715E+01 -2.6998E+00  1.9339E-01
               ELE.NO.   1601 FOR LOAD CASE      2
  901  1.8803E-04  1.3926E-03  4.8500E-01  4.2503E+00  2.0299E-01 -4.7419E-03
 1001 -3.8105E-04  3.0283E-03 -4.8500E-01 -4.2520E+00 -1.9112E-01  1.2130E-03
 1002 -1.1567E-04 -3.0500E-03 -4.8500E-01  4.2525E+00  1.8020E-01 -1.2130E-03
  902  3.0869E-04 -1.3709E-03  4.8500E-01 -4.2518E+00 -1.6823E-01  4.7420E-03
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 ELEMENT FORCES    FORCE,LENGTH UNITS= KIP  INCH
 --------------
   GLOBAL CORNER FORCES
JOINT      FX          FY          FZ          MX          MY          MZ
            ELE.NO.   1601 FOR LOAD CASE     3
  901  2.4812E-04  1.8377E-03  6.4000E-01  5.6086E+00  2.6786E-01 -6.2575E-03
 1001 -5.0284E-04  3.9962E-03 -6.4000E-01 -5.6109E+00 -2.5220E-01  1.6007E-03
 1002 -1.5263E-04 -4.0248E-03 -6.4000E-01  5.6115E+00  2.3779E-01 -1.6008E-03
  902  4.0735E-04 -1.8091E-03  6.4000E-01 -5.6107E+00 -2.2199E-01  6.2574E-03
            ELE.NO.   1601 FOR LOAD CASE     5
  901  7.8161E+00 -1.6182E+02  2.8693E-05  1.2486E+03  8.4474E+01 -1.0827E+01
 1001  5.8823E+00 -1.5193E+02 -1.8187E-05 -1.2604E+03 -4.8936E+01  7.1486E+00
 1002 -7.3817E+00  1.5186E+02 -3.6265E-05  1.2598E+03  6.1098E+01 -7.1462E+00
  902 -6.3167E+00  1.6188E+02  2.5759E-05 -1.2512E+03 -2.4665E+01  1.0830E+01
            ELE.NO.   1601 FOR LOAD CASE     6
  901  7.1698E+00 -1.6558E+02 -1.5204E+02 -3.1180E+01 -6.4952E+01  1.0299E+01
 1001  7.1016E+00 -1.6129E+02  1.5204E+02  2.5193E+01  6.1827E+01  8.8714E+00
 1002 -6.9825E+00  1.6129E+02  1.5204E+02 -3.0486E+01  5.9396E+01 -8.8709E+00
  902 -7.2889E+00  1.6558E+02 -1.5204E+02  3.6722E+01 -6.1987E+01 -1.0299E+01
            ELE.NO.   1601 FOR LOAD CASE     7
  901 -3.3946E+00  7.0044E+01 -1.3777E-05 -5.4134E+02 -4.3820E+01  5.8920E+00
 1001 -2.5459E+00  6.6015E+01  1.1207E-05  5.4608E+02  2.7882E+01 -2.1574E+00
 1002  3.2173E+00 -6.5985E+01  2.2706E-05 -5.4643E+02 -1.9818E+01  2.1563E+00
  902  2.7231E+00 -7.0074E+01 -2.0136E-05  5.4309E+02  3.5268E+00 -5.8933E+00
            ELE.NO.   1601 FOR LOAD CASE     8
  901  1.1609E+01 -2.5740E+02 -1.4267E+02  7.5857E+02 -2.0179E+01  5.1597E+00
 1001  1.0421E+01 -2.4717E+02  1.4267E+02 -7.7170E+02  3.7377E+01  1.4020E+01
 1002 -1.1160E+01  2.4714E+02  1.4267E+02  7.6550E+02  1.0449E+02 -1.4018E+01
  902 -1.0870E+01  2.5744E+02 -1.4267E+02 -7.5393E+02 -8.6216E+01 -5.1575E+00

            ELE.NO.   1501 FOR LOAD CASE     1
  801  2.0538E-02 -6.2971E-02  9.3489E+00  8.2602E+01  4.5012E+00 -2.8498E-01
  901 -1.6873E-02 -2.0977E-02 -9.3489E+00 -8.2620E+01 -3.6481E+00  1.4074E-01
  902 -1.8637E-02  1.9428E-02 -9.3489E+00  8.2624E+01  3.5667E+00 -1.4074E-01
  802  1.4972E-02  6.4521E-02  9.3489E+00 -8.2680E+01 -2.7153E+00  2.8498E-01
            ELE.NO.   1501 FOR LOAD CASE     2
  801  1.7811E-04  3.5605E-04  4.8500E-01  4.2680E+00  2.1233E-01 -5.6073E-03
  901 -1.8803E-04 -1.2908E-04 -4.8500E-01 -4.2669E+00 -2.0299E-01 -9.7274E-04
  902 -1.9856E-04  1.1220E-04 -4.8500E-01  4.2684E+00  1.6967E-01  9.7283E-04
  802  2.0847E-04 -3.3917E-04  4.8500E-01 -4.2703E+00 -1.6046E-01  5.6074E-03
            ELE.NO.   1501 FOR LOAD CASE     3
  801  2.3503E-04  4.6996E-04  6.4000E-01  5.6320E+00  2.8019E-01 -7.3994E-03
  901 -2.4812E-04 -1.7020E-04 -6.4000E-01 -5.6306E+00 -2.6786E-01 -1.2837E-03
  902 -2.6201E-04  1.4793E-04 -6.4000E-01  5.6325E+00  2.2390E-01  1.2836E-03
  802  2.7510E-04 -4.4769E-04  6.4000E-01 -5.6350E+00 -2.1174E-01  7.3994E-03
            ELE.NO.   1501 FOR LOAD CASE     5
  801  9.2957E+00 -1.8640E+02  2.4823E-05  1.4611E+03  1.3976E+02 -2.1278E+01
  901  6.7084E+00 -1.8015E+02 -3.4362E-05 -1.4671E+03 -8.4474E+01  6.4170E+00
  902 -9.0185E+00  1.8005E+02 -5.9240E-05  1.4689E+03  4.3712E+01 -6.4140E+00
  802 -6.9856E+00  1.8650E+02  6.8779E-05 -1.4678E+03  1.1885E+01  2.1281E+01
            ELE.NO.   1501 FOR LOAD CASE     6
  801  1.1483E+01 -1.9215E+02 -1.5204E+02  1.5676E+02  8.3236E+01 -3.7343E+01
  901  4.8730E+00 -1.8245E+02  1.5204E+02 -1.6312E+02  6.4952E+01  3.6678E+01
  902 -1.1047E+01  1.8218E+02  1.5204E+02  1.5684E+02  7.8922E+01 -3.6677E+01
  802 -5.3082E+00  1.9242E+02 -1.5204E+02 -1.6342E+02  6.9256E+01  3.7344E+01
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  ELEMENT FORCES    FORCE,LENGTH UNITS= KIP  INCH
  --------------
    GLOBAL CORNER FORCES
JOINT      FX           FY           FZ           MX           MY           MZ
            ELE.NO.   1501 FOR LOAD CASE     7
  801 -3.7252E+00  7.8224E+01 -1.0263E-05 -6.1714E+02 -5.8624E+01  7.4457E+00
  901 -3.0314E+00  7.6529E+01  1.5596E-05  6.1876E+02  4.3820E+01  2.9623E-02
  902  3.6500E+00 -7.6502E+01  2.5765E-05 -6.2023E+02 -1.0275E+01 -3.0918E-02
  802  3.1066E+00 -7.8251E+01 -3.1099E-05  6.1990E+02 -4.6134E+00 -7.4469E+00
            ELE.NO.   1501 FOR LOAD CASE     8
  801  1.7074E+01 -3.0039E+02 -1.4157E+02  1.0933E+03  1.6937E+02 -5.1474E+01
  901  8.5326E+00 -2.8610E+02  1.4157E+02 -1.1040E+03  2.0179E+01  4.3263E+01
  902 -1.6435E+01  2.8575E+02  1.4157E+02  1.0980E+03  1.1632E+02 -4.3261E+01
  802 -9.1717E+00  3.0073E+02 -1.4157E+02 -1.1039E+03  7.3441E+01  5.1476E+01

            ELE.NO.   1401 FOR LOAD CASE     1
  701  3.5092E-02 -1.6058E-01  1.0395E+01  9.2475E+01  5.5130E+00 -4.1560E-01
  801 -2.0538E-02 -1.7276E-01 -1.0395E+01 -9.2454E+01 -4.5012E+00  1.9125E-01
  802 -3.5517E-02  1.7031E-01 -1.0395E+01  9.2495E+01  3.5739E+00 -1.9124E-01
  702  2.0963E-02  1.6303E-01  1.0395E+01 -9.2604E+01 -2.5678E+00  4.1560E-01
            ELE.NO.   1401 FOR LOAD CASE     2
  701  8.0210E-04 -6.2181E-03  4.8500E-01  4.3119E+00  2.3153E-01 -9.6332E-03
  801 -1.7811E-04 -8.0737E-03 -4.8500E-01 -4.3096E+00 -2.1233E-01  1.8336E-03
  802 -8.8109E-04  8.0274E-03 -4.8500E-01  4.3117E+00  1.6408E-01 -1.8335E-03
  702  2.5710E-04  6.2644E-03  4.8500E-01 -4.3156E+00 -1.4515E-01  9.6333E-03
            ELE.NO.   1401 FOR LOAD CASE     3
  701  1.0584E-03 -8.2053E-03  6.4000E-01  5.6899E+00  3.0553E-01 -1.2712E-02
  801 -2.3502E-04 -1.0654E-02 -6.4000E-01 -5.6869E+00 -2.8019E-01  2.4195E-03
  802 -1.1627E-03  1.0593E-02 -6.4000E-01  5.6897E+00  2.1652E-01 -2.4194E-03
  702  3.3926E-04  8.2664E-03  6.4000E-01 -5.6949E+00 -1.9154E-01  1.2712E-02
            ELE.NO.   1401 FOR LOAD CASE     5
  701  9.8031E+00 -1.7253E+02  1.1636E-06  1.0313E+03  2.2154E+02 -4.0218E+01
  801  5.2838E+00 -1.7302E+02 -2.2884E-05 -1.0302E+03 -1.3976E+02  8.8439E+00
  802 -9.8158E+00  1.7282E+02 -7.1152E-05  1.0384E+03 -4.9447E+01 -8.8406E+00
  702 -5.2712E+00  1.7273E+02  9.2873E-05 -1.0467E+03  1.3082E+02  4.0221E+01
            ELE.NO.   1401 FOR LOAD CASE     6
  701  1.4009E+01 -2.0622E+02 -3.1277E+02 -1.5342E+03  1.3765E+02 -6.7329E+01
  801  3.8291E+00 -2.0234E+02  3.1277E+02  1.5309E+03  4.2395E+01  4.0835E+01
  802 -1.3820E+01  2.0190E+02  3.1277E+02 -1.5288E+03 -9.1195E+01 -4.0835E+01
  702 -4.0176E+00  2.0665E+02 -3.1277E+02  1.5163E+03  2.7084E+02  6.7329E+01
            ELE.NO.   1401 FOR LOAD CASE     7
  701 -3.6762E+00  6.9942E+01 -6.7708E-06 -4.2064E+02 -8.1082E+01  1.2683E+01
  801 -2.4697E+00  7.0822E+01  8.4363E-06  4.1946E+02  5.8624E+01 -7.6807E-01
  802  3.7122E+00 -7.0767E+01  3.3544E-05 -4.2297E+02  2.1843E+01  7.6688E-01
  702  2.4337E+00 -6.9997E+01 -3.5209E-05  4.2610E+02 -4.4113E+01 -1.2684E+01
            ELE.NO.   1401 FOR LOAD CASE     8
  701  2.0173E+01 -3.0898E+02 -3.0125E+02 -8.2102E+02  2.8416E+02 -9.5302E+01
  801  6.6222E+00 -3.0472E+02  3.0125E+02  8.1775E+02 -4.3738E+01  4.9106E+01
  802 -1.9961E+01  3.0414E+02  3.0125E+02 -8.1082E+02 -1.1484E+02 -4.9104E+01
  702 -6.8335E+00  3.0956E+02 -3.0125E+02  7.9313E+02  3.5464E+02  9.5304E+01

            ELE.NO.   1301 FOR LOAD CASE     1
  601  2.9961E-02  8.9830E-02  1.1386E+01  9.9843E+01  6.7363E+00 -5.7048E-01
  701 -3.5093E-02  2.7717E-02 -1.1386E+01 -9.9762E+01 -5.5130E+00  1.6174E-01
  702 -3.2544E-02 -3.0656E-02 -1.1386E+01  9.9863E+01  3.2029E+00 -1.6174E-01
  602  3.7676E-02 -8.6891E-02  1.1386E+01 -1.0005E+02 -1.9913E+00  5.7048E-01
```

```
 ELEMENT FORCES    FORCE,LENGTH UNITS= KIP  INCH
 --------------
   GLOBAL CORNER FORCES
JOINT     FX          FY          FZ          MX          MY          MZ
          ELE.NO.   1301 FOR LOAD CASE     2
  601  6.9603E-04  2.9965E-03  4.8500E-01  4.2616E+00  2.6149E-01 -1.5936E-02
  701 -8.0211E-04 -5.6696E-04 -4.8500E-01 -4.2572E+00 -2.3153E-01  1.9327E-03
  702 -8.4846E-04  4.9483E-04 -4.8500E-01  4.2612E+00  1.4039E-01 -1.9327E-03
  602  9.5454E-04 -2.9243E-03  4.8500E-01 -4.2682E+00 -1.1093E-01  1.5936E-02
          ELE.NO.   1301 FOR LOAD CASE     3
  601  9.1849E-04  3.9538E-03  6.4000E-01  5.6235E+00  3.4506E-01 -2.1029E-02
  701 -1.0584E-03 -7.4843E-04 -6.4000E-01 -5.6178E+00 -3.0553E-01  2.5504E-03
  702 -1.1196E-03  6.5325E-04 -6.4000E-01  5.6230E+00  1.8526E-01 -2.5504E-03
  602  1.2596E-03 -3.8586E-03  6.4000E-01 -5.6322E+00 -1.4638E-01  2.1029E-02
          ELE.NO.   1301 FOR LOAD CASE     5
  601  9.8038E+00 -1.5782E+02 -2.5034E-05  9.6299E+02  3.2682E+02 -5.8350E+01
  701  4.2923E+00 -1.6504E+02 -2.5375E-06 -9.5388E+02 -2.2154E+02  4.6103E+00
  702 -1.0108E+01  1.6478E+02 -9.0720E-05  9.6956E+02 -1.3757E+02 -4.6077E+00
  602 -3.9881E+00  1.5807E+02  1.1829E-04 -9.8781E+02  2.4165E+02  5.8352E+01
          ELE.NO.   1301 FOR LOAD CASE     6
  601  1.3445E+01 -2.0453E+02 -3.1277E+02 -1.5250E+03  3.0044E+02 -8.1837E+01
  701  4.5715E+00 -2.0812E+02  3.1277E+02  1.5304E+03 -1.3765E+02  1.5743E+01
  702 -1.3585E+01  2.0773E+02  3.1277E+02 -1.5125E+03 -2.7051E+02 -1.5743E+01
  602 -4.4317E+00  2.0492E+02 -3.1277E+02  1.4931E+03  4.3221E+02  8.1837E+01
          ELE.NO.   1301 FOR LOAD CASE     7
  601 -3.7523E+00  6.2343E+01  1.2154E-05 -3.8245E+02 -1.1836E+02  2.0745E+01
  701 -1.8365E+00  6.5663E+01  4.4660E-06  3.7834E+02  8.1082E+01 -1.5219E+00
  702  3.8934E+00 -6.5574E+01  3.0326E-05 -3.8397E+02  4.7800E+01  1.5208E+00
  602  1.6955E+00 -6.2433E+01 -4.6946E-05  3.9131E+02 -8.4572E+01 -2.0746E+01
          ELE.NO.   1301 FOR LOAD CASE     8
  601  1.9528E+01 -2.9990E+02 -3.0026E+02 -8.3478E+02  5.1625E+02 -1.2005E+02
  701  6.9903E+00 -3.0747E+02  3.0026E+02  8.4518E+02 -2.8416E+02  1.8998E+01
  702 -1.9834E+01  3.0691E+02  3.0026E+02 -8.1720E+02 -3.5674E+02 -1.8997E+01
  602 -6.6844E+00  3.0046E+02 -3.0026E+02  7.8661E+02  5.8704E+02  1.2005E+02

          ELE.NO.   1201 FOR LOAD CASE     1
  501  6.9924E-03  2.9110E-01  1.2213E+01  1.0637E+02  7.2110E+00 -3.7236E-01
  601 -2.9960E-02  2.3496E-01 -1.2213E+01 -1.0633E+02 -6.7363E+00  1.3018E-02
  602 -9.3687E-03 -2.3666E-01 -1.2212E+01  1.0651E+02  2.5565E+00 -1.3026E-02
  502  3.2337E-02 -2.8939E-01  1.2212E+01 -1.0660E+02 -2.0874E+00  3.7236E-01
          ELE.NO.   1201 FOR LOAD CASE     2
  501 -7.4366E-05  1.0096E-02  4.8500E-01  4.2315E+00  2.7038E-01 -9.8467E-03
  601 -6.9602E-04  7.5484E-03 -4.8500E-01 -4.2294E+00 -2.6149E-01 -2.6786E-03
  602 -3.5483E-05 -7.5805E-03 -4.8500E-01  4.2361E+00  1.0813E-01  2.6784E-03
  502  8.0587E-04 -1.0064E-02  4.8500E-01 -4.2390E+00 -9.9457E-02  9.8465E-03
          ELE.NO.   1201 FOR LOAD CASE     3
  501 -9.8124E-05  1.3323E-02  6.4000E-01  5.5839E+00  3.5679E-01 -1.2994E-02
  601 -9.1849E-04  9.9613E-03 -6.4000E-01 -5.5811E+00 -3.4506E-01 -3.5346E-03
  602 -4.6834E-05 -1.0003E-02 -6.4000E-01  5.5900E+00  1.4268E-01  3.5343E-03
  502  1.0635E-03 -1.3281E-02  6.4000E-01 -5.5937E+00 -1.3124E-01  1.2993E-02
          ELE.NO.   1201 FOR LOAD CASE     5
  501  4.7851E+00 -8.4695E+01 -5.0507E-05  3.4147E+02  3.5317E+02 -3.5708E+01
  601  2.9161E+00 -9.1692E+01  2.5707E-05 -3.3574E+02 -3.2682E+02 -1.4440E+01
  602 -5.0865E+00  9.1598E+01 -7.5737E-05  3.6294E+02 -2.9632E+02  1.4442E+01
  502 -2.6148E+00  8.4790E+01  1.0054E-04 -3.7095E+02  3.2206E+02  3.5709E+01
```

```
 ELEMENT FORCES    FORCE,LENGTH UNITS= KIP  INCH
 --------------
   GLOBAL CORNER FORCES
JOINT      FX          FY          FZ          MX          MY          MZ
                ELE.NO.   1201 FOR LOAD CASE     6
  501  8.6984E+00 -1.1977E+02 -3.1277E+02 -2.2770E+03  3.5293E+02 -6.5595E+01
  601  2.0383E+00 -1.2614E+02  3.1277E+02  2.2816E+03 -2.6947E+02  2.2614E+00
  602 -8.9631E+00  1.2583E+02  3.1277E+02 -2.2494E+03 -4.6730E+02 -2.2615E+00
  502 -1.7736E+00  1.2007E+02 -3.1277E+02  2.2376E+03  5.5004E+02  6.5595E+01
                ELE.NO.   1201 FOR LOAD CASE     7
  501 -1.8718E+00  3.2996E+01  1.8699E-05 -1.3368E+02 -1.2881E+02  1.3299E+01
  601 -1.1332E+00  3.5831E+01 -1.0780E-05  1.3136E+02  1.1836E+02  4.8647E+00
  602  1.9940E+00 -3.5793E+01  2.6270E-05 -1.4117E+02  1.0646E+02 -4.8653E+00
  502  1.0111E+00 -3.3033E+01 -3.4189E-05  1.4440E+02 -1.1666E+02 -1.3300E+01
                ELE.NO.   1201 FOR LOAD CASE     8
  501  1.1618E+01 -1.7116E+02 -2.9943E+02 -1.9530E+03  5.8512E+02 -8.8398E+01
  601  3.7897E+00 -1.8175E+02  2.9943E+02  1.9611E+03 -4.8528E+02 -7.3081E+00
  602 -1.2065E+01  1.8138E+02  2.9943E+02 -1.9113E+03 -6.5435E+02  7.3087E+00
  502 -3.3431E+00  1.7152E+02 -2.9943E+02  1.8946E+03  7.5312E+02  8.8398E+01

                ELE.NO.   1101 FOR LOAD CASE     1
  401 -3.9666E-02  5.7488E-01  1.2873E+01  1.1112E+02  6.8646E+00 -2.6203E-02
  501 -6.9917E-03  4.9377E-01 -1.2873E+01 -1.1105E+02 -7.2110E+00 -3.1114E-01
  502  3.6070E-02 -4.9250E-01 -1.2873E+01  1.1126E+02  2.4953E+00  3.1113E-01
  402  1.0588E-02 -5.7615E-01  1.2873E+01 -1.1130E+02 -2.8467E+00  2.6194E-02
                ELE.NO.   1101 FOR LOAD CASE     2
  401 -1.6835E-03  2.0140E-02  4.8500E-01  4.1938E+00  2.5122E-01  1.8692E-03
  501  7.4357E-05  1.6714E-02 -4.8500E-01 -4.1907E+00 -2.7038E-01 -1.3860E-02
  502  1.5308E-03 -1.6644E-02 -4.8500E-01  4.1983E+00  9.5895E-02  1.3860E-02
  402  7.8275E-05 -2.0210E-02  4.8500E-01 -4.1997E+00 -1.1526E-01 -1.8694E-03
                ELE.NO.   1101 FOR LOAD CASE     3
  401 -2.2215E-03  2.6576E-02  6.4000E-01  5.5341E+00  3.3150E-01  2.4667E-03
  501  9.8124E-05  2.2056E-02 -6.4000E-01 -5.5299E+00 -3.5679E-01 -1.8290E-02
  502  2.0200E-03 -2.1963E-02 -6.4000E-01  5.5400E+00  1.2654E-01  1.8289E-02
  402  1.0328E-04 -2.6669E-02  6.4000E-01 -5.5419E+00 -1.5209E-01 -2.4671E-03
                ELE.NO.   1101 FOR LOAD CASE     5
  401 -9.3087E-01 -5.4814E+01 -3.7971E-05  2.3187E+02  2.7382E+02  9.1043E+00
  501  6.1743E+00 -6.5281E+01  5.3217E-05 -2.2205E+02 -3.5317E+02 -5.5917E+01
  502  4.6124E-01  6.5570E+01 -2.7820E-05  2.5198E+02 -3.3247E+02  5.5919E+01
  402 -5.7047E+00  5.4524E+01  1.2575E-05 -2.5485E+02  2.5257E+02 -9.1036E+00
                ELE.NO.   1101 FOR LOAD CASE     6
  401  4.6202E+00 -8.9567E+01 -3.1277E+02 -2.3882E+03  3.7037E+02 -4.2879E+01
  501  3.6885E+00 -1.0073E+02  3.1277E+02  2.3976E+03 -3.5293E+02 -2.8999E+01
  502 -5.1050E+00  1.0067E+02  3.1277E+02 -2.3577E+03 -5.6055E+02  2.8998E+01
  402 -3.2037E+00  8.9629E+01 -3.1277E+02  2.3468E+03  5.7710E+02  4.2879E+01
                ELE.NO.   1101 FOR LOAD CASE     7
  401  2.5702E-01  2.1204E+01  1.3044E-05 -9.0086E+01 -1.0059E+02 -3.0220E+00
  501 -2.2874E+00  2.5300E+01 -1.7646E-05  8.6271E+01  1.2881E+02  2.0115E+01
  502 -7.3664E-02 -2.5404E+01  9.2558E-06 -9.7169E+01  1.2080E+02 -2.0115E+01
  402  2.1041E+00 -2.1101E+01 -4.6539E-06  9.8510E+01 -9.2351E+01  3.0217E+00
                ELE.NO.   1101 FOR LOAD CASE     8
  401  3.9028E+00 -1.2256E+02 -2.9877E+02 -2.1256E+03  5.5105E+02 -3.6819E+01
  501  7.5686E+00 -1.4018E+02  2.9877E+02  2.1411E+03 -5.8513E+02 -6.5145E+01
  502 -4.6778E+00  1.4031E+02  2.9877E+02 -2.0819E+03 -7.6951E+02  6.5146E+01
  402 -6.7935E+00  1.2243E+02 -2.9877E+02  2.0695E+03  7.3421E+02  3.6819E+01
```

```
 ELEMENT FORCES    FORCE,LENGTH UNITS= KIP  INCH
 --------------
   GLOBAL CORNER FORCES
JOINT      FX           FY           FZ           MX           MY           MZ
             ELE.NO.   1001 FOR LOAD CASE     1
  201 -1.1976E-01  1.0346E+00  1.3534E+01  1.1464E+02  5.0051E+00  6.6048E-01
  401  3.9666E-02  7.9983E-01 -1.3534E+01 -1.1623E+02 -6.8647E+00 -7.9851E-01
  402  1.0923E-01 -7.9333E-01 -1.3534E+01  1.1638E+02  3.2913E+00  7.9850E-01
  202 -2.9133E-02 -1.0411E+00  1.3534E+01 -1.1464E+02 -5.0051E+00 -6.6049E-01
             ELE.NO.   1001 FOR LOAD CASE     2
  201 -4.5177E-03  3.7754E-02  4.8500E-01  4.0995E+00  1.7899E-01  2.5408E-02
  401  1.6835E-03  2.7160E-02 -4.8500E-01 -4.1765E+00 -2.5122E-01 -3.0718E-02
  402  4.0442E-03 -2.6910E-02 -4.8500E-01  4.1825E+00  1.1375E-01  3.0717E-02
  202 -1.2100E-03 -3.8004E-02  4.8500E-01 -4.0995E+00 -1.7899E-01 -2.5408E-02
             ELE.NO.   1001 FOR LOAD CASE     3
  201 -5.9614E-03  4.9819E-02  6.4000E-01  5.4096E+00  2.3619E-01  3.3528E-02
  401  2.2215E-03  3.5840E-02 -6.4000E-01 -5.5113E+00 -3.3150E-01 -4.0535E-02
  402  5.3367E-03 -3.5510E-02 -6.4000E-01  5.5192E+00  1.5010E-01  4.0534E-02
  202 -1.5967E-03 -5.0149E-02  6.4000E-01 -5.4096E+00 -2.3619E-01 -3.3528E-02
             ELE.NO.   1001 FOR LOAD CASE     5
  201 -1.0943E+01 -4.7696E+00  6.0459E-05 -1.0166E+01 -4.4385E-01  9.8747E+01
  401  1.2506E+01 -3.1038E+01  3.3431E-05 -1.4173E+02 -2.7382E+02 -1.1938E+02
  402  9.7537E+00  3.2010E+01  3.8222E-05  1.6506E+02 -2.6042E+02  1.1938E+02
  202 -1.1317E+01  3.7979E+00 -1.3211E-04  1.0165E+01  4.4382E-01 -9.8747E+01
             ELE.NO.   1001 FOR LOAD CASE     6
  201 -2.3503E+01 -3.0306E+01 -3.1277E+02 -2.6738E+03 -1.1674E+02  2.1984E+02
  401  2.7554E+01 -6.2474E+01  3.1277E+02  2.4875E+03 -4.8722E+02 -2.6578E+02
  402  2.2004E+01  6.4637E+01  3.1277E+02 -2.4356E+03 -7.0217E+02  2.6578E+02
  202 -2.6055E+01  2.8142E+01 -3.1277E+02  2.6738E+03  1.1674E+02 -2.1984E+02
             ELE.NO.   1001 FOR LOAD CASE     7
  201  4.0112E+00  1.8371E+00 -2.2323E-05  3.8188E+00  1.6673E-01 -3.6230E+01
  401 -4.6144E+00  1.1978E+01 -1.3196E-05  5.4802E+01  1.0059E+02  4.3801E+01
  402 -3.5528E+00 -1.2335E+01 -1.6940E-05 -6.3360E+01  9.5427E+01 -4.3801E+01
  202  4.1560E+00 -1.4806E+00  5.2459E-05 -3.8186E+00 -1.6673E-01  3.6230E+01
             ELE.NO.   1001 FOR LOAD CASE     8
  201 -3.0565E+01 -3.2116E+01 -2.9811E+02 -2.5560E+03 -1.1160E+02  2.8308E+02
  401  3.5489E+01 -8.0671E+01  2.9811E+02  2.2747E+03 -6.6790E+02 -3.4223E+02
  402  2.8323E+01  8.3456E+01  2.9811E+02 -2.2078E+03 -8.6361E+02  3.4223E+02
  202 -3.3248E+01  2.9330E+01 -2.9811E+02  2.5560E+03  1.1160E+02 -2.8308E+02
  241. *
  242. FINISH
```

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ATTACHMENT B
Digester 12 Calculations

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SAN JOSE / SANTA CLARA WATER POLLUTION CONTROL PLANT -- CIRCULAR CONCRETE SLUDGE DIGESTERS 12 to 16 -- UNSUBMERGED CASE

DESIGN DATA AND ASSUMPTIONS

DIMENSIONS

Tank inside diameter $D := 110.0 \cdot ft$

Top of Footing $y_f := 0.5 \cdot ft$

Top of Wall $y_r := 40.5 \cdot ft$

Maximum sludge surface elevation $y_w := 38.5 \cdot ft$

Tank height $Y_r := y_r - y_f$ $Y_r = 40\,ft$

Shell wall thickness $t_w := 14 \cdot in$

Footing toe width (outside wall) $b_{fe} := 3.33 \cdot ft$

Footing thickness (floor slab is footing) $t_f := 24.0 \cdot in$

Water table elevation $y_g := 4.5 \cdot ft$

Maximum water height $H := y_w - y_f$ $H = 38\,ft$

Capacity of tank $Q := \frac{\pi}{4} \cdot D^2 \cdot H$ $Q = 2701411\,gal$

DESIGN LOADS

Dead load

Unit weight of concrete $\gamma_c := 150 \cdot \frac{lbf}{ft^3}$

Unit weight of soil $\gamma_s := 130 \cdot \frac{lbf}{ft^3}$

Unit weight of sludge $\gamma_w := 70 \cdot \frac{lbf}{ft^3}$

Unit dead weight of roof $\sigma_{rd} := 175 \cdot \frac{lbf}{ft^2}$

Design live load $\sigma_l := 20 \cdot \frac{lbf}{ft^2}$

REINFORCED CONCRETE PROPERTIES

$kip := lbf \cdot 1000$

Reinforcement yield stress $f_y := 60 \cdot \frac{kip}{in^2}$

Concrete compressive stress $f_c := 4.0 \cdot \frac{kip}{in^2}$

Concrete Young's Modulus $E_c := 3600 \cdot \frac{kip}{in^2}$

SEISMIC ACCELERATIONS

$r := \frac{D}{2}$

$C_a := 0.528$ Ref.: UBC, Tables 16-S and 16-Q and UBC-California maps (~ 5km. from Type 'A' fault); assumed Type 'S_D' soil

$I := 1.25$

$S_s := 1.0$ Ref.: .

$g = 32 \frac{ft}{s^2}$ gravitational acceleration

$W_w := \gamma_w \cdot Q$ $W_w = 25279\,kip$ weight of contained water

$W_s := \gamma_c \cdot \pi \cdot (t_w \cdot Y_r) \cdot D$ $W_s = 2419\,kip$ weight of shell

$W_r := (\sigma_{rd} \cdot \pi \cdot r^2)$

$W_r = 1663\,kip$ weight of roof

$W_t := (W_s + W_r + W_w)$ $W_t = 29361\,kip$

$\alpha_{ca} := 45 \cdot deg$ angle of inclination of steel connection strands used at base

$A_{ca} := 0.331 \cdot in^2$ area of connection strands, ((3) 3/8" 7-wire strands)

$G_{pd} := 135 \cdot \frac{lbf}{in^2}$ shear modulus of bearing pads

$\lambda_{pd} := 1.0$

$b_{pd} := 5.5 \cdot in$

$E_s := 29000 \cdot \frac{kip}{in^2}$ modulus of elasticity of steel strands

$s_{ca} := 30 \cdot in$ spacing of diagonal strands at base; initial trial

$L_{sl} := 15 \cdot in$ sleeve length at cables

$L_{ca} := L_{sl} + 18 \cdot in$ $L_{ca} = 33\,in$

$t_{pd} := 1.5 \cdot in$

Horizontal - impulsive seismic load - AWWA method

Ref.: AWWA, Ch. 4

$$W_i := \frac{\tanh\left(3^{0.5} \cdot \frac{r}{H}\right) \cdot W_w}{\frac{3^{0.5} \cdot r}{H}} \qquad W_i = 9951\,kip$$

weight of water which moves in concert with tank

$$k_j := 144 \cdot \left(\frac{A_{ca} \cdot E_s \cdot \cos(\alpha_{ca})^2}{L_{ca} \cdot s_{ca}} + \frac{2 \cdot G_{pd} \cdot b_{pd} \cdot \lambda_{pd}}{t_{pd}}\right) \qquad k_j = 841\,\frac{kip}{in^2}$$

Ref AWWA, Eq. 4-9

$T_i := 0.10$ (SEE BELOW)

$T_i = 0.100$ $\quad T_{ii} := \frac{T_i}{sec}$ period of vibration of tank

$C_{it} := (1.25 \cdot S_s) / [T_{ii}]^{0.667}$

$C_{it} := 5.80$ $\quad C_{it} = 6$

$C_i := \min(2.75, C_{it})$ $\quad C_i = 2.75$

$R_i := 4.5$ Ref: AWWA, Table 4 Tank with anchored, flexible base

$\alpha_i := \frac{C_a \cdot I \cdot C_i}{R_i}$ EQ 4-4

$\alpha_i = 0.403$ Horizontal-impulsive seismic acceleration as proportion of gravitational

---

$T_I = 2\pi / \omega_I$ $\quad C_L = C_W \times 10 \sqrt{\frac{t_w}{12r}}$

$\omega_I = C_L \times 12/H \sqrt{\frac{E_c}{\rho_c}}$; $\quad r/H = \frac{55}{38} = 1.45$

$\rightarrow C_W = 0.15$ (Fig. 6)

$C_L = 0.15 \times 10 \sqrt{\frac{14.0}{12 \times 55}} = 0.219$

$\omega_I = 0.219 \times \frac{12}{38} \sqrt{\frac{3{,}600 \times 10^3 \text{ lb/in}^2}{4.66 \text{ lb-s}^2/\text{ft}^4}}$

$\omega_I = 60.78$ rad/sec

$T_I = 2\pi / 60.78 \text{ rad/sec} = \underline{0.10 \text{ sec}} < 0.3 \text{ sec}$

Horizontal - convective seismic load - AWWA method

$$W_c := \tanh\left(3.375^{0.5} \cdot \frac{H}{r}\right) \cdot \frac{3.375^{0.5} \cdot r W_w}{4 \cdot H}$$ $W_c = 14344\ \text{kip}$ weight of water which moves in waves

$$T_c := \left(\frac{r}{1.5 \cdot \tanh\left(3.375^{0.5} \cdot \frac{H}{r}\right) \cdot \text{ft}}\right)^{0.5} \cdot \text{sec}$$

$T_c = 6.55\ \text{s}$ $\quad T_{ci} := \frac{T_c}{\text{sec}}$ period of vibration of water waves

$C_c := \frac{6 \cdot S_s}{T_{ci}^{\ 2}}$ $\quad C_c = 0.140$

$R_c := 1$

$$Y_c := H \cdot \left[1 - \left[\frac{\cosh\left(3.375^{0.5} \cdot \frac{H}{r}\right) - 1}{\left(3.375^{0.5} \cdot \frac{H}{r}\right) \cdot \sinh\left(3.375^{0.5} \cdot \frac{H}{r}\right)}\right]\right]$$ $Y_c = 21\ \text{ft}$

$\alpha_c := \frac{C_a \cdot I \cdot C_c}{R_c}$ $\quad \alpha_c = 0.092$ Horizontal-convective seismic acceleration as proportion of gravitational

Vertical seismic load - AWWA

Ref.: AWWA, Sec. 4.5

$C_v := 2.75$

$R_v := 3.0$

$B := 0.66$ For Zone 4

$\beta := \frac{C_a \cdot I \cdot C_v}{R_v} \cdot B$ $\beta = 0.399$ Vertical seismic acceleration as proportion of gravitational

SHELL WALL

STATIC-LOAD CASE

$D = 110.0\,\text{ft}$ tank diameter

$H = 38.0\,\text{ft}$ water depth

$t_w = 14.0\,\text{in}$ ***wall thickness***

Circumferential compression force in wall, required

$$f_c = 4.0\,\frac{\text{kip}}{\text{in}^2}$$

$$\omega_{sw} := \left(\frac{\gamma_w \cdot D \cdot H}{2}\right) \qquad \omega_{sw} = 146\,\frac{\text{kip}}{\text{ft}}$$

prestress force in circumferential direction required for static loading considerations

Assumed: that prestress strand stress after all losses is: $f_{pss} := 150 \cdot \frac{\text{kip}}{\text{in}^2}$ *

Required strand area at base is: $A_{psr} := \frac{\omega_{sw}}{f_{pss}}$ $\quad A_{psr} = 0.975\,\frac{\text{in}^2}{\text{ft}}$

$\sigma_{crd} := 200 \cdot \frac{\text{lbf}}{\text{in}^2}$ required minimum residual compression hoop stress in shell, empty tank; Ref.: AWWA D110, Sec. 3.5.2

$\omega_{sd} := \sigma_{crd} \cdot t_w$ $\quad \omega_{sd} = 34\,\frac{\text{kip}}{\text{ft}}$ Provide for $\boldsymbol{\omega_{sd}}$ at top of shell and $\boldsymbol{\omega_{sw}}$ at bottom of shell

* $f_{pss_{MAX}} = 0.65F_u = 0.65 \times 240\,ksi = 156\,ksi$
(AWWA 3.4.2.3)

USE 150 ksi

SEISMIC-LOAD CASE

Base shear and overturning moment - AWWA method

$$V_i := \alpha_i \cdot (W_t - W_w + W_i)$$

$V_i = 5660\,\text{kip}$ impulsive-load base shear

$Y_s := \frac{Y_r}{2}$ $Y_s = 20\,\text{ft}$

$Y_i := 0.375 \cdot H$ $Y_i = 14\,\text{ft}$

$$M_i := \alpha_i \cdot (W_s \cdot Y_s + W_r \cdot Y_r + W_i \cdot Y_i)$$

$M_i = 103535\,\text{ft} \cdot \text{kip}$ impulsive-load overturning moment at base

$Y_c = 21\,\text{ft}$

$V_c := \alpha_c \cdot W_c$ $V_c = 1322\,\text{kip}$ convective-load base shear

$M_c := V_c \cdot Y_c$ $M_c = 28031\,\text{ft} \cdot \text{kip}$ convective-load overturning moment at base

$V_q := \text{hyp}(V_c, V_i)$ $V_q = 5812\,\text{kip}$ total seismically-generated shear at base

$M_q := \text{hyp}(M_c, M_i)$ $M_q = 107262\,\text{ft}\,\text{kip}$ total seismically-generated overturning moment at base

Shell shear capacity - AWWA method

$f_{ci} := 1000 f_c \cdot \frac{in^2}{kip}$ $f_{ci} = 4000$

$V_{scq1} := 1.1 \cdot 1.25 \cdot f_{ci}^{0.5} \cdot \frac{lbf}{in^2} \cdot t_w \cdot 2 \cdot D$ Ref.: AWWA D110, Sec. 4.6.1

$V_{scq1} = 3214\,kip$ $if(V_{scq1} > V_q, 1, 0) = 0$ need wall reinforcement

Provide wall reinforcement : # 6 bars, @ : $s_{wb1a} := 12 \cdot in$

Provide wall reinforcement : # 5 bars, @ : $s_{wb1b} := 12 \cdot in$

#6: $A_{b4i} := 0.44 \cdot in^2$

#5: $A_{b5i} := 0.31 \cdot in^2$

$A_{wb1} := \frac{A_{b4i}}{s_{wb1a}} + \frac{A_{b5i}}{s_{wb1b}}$ $A_{wb1} = 0.75 \frac{in^2}{ft}$

$f_{sra} := 18 \frac{kip}{in^2}$ allowable reinf. tensile stress; Ref.: AWWA D110, Sec. 3.5.6

$V_{srq1} := f_{sra} \cdot 2 \cdot D \cdot A_{wb1}$ $V_{srq1} = 2970\,kip$ Additional shear capy. due to reinf.

$V_{sq1} := \min(V_{scq1} + V_{srq1}, 5.0 \cdot V_{scq1})$ Ref.: AWWA D110, Sec. 3.4.1

$V_{sq1} = 6184\,kip$ $if(V_{sq1} > V_q, 1, 0) = 1$ (OK)

Water waves and freeboard - AWWA method

$Y_{frp} := y_r - y_w$ $\qquad Y_{frp} = 2.0\,\text{ft}$

$H_{wq1} := C_a \cdot I \cdot C_c \cdot r$ $\qquad H_{wq1} = 5.07\,\text{ft}$

$$H_{wq2} := \frac{\coth\left(3.375^{0.5} \cdot \frac{H}{r}\right) \cdot 3 \cdot r}{\left(\frac{6 \cdot T_{ci}^{\,2}}{C_a \cdot I \cdot C_c \cdot r_i}\right) - 54^{0.5}} \qquad H_{wq2} = 4.45\,\text{ft}$$

$H_{wq} := \min\left(H_{wq1}, H_{wq2}\right)$ $\qquad H_{wq} = 4.45\,\text{ft}$ design seismic water wave height

$\text{if}\left(Y_{frp} > H_{wq}, 1, 0\right) = 0$ waves will hit roof

Seismic hoop forces at base of wall - AWWA method (N/A)

$$\omega_{nim} := \frac{\alpha_i\left(\frac{W_s}{2} + W_r + W_i\right)\cdot\left(4 - \frac{6\cdot Y_i}{H}\right)}{\pi\cdot H}$$

$$\omega_{nim} = 76\,\frac{kip}{ft}$$

maximum impulsive seismic hoop tension in shell, which occurs at base of tank; Assumed: trapezoidal distribution

$$\omega_{ncn} := \frac{8\alpha_c W_c\cdot\left(4 - \frac{6Y_c}{H}\right)}{9\cdot\pi\cdot H}$$

$$\omega_{ncn} = 6\,\frac{kip}{ft}$$

convective seismic hoop tension in shell occurring at base; Assumed: trapezoidal distribution

$$\omega_{nvm} := \beta\cdot\gamma_w\cdot H\cdot r \qquad \omega_{nvm} = 58\,\frac{kip}{ft}$$

maximum vertically-induced seismic hoop tension in shell, which occurs at base of tank; Assumed: triangular distribution of stresses

$$\omega_{qm} := \omega_{sw} + \mathrm{hyp}\left(\mathrm{hyp}\left(\omega_{nim}, \omega_{ncn}\right), \omega_{nvm}\right)$$

combines statically- and seismically-induced hoop stresses in wall

$$\omega_{qm} = 242\,\frac{kip}{ft}$$

maximum circumferential tension at base of shell during earthquake, due to combination of static and earthquake loads; provide at least enough prestress force at base to account for this case, assumed:

* $f_{psq} := 195\cdot\frac{kip}{in^2}$

prestress strand stress developed in earthquake-load case

$$A_{sqr} := \frac{\omega_{qm}}{f_{psq}} \qquad A_{sqr} = 1.242\,\frac{in^2}{ft}$$

Note that this amount is more than that required for static loads

Use "virtual" prestress force: $\omega_{qv} := A_{sqr}\cdot f_{psq}$ $\quad \omega_{qv} = 242\,\frac{kip}{ft}$ at base

* $f_{psq} = 1.25 \times 0.65 \times F_u$
$= 1.25 \times 0.65 \times 240ksi = \underline{195 ksi}$

Seismic hoop forces at top of wall - AWWA method

$$\omega_{nin} := \frac{\alpha_i\left(\frac{W_s}{2} + W_r + W_i\right)\cdot\left(\frac{6\cdot Y_i}{H} - 2\right)}{\pi\cdot H}$$

$$\omega_{nin} = 11\,\frac{kip}{ft}$$

minimum impulsive seismic hoop tension in shell, which occurs at top of wall

$$\omega_{ncm} := \frac{8\alpha_c W_c\cdot\left(\frac{6\cdot Y_c}{H} - 2\right)}{9\cdot\pi H}$$

$$\omega_{ncm} = 13\,\frac{kip}{ft}$$

maximum convective seismic hoop tension in shell, which occurs at top

$$\omega_{qt} := \omega_{nin} + \omega_{ncm}$$

$$\omega_{qt} = 24\,\frac{kip}{ft}$$

maximum circumferential tension at top of shell during earthquake; since ω_{sd} is more than this, provide at least that much prestress force at top

Vertical forces at wall base, seismic-load case - AWWA method

$$\omega_w := \left(Y_r \cdot t_w\right)$$

$$\sigma_g := -94.0 \cdot \frac{\text{lbf}}{\text{ft}^2}$$ gas upward pressure

$$\omega_{qc} := \left(\omega_w \cdot \gamma_c + \frac{\sigma_{rd} \cdot r}{2}\right) + \text{hyp}\left[\frac{1.273 \cdot M_q}{D^2}, \left(\omega_w \cdot \gamma_c + \frac{\sigma_{rd} \cdot r}{2}\right) \cdot \beta\right]$$

$$\omega_{qc} = 24.04 \frac{\text{kip}}{\text{ft}}$$

$$\omega_{qt} := \left[\omega_w \cdot \gamma_c + \frac{\left(\sigma_{rd} + \sigma_g\right) \cdot r}{2}\right] - \text{hyp}\left[\frac{1.273 \cdot M_q}{D^2}, \left(\omega_w \cdot \gamma_c + \frac{\sigma_{rd} \cdot r}{2}\right) \cdot \beta\right]$$

maximum tension (if < 0) or minimum compression (if > 0) force at base, seismic-load case

$$\omega_{qt} = -3.00 \frac{\text{kip}}{\text{ft}}$$ **Note that this value is LESS than zero; i.e., net UPLIFT OCCURS at wall-wall joint.**

Compare with reinforcement capacity at same location

$$\phi_t := 0.90$$

$$\omega_{tr2} := f_y \cdot \phi_t \cdot A_{wb1} \qquad \omega_{tr2} = 40.5 \frac{\text{kip}}{\text{ft}}$$

Vertical forces at top of wall, seismic-load case

$$\omega_{qct} := \left(\frac{\sigma_{rd} \cdot r}{2}\right) + \left(\frac{\sigma_{rd} \cdot r}{2}\right) \cdot \beta$$

$$\omega_{qct} = 6.73 \frac{kip}{ft}$$

$$\omega_{qtt} := \left[\frac{(\sigma_{rd} + \sigma_g) \cdot r}{2}\right] - \left[\left(\frac{\sigma_{rd} \cdot r}{2}\right) \cdot \beta\right]$$

maximum tension (if < 0) or minimum compression (if > 0) force at base, seismic-load case

$\omega_{qtt} = 0.31 \frac{kip}{ft}$ **>0, No net uplift**

Compare with reinforcement capacity at same location

$\omega_{tr1} := f_y \cdot \phi_t \cdot A_{wb1}$ $\omega_{tr1} = 40.5 \frac{kip}{ft}$

Vertical forces at top of wall, normal-load case

$$\omega_{nct} := \left(\frac{\sigma_{rd} \cdot r}{2}\right) \qquad \omega_{nct} = 4.81 \, \frac{kip}{ft}$$

$$\omega_{ntt} := \left[\frac{\left(\sigma_{rd} + \sigma_g\right) \cdot r}{2}\right]$$

$\omega_{ntt} = 2.23 \, \frac{kip}{ft}$ **>0, no net uplift.**

$$\sigma_{ntt} := \frac{\omega_{ntt}}{t_w} \qquad \sigma_{ntt} = 13.3 \, \frac{lbf}{in^2}$$

EMPTY-TANK CASE

Residual concrete compressive hoop stress at base due to prestressing, empty-tank case:

$f_{cer} := \frac{\omega_{qv}}{t_w}$ $\qquad$ $f_{cer} = 1442 \frac{lbf}{in^2}$

Concrete compressive hoop stress at base due to soil active pressure:

$\gamma_{sa} := 65 \cdot \frac{lbf}{ft^3}$ $\qquad$ active pressure fluid equiv.

$Y_e := 8 \cdot ft$ $\qquad$ soil embedment depth

$Y_g := y_g - y_f$ $\qquad$ $Y_g = 4\,ft$ $\qquad$ vertical distance from highest possible water table to base of wall

$f_{cs} := \frac{(\gamma_{sa} \cdot Y_e + \gamma_w \cdot Y_g) \cdot r}{t_w}$ $\qquad$ $f_{cs} = 262 \frac{lbf}{in^2}$

Any compression force due to soil loading will lead to a corresponding relaxation of prestress strands; therefore, the two types of loads do not act in superposition.

Maximum compressive hoop stress:

$f_{ce} := \max(f_{cs}, f_{cer})$ $\qquad$ $f_{ce} = 1442 \frac{lbf}{in^2}$

Concrete allowable compr. stress: $\qquad$ $f_{cr} := 0.45 \cdot f_c$

$f_{cr} = 1800 \frac{lbf}{in^2}$ $\qquad$ $\text{if}(f_{cr} > f_{ce}, 1, 0) = 1$ $\qquad$ (OK)

Provide wall thickness: $\qquad$ $t_w = 14\,in$

RING FOUNDATION

STATIC-LOAD SOIL BEARING

$b_{fe} = 3.3\,\text{ft}$ Use $b_f := 4.5\cdot\text{ft}$ $b_f = 4.5\,\text{ft}$

$\sigma_l := \dfrac{W_t}{\pi\cdot(r + b_{fe})^2}$ $\sigma_l = 2.75\,\dfrac{\text{kip}}{\text{ft}^2}$

$\omega_{fd} := \left[(\omega_w + b_f\cdot t_f)\cdot\gamma_c + \dfrac{\sigma_{rd}\cdot r}{2}\right]$ $\omega_{fd} = 13.2\,\dfrac{\text{kip}}{\text{ft}}$ dead weight of tank carried by ring footing, per unit length of wall

$b_{fn} := \left(b_f - \dfrac{t_w}{2}\right)$ $b_{fn} = 3.92\,\text{ft}$ portion of footing width inside tank wall

$\omega_{ws} := H\cdot\gamma_w\cdot b_{fn}$ $\omega_{ws} = 10.4\,\dfrac{\text{kip}}{\text{ft}}$ weight of water carried by ring footing, per unit length of wall

$$x_{fd} := \left[\left(Y_r\cdot t_w\cdot b_{fn} + b_f\cdot t_f\cdot\frac{b_f}{2}\right)\cdot\gamma_c + \frac{\sigma_{rd}\cdot\left(b_{fn} + \frac{t_w}{2}\right)\cdot r}{2}\right]\cdot\frac{1}{\omega_{fd}}$$

$x_{fd} = 3.96\,\text{ft}$ location of centroid of concrete dead load on footing

$x_{ws} := \dfrac{b_{fn}}{2}$ $x_{ws} = 1.96\,\text{ft}$ location of centroid of water bearing on footing

$\omega_{fl} := \sigma_l\cdot b_f$ $\omega_{fl} = 0.1\,\dfrac{\text{kip}}{\text{ft}}$

$x_{fl} := \left(\dfrac{b_{fn}}{2}\right)$ $x_{fl} = 1.96\,\text{ft}$

$$x_{fl} := \frac{\omega_{fd} \cdot x_{fd} + \omega_{ws} \cdot x_{ws} + \omega_{fl} \cdot x_{fl}}{\omega_{fd} + \omega_{ws} + \omega_{fl}} \qquad x_{fl} = 3.07\,\text{ft}$$

location of net centroid

$y_{sa} := \cancel{13.5}\,\text{ft}$ 10.0 —— SOIL DEPTH TO BOTTOM OF FOOTING

$$\sigma_{ssa} := \cancel{2.00}\ 3.00\,\frac{\text{kip}}{\text{ft}^2} + y_{sa} \cdot \gamma_s \qquad \sigma_{ssa} = \cancel{3.8}\ 4.3\,\frac{\text{kip}}{\text{ft}^2}$$

allowable soil bearing stress

Since ring-foundation is rigidly connected to rest of foundation, ignore eccentricity in considering soil-bearing pressure; however, consider transferred bending moment in design of floor slab.

$$\sigma_{ss} := \frac{\omega_{fd} + \omega_{ws} + \omega_{fl}}{b_f} \qquad \sigma_{ss} = 5.26\,\frac{\text{kip}}{\text{ft}^2}$$

$$\text{if}\left(\sigma_{ssa} > \sigma_{ss}, 1, 0\right) = 0$$

~~(OK)~~

$$D/C = \frac{5.26\,\text{ksf}}{4.3\,\text{ksf}} = \underline{\underline{1.22}}\ \underline{NG}$$

$$m_{ss} := \left(\omega_{fd} + \omega_{ws} + \omega_{fl}\right) \cdot \left(\frac{\frac{b_f}{2} - x_{fl}}{2}\right) \qquad m_{ss} = -9.7\,\frac{\text{kip} \cdot \text{ft}}{\text{ft}}$$

$m_{ssu} := 1.7 \cdot m_{ss}$ bending moment to be transferred to rest of floor slab

Use $d_{fb} := t_f - 8.7\text{in}$ $d_{fb} = 15\,\text{in}$

$$\xi := 0.85 \cdot \frac{f_c}{f_y} \qquad \xi = 0.056667$$

$$\Phi_f := 0.90$$

$$\psi := \frac{2 \cdot 1.3 \cdot 0.85 f_c}{\Phi_f {f_y}^2} \qquad \psi = 0.002728\,\frac{\text{in}^2}{\text{kip}}$$

factor ***1.3*** is for reinforcement in water resources structures; Ref: ACI 350, Sect. 2.6.5

Required reinforcement ratio as a function of moment per unit width and of effective depth

$$\rho\left(M_a, d_j, b_s\right) := \xi - \frac{\left[\left(\xi \cdot d_j\right)^2 - \psi \cdot \frac{M_a}{b_s}\right]^{0.5}}{d_j}$$

$$\rho_{ssu} := \xi - \frac{\left[\left(\xi \cdot d_{fb}\right)^2 - \psi \cdot m_{ssu}\right]^{0.5}}{d_{fb}} \qquad \rho_{ssu} = -0.00167$$

$A_{sfssr} := \rho_{ssu} \cdot d_{fb} \qquad A_{sfssr} = -0.307 \frac{in^2}{ft}$

Provide: # 5 bars, each way, bottom face; $A_{b7i} := 0.31 in^2$

space at: $s_{bf} := 15 \cdot in$ radially

reinf. area provided: $A_{sfbp} := \frac{A_{b7i}}{s_{bf}} \qquad A_{sfbp} = 0.248 \frac{in^2}{ft}$

$\text{if}\left(A_{sfbp} > A_{sfssr}, 1, 0\right) = 1$ (OK)

SEISMIC-LOAD CASE

Soil bearing

=4.3K/ft² (4.19)

5.7

$$\sigma_{sqa} := \frac{4 \cdot \sigma_{ssa}}{3} \qquad \sigma_{sqa} = \cancel{5}.0\,\frac{kip}{ft^2}$$

allowable soil bearing pressure, seismic-load case

$$\omega_{fq} := \omega_{qc} + b_f \cdot t_f \cdot \gamma_c \cdot (1 + \beta) \qquad \omega_{fq} = 25.93\,\frac{kip}{ft}$$

Note that "SRSS" was not used here; value is slightly exaggerated

$$\omega_{wq} := (H + H_{wq}) \cdot \gamma_w \cdot b_{fn} \cdot (1 + \beta) \qquad \omega_{wq} = 16.28\,\frac{kip}{ft}$$

$$x_{wq} := \frac{\dfrac{H \cdot b_{fn}}{2} + \dfrac{H_{wq} \cdot b_{fn}}{2}}{H + H_{wq}} \qquad x_{wq} = 1.96\,ft$$

$$x_{fq} := \frac{\omega_{fq} \cdot x_{fd} + \omega_{wq} \cdot x_{wq}}{\omega_{fq} + \omega_{wq}} \qquad x_{fq} = 3.19\,ft$$

$$\sigma_{sqm} := \frac{\omega_{fq} + \omega_{wq}}{b_f} \cdot \left(1 + 6 \cdot \frac{\dfrac{b_f}{2} - x_{fq}}{b_f}\right) \qquad \sigma_{sqm} = -2.34\,\frac{kip}{ft^2}$$

calculated "actual" soil bearing pressure, seismic-load case

$$\text{if}(\sigma_{sqa} > \sigma_{sqm}, 1, 0) = 1$$

(OK)

$D/C = \frac{2.34}{5.7} = 0.41$
(SEISMIC ONLY)

Provide ring footing width: $b_f = 5\,ft$

Flexure in ring beam, radial plane

Note that load of water is carried directly through footing, therefore does not contribute to bending in footing.

$$\sigma_{sqmn} := \frac{\omega_{fq}}{b_f} \cdot \left(1 + 6 \cdot \frac{\dfrac{b_f}{2} - x_{fq}}{b_f}\right) \qquad \sigma_{sqmn} = -1.44\,\frac{kip}{ft^2}$$

$$\gamma_{sq} := \frac{12 \cdot \omega_{fq} \cdot \left(\frac{b_f}{2} - x_{fq}\right)}{{b_f}^3} \qquad \gamma_{sq} = -3.201 \frac{kip}{ft^3}$$

$$m_{sq} := \frac{\sigma_{sqmn} \cdot {b_{fn}}^2}{2} - \frac{\gamma_{sq} \cdot {b_{fn}}^3}{6} \qquad m_{sq} = 21 \frac{ft \cdot kip}{ft}$$

$$d_{fl} := t_f - 4 \cdot in \qquad d_{fl} = 20\,in$$

Resistance to seismically-induced lateral sliding on soil

Soil passive fluid equivalent is given by: $\gamma_{sp} := 250 \cdot \frac{lbf}{ft^3}$

Coefficient of friction, concrete on soil: $\nu := 0.25$

Soil embedment depth: $h_s := 8 \cdot ft$

Soil lateral resistance capacity is given by:

$$V_{sr} := \left(W_w + W_r + W_f\right) \cdot \nu \qquad V_{sr} = 7537\,kip$$

using friction alone

$$\text{if}\left(V_{sr} > V_q, 1, 0\right) = 1 \qquad \text{(OK)}$$

$V_q = 5{,}812^k$ (pg-9)

DIGESTER NO. 12 — DIMENSIONS AND MATERIAL PROPERTIES

- DIMENSIONS

TANK ID = 110'-0"

R = 55'-0"

GRADE EL 8.5' ±
(8.0 ft ABOVE T/FTG)

WALL THICKNESS t = 1'-2" (FULL HT.)

TOP OF WALL EL 40.50
BASE OF WALL EL 0.50 (TOP FTG.)
} WALL HT = 40.0 ft

BASE SLAB t = 1'-0"

FOOTING t = 2'-0"

FTG. PROJECTION = 3'-4"
(FROM WALL EXTERIOR FACE)

TOT. FOOTING WIDTH = 10'-9"
(EXIST. DWG 68, SECT. A)

- MATERIALS:

CONCRETE $f'_c = 4{,}000$ psi

REINFORCING $f_y = 60{,}000$ psi

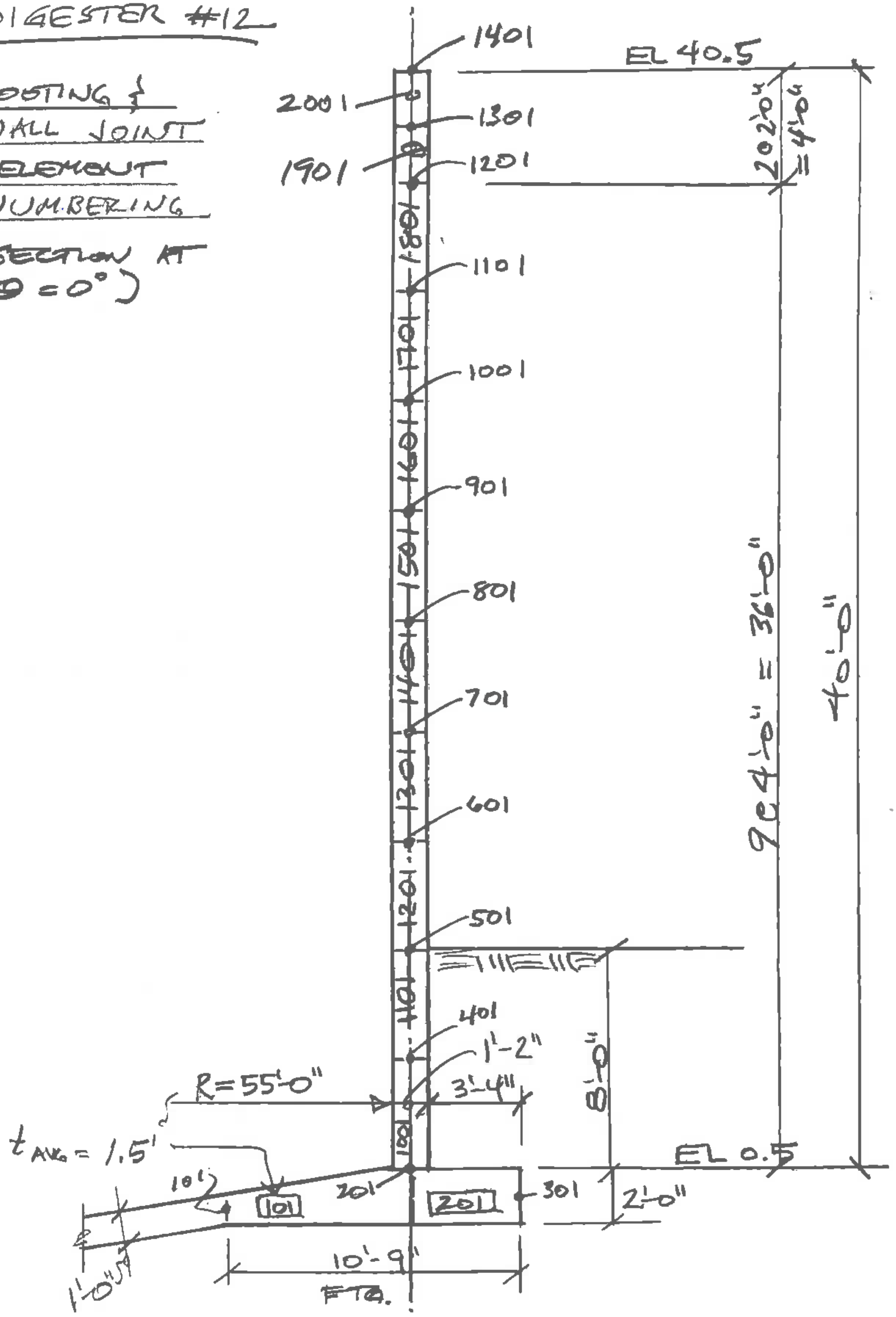
PRESTRESSING — 3/8" ɸ 7-WIRE STRAND
BASE EARTHQUAKE CABLES — 3/8" ɸ
} $f_u = 240{,}000$ psi
$f_y = 180{,}000$ psi

VERT. PRESTRESSING BARS — $f_u = 145{,}000$ psi
$f_y = 125{,}000$ psi
$E = 30 \times 10^6$ psi

BY: GGH	12-16-08	WD803	PROJECT	SAN JOSE DIGESTERS	1
CHKD:		PROJECT NO.	SUBJECT	#12 — DIM'S & PROPERTIES	SHEET NO.

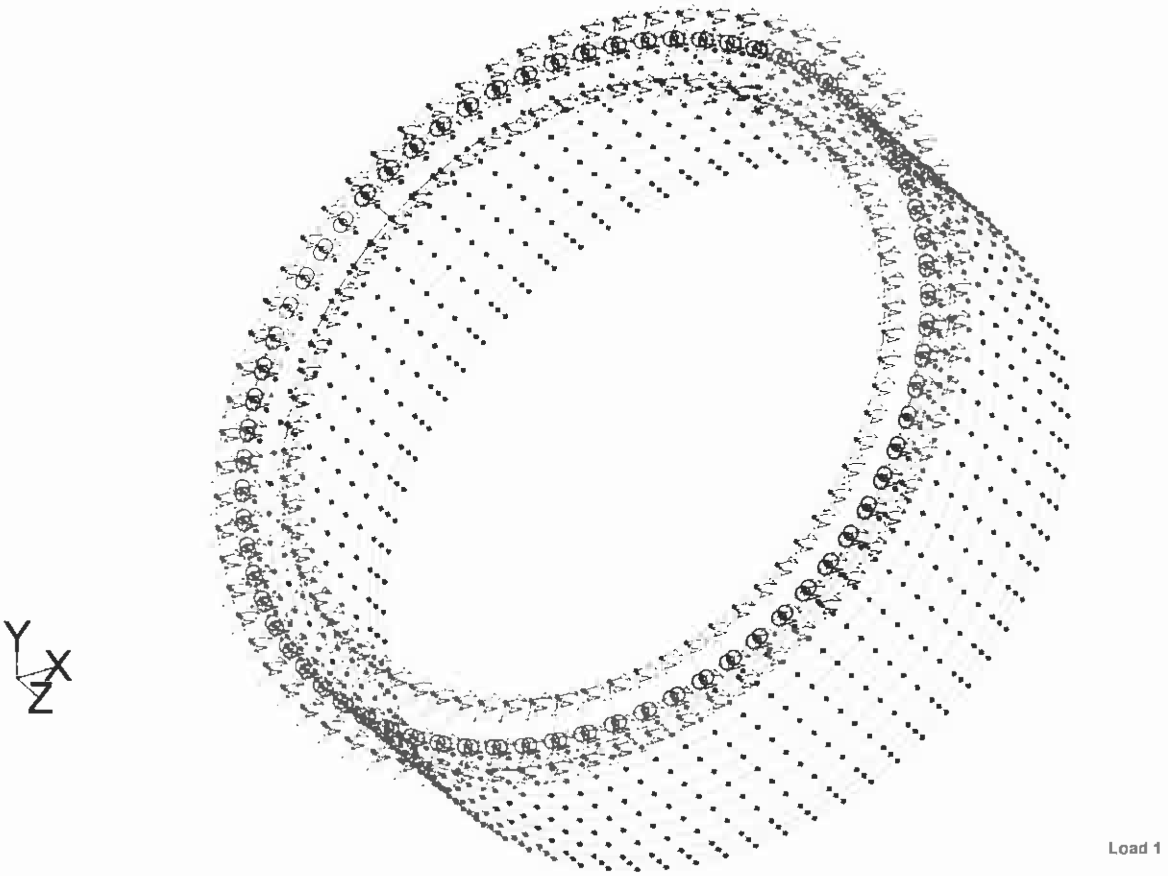
DIGESTER #12

FOOTING & WALL JOINT & ELEMENT NUMBERING (SECTION AT $\theta = 0°$)



BY: GGH	12-16-08	W0803	PROJECT	SAN JOSE DIGESTERS	2
CHKD:		PROJECT NO.	SUBJECT	DIGESTER #12 – WALL SECTION	SHEET NO.

Software licensed to Beyaz & Patel, Inc.	Job No	Sheet No 1	Rev
	Part		
Job Title DIGESTER #12 - UNSUBMERGED	Ref		
	By	Date 20-Dec-08	Chd
Client	File Digester12.std.std	Date/Time 20-Dec-2008 11:31	



3

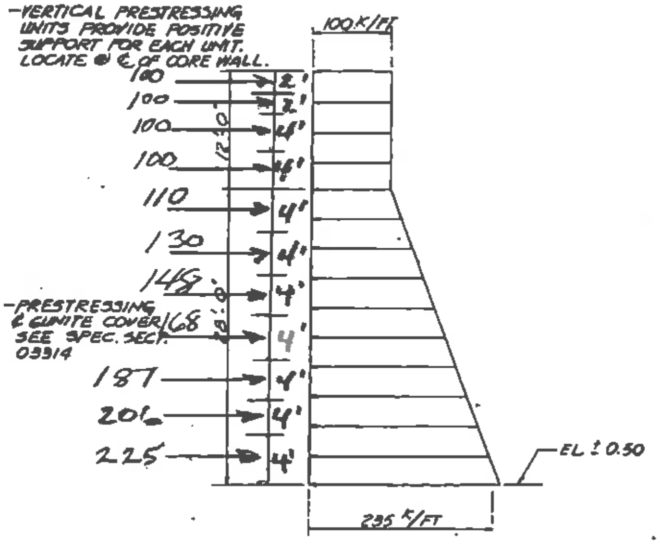
PRESTRESS FORCE TO ELEMENTS

- SEE DIAGRAM FOR PRESTRESSING FORCES APPLIED; ASSUME PRESTRESS FORCES AFTER LOSSES TO BE 75% OF THESE VALUES (PER AWWA 3.4.2.1)

ELEMENT	FINAL PRESTRESS PER EXIST. DWG. (K/ft)	RADIAL PRESTRESS ELEMENT PRESSURE (ksf) (= FINAL PRESTRESS / RADIUS)
1001	225 k/ft	4.04 ksf × 0.75
1101	206	3.71
1201	187	3.37
1301	168	3.03
1401	148	2.66
1501	130	2.34
1601	110	1.98
1701	100	1.80
1801	100	1.80
1901	100	
2001	100	

RADIUS = 55.58'

0.75 TO ACCOUNT FOR LOSSES



FORCE DIAGRAM
MINIMUM FINAL CIRCUMFERENTIAL PRESTRESSING FORCE

BY: GGH	12-18-08	W0803	PROJECT	SAN JOSE DIGESTERS	4
CHKD:		PROJECT NO.	SUBJECT	PRESTRESS FORCE (PER EXIST. DRAWINGS)	SHEET NO.

FOUNDATION SPRING CONSTANTS — DIGESTER #12

- DETERMINE SPRING CONSTANTS FOR FOUNDATION SUPPORT JOINTS IN 'STAAD' MODEL

— FROM GEOTECHNICAL REPORT BY WOODWARD-LUNDGREN, p. 16, 1,500 psf OF NET PRESSURE SHOULD RESULT IN A SETTLEMENT OF 3½ INCHES.

$$K \approx \frac{1{,}500\,psf}{3\tfrac{1}{2}\,in} \times 144\,in^2/ft \times 1^k/1000\,lb$$

$$K = 61.7 \longrightarrow 62^k/in \quad (\text{PER SF OF AREA})$$

— FOR FOUNDATION SUPPORT JOINTS IN MODEL:

- JOINTS 101 TO 172:

$$A_1 = 4.40' \times 3.71' = 16.33\ ft^2$$

$$K_1 = K \times A = \frac{62^k/in}{ft^2} \times 16.33\ ft^2 = \underline{\underline{1012^k/in}}$$

- JOINTS 201 TO 272:

$$A_2 = 4.78' \times 5.38' = 25.72\ ft^2$$

$$K_2 = 62 \times 25.72 = \underline{\underline{1{,}600^k/in}}$$

- JOINTS 301 TO 372

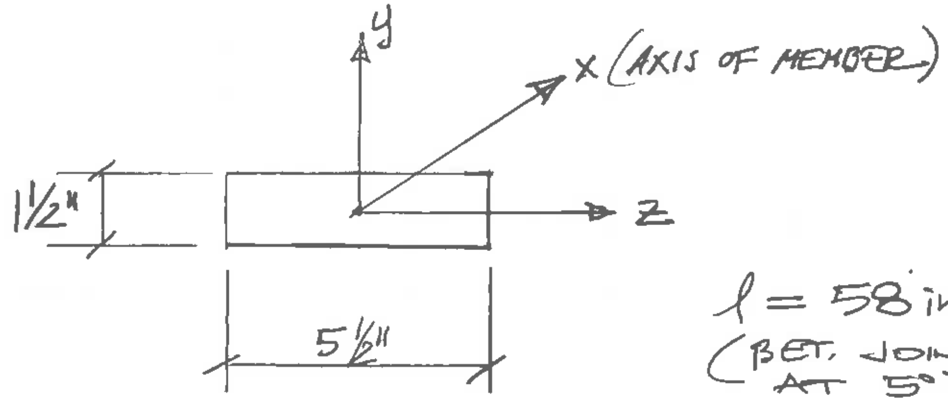
$$A_3 = 5.02' \times 1.67' = 8.36\ ft^2$$

$$K_3 = 62 \times 8.36 = \underline{\underline{520^k/in}}$$

BY: GGH	12-19-08	W0803	PROJECT	SAN JOSE DIGESTERS	5
CHKD:		PROJECT NO.	SUBJECT	#12 - FND. SPRING CONSTANTS	SHEET NO.

BEARING PAD
MEMBER PROPERTIES

(PAD DIMENSIONS FROM EXISTING DWGS)



$\ell = 58$ in
(BET. JOINTS AT 5')

$AX = 1.5 \times 5.5 = 8.25 \, in^2$

$AZ = 8.25 \, in^2$

$IY = \frac{1}{12} \times 1.5 \times 5.5^3 = 20.8 \, in^4$

$IZ = \frac{1}{12} \times 5.5 \times 1.5^3 = 1.55 \, in^4$

$IX = \frac{5.5 \times 1.5^3}{3.64} = 5.10 \, in^4$

(BASED ON BLODGETT)
$b/d = 3.67$
$\rightarrow \beta = 0.275$
$R = \beta b d^3$

BY: GGH	1-5-09	W0803	PROJECT	SAN JOSE DIGESTERS	6
CHKD:		PROJECT NO.	SUBJECT	DIGESTER 12 – PADS	SHEET NO.

'STAAD' OUTPUT RESULTS — DIGESTER 12

- CHECK HOOP TENSION FORCE
  TO VERIFY IF CIRCUMFERENTIAL PRESTRESSING IS ADEQUATE

① UNSUBMERGED CASE

- AT ELEMENT '1101', LC 8 (COMBINED LOADING),

HOOP TENSION PER FT. OF WALL HEIGHT:

$$F_{1101} = \frac{\overset{JT.\ 401}{220.9^k} + \overset{JT.\ 501}{242.4^k}}{4\ ft} = \underline{115.8^k/ft\ AT.}$$

FINAL PRESTRESS FORCE PER DIAGRAM ON EXIST. DWG:

$$F = 206^k/ft > 115.8^k/ft \quad \underline{\underline{OK}}$$

(AT 6' ABOVE BASE)

$$\left(D/C = 115.8/206 = 0.\underline{56} \right)$$

- AT ELEMENT '1301':

$$F_{1301} = = \frac{219.5^k + 209.7^k}{4\ ft} = \underline{107.3^k/ft}$$

$$F_{(AT\ 14'\ ABOVE\ BASE)} = 168^k/ft > 107.3^k/ft \quad \underline{\underline{OK}} \quad \left(D/C = 0.\underline{64} \right)$$

- AT ELEMENT '1501':

$$F_{1501} = \frac{175.3^k + 174.0^k}{4\ ft} = \underline{87.3^k/ft}$$

$$F_{(AT\ 22')} = 130^k/ft > 87.3^k/ft \quad \underline{\underline{OK}} \quad \left(D/C = \underline{0.67} \right)$$

- AT ELEMENT '1601':

$$F_{1601} = (175.2^k + 176.1^k)/4\ ft = 87.8^k$$

$$F_{(AT\ 26')} = 110^k/ft > 87.8^k/ft \quad \underline{\underline{OK}} \quad \left(D/C = \underline{0.80} \right)$$

BY: GGH	1-6-09	W0803	PROJECT	SAN JOSE DIGESTERS	7
CHKD:		PROJECT NO.	SUBJECT	DIG. 12 – HOOP TENSION CHECK	SHEET NO.

'STAAD' OUTPUT – HOOP TENSION CHECK (CONT.)

- AT ELEMENT '1701':

$$F_{1701} = \frac{174.4^{k} + 169.0^{k}}{4\ ft} = \underline{85.9^{k}/ft} < 100^{k}/ft \quad \underline{\underline{OK}}$$

$$\left(D/C = \underline{0.86}\right)$$

GOVERNS

∴ HOOP TENSION FORCE IS CRITICAL AT 10 ft BELOW TOP OF WALL;
$D/C = 0.86 \longrightarrow \underline{\underline{OK}}$

② SUBMERGED CASE

- AT ELEMENT '1101', LCB (COMBINED LOADING),

HOOP TENSION PER FOOT OF WALL HEIGHT:

$$F_{1101} = \frac{329.6^{k} + 338.2^{k}}{4\ ft} = \underline{167.0}^{k}/ft$$

FROM FINAL PRESTRESS DIAGRAM ON EXIST. DWG:

$$F = 206^{k}/ft > 167.0^{k}/ft \quad \underline{\underline{OK}}$$
(AT 6' ABOVE BASE)

$$D/C = 167.0/206 = \underline{0.81}$$

- AT ELEMENT '1301',

$$F_{1301} = \frac{284.4^{k} + 273.5^{k}}{4\ ft} = 139.5^{k}/ft$$

$$F_{(AT\ 14')} = 168^{k}/ft \qquad D/C = \underline{0.83}$$

- AT ELEMENT '1501',

$$D/C = 120.6^{k}/ft \Big/ 130^{k}/ft = \underline{0.93}$$

BY: GGH	1-6-09	W0803	PROJECT	SAN JOSE DIGESTERS	8
CHKD:		PROJECT NO.	SUBJECT	DIG. 12 - HOOP TENSION CHECK	SHEET NO.

'STAAD' OUTPUT — HOOP TENSION CHECK (CONT.)

- AT ELEMENT '1601',

$$F_{1601} = \frac{243.3^{k} + 244.6^{k}}{4\ ft} = \underline{122.0\ k/ft}$$

$$\underset{(AT\ 26')}{F} = 110\ k/ft \qquad D/C = \frac{122.0}{110} = \underline{\underline{1.11}} > 1.0$$

- AT ELEMENT '1701',

$$F_{1701} = \frac{243.2^{k} + 237.8^{k}}{4\ ft} = \underline{120.2\ k/ft}$$

$$\underset{(AT\ 30')}{F} = 100\ k/ft \qquad D/C = \frac{120.2}{100} = \underline{\underline{1.20}}$$

- AT ELEMENT '1901'

$$D/C = 0.50 \quad \underline{\underline{OK}}$$

BY: GGH	1.6.09	W0803	PROJECT	SAN JOSE DIGESTERS	9
CHKD:		PROJECT NO.	SUBJECT	DIG. 12 - HOOP TENSION CHECK	SHEET NO.

AWWA ANALYSIS SUMMARY

- HOOP TENSION AT BASE (UNSUBMERGED CASE)

$F_1 = \omega_{2m} = 242^{k}/ft$ (p. 12 OF MATHCAD CALCULATIONS; SEISMIC + STATIC LOAD (NOT INCL. THERMAL))

JT. 401

$F_2 = \frac{312^{k}}{2\,ft} = 156^{k}/ft$ (THERMAL LOAD CASE '6' FROM 'STAAD' OUTPUT — ELEMENT 1001)

℄ 1/2 ELEMENT AT (TYP.) TO JT-401

TOTAL HOOP TENSION:

$F = 242^{k}/ft + 156^{k}/ft = 398^{k}/ft$

CAPACITY (VALUE FROM LOAD DIAGRAM ON EXIST DWG)

$F_{all} = 235^{k}/ft \times 1.25 = 294^{k}/ft$

INCREASE PER AWWA FOR COMBINED LOADING INCL. SEISMIC

$D/C = \frac{398^{k}/ft}{294^{k}/ft} = \underline{\underline{1.35}} > 1.0$ NG

∴ 35% OVERSTRESS

- WALL SHEAR (SEISMIC) — UNSUBMERGED CASE

$D/C = \frac{V_q}{V_{sq}'} = \frac{5812^{k}}{6184^{k}} = 0.94$ (SEISMIC ONLY)

(SEE FOLLOWING PAGES)

- WATER (SLUDGE) WAVE HEIGHT — FREEBOARD CHECK:

FREEBOARD — $Y_{frp} = 2.0\,ft$

WAVE HT — $H_{wz} = 4.45\,ft > 2.0\,ft$

$D/C = \frac{4.45}{2.0} = \underline{2.23}$ ∴ WAVES WILL HIT BOTTOM OF ROOF SLAB.

BY: GGH	1-14-09	W0803	PROJECT	SAN JOSE DIGESTERS	10
CHKD:		PROJECT NO.	SUBJECT	DIG. #12 RESULTS SUMMARY	SHEET NO.

WALL SHEAR

1) STATIC (UNSUBMERGED)

$V = -25.49^K$ (LC8, INCLUDES FLUID, TEMP, PRESTRESS) — REACTION AT JT. 201

$V_u = 1.2\,(D+F+T)$

$V_u = 1.2 \times 25.49 = \underline{30.59^K}$

1'-2" WALL $\quad f'_c = 4000\text{ psi}$

$d = 14 - 2 - \frac{0.75}{2} = 11.6"$; $b = 58.2"$

$\phi V_c = 0.75 \times 2\sqrt{4000} \times 58.2 \times 11.6$

$\phi V_c = \underline{64.05^K} > V_u = 30.59^K$ OK

$D/C = \frac{30.59^K}{64.05K} = \underline{0.48}$ OK

2) STATIC (SUBMERGED)

$V = -22.32K$ (REACTION AT JT 201, LC8 — INCLUDES FLUID, TEMP, PRESTRESS)

$V_u = 1.2 \times 22.32$

$V_u = 26.78^K$

$\phi V_c = 64.05^K$

$D/C = 26.78/64.05 = \underline{0.42}$

(NOTE: THIS IS LESS THAN UNSUBMERGED CASE SINCE PRESTRESS IS (−) VALUE AT BASE — SEE △ PLOTS FOR UNSUBMERGED CASE)

BY: GGH	1.09	W0807	PROJECT	SAN JOSE DIGESTERS	10A
CHKD:		PROJECT NO.	SUBJECT	DIG #12 RESULTS	SHEET NO.

WALL SHEAR (CONT.)

3) STATIC + SEISMIC (UNSUBMERGED)

$$D/C = \frac{\left(\overset{p\,10A}{0.48} + \overset{p\,10}{0.94}\right)}{1.25} = \underline{\underline{1.14}} \quad \underline{\underline{NG}}$$

INCREASE PER AWWA FOR COMBINED STATIC & SEISMIC

BY: GGH	1.09	W0803	PROJECT	SAN JOSE DIGESTERS	10B
CHKD:		PROJECT NO.	SUBJECT	DIG. #12 RESULTS	SHEET NO.

AWWA ANALYSIS SUMMARY (CONT.)

- SOIL BEARING CHECK (SEISMIC)

$\sigma_{sqa} = 5.7\,ksf$ (ALLOWABLE)

$\sigma_{sqm} = 2.34\,ksf$

$$D/C = \frac{2.34\,ksf}{5.7\,ksf} = \underline{0.41} \quad \underline{OK}$$

- SLIDING STABILITY

$$D/C = \frac{\overbrace{5812k}^{V_q}}{\underbrace{7537k}_{V_{sr}}} = \underline{\underline{0.77}} \quad \underline{OK}$$

- SOIL BEARING CHECK (STATIC + SEISMIC)

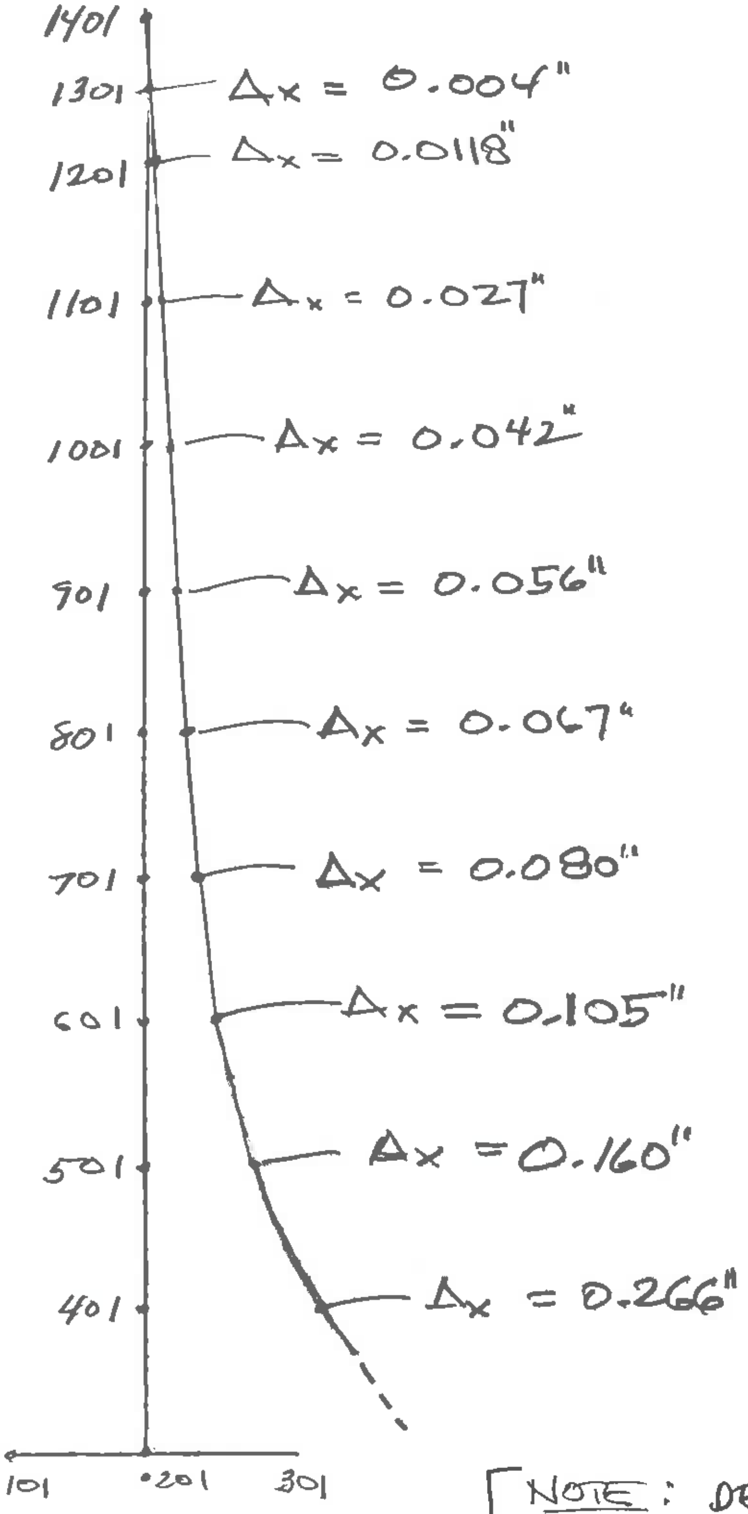
$$D/C = \frac{(\overset{\text{AWWA - STATIC LOAD CASE D/C}}{1.22} + \underset{\text{SEISMIC D/C}}{0.41})}{\underset{\text{ALLOWABLE INCR. FOR STATIC + SEISMIC PER AWWA}}{1.25}}$$

$$D/C = \underline{1.31}$$

LOAD 5 DEFLECTIONS FLUID STATIC

(AT θ=0, JOINTS IN VERT. STRIP)

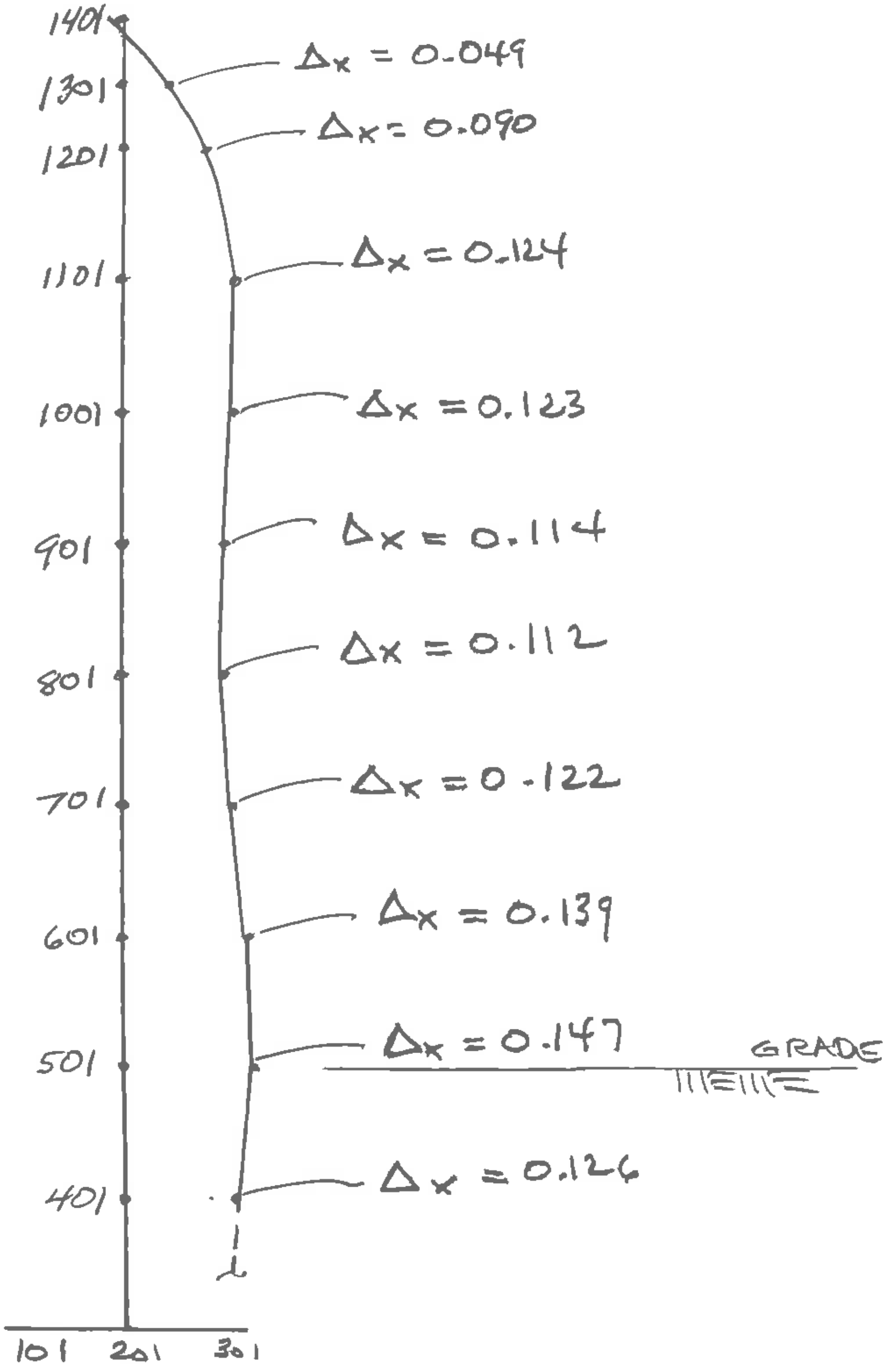
(UNSUBMERGED CASE)



[NOTE: DEFLECTIONS ARE CONSISTENT W/ ELEMENT NODE RELEASES AT BASE]

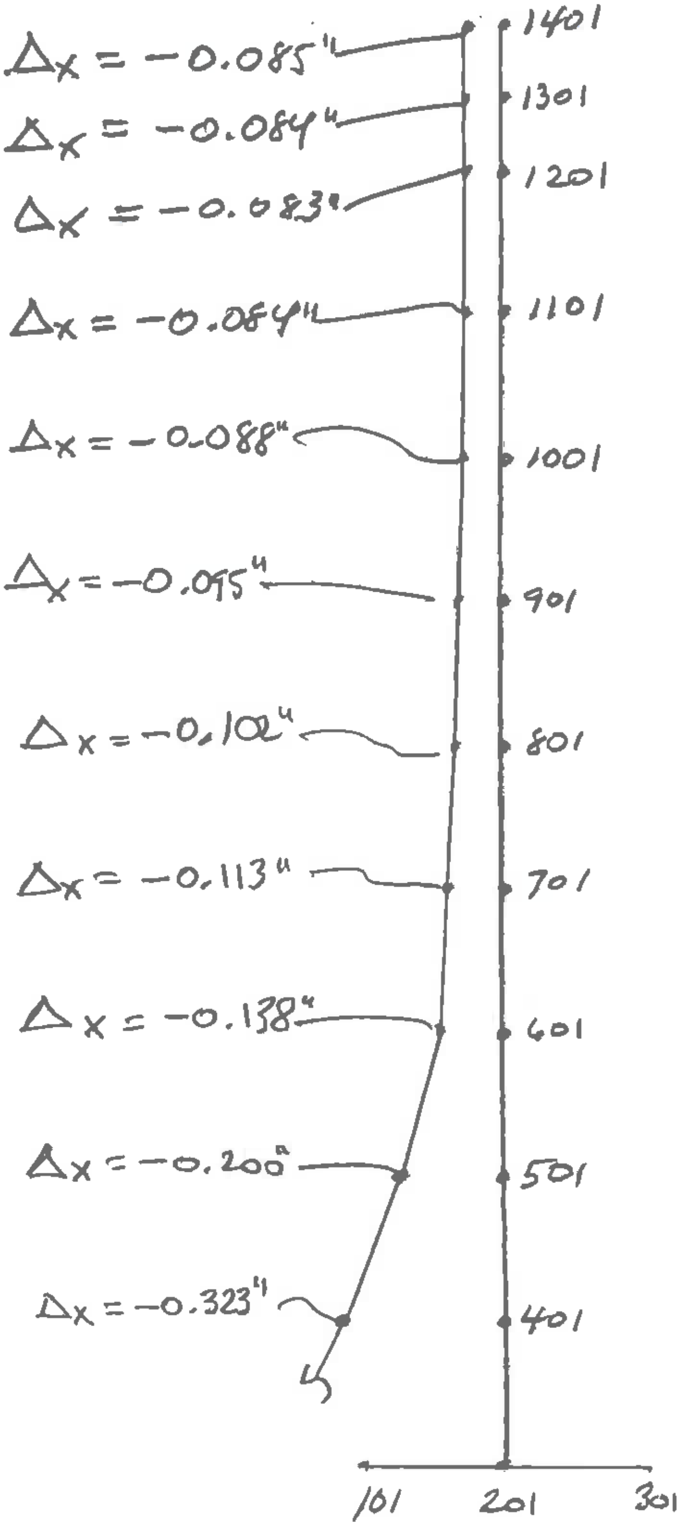
BY: GGH 1.5.09
CHKD:
W0803 PROJECT NO.
PROJECT: SAN JOSE DIGESTERS
SUBJECT: DIGESTER 12 – FLUID DEFL'S
SHEET NO. 12

LOAD 6 DEFLECTIONS (UNSUBMERGED CASE)
TEMPERATURE



BY: GGH	1-5-09	W0803	PROJECT	SAN JOSE DIGESTERS	13
CHKD:		PROJECT NO.	SUBJECT	DIGESTER 12 – TEMP. DEFL's	SHEET NO.

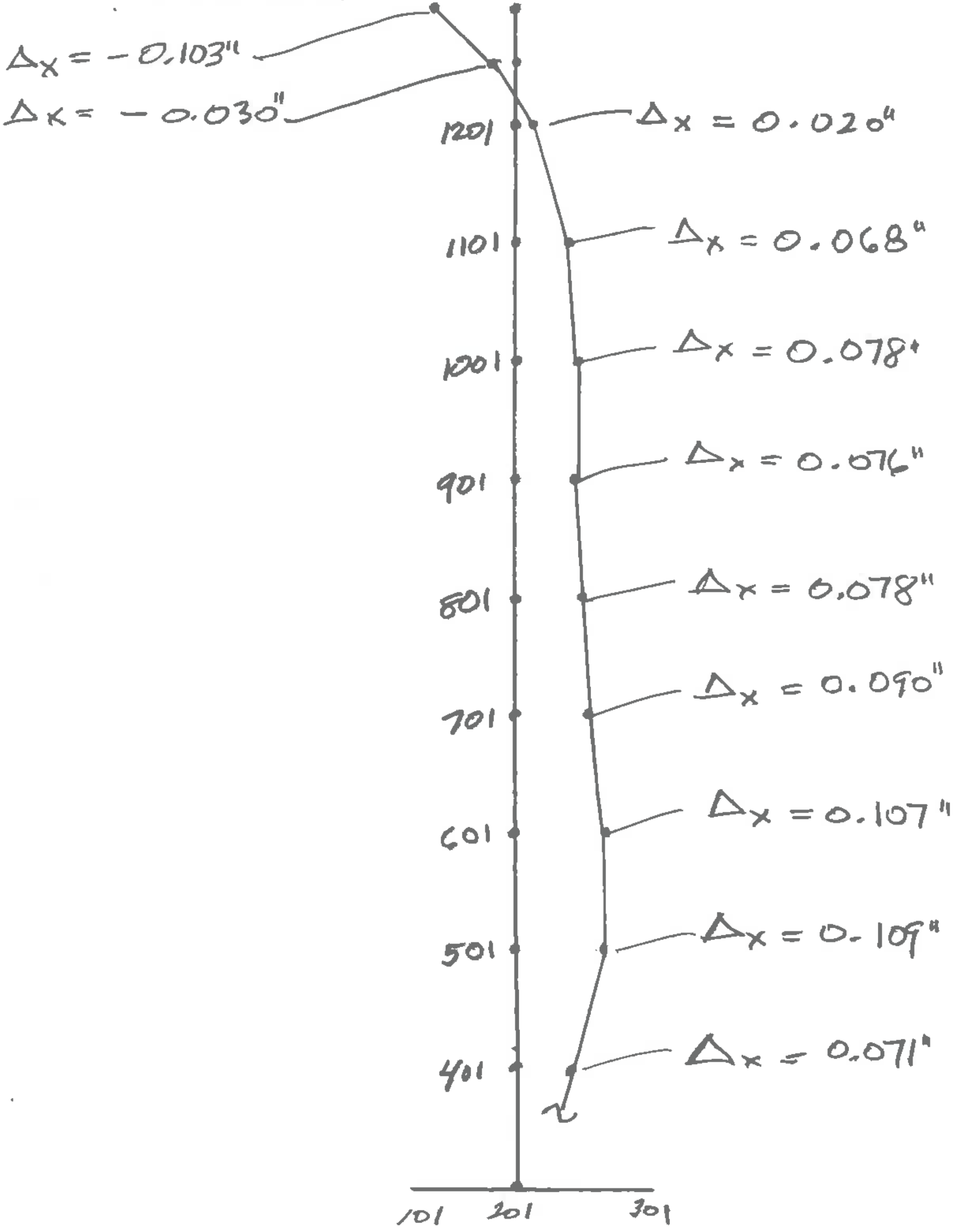
LOAD 7 DEFLECTIONS (UNSUBMERGED CASE)
PRESTRESS



BY: GGH	1.5.09	W0803	PROJECT	SAN JOSE DIGESTERS	14
CHKD:		PROJECT NO.	SUBJECT	DIG. 12 – PRESTRESS DEFL'S	SHEET NO.

LOAD & DEFLECTIONS (UNSUBMERGED CASE)

COMBINED LOAD CASE



BY: GGH 1-5-09
CHKD:
W0803
PROJECT NO.
PROJECT SAN JOSE DIGESTERS
SUBJECT D16.12 — COMBINED LOAD DEFL'S
15
SHEET NO.

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          ****************************************************
          *                                                  *
          *           STAAD.Pro                              *
          *           Version  2006    Bld 1001.US           *
          *           Proprietary Program of                 *
          *           Research Engineers,  Intl.             *
          *           Date=    JAN  5, 2009                  *
          *           Time=    14:57:25                      *
          *                                                  *
          *      USER ID: Beyaz  Patel, Inc.                 *
          ****************************************************


     1. STAAD SPACE SAN JOSE DIGESTER #12 - UNSUBMERGED CASE
INPUT FILE: Digester12.std.STD
     2. START JOB INFORMATION
     3. ENGINEER DATE 20-DEC-08
     4. END JOB INFORMATION
     5. INPUT WIDTH 79
     6. *BY:  GLENN HUDSON
     7. *ANALYSIS IS FOR UNSUBMERGED CASE WITH SURFACE AT 2 FT BELOW
     8. *TOP OF WALL
     9. *
    10. UNIT KIP FEET
    11. *
    12. JOINT COORDINATES CYLINDRICAL
    13. *
    14. *FOLLOWING JOINTS ARE FOR WALL FOOTING
    15. *
    16. 101   48.75  0.  0.
    17. REPEAT  71  0  5  0
    18. 201   55.58  0.  0.
    19. REPEAT  71  0  5  0
    20. 301   59.50  0.  0.
    21. REPEAT  71  0  5  0
    22. *
    23. *FOLLOWING JOINTS ARE FOR SHELL WALL
    24. *
    25. 401   55.58  0.   4.0
    26. REPEAT  71  0  5  0
    27. 501   55.58  0.   8.0
    28. REPEAT  71  0  5  0
    29. 601   55.58  0.  12.0
    30. REPEAT  71  0  5  0
    31. 701   55.58  0.  16.0
    32. REPEAT  71  0  5  0
    33. 801   55.58  0.  20.0
    34. REPEAT  71  0  5  0
    35. 901   55.58  0.  24.0
    36. REPEAT  71  0  5  0
    37. 1001  55.58  0.  28.0
    38. REPEAT  71  0  5  0
    39. 1101  55.58  0.  32.0
    40. REPEAT  71  0  5  0
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41. 1201  55.58  0.  36.0
42. REPEAT  71  0  5  0
43. 1301  55.58  0.  38.0
44. REPEAT  71  0  5  0
45. 1401  55.58  0.  40.0
46. REPEAT  71  0  5  0
47. *
48. MEMBER INCIDENCES
49. *MEMBERS BELOW REPRESENT RUBBER BEARING PADS BETWEEN WALL BASE AND FOOTING
50. 3001  201  202
51. REPEAT  70  1  1
52. 3072  272  201
53. *
54. ELEMENT INCIDENCES SHELL
55. *
56. *ELEMENTS WITH NUMBERS BELOW 1000 ARE FOR FOOTING
57. *ELEMENTS WITH NUMBERS ABOVE 1000 ARE FOR SHELL WALL
58. *
59. *FOOTING ELEMENTS
60. 101  101  102  202  201 TO 171  1  1
61. 172  172  101  201  272
62. 201  201  202  302  301 TO 271  1  1
63. 272  272  201  301  372
64. *
65. *SHELL WALL ELEMENTS
66. 1001  201  401  402  202  TO  1071  1  1
67. 1072  272  472  401  201
68. 1101  401  501  502  402  TO  1171  1  1
69. 1172  472  572  501  401
70. 1201  501  601  602  502  TO  1271  1  1
71. 1272  572  672  601  501
72. 1301  601  701  702  602  TO  1371  1  1
73. 1372  672  772  701  601
74. 1401  701  801  802  702  TO  1471  1  1
75. 1472  772  872  801  701
76. 1501  801  901  902  802  TO  1571  1  1
77. 1572  872  972  901  801
78. 1601  901  1001  1002  902  TO  1671  1  1
79. 1672  972  1072  1001  901
80. 1701  1001  1101  1102  1002  TO  1771  1  1
81. 1772  1072  1172  1101  1001
82. 1801  1101  1201  1202  1102  TO  1871  1  1
83. 1872  1172  1272  1201  1101
84. 1901  1201  1301  1302  1202  TO  1971  1  1
85. 1972  1272  1372  1301  1201
86. 2001  1301  1401  1402  1302  TO  2071  1  1
87. 2072  1372  1472  1401  1301
88. *
89. UNIT KIP INCH
90. *
91. MEMBER PROPERTIES
92. *FOLLOWING PROPERTIES ARE FOR BEARING PADS
93. 3001 TO 3072  PRIS AX 8.25 AZ 8.25  IX 5.10 IY 20.8 IZ 1.55
94. *
95. ELEMENT PROPERTY
96. *
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  97. *FOLLOWING ARE FOOTING ELEMENT THICKNESSES (101 TO 172 USE
  98. *AVERAGE THICKNESS)
  99. 101 TO 172  THICKNESS 18
 100. 201 TO 272  THICKNESS 24
 101. *
 102. *FOLLOWING ARE SHELL WALL ELEMENTS
 103. 1001 TO 1072   1101 TO 1172   1201 TO 1272   1301 TO 1372 -
 104. 1401 TO 1472   1501 TO 1572   1601 TO 1672   1701 TO 1772 -
 105. 1801 TO 1872   1901 TO 1972   2001 TO 2072  THICKNESS 14
 106. *
 107. *JOINTS AT THE BOTTOM OF WALL ELEMENTS ARE RELEASED WITH RESPECT
 108. *TO MOMENT MX(LOCAL) SINCE THERE IS NO BAR REINFORCING THROUGH THE WALL-TO -
 109. *FOOTING JOINT, AND WITH RESPECT TO FZ(LOCAL)SINCE JOINT CAN
 110. *TRANSLATE IN RADIAL DIRECTION ON BEARING PAD
 111. *
 112. MEMBER RELEASE
 113. 3001 TO 3072  END MX MY MZ  KFZ 300
 114. *
 115. ELEMENT RELEASE
 116. 1001 TO 1072  J1  FZ  MX
 117. 1001 TO 1072  J4  FZ  MX
 118. *
 119. SUPPORTS
 120. *
 121. *SUPPORT JOINTS AT FOOTINGS HAVE VERTICAL SPRING CONSTANTS
 122. *TO MODEL SOIL RIGIDITY AND GIVE VERTICAL DEFLECTION OUTPUT
 123. *THAT IS INDICATION OF PREDICTED VERTICAL SETTLEMENT
 124. *
 125. 101 TO 172 FIXED BUT MX MY MZ  KFZ 1010
 126. 201 TO 272 FIXED BUT MX MY MZ  KFZ 1600
 127. 301 TO 372 FIXED BUT MX MY MZ  KFZ 520
 128. *
 129. UNIT KIP INCH
 130. *
 131. CONSTANTS
 132. *
 133. E 3600 MEMB  101 TO 172  201 TO 272  1001 TO 1072  1101 TO 1172 -
 134. 1201 TO 1272  1301 TO 1372  1401 TO 1472  1501 TO 1572  1601 TO 1672 -
 135. 1701 TO 1772  1801 TO 1872  1901 TO 1972  2001 TO 2072
 136. *
 137. *FOLLOWING IS FOR BEARING PADS
 138. E 350 MEMB 3001 TO 3072
 139. *
 140. BETA 5  MEMB  3002  3038
 141. BETA 10 MEMB  3003  3039
 142. BETA 15 MEMB  3004  3040
 143. BETA 20 MEMB  3005  3041
 144. BETA 25 MEMB  3006  3042
 145. BETA 30 MEMB  3007  3043
 146. BETA 35 MEMB  3008  3044
 147. BETA 40 MEMB  3009  3045
 148. BETA 45 MEMB  3010  3046
 149. BETA 50 MEMB  3011  3047
 150. BETA 55 MEMB  3012  3048
 151. BETA 60 MEMB  3013  3049
 152. BETA 65 MEMB  3014  3050
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153. BETA 70 MEMB  3015  3051
154. BETA 75 MEMB  3016  3052
155. BETA 80 MEMB  3017  3053
156. BETA 85 MEMB  3018  3054
157. BETA 90 MEMB  3019  3055
158. BETA 95 MEMB  3020  3056
159. BETA 100 MEMB 3021  3057
160. BETA 105 MEMB 3022  3058
161. BETA 110 MEMB 3023  3059
162. BETA 115 MEMB 3024  3060
163. BETA 120 MEMB 3025  3061
164. BETA 125 MEMB 3026  3062
165. BETA 130 MEMB 3027  3063
166. BETA 135 MEMB 3028  3064
167. BETA 140 MEMB 3029  3065
168. BETA 145 MEMB 3030  3066
169. BETA 150 MEMB 3031  3067
170. BETA 155 MEMB 3032  3068
171. BETA 160 MEMB 3033  3069
172. BETA 165 MEMB 3034  3070
173. BETA 170 MEMB 3035  3071
174. BETA 175 MEMB 3036  3072
175. *
176. POISSON 0.17 ALL
177. *FOLLOWING IS FOR BEARING PADS
178. POISSON 0.4 MEMBER 3001 TO 3072
179. *
180. ALPHA CONCRETE ALL
181. *FOLLOWING IS FOR BEARING PADS
182. ALPHA 6E-006 MEMB 3001 TO 3072
183. *
184. UNIT KIP FEET
185. *
186. DENSITY 0.150 ALL
187. *FOLLOWING IS FOR BEARING PADS
188. UNIT KIP INCH
189. DENSITY 4E-005 MEMBER 3001 TO 3072
190. *
191. UNIT KIP FEET
192. *
193. *LOADS
194. *
195. LOAD 1  DEAD LOAD
196. SELFWEIGHT  Z  -1.0
197. *REACTIONS FROM TRIBUTARY PORTION OF ROOF STRUCTURE ARE APPLIED AS
198. *VERTICAL JOINT LOADS ON TOP OF WALL
199. *NOTE:  THESE LOADS ARE 10% HIGHER THAN FOR DIGESTER #1 BASED ON RATIO
200. *OF DIGESTER INSIDE DIAMETERS
201. *
202. *TRIBUTARY ROOF STRUCTURE DEAD LOAD:
203. JOINT LOAD
204. 1401 TO 1472  FZ  -9.36
205. *
206. LOAD 2 TRIBUTARY ROOF LIVE LOAD
207. JOINT LOAD
208. 1401 TO 1472  FZ  -1.07
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 209. *
 210. LOAD 3 TRIBUTARY ROOF VACUUM PRESSURE
 211. JOINT LOAD
 212. 1401 TO 1472  FZ  -1.41
 213. *
 214. LOAD 4 TRIBUTARY ROOF GAS UPLIFT PRESSURE
 215. JOINT LOAD
 216. 1401 TO 1472  FZ  -5.05
 217. *
 218. LOAD 5 FLUID STATIC LOAD
 219. *FOLLOWING IS FLUID STATIC LOAD ON WALL BASED ON SLUDGE DENSITY OF 70 PCF.
 220. *NOTE THAT FOR UNSUBMERGED CASE, SURFACE IS AT 2FT. BELOW TOP OF WALL.
 221. *
 222. ELEMENT LOAD
 223. 1001 TO 1072  PR -2.52
 224. 1101 TO 1172  PR -2.24
 225. 1201 TO 1272  PR -1.96
 226. 1301 TO 1372  PR -1.68
 227. 1401 TO 1472  PR -1.40
 228. 1501 TO 1572  PR -1.12
 229. 1601 TO 1672  PR -0.84
 230. 1701 TO 1772  PR -0.56
 231. 1801 TO 1872  PR -0.28
 232. 1901 TO 1972  PR -0.07
 233. 2001 TO 2072  PR  0.
 234. *
 235. LOAD 6 TEMPERATURE LOAD
 236. *
 237. *FIRST TEMPERATURE LOAD VALUE SPECIFIED IS THE AVERAGE RISE, AS MEASURED FROM
 238. *THE STRUCTURE AVERAGE START TEMPERATURE.  SECOND TEMPERATURE LOAD VALUE
 239. *SPECIFIED IS THE THRU-WALL TEMPERATURE DIFFERENTIAL
 240. *
 241. *ASSUMED TEMPERATURE VALUES FOR SITE (SAN JOSE) ARE:
 242. *AIR AMBIENT LOW TEMPERATURE (JANUARY) = 40 DEG. F.
 243. *STRUCTURE START TEMPERATURE (ANNUAL AVERAGE TEMP.) = 60 DEG. F.
 244. *SOIL AMBIENT TEMPERATURE (INFLUENCED BY DIGESTER) = 80 DEG. F.
 245. *DIGESTER INTERIOR TEMPERATURE = 135 DEG. F.
 246. *
 247. TEMPERATURE LOAD
 248. *ABOVE GRADE ELEMENTS:
 249. *FIRST TEMP LOAD VALUE = ((135-60) + (40-60))/2 = 27.5,  USE 28
 250. *SECOND TEMP LOAD VALUE = 40 - 135 = -95
 251. 1201 TO 1272  1301 TO 1372  1401 TO 1472  1501 TO 1572  1601 TO 1672 -
 252. 1701 TO 1772  1801 TO 1872  1901 TO 1972  2001 TO 2072  TEMP 28  -95
 253. *
 254. *BELOW GRADE ELEMENTS:
 255. *FIRST TEMP LOAD VALUE = ((135-60) + (80-60))/2 = 48
 256. *SECOND TEMP LOAD VALUE = 80 - 135 = -55
 257. 1001 TO 1072  1101 TO 1172  TEMP 48  -55
 258. *
 259. LOAD 7  PRESTRESS LOAD
 260. *BASED ON CIRCUMFERENTIAL PRESTRESS FORCE DIAGRAM ON EXISTING DRAWINGS (SHEET 6
 261. *ASSUMED TO BE 75% OF FORCE DIAGRAM VALUE, AFTER LOSSES
 262. *
 263. ELEMENT LOAD
 264. 1001 TO 1072  PR 3.03
```

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   SAN JOSE DIGESTER #12 - UNSUBMERGED CASE                    -- PAGE NO.    6

  265. 1101 TO 1172  PR 2.78
  266. 1201 TO 1272  PR 2.53
  267. 1301 TO 1372  PR 2.27
  268. 1401 TO 1472  PR 2.00
  269. 1501 TO 1572  PR 1.76
  270. 1601 TO 1672  PR 1.49
  271. 1701 TO 1772  PR 1.35
  272. 1801 TO 1872  PR 1.35
  273. 1901 TO 1972  PR 1.35
  274. 2001 TO 2072  PR 1.35
  275. *
  276. *FOLLOWING LOAD COMBINATION INCLUDES TRIBUTARY ROOF VERTICAL DL, LL, VACUUM
  277. *AND GAS PRESSURE LOADS; AND STATIC FLUID, TEMPERATURE AND PRESTRESS LATERAL
  278. *LOADS ON SHELL WALL
  279. *
  280. LOAD COMB 8  TRIB. ROOF LOADS + FLUID STATIC + TEMP + PRESTRESS
  281. 1 1.0  2 1.0  3 1.0  4 1.0  5 1.0  6 1.0  7 1.0
  282. *
  283. UNIT KIP INCH
  284. *
  285. PERFORM ANALYSIS

 ** WARNING ** A SOFT MATERIAL WITH (1.0 / 9.000E+00) TIMES THE STIFFNESS OF
              CONCRETE ENTERED. PLEASE CHECK.



          P R O B L E M   S T A T I S T I C S
          -----------------------------------

   NUMBER OF JOINTS/MEMBER+ELEMENTS/SUPPORTS =  1008/  1008/   216
   ORIGINAL/FINAL BAND-WIDTH=  215/    47/    288 DOF
   TOTAL PRIMARY LOAD CASES =    7, TOTAL DEGREES OF FREEDOM =   6048
   SIZE OF STIFFNESS MATRIX =     1742 DOUBLE  KILO-WORDS
   REQRD/AVAIL. DISK SPACE  =     36.1/  63007.7 MB



  286. *
  287. LOAD LIST 1 TO 8
  288. *DISPLACEMENTS AT FOOTING AND FROM BOTTOM TO TOP OF WALL IN A STRIP THAT IS
  289. *ONE ELEMENT WIDE (ELEMENT AT 0 TO 5 DEGREES):
  290. PRINT JOINT DISPLACEMENTS LIST 101 201 301 401 501 601 701 801 901 1001 1101 -
  291. 1201 1301 1401
```

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   SAN JOSE DIGESTER #12 - UNSUBMERGED CASE                    -- PAGE NO.    7



  JOINT DISPLACEMENT (INCH RADIANS)    STRUCTURE TYPE = SPACE
  ------------------

JOINT  LOAD   X-TRANS   Y-TRANS   Z-TRANS   X-ROTAN   Y-ROTAN   Z-ROTAN


   101    1    0.00000   0.00000  -0.00867   0.00000   0.00024   0.00000
          2    0.00000   0.00000  -0.00014   0.00000   0.00001   0.00000
          3    0.00000   0.00000  -0.00018   0.00000   0.00001   0.00000
          4    0.00000   0.00000  -0.00064   0.00000   0.00003   0.00000
          5    0.00000   0.00000  -0.00072   0.00000   0.00000   0.00000
          6    0.00000   0.00000   0.00142   0.00000   0.00000   0.00000
          7    0.00000   0.00000   0.00088   0.00000   0.00000   0.00000
          8    0.00000   0.00000  -0.00805   0.00000   0.00028   0.00000
   201    1    0.00000   0.00000  -0.02210   0.00000   0.00005   0.00000
          2    0.00000   0.00000  -0.00044   0.00000   0.00000   0.00000
          3    0.00000   0.00000  -0.00058   0.00000   0.00000   0.00000
          4    0.00000   0.00000  -0.00207   0.00000   0.00000   0.00000
          5    0.00000   0.00000   0.00008   0.00000  -0.00002   0.00000
          6    0.00000   0.00000  -0.00017   0.00000   0.00005   0.00000
          7    0.00000   0.00000  -0.00010   0.00000   0.00003   0.00000
          8    0.00000   0.00000  -0.02537   0.00000   0.00011   0.00000
   301    1    0.00000   0.00000  -0.02324   0.00000   0.00001   0.00000
          2    0.00000   0.00000  -0.00045   0.00000   0.00000   0.00000
          3    0.00000   0.00000  -0.00059   0.00000   0.00000   0.00000
          4    0.00000   0.00000  -0.00210   0.00000   0.00000   0.00000
          5    0.00000   0.00000   0.00114   0.00000  -0.00002   0.00000
          6    0.00000   0.00000  -0.00224   0.00000   0.00004   0.00000
          7    0.00000   0.00000  -0.00138   0.00000   0.00003   0.00000
          8    0.00000   0.00000  -0.02887   0.00000   0.00006   0.00000
   401    1    0.00160   0.00000  -0.02275   0.00000   0.00000   0.00000
          2    0.00005   0.00000  -0.00046   0.00000   0.00000   0.00000
          3    0.00006   0.00000  -0.00060   0.00000   0.00000   0.00000
          4    0.00022   0.00000  -0.00215   0.00000   0.00000   0.00000
          5    0.26589   0.00000  -0.00051   0.00000  -0.00279   0.00000
          6    0.12632   0.00000   0.01359   0.00000   0.00084   0.00000
          7   -0.32295   0.00000   0.00066   0.00000   0.00326   0.00000
          8    0.07118   0.00000  -0.01221   0.00000   0.00131   0.00000
   501    1    0.00144   0.00000  -0.02338   0.00000   0.00000   0.00000
          2    0.00004   0.00000  -0.00047   0.00000   0.00000   0.00000
          3    0.00006   0.00000  -0.00062   0.00000   0.00000   0.00000
          4    0.00020   0.00000  -0.00223   0.00000   0.00000   0.00000
          5    0.15960   0.00000  -0.00355   0.00000  -0.00162   0.00000
          6    0.14700   0.00000   0.02699   0.00000   0.00018   0.00000
          7   -0.19964   0.00000   0.00438   0.00000   0.00186   0.00000
          8    0.10870   0.00000   0.00113   0.00000   0.00041   0.00000
   601    1    0.00129   0.00000  -0.02395   0.00000   0.00000   0.00000
          2    0.00004   0.00000  -0.00049   0.00000   0.00000   0.00000
          3    0.00005   0.00000  -0.00065   0.00000   0.00000   0.00000
          4    0.00020   0.00000  -0.00231   0.00000   0.00000   0.00000
          5    0.10444   0.00000  -0.00549   0.00000  -0.00075   0.00000
          6    0.13906   0.00000   0.03409   0.00000  -0.00036   0.00000
          7   -0.13776   0.00000   0.00684   0.00000   0.00081   0.00000
          8    0.10732   0.00000   0.00805   0.00000  -0.00031   0.00000
```

```
  JOINT DISPLACEMENT (INCH RADIANS)    STRUCTURE TYPE = SPACE
  ------------------

 JOINT  LOAD   X-TRANS   Y-TRANS   Z-TRANS   X-ROTAN   Y-ROTAN   Z-ROTAN


   701    1    0.00114   0.00000  -0.02446   0.00000   0.00000   0.00000
          2    0.00004   0.00000  -0.00051   0.00000   0.00000   0.00000
          3    0.00005   0.00000  -0.00067   0.00000   0.00000   0.00000
          4    0.00019   0.00000  -0.00240   0.00000   0.00000   0.00000
          5    0.07995   0.00000  -0.00677   0.00000  -0.00034   0.00000
          6    0.12156   0.00000   0.04113   0.00000  -0.00031   0.00000
          7   -0.11273   0.00000   0.00856   0.00000   0.00031   0.00000
          8    0.09021   0.00000   0.01488   0.00000  -0.00034   0.00000
   801    1    0.00100   0.00000  -0.02492   0.00000   0.00000   0.00000
          2    0.00004   0.00000  -0.00053   0.00000   0.00000   0.00000
          3    0.00005   0.00000  -0.00069   0.00000   0.00000   0.00000
          4    0.00019   0.00000  -0.00248   0.00000   0.00000   0.00000
          5    0.06701   0.00000  -0.00771   0.00000  -0.00023   0.00000
          6    0.11221   0.00000   0.04826   0.00000  -0.00007   0.00000
          7   -0.10211   0.00000   0.00993   0.00000   0.00017   0.00000
          8    0.07840   0.00000   0.02186   0.00000  -0.00014   0.00000
   901    1    0.00085   0.00000  -0.02532   0.00000   0.00000   0.00000
          2    0.00004   0.00000  -0.00054   0.00000   0.00000   0.00000
          3    0.00005   0.00000  -0.00072   0.00000   0.00000   0.00000
          4    0.00018   0.00000  -0.00256   0.00000   0.00000   0.00000
          5    0.05539   0.00000  -0.00845   0.00000  -0.00026   0.00000
          6    0.11424   0.00000   0.05544   0.00000   0.00014   0.00000
          7   -0.09464   0.00000   0.01114   0.00000   0.00015   0.00000
          8    0.07612   0.00000   0.02899   0.00000   0.00003   0.00000
  1001    1    0.00071   0.00000  -0.02567   0.00000   0.00000   0.00000
          2    0.00004   0.00000  -0.00056   0.00000   0.00000   0.00000
          3    0.00005   0.00000  -0.00074   0.00000   0.00000   0.00000
          4    0.00017   0.00000  -0.00265   0.00000   0.00000   0.00000
          5    0.04194   0.00000  -0.00903   0.00000  -0.00030   0.00000
          6    0.12274   0.00000   0.06263   0.00000   0.00017   0.00000
          7   -0.08800   0.00000   0.01227   0.00000   0.00012   0.00000
          8    0.07764   0.00000   0.03625   0.00000  -0.00001   0.00000
  1101    1    0.00059   0.00000  -0.02596   0.00000   0.00000   0.00000
          2    0.00004   0.00000  -0.00058   0.00000   0.00000   0.00000
          3    0.00005   0.00000  -0.00076   0.00000   0.00000   0.00000
          4    0.00017   0.00000  -0.00273   0.00000   0.00000   0.00000
          5    0.02701   0.00000  -0.00944   0.00000  -0.00032   0.00000
          6    0.12378   0.00000   0.06991   0.00000  -0.00022   0.00000
          7   -0.08361   0.00000   0.01334   0.00000   0.00006   0.00000
          8    0.06804   0.00000   0.04378   0.00000  -0.00048   0.00000
  1201    1    0.00057   0.00000  -0.02620   0.00000   0.00000   0.00000
          2    0.00004   0.00000  -0.00060   0.00000   0.00000   0.00000
          3    0.00006   0.00000  -0.00078   0.00000   0.00000   0.00000
          4    0.00021   0.00000  -0.00281   0.00000   0.00000   0.00000
          5    0.01182   0.00000  -0.00968   0.00000  -0.00031   0.00000
          6    0.09003   0.00000   0.07767   0.00000  -0.00133   0.00000
          7   -0.08285   0.00000   0.01439   0.00000  -0.00003   0.00000
          8    0.01988   0.00000   0.05199   0.00000  -0.00166   0.00000
```

```
  JOINT DISPLACEMENT (INCH RADIANS)    STRUCTURE TYPE = SPACE
  ------------------

 JOINT  LOAD   X-TRANS   Y-TRANS   Z-TRANS   X-ROTAN   Y-ROTAN   Z-ROTAN


  1301     1    0.00062   0.00000  -0.02630   0.00000   0.00000   0.00000
           2    0.00005   0.00000  -0.00060   0.00000   0.00000   0.00000
           3    0.00007   0.00000  -0.00080   0.00000   0.00000   0.00000
           4    0.00025   0.00000  -0.00285   0.00000   0.00000   0.00000
           5    0.00432   0.00000  -0.00973   0.00000  -0.00031   0.00000
           6    0.04846   0.00000   0.08193   0.00000  -0.00219   0.00000
           7   -0.08362   0.00000   0.01490   0.00000  -0.00004   0.00000
           8   -0.02985   0.00000   0.05655   0.00000  -0.00254   0.00000
  1401     1    0.00071   0.00000  -0.02639   0.00000   0.00001   0.00000
           2    0.00007   0.00000  -0.00061   0.00000   0.00000   0.00000
           3    0.00009   0.00000  -0.00081   0.00000   0.00000   0.00000
           4    0.00031   0.00000  -0.00289   0.00000   0.00000   0.00000
           5   -0.00317   0.00000  -0.00974   0.00000  -0.00031   0.00000
           6   -0.01612   0.00000   0.08657   0.00000  -0.00321   0.00000
           7   -0.08466   0.00000   0.01542   0.00000  -0.00005   0.00000
           8   -0.10277   0.00000   0.06156   0.00000  -0.00356   0.00000

  ************** END OF LATEST ANALYSIS RESULT **************

  292. *
  293. *REACTIONS AT FOOTING/WALL BASE
  294. PRINT SUPPORT REACTIONS LIST 101 201 301
```

```
  SUPPORT REACTIONS -UNIT KIP  INCH    STRUCTURE TYPE = SPACE
  -----------------

JOINT  LOAD   FORCE-X   FORCE-Y   FORCE-Z     MOM-X     MOM-Y     MOM Z


   101    1      0.00      0.00      8.76      0.00      0.00      0.00
          2      0.00      0.00      0.14      0.00      0.00      0.00
          3      0.00      0.00      0.18      0.00      0.00      0.00
          4      0.00      0.00      0.65      0.00      0.00      0.00
          5      0.00      0.00      0.73      0.00      0.00      0.00
          6      0.00      0.00     -1.44      0.00      0.00      0.00
          7      0.00      0.00     -0.88      0.00      0.00      0.00
          8      0.00      0.00      8.13      0.00      0.00      0.00
   201    1     -0.14      0.00     35.36      0.00      0.00      0.00
          2      0.00      0.00      0.70      0.00      0.00      0.00
          3      0.00      0.00      0.92      0.00      0.00      0.00
          4     -0.02      0.00      3.31      0.00      0.00      0.00
          5     12.32      0.00     -0.14      0.00      0.00      0.00
          6    -22.73      0.00      0.27      0.00      0.00      0.00
          7    -14.92      0.00      0.17      0.00      0.00      0.00
          8    -25.49      0.00     40.60      0.00      0.00      0.00
   301    1      0.00      0.00     12.08      0.00      0.00      0.00
          2      0.00      0.00      0.23      0.00      0.00      0.00
          3      0.00      0.00      0.31      0.00      0.00      0.00
          4      0.00      0.00      1.09      0.00      0.00      0.00
          5      0.00      0.00     -0.59      0.00      0.00      0.00
          6      0.00      0.00      1.17      0.00      0.00      0.00
          7      0.00      0.00      0.72      0.00      0.00      0.00
          8      0.00      0.00     15.01      0.00      0.00      0.00


  ************** END OF LATEST ANALYSIS RESULT **************


  295. *
  296. *ELEMENT STRESSES IN STRIP FROM TOP TO BOTTOM FO WALL:
  297. PRINT ELEMENT STRESSES LIST 2001 1901 1801 1701 1601 1501 1401 1301 1201 -
  298. 1101 1001
```

```
 ELEMENT STRESSES    FORCE,LENGTH UNITS= KIP  INCH
 ----------------

         STRESS = FORCE/UNIT WIDTH/THICK, MOMENT = FORCE-LENGTH/UNIT WIDTH

ELEMENT  LOAD       SQX        SQY          MX          MY           MXY
                    VONT       VONB         SX          SY           SXY
                    TRESCAT    TRESCAB


 2001      1        0.00       0.00        0.07        0.01         0.00
                    0.01       0.02       -0.01        0.00         0.00
                    0.01       0.02
     TOP :  SMAX=     0.00  SMIN=    -0.01  TMAX=     0.01  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=    -0.01  TMAX=     0.01  ANGLE=  90.0
           2        0.00       0.00        0.01        0.00         0.00
                    0.00       0.00        0.00        0.00         0.00
                    0.00       0.00
     TOP :  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
           3        0.00       0.00        0.01        0.00         0.00
                    0.00       0.00        0.00        0.00         0.00
                    0.00       0.00
     TOP :  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
           4        0.00       0.00        0.04        0.01         0.00
                    0.01       0.01       -0.01        0.00         0.00
                    0.01       0.01
     TOP :  SMAX=     0.00  SMIN=    -0.01  TMAX=     0.00  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=    -0.01  TMAX=     0.00  ANGLE=  90.0
           5        0.00       0.00        0.01        0.00         0.00
                    0.00       0.00        0.00        0.00         0.00
                    0.00       0.00
     TOP :  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
           6       -0.01       0.00        1.10       30.91         0.00
                    0.47       1.39        0.00       -0.46         0.00
                    0.49       1.40
     TOP :  SMAX=     0.49  SMIN=     0.03  TMAX=     0.23  ANGLE=   0.0
     BOTT:  SMAX=    -0.03  SMIN=    -1.40  TMAX=     0.68  ANGLE=   0.0
           7        0.00       0.00       -0.43       -0.07         0.00
                    0.45       0.46        0.00       -0.45         0.00
                    0.46       0.46
     TOP :  SMAX=    -0.01  SMIN=    -0.46  TMAX=     0.22  ANGLE=   0.0
     BOTT:  SMAX=     0.01  SMIN=    -0.45  TMAX=     0.23  ANGLE=   0.0
           8       -0.01       0.00        0.80       30.86         0.00
                    0.04       1.83       -0.02       -0.90         0.00
                    0.04       1.85
     TOP :  SMAX=     0.04  SMIN=     0.00  TMAX=     0.02  ANGLE=  90.0
     BOTT:  SMAX=    -0.05  SMIN=    -1.85  TMAX=     0.90  ANGLE=   0.0

 1901      1        0.00       0.00        0.07        0.01         0.00
                    0.01       0.02       -0.01        0.00         0.00
                    0.01       0.02
     TOP :  SMAX=     0.00  SMIN=    -0.01  TMAX=     0.01  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=    -0.02  TMAX=     0.01  ANGLE=  90.0
```

```
 ELEMENT STRESSES    FORCE,LENGTH UNITS= KIP  INCH
 ----------------

        STRESS = FORCE/UNIT WIDTH/THICK, MOMENT = FORCE-LENGTH/UNIT WIDTH

ELEMENT  LOAD       SQX         SQY          MX          MY           MXY
                    VONT        VONB         SX          SY           SXY
                    TRESCAT     TRESCAB

          2         0.00        0.00        0.01        0.00         0.00
                    0.00        0.00        0.00        0.00         0.00
                    0.00        0.00
     TOP :  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
          3         0.00        0.00        0.01        0.00         0.00
                    0.00        0.00        0.00        0.00         0.00
                    0.00        0.00
     TOP :  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
          4         0.00        0.00        0.03        0.01         0.00
                    0.01        0.01       -0.01        0.00         0.00
                    0.01        0.01
     TOP :  SMAX=     0.00  SMIN=    -0.01  TMAX=     0.00  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=    -0.01  TMAX=     0.00  ANGLE=  90.0
          5         0.00        0.00        0.01        0.00         0.00
                    0.04        0.04        0.00        0.04         0.00
                    0.04        0.04
     TOP :  SMAX=     0.04  SMIN=     0.00  TMAX=     0.02  ANGLE=  90.0
     BOTT:  SMAX=     0.04  SMIN=     0.00  TMAX=     0.02  ANGLE=  90.0
          6        -0.02        0.00        6.33       31.80         0.00
                    0.72        1.06        0.00       -0.17         0.00
                    0.80        1.14
     TOP :  SMAX=     0.80  SMIN=     0.19  TMAX=     0.30  ANGLE=   0.0
     BOTT:  SMAX=    -0.19  SMIN=    -1.14  TMAX=     0.48  ANGLE=   0.0
          7         0.00        0.00       -0.34       -0.06         0.00
                    0.45        0.45        0.00       -0.45         0.00
                    0.45        0.46
     TOP :  SMAX=    -0.01  SMIN=    -0.45  TMAX=     0.22  ANGLE=   0.0
     BOTT:  SMAX=     0.01  SMIN=    -0.45  TMAX=     0.23  ANGLE=   0.0
          8        -0.02        0.00        6.11       31.76         0.00
                    0.35        1.45       -0.02       -0.58         0.00
                    0.40        1.55
     TOP :  SMAX=     0.40  SMIN=     0.16  TMAX=     0.12  ANGLE=   0.0
     BOTT:  SMAX=    -0.21  SMIN=    -1.55  TMAX=     0.67  ANGLE=   0.0

 1801     1         0.00        0.00        0.05        0.01         0.00
                    0.02        0.02       -0.02        0.00         0.00
                    0.02        0.02
     TOP :  SMAX=     0.00  SMIN=    -0.02  TMAX=     0.01  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=    -0.02  TMAX=     0.01  ANGLE=  90.0
          2         0.00        0.00        0.00        0.00         0.00
                    0.00        0.00        0.00        0.00         0.00
                    0.00        0.00
     TOP :  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
```

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 ELEMENT STRESSES    FORCE,LENGTH UNITS= KIP  INCH
 ----------------

          STRESS = FORCE/UNIT WIDTH/THICK, MOMENT = FORCE-LENGTH/UNIT WIDTH

ELEMENT  LOAD       SQX        SQY          MX          MY          MXY
                    VONT       VONB         SX          SY          SXY
                    TRESCAT    TRESCAB

           3        0.00       0.00        0.01        0.00         0.00
                    0.00       0.00        0.00        0.00         0.00
                    0.00       0.00
     TOP :  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
           4        0.00       0.00        0.02        0.00         0.00
                    0.01       0.01       -0.01        0.00         0.00
                    0.01       0.01
     TOP :  SMAX=     0.00  SMIN=    -0.01  TMAX=     0.00  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=    -0.01  TMAX=     0.00  ANGLE=  90.0
           5        0.00       0.00        0.06        0.01         0.00
                    0.10       0.11        0.00        0.10         0.00
                    0.11       0.11
     TOP :  SMAX=     0.11  SMIN=     0.00  TMAX=     0.05  ANGLE=   0.0
     BOTT:  SMAX=     0.10  SMIN=     0.00  TMAX=     0.05  ANGLE=   0.0
           6       -0.02       0.00       17.48       33.70         0.00
                    0.93       0.85        0.00        0.05         0.00
                    1.08       0.98
     TOP :  SMAX=     1.08  SMIN=     0.54  TMAX=     0.27  ANGLE=   0.0
     BOTT:  SMAX=    -0.54  SMIN=    -0.98  TMAX=     0.22  ANGLE=   0.0
           7        0.00       0.00       -1.50       -0.25         0.00
                    0.43       0.46        0.00       -0.45         0.00
                    0.46       0.49
     TOP :  SMAX=    -0.05  SMIN=    -0.46  TMAX=     0.20  ANGLE=   0.0
     BOTT:  SMAX=     0.05  SMIN=    -0.44  TMAX=     0.24  ANGLE=   0.0
           8       -0.02       0.00       16.12       33.46         0.00
                    0.64       1.15       -0.03       -0.30         0.00
                    0.73       1.32
     TOP :  SMAX=     0.73  SMIN=     0.47  TMAX=     0.13  ANGLE=   0.0
     BOTT:  SMAX=    -0.52  SMIN=    -1.32  TMAX=     0.40  ANGLE=   0.0

 1701      1        0.00       0.00        0.02        0.00         0.00
                    0.02       0.02       -0.02        0.00         0.00
                    0.02       0.02
     TOP :  SMAX=     0.00  SMIN=    -0.02  TMAX=     0.01  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=    -0.02  TMAX=     0.01  ANGLE=  90.0
           2        0.00       0.00        0.00        0.00         0.00
                    0.00       0.00        0.00        0.00         0.00
                    0.00       0.00
     TOP :  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
           3        0.00       0.00        0.00        0.00         0.00
                    0.00       0.00        0.00        0.00         0.00
                    0.00       0.00
     TOP :  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
```

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 ELEMENT STRESSES    FORCE,LENGTH UNITS= KIP  INCH
 ----------------

          STRESS = FORCE/UNIT WIDTH/THICK, MOMENT = FORCE-LENGTH/UNIT WIDTH

ELEMENT  LOAD       SQX        SQY          MX          MY          MXY
                    VONT       VONB         SX          SY          SXY
                    TRESCAT    TRESCAB

           4        0.00       0.00        0.01        0.00         0.00
                    0.01       0.01       -0.01        0.00         0.00
                    0.01       0.01
     TOP :  SMAX=     0.00  SMIN=    -0.01  TMAX=     0.00  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=    -0.01  TMAX=     0.00  ANGLE=  90.0
           5        0.00       0.00       -0.31       -0.05         0.00
                    0.19       0.18        0.00        0.19         0.00
                    0.19       0.19
     TOP :  SMAX=     0.18  SMIN=    -0.01  TMAX=     0.10  ANGLE=   0.0
     BOTT:  SMAX=     0.19  SMIN=     0.01  TMAX=     0.09  ANGLE=   0.0
           6       -0.01       0.00       30.19       35.86         0.00
                    1.10       0.95        0.00        0.12         0.00
                    1.22       0.98
     TOP :  SMAX=     1.22  SMIN=     0.92  TMAX=     0.15  ANGLE=   0.0
     BOTT:  SMAX=    -0.92  SMIN=    -0.98  TMAX=     0.03  ANGLE=  90.0
           7        0.00       0.00       -1.12       -0.19         0.00
                    0.45       0.47        0.00       -0.46         0.00
                    0.47       0.49
     TOP :  SMAX=    -0.03  SMIN=    -0.47  TMAX=     0.22  ANGLE=   0.0
     BOTT:  SMAX=     0.03  SMIN=    -0.46  TMAX=     0.25  ANGLE=   0.0
           8       -0.01       0.00       28.79       35.62         0.00
                    0.90       1.12       -0.03       -0.16         0.00
                    0.93       1.25
     TOP :  SMAX=     0.93  SMIN=     0.85  TMAX=     0.04  ANGLE=  90.0
     BOTT:  SMAX=    -0.91  SMIN=    -1.25  TMAX=     0.17  ANGLE=   0.0

 1601      1        0.00       0.00        0.00        0.00         0.00
                    0.03       0.03       -0.03        0.00         0.00
                    0.03       0.03
     TOP :  SMAX=     0.00  SMIN=    -0.03  TMAX=     0.01  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=    -0.03  TMAX=     0.01  ANGLE=  90.0
           2        0.00       0.00        0.00        0.00         0.00
                    0.00       0.00        0.00        0.00         0.00
                    0.00       0.00
     TOP :  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
           3        0.00       0.00        0.00        0.00         0.00
                    0.00       0.00        0.00        0.00         0.00
                    0.00       0.00
     TOP :  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
           4        0.00       0.00        0.00        0.00         0.00
                    0.01       0.01       -0.01        0.00         0.00
                    0.01       0.01
     TOP :  SMAX=     0.00  SMIN=    -0.01  TMAX=     0.00  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=    -0.01  TMAX=     0.00  ANGLE=  90.0
```

```
 ELEMENT STRESSES    FORCE,LENGTH UNITS= KIP  INCH
 ----------------

         STRESS = FORCE/UNIT WIDTH/THICK, MOMENT = FORCE-LENGTH/UNIT WIDTH

ELEMENT  LOAD        SQX         SQY          MX          MY           MXY
                     VONT        VONB         SX          SY           SXY
                     TRESCAT     TRESCAB

           5         0.00        0.00        -0.73       -0.12         0.00
                     0.27        0.26         0.00        0.26         0.00
                     0.28        0.27
     TOP :  SMAX=     0.26  SMIN=    -0.02  TMAX=      0.14  ANGLE=   0.0
     BOTT:  SMAX=     0.27  SMIN=     0.02  TMAX=      0.12  ANGLE=   0.0
           6        -0.01        0.00        37.53       37.10         0.00
                     1.19        1.10         0.00        0.08         0.00
                     1.22        1.15
     TOP :  SMAX=     1.22  SMIN=     1.15  TMAX=      0.04  ANGLE=  90.0
     BOTT:  SMAX=    -1.05  SMIN=    -1.15  TMAX=      0.05  ANGLE=  90.0
           7         0.00        0.00        -0.48       -0.08         0.00
                     0.49        0.50         0.00       -0.49         0.00
                     0.49        0.50
     TOP :  SMAX=    -0.01  SMIN=    -0.49  TMAX=      0.24  ANGLE=   0.0
     BOTT:  SMAX=     0.01  SMIN=    -0.49  TMAX=      0.25  ANGLE=   0.0
           8        -0.01        0.00        36.33       36.90         0.00
                     1.03        1.22        -0.04       -0.14         0.00
                     1.08        1.27
     TOP :  SMAX=     1.08  SMIN=     0.98  TMAX=      0.05  ANGLE=  90.0
     BOTT:  SMAX=    -1.15  SMIN=    -1.27  TMAX=      0.06  ANGLE=   0.0

 1501      1         0.00        0.00         0.00        0.00         0.00
                     0.03        0.03        -0.03        0.00         0.00
                     0.03        0.03
     TOP :  SMAX=     0.00  SMIN=    -0.03  TMAX=      0.02  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=    -0.03  TMAX=      0.02  ANGLE=  90.0
           2         0.00        0.00         0.00        0.00         0.00
                     0.00        0.00         0.00        0.00         0.00
                     0.00        0.00
     TOP :  SMAX=     0.00  SMIN=     0.00  TMAX=      0.00  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=     0.00  TMAX=      0.00  ANGLE=  90.0
           3         0.00        0.00         0.00        0.00         0.00
                     0.00        0.00         0.00        0.00         0.00
                     0.00        0.00
     TOP :  SMAX=     0.00  SMIN=     0.00  TMAX=      0.00  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=     0.00  TMAX=      0.00  ANGLE=  90.0
           4         0.00        0.00         0.00        0.00         0.00
                     0.01        0.01        -0.01        0.00         0.00
                     0.01        0.01
     TOP :  SMAX=     0.00  SMIN=    -0.01  TMAX=      0.00  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=    -0.01  TMAX=      0.00  ANGLE=  90.0
           5         0.00        0.00        -0.42       -0.07         0.00
                     0.34        0.33         0.00        0.33         0.00
                     0.34        0.33
     TOP :  SMAX=     0.33  SMIN=    -0.01  TMAX=      0.17  ANGLE=   0.0
     BOTT:  SMAX=     0.33  SMIN=     0.01  TMAX=      0.16  ANGLE=   0.0
```

```
 ELEMENT STRESSES    FORCE,LENGTH UNITS= KIP  INCH
 ----------------

         STRESS = FORCE/UNIT WIDTH/THICK, MOMENT = FORCE-LENGTH/UNIT WIDTH

ELEMENT  LOAD       SQX         SQY          MX           MY           MXY
                    VONT        VONB         SX           SY           SXY
                    TRESCAT     TRESCAB

           6        0.00        0.00        40.74        37.65         0.00
                    1.23        1.18         0.00         0.05         0.00
                    1.25        1.25
     TOP :  SMAX=     1.25  SMIN=     1.20  TMAX=     0.02  ANGLE=  90.0
     BOTT:  SMAX=    -1.10  SMIN=    -1.25  TMAX=     0.07  ANGLE=   0.0
           7        0.00        0.00        -0.34        -0.06         0.00
                    0.53        0.53         0.00        -0.53         0.00
                    0.53        0.54
     TOP :  SMAX=    -0.01  SMIN=    -0.53  TMAX=     0.26  ANGLE=   0.0
     BOTT:  SMAX=     0.01  SMIN=    -0.53  TMAX=     0.27  ANGLE=   0.0
           8        0.00        0.00        39.98        37.52         0.00
                    1.10        1.28        -0.04        -0.15         0.00
                    1.18        1.30
     TOP :  SMAX=     1.18  SMIN=     1.00  TMAX=     0.09  ANGLE=   0.0
     BOTT:  SMAX=    -1.26  SMIN=    -1.30  TMAX=     0.02  ANGLE=  90.0

 1401      1        0.00        0.00         0.00         0.00         0.00
                    0.03        0.03        -0.03         0.00         0.00
                    0.03        0.03
     TOP :  SMAX=     0.00  SMIN=    -0.03  TMAX=     0.02  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=    -0.03  TMAX=     0.02  ANGLE=  90.0
           2        0.00        0.00         0.00         0.00         0.00
                    0.00        0.00         0.00         0.00         0.00
                    0.00        0.00
     TOP :  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
           3        0.00        0.00         0.00         0.00         0.00
                    0.00        0.00         0.00         0.00         0.00
                    0.00        0.00
     TOP :  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
           4        0.00        0.00         0.00         0.00         0.00
                    0.01        0.01        -0.01         0.00         0.00
                    0.01        0.01
     TOP :  SMAX=     0.00  SMIN=    -0.01  TMAX=     0.00  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=    -0.01  TMAX=     0.00  ANGLE=  90.0
           5        0.00        0.00         1.82         0.31         0.00
                    0.38        0.42         0.00         0.39         0.00
                    0.40        0.44
     TOP :  SMAX=     0.40  SMIN=     0.06  TMAX=     0.17  ANGLE=   0.0
     BOTT:  SMAX=     0.38  SMIN=    -0.06  TMAX=     0.22  ANGLE=   0.0
           6        0.00        0.00        41.21        37.73         0.00
                    1.24        1.18         0.00         0.07         0.00
                    1.26        1.26
     TOP :  SMAX=     1.26  SMIN=     1.23  TMAX=     0.02  ANGLE=  90.0
     BOTT:  SMAX=    -1.08  SMIN=    -1.26  TMAX=     0.09  ANGLE=   0.0
```

```
 ELEMENT STRESSES    FORCE,LENGTH UNITS= KIP   INCH
 ----------------

          STRESS = FORCE/UNIT WIDTH/THICK, MOMENT = FORCE-LENGTH/UNIT WIDTH

ELEMENT  LOAD         SQX         SQY          MX           MY            MXY
                      VONT        VONB         SX           SY            SXY
                      TRESCAT     TRESCAB

          7           0.01        0.00        -2.53        -0.43          0.00
                      0.56        0.61         0.00        -0.58          0.00
                      0.59        0.64
     TOP :  SMAX=    -0.08  SMIN=    -0.59  TMAX=     0.26  ANGLE=   0.0
     BOTT:  SMAX=     0.08  SMIN=    -0.56  TMAX=     0.32  ANGLE=   0.0
          8           0.00        0.00        40.49        37.61          0.00
                      1.13        1.27        -0.04        -0.11          0.00
                      1.20        1.28
     TOP :  SMAX=     1.20  SMIN=     1.04  TMAX=     0.08  ANGLE=   0.0
     BOTT:  SMAX=    -1.26  SMIN=    -1.28  TMAX=     0.01  ANGLE=  90.0

 1301     1           0.00        0.00         0.00         0.00          0.00
                      0.04        0.04        -0.04         0.00          0.00
                      0.04        0.04
     TOP :  SMAX=     0.00  SMIN=    -0.04  TMAX=     0.02  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=    -0.04  TMAX=     0.02  ANGLE=  90.0
          2           0.00        0.00         0.00         0.00          0.00
                      0.00        0.00         0.00         0.00          0.00
                      0.00        0.00
     TOP :  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
          3           0.00        0.00         0.00         0.00          0.00
                      0.00        0.00         0.00         0.00          0.00
                      0.00        0.00
     TOP :  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
          4           0.00        0.00         0.00         0.00          0.00
                      0.01        0.01        -0.01         0.00          0.00
                      0.01        0.01
     TOP :  SMAX=     0.00  SMIN=    -0.01  TMAX=     0.00  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=    -0.01  TMAX=     0.00  ANGLE=  90.0
          5          -0.01        0.00         7.25         1.23          0.00
                      0.46        0.59         0.00         0.49          0.00
                      0.53        0.67
     TOP :  SMAX=     0.53  SMIN=     0.22  TMAX=     0.15  ANGLE=   0.0
     BOTT:  SMAX=     0.45  SMIN=    -0.22  TMAX=     0.34  ANGLE=   0.0
          6           0.01        0.00        37.97        37.18          0.00
                      1.23        1.09         0.00         0.15          0.00
                      1.29        1.16
     TOP :  SMAX=     1.29  SMIN=     1.16  TMAX=     0.06  ANGLE=   0.0
     BOTT:  SMAX=    -0.99  SMIN=    -1.16  TMAX=     0.09  ANGLE=   0.0
          7           0.01        0.00        -8.78        -1.49          0.00
                      0.62        0.79         0.00        -0.67          0.00
                      0.71        0.89
     TOP :  SMAX=    -0.27  SMIN=    -0.71  TMAX=     0.22  ANGLE=   0.0
     BOTT:  SMAX=     0.27  SMIN=    -0.62  TMAX=     0.44  ANGLE=   0.0
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 ELEMENT STRESSES    FORCE,LENGTH UNITS= KIP   INCH
 ----------------

         STRESS = FORCE/UNIT WIDTH/THICK, MOMENT = FORCE-LENGTH/UNIT WIDTH

ELEMENT  LOAD       SQX         SQY          MX          MY           MXY
                    VONT        VONB         SX          SY           SXY
                    TRESCAT     TRESCAB

          8         0.01        0.00        36.45       36.92         0.00
                    1.09        1.16        -0.05       -0.03         0.00
                    1.10        1.16
     TOP :  SMAX=     1.10  SMIN=     1.07  TMAX=      0.02  ANGLE=  90.0
     BOTT:  SMAX=    -1.16  SMIN=    -1.16  TMAX=      0.00  ANGLE=  90.0

 1201     1         0.00        0.00         0.00        0.00         0.00
                    0.04        0.04        -0.04        0.00         0.00
                    0.04        0.04
     TOP :  SMAX=     0.00  SMIN=    -0.04  TMAX=      0.02  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=    -0.04  TMAX=      0.02  ANGLE=  90.0
          2         0.00        0.00         0.00        0.00         0.00
                    0.00        0.00         0.00        0.00         0.00
                    0.00        0.00
     TOP :  SMAX=     0.00  SMIN=     0.00  TMAX=      0.00  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=     0.00  TMAX=      0.00  ANGLE=  90.0
          3         0.00        0.00         0.00        0.00         0.00
                    0.00        0.00         0.00        0.00         0.00
                    0.00        0.00
     TOP :  SMAX=     0.00  SMIN=     0.00  TMAX=      0.00  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=     0.00  TMAX=      0.00  ANGLE=  90.0
          4         0.00        0.00         0.00        0.00         0.00
                    0.01        0.01        -0.01        0.00         0.00
                    0.01        0.01
     TOP :  SMAX=     0.00  SMIN=    -0.01  TMAX=      0.00  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=    -0.01  TMAX=      0.00  ANGLE=  90.0
          5        -0.01        0.00        15.48        2.63         0.00
                    0.68        0.94         0.00        0.69         0.00
                    0.77        1.09
     TOP :  SMAX=     0.77  SMIN=     0.47  TMAX=      0.15  ANGLE=   0.0
     BOTT:  SMAX=     0.61  SMIN=    -0.47  TMAX=      0.54  ANGLE=   0.0
          6         0.02        0.00        27.52       35.40         0.00
                    1.15        0.85         0.00        0.23         0.00
                    1.31        0.85
     TOP :  SMAX=     1.31  SMIN=     0.84  TMAX=      0.24  ANGLE=   0.0
     BOTT:  SMAX=    -0.84  SMIN=    -0.85  TMAX=      0.01  ANGLE=  90.0
          7         0.01        0.00       -18.58       -3.16         0.00
                    0.86        1.18         0.00       -0.89         0.00
                    0.98        1.36
     TOP :  SMAX=    -0.57  SMIN=    -0.98  TMAX=      0.21  ANGLE=   0.0
     BOTT:  SMAX=     0.57  SMIN=    -0.79  TMAX=      0.68  ANGLE=   0.0
          8         0.03        0.00        24.43       34.88         0.00
                    0.97        0.94        -0.05        0.04         0.00
                    1.10        1.03
     TOP :  SMAX=     1.10  SMIN=     0.70  TMAX=      0.20  ANGLE=   0.0
     BOTT:  SMAX=    -0.80  SMIN=    -1.03  TMAX=      0.12  ANGLE=   0.0
```

```
 ELEMENT STRESSES    FORCE,LENGTH UNITS= KIP  INCH
 ----------------

         STRESS = FORCE/UNIT WIDTH/THICK, MOMENT = FORCE-LENGTH/UNIT WIDTH

ELEMENT  LOAD       SQX         SQY          MX          MY          MXY
                    VONT        VONB         SX          SY          SXY
                    TRESCAT     TRESCAB


 1101      1        0.00        0.00         0.00        0.00         0.00
                    0.05        0.05        -0.05        0.00         0.00
                    0.05        0.05
     TOP :  SMAX=     0.00  SMIN=    -0.05  TMAX=      0.02  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=    -0.05  TMAX=      0.02  ANGLE=  90.0
           2        0.00        0.00         0.00        0.00         0.00
                    0.00        0.00         0.00        0.00         0.00
                    0.00        0.00
     TOP :  SMAX=     0.00  SMIN=     0.00  TMAX=      0.00  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=     0.00  TMAX=      0.00  ANGLE=  90.0
           3        0.00        0.00         0.00        0.00         0.00
                    0.00        0.00         0.00        0.00         0.00
                    0.00        0.00
     TOP :  SMAX=     0.00  SMIN=     0.00  TMAX=      0.00  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=     0.00  TMAX=      0.00  ANGLE=  90.0
           4        0.00        0.00         0.00        0.00         0.00
                    0.01        0.01        -0.01        0.00         0.00
                    0.01        0.01
     TOP :  SMAX=     0.00  SMIN=    -0.01  TMAX=      0.00  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=    -0.01  TMAX=      0.00  ANGLE=  90.0
           5        0.00        0.00        20.58        3.50         0.00
                    1.07        1.44         0.00        1.12         0.00
                    1.23        1.65
     TOP :  SMAX=     1.23  SMIN=     0.63  TMAX=      0.30  ANGLE=   0.0
     BOTT:  SMAX=     1.02  SMIN=    -0.63  TMAX=      0.82  ANGLE=   0.0
           6        0.02        0.00         9.66       19.43         0.00
                    0.36        0.69         0.00       -0.20         0.00
                    0.40        0.79
     TOP :  SMAX=     0.40  SMIN=     0.30  TMAX=      0.05  ANGLE=   0.0
     BOTT:  SMAX=    -0.30  SMIN=    -0.79  TMAX=      0.25  ANGLE=   0.0
           7        0.00        0.00       -24.74       -4.21         0.00
                    1.31        1.76         0.00       -1.38         0.00
                    1.51        2.01
     TOP :  SMAX=    -0.76  SMIN=    -1.51  TMAX=      0.38  ANGLE=   0.0
     BOTT:  SMAX=     0.76  SMIN=    -1.25  TMAX=      1.00  ANGLE=   0.0
           8        0.02        0.00         5.49       18.72         0.00
                    0.12        0.94        -0.06       -0.45         0.00
                    0.12        1.03
     TOP :  SMAX=     0.12  SMIN=     0.11  TMAX=      0.00  ANGLE=  90.0
     BOTT:  SMAX=    -0.22  SMIN=    -1.03  TMAX=      0.40  ANGLE=   0.0

 1001      1        0.00        0.00         0.00        0.00         0.00
                    0.05        0.05        -0.05        0.00         0.00
                    0.05        0.05
     TOP :  SMAX=     0.00  SMIN=    -0.05  TMAX=      0.02  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=    -0.05  TMAX=      0.02  ANGLE=  90.0
```

```
 ELEMENT STRESSES    FORCE,LENGTH UNITS= KIP  INCH
 ----------------

        STRESS = FORCE/UNIT WIDTH/THICK, MOMENT = FORCE-LENGTH/UNIT WIDTH

ELEMENT  LOAD       SQX         SQY          MX          MY          MXY
                    VONT        VONB         SX          SY          SXY
                    TRESCAT     TRESCAB

          2        0.00        0.00        0.00        0.00         0.00
                   0.00        0.00        0.00        0.00         0.00
                   0.00        0.00
     TOP :  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
          3        0.00        0.00        0.00        0.00         0.00
                   0.00        0.00        0.00        0.00         0.00
                   0.00        0.00
     TOP :  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
          4        0.00        0.00        0.00        0.00         0.00
                   0.01        0.01       -0.01        0.00         0.00
                   0.01        0.01
     TOP :  SMAX=     0.00  SMIN=    -0.01  TMAX=     0.00  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=    -0.01  TMAX=     0.00  ANGLE=  90.0
          5        0.00        0.00        0.00        0.00         0.00
                   0.78        0.78        0.00        0.78         0.00
                   0.78        0.78
     TOP :  SMAX=     0.78  SMIN=     0.00  TMAX=     0.39  ANGLE=   0.0
     BOTT:  SMAX=     0.78  SMIN=     0.00  TMAX=     0.39  ANGLE=   0.0
          6        0.00        0.00       21.43       21.43         0.00
                   0.64        1.11        0.00       -0.63         0.00
                   0.66        1.28
     TOP :  SMAX=     0.66  SMIN=     0.03  TMAX=     0.31  ANGLE=   0.0
     BOTT:  SMAX=    -0.66  SMIN=    -1.28  TMAX=     0.31  ANGLE=   0.0
          7        0.00        0.00        0.00        0.00         0.00
                   0.94        0.94        0.00       -0.94         0.00
                   0.94        0.94
     TOP :  SMAX=     0.00  SMIN=    -0.94  TMAX=     0.47  ANGLE=   0.0
     BOTT:  SMAX=     0.00  SMIN=    -0.94  TMAX=     0.47  ANGLE=   0.0
          8        0.00        0.00       21.43       21.43         0.00
                   0.68        1.26       -0.06       -0.79         0.00
                   0.73        1.45
     TOP :  SMAX=     0.60  SMIN=    -0.14  TMAX=     0.37  ANGLE=   0.0
     BOTT:  SMAX=    -0.72  SMIN=    -1.45  TMAX=     0.37  ANGLE=   0.0
```

```
        **** MAXIMUM STRESSES AMONG SELECTED PLATES AND CASES ****
           MAXIMUM        MINIMUM        MAXIMUM        MAXIMUM        MAXIMUM
          PRINCIPAL      PRINCIPAL        SHEAR         VONMISES        TRESCA
           STRESS         STRESS         STRESS         STRESS         STRESS

        1.312954E+00 -1.849616E+00  1.004414E+00  1.826875E+00  2.008828E+00
PLATE NO.     1201          2001           1101           2001           1101
CASE  NO.        6             8              7              8              7


  ********************END OF ELEMENT FORCES********************


  299. *
  300. *ELEMENT FORCES IN STRIP FROM TOP TO BOTTOM OF WALL:
  301. PRINT ELEMENT FORCES LIST 2001 1901 1801 1701 1601 1501 1401 1301 1201 -
  302. 1101 1001
```

```
 ELEMENT FORCES    FORCE,LENGTH UNITS= KIP  INCH
 --------------

 **NOTE- IF A COMBINATION INCLUDES A DYNAMIC CASE OR IS AN SRSS OR ABS COMBINATION
         THEN RESULTS CANNOT BE COMPUTED PROPERLY.
   GLOBAL CORNER FORCES
JOINT      FX           FY           FZ           MX           MY           MZ

             ELE.NO.   2001 FOR LOAD CASE      1
 1301  2.1197E-02 -2.2877E-01  5.1043E+00  5.0521E+01  2.6960E-01  2.6505E-02
 1401 -2.1057E-05 -2.5614E-01 -5.1043E+00 -5.0502E+01  2.7754E-04  2.6349E-01
 1402 -2.2303E-02  2.5516E-01 -5.1043E+00  5.0309E+01  4.4012E+00 -2.6348E-01
 1302  1.1262E-03  2.2974E-01  5.1043E+00 -5.0352E+01 -4.1353E+00 -2.6789E-02
             ELE.NO.   2001 FOR LOAD CASE      2
 1301  1.4112E-03 -1.4217E-02  5.3500E-01  5.2590E+00  1.9108E-02  7.0396E-03
 1401 -3.5589E-08 -1.8103E-02 -5.3500E-01 -5.2559E+00  5.3711E-07  2.3782E-02
 1402 -1.5779E-03  1.8034E-02 -5.3500E-01  5.2359E+00  4.5808E-01 -2.3781E-02
 1302  1.6664E-04  1.4286E-02  5.3500E-01 -5.2406E+00 -4.3932E-01 -7.0432E-03
             ELE.NO.   2001 FOR LOAD CASE      3
 1301  1.8596E-03 -1.8734E-02  7.0500E-01  6.9300E+00  2.5178E-02  9.2769E-03
 1401  5.2528E-09 -2.3856E-02 -7.0500E-01 -6.9260E+00  5.8686E-07  3.1338E-02
 1402 -2.0792E-03  2.3765E-02 -7.0500E-01  6.8996E+00  6.0364E-01 -3.1337E-02
 1302  2.1955E-04  1.8826E-02  7.0500E-01 -6.9059E+00 -5.7892E-01 -9.2815E-03
             ELE.NO.   2001 FOR LOAD CASE      4
 1301  6.6604E-03 -6.7100E-02  2.5250E+00  2.4820E+01  9.0181E-02  3.3226E-02
 1401 -3.3024E-08 -8.5440E-02 -2.5250E+00 -2.4806E+01 -2.7677E-06  1.1224E-01
 1402 -7.4468E-03  8.5117E-02 -2.5250E+00  2.4711E+01  2.1620E+00 -1.1224E-01
 1302  7.8642E-04  6.7423E-02  2.5250E+00 -2.4734E+01 -2.0734E+00 -3.3243E-02
             ELE.NO.   2001 FOR LOAD CASE      5
 1301  4.5342E-02 -1.5751E+00  2.8038E-05  1.1791E+00 -6.4233E-01  2.7676E-01
 1401 -3.6786E-06  5.3665E-01 -2.8580E-05 -3.0111E+00  2.9350E-05 -2.1946E-01
 1402  4.6773E-02 -5.3461E-01 -9.0720E-06  2.9997E+00  2.6247E-01  2.1946E-01
 1302 -9.2111E-02  1.5731E+00  9.6137E-06 -1.1186E+00 -7.4262E-01 -2.7663E-01
             ELE.NO.   2001 FOR LOAD CASE      6
 1301 -1.7900E+00 -4.4721E+01 -2.7205E+02 -2.5464E+03  8.8989E+02 -3.3647E+01
 1401  4.8949E+00 -2.6389E+01  2.7205E+02  2.5318E+03 -9.8035E+02 -1.1291E+02
 1402  2.5761E+00  2.6715E+01  2.7205E+02 -2.4367E+03 -1.1973E+03  1.1290E+02
 1302 -5.6810E+00  4.4395E+01 -2.7205E+02  2.4591E+03  1.1084E+03  3.3643E+01
             ELE.NO.   2001 FOR LOAD CASE      7
 1301 -3.3846E+00  7.6058E+01 -1.8498E-05 -3.0549E+02 -1.5436E+00 -2.0383E-01
 1401 -3.2698E+00  7.6354E+01  1.8100E-05  3.0525E+02 -3.9699E-06 -1.5569E+00
 1402  3.3973E+00 -7.6348E+01  1.8497E-05 -3.0409E+02 -2.6605E+01  1.5543E+00
 1302  3.2571E+00 -7.6063E+01 -1.8100E-05  3.0446E+02  2.5087E+01  2.0101E-01
             ELE.NO.   2001 FOR LOAD CASE      8
 1301 -5.0982E+00  2.9432E+01 -2.6318E+02 -2.7631E+03  8.8811E+02 -3.3498E+01
 1401  1.6251E+00  5.0118E+01  2.6318E+02  2.7465E+03 -9.8035E+02 -1.1425E+02
 1402  5.9868E+00 -4.9785E+01  2.6318E+02 -2.6506E+03 -1.2160E+03  1.1425E+02
 1302 -2.5137E+00 -2.9765E+01 -2.6318E+02  2.6752E+03  1.1256E+03  3.3491E+01

             ELE.NO.   1901 FOR LOAD CASE      1
 1201  3.1525E-02 -1.1119E-01  5.9527E+00  5.8231E+01  9.0922E-01 -1.4542E-01
 1301 -2.1196E-02 -1.2542E-01 -5.9527E+00 -5.8229E+01 -2.6894E-01  4.1913E-01
 1302 -3.1996E-02  1.2309E-01 -5.9527E+00  5.8031E+01  4.8065E+00 -4.1886E-01
 1202  2.1666E-02  1.1351E-01  5.9527E+00 -5.8089E+01 -4.1701E+00  1.4522E-01
             ELE.NO.   1901 FOR LOAD CASE      2
 1201  1.9356E-03 -4.7310E-03  5.3500E-01  5.2162E+00  6.0674E-02 -5.1499E-03
 1301 -1.4112E-03 -7.2803E-03 -5.3500E-01 -5.2146E+00 -1.9107E-02  3.1467E-02
 1302 -2.0403E-03  7.1305E-03 -5.3500E-01  5.1964E+00  4.3545E-01 -3.1465E-02
 1202  1.5159E-03  4.8808E-03  5.3500E-01 -5.2016E+00 -3.9419E-01  5.1512E-03
```

LOAD 5 = FLUID STATIC
LOAD 6 = TEMP
LOAD 7 = PRESTRESS
LOAD 8 = COMBINED

```
  ELEMENT FORCES    FORCE,LENGTH UNITS= KIP  INCH
  --------------
    GLOBAL CORNER FORCES
JOINT      FX          FY          FZ          MX          MY          MZ
              ELE.NO.   1901 FOR LOAD CASE     3
 1201  2.5506E-03 -6.2337E-03  7.0500E-01  6.8737E+00  7.9954E-02 -6.7865E-03
 1301 -1.8596E-03 -9.5940E-03 -7.0500E-01 -6.8716E+00 -2.5179E-02  4.1467E-02
 1302 -2.6885E-03  9.3956E-03 -7.0500E-01  6.8477E+00  5.7382E-01 -4.1463E-02
 1202  1.9976E-03  6.4321E-03  7.0500E-01 -6.8545E+00 -5.1944E-01  6.7882E-03
              ELE.NO.   1901 FOR LOAD CASE     4
 1201  9.1354E-03 -2.2328E-02  2.5250E+00  2.4618E+01  2.8636E-01 -2.4307E-02
 1301 -6.6606E-03 -3.4361E-02 -2.5250E+00 -2.4611E+01 -9.0177E-02  1.4852E-01
 1302 -9.6294E-03  3.3653E-02 -2.5250E+00  2.4525E+01  2.0552E+00 -1.4850E-01
 1202  7.1546E-03  2.3036E-02  2.5250E+00 -2.4550E+01 -1.8604E+00  2.4313E-02
              ELE.NO.   1901 FOR LOAD CASE     5
 1201  5.1404E-01 -8.3652E+00 -2.9277E-05  2.8295E+01  2.8459E+00 -1.5635E+00
 1301  1.2420E-01 -6.2528E+00  2.9667E-05 -3.0192E+01  6.4244E-01  1.5877E+00
 1302 -4.2124E-01  6.2399E+00  1.0311E-05  3.0021E+01  3.2715E+00 -1.5876E+00
 1202 -2.1699E-01  8.3782E+00 -1.0702E-05 -2.8435E+01  3.6916E-01  1.5640E+00
              ELE.NO.   1901 FOR LOAD CASE     6
 1201 -4.2997E+00 -8.9357E+01 -2.7205E+02 -2.3449E+03  6.9274E+02  2.4245E+01
 1301  1.1580E+01 -7.7379E+01  2.7205E+02  2.3375E+03 -8.8989E+02 -1.4944E+02
 1302  4.7914E+00  7.8094E+01  2.7205E+02 -2.2510E+03 -1.0902E+03  1.4944E+02
 1202 -1.2071E+01  8.8642E+01 -2.7205E+02  2.2756E+03  8.9447E+02 -2.4246E+01
              ELE.NO.   1901 FOR LOAD CASE     7
 1201 -3.4281E+00  7.5277E+01 -2.3463E-05 -3.0206E+02 -4.9437E+00  8.0050E-01
 1301 -3.1550E+00  7.5499E+01  1.4208E-05  3.0191E+02  1.5438E+00 -2.1946E+00
 1302  3.4373E+00 -7.5487E+01  4.4965E-06 -3.0090E+02 -2.4776E+01  2.1915E+00
 1202  3.1457E+00 -7.5289E+01  4.7582E-06  3.0134E+02  2.1400E+01 -8.0375E-01
              ELE.NO.   1901 FOR LOAD CASE     8
 1201 -7.1686E+00 -2.2590E+01 -2.6234E+02 -2.5237E+03  6.9198E+02  2.3300E+01
 1301  8.5178E+00 -8.3095E+00  2.6233E+02  2.5143E+03 -8.8811E+02 -1.4940E+02
 1302  7.7611E+00  9.0204E+00  2.6233E+02 -2.4273E+03 -1.1039E+03  1.4940E+02
 1202 -9.1104E+00  2.1879E+01 -2.6233E+02  2.4538E+03  9.0930E+02 -2.3304E+01

              ELE.NO.   1801 FOR LOAD CASE     1
 1101  3.3535E-02 -2.9843E-02  7.2256E+00  7.0248E+01  2.4558E+00 -2.1516E-01
 1201 -3.1511E-02 -1.6497E-02 -7.2256E+00 -7.0250E+01 -9.0865E-01  6.0324E-01
 1202 -3.2810E-02  1.3689E-02 -7.2256E+00  7.0062E+01  5.2170E+00 -6.0302E-01
 1102  3.0786E-02  3.2651E-02  7.2256E+00 -7.0195E+01 -3.6768E+00  2.1492E-01
              ELE.NO.   1801 FOR LOAD CASE     2
 1101  1.6152E-03  5.7618E-03  5.3500E-01  5.1626E+00  1.5058E-01 -6.9393E-03
 1201 -1.9356E-03  1.5767E-03 -5.3500E-01 -5.1556E+00 -6.0674E-02  4.0461E-02
 1202 -1.7908E-03 -1.7390E-03 -5.3500E-01  5.1412E+00  3.8890E-01 -4.0460E-02
 1102  2.1112E-03 -5.5996E-03  5.3500E-01 -5.1560E+00 -2.9994E-01  6.9393E-03
              ELE.NO.   1801 FOR LOAD CASE     3
 1101  2.1284E-03  7.5924E-03  7.0500E-01  6.8030E+00  1.9843E-01 -9.1442E-03
 1201 -2.5506E-03  2.0779E-03 -7.0500E-01 -6.7938E+00 -7.9953E-02  5.3317E-02
 1202 -2.3598E-03 -2.2913E-03 -7.0500E-01  6.7749E+00  5.1248E-01 -5.3317E-02
 1102  2.7821E-03 -7.3791E-03  7.0500E-01 -6.7944E+00 -3.9525E-01  9.1444E-03
              ELE.NO.   1801 FOR LOAD CASE     4
 1101  7.6229E-03  2.7194E-02  2.5250E+00  2.4365E+01  7.1069E-01 -3.2750E-02
 1201 -9.1353E-03  7.4419E-03 -2.5250E+00 -2.4332E+01 -2.8636E-01  1.9096E-01
 1202 -8.4518E-03 -8.2080E-03 -2.5250E+00  2.4265E+01  1.8355E+00 -1.9096E-01
 1102  9.9642E-03 -2.6428E-02  2.5250E+00 -2.4335E+01 -1.4156E+00  3.2751E-02
```

```
 ELEMENT FORCES    FORCE,LENGTH UNITS= KIP  INCH
 --------------
   GLOBAL CORNER FORCES
JOINT      FX          FY          FZ          MX          MY          MZ
              ELE.NO.   1801 FOR LOAD CASE      5
 1101  2.0581E+00 -3.9516E+01  1.8077E-06  2.7517E+02  1.8281E+01 -3.9839E+00
 1201  1.0119E+00 -3.0797E+01 -8.1422E-06 -2.8748E+02 -2.8459E+00  4.4654E+00
 1202 -1.6761E+00  3.0768E+01  7.9983E-06  2.8663E+02  2.2220E+01 -4.4644E+00
 1102 -1.3938E+00  3.9545E+01 -1.6637E-06 -2.7572E+02 -5.7710E+00  3.9854E+00
              ELE.NO.   1801 FOR LOAD CASE      6
 1101  1.9594E+00 -2.4948E+02 -2.7205E+02 -7.5794E+02  3.2126E+02  3.3730E+01
 1201  1.8984E+01 -2.3020E+02  2.7205E+02  7.2558E+02 -7.5148E+02 -1.9311E+02
 1202 -1.1515E+00  2.3098E+02  2.7205E+02 -6.5733E+02 -8.1186E+02  1.9311E+02
 1102 -1.9792E+01  2.4870E+02 -2.7205E+02  7.2706E+02  3.8610E+02 -3.3729E+01
              ELE.NO.   1801 FOR LOAD CASE      7
 1101 -6.7332E+00  1.5040E+02 -1.4815E-05 -1.2031E+03 -1.2908E+01 -3.9989E+00
 1201 -6.3813E+00  1.4997E+02  1.4089E-05  1.2037E+03  4.9439E+00 -8.2242E+00
 1202  6.7134E+00 -1.4995E+02 -1.0275E-05 -1.1995E+03 -9.9979E+01  8.2190E+00
 1102  6.4010E+00 -1.5042E+02  1.1001E-05  1.1997E+03  9.1999E+01  3.9934E+00
              ELE.NO.   1801 FOR LOAD CASE      8
 1101 -2.6709E+00 -1.3858E+02 -2.6106E+02 -1.5793E+03  3.3015E+02  2.5483E+01
 1201  1.3570E+01 -1.1104E+02  2.6106E+02  1.5352E+03 -7.5072E+02 -1.9598E+02
 1202  3.8404E+00  1.1180E+02  2.6106E+02 -1.4640E+03 -8.8166E+02  1.9597E+02
 1102 -1.4739E+01  1.3782E+02 -2.6106E+02  1.5445E+03  4.6654E+02 -2.5487E+01

              ELE.NO.   1701 FOR LOAD CASE      1
 1001  2.6611E-02  4.6328E-02  8.9226E+00  8.5797E+01  3.8262E+00 -2.7847E-01
 1101 -3.3535E-02  1.1227E-01 -8.9226E+00 -8.5876E+01 -2.4552E+00  4.4857E-01
 1102 -2.3602E-02 -1.1476E-01 -8.9226E+00  8.5763E+01  5.0383E+00 -4.4833E-01
 1002  3.0527E-02 -4.3835E-02  8.9226E+00 -8.5804E+01 -3.6667E+00  2.7822E-01
              ELE.NO.   1701 FOR LOAD CASE      2
 1001  8.1325E-04  9.1626E-03  5.3500E-01  5.1119E+00  2.0885E-01 -9.3139E-03
 1101 -1.6151E-03  9.2039E-03 -5.3500E-01 -5.1113E+00 -1.5058E-01  2.1494E-02
 1102 -8.0683E-04 -9.3097E-03 -5.3500E-01  5.1050E+00  2.9548E-01 -2.1494E-02
 1002  1.6087E-03 -9.0568E-03  5.3500E-01 -5.1107E+00 -2.3749E-01  9.3133E-03
              ELE.NO.   1701 FOR LOAD CASE      3
 1001  1.0717E-03  1.2074E-02  7.0500E-01  6.7363E+00  2.7521E-01 -1.2273E-02
 1101 -2.1284E-03  1.2129E-02 -7.0500E-01 -6.7355E+00 -1.9843E-01  2.8324E-02
 1102 -1.0632E-03 -1.2268E-02 -7.0500E-01  6.7272E+00  3.8937E-01 -2.8324E-02
 1002  2.1199E-03 -1.1935E-02  7.0500E-01 -6.7346E+00 -3.1295E-01  1.2273E-02
              ELE.NO.   1701 FOR LOAD CASE      4
 1001  3.8382E-03  4.3245E-02  2.5250E+00  2.4126E+01  9.8567E-01 -4.3958E-02
 1101 -7.6229E-03  4.3439E-02 -2.5250E+00 -2.4124E+01 -7.1069E-01  1.0144E-01
 1102 -3.8079E-03 -4.3939E-02 -2.5250E+00  2.4094E+01  1.3946E+00 -1.0145E-01
 1002  7.5926E-03 -4.2745E-02  2.5250E+00 -2.4120E+01 -1.1209E+00  4.3956E-02
              ELE.NO.   1701 FOR LOAD CASE      5
 1001  3.4547E+00 -6.6877E+01 -2.1446E-05  4.9436E+02  4.3430E+01 -8.0521E+00
 1101  2.0110E+00 -5.8309E+01 -1.3723E-06 -5.0634E+02 -1.8281E+01  5.5278E+00
 1102 -3.0786E+00  5.8262E+01  1.2597E-06  5.0600E+02  2.5918E+01 -5.5258E+00
 1002 -2.3871E+00  6.6923E+01  2.1559E-05 -4.9626E+02  1.7870E-01  8.0548E+00
              ELE.NO.   1701 FOR LOAD CASE      6
 1001  5.4552E+00 -2.6392E+02 -2.7205E+02 -5.3150E+02  2.9889E+01  4.9197E+01
 1101  1.7620E+01 -2.6458E+02  2.7205E+02  5.2920E+02 -3.2126E+02 -1.0488E+02
 1102 -5.5069E+00  2.6511E+02  2.7205E+02 -4.9919E+02 -3.6616E+02  1.0489E+02
 1002 -1.7568E+01  2.6340E+02 -2.7205E+02  5.2687E+02  7.6101E+01 -4.9196E+01
```

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 ELEMENT FORCES    FORCE,LENGTH UNITS= KIP  INCH
 --------------
   GLOBAL CORNER FORCES
JOINT      FX           FY           FZ           MX           MY           MZ
             ELE.NO.   1701 FOR LOAD CASE     7
 1001 -7.1900E+00  1.5627E+02  2.0030E-05 -1.2398E+03 -3.0371E+01  9.4584E-02
 1101 -6.3459E+00  1.5375E+02  1.4660E-05  1.2432E+03  1.2908E+01 -9.2222E+00
 1102  7.0784E+00 -1.5372E+02 -4.7407E-05 -1.2396E+03 -9.5494E+01  9.2163E+00
 1002  6.4575E+00 -1.5631E+02  1.2717E-05  1.2377E+03  7.7799E+01 -1.0112E-01
             ELE.NO.   1701 FOR LOAD CASE     8
 1001  1.7523E+00 -1.7442E+02 -2.5936E+02 -1.1552E+03  4.8244E+01  4.0896E+01
 1101  1.3240E+01 -1.6896E+02  2.5936E+02  1.1442E+03 -3.3015E+02 -1.0798E+02
 1102 -1.5364E+00  1.6947E+02  2.5936E+02 -1.1111E+03 -4.2862E+02  1.0798E+02
 1002 -1.3456E+01  1.7391E+02 -2.5936E+02  1.1466E+03  1.4874E+02 -4.0899E+01

             ELE.NO.   1601 FOR LOAD CASE     1
  901  2.0131E-02  3.2189E-02  1.0620E+01  1.0224E+02  4.8548E+00 -2.5573E-01
 1001 -2.6611E-02  1.1622E-01 -1.0620E+01 -1.0235E+02 -3.8257E+00  2.9111E-01
 1002 -1.6360E-02 -1.1809E-01 -1.0620E+01  1.0230E+02  5.1091E+00 -2.9087E-01
  902  2.2840E-02 -3.0315E-02  1.0620E+01 -1.0228E+02 -4.0756E+00  2.5548E-01
             ELE.NO.   1601 FOR LOAD CASE     2
  901  2.2102E-04  6.2141E-03  5.3500E-01  5.1284E+00  2.3242E-01 -5.7866E-03
 1001 -8.1325E-04  7.3503E-03 -5.3500E-01 -5.1298E+00 -2.0885E-01  6.7146E-03
 1002 -1.6954E-04 -7.3932E-03 -5.3500E-01  5.1285E+00  2.3905E-01 -6.7148E-03
  902  7.6177E-04 -6.1712E-03  5.3500E-01 -5.1292E+00 -2.1544E-01  5.7863E-03
             ELE.NO.   1601 FOR LOAD CASE     3
  901  2.9126E-04  8.1885E-03  7.0500E-01  6.7580E+00  3.0627E-01 -7.6254E-03
 1001 -1.0717E-03  9.6858E-03 -7.0500E-01 -6.7598E+00 -2.7521E-01  8.8481E-03
 1002 -2.2342E-04 -9.7423E-03 -7.0500E-01  6.7581E+00  3.1500E-01 -8.8485E-03
  902  1.0038E-03 -8.1320E-03  7.0500E-01 -6.7590E+00 -2.8390E-01  7.6249E-03
             ELE.NO.   1601 FOR LOAD CASE     4
  901  1.0432E-03  2.9327E-02  2.5250E+00  2.4204E+01  1.0969E+00 -2.7311E-02
 1001 -3.8382E-03  3.4690E-02 -2.5250E+00 -2.4211E+01 -9.8567E-01  3.1690E-02
 1002 -8.0017E-04 -3.4892E-02 -2.5250E+00  2.4204E+01  1.1282E+00 -3.1691E-02
  902  3.5952E-03 -2.9125E-02  2.5250E+00 -2.4208E+01 -1.0168E+00  2.7309E-02
             ELE.NO.   1601 FOR LOAD CASE     5
  901  4.3988E+00 -9.2337E+01 -6.9315E-05  7.0145E+02  6.0586E+01 -7.6251E+00
 1001  3.3270E+00 -8.4614E+01  3.4721E-05 -7.1231E+02 -4.3430E+01  1.7011E+00
 1002 -4.0602E+00  8.4582E+01  6.0740E-05  7.1339E+02  1.8818E+01 -1.6980E+00
  902 -3.6656E+00  9.2369E+01 -2.6146E-05 -7.0407E+02 -7.7994E-01  7.6289E+00
             ELE.NO.   1601 FOR LOAD CASE     6
  901  7.9328E+00 -2.5014E+02 -2.7205E+02 -6.1161E+02 -1.1333E+02  4.0032E+01
 1001  1.4124E+01 -2.5504E+02  2.7205E+02  6.1704E+02 -2.9889E+01 -3.5856E+01
 1002 -8.1583E+00  2.5530E+02  2.7205E+02 -6.1208E+02 -8.3555E+01  3.5857E+01
  902 -1.3899E+01  2.4988E+02 -2.7205E+02  6.1916E+02 -5.9594E+01 -4.0031E+01
             ELE.NO.   1601 FOR LOAD CASE     7
  901 -7.8643E+00  1.6718E+02  5.7264E-05 -1.3202E+03 -5.7276E+01  5.2231E+00
 1001 -6.5673E+00  1.6336E+02 -2.6257E-05  1.3253E+03  3.0371E+01 -9.1288E+00
 1002  7.6956E+00 -1.6331E+02 -7.5869E-05 -1.3229E+03 -8.5254E+01  9.1220E+00
  902  6.7360E+00 -1.6723E+02  4.4862E-05  1.3201E+03  5.8002E+01 -5.2303E+00
             ELE.NO.   1601 FOR LOAD CASE     8
  901  4.4891E+00 -1.7523E+02 -2.5767E+02 -1.0920E+03 -1.0353E+02  3.7333E+01
 1001  1.0852E+01 -1.7613E+02  2.5767E+02  1.0916E+03 -4.8243E+01 -4.2946E+01
 1002 -4.5405E+00  1.7640E+02  2.5767E+02 -1.0832E+03 -1.4320E+02  4.2943E+01
  902 -1.0800E+01  1.7495E+02 -2.5767E+02  1.0969E+03 -7.9636E+00 -3.7336E+01
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 ELEMENT FORCES    FORCE,LENGTH UNITS= KIP  INCH
 --------------
   GLOBAL CORNER FORCES
JOINT      FX          FY          FZ          MX          MY          MZ
             ELE.NO.   1501 FOR LOAD CASE     1
  801  1.6357E-02  7.6477E-04  1.2317E+01  1.1892E+02  5.6361E+00 -2.1513E-01
  901 -2.0131E-02  8.5677E-02 -1.2317E+01 -1.1904E+02 -4.8542E+00  2.0103E-01
  902 -1.2566E-02 -8.7122E-02 -1.2317E+01  1.1901E+02  5.5385E+00 -2.0079E-01
  802  1.6340E-02  6.8042E-04  1.2317E+01 -1.1896E+02 -4.7510E+00  2.1488E-01
             ELE.NO.   1501 FOR LOAD CASE     2
  801 -7.6616E-05  2.9589E-03  5.3500E-01  5.1549E+00  2.3489E-01 -1.8657E-03
  901 -2.2102E-04  3.8579E-03 -5.3500E-01 -5.1562E+00 -2.3242E-01 -5.3075E-04
  902  1.1607E-04 -3.8625E-03 -5.3500E-01  5.1568E+00  2.1786E-01  5.3081E-04
  802  1.8156E-04 -2.9544E-03  5.3500E-01 -5.1558E+00 -2.1530E-01  1.8657E-03
             ELE.NO.   1501 FOR LOAD CASE     3
  801 -1.0097E-04  3.8994E-03  7.0500E-01  6.7930E+00  3.0952E-01 -2.4588E-03
  901 -2.9126E-04  5.0841E-03 -7.0500E-01 -6.7946E+00 -3.0627E-01 -6.9947E-04
  902  1.5296E-04 -5.0901E-03 -7.0500E-01  6.7954E+00  2.8709E-01  6.9930E-04
  802  2.3927E-04 -3.8934E-03  7.0500E-01 -6.7941E+00 -2.8371E-01  2.4584E-03
             ELE.NO.   1501 FOR LOAD CASE     4
  801 -3.6159E-04  1.3965E-02  2.5250E+00  2.4329E+01  1.1086E+00 -8.8062E-03
  901 -1.0431E-03  1.8208E-02 -2.5250E+00 -2.4335E+01 -1.0969E+00 -2.5053E-03
  902  5.4778E-04 -1.8230E-02 -2.5250E+00  2.4338E+01  1.0282E+00  2.5043E-03
  802  8.5694E-04 -1.3944E-02  2.5250E+00 -2.4333E+01 -1.0161E+00  8.8051E-03
             ELE.NO.   1501 FOR LOAD CASE     5
  801  4.6028E+00 -1.1440E+02 -6.1064E-05  8.8312E+02  4.1351E+01  3.2669E+00
  901  5.0956E+00 -1.0773E+02  5.2937E-05 -8.9286E+02 -6.0586E+01 -6.6835E+00
  902 -4.3134E+00  1.0777E+02  5.6624E-05  8.9475E+02  1.7463E+01  6.6875E+00
  802 -5.3850E+00  1.1436E+02 -4.8497E-05 -8.8336E+02 -3.5775E+01 -3.2622E+00
             ELE.NO.   1501 FOR LOAD CASE     6
  801  9.4624E+00 -2.4115E+02 -2.7205E+02 -6.9655E+02 -1.6448E+02  2.8738E+01
  901  1.1647E+01 -2.4232E+02  2.7205E+02  6.9766E+02  1.1333E+02  1.6569E+00
  902 -9.5177E+00  2.4241E+02  2.7205E+02 -7.0488E+02  5.2094E+01 -1.6564E+00
  802 -1.1591E+01  2.4105E+02 -2.7205E+02  7.0823E+02 -1.0314E+02 -2.8737E+01
             ELE.NO.   1501 FOR LOAD CASE     7
  801 -7.6735E+00  1.8025E+02  9.5979E-05 -1.4222E+03 -4.7582E+01 -3.8665E+00
  901 -7.8791E+00  1.7596E+02 -6.9694E-05  1.4284E+03  5.7276E+01  1.1179E+00
  902  7.4872E+00 -1.7598E+02 -1.0447E-04 -1.4279E+03 -6.7433E+01 -1.1251E+00
  802  8.0653E+00 -1.8023E+02  7.8188E-05  1.4209E+03  7.6547E+01  3.8588E+00
             ELE.NO.   1501 FOR LOAD CASE     8
  801  6.4075E+00 -1.7528E+02 -2.5597E+02 -1.0804E+03 -1.6342E+02  2.7910E+01
  901  8.8415E+00 -1.7398E+02  2.5597E+02  1.0779E+03  1.0353E+02 -3.7115E+00
  902 -6.3556E+00  1.7409E+02  2.5597E+02 -1.0828E+03  9.1952E+00  3.7090E+00
  802 -8.8934E+00  1.7517E+02 -2.5597E+02  1.0905E+03 -6.8634E+01 -2.7912E+01

             ELE.NO.   1401 FOR LOAD CASE     1
  701  1.4772E-02 -2.2784E-02  1.4014E+01  1.3557E+02  6.2921E+00 -1.8084E-01
  801 -1.6357E-02  5.9070E-02 -1.4014E+01 -1.3568E+02 -5.6355E+00  1.6898E-01
  802 -1.1124E-02 -6.0288E-02 -1.4014E+01  1.3565E+02  6.2106E+00 -1.6873E-01
  702  1.2709E-02  2.4001E-02  1.4014E+01 -1.3560E+02 -5.5481E+00  1.8059E-01
             ELE.NO.   1401 FOR LOAD CASE     2
  701 -1.8808E-04  1.0380E-03  5.3500E-01  5.1724E+00  2.2800E-01  1.0287E-03
  801  7.6617E-05  1.5149E-03 -5.3500E-01 -5.1731E+00 -2.3489E-01 -2.5962E-03
  802  2.0836E-04 -1.5025E-03 -5.3500E-01  5.1739E+00  2.1688E-01  2.5961E-03
  702 -9.6898E-05 -1.0504E-03  5.3500E-01 -5.1726E+00 -2.2368E-01 -1.0289E-03
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 ELEMENT FORCES    FORCE,LENGTH UNITS= KIP  INCH
 --------------
   GLOBAL CORNER FORCES
JOINT      FX          FY          FZ          MX          MY          MZ
               ELE.NO.   1401 FOR LOAD CASE     3
  701 -2.4785E-04  1.3678E-03  7.0500E-01  6.8159E+00  3.0045E-01  1.3557E-03
  801  1.0097E-04  1.9962E-03 -7.0500E-01 -6.8169E+00 -3.0952E-01 -3.4212E-03
  802  2.7457E-04 -1.9798E-03 -7.0500E-01  6.8180E+00  2.8580E-01  3.4211E-03
  702 -1.2769E-04 -1.3842E-03  7.0500E-01 -6.8162E+00 -2.9475E-01 -1.3558E-03
               ELE.NO.   1401 FOR LOAD CASE     4
  701 -8.8766E-04  4.8991E-03  2.5250E+00  2.4412E+01  1.0761E+00  4.8552E-03
  801  3.6160E-04  7.1498E-03 -2.5250E+00 -2.4415E+01 -1.1086E+00 -1.2253E-02
  802  9.8339E-04 -7.0911E-03 -2.5250E+00  2.4419E+01  1.0236E+00  1.2253E-02
  702 -4.5732E-04 -4.9578E-03  2.5250E+00 -2.4413E+01 -1.0557E+00 -4.8558E-03
               ELE.NO.   1401 FOR LOAD CASE     5
  701  3.9562E+00 -1.3609E+02 -4.8605E-05  1.0556E+03 -5.4471E+01  3.2623E+01
  801  7.6044E+00 -1.2869E+02  7.2941E-05 -1.0673E+03 -4.1351E+01 -1.7797E+01
  802 -3.6406E+00  1.2886E+02  9.7008E-05  1.0668E+03  5.1823E+01  1.7802E+01
  702 -7.9200E+00  1.3592E+02 -1.2134E-04 -1.0468E+03 -1.4626E+02 -3.2618E+01
               ELE.NO.   1401 FOR LOAD CASE     6
  701  1.1555E+01 -2.5086E+02 -2.7205E+02 -6.4865E+02 -1.3593E+02  9.4638E+00
  801  1.0117E+01 -2.4549E+02  2.7205E+02  6.4129E+02  1.6448E+02  2.4736E+01
  802 -1.1318E+01  2.4544E+02  2.7205E+02 -6.5318E+02  1.0796E+02 -2.4734E+01
  702 -1.0354E+01  2.5092E+02 -2.7205E+02  6.5803E+02 -7.8876E+01 -9.4622E+00
               ELE.NO.   1401 FOR LOAD CASE     7
  701 -6.3644E+00  1.9663E+02  7.8130E-05 -1.5470E+03  5.9439E+01 -3.8518E+01
  801 -1.0540E+01  1.9056E+02 -9.9700E-05  1.5569E+03  4.7582E+01  1.7867E+01
  802  6.1077E+00 -1.9075E+02 -1.5562E-04 -1.5551E+03 -8.8290E+01 -1.7875E+01
  702  1.0797E+01 -1.9644E+02  1.7719E-04  1.5359E+03  1.9404E+02  3.8510E+01
               ELE.NO.   1401 FOR LOAD CASE     8
  701  9.1598E+00 -1.9034E+02 -2.5427E+02 -9.6809E+02 -1.2306E+02  3.3952E+00
  801  7.1652E+00 -1.8356E+02  2.5427E+02  9.5884E+02  1.6342E+02  2.4957E+01
  802 -8.8603E+00  1.8348E+02  2.5427E+02 -9.6943E+02  7.9227E+01 -2.4957E+01
  702 -7.4647E+00  1.9041E+02 -2.5427E+02  9.7513E+02 -3.8220E+01 -3.3960E+00

               ELE.NO.   1301 FOR LOAD CASE     1
  601  1.4849E-02 -4.1752E-02  1.5711E+01  1.5216E+02  6.9121E+00 -1.5916E-01
  701 -1.4773E-02  4.0011E-02 -1.5711E+01 -1.5227E+02 -6.2915E+00  1.7158E-01
  702 -1.1208E-02 -4.1143E-02 -1.5711E+01  1.5224E+02  7.0036E+00 -1.7133E-01
  602  1.1132E-02  4.2883E-02  1.5711E+01 -1.5219E+02 -6.3771E+00  1.5890E-01
               ELE.NO.   1301 FOR LOAD CASE     2
  601 -1.8928E-04 -1.8461E-04  5.3500E-01  5.1829E+00  2.1850E-01  2.9339E-03
  701  1.8807E-04  2.1231E-04 -5.3500E-01 -5.1836E+00 -2.2800E-01 -2.0770E-03
  702  2.0586E-04 -1.9510E-04 -5.3500E-01  5.1837E+00  2.2465E-01  2.0769E-03
  602 -2.0465E-04  1.6740E-04  5.3500E-01 -5.1822E+00 -2.3406E-01 -2.9339E-03
               ELE.NO.   1301 FOR LOAD CASE     3
  601 -2.4943E-04 -2.4342E-04  7.0500E-01  6.8298E+00  2.8793E-01  3.8662E-03
  701  2.4785E-04  2.7962E-04 -7.0500E-01 -6.8307E+00 -3.0045E-01 -2.7371E-03
  702  2.7128E-04 -2.5695E-04 -7.0500E-01  6.8309E+00  2.9604E-01  2.7370E-03
  602 -2.6970E-04  2.2075E-04  7.0500E-01 -6.8289E+00 -3.0843E-01 -3.8663E-03
               ELE.NO.   1301 FOR LOAD CASE     4
  601 -8.9337E-04 -8.7154E-04  2.5250E+00  2.4461E+01  1.0312E+00  1.3847E-02
  701  8.8770E-04  1.0017E-03 -2.5250E+00 -2.4464E+01 -1.0761E+00 -9.8034E-03
  702  9.7162E-04 -9.2052E-04 -2.5250E+00  2.4465E+01  1.0603E+00  9.8029E-03
  602 -9.6595E-04  7.9032E-04  2.5250E+00 -2.4458E+01 -1.1047E+00 -1.3848E-02
```

```
 ELEMENT FORCES    FORCE,LENGTH UNITS= KIP  INCH
 --------------
   GLOBAL CORNER FORCES
JOINT      FX          FY          FZ          MX          MY          MZ
           ELE.NO.   1301 FOR LOAD CASE     5
  601  3.3625E+00 -1.7107E+02  2.0343E-05  1.3106E+03 -2.5256E+02  8.1732E+01
  701  1.0964E+01 -1.5705E+02  4.1813E-05 -1.3328E+03  5.4472E+01 -2.2541E+01
  702 -2.7662E+00  1.5741E+02  1.6093E-04  1.3230E+03  1.7043E+02  2.2547E+01
  602 -1.1560E+01  1.7071E+02 -2.2309E-04 -1.2836E+03 -3.6582E+02 -8.1725E+01
           ELE.NO.   1301 FOR LOAD CASE     6
  601  1.5887E+01 -2.7886E+02 -2.7205E+02 -4.5009E+02  4.1656E+01 -4.3224E+01
  701  8.0249E+00 -2.6879E+02  2.7205E+02  4.3765E+02  1.3593E+02  5.1004E+01
  702 -1.5433E+01  2.6847E+02  2.7205E+02 -4.4783E+02  9.7265E+01 -5.1002E+01
  602 -8.4787E+00  2.7919E+02 -2.7205E+02  4.4474E+02  8.0727E+01  4.3227E+01
           ELE.NO.   1301 FOR LOAD CASE     7
  601 -5.1806E+00  2.3048E+02 -1.5005E-05 -1.7861E+03  2.9479E+02 -9.7797E+01
  701 -1.4320E+01  2.1616E+02 -6.6772E-05  1.8092E+03 -5.9438E+01  2.6169E+01
  702  4.5743E+00 -2.1659E+02 -1.9996E-04 -1.7972E+03 -2.1690E+02 -2.6178E+01
  602  1.4926E+01 -2.3005E+02  2.8173E-04  1.7537E+03  4.4934E+02  9.7788E+01
           ELE.NO.   1301 FOR LOAD CASE     8
  601  1.4082E+01 -2.1950E+02 -2.5258E+02 -7.3702E+02  9.2338E+01 -5.9428E+01
  701  4.6552E+00 -2.0964E+02  2.5258E+02  7.2531E+02  1.2307E+02  5.4789E+01
  702 -1.3634E+01  2.0925E+02  2.5258E+02 -7.3328E+02  5.9380E+01 -5.4789E+01
  602 -5.1026E+00  2.1989E+02 -2.5258E+02  7.2617E+02  1.5622E+02  5.9429E+01

           ELE.NO.   1201 FOR LOAD CASE     1
  501  1.7236E-02 -7.0608E-02  1.7408E+01  1.6882E+02  7.5859E+00 -1.6220E-01
  601 -1.4850E-02  1.5935E-02 -1.7408E+01 -1.6893E+02 -6.9115E+00  1.9716E-01
  602 -1.3382E-02 -1.7164E-02 -1.7408E+01  1.6889E+02  7.8381E+00 -1.9690E-01
  502  1.0995E-02  7.1836E-02  1.7408E+01 -1.6884E+02 -7.1573E+00  1.6196E-01
           ELE.NO.   1201 FOR LOAD CASE     2
  501 -3.4959E-05 -2.1695E-03  5.3500E-01  5.1972E+00  2.1222E-01  3.2698E-03
  601  1.8929E-04 -1.3652E-03 -5.3500E-01 -5.1985E+00 -2.1850E-01 -2.3111E-05
  602  6.9581E-05  1.3766E-03 -5.3500E-01  5.1977E+00  2.3542E-01  2.3104E-05
  502 -2.2391E-04  2.1581E-03  5.3500E-01 -5.1960E+00 -2.4156E-01 -3.2698E-03
           ELE.NO.   1201 FOR LOAD CASE     3
  501 -4.6048E-05 -2.8592E-03  7.0500E-01  6.8487E+00  2.7966E-01  4.3087E-03
  601  2.4942E-04 -1.7987E-03 -7.0500E-01 -6.8503E+00 -2.8793E-01 -3.0357E-05
  602  9.1668E-05  1.8143E-03 -7.0500E-01  6.8493E+00  3.1022E-01  3.0336E-05
  502 -2.9504E-04  2.8436E-03  7.0500E-01 -6.8470E+00 -3.1832E-01 -4.3086E-03
           ELE.NO.   1201 FOR LOAD CASE     4
  501 -1.6493E-04 -1.0239E-02  2.5250E+00  2.4529E+01  1.0016E+00  1.5431E-02
  601  8.9335E-04 -6.4434E-03 -2.5250E+00 -2.4535E+01 -1.0312E+00 -1.0892E-04
  602  3.2835E-04  6.4970E-03 -2.5250E+00  2.4531E+01  1.1111E+00  1.0827E-04
  502 -1.0568E-03  1.0186E-02  2.5250E+00 -2.4523E+01 -1.1401E+00 -1.5432E-02
           ELE.NO.   1201 FOR LOAD CASE     5
  501  6.0623E+00 -2.4865E+02 -2.7208E-04  1.8585E+03 -4.8475E+02  1.2403E+02
  601  1.4270E+01 -2.1704E+02 -1.9293E-05 -1.9063E+03  2.5256E+02  2.3070E+00
  602 -4.7006E+00  2.1746E+02  2.9260E-04  1.8770E+03  4.1774E+02 -2.2976E+00
  502 -1.5632E+01  2.4823E+02 -1.2295E-06 -1.8092E+03 -6.4488E+02 -1.2402E+02
           ELE.NO.   1201 FOR LOAD CASE     6
  501  2.2606E+01 -3.0349E+02 -2.7205E+02 -2.3922E+02  4.9064E+02 -1.5752E+02
  601  3.6929E+00 -2.9885E+02  2.7205E+02  2.3756E+02 -4.1656E+01  8.0027E+01
  602 -2.2368E+01  2.9803E+02  2.7205E+02 -2.3302E+02 -6.2204E+01 -8.0024E+01
  502 -3.9313E+00  3.0431E+02 -2.7205E+02  1.9555E+02  5.0962E+02  1.5752E+02
```

```
 ELEMENT FORCES    FORCE,LENGTH UNITS= KIP  INCH
 --------------
   GLOBAL CORNER FORCES
JOINT      FX          FY          FZ          MX          MY          MZ
              ELE.NO.   1201 FOR LOAD CASE     7
 501 -7.9535E+00  3.1576E+02  3.6614E-04 -2.3809E+03  5.7711E+02 -1.4987E+02
 601 -1.8071E+01  2.8030E+02 -5.0662E-06  2.4347E+03 -2.9479E+02 -1.7616E+00
 602  6.4278E+00 -2.8081E+02 -3.8786E-04 -2.3998E+03 -5.0587E+02  1.7489E+00
 502  1.9597E+01 -3.1525E+02  2.6784E-05  2.3215E+03  7.8242E+02  1.4985E+02
              ELE.NO.   1201 FOR LOAD CASE     8
 501  2.0732E+01 -2.3647E+02 -2.5088E+02 -5.5621E+02  5.9208E+02 -1.8349E+02
 601 -1.2157E-01 -2.3558E+02  2.5088E+02  5.6049E+02 -9.2338E+01  8.0769E+01
 602 -2.0654E+01  2.3467E+02  2.5088E+02 -5.5031E+02 -1.4084E+02 -8.0769E+01
 502  4.3068E-02  2.3738E+02 -2.5088E+02  5.0249E+02  6.3830E+02  1.8349E+02

              ELE.NO.   1101 FOR LOAD CASE     1
 401  2.3637E-02 -1.1980E-01  1.9105E+01  1.8562E+02  8.4634E+00 -2.2208E-01
 501 -1.7237E-02 -2.6739E-02 -1.9105E+01 -1.8574E+02 -7.5852E+00  2.4526E-01
 502 -1.9481E-02  2.5160E-02 -1.9105E+01  1.8570E+02  8.6320E+00 -2.4502E-01
 402  1.3081E-02  1.2138E-01  1.9105E+01 -1.8565E+02 -7.7477E+00  2.2173E-01
              ELE.NO.   1101 FOR LOAD CASE     2
 401  4.3683E-04 -6.1540E-03  5.3500E-01  5.2259E+00  2.2020E-01 -4.5254E-04
 501  3.4948E-05 -4.6516E-03 -5.3500E-01 -5.2280E+00 -2.1222E-01  3.8169E-03
 502 -3.7062E-04  4.6373E-03 -5.3500E-01  5.2266E+00  2.4424E-01 -3.8167E-03
 402 -1.0116E-04  6.1683E-03  5.3500E-01 -5.2252E+00 -2.3611E-01  4.5295E-04
              ELE.NO.   1101 FOR LOAD CASE     3
 401  5.7566E-04 -8.1100E-03  7.0500E-01  6.8865E+00  2.9017E-01 -5.9632E-04
 501  4.6037E-05 -6.1293E-03 -7.0500E-01 -6.8892E+00 -2.7966E-01  5.0298E-03
 502 -4.8840E-04  6.1113E-03 -7.0500E-01  6.8874E+00  3.2185E-01 -5.0294E-03
 402 -1.3330E-04  8.1280E-03  7.0500E-01 -6.8856E+00 -3.1114E-01  5.9682E-04
              ELE.NO.   1101 FOR LOAD CASE     4
 401  2.0617E-03 -2.9044E-02  2.5250E+00  2.4664E+01  1.0393E+00 -2.1365E-03
 501  1.6498E-04 -2.1954E-02 -2.5250E+00 -2.4674E+01 -1.0016E+00  1.8014E-02
 502 -1.7492E-03  2.1885E-02 -2.5250E+00  2.4668E+01  1.1527E+00 -1.8014E-02
 402 -4.7749E-04  2.9113E-02  2.5250E+00 -2.4661E+01 -1.1144E+00  2.1373E-03
              ELE.NO.   1101 FOR LOAD CASE     5
 401  1.8639E+01 -4.0751E+02 -1.8579E-03  2.9988E+03 -4.4791E+02  7.3207E+01
 501  1.4283E+01 -3.4652E+02  2.6435E-04 -3.0857E+03  4.8475E+02  9.4702E+01
 502 -1.5973E+01  3.4645E+02  5.4210E-04  3.0317E+03  7.5184E+02 -9.4685E+01
 402 -1.6949E+01  4.0758E+02  1.0514E-03 -2.9484E+03 -7.0756E+02 -7.3189E+01
              ELE.NO.   1101 FOR LOAD CASE     6
 401  2.3785E+01 -3.1191E+02 -4.6638E+02 -1.9798E+03  5.0036E+02 -1.7711E+02
 501  3.9658E+00 -3.2368E+02  4.6638E+02  2.0021E+03 -1.1390E+01  8.1044E+01
 502 -2.4261E+01  3.2280E+02  4.6638E+02 -1.9935E+03 -1.8584E+02 -8.1046E+01
 402 -3.4905E+00  3.1279E+02 -4.6638E+02  1.9286E+03  6.7101E+02  1.7710E+02
              ELE.NO.   1101 FOR LOAD CASE     7
 401 -2.2685E+01  4.9865E+02  2.2836E-03 -3.6872E+03  5.3766E+02 -8.9368E+01
 501 -1.7769E+01  4.2790E+02 -3.6257E-04  3.7880E+03 -5.7711E+02 -1.1257E+02
 502  1.9593E+01 -4.2782E+02 -7.0743E-04 -3.7233E+03 -9.0506E+02  1.1255E+02
 402  2.0861E+01 -4.9873E+02 -1.2136E-03  3.6263E+03  8.5697E+02  8.9347E+01
              ELE.NO.   1101 FOR LOAD CASE     8
 401  1.9766E+01 -2.2093E+02 -4.4351E+02 -2.4458E+03  6.0013E+02 -1.9350E+02
 501  4.6305E-01 -2.4237E+02  4.4351E+02  2.4818E+03 -1.1283E+02  6.3451E+01
 502 -2.0663E+01  2.4149E+02  4.4351E+02 -2.4626E+03 -3.2871E+02 -6.3459E+01
 402  4.3424E-01  2.2181E+02 -4.4351E+02  2.3842E+03  8.1101E+02  1.9349E+02
```

6= TEMP. LOAD

8 = LOAD COMB.

```
   SAN JOSE DIGESTER #12 - UNSUBMERGED CASE                  -- PAGE NO.   30



  ELEMENT FORCES    FORCE,LENGTH UNITS= KIP  INCH
  --------------
    GLOBAL CORNER FORCES
JOINT      FX          FY          FZ          MX          MY          MZ
             ELE.NO.   1001 FOR LOAD CASE     1
  201 -6.8037E-02  1.5583E+00  2.0802E+01  1.9244E+02  8.4023E+00 -2.7227E-06
  401 -2.3630E-02  5.4107E-01 -2.0802E+01 -1.9383E+02 -8.4628E+00  1.6721E-04
  402  2.3630E-02 -5.4107E-01 -2.0802E+01  1.9383E+02  8.4629E+00  1.7251E-04
  202  6.8037E-02 -1.5583E+00  2.0802E+01 -1.9244E+02 -8.4023E+00  1.9664E-06
             ELE.NO.   1001 FOR LOAD CASE     2
  201 -1.8749E-03  4.2941E-02  5.3500E-01  4.8995E+00  2.1392E-01  3.3983E-08
  401 -4.3684E-04  1.0005E-02 -5.3500E-01 -5.0434E+00 -2.2020E-01  4.6249E-08
  402  4.3685E-04 -1.0005E-02 -5.3500E-01  5.0434E+00  2.2020E-01  2.8100E-07
  202  1.8749E-03 -4.2941E-02  5.3500E-01 -4.8995E+00 -2.1392E-01  4.4864E-07
             ELE.NO.   1001 FOR LOAD CASE     3
  201 -2.4706E-03  5.6586E-02  7.0500E-01  6.4563E+00  2.8189E-01  2.0334E-08
  401 -5.7566E-04  1.3184E-02 -7.0500E-01 -6.6460E+00 -2.9017E-01  1.0786E-08
  402  5.7566E-04 -1.3184E-02 -7.0500E-01  6.6460E+00  2.9017E-01  3.2013E-07
  202  2.4706E-03 -5.6586E-02  7.0500E-01 -6.4563E+00 -2.8189E-01  5.6676E-07
             ELE.NO.   1001 FOR LOAD CASE     4
  201 -8.8488E-03  2.0267E-01  2.5250E+00  2.3124E+01  1.0096E+00 -1.3363E-08
  401 -2.0617E-03  4.7218E-02 -2.5250E+00 -2.3803E+01 -1.0393E+00 -1.3749E-07
  402  2.0617E-03 -4.7220E-02 -2.5250E+00  2.3803E+01  1.0393E+00  9.7044E-07
  202  8.8487E-03 -2.0267E-01  2.5250E+00 -2.3124E+01 -1.0096E+00  1.9437E-06
             ELE.NO.   1001 FOR LOAD CASE     5
  201  6.1587E+00 -1.4106E+02  8.7385E-04  1.0132E+03  4.4240E+01  1.6516E-03
  401  1.6626E+01 -3.8081E+02  1.8625E-03 -3.1616E+03 -1.3804E+02  5.4420E-03
  402 -1.6626E+01  3.8080E+02 -1.2958E-03  3.1616E+03  1.3804E+02  7.6817E-03
  202 -6.1589E+00  1.4106E+02 -1.4405E-03 -1.0132E+03 -4.4240E+01  2.8834E-03
             ELE.NO.   1001 FOR LOAD CASE     6
  201  5.4171E+00 -1.2407E+02 -4.6638E+02 -3.4467E+03 -1.5049E+02 -1.1253E-03
  401  9.7796E+00 -2.2398E+02  4.6638E+02  2.8056E+03  1.2250E+02 -1.7494E-03
  402 -9.7796E+00  2.2398E+02  4.6638E+02 -2.8056E+03 -1.2250E+02 -1.1961E-03
  202 -5.4171E+00  1.2407E+02 -4.6638E+02  3.4467E+03  1.5049E+02 -8.9548E-04
             ELE.NO.   1001 FOR LOAD CASE     7
  201 -7.4576E+00  1.7080E+02 -1.0163E-03 -1.2341E+03 -5.3884E+01 -1.6169E-03
  401 -2.0137E+01  4.6121E+02 -2.2780E-03  3.8220E+03  1.6687E+02 -6.0040E-03
  402  2.0137E+01 -4.6121E+02  1.5079E-03 -3.8220E+03 -1.6687E+02 -8.9070E-03
  202  7.4578E+00 -1.7081E+02  1.7864E-03  1.2341E+03  5.3884E+01 -3.1832E-03
             ELE.NO.   1001 FOR LOAD CASE     8
  201  4.0369E+00 -9.2459E+01 -4.4181E+02 -3.4406E+03 -1.5022E+02 -1.7843E-03
  401  6.2424E+00 -1.4297E+02  4.4181E+02  3.2366E+03  1.4131E+02 -3.5592E-03
  402 -6.2424E+00  1.4297E+02  4.4181E+02 -3.2366E+03 -1.4131E+02 -3.6622E-03
  202 -4.0370E+00  9.2460E+01 -4.4181E+02  3.4406E+03  1.5022E+02 -1.8813E-03
  303. *
  304. FINISH
```

```
           ****************************************************
           *                                                  *
           *           STAAD.Pro                              *
           *           Version  2006    Bld 1001.US           *
           *           Proprietary Program of                 *
           *           Research Engineers,  Intl.             *
           *           Date=    JAN  5, 2009                  *
           *           Time=    15:35:35                      *
           *                                                  *
           *      USER ID: Beyaz _Patel, Inc.                *
           ****************************************************



     1. STAAD SPACE SAN JOSE DIGESTER #12 - SUBMERGED CASE
INPUT FILE: Digester12S.STD
     2. START JOB INFORMATION
     3. ENGINEER DATE 21-DEC-08
     4. END JOB INFORMATION
     5. INPUT WIDTH 79
     6. *BY: GLENN HUDSON
     7. *ANALYSIS IS FOR SUBMERGED CASE WITH 6-FOOT FLUID HEAD ABOVE BOTTOM OF
     8. *ROOF SLAB AT HIGH POINT (7 FEET ABOVE TOP OF WALL; 47 FEET ABOVE BOTTOM
     9. *OF WALL)
    10. *
    11. UNIT KIP FEET
    12. *
    13. JOINT COORDINATES CYLINDRICAL
    14. *
    15. *FOLLOWING JOINTS ARE FOR WALL FOOTING
    16. *
    17. 101   48.75  0.  0.
    18. REPEAT  71  0  5  0
    19. 201   55.58  0.  0.
    20. REPEAT  71  0  5  0
    21. 301   59.50  0.  0.
    22. REPEAT  71  0  5  0
    23. *
    24. *FOLLOWING JOINTS ARE FOR SHELL WALL
    25. *
    26. 401   55.58  0.   4.0
    27. REPEAT  71  0  5  0
    28. 501   55.58  0.   8.0
    29. REPEAT  71  0  5  0
    30. 601   55.58  0.  12.0
    31. REPEAT  71  0  5  0
    32. 701   55.58  0.  16.0
    33. REPEAT  71  0  5  0
    34. 801   55.58  0.  20.0
    35. REPEAT  71  0  5  0
    36. 901   55.58  0.  24.0
    37. REPEAT  71  0  5  0
    38. 1001  55.58  0.  28.0
    39. REPEAT  71  0  5  0
    40. 1101  55.58  0.  32.0
```

```
41. REPEAT  71  0  5  0
42. 1201  55.58  0.  36.0
43. REPEAT  71  0  5  0
44. 1301  55.58  0.  38.0
45. REPEAT  71  0  5  0
46. 1401  55.58  0.  40.0
47. REPEAT  71  0  5  0
48. *
49. MEMBER INCIDENCES
50. *MEMBERS BELOW REPRESENT BUBBER BEARING PADS BETWEEN WALL BASE AND FOOTING
51. 3001  201  202
52. REPEAT  70  1  1
53. 3072  272  201
54. *
55. ELEMENT INCIDENCES SHELL
56. *
57. *ELEMENTS WITH NUMBERS BELOW 1000 ARE FOR FOOTING
58. *ELEMENTS WITH NUMBERS ABOVE 1000 ARE FOR SHELL WALL
59. *
60. *FOOTING ELEMENTS
61. 101  101  102  202  201 TO 171  1  1
62. 172  172  101  201  272
63. 201  201  202  302  301 TO 271  1  1
64. 272  272  201  301  372
65. *
66. *SHELL WALL ELEMENTS
67. 1001  201  401  402  202  TO  1071  1  1
68. 1072  272  472  401  201
69. 1101  401  501  502  402  TO  1171  1  1
70. 1172  472  572  501  401
71. 1201  501  601  602  502  TO  1271  1  1
72. 1272  572  672  601  501
73. 1301  601  701  702  602  TO  1371  1  1
74. 1372  672  772  701  601
75. 1401  701  801  802  702  TO  1471  1  1
76. 1472  772  872  801  701
77. 1501  801  901  902  802  TO  1571  1  1
78. 1572  872  972  901  801
79. 1601  901  1001  1002  902  TO  1671  1  1
80. 1672  972  1072  1001  901
81. 1701  1001  1101  1102  1002  TO  1771  1  1
82. 1772  1072  1172  1101  1001
83. 1801  1101  1201  1202  1102  TO  1871  1  1
84. 1872  1172  1272  1201  1101
85. 1901  1201  1301  1302  1202  TO  1971  1  1
86. 1972  1272  1372  1301  1201
87. 2001  1301  1401  1402  1302  TO  2071  1  1
88. 2072  1372  1472  1401  1301
89. *
90. UNIT KIP INCH
91. *
92. MEMBER PROPERTIES
93. *FOLLOWING MEMBER PROPERTIES ARE FOR BEARING PADS
94. 3001 TO 3072  PRIS AX 8.25  AZ 8.25  IX 5.10  IY 20.8  IZ 1.55
95. *
96. ELEMENT PROPERTY
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  97. *
  98. *FOLLOWING ARE FOOTING ELEMENT THICKNESSES (101 TO 172 USE
  99. *AVERAGE THICKNESS)
 100. 101 TO 172  THICKNESS 18
 101. 201 TO 272  THICKNESS 24
 102. *
 103. *FOLLOWING ARE SHELL WALL ELEMENTS
 104. 1001 TO 1072   1101 TO 1172   1201 TO 1272   1301 TO 1372 -
 105. 1401 TO 1472   1501 TO 1572   1601 TO 1672   1701 TO 1772 -
 106. 1801 TO 1872   1901 TO 1972   2001 TO 2072  THICKNESS 14
 107. *
 108. *JOINTS AT THE BOTTOM OF WALL ELEMENTS ARE RELEASED WITH RESPECT
 109. *TO MOMENT MX(LOCAL) SINCE THERE IS NO BAR REINFORCING THROUGH THE WALL-TO -
 110. *FOOTING JOINT, AND WITH RESPECT TO FZ(LOCAL) SINCE JOINT CAN
 111. *TRANSLATE IN RADIAL DIRECTION ON BEARING PAD
 112. *
 113. MEMBER RELEASE
 114. 3001 TO 3072  END MX MY MZ  KFZ 300
 115. *
 116. ELEMENT RELEASE
 117. 1001 TO 1072  J1  FZ  MX
 118. 1001 TO 1072  J4  FZ  MX
 119. *
 120. SUPPORTS
 121. *
 122. *SUPPORT JOINTS AT FOOTINGS HAVE VERTICAL SPRING CONSTANTS
 123. *TO MODEL SOIL RIGIDITY AND GIVE VERTICAL DEFLECTION OUTPUT
 124. *THAT IS INDICATION OF PREDICTED VERTICAL SETTLEMENT
 125. *
 126. 101 TO 172 FIXED BUT MX MY MZ  KFZ 1010
 127. 201 TO 272 FIXED BUT MX MY MZ  KFZ 1600
 128. 301 TO 372 FIXED BUT MX MY MZ  KFZ 520
 129. *
 130. UNIT KIP INCH
 131. *
 132. CONSTANTS
 133. *
 134. E 3600 ALL
 135. *
 136. *FOLLOWING IS FOR BEARING PADS
 137. E 350  MEMB 3001 TO 3072
 138. *
 139. BETA 5  MEMB  3003  3038
 140. BETA 10 MEMB  3003  3039
 141. BETA 15 MEMB  3004  3040
 142. BETA 20 MEMB  3005  3041
 143. BETA 25 MEMB  3006  3042
 144. BETA 30 MEMB  3007  3043
 145. BETA 35 MEMB  3008  3044
 146. BETA 40 MEMB  3009  3045
 147. BETA 45 MEMB  3010  3046
 148. BETA 50 MEMB  3011  3047
 149. BETA 55 MEMB  3012  3048
 150. BETA 60 MEMB  3013  3049
 151. BETA 65 MEMB  3014  3050
 152. BETA 70 MEMB  3015  3051
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153. BETA 75 MEMB  3016  3052
154. BETA 80 MEMB  3017  3053
155. BETA 85 MEMB  3018  3054
156. BETA 90 MEMB  3019  3055
157. BETA 95 MEMB  3020  3056
158. BETA 100 MEMB 3021  3057
159. BETA 105 MEMB 3022  3058
160. BETA 110 MEMB 3023  3059
161. BETA 115 MEMB 3024  3060
162. BETA 120 MEMB 3025  3061
163. BETA 125 MEMB 3026  3062
164. BETA 130 MEMB 3027  3063
165. BETA 135 MEMB 3028  3064
166. BETA 140 MEMB 3029  3065
167. BETA 145 MEMB 3030  3066
168. BETA 150 MEMB 3031  3067
169. BETA 155 MEMB 3032  3068
170. BETA 160 MEMB 3033  3069
171. BETA 165 MEMB 3034  3070
172. BETA 170 MEMB 3035  3071
173. BETA 175 MEMB 3036  3072
174. *
175. POISSON 0.17 ALL
176. *FOLLOWING IS FOR BEARING PADS
177. POISSON 0.4 MEMBER 3001 TO 3072
178. *
179. ALPHA CONCRETE ALL
180. *FOLLOWING IS FOR BEARING PADS
181. ALPHA 6E-006 MEMB 3001 TO 3072
182. *
183. UNIT KIP FEET
184. *
185. DENSITY 0.150 ALL
186. *FOLLOWING IS FOR BEARING PADS
187. DENSITY 4E-005 MEMBER 3001 TO 3072
188. *
189. UNIT KIP FEET
190. *
191. *LOADS
192. *
193. LOAD 1  DEAD LOAD
194. SELFWEIGHT  Z  -1.0
195. *REACTIONS FROM TRIBUTARY PORTION OF ROOF STRUCTURE ARE APPLIED AS
196. *VERTICAL JOINT LOADS ON TOP OF WALL
197. *NOTE:  THESE LOADS ARE 10% HIGHER THAN FOR DIGESTER #1 BASED ON RATIO
198. *OF DIGESTER INSIDE DIAMETERS
199. *
200. *TRIBUTARY ROOF STRUCTURE DEAD LOAD:
201. JOINT LOAD
202. 1401 TO 1472  FZ  -9.36
203. *
204. LOAD 2 TRIBUTARY ROOF LIVE LOAD
205. JOINT LOAD
206. 1401 TO 1472  FZ  -1.07
207. *
208. LOAD 3 TRIBUTARY ROOF VACUUM PRESSURE
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209. JOINT LOAD
210. 1401 TO 1472  FZ  -1.41
211. *
212. *NOTE:  GAS UPLIFT PRESSURE DOES NOT APPLY FOR SUBMERGED CASE
213. *LOAD 4 TRIBUTARY ROOF GAS UPLIFT PRESSURE
214. *JOINT LOAD
215. *1401 TO 1472  FZ  -5.05
216. *
217. LOAD 5 FLUID STATIC LOAD
218. *FOLLOWING IS FLUID STATIC LOAD ON WALL BASED ON SLUDGE DENSITY OF 70 PCF.
219. *NOTE THAT FOR SUBMERGED CASE THERE IS A 7-FOOT HEAD AT TOP OF WALL (6 FT
220. *PLUS 1 FT ROOF SLAB SLOPE).  PRESSURE HEAD AT BASE = 40 FT + 7 FT = 47 FT.
221. *
222. ELEMENT LOAD
223. 1001 TO 1072  PR -3.15
224. 1101 TO 1172  PR -2.87
225. 1201 TO 1272  PR -2.59
226. 1301 TO 1372  PR -2.31
227. 1401 TO 1472  PR -2.03
228. 1501 TO 1572  PR -1.75
229. 1601 TO 1672  PR -1.47
230. 1701 TO 1772  PR -1.19
231. 1801 TO 1872  PR -0.91
232. 1901 TO 1972  PR -0.70
233. 2001 TO 2072  PR -0.56
234. *
235. LOAD 6 TEMPERATURE LOAD
236. *
237. *FIRST TEMPERATURE LOAD VALUE SPECIFIED IS THE AVERAGE RISE, AS MEASURED FROM
238. *THE STRUCTURE AVERAGE START TEMPERATURE.  SECOND TEMPERATURE LOAD VALUE
239. *SPECIFIED IS THE THRU-WALL TEMPERATURE DIFFERENTIAL
240. *
241. *ASSUMED TEMPERATURE VALUES FOR SITE (SAN JOSE) ARE:
242. *AIR AMBIENT LOW TEMPERATURE (JANUARY) = 40 DEG. F.
243. *STRUCTURE START TEMPERATURE (ANNUAL AVERAGE TEMP.) = 60 DEG. F.
244. *SOIL AMBIENT TEMPERATURE (INFLUENCED BY DIGESTER) = 80 DEG. F.
245. *DIGESTER INTERIOR TEMPERATURE = 135 DEG. F.
246. *
247. TEMPERATURE LOAD
248. *ABOVE GRADE ELEMENTS:
249. *FIRST TEMP LOAD VALE = ((135-60) + (40-60))/2 = 27.5,  USE 28
250. *SECOND TEMP LOAD VALUE = 40 - 135 = -95
251. 1201 TO 1272  1301 TO 1372  1401 TO 1472  1501 TO 1572  1601 TO 1672 -
252. 1701 TO 1772  1801 TO 1872  1901 TO 1972  2001 TO 2072  TEMP 28  -95
253. *
254. *BELOW GRADE ELEMENTS:
255. *FIRST TEMP LOAD VALUE = ((135-60) + (80-60))/2 = 48
256. *SECOND TEMP LOAD VALUE = 80 - 135 = -55
257. 1001 TO 1072  1101 TO 1172  TEMP 48  -55
258. *
259. LOAD 7 PRESTRESS LOAD
260. *BASED ON CIRCUMFERENTIAL PRESTRESS FORCE DIAGRAM ON EXISTING DRAWINGS (SHEET 6
261. *ASSUMED TO BE 75% OF DIAGRAM VALUES AFTER LOSSES
262. *
263. ELEMENT LOAD
264. 1001 TO 1072  PR 3.03
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265. 1101 TO 1172  PR 2.78
266. 1201 TO 1272  PR 2.53
267. 1301 TO 1372  PR 2.27
268. 1401 TO 1472  PR 2.00
269. 1501 TO 1572  PR 1.76
270. 1601 TO 1672  PR 1.49
271. 1701 TO 1772  PR 1.35
272. 1801 TO 1872  PR 1.35
273. 1901 TO 1972  PR 1.35
274. 2001 TO 2072  PR 1.35
275. *
276. *FOLLOWING LOAD COMBINATION INCLUDES TRIBUTARY ROO VERTICAL DL, LL,AND VACUUM P
277. *LOADS; AND STATIC FLUID, TEMPERATURE AND PRESTRESS LATERAL LOADS ON SHELL WALL
278. *
279. LOAD COMB 8  TRIB. ROOF LOADS + FLUID STATIC + TEMP + PRESTRESS
280. 1 1.0  2 1.0  3 1.0  5 1.0  6 1.0  7 1.0
281. *
282. UNIT KIP INCH
283. *
284. PERFORM ANALYSIS

** WARNING ** A SOFT MATERIAL WITH (1.0 / 9.000E+00) TIMES THE STIFFNESS OF
              CONCRETE ENTERED. PLEASE CHECK.



          P R O B L E M   S T A T I S T I C S
          -----------------------------------

  NUMBER OF JOINTS/MEMBER+ELEMENTS/SUPPORTS =  1008/  1008/   216
  ORIGINAL/FINAL BAND-WIDTH=   215/    47/    288 DOF
  TOTAL PRIMARY LOAD CASES =    6, TOTAL DEGREES OF FREEDOM =    6048
  SIZE OF STIFFNESS MATRIX =     1742 DOUBLE  KILO-WORDS
  REQRD/AVAIL. DISK SPACE  =     36.1/  63005.9 MB



285. *
286. LOAD LIST 1 TO 3  5 TO 8
287. *DISPLACEMENTS AT FOOTING AND FROM BOTTOM TO TOP OF WALL IN A STRIP THAT IS
288. *ONE ELEMENT WIDE (ELEMENT AT 0 TO 5 DEGREES):
289. PRINT JOINT DISPLACEMENTS LIST 101 201 301 401 501 601 701 801 901 1001 1101 -
290. 1201 1301 1401
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  JOINT DISPLACEMENT (INCH RADIANS)    STRUCTURE TYPE = SPACE
  ------------------

JOINT  LOAD   X-TRANS   Y-TRANS   Z-TRANS   X-ROTAN   Y-ROTAN   Z-ROTAN


  101    1    0.00000   0.00000  -0.00867   0.00000   0.00024   0.00000
         2    0.00000   0.00000  -0.00014   0.00000   0.00001   0.00000
         3    0.00000   0.00000  -0.00018   0.00000   0.00001   0.00000
         5    0.00000   0.00000  -0.00091   0.00000   0.00000   0.00000
         6    0.00000   0.00000   0.00142   0.00000   0.00000   0.00000
         7    0.00000   0.00000   0.00088   0.00000   0.00000   0.00000
         8    0.00000   0.00000  -0.00759   0.00000   0.00025   0.00000
  201    1    0.00000   0.00000  -0.02209   0.00000   0.00005   0.00000
         2    0.00000   0.00000  -0.00044   0.00000   0.00000   0.00000
         3    0.00000   0.00000  -0.00058   0.00000   0.00000   0.00000
         5    0.00000   0.00000   0.00011   0.00000  -0.00003   0.00000
         6    0.00000   0.00000  -0.00017   0.00000   0.00005   0.00000
         7    0.00000   0.00000  -0.00010   0.00000   0.00003   0.00000
         8    0.00000   0.00000  -0.02327   0.00000   0.00010   0.00000
  301    1    0.00000   0.00000  -0.02323   0.00000   0.00001   0.00000
         2    0.00000   0.00000  -0.00045   0.00000   0.00000   0.00000
         3    0.00000   0.00000  -0.00059   0.00000   0.00000   0.00000
         5    0.00000   0.00000   0.00143   0.00000  -0.00003   0.00000
         6    0.00000   0.00000  -0.00224   0.00000   0.00004   0.00000
         7    0.00000   0.00000  -0.00138   0.00000   0.00003   0.00000
         8    0.00000   0.00000  -0.02646   0.00000   0.00006   0.00000
  401    1    0.00160   0.00000  -0.02274   0.00000   0.00000   0.00000
         2    0.00005   0.00000  -0.00046   0.00000   0.00000   0.00000
         3    0.00006   0.00000  -0.00060   0.00000   0.00000   0.00000
         5    0.33472   0.00000  -0.00068   0.00000  -0.00340   0.00000
         6    0.12632   0.00000   0.01359   0.00000   0.00084   0.00000
         7   -0.32295   0.00000   0.00066   0.00000   0.00326   0.00000
         8    0.13979   0.00000  -0.01023   0.00000   0.00070   0.00000
  501    1    0.00144   0.00000  -0.02337   0.00000   0.00000   0.00000
         2    0.00004   0.00000  -0.00047   0.00000   0.00000   0.00000
         3    0.00006   0.00000  -0.00062   0.00000   0.00000   0.00000
         5    0.20601   0.00000  -0.00453   0.00000  -0.00194   0.00000
         6    0.14700   0.00000   0.02699   0.00000   0.00018   0.00000
         7   -0.19964   0.00000   0.00438   0.00000   0.00186   0.00000
         8    0.15491   0.00000   0.00238   0.00000   0.00009   0.00000
  601    1    0.00129   0.00000  -0.02394   0.00000   0.00000   0.00000
         2    0.00004   0.00000  -0.00049   0.00000   0.00000   0.00000
         3    0.00005   0.00000  -0.00065   0.00000   0.00000   0.00000
         5    0.14130   0.00000  -0.00707   0.00000  -0.00085   0.00000
         6    0.13906   0.00000   0.03409   0.00000  -0.00036   0.00000
         7   -0.13776   0.00000   0.00684   0.00000   0.00081   0.00000
         8    0.14398   0.00000   0.00879   0.00000  -0.00040   0.00000
  701    1    0.00114   0.00000  -0.02445   0.00000   0.00000   0.00000
         2    0.00004   0.00000  -0.00051   0.00000   0.00000   0.00000
         3    0.00005   0.00000  -0.00067   0.00000   0.00000   0.00000
         5    0.11497   0.00000  -0.00883   0.00000  -0.00033   0.00000
         6    0.12156   0.00000   0.04113   0.00000  -0.00031   0.00000
         7   -0.11273   0.00000   0.00856   0.00000   0.00031   0.00000
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  JOINT DISPLACEMENT (INCH RADIANS)    STRUCTURE TYPE = SPACE
  ------------------

JOINT  LOAD   X-TRANS   Y-TRANS   Z-TRANS   X-ROTAN   Y-ROTAN   Z-ROTAN


          8    0.12504   0.00000   0.01523   0.00000  -0.00033   0.00000
  801     1    0.00100   0.00000  -0.02491   0.00000   0.00000   0.00000
          2    0.00004   0.00000  -0.00053   0.00000   0.00000   0.00000
          3    0.00005   0.00000  -0.00069   0.00000   0.00000   0.00000
          5    0.10307   0.00000  -0.01021   0.00000  -0.00020   0.00000
          6    0.11221   0.00000   0.04826   0.00000  -0.00007   0.00000
          7   -0.10211   0.00000   0.00993   0.00000   0.00017   0.00000
          8    0.11427   0.00000   0.02184   0.00000  -0.00011   0.00000
  901     1    0.00085   0.00000  -0.02532   0.00000   0.00000   0.00000
          2    0.00004   0.00000  -0.00054   0.00000   0.00000   0.00000
          3    0.00005   0.00000  -0.00072   0.00000   0.00000   0.00000
          5    0.09270   0.00000  -0.01139   0.00000  -0.00024   0.00000
          6    0.11424   0.00000   0.05544   0.00000   0.00014   0.00000
          7   -0.09464   0.00000   0.01114   0.00000   0.00015   0.00000
          8    0.11324   0.00000   0.02861   0.00000   0.00005   0.00000
 1001     1    0.00071   0.00000  -0.02566   0.00000   0.00000   0.00000
          2    0.00004   0.00000  -0.00056   0.00000   0.00000   0.00000
          3    0.00005   0.00000  -0.00074   0.00000   0.00000   0.00000
          5    0.07983   0.00000  -0.01243   0.00000  -0.00029   0.00000
          6    0.12274   0.00000   0.06263   0.00000   0.00017   0.00000
          7   -0.08800   0.00000   0.01227   0.00000   0.00012   0.00000
          8    0.11536   0.00000   0.03550   0.00000  -0.00001   0.00000
 1101     1    0.00059   0.00000  -0.02595   0.00000   0.00000   0.00000
          2    0.00004   0.00000  -0.00058   0.00000   0.00000   0.00000
          3    0.00005   0.00000  -0.00076   0.00000   0.00000   0.00000
          5    0.06494   0.00000  -0.01331   0.00000  -0.00032   0.00000
          6    0.12378   0.00000   0.06991   0.00000  -0.00022   0.00000
          7   -0.08361   0.00000   0.01334   0.00000   0.00006   0.00000
          8    0.10579   0.00000   0.04265   0.00000  -0.00048   0.00000
 1201     1    0.00057   0.00000  -0.02619   0.00000   0.00000   0.00000
          2    0.00004   0.00000  -0.00060   0.00000   0.00000   0.00000
          3    0.00006   0.00000  -0.00078   0.00000   0.00000   0.00000
          5    0.04990   0.00000  -0.01401   0.00000  -0.00030   0.00000
          6    0.09003   0.00000   0.07767   0.00000  -0.00133   0.00000
          7   -0.08285   0.00000   0.01439   0.00000  -0.00003   0.00000
          8    0.05776   0.00000   0.05047   0.00000  -0.00165   0.00000
 1301     1    0.00062   0.00000  -0.02629   0.00000   0.00000   0.00000
          2    0.00005   0.00000  -0.00060   0.00000   0.00000   0.00000
          3    0.00007   0.00000  -0.00080   0.00000   0.00000   0.00000
          5    0.04263   0.00000  -0.01430   0.00000  -0.00030   0.00000
          6    0.04846   0.00000   0.08193   0.00000  -0.00219   0.00000
          7   -0.08362   0.00000   0.01490   0.00000  -0.00004   0.00000
          8    0.00821   0.00000   0.05484   0.00000  -0.00253   0.00000
 1401     1    0.00071   0.00000  -0.02638   0.00000   0.00001   0.00000
          2    0.00007   0.00000  -0.00061   0.00000   0.00000   0.00000
          3    0.00009   0.00000  -0.00081   0.00000   0.00000   0.00000
          5    0.03541   0.00000  -0.01454   0.00000  -0.00030   0.00000
          6   -0.01612   0.00000   0.08657   0.00000  -0.00321   0.00000
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```
  JOINT DISPLACEMENT (INCH RADIANS)    STRUCTURE TYPE = SPACE
  ------------------

JOINT  LOAD   X-TRANS   Y-TRANS   Z-TRANS   X-ROTAN   Y-ROTAN   Z-ROTAN


          7   -0.08466   0.00000   0.01542   0.00000  -0.00005   0.00000
          8   -0.06450   0.00000   0.05966   0.00000  -0.00355   0.00000


  ************** END OF LATEST ANALYSIS RESULT **************


  291. *
  292. *REACTIONS AT FOOTING/WALL BASE
  293. PRINT SUPPORT REACTIONS LIST 101 201 301
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```
   SUPPORT REACTIONS -UNIT KIP  INCH    STRUCTURE TYPE = SPACE
   -----------------

  JOINT  LOAD   FORCE-X   FORCE-Y   FORCE-Z     MOM-X     MOM-Y     MOM Z


    101     1      0.00      0.00      8.75      0.00      0.00      0.00
            2      0.00      0.00      0.14      0.00      0.00      0.00
            3      0.00      0.00      0.18      0.00      0.00      0.00
            5      0.00      0.00      0.92      0.00      0.00      0.00
            6      0.00      0.00     -1.44      0.00      0.00      0.00
            7      0.00      0.00     -0.88      0.00      0.00      0.00
            8      0.00      0.00      7.67      0.00      0.00      0.00
    201     1     -0.14      0.00     35.35      0.00      0.00      0.00
            2      0.00      0.00      0.70      0.00      0.00      0.00
            3      0.00      0.00      0.92      0.00      0.00      0.00
            5     15.47      0.00     -0.17      0.00      0.00      0.00
            6    -22.73      0.00      0.27      0.00      0.00      0.00
            7    -14.92      0.00      0.17      0.00      0.00      0.00
            8    -22.32      0.00     37.24      0.00      0.00      0.00
    301     1      0.00      0.00     12.08      0.00      0.00      0.00
            2      0.00      0.00      0.23      0.00      0.00      0.00
            3      0.00      0.00      0.31      0.00      0.00      0.00
            5      0.00      0.00     -0.74      0.00      0.00      0.00
            6      0.00      0.00      1.17      0.00      0.00      0.00
            7      0.00      0.00      0.72      0.00      0.00      0.00
            8      0.00      0.00     13.76      0.00      0.00      0.00


   ************** END OF LATEST ANALYSIS RESULT **************


   294. *
   295. *PRINT ELEMENT STRESSES IN STRIP FROM TOP TO BOTTOM OF WALL:
   296. PRINT ELEMENT STRESSES LIST 2001 1901 1801 1701 1601 1501 1401 1301 1201 -
   297. 1101 1001
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ELEMENT STRESSES    FORCE,LENGTH UNITS= KIP  INCH
----------------

         STRESS = FORCE/UNIT WIDTH/THICK, MOMENT = FORCE-LENGTH/UNIT WIDTH

ELEMENT  LOAD       SQX        SQY          MX           MY           MXY
                    VONT       VONB         SX           SY           SXY
                    TRESCAT    TRESCAB


 2001      1        0.00       0.00        0.07        0.01          0.00
                    0.01       0.02       -0.01        0.00          0.00
                    0.01       0.02
    TOP :  SMAX=      0.00  SMIN=    -0.01  TMAX=      0.01  ANGLE=  90.0
    BOTT:  SMAX=      0.00  SMIN=    -0.01  TMAX=      0.01  ANGLE=  90.0
           2        0.00       0.00        0.01        0.00          0.00
                    0.00       0.00        0.00        0.00          0.00
                    0.00       0.00
    TOP :  SMAX=      0.00  SMIN=     0.00  TMAX=      0.00  ANGLE=  90.0
    BOTT:  SMAX=      0.00  SMIN=     0.00  TMAX=      0.00  ANGLE=  90.0
           3        0.00       0.00        0.01        0.00          0.00
                    0.00       0.00        0.00        0.00          0.00
                    0.00       0.00
    TOP :  SMAX=      0.00  SMIN=     0.00  TMAX=      0.00  ANGLE=  90.0
    BOTT:  SMAX=      0.00  SMIN=     0.00  TMAX=      0.00  ANGLE=  90.0
           5        0.00       0.00        0.15        0.03          0.00
                    0.21       0.21        0.00        0.21          0.00
                    0.21       0.21
    TOP :  SMAX=      0.21  SMIN=     0.00  TMAX=      0.10  ANGLE=   0.0
    BOTT:  SMAX=      0.21  SMIN=     0.00  TMAX=      0.11  ANGLE=   0.0
           6       -0.01       0.00        1.10       30.91          0.00
                    0.47       1.39        0.00       -0.46          0.00
                    0.49       1.40
    TOP :  SMAX=      0.49  SMIN=     0.03  TMAX=      0.23  ANGLE=   0.0
    BOTT:  SMAX=     -0.03  SMIN=    -1.40  TMAX=      0.68  ANGLE=   0.0
           7        0.00       0.00       -0.43       -0.07          0.00
                    0.45       0.46        0.00       -0.45          0.00
                    0.46       0.46
    TOP :  SMAX=     -0.01  SMIN=    -0.46  TMAX=      0.22  ANGLE=   0.0
    BOTT:  SMAX=      0.01  SMIN=    -0.45  TMAX=      0.23  ANGLE=   0.0
           8       -0.01       0.00        0.91       30.88          0.00
                    0.24       1.62       -0.02       -0.70          0.00
                    0.25       1.64
    TOP :  SMAX=      0.25  SMIN=     0.01  TMAX=      0.12  ANGLE=   0.0
    BOTT:  SMAX=     -0.04  SMIN=    -1.64  TMAX=      0.80  ANGLE=   0.0

 1901      1        0.00       0.00        0.07        0.01          0.00
                    0.01       0.02       -0.01        0.00          0.00
                    0.01       0.02
    TOP :  SMAX=      0.00  SMIN=    -0.01  TMAX=      0.01  ANGLE=  90.0
    BOTT:  SMAX=      0.00  SMIN=    -0.02  TMAX=      0.01  ANGLE=  90.0
           2        0.00       0.00        0.01        0.00          0.00
                    0.00       0.00        0.00        0.00          0.00
                    0.00       0.00
    TOP :  SMAX=      0.00  SMIN=     0.00  TMAX=      0.00  ANGLE=  90.0
    BOTT:  SMAX=      0.00  SMIN=     0.00  TMAX=      0.00  ANGLE=  90.0
```

```
 ELEMENT STRESSES    FORCE,LENGTH UNITS= KIP  INCH
 ----------------

         STRESS = FORCE/UNIT WIDTH/THICK, MOMENT = FORCE-LENGTH/UNIT WIDTH

ELEMENT  LOAD        SQX         SQY          MX          MY           MXY
                     VONT        VONB         SX          SY           SXY
                     TRESCAT     TRESCAB

           3         0.00        0.00        0.01        0.00         0.00
                     0.00        0.00        0.00        0.00         0.00
                     0.00        0.00
      TOP :  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
      BOTT:  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
           5         0.00        0.00       -0.05       -0.01         0.00
                     0.25        0.25        0.00        0.25         0.00
                     0.25        0.25
      TOP :  SMAX=     0.25  SMIN=     0.00  TMAX=     0.13  ANGLE=   0.0
      BOTT:  SMAX=     0.25  SMIN=     0.00  TMAX=     0.12  ANGLE=   0.0
           6        -0.02        0.00        6.33       31.80         0.00
                     0.72        1.06        0.00       -0.17         0.00
                     0.80        1.14
      TOP :  SMAX=     0.80  SMIN=     0.19  TMAX=     0.30  ANGLE=   0.0
      BOTT:  SMAX=    -0.19  SMIN=    -1.14  TMAX=     0.48  ANGLE=   0.0
           7         0.00        0.00       -0.34       -0.06         0.00
                     0.45        0.45        0.00       -0.45         0.00
                     0.45        0.46
      TOP :  SMAX=    -0.01  SMIN=    -0.45  TMAX=     0.22  ANGLE=   0.0
      BOTT:  SMAX=     0.01  SMIN=    -0.45  TMAX=     0.23  ANGLE=   0.0
           8        -0.02        0.00        6.02       31.75         0.00
                     0.54        1.25       -0.02       -0.37         0.00
                     0.60        1.34
      TOP :  SMAX=     0.60  SMIN=     0.17  TMAX=     0.22  ANGLE=   0.0
      BOTT:  SMAX=    -0.20  SMIN=    -1.34  TMAX=     0.57  ANGLE=   0.0

 1801      1         0.00        0.00        0.05        0.01         0.00
                     0.02        0.02       -0.02        0.00         0.00
                     0.02        0.02
      TOP :  SMAX=     0.00  SMIN=    -0.02  TMAX=     0.01  ANGLE=  90.0
      BOTT:  SMAX=     0.00  SMIN=    -0.02  TMAX=     0.01  ANGLE=  90.0
           2         0.00        0.00        0.00        0.00         0.00
                     0.00        0.00        0.00        0.00         0.00
                     0.00        0.00
      TOP :  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
      BOTT:  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
           3         0.00        0.00        0.01        0.00         0.00
                     0.00        0.00        0.00        0.00         0.00
                     0.00        0.00
      TOP :  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
      BOTT:  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
           5         0.00        0.00        0.28        0.05         0.00
                     0.31        0.31        0.00        0.31         0.00
                     0.31        0.32
      TOP :  SMAX=     0.31  SMIN=     0.01  TMAX=     0.15  ANGLE=   0.0
      BOTT:  SMAX=     0.31  SMIN=    -0.01  TMAX=     0.16  ANGLE=   0.0
```

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 ELEMENT STRESSES    FORCE,LENGTH UNITS= KIP  INCH
 ----------------

         STRESS = FORCE/UNIT WIDTH/THICK, MOMENT = FORCE-LENGTH/UNIT WIDTH

ELEMENT  LOAD        SQX         SQY          MX          MY           MXY
                     VONT        VONB         SX          SY           SXY
                     TRESCAT     TRESCAB

          6        -0.02        0.00       17.48       33.70          0.00
                    0.93        0.85        0.00        0.05          0.00
                    1.08        0.98
     TOP :  SMAX=     1.08  SMIN=     0.54  TMAX=     0.27  ANGLE=   0.0
     BOTT:  SMAX=    -0.54  SMIN=    -0.98  TMAX=     0.22  ANGLE=   0.0
          7         0.00        0.00       -1.50       -0.25          0.00
                    0.43        0.46        0.00       -0.45          0.00
                    0.46        0.49
     TOP :  SMAX=    -0.05  SMIN=    -0.46  TMAX=     0.20  ANGLE=   0.0
     BOTT:  SMAX=     0.05  SMIN=    -0.44  TMAX=     0.24  ANGLE=   0.0
          8        -0.02        0.00       16.33       33.50          0.00
                    0.81        0.97       -0.02       -0.09          0.00
                    0.93        1.12
     TOP :  SMAX=     0.93  SMIN=     0.48  TMAX=     0.23  ANGLE=   0.0
     BOTT:  SMAX=    -0.52  SMIN=    -1.12  TMAX=     0.30  ANGLE=   0.0

 1701     1         0.00        0.00        0.02        0.00          0.00
                    0.02        0.02       -0.02        0.00          0.00
                    0.02        0.02
     TOP :  SMAX=     0.00  SMIN=    -0.02  TMAX=     0.01  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=    -0.02  TMAX=     0.01  ANGLE=  90.0
          2         0.00        0.00        0.00        0.00          0.00
                    0.00        0.00        0.00        0.00          0.00
                    0.00        0.00
     TOP :  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
          3         0.00        0.00        0.00        0.00          0.00
                    0.00        0.00        0.00        0.00          0.00
                    0.00        0.00
     TOP :  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
          5         0.00        0.00       -0.42       -0.07          0.00
                    0.40        0.39        0.00        0.39          0.00
                    0.40        0.39
     TOP :  SMAX=     0.39  SMIN=    -0.01  TMAX=     0.20  ANGLE=   0.0
     BOTT:  SMAX=     0.39  SMIN=     0.01  TMAX=     0.19  ANGLE=   0.0
          6        -0.01        0.00       30.19       35.86          0.00
                    1.10        0.95        0.00        0.12          0.00
                    1.22        0.98
     TOP :  SMAX=     1.22  SMIN=     0.92  TMAX=     0.15  ANGLE=   0.0
     BOTT:  SMAX=    -0.92  SMIN=    -0.98  TMAX=     0.03  ANGLE=  90.0
          7         0.00        0.00       -1.12       -0.19          0.00
                    0.45        0.47        0.00       -0.46          0.00
                    0.47        0.49
     TOP :  SMAX=    -0.03  SMIN=    -0.47  TMAX=     0.22  ANGLE=   0.0
     BOTT:  SMAX=     0.03  SMIN=    -0.46  TMAX=     0.25  ANGLE=   0.0
```

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 ELEMENT STRESSES    FORCE,LENGTH UNITS= KIP  INCH
 ----------------

          STRESS = FORCE/UNIT WIDTH/THICK, MOMENT = FORCE-LENGTH/UNIT WIDTH

ELEMENT  LOAD       SQX          SQY           MX           MY           MXY
                    VONT         VONB          SX           SY           SXY
                    TRESCAT      TRESCAB

          8        -0.01         0.00        28.68        35.60         0.00
                    1.03         0.98        -0.02         0.05         0.00
                    1.14         1.04
     TOP :  SMAX=     1.14  SMIN=     0.85  TMAX=     0.14  ANGLE=   0.0
     BOTT:  SMAX=    -0.90  SMIN=    -1.04  TMAX=     0.07  ANGLE=   0.0

 1601     1         0.00         0.00         0.00         0.00         0.00
                    0.03         0.03        -0.03         0.00         0.00
                    0.03         0.03
     TOP :  SMAX=     0.00  SMIN=    -0.03  TMAX=     0.01  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=    -0.03  TMAX=     0.01  ANGLE=  90.0
          2         0.00         0.00         0.00         0.00         0.00
                    0.00         0.00         0.00         0.00         0.00
                    0.00         0.00
     TOP :  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
          3         0.00         0.00         0.00         0.00         0.00
                    0.00         0.00         0.00         0.00         0.00
                    0.00         0.00
     TOP :  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
          5         0.00         0.00        -0.99        -0.17         0.00
                    0.48         0.46         0.00         0.47         0.00
                    0.49         0.47
     TOP :  SMAX=     0.46  SMIN=    -0.03  TMAX=     0.25  ANGLE=   0.0
     BOTT:  SMAX=     0.47  SMIN=     0.03  TMAX=     0.22  ANGLE=   0.0
          6        -0.01         0.00        37.53        37.10         0.00
                    1.19         1.10         0.00         0.08         0.00
                    1.22         1.15
     TOP :  SMAX=     1.22  SMIN=     1.15  TMAX=     0.04  ANGLE=  90.0
     BOTT:  SMAX=    -1.05  SMIN=    -1.15  TMAX=     0.05  ANGLE=  90.0
          7         0.00         0.00        -0.48        -0.08         0.00
                    0.49         0.50         0.00        -0.49         0.00
                    0.49         0.50
     TOP :  SMAX=    -0.01  SMIN=    -0.49  TMAX=     0.24  ANGLE=   0.0
     BOTT:  SMAX=     0.01  SMIN=    -0.49  TMAX=     0.25  ANGLE=   0.0
          8        -0.01         0.00        36.06        36.85         0.00
                    1.14         1.10        -0.03         0.06         0.00
                    1.19         1.13
     TOP :  SMAX=     1.19  SMIN=     1.07  TMAX=     0.06  ANGLE=   0.0
     BOTT:  SMAX=    -1.07  SMIN=    -1.13  TMAX=     0.03  ANGLE=  90.0

 1501     1         0.00         0.00         0.00         0.00         0.00
                    0.03         0.03        -0.03         0.00         0.00
                    0.03         0.03
     TOP :  SMAX=     0.00  SMIN=    -0.03  TMAX=     0.02  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=    -0.03  TMAX=     0.02  ANGLE=  90.0
```

```
 ELEMENT STRESSES    FORCE,LENGTH UNITS= KIP  INCH
 ----------------

          STRESS = FORCE/UNIT WIDTH/THICK, MOMENT = FORCE-LENGTH/UNIT WIDTH

ELEMENT  LOAD       SQX        SQY          MX          MY          MXY
                    VONT       VONB         SX          SY          SXY
                    TRESCAT    TRESCAB

           2        0.00       0.00        0.00        0.00         0.00
                    0.00       0.00        0.00        0.00         0.00
                    0.00       0.00
     TOP :  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
           3        0.00       0.00        0.00        0.00         0.00
                    0.00       0.00        0.00        0.00         0.00
                    0.00       0.00
     TOP :  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
           5        0.00       0.00       -0.58       -0.10         0.00
                    0.54       0.52        0.00        0.53         0.00
                    0.54       0.53
     TOP :  SMAX=     0.53  SMIN=    -0.02  TMAX=     0.27  ANGLE=   0.0
     BOTT:  SMAX=     0.53  SMIN=     0.02  TMAX=     0.26  ANGLE=   0.0
           6        0.00       0.00       40.74       37.65         0.00
                    1.23       1.18        0.00        0.05         0.00
                    1.25       1.25
     TOP :  SMAX=     1.25  SMIN=     1.20  TMAX=     0.02  ANGLE=  90.0
     BOTT:  SMAX=    -1.10  SMIN=    -1.25  TMAX=     0.07  ANGLE=   0.0
           7        0.00       0.00       -0.34       -0.06         0.00
                    0.53       0.53        0.00       -0.53         0.00
                    0.53       0.54
     TOP :  SMAX=    -0.01  SMIN=    -0.53  TMAX=     0.26  ANGLE=   0.0
     BOTT:  SMAX=     0.01  SMIN=    -0.53  TMAX=     0.27  ANGLE=   0.0
           8        0.00       0.00       39.82       37.49         0.00
                    1.19       1.18       -0.03        0.05         0.00
                    1.20       1.25
     TOP :  SMAX=     1.20  SMIN=     1.19  TMAX=     0.01  ANGLE=  90.0
     BOTT:  SMAX=    -1.10  SMIN=    -1.25  TMAX=     0.08  ANGLE=   0.0

 1401      1        0.00       0.00        0.00        0.00         0.00
                    0.03       0.03       -0.03        0.00         0.00
                    0.03       0.03
     TOP :  SMAX=     0.00  SMIN=    -0.03  TMAX=     0.02  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=    -0.03  TMAX=     0.02  ANGLE=  90.0
           2        0.00       0.00        0.00        0.00         0.00
                    0.00       0.00        0.00        0.00         0.00
                    0.00       0.00
     TOP :  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
           3        0.00       0.00        0.00        0.00         0.00
                    0.00       0.00        0.00        0.00         0.00
                    0.00       0.00
     TOP :  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
```

```
 ELEMENT STRESSES    FORCE,LENGTH UNITS= KIP  INCH
 ----------------

         STRESS = FORCE/UNIT WIDTH/THICK, MOMENT = FORCE-LENGTH/UNIT WIDTH

ELEMENT  LOAD         SQX         SQY          MX          MY           MXY
                      VONT        VONB         SX          SY           SXY
                      TRESCAT     TRESCAB

           5        -0.01        0.00        2.25        0.38          0.00
                     0.57        0.61        0.00        0.59          0.00
                     0.60        0.64
     TOP :  SMAX=     0.60  SMIN=     0.07  TMAX=     0.26  ANGLE=   0.0
     BOTT:  SMAX=     0.57  SMIN=    -0.07  TMAX=     0.32  ANGLE=   0.0
           6         0.00        0.00       41.21       37.73          0.00
                     1.24        1.18        0.00        0.07          0.00
                     1.26        1.26
     TOP :  SMAX=     1.26  SMIN=     1.23  TMAX=     0.02  ANGLE=  90.0
     BOTT:  SMAX=    -1.08  SMIN=    -1.26  TMAX=     0.09  ANGLE=   0.0
           7         0.01        0.00       -2.53       -0.43          0.00
                     0.56        0.61        0.00       -0.58          0.00
                     0.59        0.64
     TOP :  SMAX=    -0.08  SMIN=    -0.59  TMAX=     0.26  ANGLE=   0.0
     BOTT:  SMAX=     0.08  SMIN=    -0.56  TMAX=     0.32  ANGLE=   0.0
           8         0.00        0.00       40.92       37.68          0.00
                     1.22        1.20       -0.04        0.08          0.00
                     1.23        1.29
     TOP :  SMAX=     1.23  SMIN=     1.22  TMAX=     0.01  ANGLE=  90.0
     BOTT:  SMAX=    -1.07  SMIN=    -1.29  TMAX=     0.11  ANGLE=   0.0

 1301      1         0.00        0.00        0.00        0.00          0.00
                     0.04        0.04       -0.04        0.00          0.00
                     0.04        0.04
     TOP :  SMAX=     0.00  SMIN=    -0.04  TMAX=     0.02  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=    -0.04  TMAX=     0.02  ANGLE=  90.0
           2         0.00        0.00        0.00        0.00          0.00
                     0.00        0.00        0.00        0.00          0.00
                     0.00        0.00
     TOP :  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
           3         0.00        0.00        0.00        0.00          0.00
                     0.00        0.00        0.00        0.00          0.00
                     0.00        0.00
     TOP :  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
           5        -0.01        0.00        9.07        1.54          0.00
                     0.64        0.81        0.00        0.68          0.00
                     0.73        0.91
     TOP :  SMAX=     0.73  SMIN=     0.28  TMAX=     0.22  ANGLE=   0.0
     BOTT:  SMAX=     0.63  SMIN=    -0.28  TMAX=     0.46  ANGLE=   0.0
           6         0.01        0.00       37.97       37.18          0.00
                     1.23        1.09        0.00        0.15          0.00
                     1.29        1.16
     TOP :  SMAX=     1.29  SMIN=     1.16  TMAX=     0.06  ANGLE=   0.0
     BOTT:  SMAX=    -0.99  SMIN=    -1.16  TMAX=     0.09  ANGLE=   0.0
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 ELEMENT STRESSES    FORCE,LENGTH UNITS= KIP  INCH
 ----------------

         STRESS = FORCE/UNIT WIDTH/THICK, MOMENT = FORCE-LENGTH/UNIT WIDTH

ELEMENT  LOAD       SQX        SQY          MX          MY          MXY
                    VONT       VONB         SX          SY          SXY
                    TRESCAT    TRESCAB

          7         0.01       0.00        -8.78       -1.49         0.00
                    0.62       0.79         0.00       -0.67         0.00
                    0.71       0.89
     TOP :  SMAX=   -0.27  SMIN=   -0.71  TMAX=    0.22  ANGLE=   0.0
     BOTT:  SMAX=    0.27  SMIN=   -0.62  TMAX=    0.44  ANGLE=   0.0
          8         0.01       0.00        38.27       37.23         0.00
                    1.23       1.11        -0.04        0.16         0.00
                    1.30       1.21
     TOP :  SMAX=    1.30  SMIN=    1.13  TMAX=    0.09  ANGLE=   0.0
     BOTT:  SMAX=   -0.98  SMIN=   -1.21  TMAX=    0.12  ANGLE=   0.0

 1201     1         0.00       0.00         0.00        0.00         0.00
                    0.04       0.04        -0.04        0.00         0.00
                    0.04       0.04
     TOP :  SMAX=    0.00  SMIN=   -0.04  TMAX=    0.02  ANGLE=  90.0
     BOTT:  SMAX=    0.00  SMIN=   -0.04  TMAX=    0.02  ANGLE=  90.0
          2         0.00       0.00         0.00        0.00         0.00
                    0.00       0.00         0.00        0.00         0.00
                    0.00       0.00
     TOP :  SMAX=    0.00  SMIN=    0.00  TMAX=    0.00  ANGLE=  90.0
     BOTT:  SMAX=    0.00  SMIN=    0.00  TMAX=    0.00  ANGLE=  90.0
          3         0.00       0.00         0.00        0.00         0.00
                    0.00       0.00         0.00        0.00         0.00
                    0.00       0.00
     TOP :  SMAX=    0.00  SMIN=    0.00  TMAX=    0.00  ANGLE=  90.0
     BOTT:  SMAX=    0.00  SMIN=    0.00  TMAX=    0.00  ANGLE=  90.0
          5        -0.01       0.00        19.38        3.29         0.00
                    0.88       1.22         0.00        0.91         0.00
                    1.01       1.41
     TOP :  SMAX=    1.01  SMIN=    0.59  TMAX=    0.21  ANGLE=   0.0
     BOTT:  SMAX=    0.81  SMIN=   -0.59  TMAX=    0.70  ANGLE=   0.0
          6         0.02       0.00        27.52       35.40         0.00
                    1.15       0.85         0.00        0.23         0.00
                    1.31       0.85
     TOP :  SMAX=    1.31  SMIN=    0.84  TMAX=    0.24  ANGLE=   0.0
     BOTT:  SMAX=   -0.84  SMIN=   -0.85  TMAX=    0.01  ANGLE=  90.0
          7         0.01       0.00       -18.58       -3.16         0.00
                    0.86       1.18         0.00       -0.89         0.00
                    0.98       1.36
     TOP :  SMAX=   -0.57  SMIN=   -0.98  TMAX=    0.21  ANGLE=   0.0
     BOTT:  SMAX=    0.57  SMIN=   -0.79  TMAX=    0.68  ANGLE=   0.0
          8         0.02       0.00        28.32       35.54         0.00
                    1.17       0.88        -0.05        0.26         0.00
                    1.34       0.91
     TOP :  SMAX=    1.34  SMIN=    0.82  TMAX=    0.26  ANGLE=   0.0
     BOTT:  SMAX=   -0.83  SMIN=   -0.91  TMAX=    0.04  ANGLE=  90.0
```

```
 ELEMENT STRESSES    FORCE,LENGTH UNITS= KIP  INCH
 ----------------

          STRESS = FORCE/UNIT WIDTH/THICK, MOMENT = FORCE-LENGTH/UNIT WIDTH

ELEMENT  LOAD        SQX        SQY          MX          MY          MXY
                     VONT       VONB         SX          SY          SXY
                     TRESCAT    TRESCAB


 1101     1          0.00       0.00        0.00        0.00         0.00
                     0.05       0.05       -0.05        0.00         0.00
                     0.05       0.05
     TOP :  SMAX=     0.00  SMIN=    -0.05  TMAX=     0.02  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=    -0.05  TMAX=     0.02  ANGLE=  90.0
          2          0.00       0.00        0.00        0.00         0.00
                     0.00       0.00        0.00        0.00         0.00
                     0.00       0.00
     TOP :  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
          3          0.00       0.00        0.00        0.00         0.00
                     0.00       0.00        0.00        0.00         0.00
                     0.00       0.00
     TOP :  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
          5          0.00       0.00       25.75        4.38         0.00
                     1.35       1.82        0.00        1.43         0.00
                     1.56       2.08
     TOP :  SMAX=     1.56  SMIN=     0.79  TMAX=     0.39  ANGLE=   0.0
     BOTT:  SMAX=     1.29  SMIN=    -0.79  TMAX=     1.04  ANGLE=   0.0
          6          0.02       0.00        9.66       19.43         0.00
                     0.36       0.69        0.00       -0.20         0.00
                     0.40       0.79
     TOP :  SMAX=     0.40  SMIN=     0.30  TMAX=     0.05  ANGLE=   0.0
     BOTT:  SMAX=    -0.30  SMIN=    -0.79  TMAX=     0.25  ANGLE=   0.0
          7          0.00       0.00      -24.74       -4.21         0.00
                     1.31       1.76        0.00       -1.38         0.00
                     1.51       2.01
     TOP :  SMAX=    -0.76  SMIN=    -1.51  TMAX=     0.38  ANGLE=   0.0
     BOTT:  SMAX=     0.76  SMIN=    -1.25  TMAX=     1.00  ANGLE=   0.0
          8          0.03       0.00       10.67       19.60         0.00
                     0.39       0.65       -0.05       -0.15         0.00
                     0.45       0.75
     TOP :  SMAX=     0.45  SMIN=     0.28  TMAX=     0.09  ANGLE=   0.0
     BOTT:  SMAX=    -0.38  SMIN=    -0.75  TMAX=     0.19  ANGLE=   0.0

 1001     1          0.00       0.00        0.00        0.00         0.00
                     0.05       0.05       -0.05        0.00         0.00
                     0.05       0.05
     TOP :  SMAX=     0.00  SMIN=    -0.05  TMAX=     0.02  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=    -0.05  TMAX=     0.02  ANGLE=  90.0
          2          0.00       0.00        0.00        0.00         0.00
                     0.00       0.00        0.00        0.00         0.00
                     0.00       0.00
     TOP :  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
```

```
 ELEMENT STRESSES    FORCE,LENGTH UNITS= KIP  INCH
 ----------------

         STRESS = FORCE/UNIT WIDTH/THICK, MOMENT = FORCE-LENGTH/UNIT WIDTH

ELEMENT  LOAD        SQX        SQY          MX          MY            MXY
                     VONT       VONB         SX          SY            SXY
                     TRESCAT    TRESCAB

           3         0.00       0.00        0.00        0.00          0.00
                     0.00       0.00        0.00        0.00          0.00
                     0.00       0.00
     TOP :  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
     BOTT:  SMAX=     0.00  SMIN=     0.00  TMAX=     0.00  ANGLE=  90.0
           5         0.00       0.00        0.00        0.00          0.00
                     0.98       0.98        0.00        0.98          0.00
                     0.98       0.98
     TOP :  SMAX=     0.98  SMIN=     0.00  TMAX=     0.49  ANGLE=   0.0
     BOTT:  SMAX=     0.98  SMIN=     0.00  TMAX=     0.49  ANGLE=   0.0
           6         0.00       0.00       21.43       21.43          0.00
                     0.64       1.11        0.00       -0.63          0.00
                     0.66       1.28
     TOP :  SMAX=     0.66  SMIN=     0.03  TMAX=     0.31  ANGLE=   0.0
     BOTT:  SMAX=    -0.66  SMIN=    -1.28  TMAX=     0.31  ANGLE=   0.0
           7         0.00       0.00        0.00        0.00          0.00
                     0.94       0.94        0.00       -0.94          0.00
                     0.94       0.94
     TOP :  SMAX=     0.00  SMIN=    -0.94  TMAX=     0.47  ANGLE=   0.0
     BOTT:  SMAX=     0.00  SMIN=    -0.94  TMAX=     0.47  ANGLE=   0.0
           8         0.00       0.00       21.43       21.43          0.00
                     0.57       1.09       -0.05       -0.60          0.00
                     0.60       1.25
     TOP :  SMAX=     0.60  SMIN=     0.06  TMAX=     0.27  ANGLE=   0.0
     BOTT:  SMAX=    -0.71  SMIN=    -1.25  TMAX=     0.27  ANGLE=   0.0


        **** MAXIMUM STRESSES AMONG SELECTED PLATES AND CASES ****
           MAXIMUM       MINIMUM       MAXIMUM       MAXIMUM       MAXIMUM
          PRINCIPAL     PRINCIPAL       SHEAR       VONMISES       TRESCA
           STRESS        STRESS        STRESS        STRESS        STRESS

        1.561821E+00 -1.643147E+00  1.041073E+00  1.820813E+00  2.082145E+00
PLATE NO.    1101          2001          1101          1101          1101
CASE  NO.       5             8             5             5             5


 ********************END OF ELEMENT FORCES********************


 298. *
 299. *ELEMENT FORCES IN STRIP FROM TOP TO BOTTOM OF WALL:
 300. PRINT ELEMENT FORCES LIST 2001 1901 1801 1701 1601 1501 1401 1301 1201 -
```

```
301. 1101 1001
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 ELEMENT FORCES    FORCE,LENGTH UNITS= KIP  INCH
 --------------

 **NOTE- IF A COMBINATION INCLUDES A DYNAMIC CASE OR IS AN SRSS OR ABS COMBINATION
         THEN RESULTS CANNOT BE COMPUTED PROPERLY.
   GLOBAL CORNER FORCES
JOINT      FX          FY          FZ          MX          MY          MZ

              ELE.NO.   2001 FOR LOAD CASE      1
  1301  2.1172E-02 -2.2877E-01  5.1043E+00  5.0521E+01  2.6928E-01  2.6628E-02
  1401  3.9340E-08 -2.5614E-01 -5.1043E+00 -5.0502E+01 -3.5573E-06  2.6348E-01
  1402 -2.2324E-02  2.5516E-01 -5.1043E+00  5.0309E+01  4.4015E+00 -2.6348E-01
  1302  1.1514E-03  2.2975E-01  5.1043E+00 -5.0352E+01 -4.1350E+00 -2.6666E-02
              ELE.NO.   2001 FOR LOAD CASE      2
  1301  1.4112E-03 -1.4217E-02  5.3500E-01  5.2590E+00  1.9108E-02  7.0396E-03
  1401 -3.5287E-08 -1.8103E-02 -5.3500E-01 -5.2559E+00  5.3248E-07  2.3782E-02
  1402 -1.5779E-03  1.8034E-02 -5.3500E-01  5.2359E+00  4.5808E-01 -2.3781E-02
  1302  1.6664E-04  1.4286E-02  5.3500E-01 -5.2406E+00 -4.3932E-01 -7.0432E-03
              ELE.NO.   2001 FOR LOAD CASE      3
  1301  1.8596E-03 -1.8734E-02  7.0500E-01  6.9300E+00  2.5178E-02  9.2769E-03
  1401  5.6217E-09 -2.3856E-02 -7.0500E-01 -6.9260E+00  5.8312E-07  3.1338E-02
  1402 -2.0792E-03  2.3765E-02 -7.0500E-01  6.8996E+00  6.0364E-01 -3.1337E-02
  1302  2.1955E-04  1.8826E-02  7.0500E-01 -6.9059E+00 -5.7892E-01 -9.2815E-03
              ELE.NO.   2001 FOR LOAD CASE      5
  1301  1.7297E+00 -3.6356E+01 -2.1313E-05  1.4065E+02  3.3361E+00 -1.1908E+00
  1401  1.3564E+00 -3.4326E+01  2.0377E-05 -1.4247E+02 -1.8872E-04  1.8231E+00
  1402 -1.6405E+00  3.4313E+01  2.1314E-05  1.4193E+02  1.2417E+01 -1.8217E+00
  1302 -1.4456E+00  3.6369E+01 -2.0378E-05 -1.4040E+02 -8.9349E+00  1.1923E+00
              ELE.NO.   2001 FOR LOAD CASE      6
  1301 -1.7900E+00 -4.4721E+01 -2.7205E+02 -2.5464E+03  8.8989E+02 -3.3647E+01
  1401  4.8949E+00 -2.6389E+01  2.7205E+02  2.5318E+03 -9.8035E+02 -1.1291E+02
  1402  2.5761E+00  2.6715E+01  2.7205E+02 -2.4367E+03 -1.1973E+03  1.1290E+02
  1302 -5.6810E+00  4.4395E+01 -2.7205E+02  2.4591E+03  1.1084E+03  3.3643E+01
              ELE.NO.   2001 FOR LOAD CASE      7
  1301 -3.3846E+00  7.6058E+01 -1.8476E-05 -3.0549E+02 -1.5436E+00 -2.0383E-01
  1401 -3.2698E+00  7.6354E+01  1.8076E-05  3.0525E+02 -4.0630E-06 -1.5569E+00
  1402  3.3973E+00 -7.6348E+01  1.8475E-05 -3.0409E+02 -2.6605E+01  1.5543E+00
  1302  3.2571E+00 -7.6063E+01 -1.8076E-05  3.0446E+02  2.5087E+01  2.0101E-01
              ELE.NO.   2001 FOR LOAD CASE      8
  1301 -3.4206E+00 -5.2821E+00 -2.6571E+02 -2.6485E+03  8.9200E+02 -3.4998E+01
  1401  2.9815E+00  1.5341E+01  2.6571E+02  2.6319E+03 -9.8035E+02 -1.1232E+02
  1402  4.3071E+00 -1.5023E+01  2.6571E+02 -2.5364E+03 -1.2060E+03  1.1232E+02
  1302 -3.8680E+00  4.9633E+00 -2.6571E+02  2.5607E+03  1.1194E+03  3.4993E+01

              ELE.NO.   1901 FOR LOAD CASE      1
  1201  3.1502E-02 -1.1119E-01  5.9527E+00  5.8231E+01  9.0891E-01 -1.4532E-01
  1301 -2.1172E-02 -1.2542E-01 -5.9527E+00 -5.8229E+01 -2.6926E-01  4.1902E-01
  1302 -3.2020E-02  1.2309E-01 -5.9527E+00  5.8031E+01  4.8068E+00 -4.1898E-01
  1202  2.1691E-02  1.1351E-01  5.9527E+00 -5.8089E+01 -4.1698E+00  1.4533E-01
              ELE.NO.   1901 FOR LOAD CASE      2
  1201  1.9356E-03 -4.7310E-03  5.3500E-01  5.2162E+00  6.0674E-02 -5.1499E-03
  1301 -1.4112E-03 -7.2803E-03 -5.3500E-01 -5.2146E+00 -1.9107E-02  3.1467E-02
  1302 -2.0403E-03  7.1305E-03 -5.3500E-01  5.1964E+00  4.3545E-01 -3.1465E-02
  1202  1.5159E-03  4.8808E-03  5.3500E-01 -5.2016E+00 -3.9419E-01  5.1512E-03
              ELE.NO.   1901 FOR LOAD CASE      3
  1201  2.5506E-03 -6.2337E-03  7.0500E-01  6.8737E+00  7.9954E-02 -6.7865E-03
  1301 -1.8596E-03 -9.5940E-03 -7.0500E-01 -6.8716E+00 -2.5179E-02  4.1467E-02
  1302 -2.6886E-03  9.3956E-03 -7.0500E-01  6.8477E+00  5.7382E-01 -4.1463E-02
  1202  1.9976E-03  6.4321E-03  7.0500E-01 -6.8545E+00 -5.1944E-01  6.7882E-03
```

```
 ELEMENT FORCES    FORCE,LENGTH UNITS= KIP  INCH
 -------------
   GLOBAL CORNER FORCES
JOINT     FX           FY           FZ           MX           MY           MZ
              ELE.NO.   1901 FOR LOAD CASE     5
 1201  2.3381E+00 -4.2935E+01  1.4813E-06  1.6662E+02  1.4375E+01 -5.0156E+00
 1301  1.3221E+00 -4.0897E+01 -1.5352E-06 -1.6857E+02 -3.3361E+00  4.8004E+00
 1302 -2.2473E+00  4.0856E+01 -1.4810E-06  1.6822E+02  1.1368E+01 -4.7987E+00
 1202 -1.4128E+00  4.2975E+01  1.5350E-06 -1.6724E+02 -2.0136E-01  5.0174E+00
              ELE.NO.   1901 FOR LOAD CASE     6
 1201 -4.2997E+00 -8.9357E+01 -2.7205E+02 -2.3449E+03  6.9274E+02  2.4245E+01
 1301  1.1580E+01 -7.7379E+01  2.7205E+02  2.3375E+03 -8.8989E+02 -1.4944E+02
 1302  4.7914E+00  7.8094E+01  2.7205E+02 -2.2510E+03 -1.0902E+03  1.4944E+02
 1202 -1.2071E+01  8.8642E+01 -2.7205E+02  2.2756E+03  8.9447E+02 -2.4246E+01
              ELE.NO.   1901 FOR LOAD CASE     7
 1201 -3.4281E+00  7.5277E+01 -2.3441E-05 -3.0206E+02 -4.9437E+00  8.0050E-01
 1301 -3.1550E+00  7.5499E+01  1.4185E-05  3.0191E+02  1.5438E+00 -2.1946E+00
 1302  3.4373E+00 -7.5487E+01  4.4753E-06 -3.0090E+02 -2.4776E+01  2.1915E+00
 1202  3.1457E+00 -7.5289E+01  4.7813E-06  3.0134E+02  2.1400E+01 -8.0376E-01
              ELE.NO.   1901 FOR LOAD CASE     8
 1201 -5.3537E+00 -5.7137E+01 -2.6486E+02 -2.4100E+03  7.0322E+02  1.9873E+01
 1301  9.7224E+00 -4.2919E+01  2.6486E+02  2.4005E+03 -8.9200E+02 -1.4634E+02
 1302  5.9446E+00  4.3603E+01  2.6486E+02 -2.3136E+03 -1.0978E+03  1.4634E+02
 1202 -1.0313E+01  5.6453E+01 -2.6486E+02  2.3395E+03  9.1059E+02 -1.9875E+01

              ELE.NO.   1801 FOR LOAD CASE     1
 1101  3.3525E-02 -2.9843E-02  7.2256E+00  7.0248E+01  2.4555E+00 -2.1504E-01
 1201 -3.1502E-02 -1.6497E-02 -7.2256E+00 -7.0250E+01 -9.0893E-01  6.0314E-01
 1202 -3.2819E-02  1.3688E-02 -7.2256E+00  7.0062E+01  5.2173E+00 -6.0313E-01
 1102  3.0796E-02  3.2652E-02  7.2256E+00 -7.0195E+01 -3.6765E+00  2.1504E-01
              ELE.NO.   1801 FOR LOAD CASE     2
 1101  1.6152E-03  5.7618E-03  5.3500E-01  5.1626E+00  1.5058E-01 -6.9393E-03
 1201 -1.9356E-03  1.5767E-03 -5.3500E-01 -5.1556E+00 -6.0674E-02  4.0461E-02
 1202 -1.7908E-03 -1.7390E-03 -5.3500E-01  5.1412E+00  3.8890E-01 -4.0460E-02
 1102  2.1112E-03 -5.5996E-03  5.3500E-01 -5.1560E+00 -2.9994E-01  6.9393E-03
              ELE.NO.   1801 FOR LOAD CASE     3
 1101  2.1284E-03  7.5925E-03  7.0500E-01  6.8030E+00  1.9843E-01 -9.1442E-03
 1201 -2.5506E-03  2.0779E-03 -7.0500E-01 -6.7938E+00 -7.9953E-02  5.3317E-02
 1202 -2.3598E-03 -2.2913E-03 -7.0500E-01  6.7749E+00  5.1248E-01 -5.3317E-02
 1102  2.7821E-03 -7.3791E-03  7.0500E-01 -6.7944E+00 -3.9525E-01  9.1444E-03
              ELE.NO.   1801 FOR LOAD CASE     5
 1101  5.3094E+00 -1.0824E+02 -7.5312E-06  8.2573E+02  4.1855E+01 -6.2585E+00
 1201  3.7656E+00 -9.9609E+01 -8.3884E-06 -8.3778E+02 -1.4375E+01  8.5567E+00
 1202 -4.9303E+00  9.9558E+01  5.6547E-06  8.3584E+02  5.8697E+01 -8.5535E+00
 1102 -4.1447E+00  1.0829E+02  1.0265E-05 -8.2624E+02 -3.0271E+01  6.2622E+00
              ELE.NO.   1801 FOR LOAD CASE     6
 1101  1.9594E+00 -2.4948E+02 -2.7205E+02 -7.5794E+02  3.2126E+02  3.3730E+01
 1201  1.8984E+01 -2.3020E+02  2.7205E+02  7.2558E+02 -7.5148E+02 -1.9311E+02
 1202 -1.1515E+00  2.3098E+02  2.7205E+02 -6.5733E+02 -8.1186E+02  1.9311E+02
 1102 -1.9792E+01  2.4870E+02 -2.7205E+02  7.2706E+02  3.8610E+02 -3.3729E+01
              ELE.NO.   1801 FOR LOAD CASE     7
 1101 -6.7332E+00  1.5040E+02 -1.4796E-05 -1.2031E+03 -1.2908E+01 -3.9989E+00
 1201 -6.3813E+00  1.4997E+02  1.4066E-05  1.2037E+03  4.9439E+00 -8.2242E+00
 1202  6.7134E+00 -1.4995E+02 -1.0294E-05 -1.1995E+03 -9.9979E+01  8.2190E+00
 1102  6.4010E+00 -1.5042E+02  1.1024E-05  1.1997E+03  9.1999E+01  3.9934E+00
```

```
 ELEMENT FORCES    FORCE,LENGTH UNITS= KIP  INCH
 -------------
   GLOBAL CORNER FORCES
JOINT     FX          FY          FZ          MX          MY          MZ
             ELE.NO.   1801 FOR LOAD CASE     8
  1101  5.7282E-01 -2.0734E+02 -2.6359E+02 -1.0531E+03  3.5301E+02  2.3242E+01
  1201  1.6333E+01 -1.7986E+02  2.6359E+02  1.0093E+03 -7.6196E+02 -1.9208E+02
  1202  5.9475E-01  1.8059E+02  2.6359E+02 -9.3901E+02 -8.4702E+02  1.9208E+02
  1102 -1.7500E+01  2.0660E+02 -2.6359E+02  1.0183E+03  4.4346E+02 -2.3242E+01

             ELE.NO.   1701 FOR LOAD CASE     1
  1001  2.6601E-02  4.6328E-02  8.9226E+00  8.5797E+01  3.8260E+00 -2.7835E-01
  1101 -3.3525E-02  1.1227E-01 -8.9226E+00 -8.5876E+01 -2.4555E+00  4.4845E-01
  1102 -2.3612E-02 -1.1476E-01 -8.9226E+00  8.5763E+01  5.0386E+00 -4.4845E-01
  1002  3.0537E-02 -4.3834E-02  8.9226E+00 -8.5804E+01 -3.6664E+00  2.7834E-01
             ELE.NO.   1701 FOR LOAD CASE     2
  1001  8.1325E-04  9.1626E-03  5.3500E-01  5.1119E+00  2.0885E-01 -9.3139E-03
  1101 -1.6151E-03  9.2039E-03 -5.3500E-01 -5.1113E+00 -1.5058E-01  2.1494E-02
  1102 -8.0683E-04 -9.3097E-03 -5.3500E-01  5.1050E+00  2.9548E-01 -2.1494E-02
  1002  1.6087E-03 -9.0568E-03  5.3500E-01 -5.1107E+00 -2.3749E-01  9.3133E-03
             ELE.NO.   1701 FOR LOAD CASE     3
  1001  1.0717E-03  1.2074E-02  7.0500E-01  6.7363E+00  2.7521E-01 -1.2273E-02
  1101 -2.1284E-03  1.2129E-02 -7.0500E-01 -6.7355E+00 -1.9843E-01  2.8324E-02
  1102 -1.0632E-03 -1.2268E-02 -7.0500E-01  6.7272E+00  3.8937E-01 -2.8324E-02
  1002  2.1199E-03 -1.1935E-02  7.0500E-01 -6.7346E+00 -3.1295E-01  1.2273E-02
             ELE.NO.   1701 FOR LOAD CASE     5
  1001  6.6043E+00 -1.3560E+02 -4.2883E-05  1.0441E+03  7.4163E+01 -1.0386E+01
  1101  4.8633E+00 -1.2705E+02 -2.8609E-06 -1.0560E+03 -4.1855E+01  6.9790E+00
  1102 -6.2284E+00  1.2699E+02  3.3473E-05  1.0556E+03  5.0340E+01 -6.9744E+00
  1002 -5.2391E+00  1.3566E+02  1.2272E-05 -1.0466E+03 -1.7120E+01  1.0391E+01
             ELE.NO.   1701 FOR LOAD CASE     6
  1001  5.4552E+00 -2.6392E+02 -2.7205E+02 -5.3150E+02  2.9889E+01  4.9197E+01
  1101  1.7620E+01 -2.6458E+02  2.7205E+02  5.2920E+02 -3.2126E+02 -1.0488E+02
  1102 -5.5069E+00  2.6511E+02  2.7205E+02 -4.9919E+02 -3.6616E+02  1.0489E+02
  1002 -1.7568E+01  2.6340E+02 -2.7205E+02  5.2687E+02  7.6101E+01 -4.9196E+01
             ELE.NO.   1701 FOR LOAD CASE     7
  1001 -7.1900E+00  1.5627E+02  2.0048E-05 -1.2398E+03 -3.0371E+01  9.4583E-02
  1101 -6.3459E+00  1.5375E+02  1.4639E-05  1.2432E+03  1.2908E+01 -9.2222E+00
  1102  7.0784E+00 -1.5372E+02 -4.7425E-05 -1.2396E+03 -9.5494E+01  9.2163E+00
  1002  6.4575E+00 -1.5631E+02  1.2738E-05  1.2377E+03  7.7799E+01 -1.0112E-01
             ELE.NO.   1701 FOR LOAD CASE     8
  1001  4.8980E+00 -2.4318E+02 -2.6189E+02 -6.2953E+02  7.7991E+01  3.8606E+01
  1101  1.6100E+01 -2.3775E+02  2.6189E+02  6.1870E+02 -3.5301E+02 -1.0663E+02
  1102 -4.6824E+00  2.3824E+02  2.6189E+02 -5.8558E+02 -4.0559E+02  1.0663E+02
  1002 -1.6316E+01  2.4268E+02 -2.6189E+02  6.2033E+02  1.3256E+02 -3.8605E+01

             ELE.NO.   1601 FOR LOAD CASE     1
   901  2.0121E-02  3.2190E-02  1.0620E+01  1.0224E+02  4.8545E+00 -2.5561E-01
  1001 -2.6601E-02  1.1622E-01 -1.0620E+01 -1.0235E+02 -3.8260E+00  2.9099E-01
  1002 -1.6370E-02 -1.1809E-01 -1.0620E+01  1.0230E+02  5.1093E+00 -2.9098E-01
   902  2.2850E-02 -3.0316E-02  1.0620E+01 -1.0228E+02 -4.0753E+00  2.5560E-01
             ELE.NO.   1601 FOR LOAD CASE     2
   901  2.2102E-04  6.2141E-03  5.3500E-01  5.1284E+00  2.3242E-01 -5.7866E-03
  1001 -8.1325E-04  7.3503E-03 -5.3500E-01 -5.1298E+00 -2.0885E-01  6.7146E-03
  1002 -1.6954E-04 -7.3932E-03 -5.3500E-01  5.1285E+00  2.3905E-01 -6.7148E-03
   902  7.6177E-04 -6.1712E-03  5.3500E-01 -5.1292E+00 -2.1544E-01  5.7863E-03
```

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  ELEMENT FORCES    FORCE,LENGTH UNITS= KIP  INCH
  -------------
    GLOBAL CORNER FORCES
JOINT      FX          FY          FZ          MX          MY          MZ
              ELE.NO.   1601 FOR LOAD CASE     3
  901  2.9126E-04  8.1885E-03  7.0500E-01  6.7580E+00  3.0627E-01 -7.6254E-03
 1001 -1.0717E-03  9.6858E-03 -7.0500E-01 -6.7598E+00 -2.7521E-01  8.8481E-03
 1002 -2.2342E-04 -9.7423E-03 -7.0500E-01  6.7581E+00  3.1500E-01 -8.8485E-03
  902  1.0038E-03 -8.1320E-03  7.0500E-01 -6.7590E+00 -2.8390E-01  7.6249E-03
              ELE.NO.   1601 FOR LOAD CASE     5
  901  7.4029E+00 -1.6040E+02 -6.5213E-05  1.2472E+03  9.2893E+01 -9.1143E+00
 1001  6.2811E+00 -1.5301E+02  2.9218E-05 -1.2576E+03 -7.4163E+01  1.0332E+00
 1002 -7.0789E+00  1.5298E+02  4.6999E-05  1.2593E+03  3.5724E+01 -1.0271E+00
  902 -6.6051E+00  1.6044E+02 -1.1004E-05 -1.2506E+03 -1.6162E+01  9.1212E+00
              ELE.NO.   1601 FOR LOAD CASE     6
  901  7.9328E+00 -2.5014E+02 -2.7205E+02 -6.1161E+02 -1.1333E+02  4.0032E+01
 1001  1.4124E+01 -2.5504E+02  2.7205E+02  6.1704E+02 -2.9889E+01 -3.5856E+01
 1002 -8.1583E+00  2.5530E+02  2.7205E+02 -6.1208E+02 -8.3555E+01  3.5857E+01
  902 -1.3899E+01  2.4988E+02 -2.7205E+02  6.1916E+02 -5.9594E+01 -4.0031E+01
              ELE.NO.   1601 FOR LOAD CASE     7
  901 -7.8643E+00  1.6718E+02  5.7281E-05 -1.3202E+03 -5.7276E+01  5.2231E+00
 1001 -6.5673E+00  1.6336E+02 -2.6277E-05  1.3253E+03  3.0371E+01 -9.1288E+00
 1002  7.6956E+00 -1.6331E+02 -7.5886E-05 -1.3229E+03 -8.5254E+01  9.1220E+00
  902  6.7360E+00 -1.6723E+02  4.4882E-05  1.3201E+03  5.8002E+01 -5.2303E+00
              ELE.NO.   1601 FOR LOAD CASE     8
  901  7.4921E+00 -2.4332E+02 -2.6019E+02 -5.7043E+02 -7.2321E+01  3.5872E+01
 1001  1.3810E+01 -2.4456E+02  2.6019E+02  5.7054E+02 -7.7991E+01 -4.3645E+01
 1002 -7.5583E+00  2.4484E+02  2.6019E+02 -5.6158E+02 -1.2742E+02  4.3646E+01
  902 -1.3743E+01  2.4305E+02 -2.6019E+02  5.7457E+02 -2.2329E+01 -3.5871E+01

              ELE.NO.   1501 FOR LOAD CASE     1
  801  1.6347E-02  7.6033E-04  1.2317E+01  1.1892E+02  5.6358E+00 -2.1501E-01
  901 -2.0121E-02  8.5692E-02 -1.2317E+01 -1.1904E+02 -4.8545E+00  2.0091E-01
  902 -1.2576E-02 -8.7118E-02 -1.2317E+01  1.1901E+02  5.5388E+00 -2.0091E-01
  802  1.6350E-02  6.6537E-04  1.2317E+01 -1.1896E+02 -4.7507E+00  2.1500E-01
              ELE.NO.   1501 FOR LOAD CASE     2
  801 -7.6616E-05  2.9589E-03  5.3500E-01  5.1549E+00  2.3489E-01 -1.8658E-03
  901 -2.2102E-04  3.8579E-03 -5.3500E-01 -5.1562E+00 -2.3242E-01 -5.3076E-04
  902  1.1607E-04 -3.8625E-03 -5.3500E-01  5.1568E+00  2.1786E-01  5.3080E-04
  802  1.8156E-04 -2.9544E-03  5.3500E-01 -5.1558E+00 -2.1530E-01  1.8656E-03
              ELE.NO.   1501 FOR LOAD CASE     3
  801 -1.0098E-04  3.8994E-03  7.0500E-01  6.7930E+00  3.0952E-01 -2.4586E-03
  901 -2.9125E-04  5.0841E-03 -7.0500E-01 -6.7946E+00 -3.0627E-01 -6.9948E-04
  902  1.5296E-04 -5.0901E-03 -7.0500E-01  6.7954E+00  2.8709E-01  6.9941E-04
  802  2.3927E-04 -3.8934E-03  7.0500E-01 -6.7941E+00 -2.8371E-01  2.4585E-03
              ELE.NO.   1501 FOR LOAD CASE     5
  801  7.3128E+00 -1.8057E+02 -1.2782E-04  1.4156E+03  6.5103E+01  4.8683E+00
  901  8.1951E+00 -1.7462E+02  1.0484E-04 -1.4244E+03 -9.2893E+01 -9.6293E+00
  902 -7.0554E+00  1.7467E+02  1.1876E-04  1.4271E+03  3.1606E+01  9.6362E+00
  802 -8.4525E+00  1.8052E+02 -9.5782E-05 -1.4159E+03 -5.8522E+01 -4.8611E+00
              ELE.NO.   1501 FOR LOAD CASE     6
  801  9.4624E+00 -2.4115E+02 -2.7205E+02 -6.9655E+02 -1.6448E+02  2.8738E+01
  901  1.1647E+01 -2.4232E+02  2.7205E+02  6.9766E+02  1.1333E+02  1.6569E+00
  902 -9.5177E+00  2.4241E+02  2.7205E+02 -7.0488E+02  5.2094E+01 -1.6564E+00
  802 -1.1591E+01  2.4105E+02 -2.7205E+02  7.0823E+02 -1.0314E+02 -2.8737E+01
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  ELEMENT FORCES    FORCE,LENGTH UNITS= KIP  INCH
  --------------
    GLOBAL CORNER FORCES
JOINT      FX          FY          FZ          MX          MY          MZ
            ELE.NO.   1501 FOR LOAD CASE     7
  801 -7.6735E+00  1.8025E+02  9.5996E-05 -1.4222E+03 -4.7582E+01 -3.8665E+00
  901 -7.8791E+00  1.7596E+02 -6.9713E-05  1.4284E+03  5.7276E+01  1.1179E+00
  902  7.4872E+00 -1.7598E+02 -1.0449E-04 -1.4279E+03 -6.7433E+01 -1.1251E+00
  802  8.0653E+00 -1.8023E+02  7.8207E-05  1.4209E+03  7.6547E+01  3.8588E+00
            ELE.NO.   1501 FOR LOAD CASE     8
  801  9.1179E+00 -2.4146E+02 -2.5850E+02 -5.7223E+02 -1.4077E+02  2.9520E+01
  901  1.1942E+01 -2.4088E+02  2.5850E+02  5.7064E+02  7.2321E+01 -6.6547E+00
  902 -9.0981E+00  2.4101E+02  2.5850E+02 -5.7478E+02  2.2310E+01  6.6549E+00
  802 -1.1962E+01  2.4134E+02 -2.5850E+02  5.8232E+02 -9.0365E+01 -2.9520E+01

            ELE.NO.   1401 FOR LOAD CASE     1
  701  1.4762E-02 -2.2797E-02  1.4014E+01  1.3557E+02  6.2918E+00 -1.8071E-01
  801 -1.6346E-02  5.9078E-02 -1.4014E+01 -1.3568E+02 -5.6358E+00  1.6885E-01
  802 -1.1135E-02 -6.0276E-02 -1.4014E+01  1.3565E+02  6.2109E+00 -1.6885E-01
  702  1.2719E-02  2.3995E-02  1.4014E+01 -1.3560E+02 -5.5478E+00  1.8071E-01
            ELE.NO.   1401 FOR LOAD CASE     2
  701 -1.8808E-04  1.0380E-03  5.3500E-01  5.1724E+00  2.2800E-01  1.0287E-03
  801  7.6617E-05  1.5149E-03 -5.3500E-01 -5.1731E+00 -2.3489E-01 -2.5962E-03
  802  2.0836E-04 -1.5024E-03 -5.3500E-01  5.1739E+00  2.1688E-01  2.5961E-03
  702 -9.6898E-05 -1.0504E-03  5.3500E-01 -5.1726E+00 -2.2368E-01 -1.0289E-03
            ELE.NO.   1401 FOR LOAD CASE     3
  701 -2.4784E-04  1.3678E-03  7.0500E-01  6.8159E+00  3.0045E-01  1.3557E-03
  801  1.0096E-04  1.9962E-03 -7.0500E-01 -6.8169E+00 -3.0952E-01 -3.4210E-03
  802  2.7457E-04 -1.9798E-03 -7.0500E-01  6.8180E+00  2.8580E-01  3.4211E-03
  702 -1.2769E-04 -1.3842E-03  7.0500E-01 -6.8162E+00 -2.9475E-01 -1.3557E-03
            ELE.NO.   1401 FOR LOAD CASE     5
  701  6.1702E+00 -2.0001E+02 -7.0314E-05  1.5702E+03 -5.8379E+01  4.1702E+01
  801  1.0998E+01 -1.9321E+02  9.6000E-05 -1.5813E+03 -6.5103E+01 -2.3363E+01
  802 -5.8829E+00  1.9343E+02  1.3878E-04  1.5809E+03  7.2961E+01  2.3370E+01
  702 -1.1285E+01  1.9979E+02 -1.6446E-04 -1.5591E+03 -1.9500E+02 -4.1694E+01
            ELE.NO.   1401 FOR LOAD CASE     6
  701  1.1555E+01 -2.5086E+02 -2.7205E+02 -6.4865E+02 -1.3593E+02  9.4638E+00
  801  1.0117E+01 -2.4549E+02  2.7205E+02  6.4129E+02  1.6448E+02  2.4736E+01
  802 -1.1318E+01  2.4544E+02  2.7205E+02 -6.5318E+02  1.0796E+02 -2.4734E+01
  702 -1.0354E+01  2.5092E+02 -2.7205E+02  6.5803E+02 -7.8876E+01 -9.4622E+00
            ELE.NO.   1401 FOR LOAD CASE     7
  701 -6.3644E+00  1.9663E+02  7.8148E-05 -1.5470E+03  5.9439E+01 -3.8518E+01
  801 -1.0540E+01  1.9056E+02 -9.9718E-05  1.5569E+03  4.7582E+01  1.7867E+01
  802  6.1077E+00 -1.9075E+02 -1.5564E-04 -1.5551E+03 -8.8290E+01 -1.7875E+01
  702  1.0797E+01 -1.9644E+02  1.7721E-04  1.5359E+03  1.9404E+02  3.8510E+01
            ELE.NO.   1401 FOR LOAD CASE     8
  701  1.1375E+01 -2.5426E+02 -2.5680E+02 -4.7794E+02 -1.2805E+02  1.2469E+01
  801  1.0559E+01 -2.4808E+02  2.5680E+02  4.6924E+02  1.4077E+02  1.9402E+01
  802 -1.1104E+01  2.4806E+02  2.5680E+02 -4.7972E+02  9.9342E+01 -1.9401E+01
  702 -1.0830E+01  2.5429E+02 -2.5680E+02  4.8728E+02 -8.5904E+01 -1.2468E+01

            ELE.NO.   1301 FOR LOAD CASE     1
  601  1.4838E-02 -4.1754E-02  1.5711E+01  1.5216E+02  6.9117E+00 -1.5902E-01
  701 -1.4762E-02  4.0011E-02 -1.5711E+01 -1.5227E+02 -6.2918E+00  1.7146E-01
  702 -1.1218E-02 -4.1143E-02 -1.5711E+01  1.5224E+02  7.0039E+00 -1.7145E-01
  602  1.1142E-02  4.2886E-02  1.5711E+01 -1.5219E+02 -6.3768E+00  1.5902E-01
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 ELEMENT FORCES    FORCE,LENGTH UNITS= KIP  INCH
 --------------
   GLOBAL CORNER FORCES
JOINT      FX          FY           FZ           MX           MY           MZ
            ELE.NO.   1301 FOR LOAD CASE     2
 601 -1.8929E-04 -1.8461E-04  5.3500E-01  5.1829E+00  2.1850E-01  2.9340E-03
 701  1.8808E-04  2.1231E-04 -5.3500E-01 -5.1836E+00 -2.2800E-01 -2.0770E-03
 702  2.0586E-04 -1.9510E-04 -5.3500E-01  5.1837E+00  2.2465E-01  2.0770E-03
 602 -2.0465E-04  1.6740E-04  5.3500E-01 -5.1822E+00 -2.3406E-01 -2.9339E-03
            ELE.NO.   1301 FOR LOAD CASE     3
 601 -2.4943E-04 -2.4342E-04  7.0500E-01  6.8298E+00  2.8793E-01  3.8662E-03
 701  2.4785E-04  2.7962E-04 -7.0500E-01 -6.8307E+00 -3.0045E-01 -2.7371E-03
 702  2.7128E-04 -2.5694E-04 -7.0500E-01  6.8309E+00  2.9604E-01  2.7370E-03
 602 -2.6970E-04  2.2074E-04  7.0500E-01 -6.8289E+00 -3.0843E-01 -3.8663E-03
            ELE.NO.   1301 FOR LOAD CASE     5
 601  5.0940E+00 -2.3596E+02  3.0109E-06  1.8268E+03 -3.0944E+02  1.0314E+02
 701  1.4853E+01 -2.2091E+02  6.9654E-05 -1.8511E+03  5.8379E+01 -2.9105E+01
 702 -4.4565E+00  2.2136E+02  2.1162E-04  1.8390E+03  2.1949E+02  2.9114E+01
 602 -1.5491E+01  2.3551E+02 -2.8429E-04 -1.7929E+03 -4.6748E+02 -1.0313E+02
            ELE.NO.   1301 FOR LOAD CASE     6
 601  1.5887E+01 -2.7886E+02 -2.7205E+02 -4.5009E+02  4.1656E+01 -4.3224E+01
 701  8.0249E+00 -2.6879E+02  2.7205E+02  4.3765E+02  1.3593E+02  5.1004E+01
 702 -1.5433E+01  2.6847E+02  2.7205E+02 -4.4783E+02  9.7265E+01 -5.1002E+01
 602 -8.4787E+00  2.7919E+02 -2.7205E+02  4.4474E+02  8.0727E+01  4.3227E+01
            ELE.NO.   1301 FOR LOAD CASE     7
 601 -5.1806E+00  2.3048E+02 -1.4987E-05 -1.7861E+03  2.9479E+02 -9.7797E+01
 701 -1.4320E+01  2.1616E+02 -6.6790E-05  1.8092E+03 -5.9438E+01  2.6169E+01
 702  4.5743E+00 -2.1659E+02 -1.9997E-04 -1.7972E+03 -2.1690E+02 -2.6178E+01
 602  1.4926E+01 -2.3005E+02  2.8175E-04  1.7537E+03  4.4934E+02  9.7788E+01
            ELE.NO.   1301 FOR LOAD CASE     8
 601  1.5814E+01 -2.8439E+02 -2.5510E+02 -2.4524E+02  3.4422E+01 -3.8030E+01
 701  8.5439E+00 -2.7350E+02  2.5510E+02  2.3145E+02  1.2805E+02  4.8234E+01
 702 -1.5326E+01  2.7320E+02  2.5510E+02 -2.4173E+02  1.0739E+02 -4.8231E+01
 602 -9.0325E+00  2.8469E+02 -2.5510E+02  2.4130E+02  5.5667E+01  3.8034E+01

            ELE.NO.   1201 FOR LOAD CASE     1
 501  1.7226E-02 -7.0618E-02  1.7408E+01  1.6882E+02  7.5855E+00 -1.6208E-01
 601 -1.4839E-02  1.5929E-02 -1.7408E+01 -1.6893E+02 -6.9117E+00  1.9704E-01
 602 -1.3393E-02 -1.7158E-02 -1.7408E+01  1.6889E+02  7.8384E+00 -1.9704E-01
 502  1.1006E-02  7.1847E-02  1.7408E+01 -1.6884E+02 -7.1571E+00  1.6207E-01
            ELE.NO.   1201 FOR LOAD CASE     2
 501 -3.4953E-05 -2.1695E-03  5.3500E-01  5.1972E+00  2.1222E-01  3.2698E-03
 601  1.8928E-04 -1.3652E-03 -5.3500E-01 -5.1985E+00 -2.1850E-01 -2.2954E-05
 602  6.9580E-05  1.3766E-03 -5.3500E-01  5.1977E+00  2.3542E-01  2.3127E-05
 502 -2.2391E-04  2.1581E-03  5.3500E-01 -5.1960E+00 -2.4156E-01 -3.2697E-03
            ELE.NO.   1201 FOR LOAD CASE     3
 501 -4.6046E-05 -2.8592E-03  7.0500E-01  6.8487E+00  2.7966E-01  4.3087E-03
 601  2.4942E-04 -1.7987E-03 -7.0500E-01 -6.8503E+00 -2.8793E-01 -3.0378E-05
 602  9.1667E-05  1.8143E-03 -7.0500E-01  6.8493E+00  3.1022E-01  3.0305E-05
 502 -2.9504E-04  2.8436E-03  7.0500E-01 -6.8470E+00 -3.1832E-01 -4.3086E-03
            ELE.NO.   1201 FOR LOAD CASE     5
 501  8.1373E+00 -3.2521E+02 -3.6598E-04  2.4498E+03 -6.0286E+02  1.5603E+02
 601  1.8642E+01 -2.8814E+02  3.0998E-06 -2.5061E+03  3.0944E+02  2.1137E+00
 602 -6.5418E+00  2.8867E+02  3.9643E-04  2.4696E+03  5.2669E+02 -2.1014E+00
 502 -2.0238E+01  3.2468E+02 -3.3556E-05 -2.3880E+03 -8.1409E+02 -1.5602E+02
```

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 ELEMENT FORCES    FORCE,LENGTH UNITS= KIP  INCH
 --------------
   GLOBAL CORNER FORCES
JOINT      FX          FY          FZ          MX          MY          MZ
            ELE.NO.   1201 FOR LOAD CASE     6
  501  2.2606E+01 -3.0349E+02 -2.7205E+02 -2.3922E+02  4.9064E+02 -1.5752E+02
  601  3.6929E+00 -2.9885E+02  2.7205E+02  2.3756E+02 -4.1656E+01  8.0027E+01
  602 -2.2368E+01  2.9803E+02  2.7205E+02 -2.3302E+02 -6.2204E+01 -8.0024E+01
  502 -3.9313E+00  3.0431E+02 -2.7205E+02  1.9555E+02  5.0962E+02  1.5752E+02
            ELE.NO.   1201 FOR LOAD CASE     7
  501 -7.9535E+00  3.1576E+02  3.6616E-04 -2.3809E+03  5.7711E+02 -1.4987E+02
  601 -1.8071E+01  2.8030E+02 -5.0838E-06  2.4347E+03 -2.9479E+02 -1.7616E+00
  602  6.4278E+00 -2.8081E+02 -3.8787E-04 -2.3998E+03 -5.0587E+02  1.7489E+00
  502  1.9597E+01 -3.1525E+02  2.6802E-05  2.3215E+03  7.8242E+02  1.4985E+02
            ELE.NO.   1201 FOR LOAD CASE     8
  501  2.2807E+01 -3.1302E+02 -2.5340E+02  1.0599E+01  4.7297E+02 -1.5151E+02
  601  4.2495E+00 -3.0667E+02  2.5340E+02 -1.4819E+01 -3.4422E+01  8.0578E+01
  602 -2.2495E+01  3.0588E+02  2.5340E+02  1.7763E+01 -3.3002E+01 -8.0572E+01
  502 -4.5617E+00  3.1382E+02 -2.5340E+02 -5.1781E+01  4.7024E+02  1.5151E+02

            ELE.NO.   1101 FOR LOAD CASE     1
  401  2.3627E-02 -1.1983E-01  1.9105E+01  1.8562E+02  8.4631E+00 -2.2192E-01
  501 -1.7226E-02 -2.6759E-02 -1.9105E+01 -1.8574E+02 -7.5855E+00  2.4516E-01
  502 -1.9494E-02  2.5179E-02 -1.9105E+01  1.8570E+02  8.6323E+00 -2.4516E-01
  402  1.3094E-02  1.2141E-01  1.9105E+01 -1.8565E+02 -7.7474E+00  2.2192E-01
            ELE.NO.   1101 FOR LOAD CASE     2
  401  4.3683E-04 -6.1540E-03  5.3500E-01  5.2259E+00  2.2020E-01 -4.5258E-04
  501  3.4948E-05 -4.6516E-03 -5.3500E-01 -5.2280E+00 -2.1222E-01  3.8169E-03
  502 -3.7062E-04  4.6373E-03 -5.3500E-01  5.2266E+00  2.4424E-01 -3.8167E-03
  402 -1.0117E-04  6.1683E-03  5.3500E-01 -5.2252E+00 -2.3611E-01  4.5292E-04
            ELE.NO.   1101 FOR LOAD CASE     3
  401  5.7566E-04 -8.1100E-03  7.0500E-01  6.8865E+00  2.9017E-01 -5.9638E-04
  501  4.6037E-05 -6.1293E-03 -7.0500E-01 -6.8892E+00 -2.7966E-01  5.0297E-03
  502 -4.8840E-04  6.1113E-03 -7.0500E-01  6.8874E+00  3.2185E-01 -5.0294E-03
  402 -1.3330E-04  8.1280E-03  7.0500E-01 -6.8856E+00 -3.1114E-01  5.9679E-04
            ELE.NO.   1101 FOR LOAD CASE     5
  401  2.3540E+01 -5.1621E+02 -2.3469E-03  3.8144E+03 -5.5935E+02  9.2358E+01
  501  1.8312E+01 -4.4236E+02  3.4918E-04 -3.9195E+03  6.0286E+02  1.1781E+02
  502 -2.0312E+01  4.4227E+02  7.1087E-04  3.8521E+03  9.4217E+02 -1.1778E+02
  402 -2.1540E+01  5.1630E+02  1.2869E-03 -3.7511E+03 -8.8966E+02 -9.2337E+01
            ELE.NO.   1101 FOR LOAD CASE     6
  401  2.3785E+01 -3.1191E+02 -4.6638E+02 -1.9798E+03  5.0036E+02 -1.7711E+02
  501  3.9658E+00 -3.2368E+02  4.6638E+02  2.0021E+03 -1.1390E+01  8.1044E+01
  502 -2.4261E+01  3.2280E+02  4.6638E+02 -1.9935E+03 -1.8584E+02 -8.1046E+01
  402 -3.4905E+00  3.1279E+02 -4.6638E+02  1.9286E+03  6.7101E+02  1.7710E+02
            ELE.NO.   1101 FOR LOAD CASE     7
  401 -2.2685E+01  4.9865E+02  2.2836E-03 -3.6872E+03  5.3766E+02 -8.9368E+01
  501 -1.7769E+01  4.2790E+02 -3.6259E-04  3.7880E+03 -5.7711E+02 -1.1257E+02
  502  1.9593E+01 -4.2782E+02 -7.0743E-04 -3.7233E+03 -9.0506E+02  1.1255E+02
  402  2.0861E+01 -4.9873E+02 -1.2136E-03  3.6263E+03  8.5697E+02  8.9347E+01
            ELE.NO.   1101 FOR LOAD CASE     8
  401  2.4665E+01 -3.2960E+02 -4.4603E+02 -1.6549E+03  4.8765E+02 -1.7434E+02
  501  4.4914E+00 -3.3818E+02  4.4603E+02  1.6727E+03  6.2805E+00  8.6538E+01
  502 -2.5000E+01  3.3729E+02  4.4603E+02 -1.6668E+03 -1.3953E+02 -8.6537E+01
  402 -4.1560E+00  3.3050E+02 -4.4603E+02  1.6061E+03  6.3003E+02  1.7434E+02
```

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  ELEMENT FORCES    FORCE,LENGTH UNITS= KIP  INCH
  --------------
    GLOBAL CORNER FORCES
JOINT      FX          FY          FZ          MX          MY          MZ
            ELE.NO.   1001 FOR LOAD CASE     1
  201 -6.8044E-02  1.5584E+00  2.0802E+01  1.9244E+02  8.4023E+00 -3.7418E-06
  401 -2.3627E-02  5.4112E-01 -2.0802E+01 -1.9383E+02 -8.4631E+00 -2.1585E-06
  402  2.3626E-02 -5.4112E-01 -2.0802E+01  1.9383E+02  8.4631E+00  1.0394E-05
  202  6.8044E-02 -1.5584E+00  2.0802E+01 -1.9244E+02 -8.4022E+00  2.0298E-05
            ELE.NO.   1001 FOR LOAD CASE     2
  201 -1.8749E-03  4.2941E-02  5.3500E-01  4.8995E+00  2.1392E-01 -4.2013E-08
  401 -4.3684E-04  1.0005E-02 -5.3500E-01 -5.0434E+00 -2.2020E-01  1.9335E-08
  402  4.3685E-04 -1.0005E-02 -5.3500E-01  5.0434E+00  2.2020E-01  2.4327E-07
  202  1.8749E-03 -4.2941E-02  5.3500E-01 -4.8995E+00 -2.1392E-01  3.4599E-07
            ELE.NO.   1001 FOR LOAD CASE     3
  201 -2.4706E-03  5.6586E-02  7.0500E-01  6.4563E+00  2.8189E-01 -7.7788E-08
  401 -5.7565E-04  1.3184E-02 -7.0500E-01 -6.6460E+00 -2.9017E-01 -2.0117E-08
  402  5.7565E-04 -1.3184E-02 -7.0500E-01  6.6460E+00  2.9017E-01  2.7497E-07
  202  2.4706E-03 -5.6586E-02  7.0500E-01 -6.4563E+00 -2.8189E-01  4.3351E-07
            ELE.NO.   1001 FOR LOAD CASE     5
  201  7.7331E+00 -1.7712E+02  1.0722E-03  1.2785E+03  5.5821E+01  1.7295E-03
  401  2.0880E+01 -4.7824E+02  2.3522E-03 -3.9643E+03 -1.7308E+02  6.2923E-03
  402 -2.0880E+01  4.7823E+02 -1.5845E-03  3.9643E+03  1.7308E+02  9.2665E-03
  202 -7.7333E+00  1.7712E+02 -1.8400E-03 -1.2785E+03 -5.5821E+01  3.3436E-03
            ELE.NO.   1001 FOR LOAD CASE     6
  201  5.4171E+00 -1.2407E+02 -4.6638E+02 -3.4467E+03 -1.5049E+02 -1.1295E-03
  401  9.7796E+00 -2.2398E+02  4.6638E+02  2.8056E+03  1.2250E+02 -1.7510E-03
  402 -9.7796E+00  2.2398E+02  4.6638E+02 -2.8056E+03 -1.2250E+02 -1.1982E-03
  202 -5.4171E+00  1.2407E+02 -4.6638E+02  3.4467E+03  1.5049E+02 -9.0102E-04
            ELE.NO.   1001 FOR LOAD CASE     7
  201 -7.4576E+00  1.7080E+02 -1.0163E-03 -1.2341E+03 -5.3884E+01 -1.6194E-03
  401 -2.0137E+01  4.6121E+02 -2.2781E-03  3.8220E+03  1.6687E+02 -6.0049E-03
  402  2.0137E+01 -4.6121E+02  1.5079E-03 -3.8220E+03 -1.6687E+02 -8.9084E-03
  202  7.4578E+00 -1.7081E+02  1.7864E-03  1.2341E+03  5.3884E+01 -3.1866E-03
            ELE.NO.   1001 FOR LOAD CASE     8
  201  5.6202E+00 -1.2872E+02 -4.4433E+02 -3.1985E+03 -1.3965E+02 -6.7724E-04
  401  1.0498E+01 -2.4045E+02  4.4433E+02  2.4578E+03  1.0731E+02 -7.5203E-04
  402 -1.0498E+01  2.4044E+02  4.4433E+02 -2.4578E+03 -1.0731E+02 -1.1531E-04
  202 -5.6203E+00  1.2872E+02 -4.4433E+02  3.1985E+03  1.3965E+02 -3.7691E-04
  302. *
  303. FINISH
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ATTACHMENT C

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Digesters Condition Assessment - Final

Prepared for: Timothy Banyai, P.E., Brown and Caldwell
Prepared by: Noy Phannavong, V&A
Reviewed by: Mike Oriol, P.E., V&A
Date: June 23, 2009

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1 INTRODUCTION

n October 27 and October 28, 2008, V&A performed a condition assessment of Digesters 2, 4, 5, 6, and 8, as defined in V&A's scope of work, located at the Water Pollution Control Plant (WPCP) in the City of San Jose, California. The purpose of the assessment was to document the condition of the interior and exterior concrete slabs, walls, and roof ceilings of the digesters and perform other corrosion observations related to the operation of the digesters. V&A reviewed the coating inspection reports (prepared by others), including Digester 1, and Digesters 3 through 16 at the WPCP. Figure 1.1 shows a satellite map of the WPCP.

Figure 1.1 – San Jose Water Pollution Control Plant

2 METHODS

2.1 Safety – Confined Space Entry

All necessary confined space entry procedures were followed in accordance with TITLE 8 - CALIFORNIA CODE OF REGULATION Section 5157 (c) (5) prior to the manned entry into the digester and throughout the duration of the digester condition assessment.

Photo 2.1 – 4-Gas Monitor

A confined space is defined as any space that is large enough and so configured that a person can bodily enter and perform assigned work, has limited or restricted means for entry or exit, and is not designed for continuous employee occupancy. Title 8, Section 5158 of the California Code of Regulations provides the guidelines and rules for working in these environments. In general, the atmosphere must be constantly monitored for sufficient levels of oxygen (19.5 to 23.0%), and the absence of Hydrogen Sulfide (H_2S) gas, Carbon Monoxide (CO) gas, and LEL levels. The entrant is the individual that will be performing the work. The entrant is equipped with the necessary personal protective equipment needed to perform the job safely, including a personal 4-gas monitor (Photo 2.1).

2.2 Literature Review

Digester Coatings Report Review

V&A reviewed the Digester Coating Inspection Reports prepared by Jorge Reyes, Michael Noble, Robert Matz, and Paul Blach for Digesters 6, 12, 13, and 14 (2003, Reyes, Noble, Matz, Blach); Digesters 9, 10, 11, 15, and 16 (2004, Reyes, Noble, Matz, Blach), Digesters 1, 2, and 3 (2005, Reyes, Noble, Matz, Blach), and Digesters 5, 7, and 8 (2007, Reyes, Noble). The primary focus of the digester coating inspection reports was to assess the condition of the coating on the interior floor, walls, and attic space of the digester floating covers.

2.3 Evaluation Techniques

The primary qualitative method for the condition assessment consisted of conducting visual examinations and documenting observations with digital photographs. It should be noted that much of the condition assessment data is subjective and is based upon the evaluators' expertise. In addition to the observations of the evaluator, quantitative concrete evaluation techniques were utilized. These techniques are described on the following pages.

Concrete Penetration Data

In order to acquire penetration measurements, a consistent level of force is applied from a chipping hammer. The depth of the resulting cavity is then measured. Cavity depth provides quantitative data on the hardness and condition of the concrete surfaces.

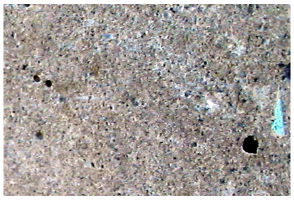
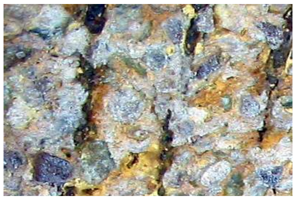
Concrete pH

The pH measurements allow for a quantitative measurement of the extent of atmospheric corrosivity on the concrete, as well as the extent of concrete degradation. Freshly poured concrete has a pH of approximately 12.5 to 13.0. As the pH declines and alkalinity is lost, the mortar loses its structural integrity. Typically, concrete with a pH less than 6.0 is highly susceptible to deterioration and loss of strength. V&A uses an Oakton® pH Testr 3+ meter to test the pH of concrete samples. Prior to testing, the pH probe is calibrated using pH 4.0 and 10.0 buffer solutions.

VANDA© Reinforced Concrete Condition Index Rating System

V&A developed the VANDA© Reinforced Concrete Condition Index Rating System as a means to consistently identify the condition of concrete. The concrete surfaces are rated according to the following table, which summarizes this concrete rating system. The extent of the concrete damage can vary from Level 1 to Level 4, with Level 1 indicating the best case and Level 4 indicating severe damage. The levels of deterioration of the concrete surfaces are based on V&A's experience and are documented using the VANDA© Rating System, shown in Table 2-1, for concrete surfaces.

Table 2.1 – VANDA© Reinforced Concrete Condition Index Rating System

Condition Rating	Description	Descriptive Photograph
Level 1	No/Minimal Damage to Concrete Hardness: no loss of hardness of mortar Smoothness: no loss of smoothness Cracking: no cracks Spalling: no spalling Reinforcing steel: not exposed or damaged	
Level 2	Damage to Concrete Mortar Hardness: some loss of hardness of mortar Smoothness: small-diameter exposed aggregate Cracking: thumbnail-sized cracks of minimal frequency Spalling: shallow spalling of minimal frequency, no related reinforcing steel damage Reinforcing steel: may be exposed but not damaged or corroded	
Level 3	Loss of Concrete Mortar/Damage to Reinforcing Steel Hardness: complete loss of hardness of mortar Smoothness: larger-diameter exposed aggregate Cracking: ¼-inch to ½-inch cracks, moderate frequency Spalling: deep spalling of moderate frequency, related reinforcing steel damage Reinforcing steel: exposed, damaged and corroded, but rehabilitatable	
Level 4	Rebar Severely Corroded/Significant Damage to Structure Hardness: complete loss of hardness of mortar Smoothness: large-diameter exposed aggregate Cracking: ½-inch cracks or greater, high frequency Spalling: deep spalling at high frequency, related reinforcing steel damage Reinforcing steel: corroded or consumed, loss of structural integrity	
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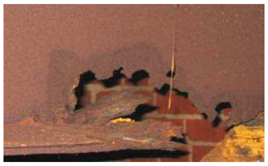
VANDA© Metal Condition Index Rating System

V&A has developed a rating system in order to identify metal condition. The condition of metal corrosion can vary from Level 1 to Level 4, based upon visual observations and ultrasonic thickness data collected in the field. Metal surfaces were evaluated according to the condition rating system, which is summarized in Table 2.2.

Table 2.2 – VANDA© Metal Condition Index Rating System

Metals Condition Rating	Description	Descriptive Photograph
Level 1	No Corrosion: The submerged, immersed and non-submerged ferrous surfaces do not show indications of corrosion damage.	
Level 2	Pitting: Localized corrosion damage of the ferrous surfaces in the form of pits. Depth of pits can range from small to large. Measuring these pits will determine the extent of corrosion loss at the localized area.	
Level 3	Flaking/Exfoliation: Top layers of the ferrous surface have corroded and exfoliated or flaked off (also referred to as scaling). The extent of corrosion can be determined by removing corroded surfaces and performing ultrasonic thickness testing. A direct measurement cannot be used as the exfoliated and corroded metal has expanded to many times its original thickness during the corrosion process.	
Level 4	Loss of Metal Material: The extent of exfoliation has reached a degree wherein the remaining thickness of metal is not sufficient to maintain the structural integrity of the structure.	
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3 FINDINGS

The condition assessment of Digesters 2, 4, 5, 6, and 8 consisted of visual observations of the interior and exterior concrete surfaces, pH testing of the concrete, and measurement of penetration depth to sound concrete. The conditions of the metallic appurtenances inside and outside the digester were also evaluated. General and notable specific findings for the digesters are summarized below. A full report of findings for each digester is located in the Appendix.

Digesters 2, 4, 5, 6, and 8 were out of service at the time of the assessment but contained groundwater. The WPCP staff pumped down the groundwater in Digesters 2, 5, 6, and 8. Digester 4 had about 5 to 6 feet of groundwater remaining. Due to the remaining groundwater, only the exterior of Digester 4 was evaluated. The interior concrete surfaces of Digesters 2, 5, 6, and 8 were evaluated by confined space manned entry. Exterior digester appurtenances (piping, valves, fittings, concrete supports, stairways, walkways, man-ways, etc.) were also evaluated. Based on the hardness of the concrete, pH, no visible reinforcing steel corrosion, and no visible significant cracks, it is V&A's opinion that Digesters 2, 5, 6, and 8 have not been adversely affected due to corrosion since original construction. Based on V&A's past experience and considering the current condition of the digesters in the current operating conditions, it is anticipated that existing digesters have an additional 15 to 20 year life span if the interior walls remain uncoated. Adding an interior protective coating to the interior walls will extend the expected life span of 35 to 40 years.

<u>Interior Wall</u>

In general, the interior concrete wall surfaces of Digesters 2, 5, 6, and 8 appeared to be in good condition. The interior walls of the digesters were not coated. Notable observations on the interior walls are listed below.

- Measurements of depth of penetration to sound concrete yielded 1/16 of an inch or less which indicates that the concrete has retained its structural integrity.
- Concrete pH tests results ranged from 9.0 to 10.5, indicating that the concrete has been resistant to corrosion.
- There was no evidence of exposed reinforcing steel. The concrete cover over the reinforcing steel appears to be adequate to protect the reinforcing steel from exposure and corrosion.

These observations were taken from a relatively small area of the digester walls at a stationary position, adjacent to the digester manways. Visual observations of other areas in the digesters, made from a distance, showed no obvious imperfections on the concrete surface. Assuming a homogeneous progression of corrosion throughout the entire interior wall structure, the interior walls of Digesters 2, 5, 6, and 8 are given a VANDA© Concrete Corrosion Index Rating of Level 1.

Exterior Wall

The exterior walls of each digester appeared to be in good condition. The concrete walls were coated with 1-1/2 inches to 3 inches of Gunite Shotcrete material and top coated with what appears to be an acrylic protective coating. The concrete beneath the coating is assumed to be in good condition and has a VANDA© Concrete Corrosion Index Rating Level 1. Notable observations on the exterior walls of the digesters are listed below.

- There were hairline cracks, either spider web or longitudinal cracks, visible on Digesters 2, 4, 5, 6, and 8. These cracks appeared to be superficial and are not an indication of the condition of the concrete beneath the Gunite coating. Hairline cracking is a common phenomenon that occurs in cement based products, due to shrinkage. An alternative source of the cracking maybe due to movement of the digester walls over time.
- There was damage or spalling visible on the Gunite coating on Digesters 4 and 6. The damage or spalling was most likely due to external impact and not due to the steel wire mesh corroding. The damaged or spalled areas appeared to be superficial, only affecting the Gunite coating.
- There were some small areas of corrosion staining on the wall of Digester 6. These stains may be an indication that the steel wire mesh in the Gunite coating may be corroded. However, the concrete beneath the coating is believed to be in good condition.

Underside of Interior Roof

The interior roof structure was constructed of steel. The coating system on the interior roof surface has failed. Notable observations on the interior roof are listed below.

- The interior roof of Digester 2 appeared to be corroded beyond superficial damage. Localized corrosion damage of the steel surface in the form of pits was observed on several parts of the interior roof structure. The pits had developed into holes in some areas of the roof where light was visible when looking from inside the digester. Digester 2 is given a VANDA© Metal Condition Index Rating Level 4.
- Surface corrosion was observed on the interior roof surface of Digesters 5, 6, and 8. The steel roofs of these digesters are given a VANDA© Metal Condition Index Rating Level 2.

Interior Digester Piping and Appurtenances

The metallic appurtenances in Digesters 2, 5, 6, and 8 appeared to be in good condition. Notable observations on the interior piping and appurtenances are listed below.

- The piping in the digesters appeared to be in good condition. There was superficial surface corrosion observed on the majority of the 8-inch cast iron pipes which would indicate that the coating has failed. The piping in the digesters is given a VANDA© Metal Condition Index Rating Level 2.
- Rust staining was observed on the conduits near the roof of Digesters 5 and 8. However, the conduits near the floor showed no rust staining. The stains may have resulted from an

external cause. The conduits of these digesters are given a VANDA© Metal Condition Index Rating Level 1.

- The circulation piping supports in Digester 2 were in good condition. The circulation piping supports in Digester 2 are given a VANDA© Metal Condition Index Rating Level 1.

<u>Exterior Digester Piping and Appurtenances</u>

In general, the piping and appurtenances outside the digesters appeared to be in good condition and are given a VANDA© Metal Condition Index Rating Level 1. Notable observations on the exterior piping and appurtenances of the digesters are listed on the next page.

- There was surface corrosion on the valves and elbows of the 90-degree circulation suction and discharge piping for Digesters 2, 4, 5, 6, and 8.
- The exterior piping for Digesters 2, 4, 5, 6, and 8 showed flaking or chips in the coating. Surface corrosion was also observed around flange connections of the piping.
- The gas piping and support brackets for Digester 2 had surface corrosion.
- Some miscellaneous actuator valves for Digester 2 showed signs of leakage.

<u>Other Exterior Observations</u>

- There were fractures in the concrete stairway on Digesters 5 and 6. The fractures were most likely caused by the corrosion of the handrails and can be potentially hazardous to persons standing below the stairway.
- The handrails for the stairways of Digesters 6 and 8 showed surface corrosion where the handrail paint was missing.
- Digester 8 had miscellaneous concrete damage. A small spall was observed on a concrete support base exposing the reinforcing steel. A broken piece of concrete was observed on the pathway leading to the stairway.

4 Recommendations

Digester No.	Recommendations
General for all Digesters	
Interior Wall	The necessity for an interior coating becomes more critical if the digesters are to be converted to a fixed roof configuration, as opposed to the existing floating roof. The potential for corrosion due to hydrogen sulfide exposure is increased due to the available oxygen in the headspace of the digester. Variable sludge levels within the digester, while operating in a fixed roof configuration, will also lead to an increase in concrete deterioration. If the digesters continue to operate in a floating cover configuration a coating is not required. However, if the digesters are to be converted to a fixed cover configuration, the following recommendations are presented: • The interior concrete surfaces of all the digesters should be coated with a 100% solids polyurethane or epoxy coating at a minimum dry film thickness of 125 mils to protect against future deterioration of the concrete. Based on the condition of the concrete, the minimum limits of the coating application should include 1 foot below the expected low liquid level in the digester and above. If the liquid level will vary greatly in the digester it is recommended that the coating limits extend all the way to the floor. Coating of the floor surfaces is not recommended due to the expected state of immersion. There is also the potential for coating delamination of coating applied on the floor due to hydrostatic pressure caused by the high ground water table at the plant. Prior to the application of the coating, the concrete surfaces should be abrasive blasted in accordance with SSPC-SP 13 and ICRI guidelines. • A cost-benefit analysis should be conducted for a fixed roof configuration to compare the value of applying a coating system to the interior digester walls as compared to allowing the uncoated concrete walls to deteriorate over time.

Digester No.	Recommendations
Digester Covers	• It is recommended that ultrasonic thickness testing and a structural analysis be performed on all of the digester covers (with the exception of Digester 2) to estimate the remaining life. • The rehabilitation of the steel covers (with the exception of Digester 2) should consist of an abrasive blast to near white metal (SSPC-SP 10) and recoated with a high build epoxy coating system. The high build property will allow the coating to fill much of the pitted steel voids in the surface without having to address each void individually. Locations where steel thickness may be questionable should be assessed for thickness with an ultrasonic thickness meter and should be structurally assessed per the guidance of a structural engineer.
Interior Piping and Appurtenances	• If interior piping of the digesters is to remain in place, recoat the piping with 100% solids polyurethane or epoxy. Prior to recoating, the piping should be sand blasted to near white metal in accordance with the SSPC-SP 10 surface preparation guidelines. • The interior surfaces of the digester piping were not assessed during the condition assessment. It is recommended that the interior surfaces of the digester piping be televised, via CCTV, to ascertain the extent of interior corrosion.
Exterior Walls, Piping, and Appurtenances	• The coating on the exterior piping of all the digesters is degraded and should be over coated. The surfaces should be pressure washed with 5,000 psi of pressure. Apply an overcoat with an epoxy/urethane protective coating system at a dry film thickness of 12 mils. • It is recommended that the City monitor the extent of cracking on an annual basis to mitigate the potential for future corrosion.
Digester No. 1	
Digester Covers	Based on the significant amount of delamination and corrosion observed, it is recommended that the cover be coated with a 100% solids polyurethane or epoxy coating at a minimum dry film thickness of 80 mils.
Digester No. 2	
Exterior Wall	Visible hairline cracks observed should be repaired with a similar acrylic coating.
Digester Covers	Based on the amount of excessive corrosion and loss of structural integrity of the digester cover, it is recommended that the cover be removed and replaced.
Exterior Piping and Appurtenances	The leaking actuator valves observed should be replaced.

Digester No.	Recommendations
Digester No. 3	
Digester Covers	The digester coating inspections that were completed in 2005 indicate that the underside of the digester cover be recoated in 2 to 4 years. If the cover has not been recoated to date it should be recoated at this time.
Digester No. 4	
Exterior Wall	• Visible hairline cracks observed should be repaired with a similar acrylic coating. • The spalls observed should be repaired with a repair mortar such as SikaTop 123 Plus at a minimum thickness of 1/8 of an inch and should not exceed a thickness of 1-1/2 inches. An acrylic top coat should be applied on top of the repair material to match the existing exterior finish.
Digester Covers	The digester coating inspections that were completed in 2005 indicate that the underside of the digester cover be recoated before being put back into operation. If the cover has not been recoated to date it should be recoated at this time.
Digester No. 5	
Exterior Wall	Visible hairline cracks observed should be repaired with a similar acrylic coating.
Digester Covers	Due to the extensive corrosion and presence of sludge observed in the attic space of the digester cover, metal thickness and structural analysis is recommended. If the cover is deemed suitable for operation, a complete coating rehabilitation is recommended for the cover.
Other Exterior Observations	Repair handrail concrete fractures on stairways by following the procedure below. • Remove all unsound or loose concrete and thoroughly clean patch area. • Remove all loose rust from base of handrail by power tools or other mechanical means. • Apply two coats of a corrosion inhibitor/bonding agent such as Sika Armatec 110 EpoCem. • Apply a suitable non-shrink epoxy grout, such as Five Star Instant Grout, manufactured by Five Star Products, Inc., and form to match the original finish.
Digester No. 6	
Exterior Wall	• Visible hairline cracks observed should be repaired with a similar acrylic coating. • The spalls observed should be repaired with a repair mortar such as SikaTop 123 Plus at a minimum thickness of 1/8 of an inch and should not exceed a thickness of 1-1/2 inches. An acrylic top coat should be applied on top of the repair material to match the existing exterior finish.

Digester No.	Recommendations
Digester Covers	Due to the extensive corrosion observed on the digester cover, a complete coating rehabilitation is recommended.
Other Exterior Observations	Repair handrail concrete fractures on stairways by following the procedure below. • Remove all unsound or loose concrete and thoroughly clean patch area. • Remove all loose rust from base of handrail by power tools or other mechanical means. • Apply two coats of a corrosion inhibitor/bonding agent such as Sika Armatec 110 EpoCem. • Apply a suitable non-shrink epoxy grout, such as Five Star Instant Grout, manufactured by Five Star Products, Inc., and form to match the original finish.
Digester No. 7	
Digester Covers	Immediate coating rehabilitation is not required at this time. An entire coating rehabilitation may be required in the next 3 to 5 years.
Digester No. 8	
Exterior Wall	Visible hairline cracks observed should be repaired with a similar acrylic coating.
Digester Covers	Due to the minimal film thickness on the underside of the digester cover and the seam corrosion that was evident on the interior attic space the coating system for the entire digester cover should be rehabilitated in the next 1 to 2 years.
Other Exterior Observations	The spall on the concrete support base should be prepared and cleaned by pressure washing with 5,000 psi to remove all loose and unsound concrete and loose rust from the exposed reinforcing steel. Residual corrosion product should be removed by wire wheel brush or other mechanical means to provide a near white metal finish, and a corrosion inhibitor, such as Sika Armatec 110 EpoCem, should be applied to the reinforcing steel. The spall area should be patched with a repair mortar, such as SikaTop 123 Plus.
Digester No. 9	
Digester Covers	The coating was in satisfactory condition after the 2004 assessment. The inspection report recommended re-inspection in 4 to 5 years. It is recommended that the digester cover be re-inspected in the next year in coordination with digester cleaning.
Digester No. 10	
Digester Covers	A complete coating rehabilitation was recommended for 2009 during the 2004 digester cover inspection. V&A recommends a complete coating rehabilitation within the next year.

Digester No.	Recommendations
Digester No. 11	
Digester Covers	The digester coating inspection conducted in 2004 recommended recoating on the interior attic surfaces and the skirt area within the next 2 years. V&A recommends recoating these areas if the recoating work has not been conducted to date.
Digester No. 12	
Digester Covers	The underside of the digester cover should be recoated within the next year, based on the 5 to 6 year time frame recommended from the coating inspection conducted in 2003. The attic space should be re-inspected prior to coating work to determine if any touch or recoating is required.
Digester No. 13	
Digester Covers	Prior inspection records indicate the bottom of the cover be recoated some time between 2008 to 2010. It is recommended that the cover be re-inspected to re-assess the existing state of the coating on the cover and determine if rehabilitation is required at this time.
Digester No. 14	
Digester Covers	Spot corrosion should be touched up on the iron frame work in the attic space if it has not been completed since the 2003 coating inspection report. The underside of the cover and the attic space should be re-inspected in the next 1 to 2 years.
Digester No. 15	
Digester Covers	Prior inspection records indicate the bottom of the cover be recoated some time between 2005 to 2006. It is recommended that the cover be re-inspected to re-assess the existing state of the coating on the cover and determine if rehabilitation is required at this time.
Digester No. 16	
Digester Covers	Prior inspection records indicate the bottom of the cover be recoated some time between 2005 to 2006. It is recommended that the cover be re-inspected to re-assess the existing state of the coating on the cover and determine if rehabilitation is required at this time.

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Appendix – Individual Digester Reports

Digester 2

Exterior Observations

Wall - The exterior wall of the digester appeared to be in good condition. The concrete wall was coated with 1-1/2 inches to 3 inches of Gunite Shotcrete material and top coated with what appears to be an acrylic protective coating. There was a crack in the coating on the east side of Digester 2 (Photo 1). There was also evidence of spider cracks on the coating throughout the entire exterior wall in the form of repair patch lines (Photo 2). These cracks appeared to be superficial and are not an indication of the condition of the concrete beneath the coating. The concrete beneath the coating is believed to be in good condition and has a VANDA© Concrete Corrosion Index Rating Level 1.

Photo 1. Exterior concrete, east wall with crack in Gunite coating

Photo 2. Exterior concrete wall showing patched spider cracks

Digester Piping and Appurtenances – In general, the piping on the outside of Digester 2 appeared to be in good condition. There was superficial surface corrosion on the digester gas piping (Photo 3 and Photo 4). Miscellaneous pipe support had surface corrosion (Photo 5). Miscellaneous actuator and valves had signs of leakage (Photo 6). The exterior piping and appurtenances of Digester 2 are given a VANDA© Metal Corrosion Index Rating Level 1.

Photo 3. Corrosion on digester gas piping

Photo 4. Corrosion on digester gas piping

Photo 5. Miscellaneous pipe support bracket with surface corrosion

Photo 6. Miscellaneous actuators and valves with signs of leakage

<u>Interior Observations</u>

Walls - The interior concrete wall surface of the digester appeared to be in good condition. The interior wall of the digester was not coated. A depth of penetration to sound concrete measurement yielded a 1/16-inch depth, indicating that the concrete has retained its structural integrity. There was no evidence of spalls or cracks. Concrete pH tests yielded a pH level of 10.1, implying that the concrete has been resistant to corrosion. There was no evidence of exposed reinforcing steel. The concrete cover over the reinforcing steel appears to be adequate to protect the reinforcing steel from exposure and corrosion. The corbels of the digester appeared to be in good condition.

These observations were taken from a relatively small area of the digester walls at a stationary position, adjacent to the digester manways. Visual observations of other areas in the digesters, made from a distance, showed no obvious imperfections on the concrete surface. Assuming a homogeneous progression of corrosion throughout the entire interior wall structure, the interior wall of Digester 2 is given a VANDA© Concrete Corrosion Index Rating of Level 1. Photo 7 and Photo 8 show the interior digester wall where the observations were made.

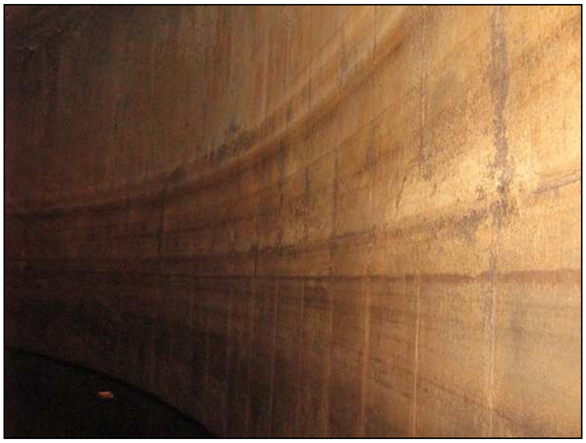


Photo 7. Interior wall in good condition

Photo 8. Interior wall (detail) in good condition

Roof – The steel interior surface of Digester 2 appeared to be corroded beyond superficial damage. Localized corrosion damage of the steel surface in the form of pits was observed on several parts of the interior roof structure (Photo 9). The pits had developed into holes in some areas of the roof where light was visible when looking from inside the digester (Photo 10). The interior roof of Digester 2 is given a VANDA© Metal Corrosion Index Rating Level 4.

Photo 9. Steel roof interior surface with pitting

Photo 10. Steel roof interior surface with holes

Digester Piping and Supports - The metallic appurtenances in the digester appeared to be in good condition. There was superficial surface corrosion observed on the 8-inch cast iron circulation suction/discharge pipe (Photo 11). The circulation/discharge pipe supports appeared to be in good condition (Photo 12). There was also superficial surface corrosion observed on the 8-inch cast iron sludge transfer line (Photo 13 and Photo 14). The interior piping and appurtenances of Digester 2 are given a VANDA© Metal Corrosion Index Rating Level 2.

Photo 11. 8-inch cast iron circulation piping with surface corrosion

Photo 12. 8-inch cast iron circulation piping support brackets in good condition

Photo 13. 8-inch cast iron sludge transfer piping with surface corrosion

Photo 14. 8-inch cast iron sludge transfer piping with surface corrosion

Digester 4

Exterior Observations

Wall - The exterior wall of the digester appeared to be in good condition (Photo 15). The concrete wall was coated with 2 inches to 3 inches of Gunite Shotcrete material and top coated with what appears to be an acrylic protective coating. There was some damage in the coating on the northeast wall of Digester 4 (Photo 16). This may have resulted from external impact. The damage appeared to be on the Gunite coating and not the concrete. The concrete beneath the coating is believed to be in good condition and have a VANDA© Concrete Corrosion Index Rating Level 1.

Photo 15. Exterior concrete wall in good condition

Photo 16. Exterior concrete, northeast wall with damage due to external impact

Digester Piping and Appurtenances – In general, the piping on the outside of Digester 4 appeared to be in good condition. There was superficial surface corrosion on the circulation suction/discharge pipes Photo 17 and Photo 18. The exterior piping and appurtenances of Digester 4 are given a VANDA© Metal Corrosion Index Rating Level 1.

Photo 17. Superficial corrosion on circulation suction/discharge piping

Photo 18. Superficial corrosion on digester gas piping

Interior Observations

The interior of Digester 4 was not evaluated due to the presence of approximately 5 to 6 feet of groundwater. The City made an effort to pump out the water for about 3 hours but the water level did not recede.

Digester 5

Exterior Observations

Wall - The exterior wall of the digester appeared to be in good condition. The concrete wall was coated with 2 to 3 inches of Gunite Shotcrete material and top coated with what appears to be an acrylic protective coating. There were spider cracks in the coating on several areas of Digester 5 (Photo 19 and Photo 20). There was also a longitudinal crack, approximately 10 feet long, on the northwest wall of the digester (Photo 21 and Photo 22). These cracks appeared to be superficial and are not an indication of the condition of the concrete beneath the coating. The concrete beneath the coating is believed to be in good condition and has a VANDA© Concrete Corrosion Index Rating Level 1.

Photo 19. Exterior concrete, east wall with spider cracks in coating

Photo 20. Exterior concrete, east wall with spider cracks in coating (detail)

Photo 21. Exterior concrete, north wall with longitudinal crack in coating

Photo 22. Exterior concrete wall with longitudinal crack in coating (detail)

Digester Piping and Appurtenances – In general, the piping on the outside of Digester 5 appeared to be in good condition. There was corrosion on the valves of the circulation pipes Photo 23 and Photo 24. The exterior piping and appurtenances of Digester 5 are given a VANDA© Metal Corrosion Index Rating Level 1.

Photo 23. Corrosion on circulation pipe valve

Photo 24. Corrosion on circulation pipe valve (detail)

Other Exterior Observations – There was a fracture in the concrete stairway of Digester 5. The fracture was most likely caused by the corrosion of the handrails. Photo 25 and Photo 26 shows the fracture in the concrete stairway.

Photo 25. Fracture in concrete stairway due to corroding handrail

Photo 26. Fracture in concrete stairway due to corroding handrail (detail)

Interior Observations

Walls - The interior concrete wall surface of the digester appeared to be in good condition. The interior wall of the digester was not coated. A depth of penetration to sound concrete measurement yielded a 1/16-inch depth, indicating that the concrete has retained its structural integrity. There was no evidence of spalls or cracks. Concrete pH tests yielded a pH level of 9.2, implying that the concrete has been resistant to corrosion. There was no evidence of exposed reinforcing steel. The concrete cover over the reinforcing steel appears to be adequate to protect the reinforcing steel from exposure and corrosion. The vertical joint of the digester showed minor chips in the concrete around the perimeter of the joint but the joint appeared to be in good condition (Photo 29). The corbels of the digester appeared to be in good condition (Photo 30).

These observations were taken from a relatively small area of the digester walls at a stationary position, adjacent to the digester manways. Visual observations of other areas in the digesters, made from a distance, showed no obvious imperfections on the concrete surface. Assuming a homogeneous progression of corrosion throughout the entire interior wall structure, the interior wall of Digester 5 is given a VANDA© Concrete Corrosion Index Rating of Level 1. Photo 27 and Photo 28 show the interior digester wall where the observations were made.

Photo 27. East wall in good condition, pipe penetration

Photo 28. West wall (detail) in good condition

Photo 29. South wall joint with chips in concrete

Photo 30. West wall corbel and roof

Roof – The steel interior surface of Digester 5 appeared to have surface corrosion. Localized corrosion was observed on the north side of the roof (Photo 31). More surface corrosion was observed where conduits enter from the north side of the digester (Photo 32). The interior roof of Digester 5 is given a VANDA© Metal Corrosion Index Rating Level 2.

Photo 31. Roof with corroded conduits

Photo 32. North roof with corroded area

Digester Piping and Supports - The metallic appurtenances in the digester appeared to be in good condition. There was superficial surface corrosion observed on the 8-inch cast iron sludge transfer pipe Photo 33. The conduits attached to the digester wall appeared to be in good condition. The conduits near the roof (Photo 34) displayed some corrosion staining that appears to be from the steel roof. The interior piping and appurtenances of Digester 5 are given a VANDA© Metal Corrosion Index Rating Level 2.

Photo 33. 8-inch cast iron sludge transfer pipe with surface corrosion

Photo 34. Conduits corroded near roof

Digester 6

Exterior Observations

Wall - The exterior wall of the digester appeared to be in good condition. The concrete wall was coated with 2 to 3 inches of Gunite Shotcrete material and top coated with what appears to be an acrylic protective coating. There were a couple of areas where the coating has spalled. There was one medium sized spall located near the W-2 pipe inlet on the southwest side of the digester (Photo 35 and Photo 36) and one small sized spall located near the E-2 inlet piping on the eastside of the digester (Photo 37). These spalls appeared to be superficial, only affecting the exterior Gunite coating, and are not an indication of the condition of the concrete beneath the coating. There was corrosion staining on the northside near the manhole (Photo 38) as well as other spots around the digester. These stains may be an indication that the steel wire mesh in the Gunite coating may be corroded. Despite these findings on the Gunite coating, the concrete beneath the coating is believed to be in good condition and has a VANDA© Concrete Corrosion Index Rating Level 1.

Photo 35. Medium-sized spall on south wall

Photo 36. Medium-sized spall (detail)

Photo 37. Small-sized spall near the E-2 inlet pipe on the east wall

Photo 38. Exterior concrete wall with corrosion staining

Digester Piping and Appurtenances – In general, the piping on the outside of Digester 6 appeared to be in good condition. There was corrosion on the valves of the circulation pipes (Photo 39). The digester gas piping is in good condition (Photo 40). The exterior piping and appurtenances of Digester 6 are given a VANDA© Metal Corrosion Index Rating Level 1.

Photo 39. Corrosion on circulation pipe valve

Photo 40. Digester gas piping in good condition

Other Exterior Observations – There were fractures in the concrete stairway of Digester 6. The fracture was most likely caused by the corrosion of the handrails. Photo 41 shows a fracture in the concrete stairway near the bottom of the stairway. Photo 42 shows a fracture at the top of the stairway. The fracture at the top of the stairway poses a potential safety hazard to persons standing below the stairway. The handrail showed surface corrosion where the handrail paint was missing (Photo 43). The concrete piping support had multiple cracks forming on it (Photo 44)

Photo 41. Fracture in the concrete stairway at the bottom of the stairway

Photo 42. Fracture in the concrete stairway at the top of the stairway

Photo 43. Corrosion on handrail system

Photo 44. Multiple cracks have formed on the piping support

Interior Observations

Walls - The interior concrete wall surface of the digester appeared to be in good condition. The interior wall of the digester was not coated. A depth of penetration to sound concrete measurement yielded a 1/16-inch depth, indicating that the concrete has retained its structural integrity. There was no evidence of spalls or cracks. Concrete pH tests yielded a pH level of 9.4, implying that the concrete has been resistant to corrosion. There was no evidence of exposed reinforcing steel. The concrete cover over the reinforcing steel appears to be adequate to protect the reinforcing steel from exposure and corrosion. The corbels of the digester appeared to be in good condition.

These observations were taken from a relatively small area of the digester walls at a stationary position, adjacent to the digester manways. Visual observations of other areas in the digesters, made from a distance, showed no obvious imperfections on the concrete surface. Assuming a homogeneous progression of corrosion throughout the entire interior wall structure, the interior wall of Digester 6 is given a VANDA$^{©}$ Concrete Corrosion Index Rating of Level 1. Photo 45 and Photo 46 show the interior digester wall where the observations were made.

Photo 45. West wall in good condition

Photo 46. South wall joint in good condition

Roof – The steel interior surface of Digester 6 appeared to be in fair condition with surface corrosion (Photo 47). The interior roof of Digester 6 is given a VANDA© Metal Corrosion Index Rating Level 2.

Photo 47. Steel interior roof in fair condition

Digester Piping and Supports - The metallic appurtenances in the digester appeared to be in good condition. There was superficial surface corrosion observed on the 8-inch cast iron sludge transfer pipe (Photo 48 and Photo 49). The conduits near the floor of the digester appeared to be in good condition (Photo 48). The interior piping and appurtenances of Digester 6 are given a VANDA© Metal Corrosion Index Rating Level 2.

Photo 48. 8-inch cast iron sludge transfer pipe with surface corrosion

Photo 49. 8-inch cast iron sludge transfer pipe with surface corrosion (detail)

Digester 8

Exterior Observations

Wall - The exterior wall of the digester appeared to be in good condition. The concrete wall was coated with 2 to 3 inches of Gunite Shotcrete material and top coated with what appears to be an acrylic protective coating. The concrete beneath the coating is believed to be in good condition and has a VANDA© Concrete Corrosion Index Rating Level 1.

Digester Piping and Appurtenances – In general, the piping on the outside of Digester 8 appeared to be in good condition (Photo 50). There were some minor corrosion stains on the 90-degree elbows of the inlet pipes. The exterior piping and appurtenances of Digester 8 are given a VANDA© Metal Corrosion Index Rating Level 1.

Photo 50. Minor corrosion staining on circulation pipe (typical)

Other Exterior Observations – There was a small spall, exposing the reinforcing steel, on a concrete support base (Photo 51). A fracture of the concrete was observed on the pathway leading to the stairway (Photo 52). The exposed steel on the handrails showed surface corrosion (Photo 53 and Photo 54).

Photo 51. Spall in concrete support base

Photo 52. Fracture in concrete pathway

Photo 53. Surface corrosion spots in the handrails

Photo 54. Surface corrosion area in the handrails

Interior Observations

Walls - The interior concrete wall surface of the digester appeared to be in good condition. The interior wall of the digester was not coated. A depth of penetration to sound concrete measurement yielded a 1/16-inch depth, indicating that the concrete has retained its structural integrity. There was no evidence of spalls or cracks. Concrete pH tests yielded a pH level of 9.2, implying that the concrete has been resistant to corrosion. There was no evidence of exposed reinforcing steel. The concrete cover over the reinforcing steel appears to be adequate to protect the reinforcing steel from exposure and corrosion. The corbels of the digester appeared to be in good condition.

These observations were taken from a relatively small area of the digester walls at a stationary position, adjacent to the digester manways. Visual observations of other areas in the digesters, made from a distance, showed no obvious imperfections on the concrete surface. Assuming a homogeneous progression of corrosion throughout the entire interior wall structure, the interior wall of Digester 8 is given a VANDA© Concrete Corrosion Index Rating of Level 1. Photo 55 and Photo 56 show the interior digester wall where the observations were made.

Photo 55. West wall in good condition

Photo 56. West wall in good condition (detail)

Roof – The steel interior surface of Digester 8 appeared to be in fair condition with surface corrosion and pitting (Photo 57). The interior roof of Digester 8 is given a VANDA© Metal Corrosion Index Rating Level 2.

Photo 57. Steel interior roof in fair condition

Digester Piping and Supports - The metallic appurtenances in the digester appeared to be in good condition. There was superficial surface corrosion observed on the 8-inch cast iron sludge transfer pipe (Photo 58). The conduits near the floor of the digester appeared to be in good condition as compared to the conduits near the roof (Photo 59) where there was some corrosion. The interior piping and appurtenances of Digester 8 are given a VANDA© Metal Corrosion Index Rating Level 2.

Photo 58. 8-inch cast iron sludge transfer pipe w/surface corrosion

Photo 59. Conduits corroded on west wall in good condition

ATTACHMENT B: STRUCTURAL CALCULATIONS

Table of Contents

By: Eric Wilkins
Date: 9/29/10

CITY OF SAN JOSE - DIGESTER STRUCTURAL EVALUATION
DIGESTER 4 - HOOP STRESSES (NON-SUBMERGED CONDITION)

(NORMAL OPERATION WATER SURFACE ELEVATION: 4 FEET BELOW TOP OF WALL)
(OVERFLOW WATER SURFACE ELEVATION: 2 FEET BELOW TOP OF WALL)
(INTERNAL GAS PRESSURE: 16-INCH WATER COLUMN)

				Dead Load (D)		Fluid Load (F)		Fluid Overflow (OF)		Seismic Load (E)		Prestress (Pe)	D+F+E	D+OF	D/C (1)	D/C (2)
				Circumferential		Circumferential		Circumferential		Circumferential		Circumferential	Circumferential		(D+F+E)/1.25Pe	(D+OF)/Pe
Node	Elevation	Plate depth, ft	Plate thickness (in)	Plate Force (kip/ft)	Stress (psi)	Plate Force (kip/ft)	Stress (psi)	Plate Force (kip/ft)	Stress (psi)	Plate Force (kip/ft)	Stress (psi)	Plate Force (kip/ft)	Plate Force (kip/ft)	Plate Force (kip/ft)		
N1	0															
		4	10	-0.69	-5.77	37	306	39	327	26	213	137	62	39	0.36	0.28
N74	4															
		4	10	-0.19	-1.56	90	751	96	803	63	528	124	153	96	0.99	0.77
N147	8															
		4	10	0.04	0.31	105	877	113	943	76	633	119	181	113	1.22	0.95
N220	12															
		4	10	0.07	0.57	94	783	102	851	71	592	104	165	102	1.27	0.98
N293	16															
		4	10	0.04	0.33	74	617	82	684	61	506	109	135	82	0.99	0.76
N366	20															
		4	10	0.02	0.16	54	454	62	521	51	423	92	105	63	0.92	0.68
N439	24															
		4	10	0.02	0.13	37	311	45	378	42	349	80	79	45	0.80	0.57
N512	28															
		4	10	0.00	0.00	23	189	30	252	32	271	68	55	30	0.65	0.45
N585	32															
		4	10	-0.05	-0.43	11	94	17	141	21	174	43	32	17	0.59	0.39
N658	36															
		2	10	-0.14	-1.19	5	39	8	66	11	89	36	15	8	0.34	0.21
N794	38															
		2	10	-0.24	-1.99	2	13	3	22	4	30	59	5	2	0.07	0.04
N867	40															

Average D/C = 1.24

By: Eric Wilkins
Date: 9/29/10

CITY OF SAN JOSE - DIGESTER STRUCTURAL EVALUATION
DIGESTER 4 - HOOP STRESSES (SUBMERGED CONDITION)

(NORMAL OPERATION WATER SURFACE ELEVATION: 3 FEET ABOVE TOP OF WALL)
(OVERFLOW WATER SURFACE ELEVATION: 5 FEET ABOVE TOP OF WALL)
(INTERNAL GAS PRESSURE: 16-INCH WATER COLUMN)

				Dead Load (D)		Fluid Load (F)		Fluid Overflow (OF)		Seismic Load (E)		Prestress (Pe)	D+F+E	D+OF	D/C (1)	D/C (2)
				Circumferential		Circumferential		Circumferential		Circumferential		Circumferential	Circumferential		(D+F+E)/1.25Pe	(D+OF)/Pe
Node	Elevation	Plate depth, ft	Plate thickness (in)	Plate Force (kip/ft)	Stress (psi)	Plate Force (kip/ft)	Stress (psi)	Plate Force (kip/ft)	Stress (psi)	Plate Force (kip/ft)	Stress (psi)	Plate Force (kip/ft)	Plate Force (kip/ft)	Plate Force (kip/ft)		
N1	0															
		4	10	-0.69	-5.77	45	378	48	398	40	335	137	85	47	0.49	0.34
N74	4															
		4	10	-0.19	-1.56	112	934	118	986	103	855	124	214	118	1.38	0.95
N147	8															
		4	10	0.04	0.31	133	1108	141	1175	130	1084	119	263	141	1.77	1.19
N220	12															
		4	10	0.07	0.57	123	1022	131	1090	134	1116	104	257	131	1.97	1.25
N293	16															
		4	10	0.04	0.33	102	852	110	919	131	1095	109	234	110	1.72	1.02
N366	20															
		4	10	0.02	0.16	83	688	91	755	131	1093	92	214	91	1.86	0.99
N439	24															
		4	10	0.02	0.13	66	547	74	615	133	1112	80	199	74	2.00	0.93
N512	28															
		4	10	0.00	0.00	50	416	58	482	130	1081	68	180	58	2.12	0.85
N585	32															
		4	10	-0.05	-0.43	33	271	39	324	104	864	43	136	39	2.53	0.90
N658	36															
		2	10	-0.14	-1.19	18	147	22	179	64	535	36	82	21	1.79	0.59
N794	38															
		2	10	-0.24	-1.99	6	51	7	62	23	190	59	29	7	0.39	0.12
N867	40															
													Average D/C =		1.91	1.22

By: Eric Wilkins

Date: 9/29/10

CITY OF SAN JOSE - DIGESTER STRUCTURAL EVALUATION
DIGESTER 12 - HOOP STRESSES (NON-SUBMERGED CONDITION)

(NORMAL OPERATION WATER SURFACE ELEVATION: 4 FEET BELOW TOP OF WALL)

(OVERFLOW WATER SURFACE ELEVATION: 2 FEET BELOW TOP OF WALL)

(INTERNAL GAS PRESSURE: 16-INCH WATER COLUMN)

				Dead Load (D)		Fluid Load (F)		Fluid Overflow (OF)		Seismic Load (E)		Prestress (Pe)	D+F+E	D+OF	D/C (1)	D/C (2)
				Circumferential		Circumferential		Circumferential		Circumferential		Circumf.	Circumferential		(D+F+E)/1.25Pe	(D+OF)/Pe
Node	Elevation	Plate depth, ft	Plate thickness (in)	Plate Force (kip/ft)	Stress (psi)	Plate Force (kip/ft)	Stress (psi)	Plate Force (kip/ft)	Stress (psi)	Plate Force (kip/ft)	Stress (psi)	Plate Force (kip/ft)	Plate Force (kip/ft)	Plate Force (kip/ft)		
N1	0															
		4	10	-0.69	-5.77	32	264	34	282	22	185	197	53	33	0.22	0.17
N74	4															
		4	10	-0.19	-1.56	80	669	86	716	57	474	182	137	86	0.60	0.47
N147	8															
		4	10	0.04	0.31	99	824	107	888	72	599	168	171	107	0.81	0.63
N220	12															
		4	10	0.07	0.57	94	780	102	849	71	593	154	165	102	0.86	0.66
N293	16															
		4	10	0.04	0.33	77	639	85	709	63	524	139	140	85	0.80	0.61
N366	20															
		4	10	0.02	0.16	57	475	65	544	53	440	125	110	65	0.70	0.52
N439	24															
		4	10	0.02	0.13	39	323	47	391	43	356	110	81	47	0.59	0.42
N512	28															
		4	10	0.00	0.00	24	197	31	257	32	268	103	56	31	0.43	0.30
N585	32															
		4	10	-0.05	-0.43	12	99	17	143	20	169	103	32	17	0.25	0.17
N658	36															
		2	10	-0.14	-1.19	5	43	8	68	10	87	103	15	8	0.12	0.08
N794	38															
		2	10	-0.24	-1.99	2	15	3	23	3	29	103	5	3	0.04	0.02
N867	40															

By: Eric Wilkins
Date: 9/29/10

CITY OF SAN JOSE - DIGESTER STRUCTURAL EVALUATION
DIGESTER 12 - HOOP STRESSES (SUBMERGED CONDITION)

(NORMAL OPERATION WATER SURFACE ELEVATION: 3 FEET ABOVE TOP OF WALL)

(OVERFLOW WATER SURFACE ELEVATION: 5 FEET ABOVE TOP OF WALL)

(INTERNAL GAS PRESSURE: 16-INCH WATER COLUMN)

				Dead Load (D)		Fluid Load (F)		Fluid Overflow (OF)		Seismic Load (E)		Prestress (Pe)	D+F+E	D+OF	D/C (1)	D/C (2)
				Circumferential		Circumferential		Circumferential		Circumferential		Circumferential	Circumferential		(D+F+E)/1.25Pe	(D+OF)/Pe
Node	Elevation	Plate depth, ft	Plate thickness (in)	Plate Force (kip/ft)	Stress (psi)	Plate Force (kip/ft)	Stress (psi)	Plate Force (kip/ft)	Stress (psi)	Plate Force (kip/ft)	Stress (psi)	Plate Force (kip/ft)	Plate Force (kip/ft)	Plate Force (kip/ft)		
N1	0															
		4	14	-0.69	-1.42	39	234	41	247	35	211	197	74	41	0.30	0.21
N74	4															
		4	14	-0.19	-0.85	100	597	106	631	93	556	182	193	106	0.85	0.58
N147	8															
		4	14	0.04	-0.31	126	748	133	793	125	742	168	250	133	1.19	0.79
N220	12															
		4	14	0.07	0.00	123	729	131	779	135	804	154	258	131	1.34	0.85
N293	16															
		4	14	0.04	0.10	106	630	114	680	136	807	139	241	114	1.39	0.82
N366	20															
		4	14	0.02	0.11	86	513	95	563	136	812	125	223	95	1.42	0.75
N439	24															
		4	14	0.02	0.23	67	401	76	450	135	802	110	202	76	1.46	0.69
N512	28															
		4	14	0.00	0.40	50	296	57	342	125	742	103	174	57	1.35	0.56
N585	32															
		4	14	-0.05	0.22	31	187	37	221	94	562	103	126	37	0.98	0.36
N658	36															
		2	14	-0.14	-1.11	17	99	20	119	56	333	103	72	20	0.56	0.19
N794	38															
		2	14	-0.24	-4.12	6	34	7	41	20	117	103	25	7	0.19	0.06
N867	40															

Average D/C = 1.36

Concrete Properties

	Label	E [ksi]	G [ksi]	Nu	Therm (\1E5 F)	Density[k/ft^3]	f'c[ksi]
1	Conc3000NW	3156	1372	.15	.6	.145	3
2	Conc3500NW	3409	1482	.15	.6	.145	3.5
3	Conc4000NW	3644	1584	.15	.6	.145	4
4	Conc3000LW	2085	907	.15	.6	.11	3
5	Conc3500LW	2252	979	.15	.6	.11	3.5
6	Conc4000LW	2408	1047	.15	.6	.11	4

Joint Boundary Conditions

	Joint Label	X [k/in]	Y [k/in]	Z [k/in]	X Rot.[k-ft/rad]	Y Rot.[k-ft/rad]	Z Rot.[k-ft/rad]	Footing
1	N1	Reaction	Reaction	Reaction				
2	N2	Reaction	Reaction	Reaction				
3	N3	Reaction	Reaction	Reaction				
4	N4	Reaction	Reaction	Reaction				
5	N5	Reaction	Reaction	Reaction				
6	N6	Reaction	Reaction	Reaction				
7	N7	Reaction	Reaction	Reaction				
8	N8	Reaction	Reaction	Reaction				
9	N9	Reaction	Reaction	Reaction				
10	N10	Reaction	Reaction	Reaction				
11	N11	Reaction	Reaction	Reaction				
12	N12	Reaction	Reaction	Reaction				
13	N13	Reaction	Reaction	Reaction				
14	N14	Reaction	Reaction	Reaction				
15	N15	Reaction	Reaction	Reaction				
16	N16	Reaction	Reaction	Reaction				
17	N17	Reaction	Reaction	Reaction				
18	N18	Reaction	Reaction	Reaction				
19	N19	Reaction	Reaction	Reaction				
20	N20	Reaction	Reaction	Reaction				
21	N21	Reaction	Reaction	Reaction				
22	N22	Reaction	Reaction	Reaction				
23	N23	Reaction	Reaction	Reaction				
24	N24	Reaction	Reaction	Reaction				
25	N25	Reaction	Reaction	Reaction				
26	N26	Reaction	Reaction	Reaction				
27	N27	Reaction	Reaction	Reaction				
28	N28	Reaction	Reaction	Reaction				
29	N29	Reaction	Reaction	Reaction				
30	N30	Reaction	Reaction	Reaction				
31	N31	Reaction	Reaction	Reaction				
32	N32	Reaction	Reaction	Reaction				
33	N33	Reaction	Reaction	Reaction				
34	N34	Reaction	Reaction	Reaction				
35	N35	Reaction	Reaction	Reaction				
36	N36	Reaction	Reaction	Reaction				
37	N37	Reaction	Reaction	Reaction				
38	N38	Reaction	Reaction	Reaction				
39	N39	Reaction	Reaction	Reaction				
40	N40	Reaction	Reaction	Reaction				
41	N41	Reaction	Reaction	Reaction				
42	N42	Reaction	Reaction	Reaction				
43	N43	Reaction	Reaction	Reaction				
44	N44	Reaction	Reaction	Reaction				
45	N45	Reaction	Reaction	Reaction				
46	N46	Reaction	Reaction	Reaction				

2

Joint Boundary Conditions (Continued)

	Joint Label	X [k/in]	Y [k/in]	Z [k/in]	X Rot.[k-ft/rad]	Y Rot.[k-ft/rad]	Z Rot.[k-ft/rad]	Footing
47	N47	Reaction	Reaction	Reaction				
48	N48	Reaction	Reaction	Reaction				
49	N49	Reaction	Reaction	Reaction				
50	N50	Reaction	Reaction	Reaction				
51	N51	Reaction	Reaction	Reaction				
52	N52	Reaction	Reaction	Reaction				
53	N53	Reaction	Reaction	Reaction				
54	N54	Reaction	Reaction	Reaction				
55	N55	Reaction	Reaction	Reaction				
56	N56	Reaction	Reaction	Reaction				
57	N57	Reaction	Reaction	Reaction				
58	N58	Reaction	Reaction	Reaction				
59	N59	Reaction	Reaction	Reaction				
60	N60	Reaction	Reaction	Reaction				
61	N61	Reaction	Reaction	Reaction				
62	N62	Reaction	Reaction	Reaction				
63	N63	Reaction	Reaction	Reaction				
64	N64	Reaction	Reaction	Reaction				
65	N65	Reaction	Reaction	Reaction				
66	N66	Reaction	Reaction	Reaction				
67	N67	Reaction	Reaction	Reaction				
68	N68	Reaction	Reaction	Reaction				
69	N69	Reaction	Reaction	Reaction				
70	N70	Reaction	Reaction	Reaction				
71	N71	Reaction	Reaction	Reaction				
72	N72	Reaction	Reaction	Reaction				
73	N867	Fixed	Fixed					
74	N868	Fixed	Fixed					
75	N869	Fixed	Fixed					
76	N870	Fixed	Fixed					
77	N871	Fixed	Fixed					
78	N872	Fixed	Fixed					
79	N873	Fixed	Fixed					
80	N874	Fixed	Fixed					
81	N875	Fixed	Fixed					
82	N876	Fixed	Fixed					
83	N877	Fixed	Fixed					
84	N878	Fixed	Fixed					
85	N879	Fixed	Fixed					
86	N880	Fixed	Fixed					
87	N881	Fixed	Fixed					
88	N882	Fixed	Fixed					
89	N883	Fixed	Fixed					
90	N884	Fixed	Fixed					
91	N885	Fixed	Fixed					
92	N886	Fixed	Fixed					
93	N887	Fixed	Fixed					
94	N888	Fixed	Fixed					
95	N889	Fixed	Fixed					
96	N890	Fixed	Fixed					
97	N891	Fixed	Fixed					
98	N892	Fixed	Fixed					
99	N893	Fixed	Fixed					
100	N894	Fixed	Fixed					
101	N895	Fixed	Fixed					
102	N896	Fixed	Fixed					
103	N897	Fixed	Fixed					

3

Joint Boundary Conditions (Continued)

	Joint Label	X [k/in]	Y [k/in]	Z [k/in]	X Rot.[k-ft/rad]	Y Rot.[k-ft/rad]	Z Rot.[k-ft/rad]	Footing
104	N898	Fixed	Fixed					
105	N899	Fixed	Fixed					
106	N900	Fixed	Fixed					
107	N901	Fixed	Fixed					
108	N902	Fixed	Fixed					
109	N903	Fixed	Fixed					
110	N904	Fixed	Fixed					
111	N905	Fixed	Fixed					
112	N906	Fixed	Fixed					
113	N907	Fixed	Fixed					
114	N908	Fixed	Fixed					
115	N909	Fixed	Fixed					
116	N910	Fixed	Fixed					
117	N911	Fixed	Fixed					
118	N912	Fixed	Fixed					
119	N913	Fixed	Fixed					
120	N914	Fixed	Fixed					
121	N915	Fixed	Fixed					
122	N916	Fixed	Fixed					
123	N917	Fixed	Fixed					
124	N918	Fixed	Fixed					
125	N919	Fixed	Fixed					
126	N920	Fixed	Fixed					
127	N921	Fixed	Fixed					
128	N922	Fixed	Fixed					
129	N923	Fixed	Fixed					
130	N924	Fixed	Fixed					
131	N925	Fixed	Fixed					
132	N926	Fixed	Fixed					
133	N927	Fixed	Fixed					
134	N928	Fixed	Fixed					
135	N929	Fixed	Fixed					
136	N930	Fixed	Fixed					
137	N931	Fixed	Fixed					
138	N932	Fixed	Fixed					
139	N933	Fixed	Fixed					
140	N934	Fixed	Fixed					
141	N935	Fixed	Fixed					
142	N936	Fixed	Fixed					
143	N937	Fixed	Fixed					
144	N938	Fixed	Fixed					

Basic Load Cases

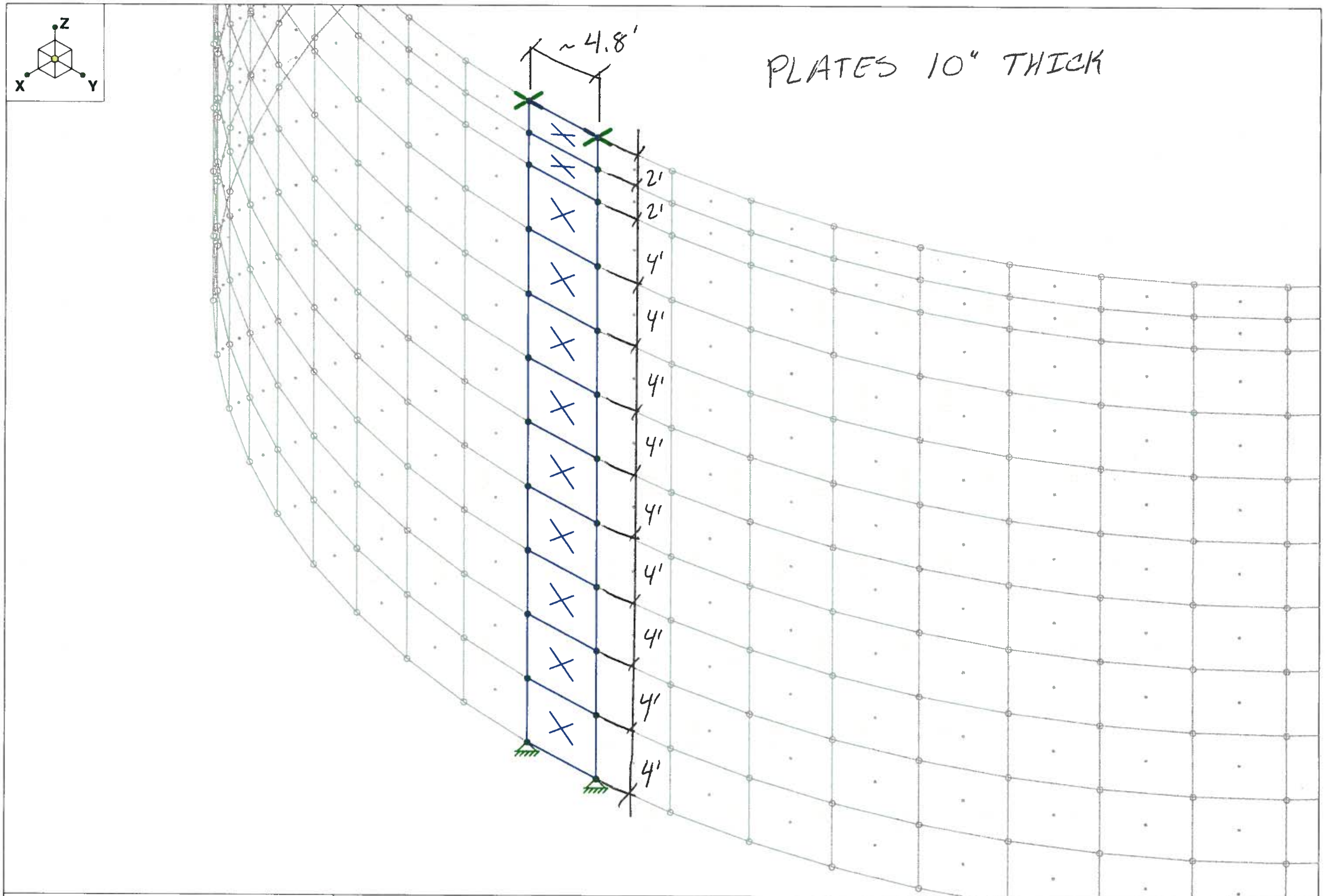
	BLC Description	Category	X Gravity	Y Gravity	Z Gravity	Joint	Point	Distributed	Area (Me...	Surface (...
1	Dead Load	None			-1	72				
2	Roof Live Load	None				72				
3	Gas Load (16")	None				72				
4	Hydrostatic Load	None								648
5	Hydrodynamic Load	None								648

Load Combinations

	Description	So...	PDelta	S...	BLC	Fac..	BLC	Fac..	BLC	Fac..	BLC	Fac..	BLC	Fac..	BLC	Fac..	BLC	Fac..	BLC	Fac...
1	1.0DL	Yes			1	1														
2	1.0Lr	Yes			2	1														
3	1.0F	Yes			3	1	4	1												

Load Combinations (Continued)

	Description	So...	PDelta	S...	BLC	Fac..	BLC	Fac..	BLC	Fac..	BLC	Fac..	BLC	Fac..	BLC	Fac..	BLC	Fac..	BLC	Fac...
4	1.0E	Yes			5	1														

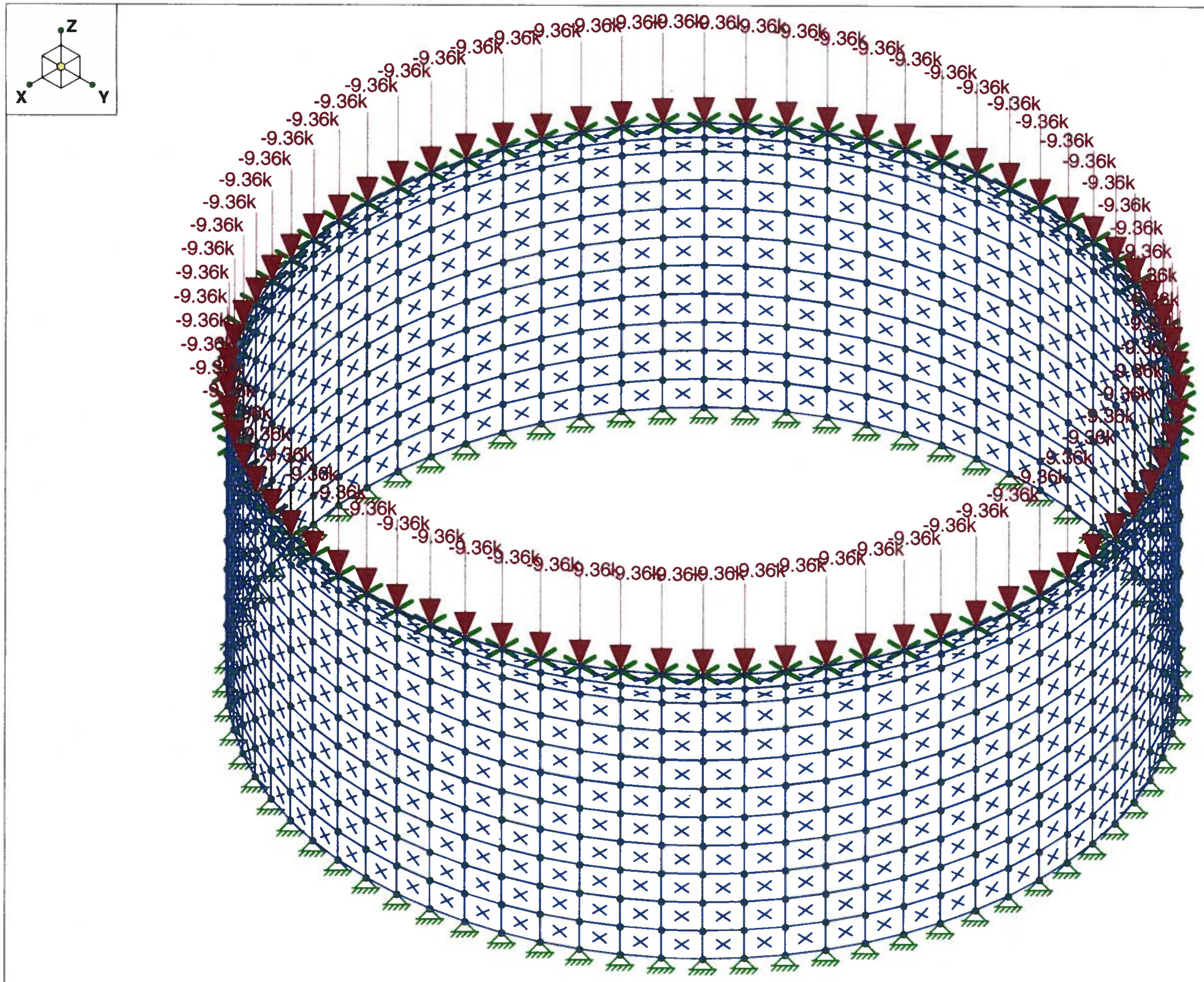


PLATES 10" THICK

Brown and Caldwell
Eric Wilkins
136242

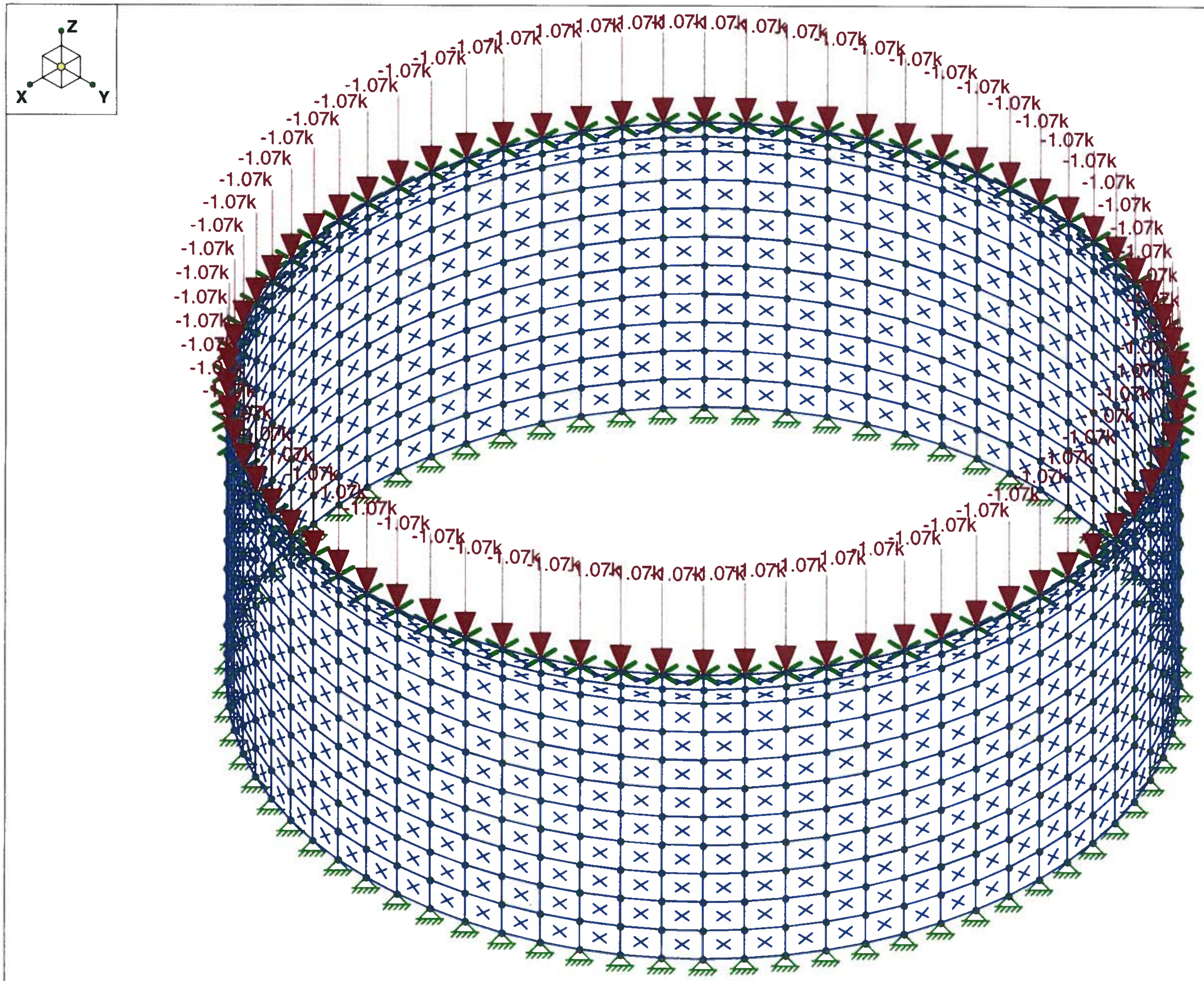
San Jose Digester 4 Non-Submerged Analysis

SK -
Oct 6, 2010 at 11:55 AM
San Jose Digester 4 Non-Submerged Analysis.r...



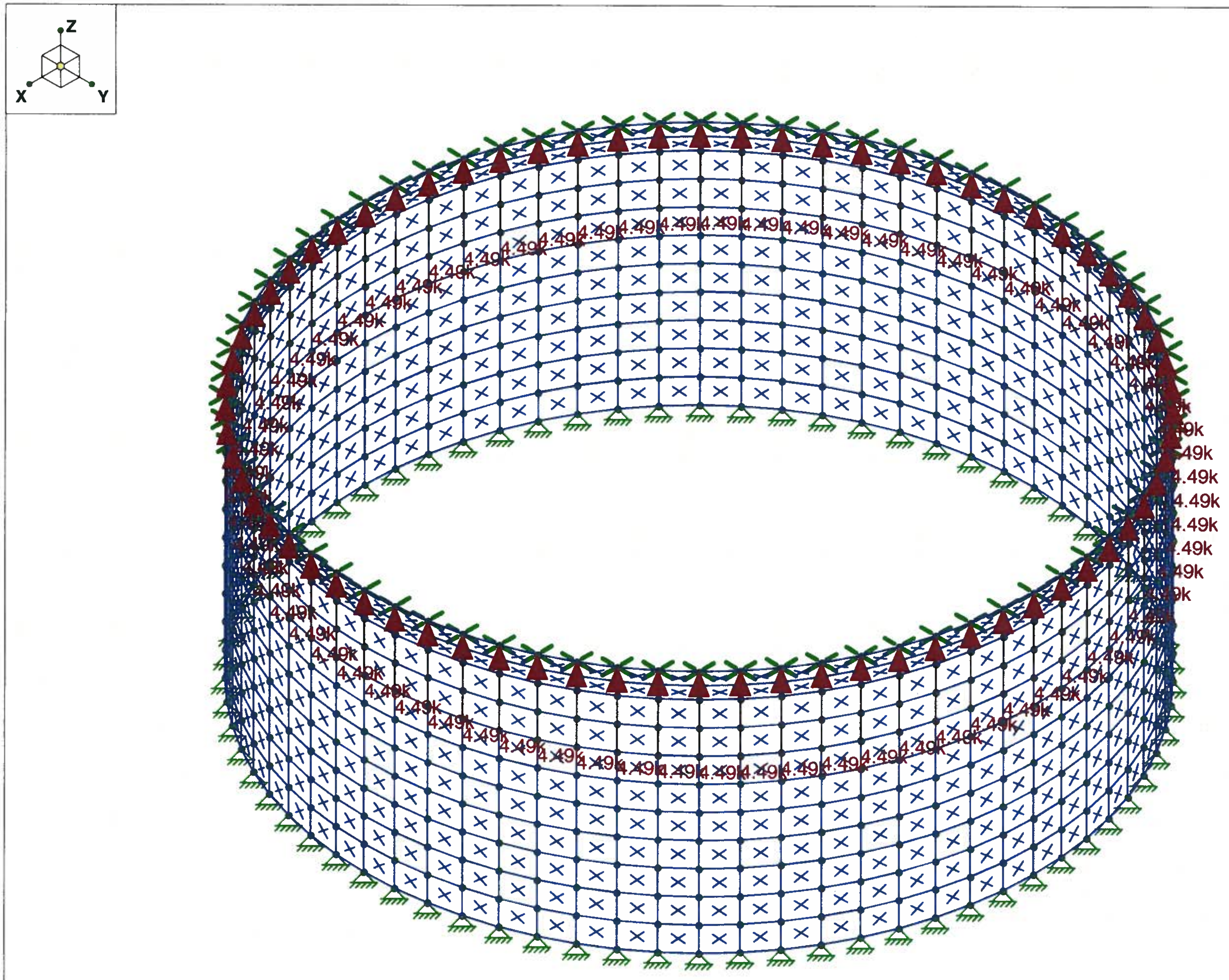
Loads: BLC 1, Dead Load

Brown and Caldwell	San Jose Digester 4 Non-Submerged Analysis	SK - 1
Eric Wilkins		Oct 6, 2010 at 11:40 AM
136242		San Jose Digester 4 Non-Submerged Analysis.r...



Loads: BLC 2, Roof Live Load

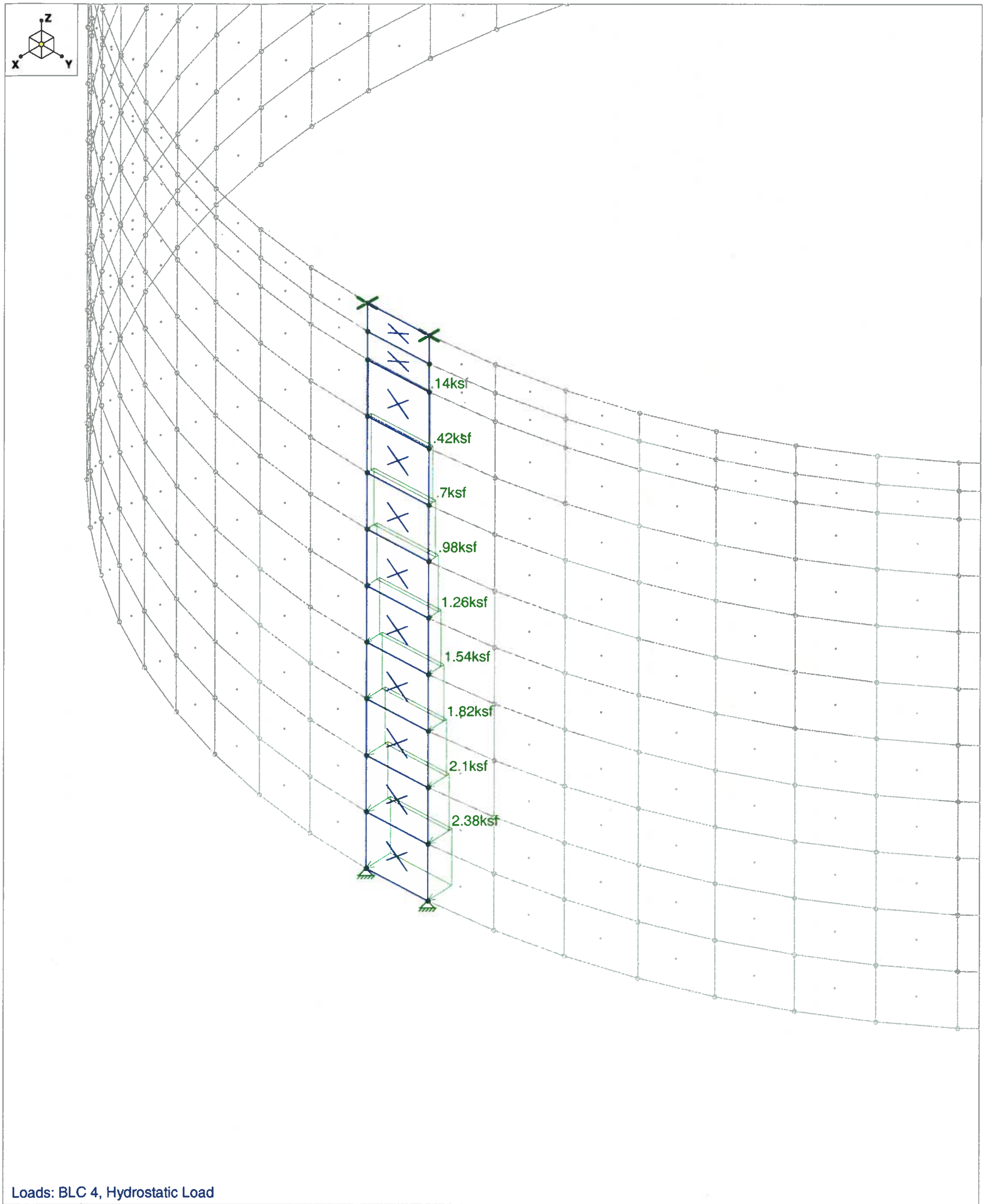
Brown and Caldwell	San Jose Digester 4 Non-Submerged Analysis	SK - 2
Eric Wilkins		Oct 6, 2010 at 11:40 AM
136242		San Jose Digester 4 Non-Submerged Analysis.r...



Loads: BLC 3, Gas Load (16")

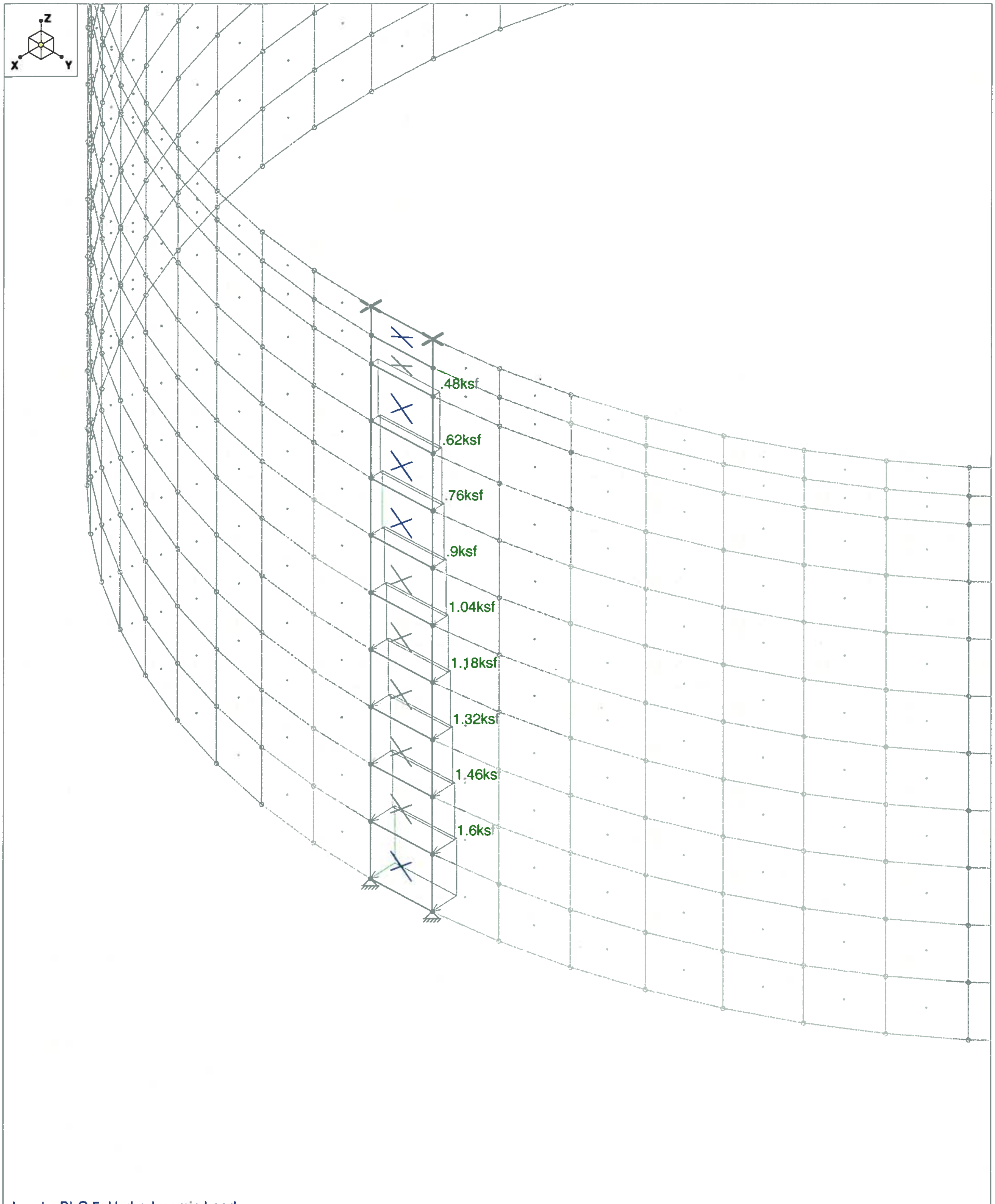
Brown and Caldwell	San Jose Digester 4 Non-Submerged Analysis	SK - 3
Eric Wilkins		Oct 6, 2010 at 11:40 AM
136242		San Jose Digester 4 Non-Submerged Analysis.r...

9



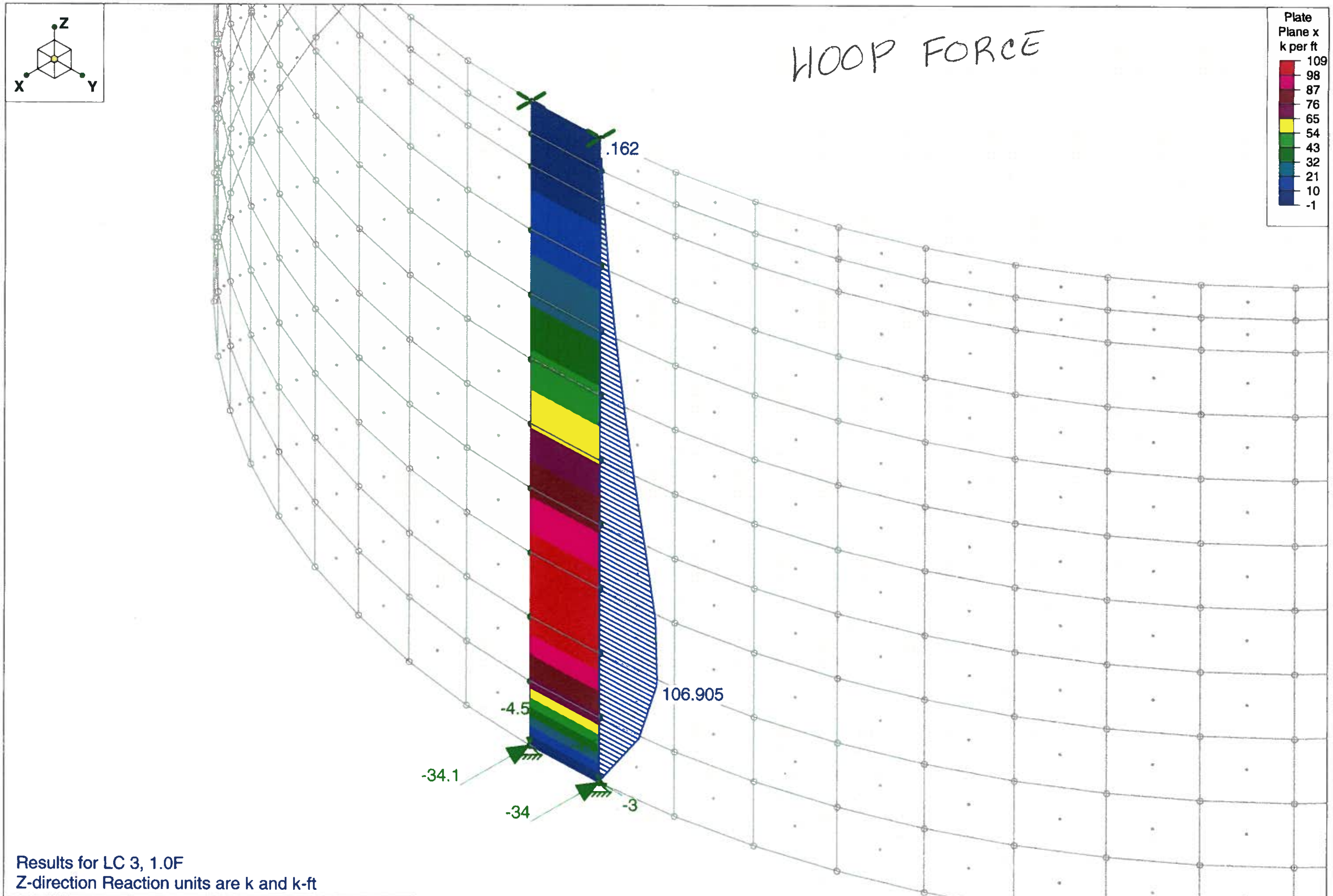
Loads: BLC 4, Hydrostatic Load

Brown and Caldwell	San Jose Digester 4 Non-Submerged Analysis	SK - 4
Eric Wilkins		Oct 6, 2010 at 11:39 AM
136242		San Jose Digester 4 Non-Submerg...



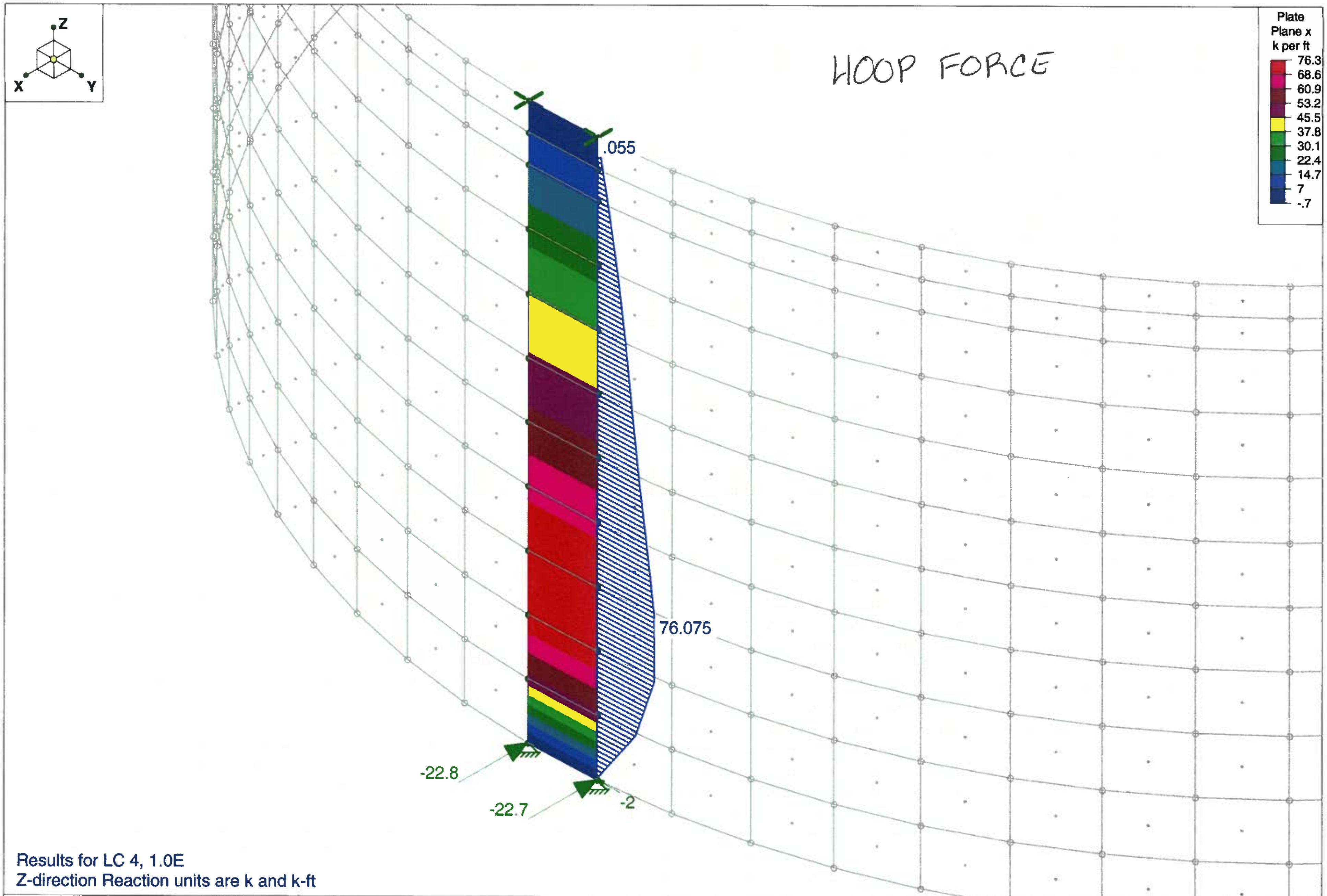
Loads: BLC 5, Hydrodynamic Load

Brown and Caldwell	San Jose Digester 4 Non-Submerged Analysis	SK - 5
Eric Wilkins		Oct 6, 2010 at 11:39 AM
136242		San Jose Digester 4 Non-Submerg...



Results for LC 3, 1.0F
Z-direction Reaction units are k and k-ft

Brown and Caldwell	San Jose Digester 4 Non-Submerged Analysis	SK - 6
Eric Wilkins		Oct 6, 2010 at 11:47 AM
136242		San Jose Digester 4 Non-Submerged Analysis.r...

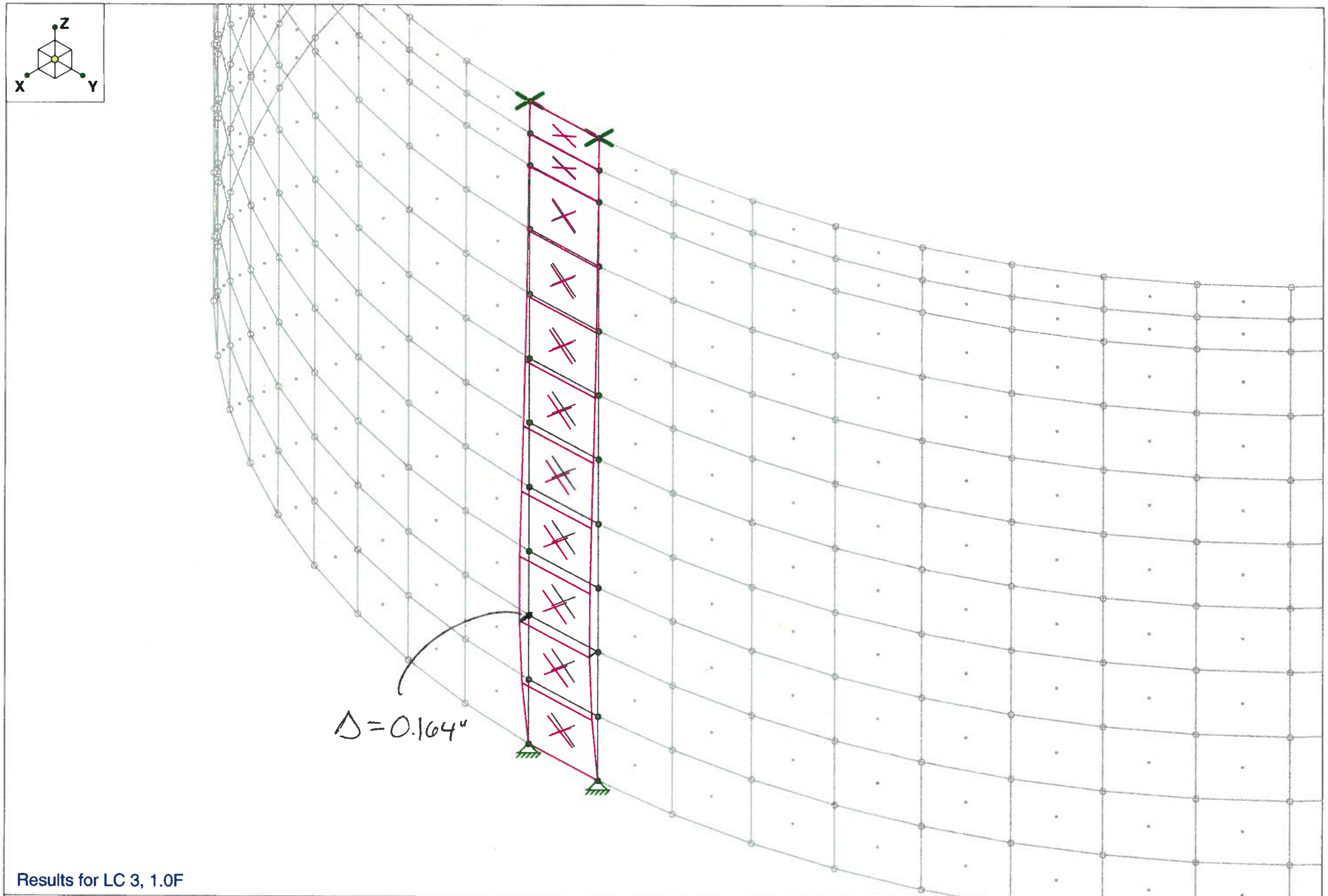


Results for LC 4, 1.0E
Z-direction Reaction units are k and k-ft

Brown and Caldwell
Eric Wilkins
136242

San Jose Digester 4 Non-Submerged Analysis

SK - 7
Oct 6, 2010 at 11:48 AM
San Jose Digester 4 Non-Submerged Analysis.r...

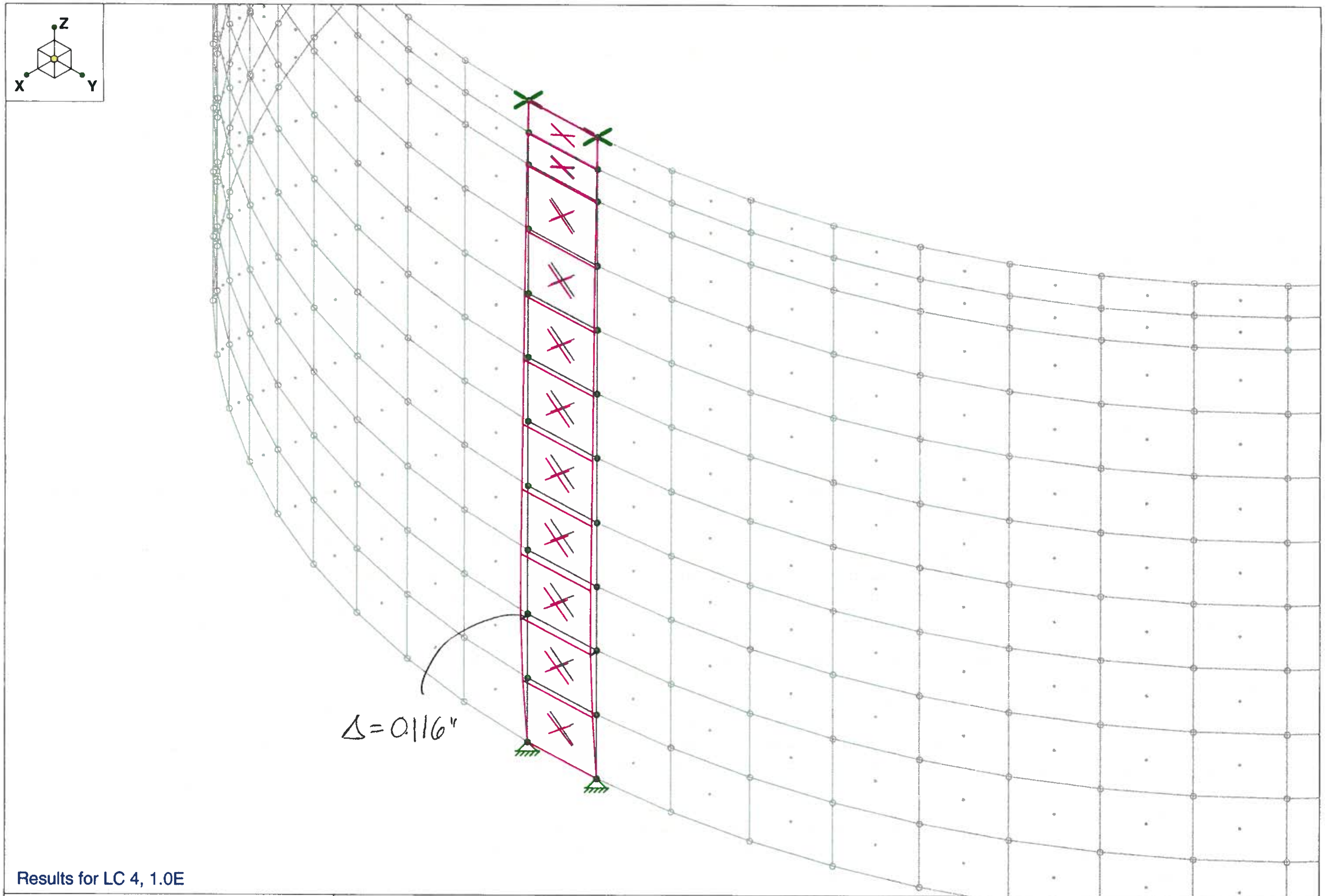


Results for LC 3, 1.0F

Brown and Caldwell
Eric Wilkins
136242

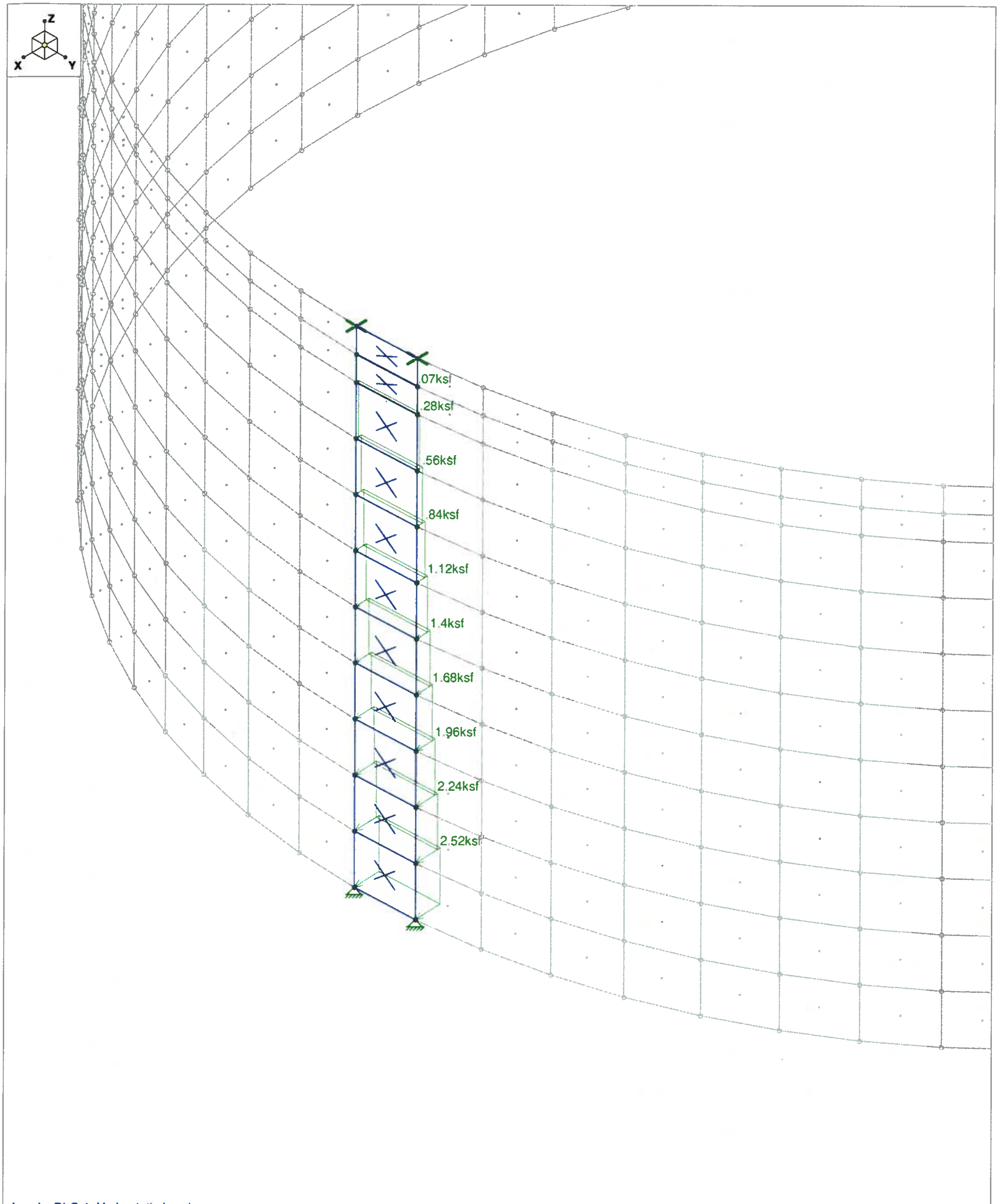
San Jose Digester 4 Non-Submerged Analysis

SK - 8
Oct 6, 2010 at 11:49 AM
San Jose Digester 4 Non-Submerged Analysis.r...



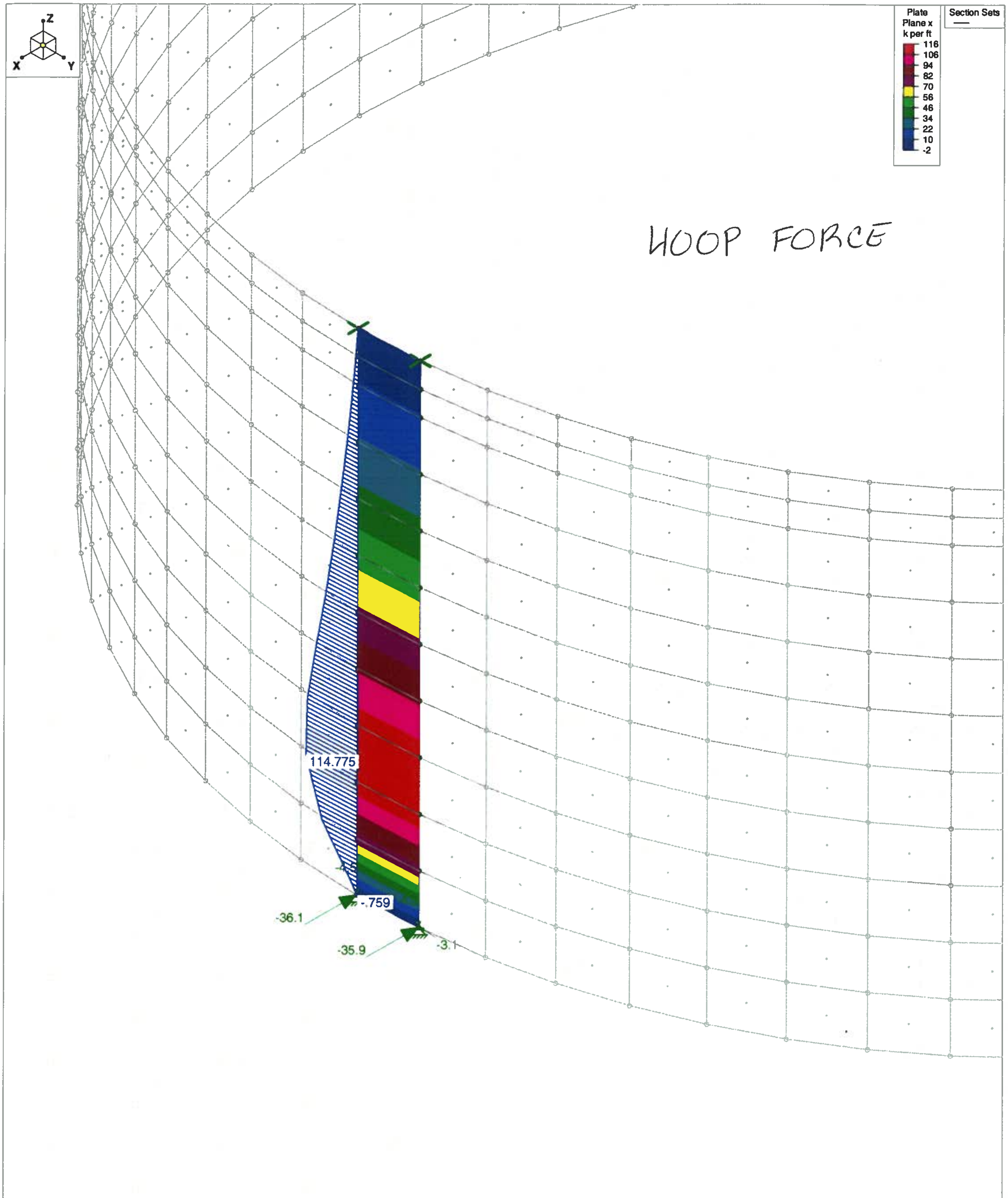
Results for LC 4, 1.0E

Brown and Caldwell	San Jose Digester 4 Non-Submerged Analysis	SK - 9
Eric Wilkins		Oct 6, 2010 at 11:50 AM
136242		San Jose Digester 4 Non-Submerged Analysis.r...



Loads: BLC 4, Hydrostatic Load

Brown and Caldwell	San Jose Digester 4 Non-Submerged Overflow Analysis	SK - 1
Eric Wilkins		Oct 6, 2010 at 12:54 PM
136242		San Jose Digester 4 Non-Submerg...



Results for LC 3, 1.0F
Z-direction Reaction units are k and k-ft

Brown and Caldwell	San Jose Digester 4 Non-Submerged Overflow Analysis	SK - 2
Eric Wilkins		Oct 6, 2010 at 12:55 PM
136242		San Jose Digester 4 Non-Submerg...

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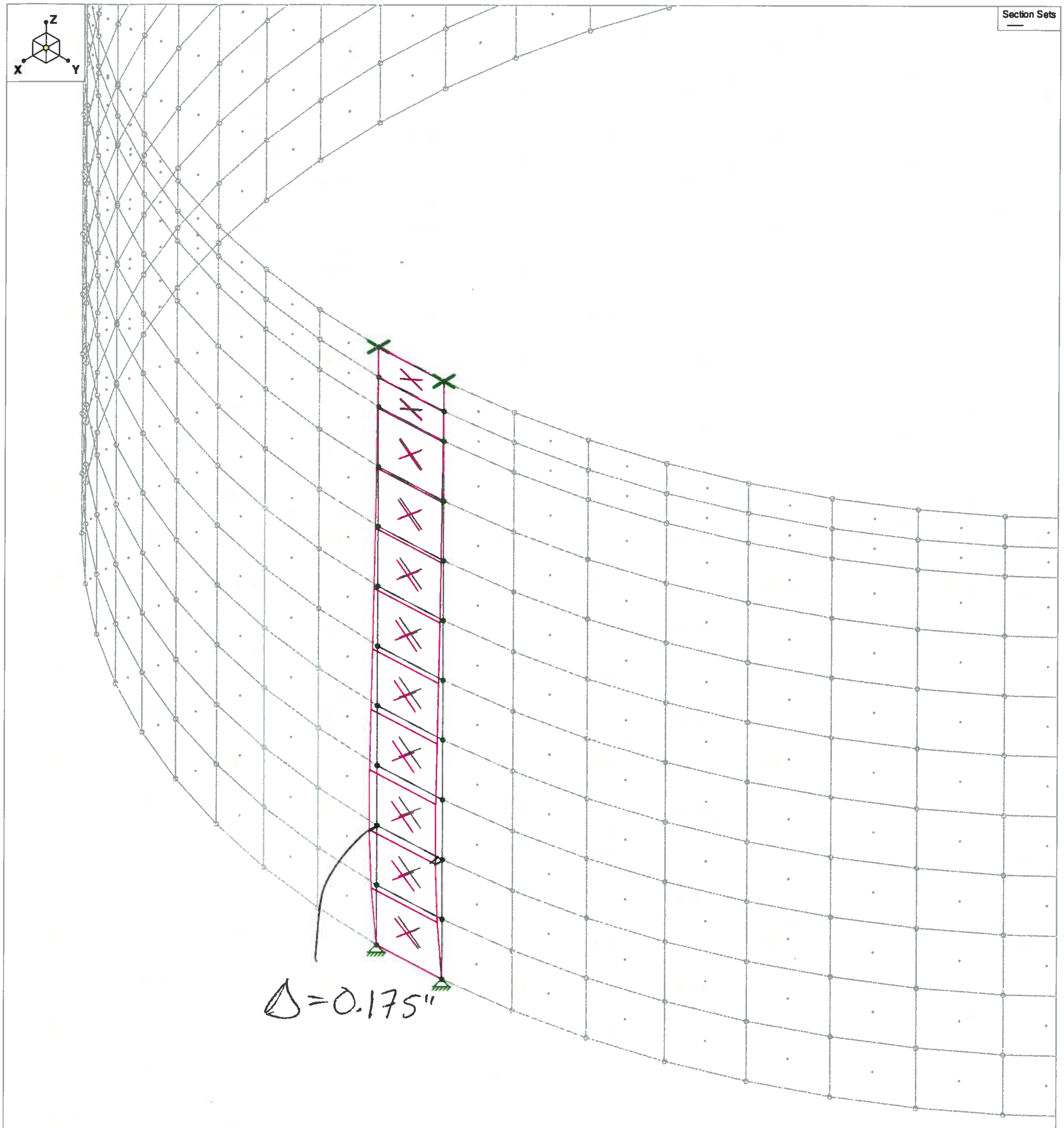
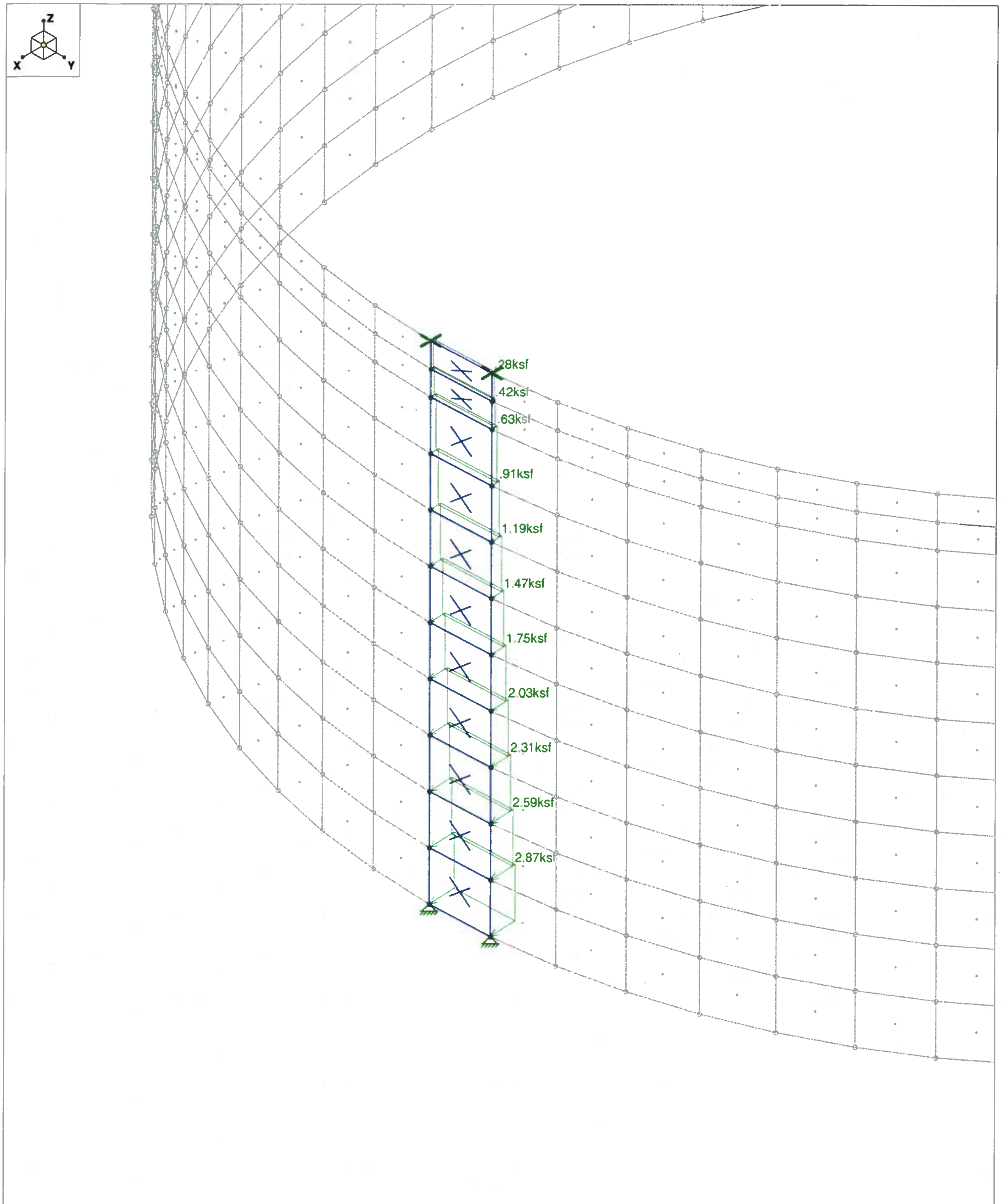


Results for LC 3, 1.0F

Brown and Caldwell	San Jose Digester 4 Non-Submerged Overflow Analysis	SK - 3
Eric Wilkins		Oct 6, 2010 at 12:55 PM
136242		San Jose Digester 4 Non-Submerg...



Loads: BLC 4, Hydrostatic Load

Brown and Caldwell	San Jose Digester 4 Submerged Analysis	SK - 1
Eric Wilkins		Oct 6, 2010 at 12:59 PM
136242		San Jose Digester 4 Submerged A...

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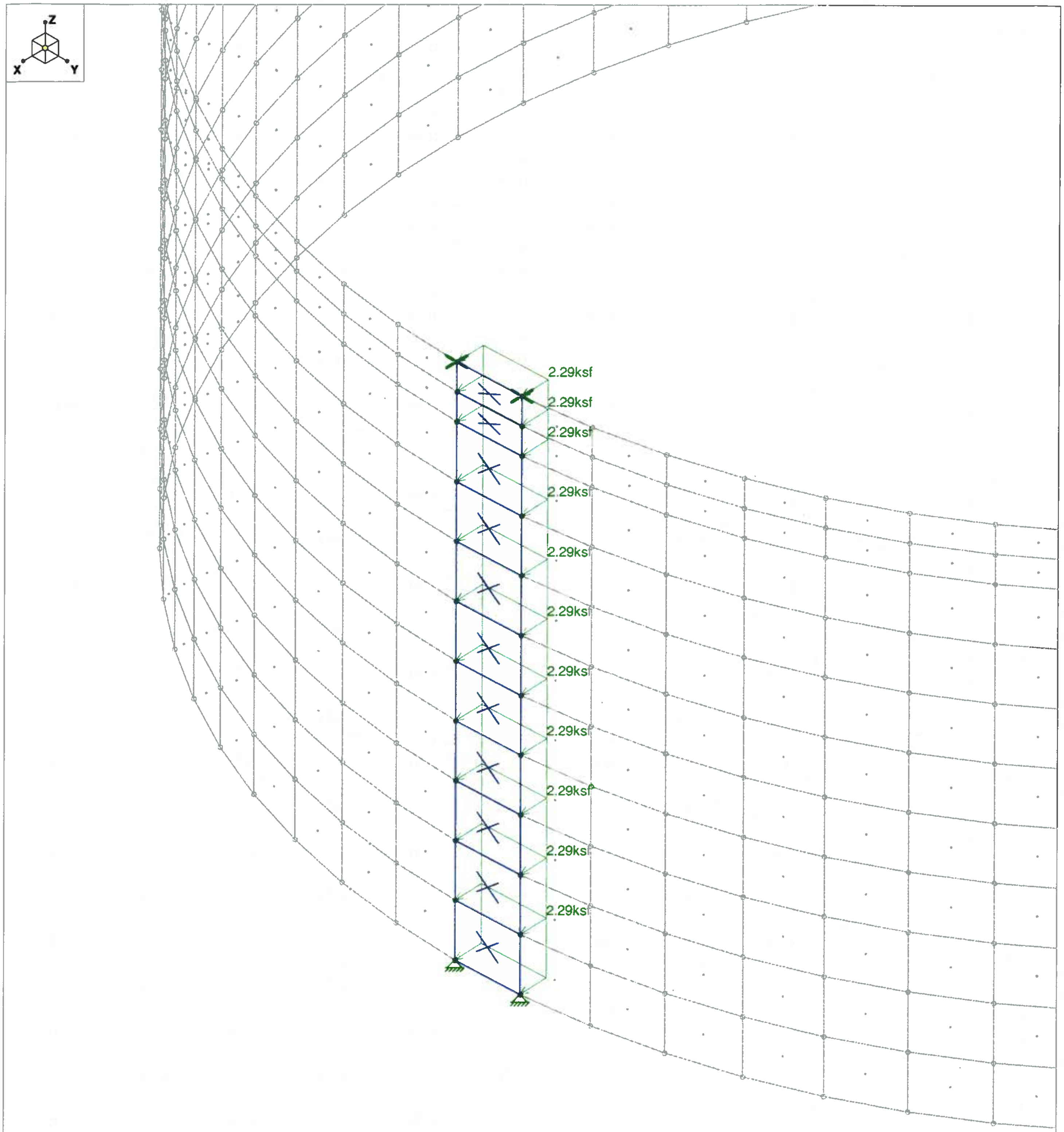
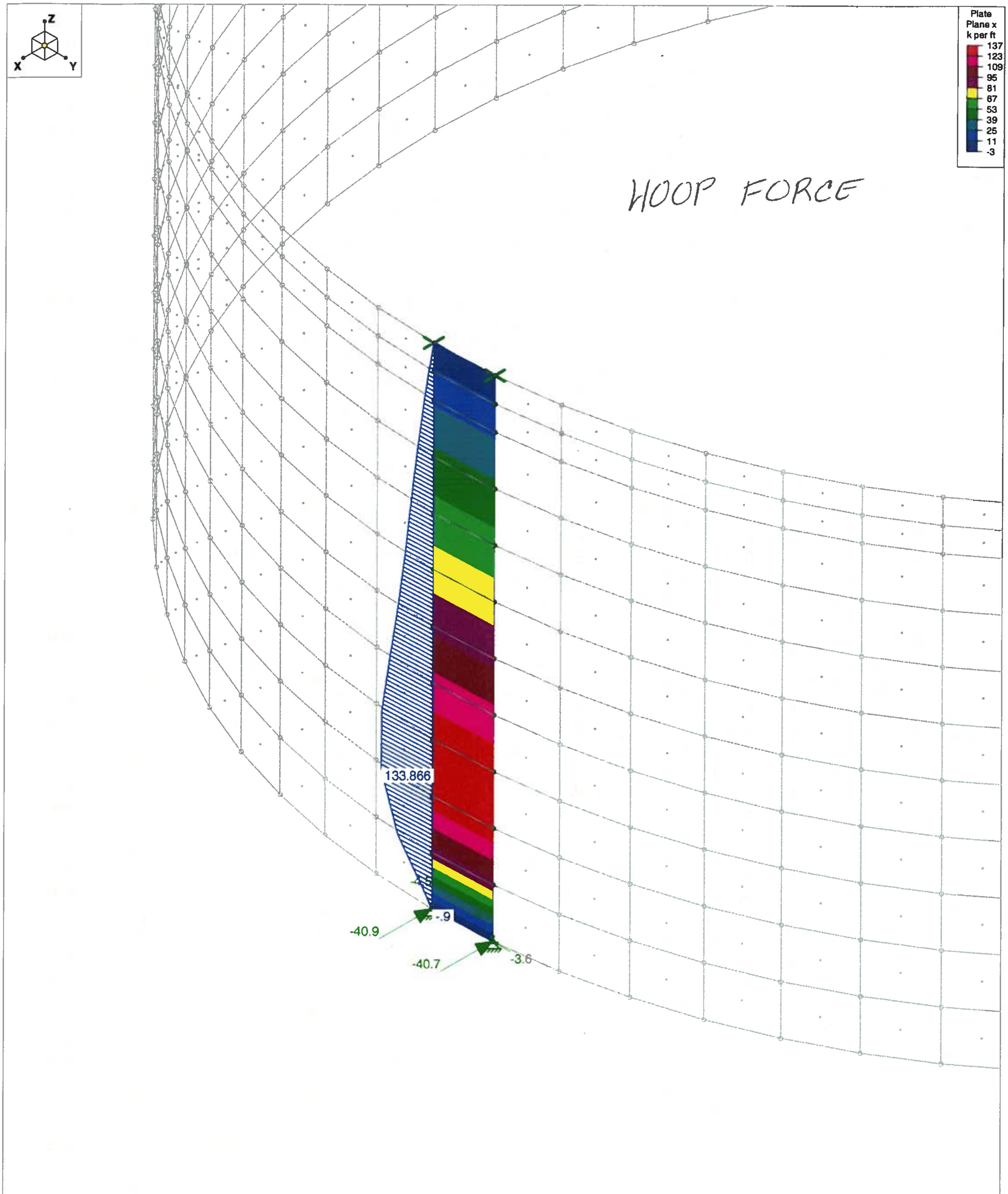


Loads: BLC 5, Hydrodynamic Load

Brown and Caldwell	San Jose Digester 4 Submerged Analysis	SK - 2
Eric Wilkins		Oct 6, 2010 at 12:59 PM
136242		San Jose Digester 4 Submerged A...



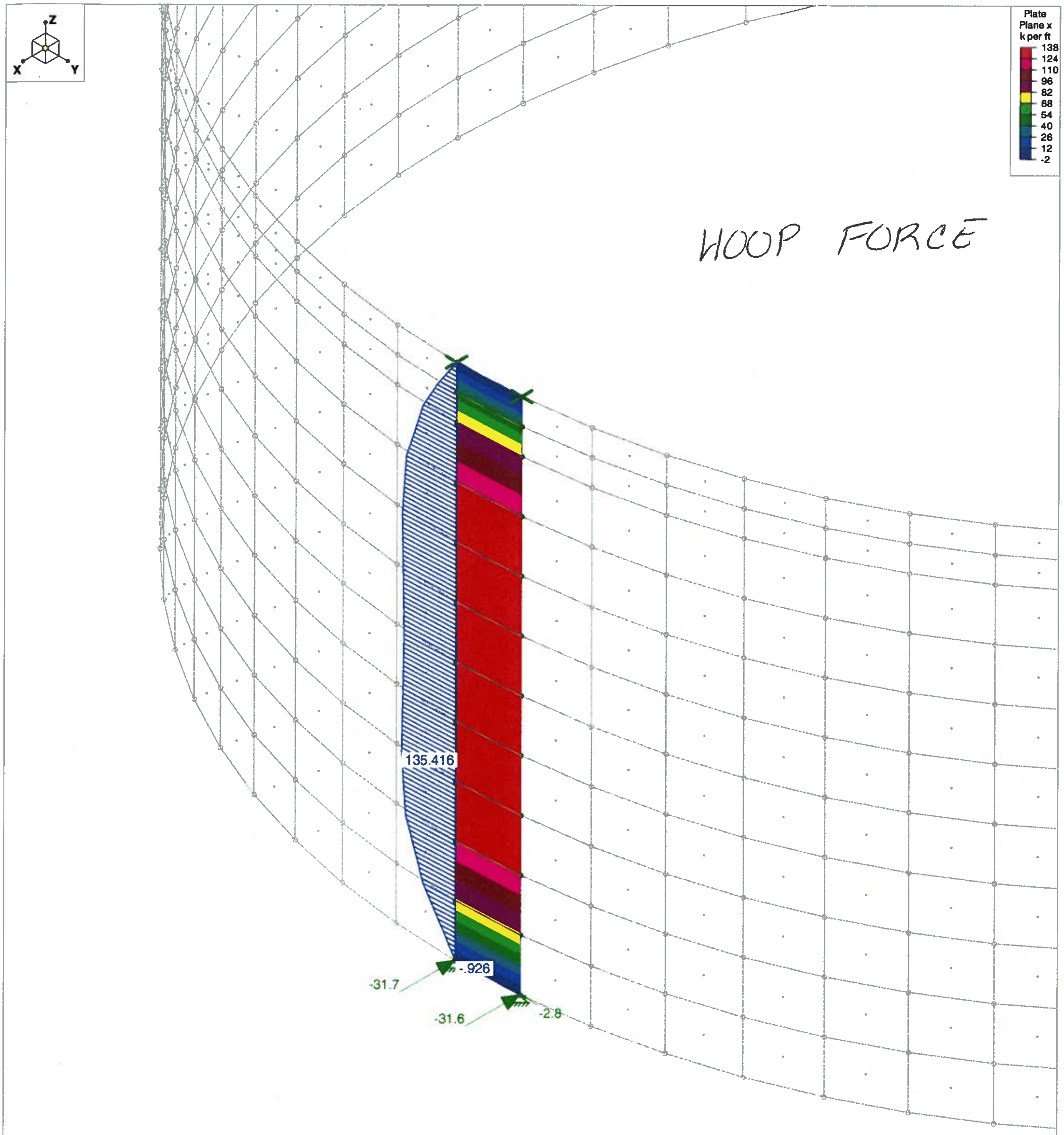
HOOP FORCE

Results for LC 3, 1.0F
Z-direction Reaction units are k and k-ft

Brown and Caldwell
Eric Wilkins
136242

San Jose Digester 4 Submerged Analysis

SK - 3
Oct 6, 2010 at 1:00 PM
San Jose Digester 4 Submerged A...



HOOP FORCE

Results for LC 4, 1.0E
Z-direction Reaction units are k and k-ft

Brown and Caldwell	San Jose Digester 4 Submerged Analysis	SK - 4
Eric Wilkins		Oct 6, 2010 at 1:00 PM
136242		San Jose Digester 4 Submerged A...

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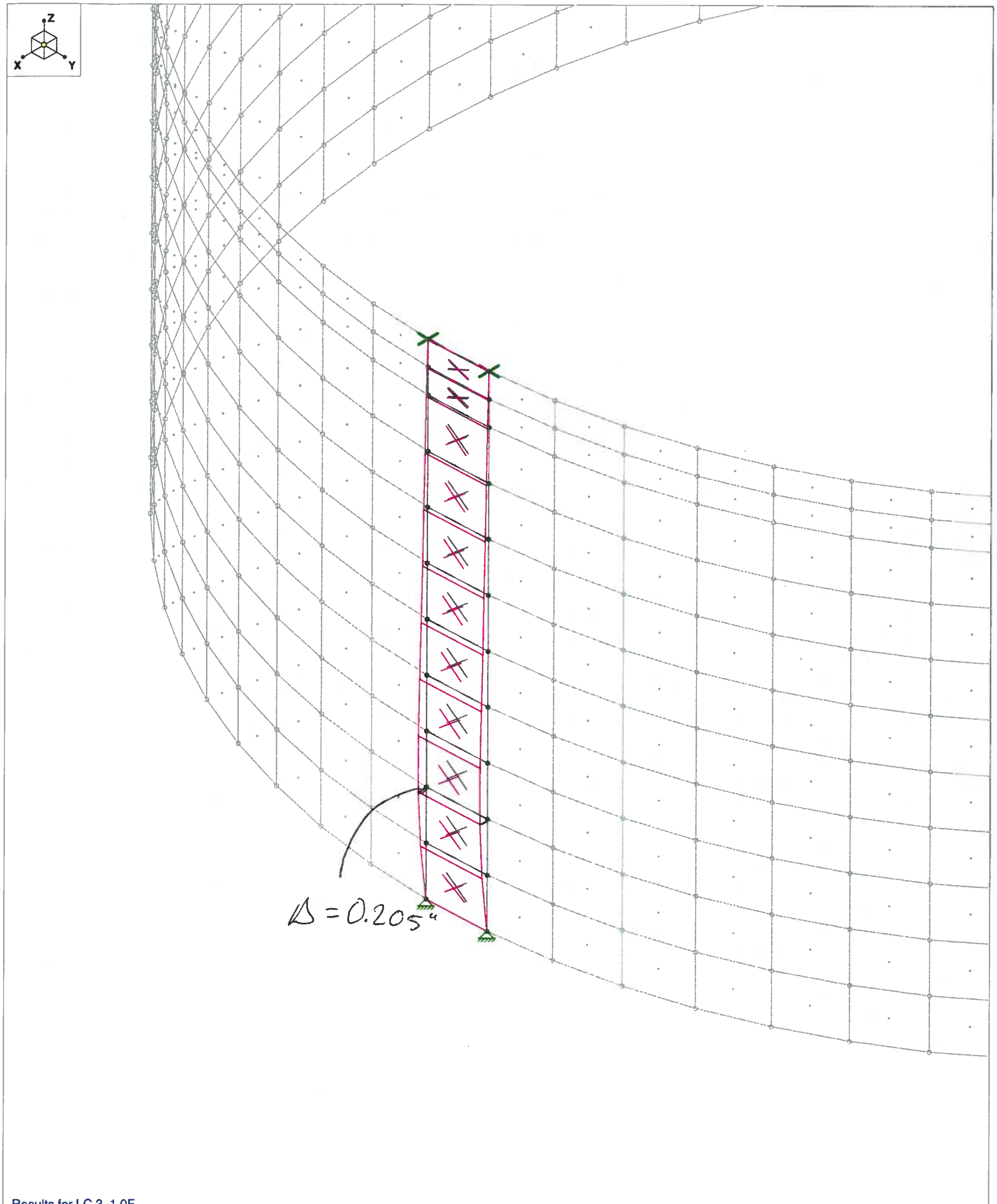
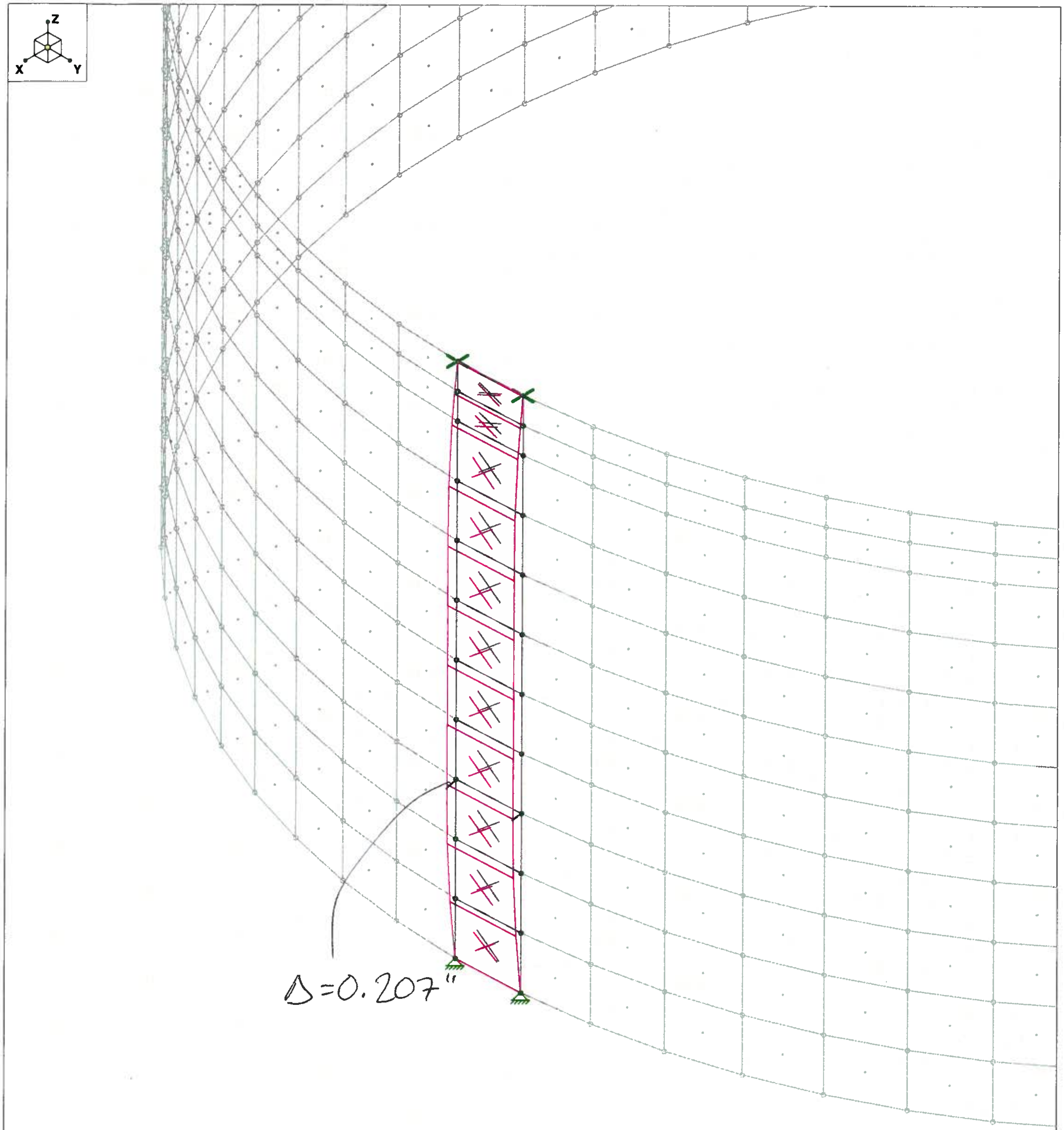


Results for LC 3, 1.0F

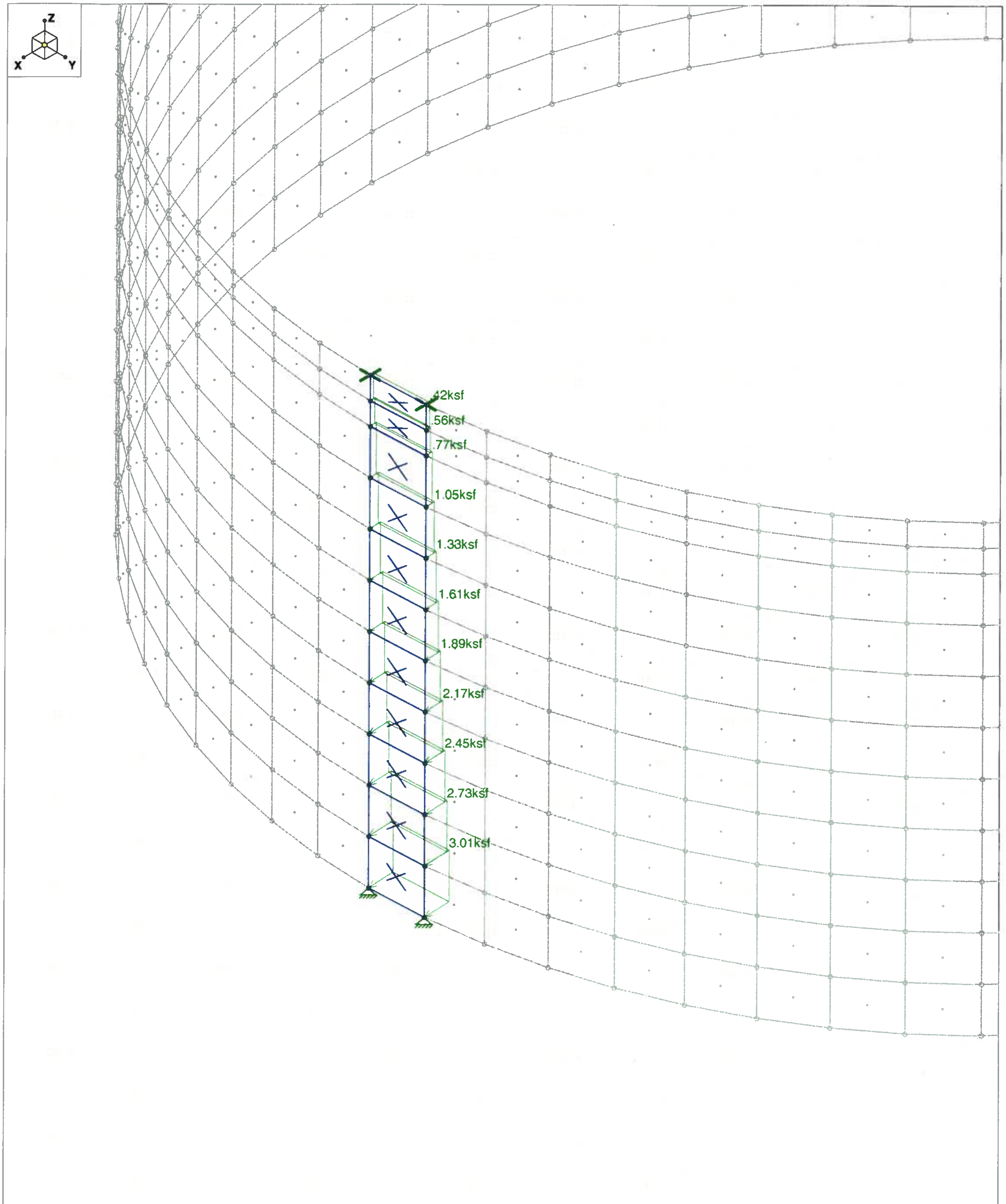
Brown and Caldwell	San Jose Digester 4 Submerged Analysis	SK - 5
Eric Wilkins		Oct 6, 2010 at 1:01 PM
136242		San Jose Digester 4 Submerged A...

23



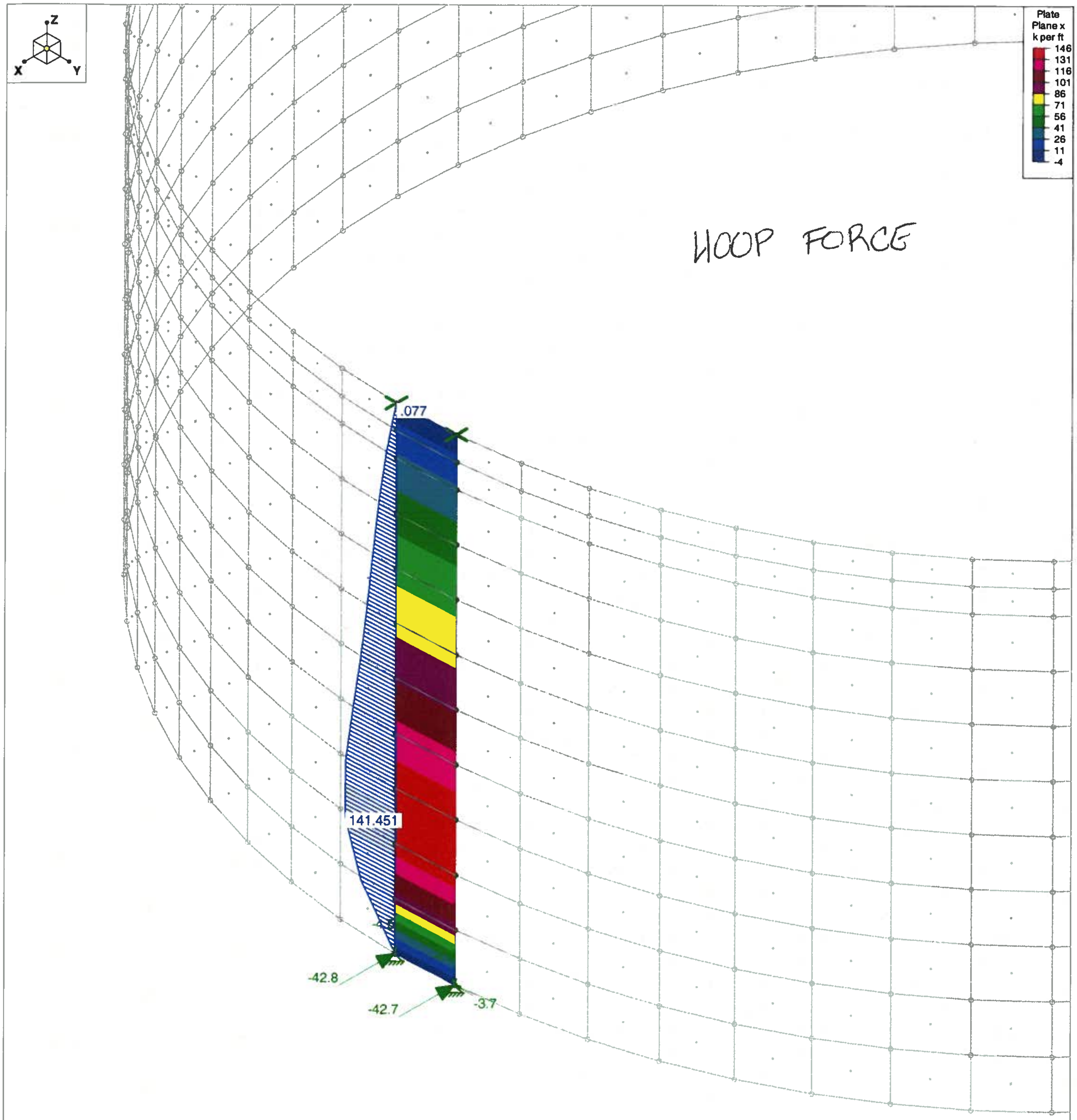
Results for LC 4, 1.0E

Brown and Caldwell	San Jose Digester 4 Submerged Analysis	SK - 6
Eric Wilkins		Oct 6, 2010 at 1:01 PM
136242		San Jose Digester 4 Submerged A...



Loads: BLC 4, Hydrostatic Load

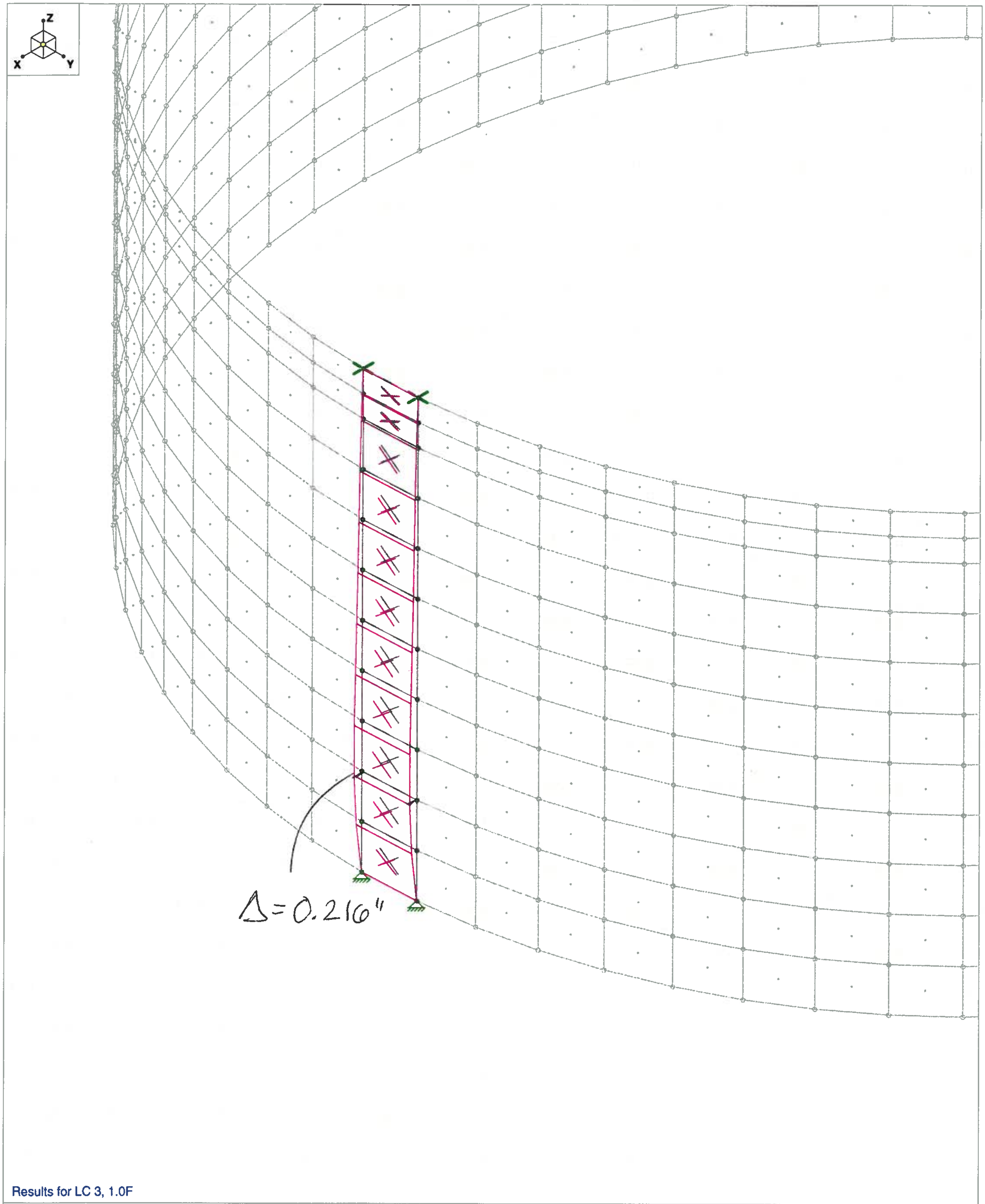
Brown and Caldwell	San Jose Digester 4 Analysis Submerged Overflow Ana...	SK - 1
Eric Wilkins		Oct 6, 2010 at 1:07 PM
136242		San Jose Digester 4 Submerged O...



HOOP FORCE

Results for LC 3, 1.0F
Z-direction Reaction units are k and k-ft

Brown and Caldwell	San Jose Digester 4 Analysis Submerged Overflow Ana...	SK - 2
Eric Wilkins		Oct 6, 2010 at 1:07 PM
136242		San Jose Digester 4 Submerged O...



Results for LC 3, 1.0F

Brown and Caldwell	San Jose Digester 4 Analysis Submerged Overflow Ana...	SK - 3
Eric Wilkins		Oct 6, 2010 at 1:07 PM
136242		San Jose Digester 4 Submerged O...

Concrete Properties

	Label	E [ksi]	G [ksi]	Nu	Therm (\1E5 F)	Density[k/ft^3]	f'c[ksi]
1	Conc3000NW	3156	1372	.15	.6	.145	3
2	Conc3500NW	3409	1482	.15	.6	.145	3.5
3	Conc4000NW	3644	1584	.15	.6	.145	4
4	Conc3000LW	2085	907	.15	.6	.11	3
5	Conc3500LW	2252	979	.15	.6	.11	3.5
6	Conc4000LW	2408	1047	.15	.6	.11	4

Joint Boundary Conditions

	Joint Label	X [k/in]	Y [k/in]	Z [k/in]	X Rot.[k-ft/rad]	Y Rot.[k-ft/rad]	Z Rot.[k-ft/rad]	Footing
1	N1	Reaction	Reaction	Reaction				
2	N2	Reaction	Reaction	Reaction				
3	N3	Reaction	Reaction	Reaction				
4	N4	Reaction	Reaction	Reaction				
5	N5	Reaction	Reaction	Reaction				
6	N6	Reaction	Reaction	Reaction				
7	N7	Reaction	Reaction	Reaction				
8	N8	Reaction	Reaction	Reaction				
9	N9	Reaction	Reaction	Reaction				
10	N10	Reaction	Reaction	Reaction				
11	N11	Reaction	Reaction	Reaction				
12	N12	Reaction	Reaction	Reaction				
13	N13	Reaction	Reaction	Reaction				
14	N14	Reaction	Reaction	Reaction				
15	N15	Reaction	Reaction	Reaction				
16	N16	Reaction	Reaction	Reaction				
17	N17	Reaction	Reaction	Reaction				
18	N18	Reaction	Reaction	Reaction				
19	N19	Reaction	Reaction	Reaction				
20	N20	Reaction	Reaction	Reaction				
21	N21	Reaction	Reaction	Reaction				
22	N22	Reaction	Reaction	Reaction				
23	N23	Reaction	Reaction	Reaction				
24	N24	Reaction	Reaction	Reaction				
25	N25	Reaction	Reaction	Reaction				
26	N26	Reaction	Reaction	Reaction				
27	N27	Reaction	Reaction	Reaction				
28	N28	Reaction	Reaction	Reaction				
29	N29	Reaction	Reaction	Reaction				
30	N30	Reaction	Reaction	Reaction				
31	N31	Reaction	Reaction	Reaction				
32	N32	Reaction	Reaction	Reaction				
33	N33	Reaction	Reaction	Reaction				
34	N34	Reaction	Reaction	Reaction				
35	N35	Reaction	Reaction	Reaction				
36	N36	Reaction	Reaction	Reaction				
37	N37	Reaction	Reaction	Reaction				
38	N38	Reaction	Reaction	Reaction				
39	N39	Reaction	Reaction	Reaction				
40	N40	Reaction	Reaction	Reaction				
41	N41	Reaction	Reaction	Reaction				
42	N42	Reaction	Reaction	Reaction				
43	N43	Reaction	Reaction	Reaction				
44	N44	Reaction	Reaction	Reaction				
45	N45	Reaction	Reaction	Reaction				
46	N46	Reaction	Reaction	Reaction				

28

Joint Boundary Conditions (Continued)

	Joint Label	X [k/in]	Y [k/in]	Z [k/in]	X Rot.[k-ft/rad]	Y Rot.[k-ft/rad]	Z Rot.[k-ft/rad]	Footing
47	N47	Reaction	Reaction	Reaction				
48	N48	Reaction	Reaction	Reaction				
49	N49	Reaction	Reaction	Reaction				
50	N50	Reaction	Reaction	Reaction				
51	N51	Reaction	Reaction	Reaction				
52	N52	Reaction	Reaction	Reaction				
53	N53	Reaction	Reaction	Reaction				
54	N54	Reaction	Reaction	Reaction				
55	N55	Reaction	Reaction	Reaction				
56	N56	Reaction	Reaction	Reaction				
57	N57	Reaction	Reaction	Reaction				
58	N58	Reaction	Reaction	Reaction				
59	N59	Reaction	Reaction	Reaction				
60	N60	Reaction	Reaction	Reaction				
61	N61	Reaction	Reaction	Reaction				
62	N62	Reaction	Reaction	Reaction				
63	N63	Reaction	Reaction	Reaction				
64	N64	Reaction	Reaction	Reaction				
65	N65	Reaction	Reaction	Reaction				
66	N66	Reaction	Reaction	Reaction				
67	N67	Reaction	Reaction	Reaction				
68	N68	Reaction	Reaction	Reaction				
69	N69	Reaction	Reaction	Reaction				
70	N70	Reaction	Reaction	Reaction				
71	N71	Reaction	Reaction	Reaction				
72	N72	Reaction	Reaction	Reaction				
73	N867	Fixed	Fixed					
74	N868	Fixed	Fixed					
75	N869	Fixed	Fixed					
76	N870	Fixed	Fixed					
77	N871	Fixed	Fixed					
78	N872	Fixed	Fixed					
79	N873	Fixed	Fixed					
80	N874	Fixed	Fixed					
81	N875	Fixed	Fixed					
82	N876	Fixed	Fixed					
83	N877	Fixed	Fixed					
84	N878	Fixed	Fixed					
85	N879	Fixed	Fixed					
86	N880	Fixed	Fixed					
87	N881	Fixed	Fixed					
88	N882	Fixed	Fixed					
89	N883	Fixed	Fixed					
90	N884	Fixed	Fixed					
91	N885	Fixed	Fixed					
92	N886	Fixed	Fixed					
93	N887	Fixed	Fixed					
94	N888	Fixed	Fixed					
95	N889	Fixed	Fixed					
96	N890	Fixed	Fixed					
97	N891	Fixed	Fixed					
98	N892	Fixed	Fixed					
99	N893	Fixed	Fixed					
100	N894	Fixed	Fixed					
101	N895	Fixed	Fixed					
102	N896	Fixed	Fixed					
103	N897	Fixed	Fixed					

Joint Boundary Conditions (Continued)

	Joint Label	X [k/in]	Y [k/in]	Z [k/in]	X Rot.[k-ft/rad]	Y Rot.[k-ft/rad]	Z Rot.[k-ft/rad]	Footing
104	N898	Fixed	Fixed					
105	N899	Fixed	Fixed					
106	N900	Fixed	Fixed					
107	N901	Fixed	Fixed					
108	N902	Fixed	Fixed					
109	N903	Fixed	Fixed					
110	N904	Fixed	Fixed					
111	N905	Fixed	Fixed					
112	N906	Fixed	Fixed					
113	N907	Fixed	Fixed					
114	N908	Fixed	Fixed					
115	N909	Fixed	Fixed					
116	N910	Fixed	Fixed					
117	N911	Fixed	Fixed					
118	N912	Fixed	Fixed					
119	N913	Fixed	Fixed					
120	N914	Fixed	Fixed					
121	N915	Fixed	Fixed					
122	N916	Fixed	Fixed					
123	N917	Fixed	Fixed					
124	N918	Fixed	Fixed					
125	N919	Fixed	Fixed					
126	N920	Fixed	Fixed					
127	N921	Fixed	Fixed					
128	N922	Fixed	Fixed					
129	N923	Fixed	Fixed					
130	N924	Fixed	Fixed					
131	N925	Fixed	Fixed					
132	N926	Fixed	Fixed					
133	N927	Fixed	Fixed					
134	N928	Fixed	Fixed					
135	N929	Fixed	Fixed					
136	N930	Fixed	Fixed					
137	N931	Fixed	Fixed					
138	N932	Fixed	Fixed					
139	N933	Fixed	Fixed					
140	N934	Fixed	Fixed					
141	N935	Fixed	Fixed					
142	N936	Fixed	Fixed					
143	N937	Fixed	Fixed					
144	N938	Fixed	Fixed					

Basic Load Cases

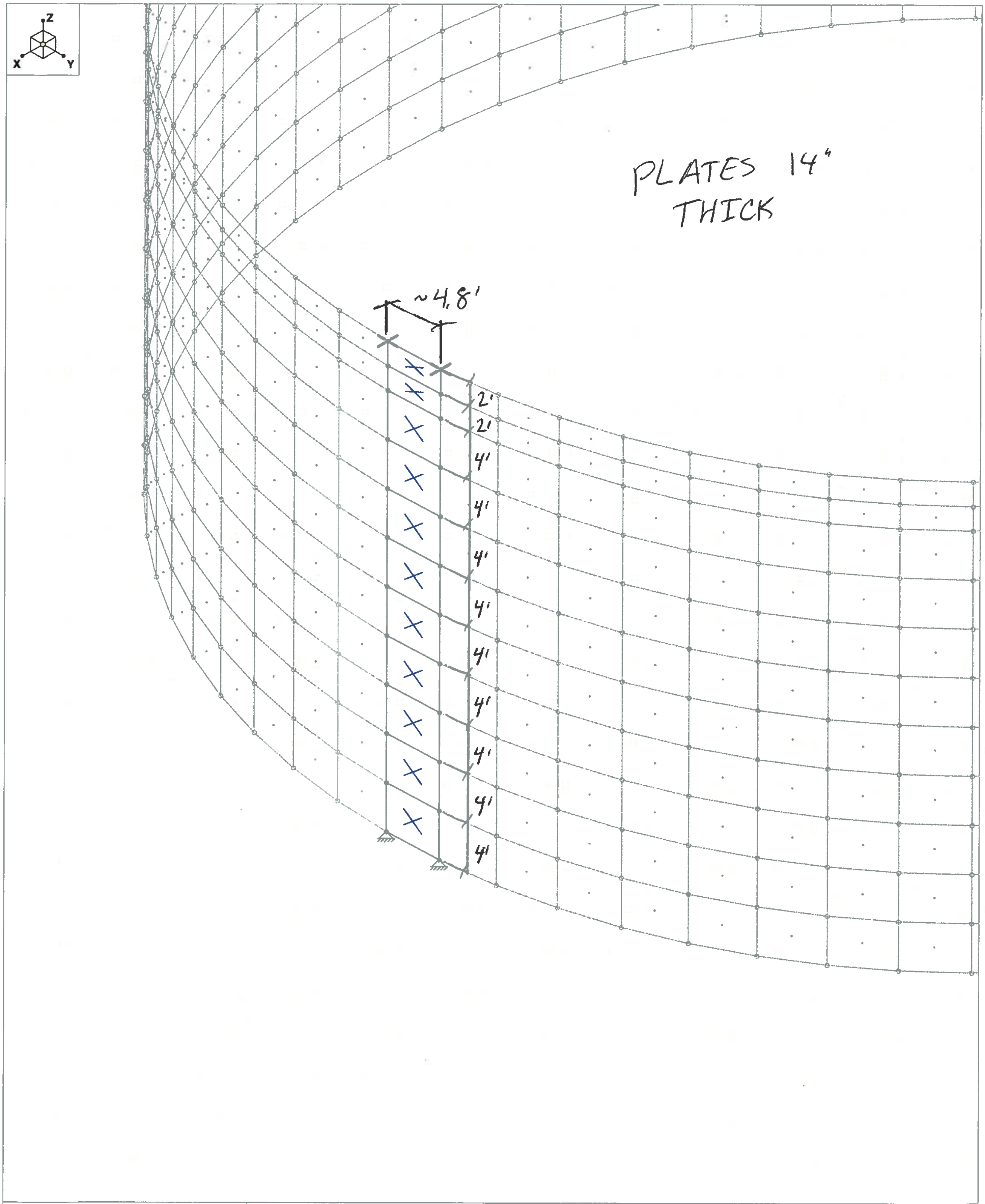
	BLC Description	Category	X Gravity	Y Gravity	Z Gravity	Joint	Point	Distributed	Area (Me...	Surface (...
1	Dead Load	None			-1	72				
2	Roof Live Load	None				72				
3	Gas Load (16")	None				72				
4	Hydrostatic Load	None								648
5	Hydrodynamic Load	None								648

Load Combinations

	Description	So...	PDelta	S...	BLC	Fac...	BLC	Fac...	BLC	Fac...	BLC	Fac...	BLC	Fac...	BLC	Fac...	BLC	Fac...	BLC	Fac...
1	1.0DL	Yes			1	1														
2	1.0Lr	Yes			2	1														
3	1.0F	Yes			3	1	4	1												

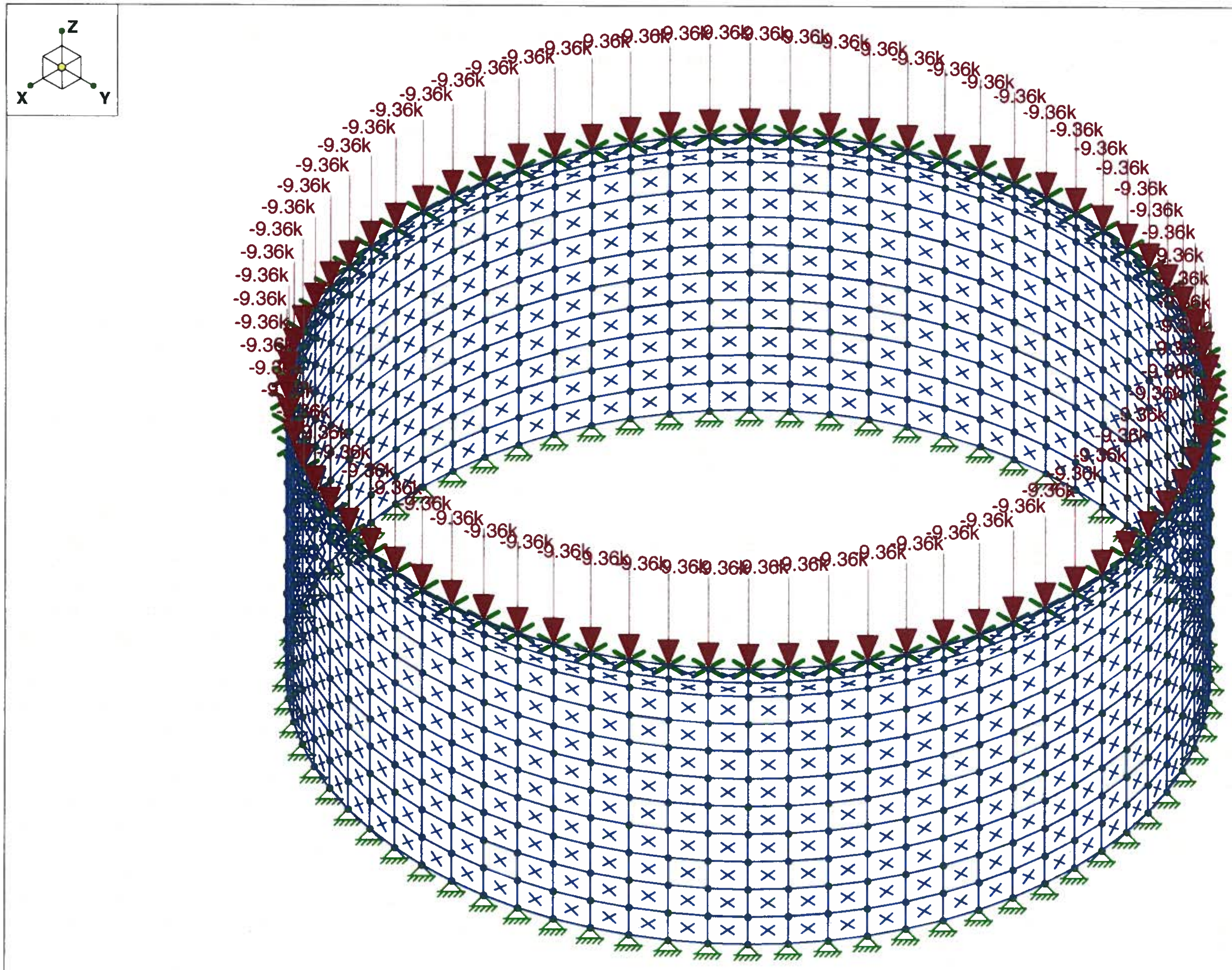
Load Combinations (Continued)

	Description	So...	PDelta	S...	BLC	Fac..	BLC	Fac..	BLC	Fac..	BLC	Fac..	BLC	Fac..	BLC	Fac..	BLC	Fac..	BLC	Fac...
4	1.0E	Yes			5	1														



PLATES 14"
THICK

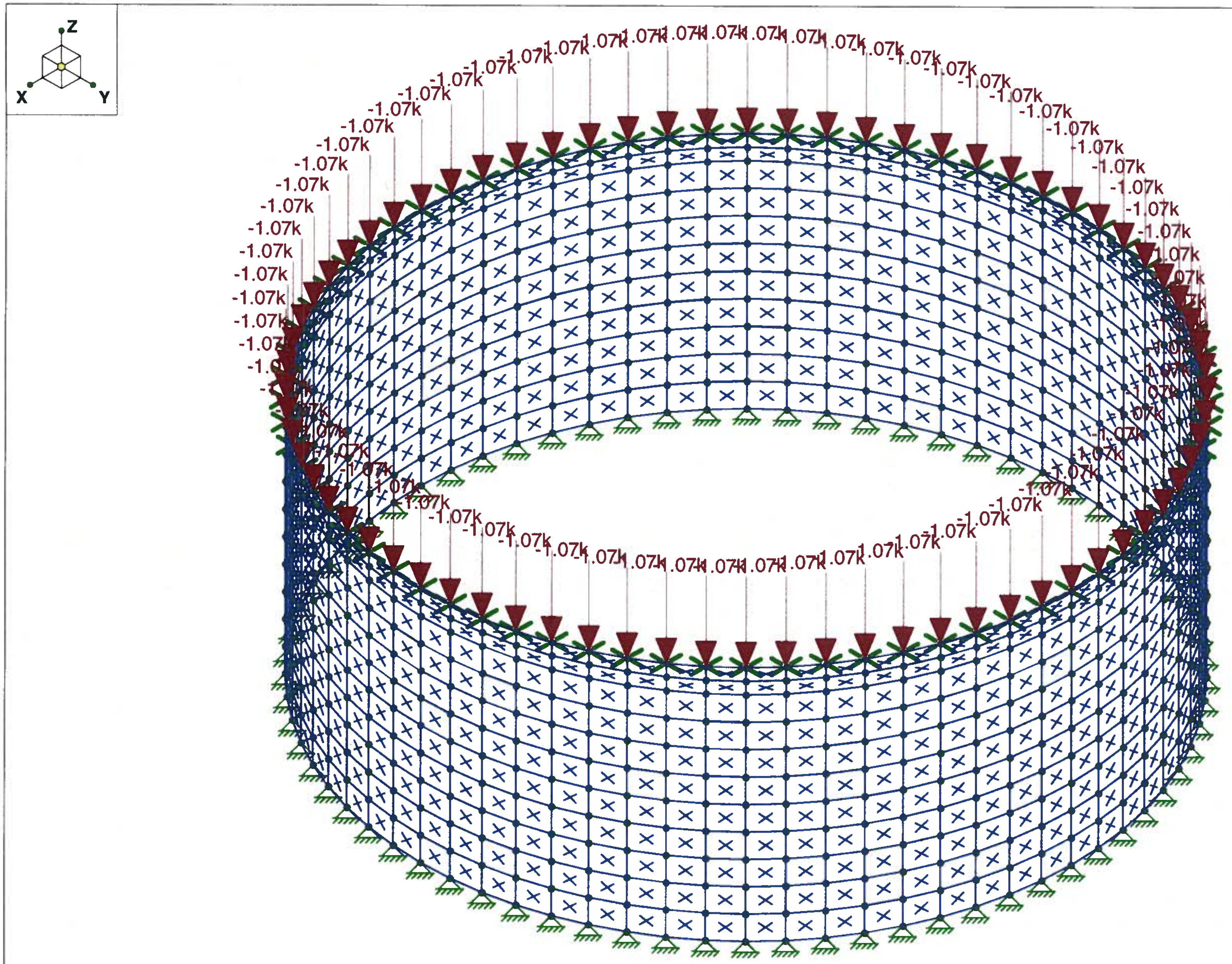
Brown and Caldwell	San Jose Digester 12 Non-Submerged Analysis	SK -
Eric Wilkins		Oct 6, 2010 at 1:20 PM
136242		San Jose Digester 12 Non-Submer...



Loads: BLC 1, Dead Load

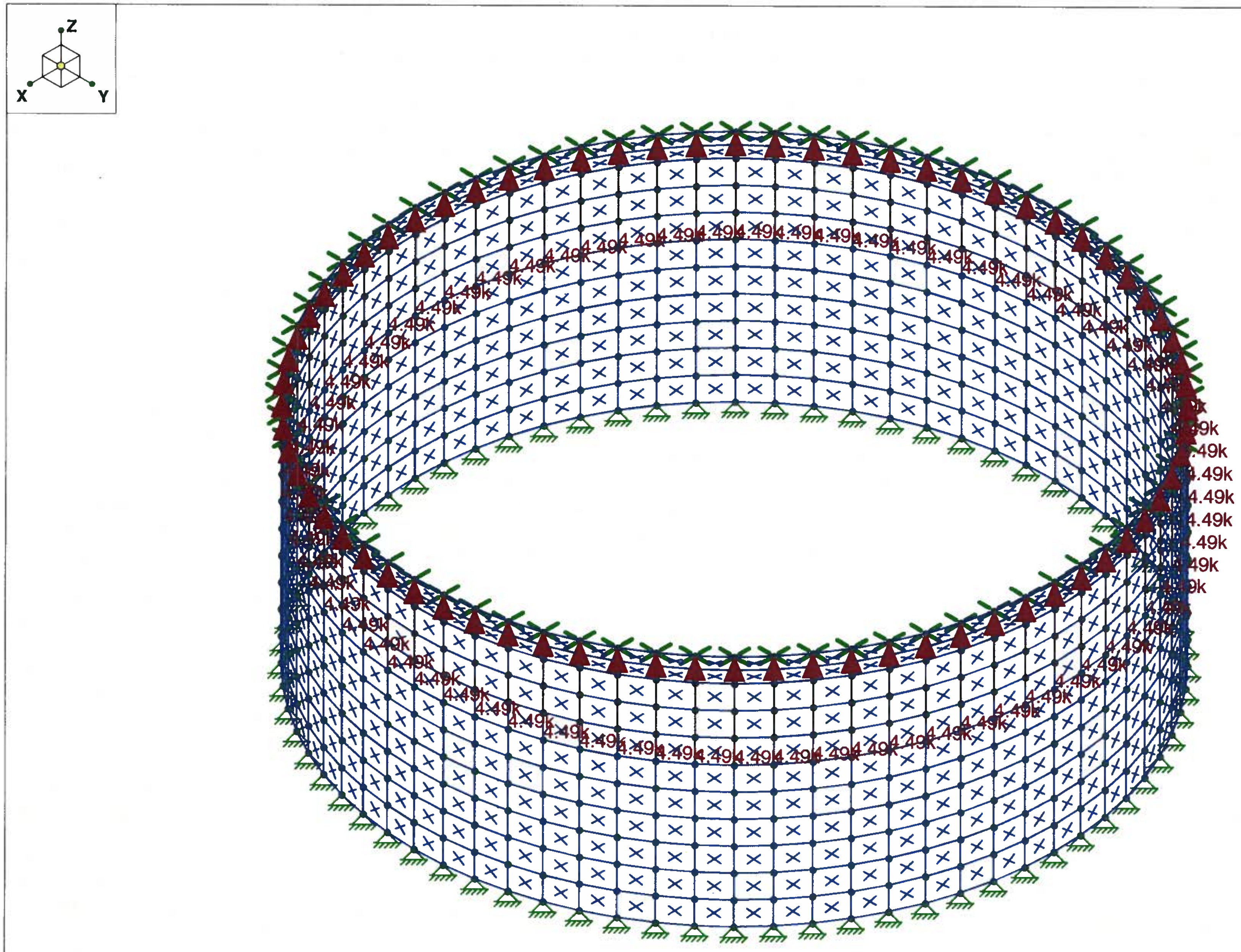
Brown and Caldwell	San Jose Digester 12 Non-Submerged Analysis	SK - 1
Eric Wilkins		Oct 6, 2010 at 1:21 PM
136242		San Jose Digester 12 Non-Submerged Analysis...

33



Loads: BLC 2, Roof Live Load

Brown and Caldwell	San Jose Digester 12 Non-Submerged Analysis	SK - 2
Eric Wilkins		Oct 6, 2010 at 1:21 PM
136242		San Jose Digester 12 Non-Submerged Analysis...

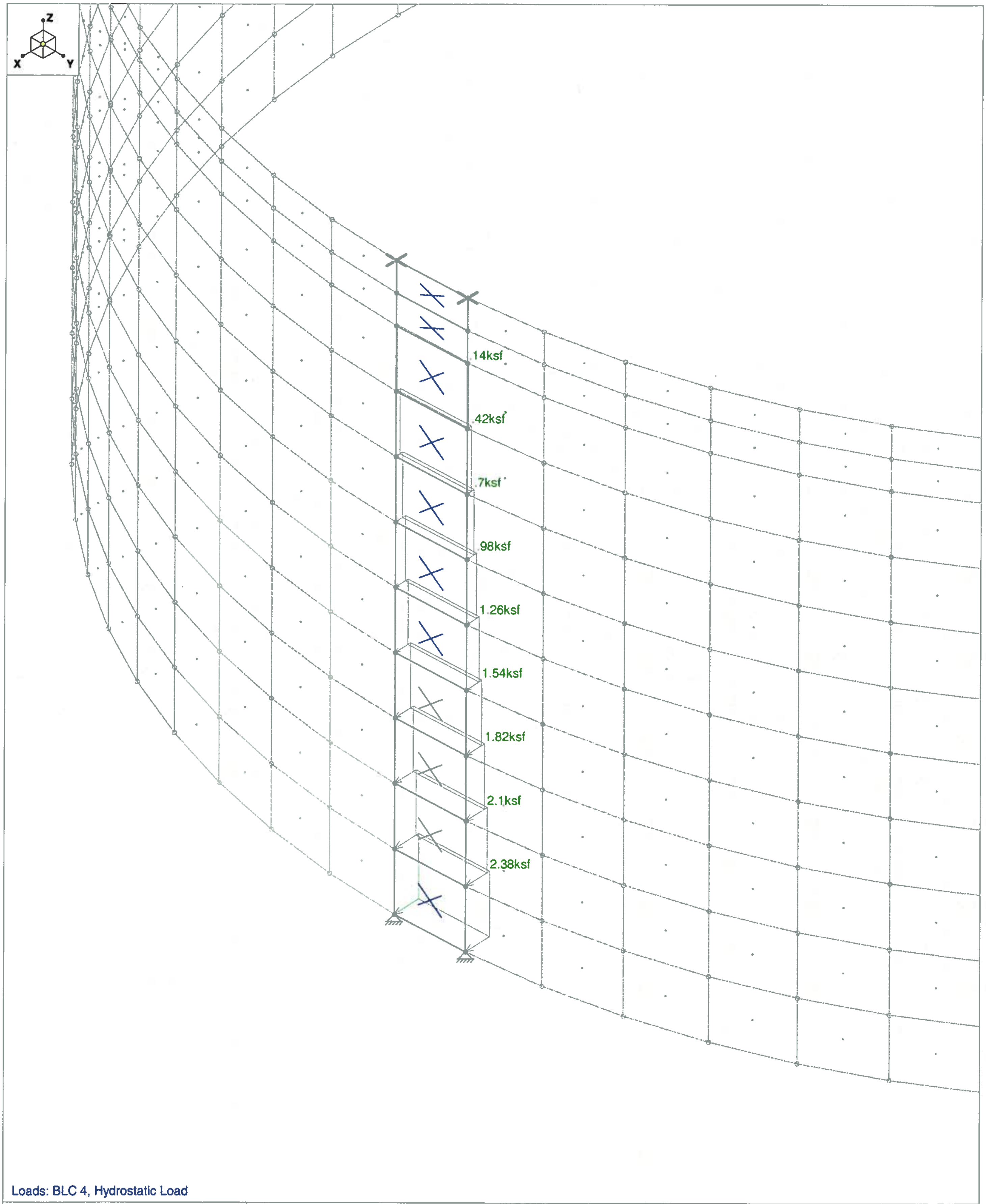


Loads: BLC 3, Gas Load (16")

Brown and Caldwell
Eric Wilkins
136242

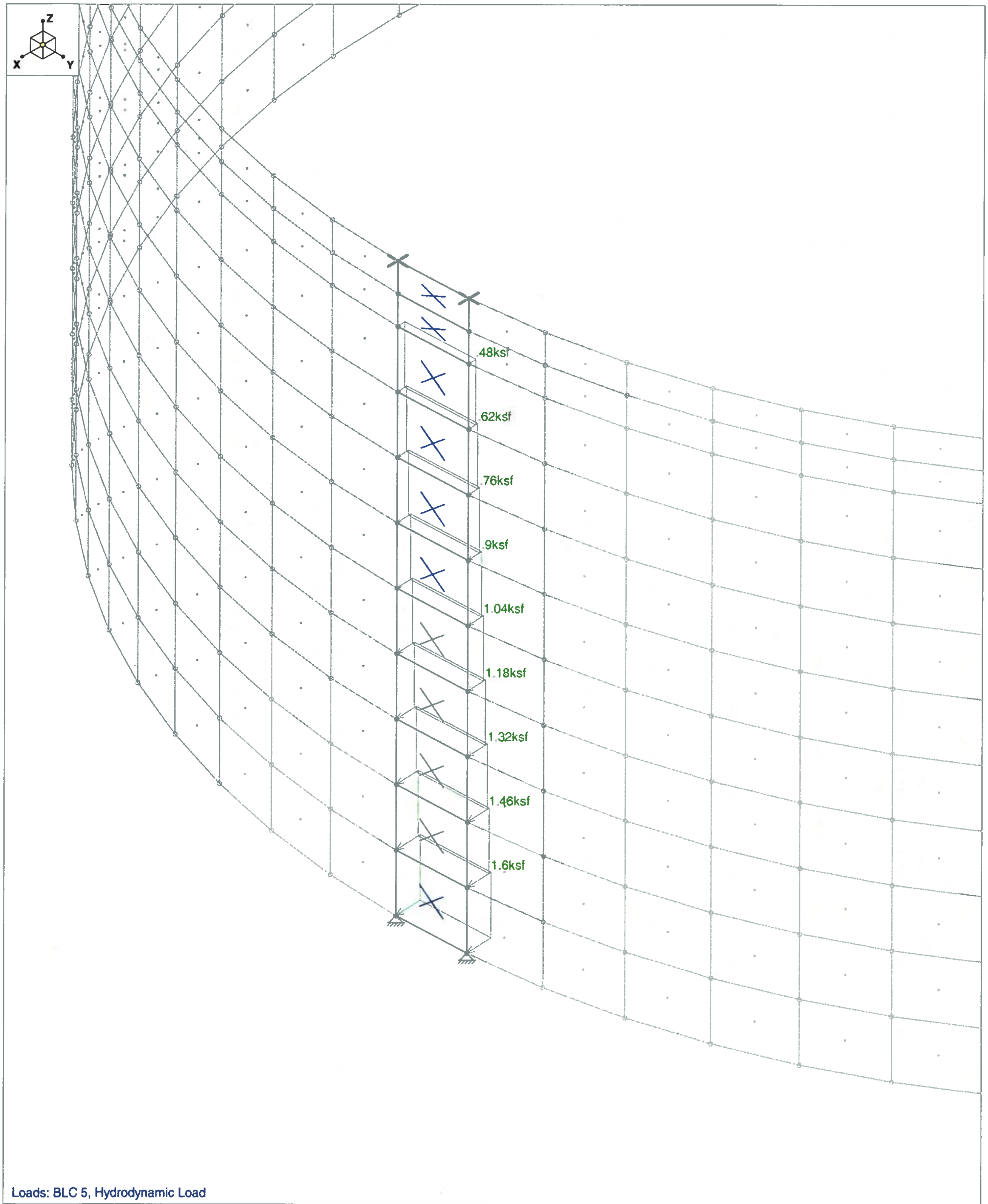
San Jose Digester 12 Non-Submerged Analysis

SK - 3
Oct 6, 2010 at 1:20 PM
San Jose Digester 12 Non-Submerged Analysis...



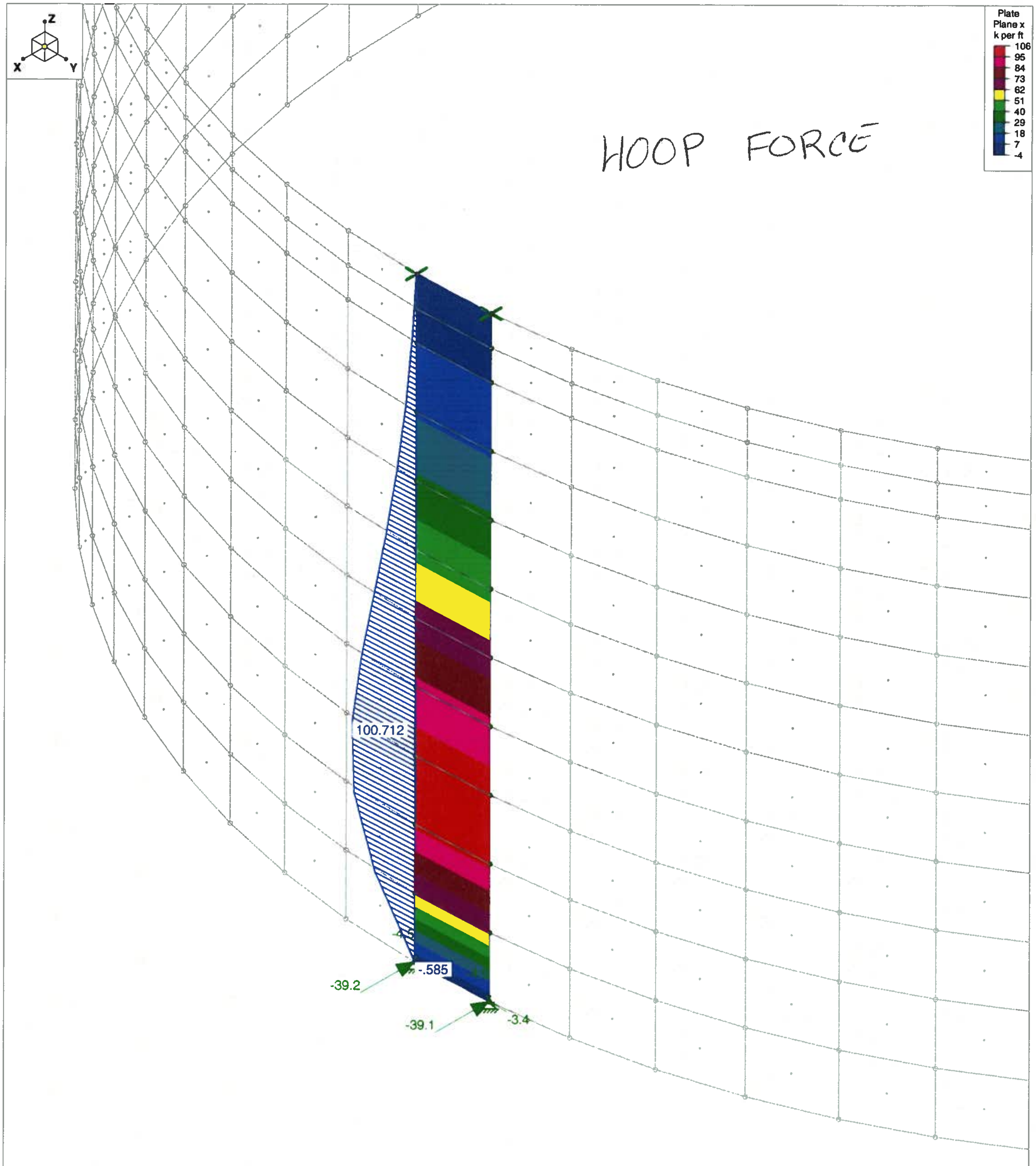
Loads: BLC 4, Hydrostatic Load

Brown and Caldwell	San Jose Digester 12 Non-Submerged Analysis	SK - 4
Eric Wilkins		Oct 6, 2010 at 1:28 PM
136242		San Jose Digester 12 Non-Submer...



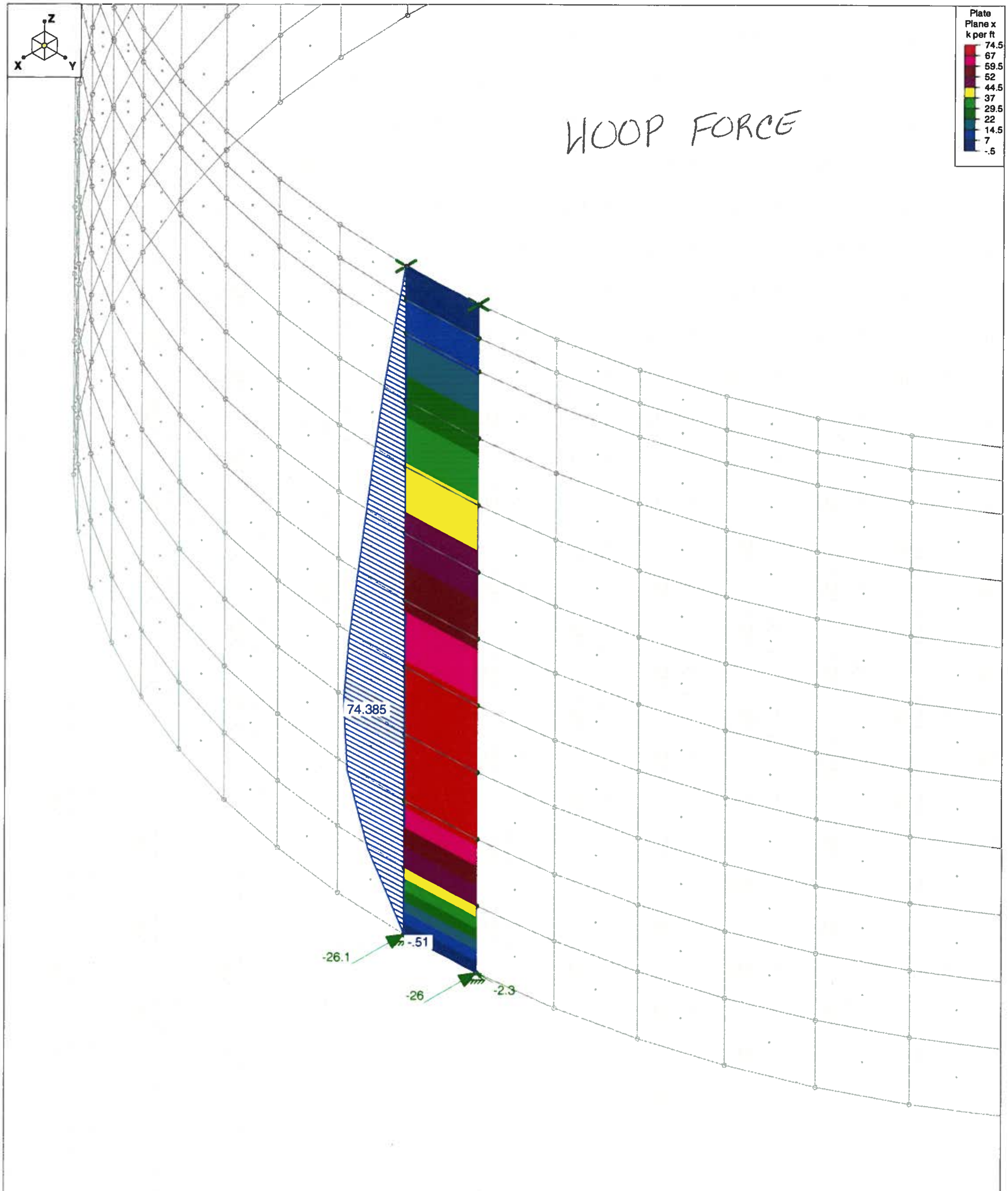
Loads: BLC 5, Hydrodynamic Load

Brown and Caldwell	San Jose Digester 12 Non-Submerged Analysis	SK - 5
Eric Wilkins		Oct 6, 2010 at 1:28 PM
136242		San Jose Digester 12 Non-Submer...



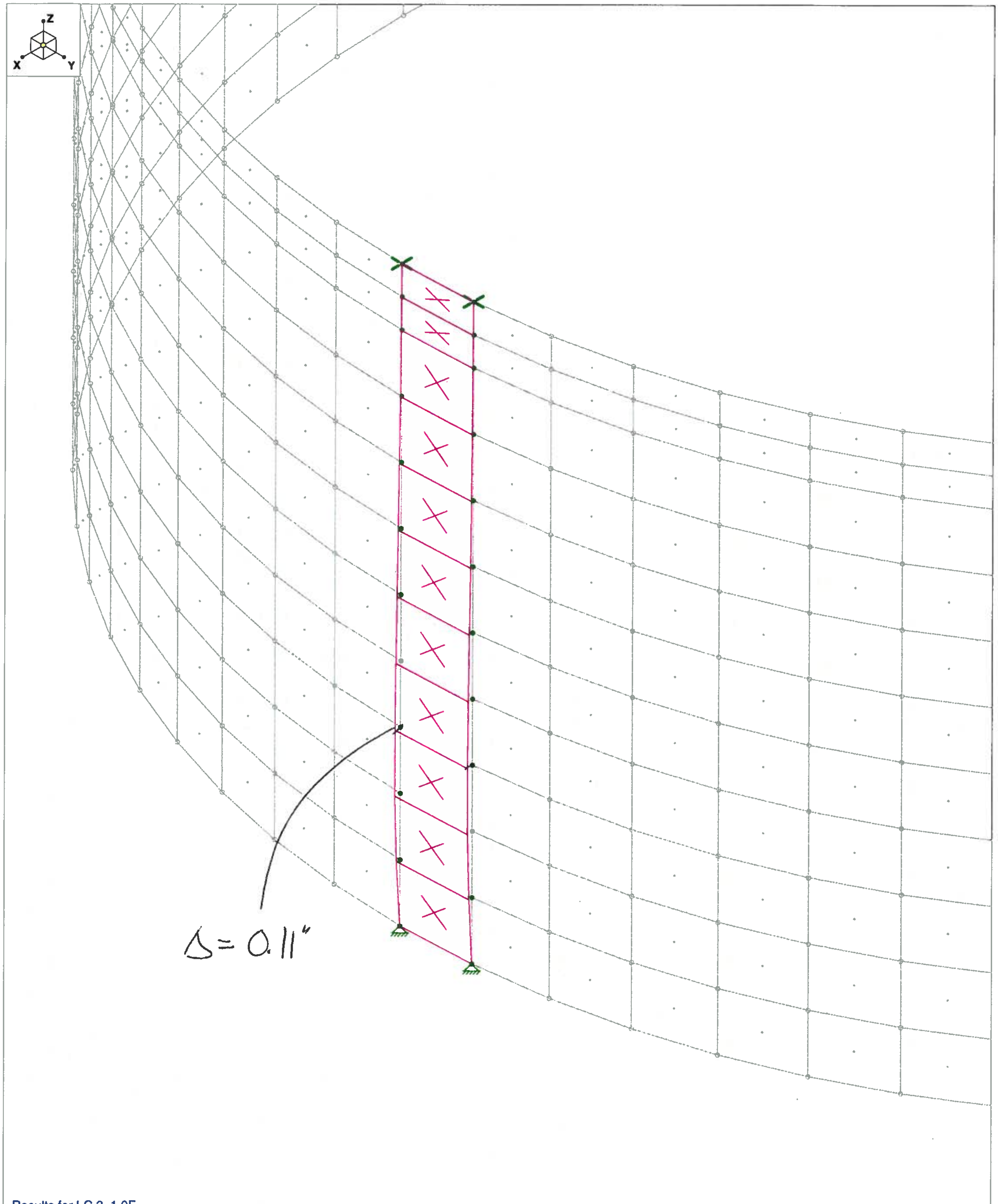
Results for LC 3, 1.0F
Z-direction Reaction units are k and k-ft

Brown and Caldwell	San Jose Digester 12 Non-Submerged Analysis	SK - 6
Eric Wilkins		Oct 6, 2010 at 1:29 PM
136242		San Jose Digester 12 Non-Submer...



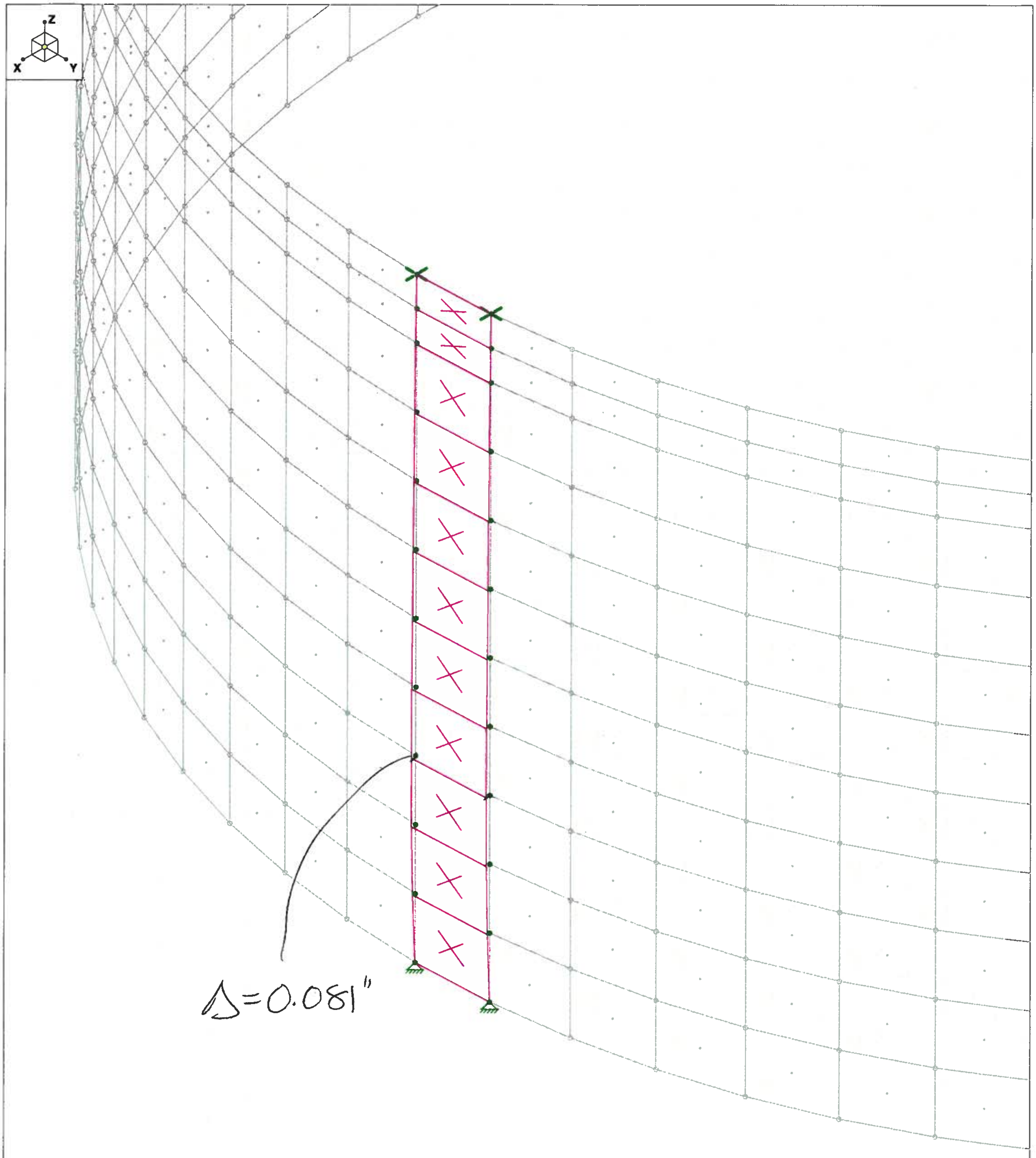
Results for LC 4, 1.0E
Z-direction Reaction units are k and k-ft

Brown and Caldwell	San Jose Digester 12 Non-Submerged Analysis	SK - 7
Eric Wilkins		Oct 6, 2010 at 1:29 PM
136242		San Jose Digester 12 Non-Submer...



Results for LC 3, 1.0F

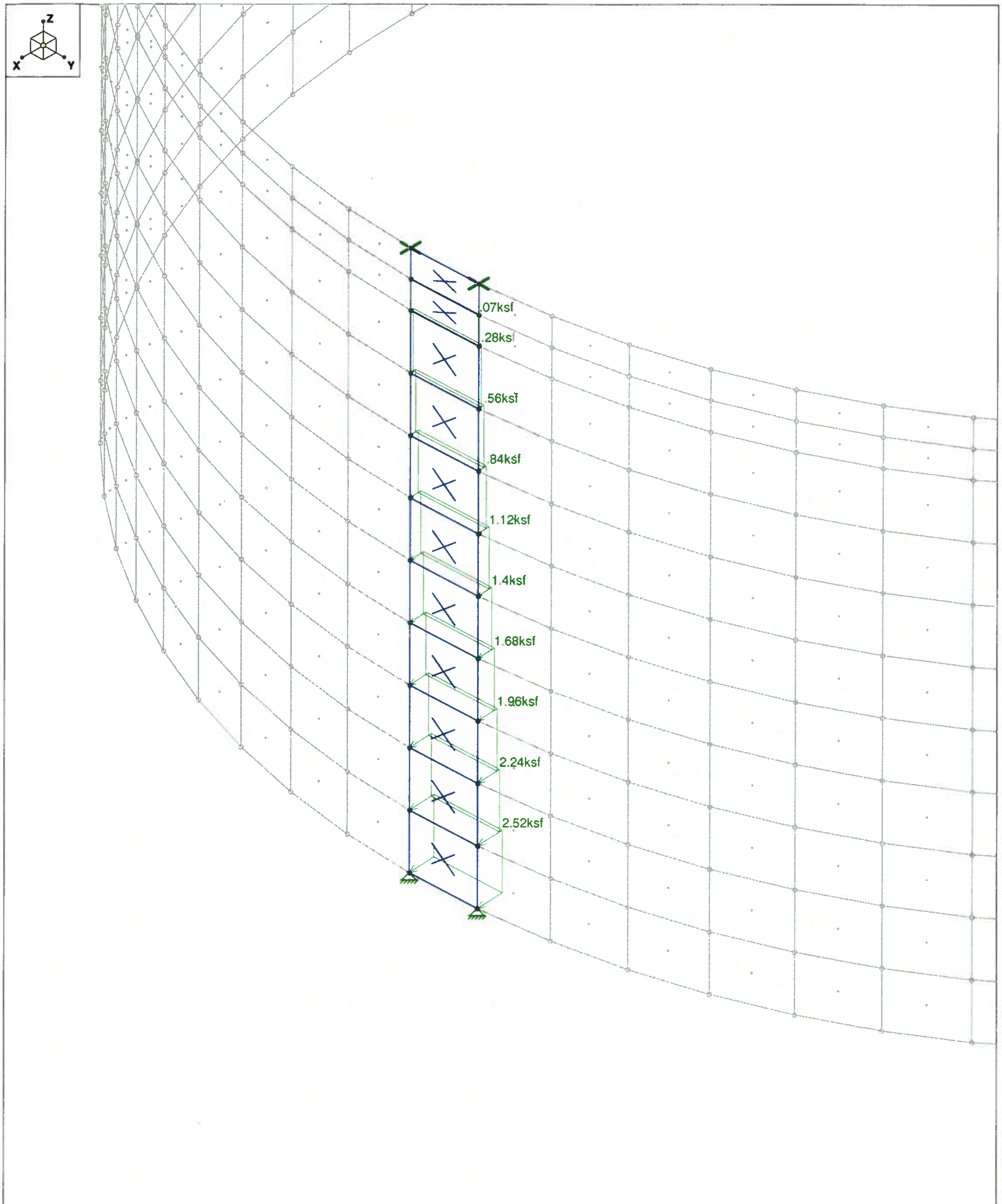
Brown and Caldwell	San Jose Digester 12 Non-Submerged Analysis	SK - 8
Eric Wilkins		Oct 6, 2010 at 1:30 PM
136242		San Jose Digester 12 Non-Submer...



Δ=0.081"

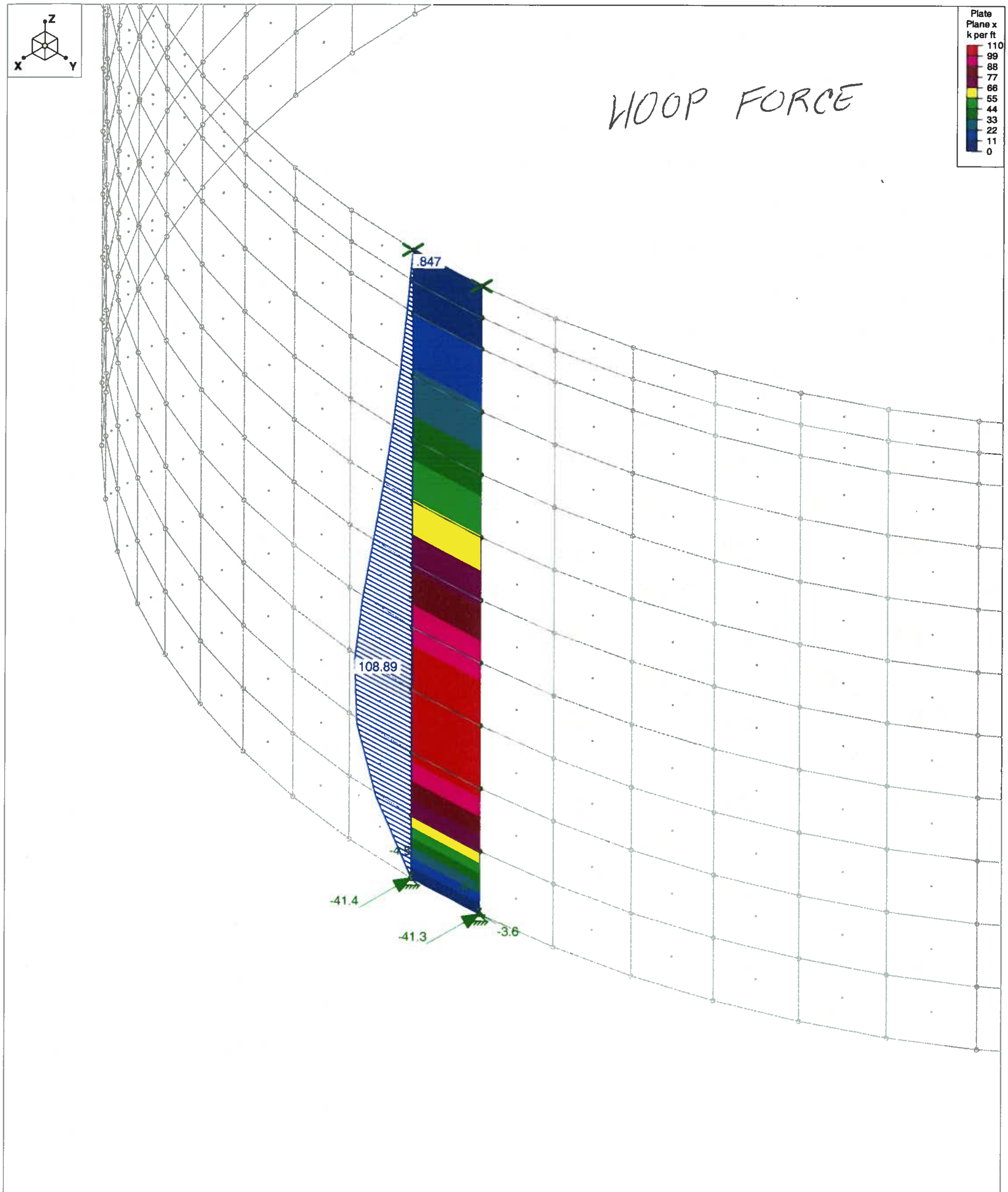
Results for LC 4, 1.0E

Brown and Caldwell	San Jose Digester 12 Non-Submerged Analysis	SK -9
Eric Wilkins		Oct 6, 2010 at 1:30 PM
136242		San Jose Digester 12 Non-Submer...



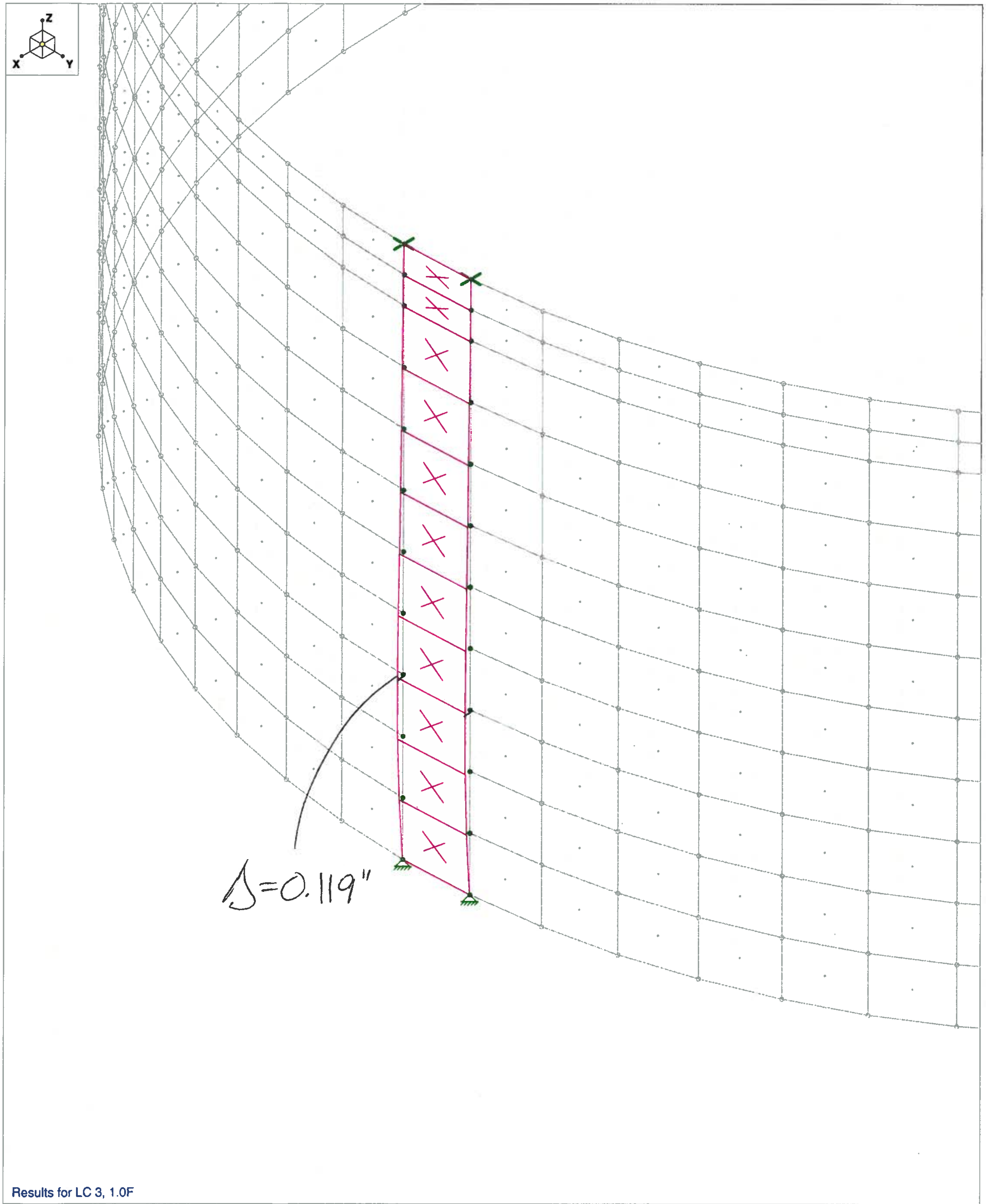
Loads: BLC 4, Hydrostatic Load

Brown and Caldwell	San Jose Digester 12 Non-Submerged Overflow Analysis	SK - 1
Eric Wilkins		Oct 6, 2010 at 1:34 PM
136242		San Jose Digester 12 Non-Submer...



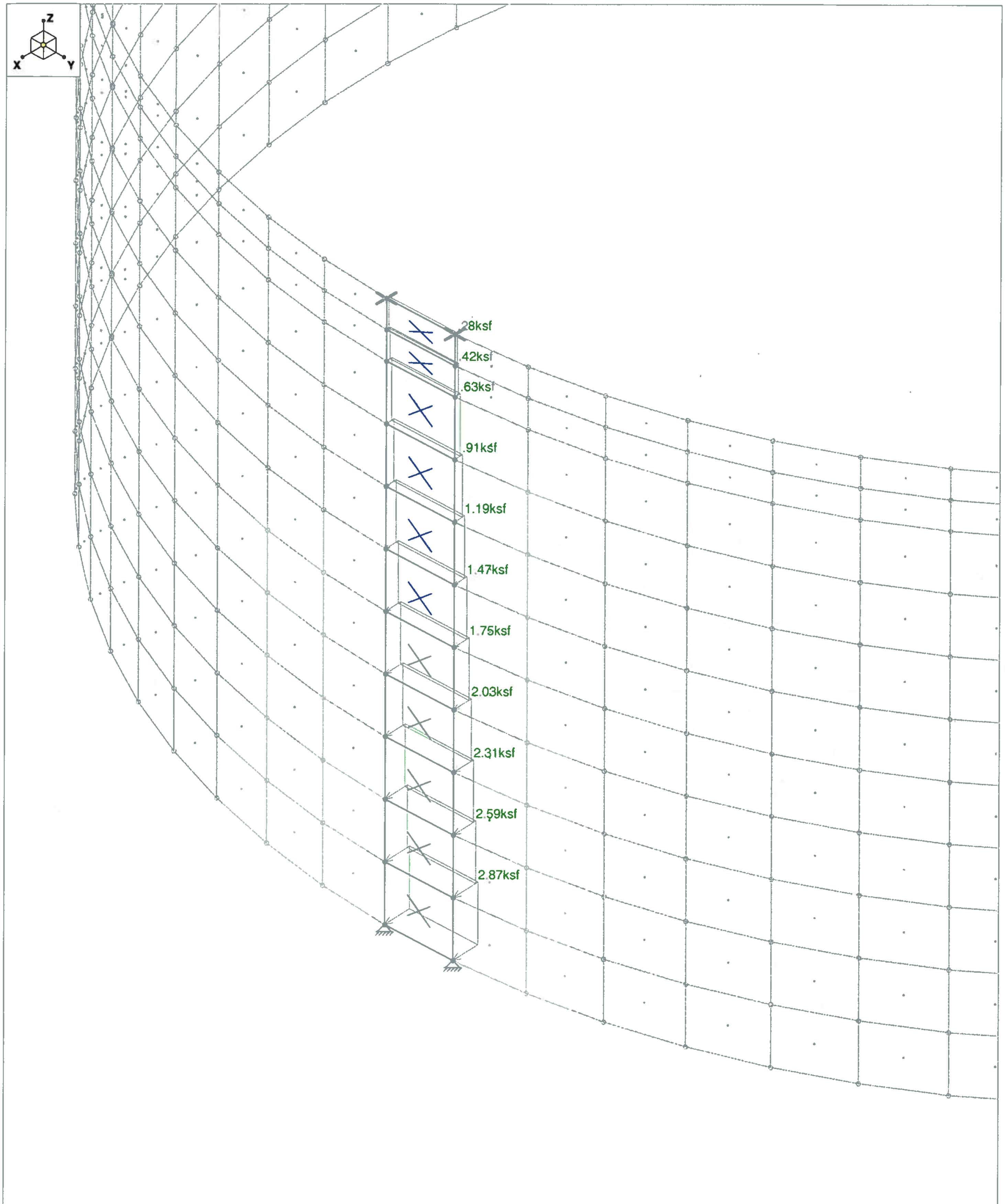
Results for LC 3, 1.0F
Z-direction Reaction units are k and k-ft

Brown and Caldwell	San Jose Digester 12 Non-Submerged Overflow Analysis	SK - 2
Eric Wilkins		Oct 6, 2010 at 1:35 PM
136242		San Jose Digester 12 Non-Submer...



Results for LC 3, 1.0F

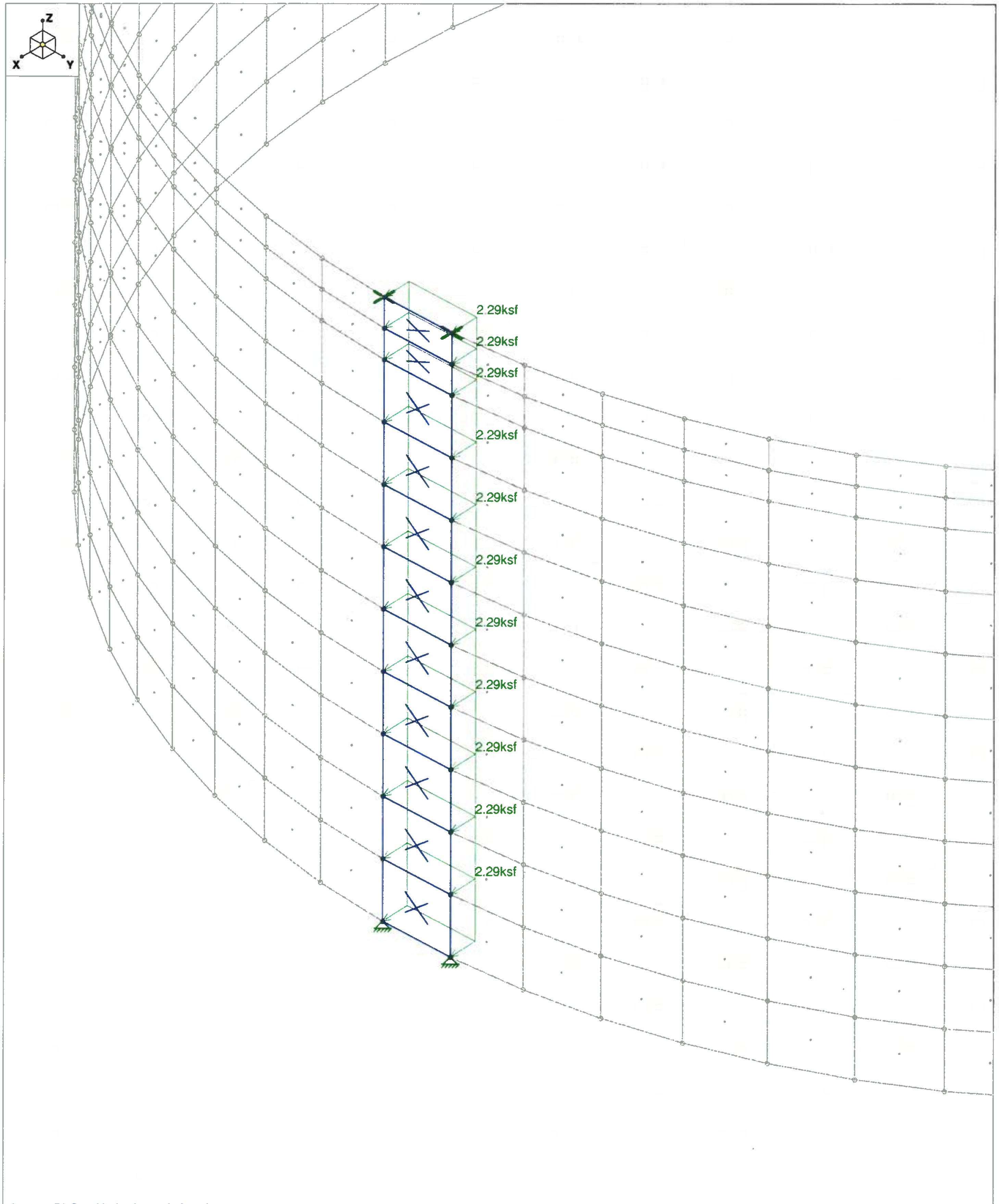
Brown and Caldwell	San Jose Digester 12 Non-Submerged Overflow Analysis	SK - 3
Eric Wilkins		Oct 6, 2010 at 1:35 PM
136242		San Jose Digester 12 Non-Submer...



Loads: BLC 4, Hydrostatic Load

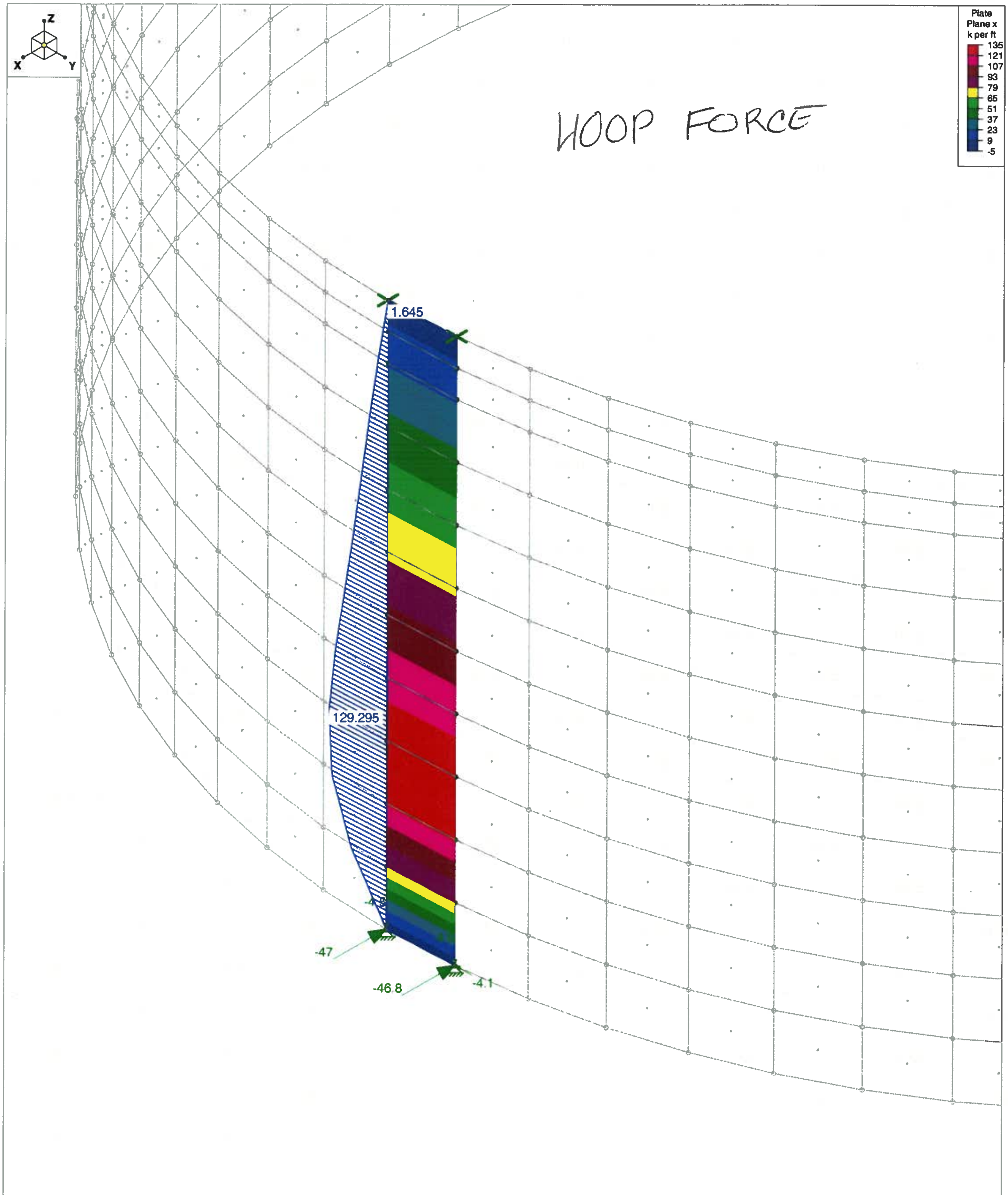
Brown and Caldwell	San Jose Digester 12 Submerged Analysis	SK - 1
Eric Wilkins		Oct 6, 2010 at 1:44 PM
136242		San Jose Digester 12 Submerged ...

45



Loads: BLC 5, Hydrodynamic Load

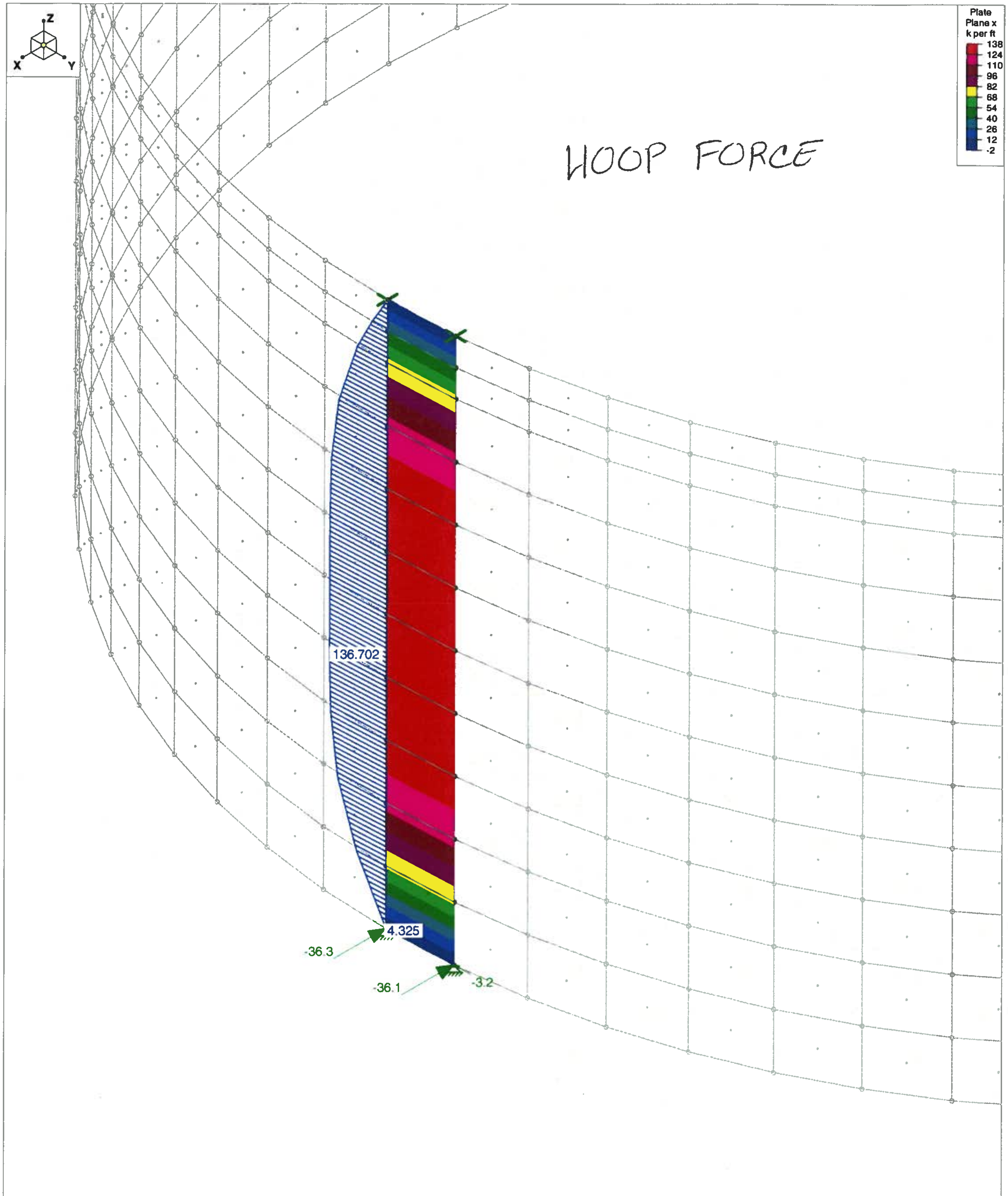
Brown and Caldwell	San Jose Digester 12 Submerged Analysis	SK - 2
Eric Wilkins		Oct 6, 2010 at 1:44 PM
136242		San Jose Digester 12 Submerged ...



HOOP FORCE

Results for LC 3, 1.0F
Z-direction Reaction units are k and k-ft

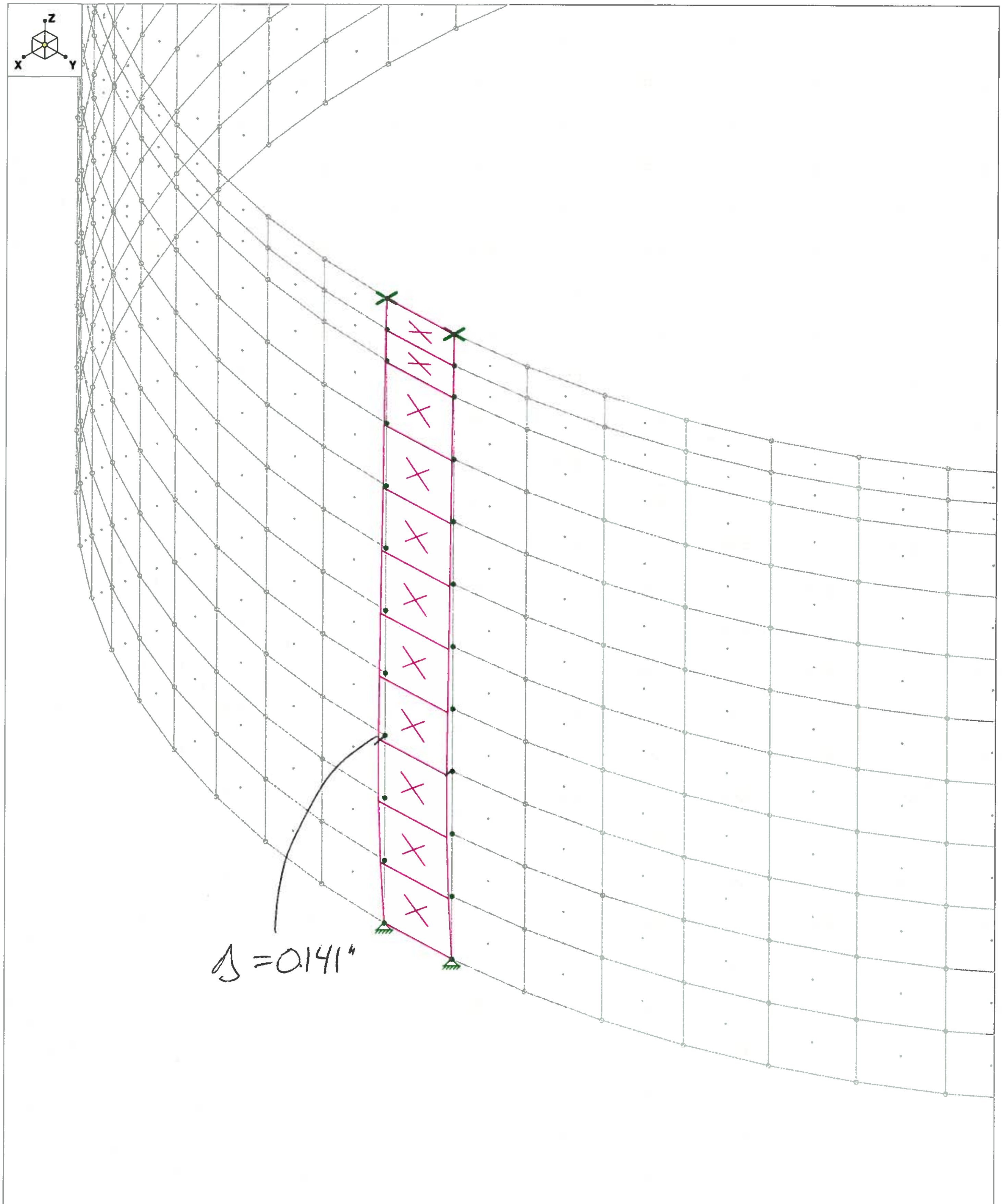
Brown and Caldwell	San Jose Digester 12 Submerged Analysis	SK - 3
Eric Wilkins		Oct 6, 2010 at 1:44 PM
136242		San Jose Digester 12 Submerged ...



HOOP FORCE

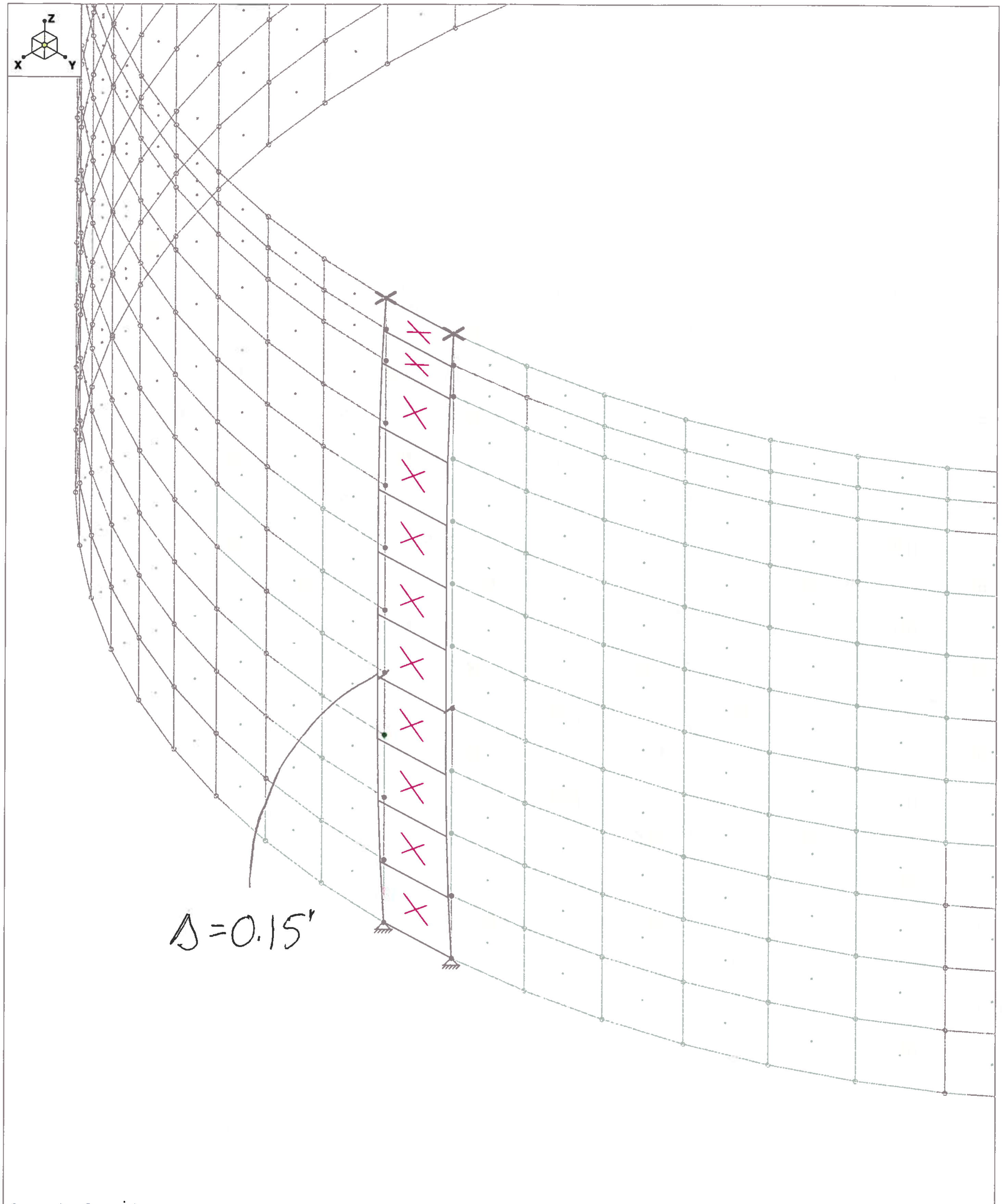
Results for LC 4, 1.0E
Z-direction Reaction units are k and k-ft

Brown and Caldwell	San Jose Digester 12 Submerged Analysis	SK - 4
Eric Wilkins		Oct 6, 2010 at 1:45 PM
136242		San Jose Digester 12 Submerged ...



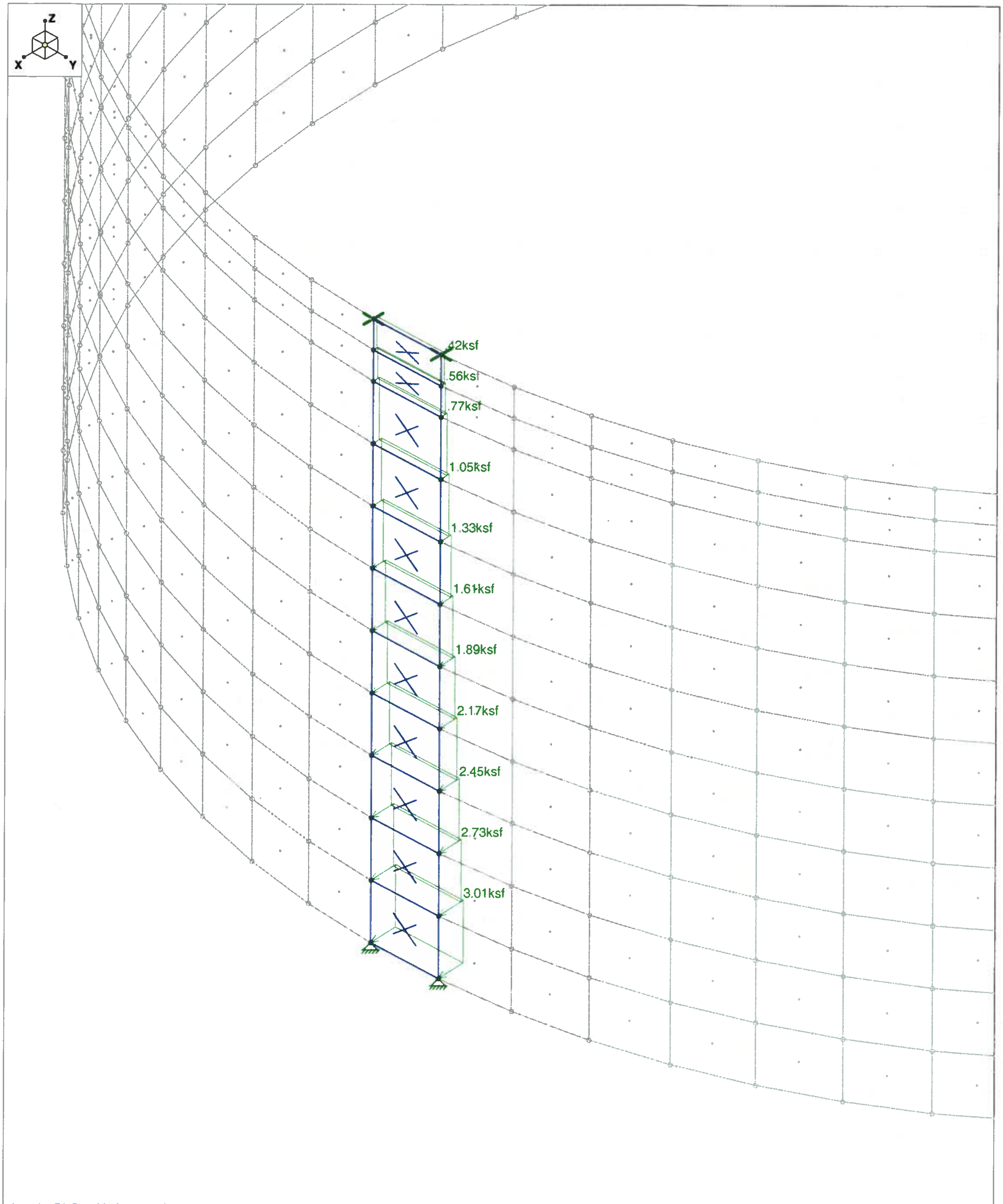
Results for LC 3, 1.0F

Brown and Caldwell	San Jose Digester 12 Submerged Analysis	SK - 5
Eric Wilkins		Oct 6, 2010 at 1:46 PM
136242		San Jose Digester 12 Submerged ...



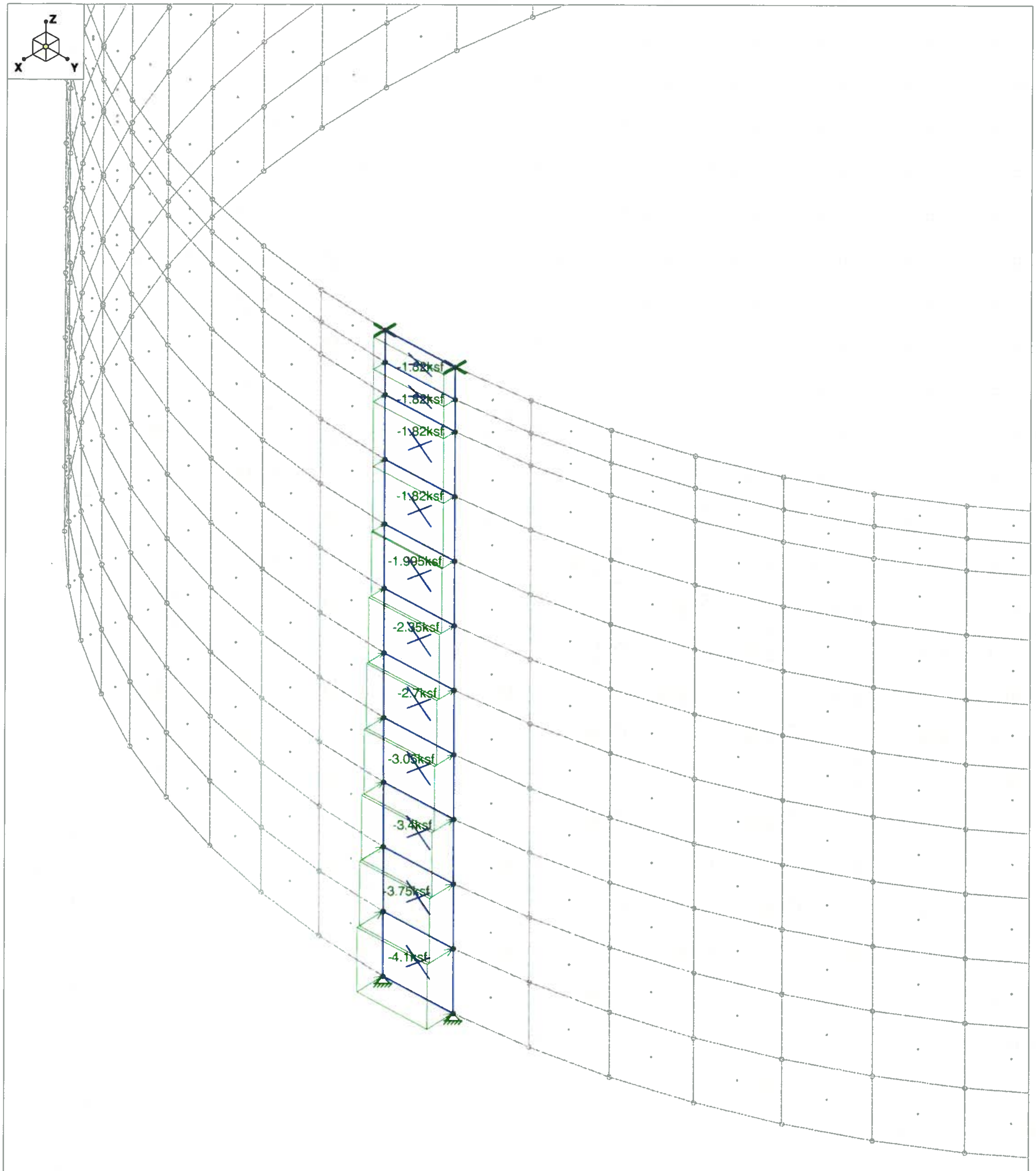
Results for LC 4, 1.0E

Brown and Caldwell	San Jose Digester 12 Submerged Analysis	SK - 6
Eric Wilkins		Oct 6, 2010 at 1:46 PM
136242		San Jose Digester 12 Submerged ...



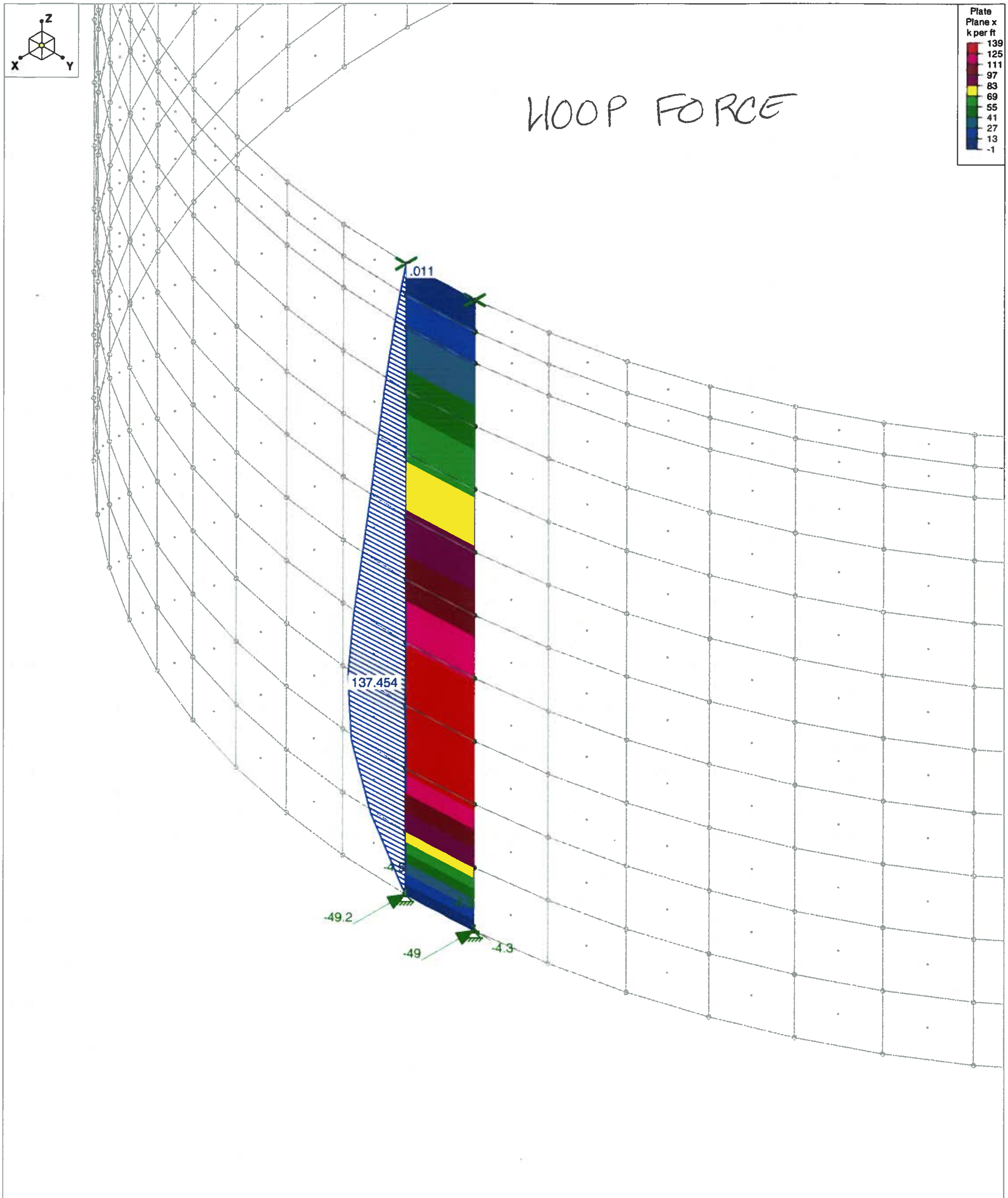
Loads: BLC 4, Hydrostatic Load

Brown and Caldwell	San Jose Digester 12 Submerged Overflow Analysis	SK - 1
Eric Wilkins		Oct 6, 2010 at 1:53 PM
136242		San Jose Digester 12 Submerged ...



Loads: BLC 5, Prestressing Force

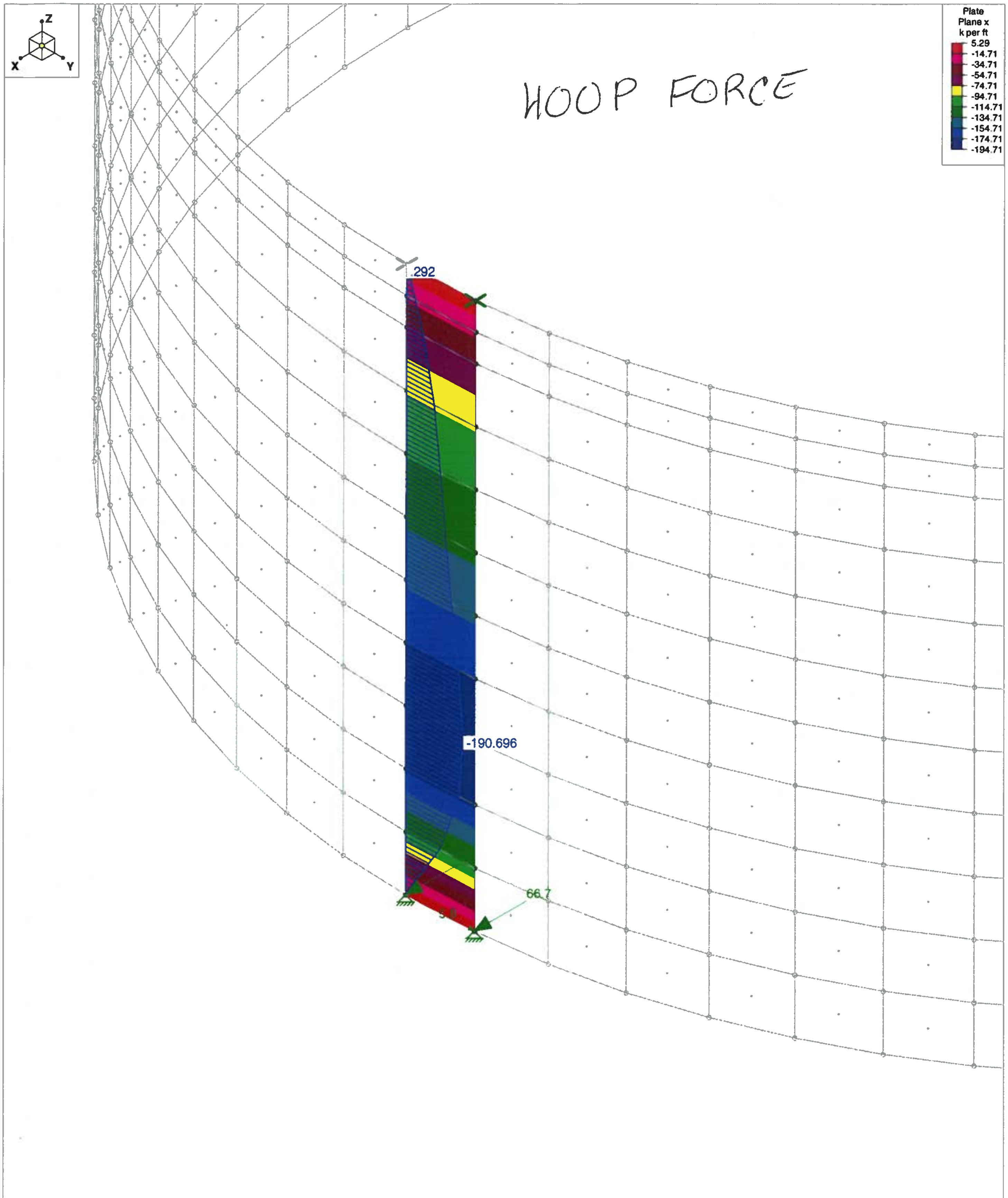
Brown and Caldwell	San Jose Digester 12 Submerged Overflow Analysis	SK - 2
Eric Wilkins		Oct 6, 2010 at 1:53 PM
136242		San Jose Digester 12 Submerged ...



HOOP FORCE

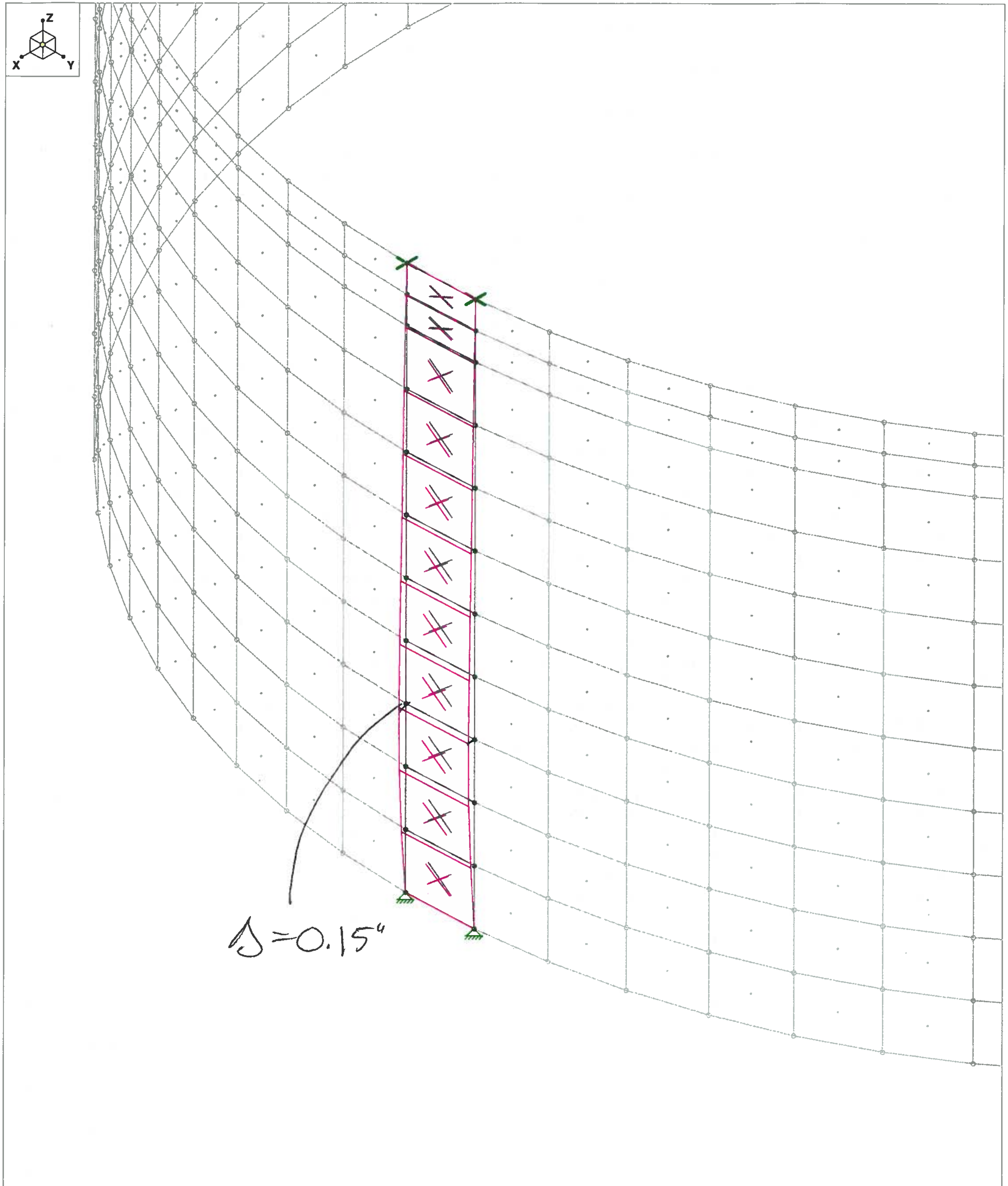
Results for LC 3, 1.0F
Z-direction Reaction units are k and k-ft

Brown and Caldwell	San Jose Digester 12 Submerged Overflow Analysis	SK - 3
Eric Wilkins		Oct 6, 2010 at 2:00 PM
136242		San Jose Digester 12 Submerged ...



Results for LC 4, 1.0P (Prestressing Force)
Z-direction Reaction units are k and k-ft

Brown and Caldwell	San Jose Digester 12 Submerged Overflow Analysis	SK - 4
Eric Wilkins		Oct 6, 2010 at 2:00 PM
136242		San Jose Digester 12 Submerged ...



Results for LC 3, 1.0F

Brown and Caldwell	San Jose Digester 12 Submerged Overflow Analysis	SK - 5
Eric Wilkins		Oct 6, 2010 at 2:00 PM
136242		San Jose Digester 12 Submerged ...

LOAD INPUTS

Digester 1

Dead Load	8.51 kip
Roof Live Load	0.97 kip
Gas Pressure (12")	3.03 kip
Gas Pressure (14")	3.53 kip
Gas Pressure (16")	4.04 kip
Gas Vacuum	1.28 kip

Digester 4 & 12

Dead Load	9.36 kip
Roof Live Load	1.07 kip
Gas Pressure (12")	3.07 kip
Gas Pressure (14")	3.93 kip
Gas Pressure (16")	4.49 kip
Gas Vacuum	5.05 kip

*Digester Loads were taken from Bayaz Patel Load input values.
A ratio of Gas Head/18" was used to determine the Gas Pressure

PLATE PRESSURE INPUTS

Digester 4 and 12

Submerged (3' above)

Sludge Pressure	70 pcf
Water Height	43 ft
Base Pressure	3.01 ksf

Joint Elev	Node Pressure	Plate Pressures
40	0.21 ksf	
38	0.35 ksf	0.28 ksf
36	0.49 ksf	0.42 ksf
32	0.77 ksf	0.63 ksf
28	1.05 ksf	0.91 ksf
24	1.33 ksf	1.19 ksf
20	1.61 ksf	1.47 ksf
16	1.89 ksf	1.75 ksf
12	2.17 ksf	2.03 ksf
8	2.45 ksf	2.31 ksf
4	2.73 ksf	2.59 ksf
0	3.01 ksf	2.87 ksf

Submerged Overflow (5' above)

Sludge Pressure	70 pcf
Water Height	45 ft
Base Pressure	3.15 ksf

Joint Elev	Node Pressure	Plate Pressures
40	0.35 ksf	
38	0.49 ksf	0.42 ksf
36	0.63 ksf	0.56 ksf
32	0.91 ksf	0.77 ksf
28	1.19 ksf	1.05 ksf
24	1.47 ksf	1.33 ksf
20	1.75 ksf	1.61 ksf
16	2.03 ksf	1.89 ksf
12	2.31 ksf	2.17 ksf
8	2.59 ksf	2.45 ksf
4	2.87 ksf	2.73 ksf
0	3.15 ksf	3.01 ksf

Non-Submerged (4' below)

Sludge Pressure	70 pcf
Water Height	36 ft
Base Pressure	2.52 ksf

Joint Elev	Node Pressure	Plate Pressures
40	0 ksf	
38	0 ksf	0 ksf
36	0.000 ksf	0.000 ksf
32	0.280 ksf	0.140 ksf
28	0.560 ksf	0.420 ksf
24	0.840 ksf	0.700 ksf
20	1.120 ksf	0.980 ksf
16	1.400 ksf	1.260 ksf
12	1.680 ksf	1.540 ksf
8	1.960 ksf	1.820 ksf
4	2.240 ksf	2.100 ksf
0	2.520 ksf	2.380 ksf

Non-Submerged Overflow (2', below)

Sludge Pressure	70 pcf
Water Height	38 ft
Base Pressure	2.66 ksf

Joint Elev	Node Pressure	Plate Pressures
40	0 ksf	
38	0 ksf	0 ksf
36	0.140 ksf	0.070 ksf
32	0.420 ksf	0.280 ksf
28	0.700 ksf	0.560 ksf
24	0.980 ksf	0.840 ksf
20	1.260 ksf	1.120 ksf
16	1.540 ksf	1.400 ksf
12	1.820 ksf	1.680 ksf
8	2.100 ksf	1.960 ksf
4	2.380 ksf	2.240 ksf
0	2.660 ksf	2.520 ksf

Digester 12 Hydrodynamic

Non-Submerged

Water Height	36 ft
Base Pressure	1.26 ksf

Joint Elev	Node Pressure	Plate Pressures
40	0 ksf	
38	0 ksf	
36	0.410 ksf	ksf
32	0.550 ksf	0.480 ksf
28	0.690 ksf	0.620 ksf
24	0.830 ksf	0.760 ksf
20	0.970 ksf	0.900 ksf
16	1.110 ksf	1.040 ksf
12	1.250 ksf	1.180 ksf
8	1.390 ksf	1.320 ksf
4	1.530 ksf	1.460 ksf
0	1.670 ksf	1.600 ksf

Digester 12

Submerged (Impulsive only)

Pressure = rectangular load of 2.29 ksf

Digester 4

Non-Submerged

Water Height	36 ft
Base Pressure	1.26 ksf

Joint Elev	Node Pressure	Plate Pressures
40	0 ksf	
38	0.000 ksf	
36	0.410 ksf	0.000 ksf
32	0.550 ksf	0.480 ksf
28	0.690 ksf	0.620 ksf
24	0.830 ksf	0.760 ksf
20	0.970 ksf	0.900 ksf
16	1.110 ksf	1.040 ksf
12	1.250 ksf	1.180 ksf
8	1.390 ksf	1.320 ksf
4	1.530 ksf	1.460 ksf
0	1.670 ksf	1.600 ksf

Digester 4

Submerged (Impulsive only)

Pressure = rectangular load of 2.29 ksf

Pressure is a polygon consisting of a rectangular load and inverse trianglular load.
Base pressure is the difference between top (rectangular) and bottom pressures.
Rectangular load is then added to the pressure at each point.

Pressure is a polygon consisting of a rectangular load and inverse trianglular load.
Base pressure is the difference between top (rectangular) and bottom pressures.
Rectangular load is then added to the pressure at each point.

> +

INPUT: ***NOTE - ALL REFERENCES ARE TO ACI 350.3-06 UNLESS NOTED OTHERWISE***

$TYPE := 2$ TANK TYPE (USE 2 FOR NONFLEXIBLE CONNECTION AND 3 FOR FLEXIBLE) PER ACI 350.3 FIGURE R2.1.1

$H_L := 36ft$ DESIGNED DEPTH OF STORED LIQUID

$H_W := 40ft$ WALL HEIGHT

$D := 110ft$ INSIDE DIAMETER OF CIRCULAR TANK

$t_w := 12in$ AVERAGE WALL THICKNESS

$t_r := 24in$ AVERAGE ROOF THICKNESS

$\gamma_L := 70 \frac{lbf}{ft^3}$ SPECIFIC WEIGHT OF CONTAINED LIQUID

$\gamma_C := 150 \frac{lbf}{ft^3}$ SPECIFIC WEIGHT OF CONCRETE

$f'_c := 3500psi$ CONCRETE COMPRESSIVE STRENGTH

$I := 1.25$ IMPORTANCE FACTOR *TABLE 4.1.1(a)*

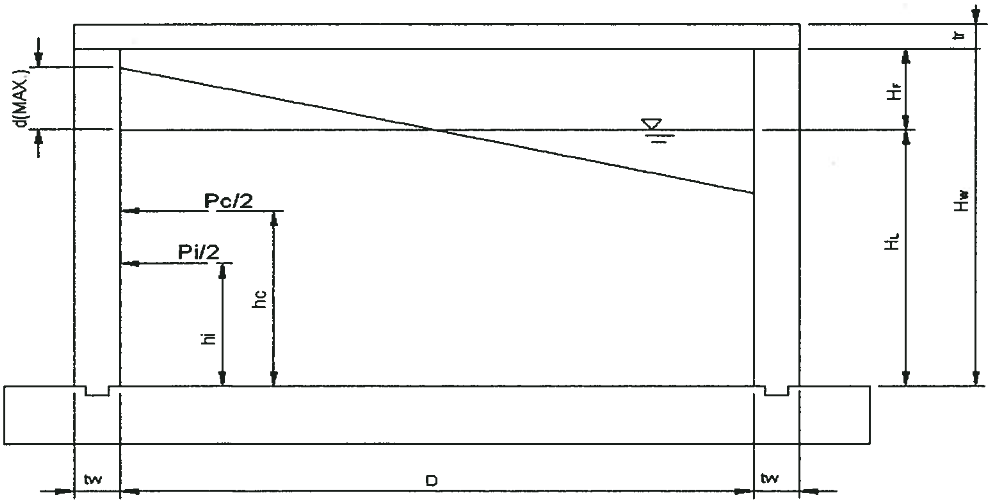
$S_{DS} := 1$ BASED ON THE GEOTECHNICAL REPORT

$S_{D1} := 0.6$ BASED ON THE GEOTECHNICAL REPORT

$R_i := 2$ ***NOTE: THIS VALUE GIVES ULTIMATE LOAD*** *Table 4.1.1(b)*

$R_c := 1$ ***NOTE: THIS VALUE GIVES ULTIMATE LOAD*** *Table 4.1.1(b)*

$b := \frac{2}{3}$ RATIO OF VERTICAL TO HORIZONTAL DESIGN ACCELERATION *Section 4.1.4*



THE FOLLOWING INPUT IS NOT REQUIRED UNLESS YOU ARE DOING A FLEXIBLE BASE CONNECTION PER ACI 350.3. TYPICALLY WILL ONLY BE USED BY DENVER OFFICE

$A_s := .5in^2$ CROSS SECTIONAL AREA OF REINFORCEMENT

$E_s := 29000000psi$ MODULUS OF ELASTICITY OF REINFORCEMENT

$L_c := 18in$ EFFECTIVE LENGTH OF BASE CABLE OR STRAND

$S_c := 24in$ CENTER TO CENTER SPACING BETWEEN INDIVIDUAL CABLE LOOPS

$\alpha := 45$ ANGLE OF BASE CABLE OR STRAND WITH HORIZONTAL, DEGREE

$G_p := 500psi$ SHEAR MODULUS OF BEARING PAD (ONLY APPPLIES FOR TYPE 3 BASES

$w_p := 18in$ WIDTH OF ELASTOMERIC BEARING PAD

$L_p := 36in$ LENGTH OF INDIVIDUAL BEARING PADS

$t_p := .25in$ THICKNESS OF ELASTOMERIC BEARING PAD

$S_p := 36in$ CENTER TO CENTER SPACING BETWEEN INDIVIDUAL BEARING PADS

CALCULATIONS

1. CALCULATE THE TOTAL WALL AND ROOF WEIGHT: *APPENDIX A - STEP 5*

$W_W := \pi \cdot (D + t_w) \cdot H_W \cdot t_w \cdot \gamma_C$ $W_W = 2.09 \times 10^3 \cdot kip$

$W_r := \frac{\pi}{4} \cdot (D + 2 \cdot t_w)^2 \cdot t_r \cdot \gamma_C$ $W_r = 2.96 \times 10^3 \cdot kip$

$W_L := \frac{\pi}{4} \cdot D^2 \cdot H_L \cdot \gamma_L$ $W_L = 2.39 \times 10^4 \cdot kip$ TOTAL MASS OF STORED LIQUID,

Determine effective mass coefficient *SECTION 9.6.2*

$$\varepsilon := \min\left[1, 0.0151 \cdot \left(\frac{D}{H_L}\right)^2 - 0.1908 \cdot \left(\frac{D}{H_L}\right) + 1.021\right] \quad \varepsilon = 0.58$$ *EQ (9-45)*

2. CALCULATE THE EQUIVALENT MASS OF THE IMPULSIVE (W_i) AND CONVECTIVE (W_c) COMPONENT OF THE STORED LIQUID : *APPENDIX A - STEP 6*

REFERENCE SECTION 9.3.1

$$W_i := \frac{\tanh\left[0.866\cdot\left(\frac{D}{H_L}\right)\right]}{0.866\cdot\left(\frac{D}{H_L}\right)}\cdot W_L \qquad W_i = 8.96\times 10^{3}\cdot kip$$ *EQ (9-15)*

$$W_c := 0.230\cdot\left(\frac{D}{H_L}\right)\cdot\tanh\left[3.68\cdot\left(\frac{H_L}{D}\right)\right]\cdot W_L \qquad W_c = 1.41\times 10^{4}\cdot kip$$ *EQ (9-16)*

3. COMPUTE HEIGHTS TO CENTER OF GRAVITY: *APPENDIX A - STEP 7*

EXCLUDING BASE PRESSURE (EBP) REFERENCE SECTION 9.3.2

$$h_w := \frac{H_W}{2} \qquad h_w = 20\cdot ft$$

$$h_r := H_W + \frac{t_r}{2} \qquad h_r = 41\cdot ft$$

$$h_i := \begin{vmatrix} \left[0.5 - \left[0.09375\cdot\left(\frac{D}{H_L}\right)\right]\right]\cdot H_L \ \text{ if } \ \frac{D}{H_L} < 1.333 \\ 0.375\cdot H_L \ \text{ otherwise} \end{vmatrix} \qquad h_i = 13.5\cdot ft$$ *EQ (9-17)* *EQ (9-18)*

$$h_c := \left[1 - \left(\frac{\cosh\left(3.68\cdot\frac{H_L}{D}\right) - 1}{3.68\cdot\frac{H_L}{D}\cdot\sinh\left(3.68\cdot\frac{H_L}{D}\right)}\right)\right]\cdot H_L \qquad h_c = 19.9\cdot ft$$ *EQ (9-19)*

INCLUDING BASE PRESSURE (IBP) REFERENCE SECTION 9.3.3

$$h'_i := \begin{vmatrix} 0.45\cdot H_L \ \text{ if } \ \frac{D}{H_L} < 0.75 \\ \left[\left(\frac{0.866\cdot\frac{D}{H_L}}{2\cdot\tanh\left(0.866\cdot\frac{D}{H_L}\right)}\right) - \frac{1}{8}\right]\cdot H_L \ \text{ otherwise} \end{vmatrix} \qquad h'_i = 43.61\cdot ft$$ *EQ (9-20)* *EQ (9-21)*

$$h'_c := \left[1 - \left(\frac{\cosh\left(3.68\cdot\frac{H_L}{D}\right) - 2.01}{3.68\cdot\frac{H_L}{D}\cdot\sinh\left(3.68\cdot\frac{H_L}{D}\right)}\right)\right]\cdot H_L$$

$h'_c = 39.8\cdot ft$

EQ (9-22)

4. CALCULATE COMBINED NATURAL FREQUENCY OF VIBRATION (ϕ_i) : *APPENDIX A - STEP 8*

REFERENCE SECTION 9.3.4

$$C_W := 0.09375 + 0.2039\cdot\left(\frac{H_L}{D}\right) - 0.1034\cdot\left(\frac{H_L}{D}\right)^2 - 0.1253\cdot\left(\frac{H_L}{D}\right)^3 + 0.1267\cdot\left(\frac{H_L}{D}\right)^4 - 0.03186\cdot\left(\frac{H_L}{D}\right)^5$$

$C_W = 0.15$ *Figure 9.3.4(a)*

$C_l := C_W\cdot 10\cdot\sqrt{\frac{t_w}{\frac{D}{2}}}$ $C_l = 0.2$ *EQ (9-24)*

$E_c := 57000\frac{lbf^{0.5}}{in}\cdot\sqrt{f'_c}$ $E_c = 3.37\times 10^6\cdot psi$ *ACI 318 Section 8.5.1*

$\omega_i := C_l\cdot\frac{1}{H_L}\cdot\sqrt{\frac{E_c}{\frac{\gamma_C}{g}}}$ $\omega_i = 55.94\cdot\frac{1}{sec}$ *EQ (9-23)*

5. CALCULATE COMBINED NATURAL FREQUENCY OF VIBRATION (ϕ_c) : *APPENDIX A - STEP 9*

REFERENCE SECTION 9.3.4

$\lambda := \sqrt{3.68\cdot g\cdot\tanh\left[3.68\cdot\left(\frac{H_L}{D}\right)\right]}$ $\lambda = 9.94\cdot\frac{ft^{0.5}}{sec}$ *EQ (9-29)*

$\omega_c := \frac{\lambda}{\sqrt{D}}$ $\omega_c = 0.95\cdot\frac{1}{sec}$ *EQ (9-28)*

6. CALCULATE COMBINED NATURAL PERIODS OF VIBRATION (T AND T_c):

REFERENCE SECTION 9.3.4 *APPENDIX A - STEP 10*

$k_a := \left(\frac{A_s\cdot E_s\cdot\cos(\alpha)^2}{L_c\cdot S_c}\right) + \left(\frac{2\cdot G_p\cdot w_p\cdot L_p}{t_p\cdot S_p}\right)$ $k_a = 1.17\times 10^4\cdot\frac{kip}{ft^2}$ *EQ (9-27)*

$$T_i := \begin{cases} \text{if } TYPE = 3 & \begin{cases} 1.25\text{sec} \text{ if } \sqrt{\dfrac{8\cdot\pi\cdot(W_W + W_r + W_i)}{g\cdot D\cdot k_a}} > 1.25\text{sec} \\ \sqrt{\dfrac{8\cdot\pi\cdot(W_W + W_r + W_i)}{g\cdot D\cdot k_a}} \text{ otherwise} \end{cases} \\ \dfrac{2\cdot\pi}{\omega_i} \text{ otherwise} \end{cases}$$

EQ (9-26)

$T_i = 0.11\cdot\text{sec}$ EQ (9-25)

$$T_c := \frac{2\pi}{\omega_c}$$

$T_c = 6.63\cdot\text{sec}$ EQ (9-30)

7. CALCULATE THE SEISMIC RESPONSE COEFFICIENTS (C_i AND C_c): *APPENDIX A - STEP 11*

REFERENCE SECTION 9.4.1

$$T_S := \frac{S_{D1}}{S_{DS}}\cdot\text{sec}$$

$T_S = 0.6\cdot\text{sec}$ EQ (9-34)

$$C_i := \begin{cases} S_{DS} \text{ if } T_i \le T_S \\ \min\left(\dfrac{S_{D1}\cdot\text{sec}}{T_i}, S_{DS}\right) \text{ otherwise} \end{cases}$$

EQ (9-32)

$C_i = 1$ EQ (9-33)

$$C_c := \begin{cases} \min\left(\dfrac{1.5S_{D1}\cdot\text{sec}}{T_c}, 1.5\cdot S_{DS}\right) \text{ if } T_c \le \dfrac{1.6\text{sec}^2}{T_S} \\ \dfrac{2.4S_{DS}\cdot 1\text{sec}^2}{{T_c}^2} \text{ otherwise} \end{cases}$$

EQ (9-37)

$C_c = 0.05$ EQ (9-38)

8. CALCULATE THE WAVE DEPTH : *APPENDIX A - STEP 12*

REFERENCE SECTION 7.1

$$d_{max} := \left(\frac{D}{2}\right)\cdot C_c\cdot I$$

$d_{max} = 3.76\cdot\text{ft}$ EQ (7-2)

CALCULATE THE FREEBOARD:

$H_F := H_W - H_L$ $H_F = 4\cdot\text{ft}$

$H_{Fcheck} :=$ if($d_{max} > H_F$, " CONFIRM LIQUID SPILLS ARE OK" , "FREEBOARD IS OK")

H_{Fcheck} = "FREEBOARD IS OK"

NOTE: REFER TO ASCE 7-05 SECTION 15.7.6.1.2 AND TABLE 15.7-3 FOR MINIMUM FREEBOARD REQUIREMENTS

9. COMPUTE DYNAMIC LATERAL FORCES

APPENDIX A - STEP 13

REFERENCE SECTION 4.1.1

$P_W := C_i \cdot I \cdot \left(\frac{\varepsilon \cdot W_W}{R_i}\right)$ $P_W = 757.13 \cdot \text{kip}$ *EQ (4-1)*

$P_r := C_i \cdot I \cdot \left(\frac{W_r}{R_i}\right)$ $P_r = 1.85 \times 10^3 \cdot \text{kip}$ *EQ (4-2)*

$P_i := C_i \cdot I \cdot \left(\frac{W_i}{R_i}\right)$ $P_i = 5.6 \times 10^3 \cdot \text{kip}$ *EQ (4-3)*

$P_c := C_c \cdot I \cdot \left(\frac{W_c}{R_c}\right)$ $P_c = 959.77 \cdot \text{kip}$ *EQ (4-4)*

DETERMINE BASE SHEAR (V_b) **NOTE: DYNAMIC EARTH PRESSURES NOT INCLUDED. PRESSURE CAN BE COMBINED BY SRSS PER EQUATION (4-5)**

$V_b := \sqrt{(P_i + P_W + P_r)^2 + P_c^2}$ $V_b = 8.26 \times 10^3 \cdot \text{kip}$ *EQ (4-5)*

10. COMPUTE BENDING AND OVERTURNING MOMENTS

APPENDIX A - STEP 14

REFERENCE SECTION 4.1.3

$M_W := P_W \cdot h_w$ $M_W = 1.51 \times 10^4 \cdot \text{ft} \cdot \text{kip}$ *EQ (4-6)*

$M_r := P_r \cdot h_r$ $(M_r) = 7.57 \times 10^4 \cdot \text{ft} \cdot \text{kip}$ *EQ (4-7)*

$M_i := P_i \cdot h_i$ $M_i = 7.56 \times 10^4 \cdot \text{ft} \cdot \text{kip}$ *EQ (4-8)*

$M_c := P_c \cdot h_c$ $M_c = 1.91 \times 10^4 \cdot \text{ft} \cdot \text{kip}$ *EQ (4-9)*

DETERMINE MOMENT EXCLUDING BASE PRESSURE (EBP)

$M_b := \sqrt{(M_i + M_W + M_r)^2 + M_c^2}$ $M_b = 1.68 \times 10^5 \cdot \text{ft} \cdot \text{kip}$ *EQ (4-10)*

DETERMINE OVERTURNING MOMENT AT BASE INCLUDING BASE PRESSURE (IBP)

$M'_i := P_i \cdot h'_i$ $M'_i = 2.44 \times 10^5 \cdot \text{ft} \cdot \text{kip}$ *EQ (4-11)*

$M'_c := P_c \cdot h'_c$ $M'_c = 3.82 \times 10^4 \cdot \text{ft} \cdot \text{kip}$ *EQ (4-12)*

$M_o := \sqrt{(M'_i + M_W + M_r)^2 + M'^2_c}$ $M_o = 3.37 \times 10^5 \cdot \text{ft} \cdot \text{kip}$ *EQ (4-13)*

11. COMPUTE VERTICAL AMPLIFICATION FACTOR:

APPENDIX A - STEP 15

REFERENCE SECTION 9.4.3

$T_V := 2\cdot\pi\cdot\sqrt{\dfrac{\gamma_L\cdot D\cdot H_L{}^2}{2\cdot g\cdot t_w\cdot E_c}}$ $\quad T_V = 0.11\,s$ $\quad$ *EQ (9-31)*

$C_t := \begin{cases} S_{DS} & \text{if } T_V \le T_S \\ \dfrac{S_{D1}\cdot sec}{T_V} & \text{otherwise} \end{cases}$ $\quad C_t = 1$

EQ (9-39)

EQ (9-40)

12. COMPUTE HYDRODYNAMIC PRESSURE:

APPENDIX A - STEP 16

REFERENCE SECTION 4.1.4

$u_v := \max\left(C_t\cdot I\cdot\dfrac{b}{R_i}, 0.2\cdot S_{DS}\right)$ $\quad u_v = 0.42 \quad i := 0..\,10$ $\quad$ *EQ (4-15)*

$y_i := (1 - .1\cdot i)\cdot H_L \qquad q_{hy_i} := \gamma_L\cdot(H_L - y_i) \qquad p_{hy_i} := u_v\cdot q_{hy_i}$ $\quad$ *EQ (4-14)*

Height	q_{hy} (ksf)	p_{hy} (ksf)	
36.00	0.00	0.00	Top
32.40	0.25	0.11	
28.80	0.50	0.21	
25.20	0.76	0.32	
21.60	1.01	0.42	
18.00	1.26	0.53	
14.40	1.51	0.63	
10.80	1.76	0.74	
7.20	2.02	0.84	
3.60	2.27	0.95	
0.00	2.52	1.05	Bottom

$$\left(\frac{y}{ft}\ \ \frac{q_{hy}}{ksf}\ \ \frac{p_{hy}}{ksf}\right)$$

13. COMPUTE VERTICAL DISTRIBUTION OF PRESSURES:

APPENDIX A - STEP 17

REFERENCE SECTION 5.3.3. AND R5.3.3

$P_{wy} := \dfrac{P_W}{2H_W}$ $\quad P_{wy} = 9.46\cdot\dfrac{kip}{ft}$

$p_{wy} := \dfrac{P_{wy}}{\pi\cdot\dfrac{D}{2}}$ $\quad p_{wy} = 0.055\cdot ksf$

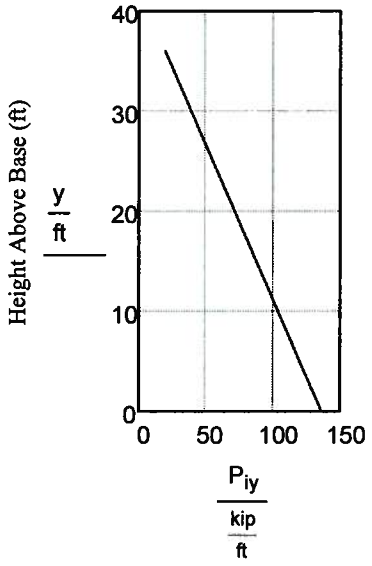
COMPUTE THE IMPULSIVE WATER PRESSURE (p_{iy}):

$$P_{iy_i} := \frac{\frac{P_i}{2}\cdot\left[4\cdot H_L - 6\cdot h_i - \left(6H_L - 12\cdot h_i\right)\cdot\frac{y_i}{H_L}\right]}{{H_L}^2}$$

$$p_{iy_i} := \frac{\left(2\cdot P_{iy_i}\right)\cdot\cos(0)}{\pi\cdot\frac{D}{2}}$$

Height	P_{iy} (kip/ft)	p_{iy} (ksf)	
36.00	19.44	0.23	Top
32.40	31.11	0.36	
28.80	42.78	0.50	
25.20	54.44	0.63	
21.60	66.11	0.77	
18.00	77.78	0.90	
14.40	89.44	1.04	
10.80	101.11	1.17	
7.20	112.78	1.31	
3.60	124.44	1.44	
0.00	136.11	1.58	Bottom

$$\begin{pmatrix} \frac{y}{ft} & \frac{P_{iy}}{\frac{kip}{ft}} & \frac{p_{iy}}{ksf} \end{pmatrix}$$



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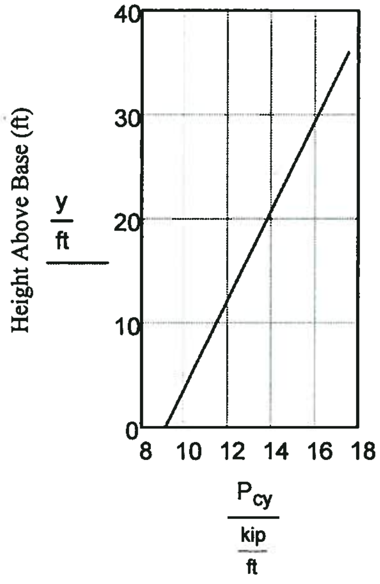
COMPUTE THE CONVECTIVE WATER PRESSURE (p_{cy}):

$$P_{cy_i} := \frac{\frac{P_c}{2}\cdot\left[4\cdot H_L - 6\cdot h_c - \left(6H_L - 12\cdot h_c\right)\cdot\frac{y_i}{H_L}\right]}{H_L^{\ 2}}$$

$$p_{cy_i} := \frac{\left(16\cdot P_{cy_i}\right)\cdot\cos(0)}{9\pi\cdot\frac{D}{2}}$$

Height	P_{cy} (kip/ft)	p_{cy} (ksf)	
36.00	17.55	0.18	Top
32.40	16.71	0.17	
28.80	15.86	0.16	
25.20	15.02	0.15	
21.60	14.17	0.15	
18.00	13.33	0.14	
14.40	12.49	0.13	
10.80	11.64	0.12	
7.20	10.80	0.11	
3.60	9.95	0.10	
0.00	9.11	0.09	Bottom

$$\left(\frac{y}{ft}\quad \frac{P_{cy}}{\frac{kip}{ft}}\quad \frac{p_{cy}}{ksf}\right)$$



14. CALCULATE THE HOOP FORCES:

APPENDIX A - STEP 18

REFERENCE SECTION 6.2

$$N_{y_i} := \sqrt{\left(p_{iy_i}\cdot\frac{D}{2} + p_{wy}\cdot\frac{D}{2}\right)^2 + \left(p_{cy_i}\cdot\frac{D}{2}\right)^2 + \left(p_{hy_i}\cdot\frac{D}{2}\right)^2}$$

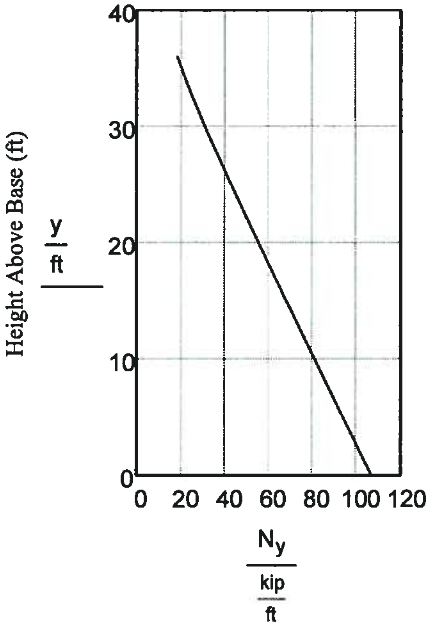
Ultimate Hoop Force *EQ (6-1)*

$$\sigma_{y_i} := \frac{N_{y_i}}{t_w}$$

Ultimate Hoop Stress *EQ (6-2)*

Height	N_y (kip/ft)	σ_y (psi)	
36.00	18.32	127.21	Top
32.40	25.37	176.15	
28.80	33.60	233.31	
25.20	42.33	293.94	
21.60	51.30	356.26	
18.00	60.41	419.53	
14.40	69.61	483.37	
10.80	78.85	547.59	
7.20	88.14	612.05	
3.60	97.45	676.71	
0.00	106.77	741.49	Bottom

$$\left(\frac{y}{ft} \quad \frac{N_y}{\frac{kip}{ft}} \quad \frac{\sigma_y}{psi}\right)$$



NOTE ABOVE FORCES ARE FOR A FREE BASE AND SHOULD BE ADJUSTED TO ACCOUNT FOR BASE RESTRAINT PER SECTION R6.2.

NOTE: DYNAMIC EARTH PRESSURES NOT INCLUDED. PRESSURE CAN BE COMBINED BY SRSS PER EQUATION (4-5)

ADDITIONAL DESIGN OUTPUT

$V_b = 8.26 \times 10^3 \cdot kip$ BASE SHEAR

$M_b = 1.68 \times 10^5 \cdot ft \cdot kip$ OTM EXCLUDING BASE PRESSURE

$M_o = 3.37 \times 10^5 \cdot ft \cdot kip$ OTM INCLUDING BASE PRESSURE

H_{Fcheck} = "FREEBOARD IS OK"

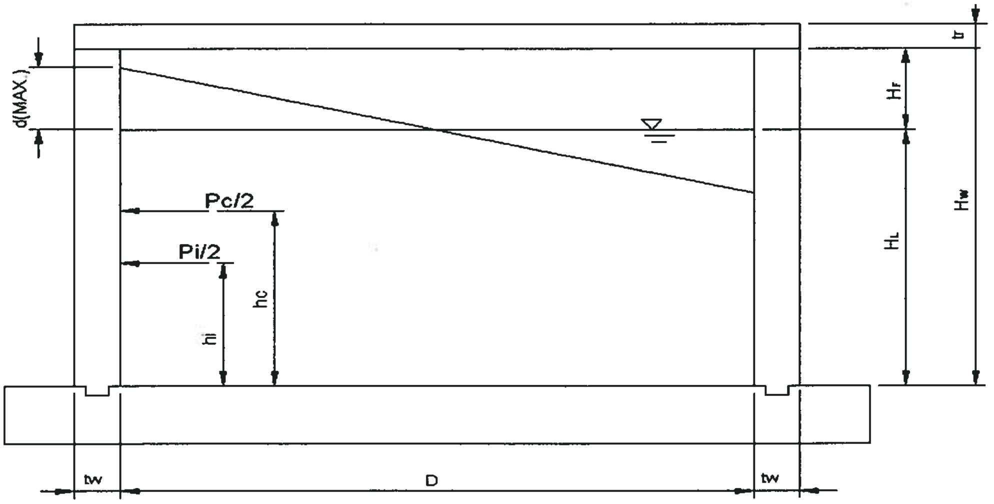
BROWN AND CALDWELL

San Jose Digester 4
Submerged Case
(No Convective Force)

Circular Tank - Hydrodynamic Slosh per ACI 350.3-06
REV 0, 09/10/2010

INPUT: ***NOTE - ALL REFERENCES ARE TO ACI 350.3-06 UNLESS NOTED OTHERWISE***

$TYPE := 3$	TANK TYPE (USE 2 FOR NONFLEXIBLE CONNECTION AND 3 FOR FLEXIBLE) PER ACI 350.3 FIGURE R2.1.1	
$H_L := 43ft$	DESIGNED DEPTH OF STORED LIQUID	
$H_W := 40ft$	WALL HEIGHT	
$D := 110ft$	INSIDE DIAMETER OF CIRCULAR TANK	
$t_w := 12in$	AVERAGE WALL THICKNESS	
$t_r := 24in$	AVERAGE ROOF THICKNESS	
$\gamma_L := 70\frac{lbf}{ft^3}$	SPECIFIC WEIGHT OF CONTAINED LIQUID	
$\gamma_C := 150\frac{lbf}{ft^3}$	SPECIFIC WEIGHT OF CONCRETE	
$f'_c := 3500psi$	CONCRETE COMPRESSIVE STRENGTH	
$I := 1.25$	IMPORTANCE FACTOR	*TABLE 4.1.1(a)*
$S_{DS} := 1$	BASED ON THE GEOTECHNICAL REPORT	
$S_{D1} := .60$	BASED ON THE GEOTECHNICAL REPORT	
$R_i := 2$	***NOTE: THIS VALUE GIVES ULTIMATE LOAD***	*Table 4.1.1(b)*
$R_c := 1$	***NOTE: THIS VALUE GIVES ULTIMATE LOAD***	*Table 4.1.1(b)*
$b := \frac{2}{3}$	RATIO OF VERTICAL TO HORIZONTAL DESIGN ACCELERATION	*Section 4.1.4*



Client: San Jose
Client Number: 136242
Task Number: 410

Date Started: Sep. 10, 2010
Last Modified:
Calc. By: E. Wilkins
Checked: E. Quiroz

P:\EWilkins\San Jose Digester Analysis\

THE FOLLOWING INPUT IS NOT REQUIRED UNLESS YOU ARE DOING A FLEXIBLE BASE CONNECTION PER ACI 350.3. TYPICALLY WILL ONLY BE USED BY DENVER OFFICE

$A_s := .5in^2$ CROSS SECTIONAL AREA OF REINFORCEMENT

$E_s := 29000000psi$ MODULUS OF ELASTICITY OF REINFORCEMENT

$L_c := 18in$ EFFECTIVE LENGTH OF BASE CABLE OR STRAND

$S_c := 24in$ CENTER TO CENTER SPACING BETWEEN INDIVIDUAL CABLE LOOPS

$\alpha := 45$ ANGLE OF BASE CABLE OR STRAND WITH HORIZONTAL, DEGREE

$G_p := 500psi$ SHEAR MODULUS OF BEARING PAD (ONLY APPPLIES FOR TYPE 3 BASES

$w_p := 18in$ WIDTH OF ELASTOMERIC BEARING PAD

$L_p := 36in$ LENGTH OF INDIVIDUAL BEARING PADS

$t_p := .25in$ THICKNESS OF ELASTOMERIC BEARING PAD

$S_p := 36in$ CENTER TO CENTER SPACING BETWEEN INDIVIDUAL BEARING PADS

CALCULATIONS

1. CALCULATE THE TOTAL WALL AND ROOF WEIGHT :

APPENDIX A - STEP 5

$W_W := \pi \cdot (D + t_w) \cdot H_W \cdot t_w \cdot \gamma_C$ $\qquad W_W = 2.09 \times 10^3 \cdot kip$

$W_r := \frac{\pi}{4} \cdot (D + 2 \cdot t_w)^2 \cdot t_r \cdot \gamma_C$ $\qquad W_r = 2.96 \times 10^3 \cdot kip$

$W_L := \frac{\pi}{4} \cdot D^2 \cdot H_L \cdot \gamma_L$ $\qquad W_L = 2.86 \times 10^4 \cdot kip$ TOTAL MASS OF STORED LIQUID,

Determine effective mass coefficient *SECTION 9.6.2*

$$\varepsilon := \min\left[1, 0.0151 \cdot \left(\frac{D}{H_L}\right)^2 - 0.1908 \cdot \left(\frac{D}{H_L}\right) + 1.021\right] \qquad \varepsilon = 0.63$$

EQ (9-45)

2. CALCULATE THE EQUIVALENT MASS OF THE IMPULSIVE (W_i) AND CONVECTIVE (W_c) COMPONENT OF THE STORED LIQUID : *APPENDIX A - STEP 6*

REFERENCE SECTION 9.3.1

$W_i := 0.95 \cdot W_L$ $\quad W_i = 2.72 \times 10^4 \cdot \text{kip}$ *EQ (9-15)*

$W_c := 0 \cdot W_L$ $\quad W_c = 0 \cdot \text{kip}$ *EQ (9-16)*

3. COMPUTE HEIGHTS TO CENTER OF GRAVITY: *APPENDIX A - STEP 7*

EXCLUDING BASE PRESSURE (EBP) REFERENCE SECTION 9.3.2

$$h_w := \frac{H_W}{2} \qquad h_w = 20 \cdot \text{ft}$$

$$h_r := H_W + \frac{t_r}{2} \qquad h_r = 41 \cdot \text{ft}$$

$$h_i := \frac{H_L}{2} \qquad h_i = 21.5 \cdot \text{ft}$$

EQ (9-17)

EQ (9-18)

$$h_c := 0 \cdot H_L \qquad h_c = 0 \cdot \text{ft}$$

EQ (9-19)

INCLUDING BASE PRESSURE (IBP) REFERENCE SECTION 9.3.3

$$h'_i := \begin{cases} 0.45 \cdot H_L & \text{if } \dfrac{D}{H_L} < 0.75 \\ \left[\left(\dfrac{0.866 \cdot \dfrac{D}{H_L}}{2 \cdot \tanh\left(0.866 \cdot \dfrac{D}{H_L}\right)}\right) - \dfrac{1}{8}\right] \cdot H_L & \text{otherwise} \end{cases} \qquad h'_i = 43.4 \cdot \text{ft}$$

EQ (9-20)

EQ (9-21)

$$h'_c := \left[1 - \left(\frac{\cosh\left(3.68\cdot\frac{H_L}{D}\right) - 2.01}{3.68\cdot\frac{H_L}{D}\cdot\sinh\left(3.68\cdot\frac{H_L}{D}\right)}\right)\right]\cdot H_L \qquad h'_c = 39.75\cdot ft$$

EQ (9-22)

4. CALCULATE COMBINED NATURAL FREQUENCY OF VIBRATION (ω_i) : *APPENDIX A - STEP 8*

REFERENCE SECTION 9.3.4

$$C_W := 0.09375 + 0.2039\cdot\left(\frac{H_L}{D}\right) - 0.1034\cdot\left(\frac{H_L}{D}\right)^2 - 0.1253\cdot\left(\frac{H_L}{D}\right)^3 + 0.1267\cdot\left(\frac{H_L}{D}\right)^4 - 0.03186\cdot\left(\frac{H_L}{D}\right)^5$$

$C_W = 0.15$ *Figure 9.3.4(a)*

$$C_l := C_W\cdot 10\cdot\sqrt{\frac{t_w}{\frac{D}{2}}} \qquad C_l = 0.21$$

EQ (9-24)

$$E_c := 57000\frac{lbf^{0.5}}{in}\cdot\sqrt{f'_c} \qquad E_c = 3.37\times 10^6\cdot psi$$

ACI 318 Section 8.5.1

$$\omega_i := C_l\cdot\frac{1}{H_L}\cdot\sqrt{\frac{E_c}{\frac{\gamma_C}{g}}} \qquad \omega_i = 48.91\cdot\frac{1}{sec}$$

EQ (9-23)

5. CALCULATE COMBINED NATURAL FREQUENCY OF VIBRATION (ω_c) : *APPENDIX A - STEP 9*

REFERENCE SECTION 9.3.4

$$\lambda := \sqrt{3.68\cdot g\cdot\tanh\left[3.68\cdot\left(\frac{H_L}{D}\right)\right]} \qquad \lambda = 10.28\cdot\frac{ft^{0.5}}{sec}$$

EQ (9-29)

$$\omega_c := \frac{\lambda}{\sqrt{D}} \qquad \omega_c = 0.98\cdot\frac{1}{sec}$$

EQ (9-28)

6. CALCULATE COMBINED NATURAL PERIODS OF VIBRATION (T_i AND T_c):

REFERENCE SECTION 9.3.4 *APPENDIX A - STEP 10*

$$k_a := \left(\frac{A_s\cdot E_s\cdot\cos(\alpha)^2}{L_c\cdot S_c}\right) + \left(\frac{2\cdot G_p\cdot w_p\cdot L_p}{t_p\cdot S_p}\right) \qquad k_a = 1.17\times 10^4\cdot\frac{kip}{ft^2}$$

EQ (9-27)

$$T_i := \begin{cases} \text{if } TYPE = 3 \\ \quad \begin{cases} 1.25\text{sec} & \text{if } \sqrt{\dfrac{8\cdot\pi\cdot(W_W + W_r + W_i)}{g\cdot D\cdot k_a}} > 1.25\text{sec} \\ \sqrt{\dfrac{8\cdot\pi\cdot(W_W + W_r + W_i)}{g\cdot D\cdot k_a}} & \text{otherwise} \end{cases} \\ \dfrac{2\cdot\pi}{\omega_i} \quad \text{otherwise} \end{cases}$$

EQ (9-26)

$T_i = 0.14\cdot\text{sec}$ *EQ (9-25)*

$$T_c := \frac{2\pi}{\omega_c}$$

$T_c = 6.41\cdot\text{sec}$ *EQ (9-30)*

7. CALCULATE THE SEISMIC RESPONSE COEFFICIENTS (C_i AND C_c): *APPENDIX A - STEP 11*

REFERENCE SECTION 9.4.1

$$T_S := \frac{S_{D1}}{S_{DS}}\cdot\text{sec}$$

$T_S = 0.6\cdot\text{sec}$ *EQ (9-34)*

$$C_i := \begin{cases} S_{DS} & \text{if } T_i \le T_S \\ \min\left(\dfrac{S_{D1}\cdot\text{sec}}{T_i}, S_{DS}\right) & \text{otherwise} \end{cases}$$

EQ (9-32)

$C_i = 1$ *EQ (9-33)*

$$C_c := \begin{cases} \min\left(\dfrac{1.5S_{D1}\cdot\text{sec}}{T_c}, 1.5\cdot S_{DS}\right) & \text{if } T_c \le \dfrac{1.6\text{sec}^2}{T_S} \\ \dfrac{2.4S_{DS}\cdot 1\text{sec}^2}{T_c^{\,2}} & \text{otherwise} \end{cases}$$

EQ (9-37)

$C_c = 0.06$ *EQ (9-38)*

8. CALCULATE THE WAVE DEPTH : *APPENDIX A - STEP 12*

REFERENCE SECTION 7.1

$$d_{max} := \left(\frac{D}{2}\right)\cdot C_c\cdot I$$

$d_{max} = 4.02\cdot\text{ft}$ *EQ (7-2)*

CALCULATE THE FREEBOARD:

$H_F := H_W - H_L$ $\qquad H_F = -3\cdot\text{ft}$

H_{Fcheck} := if($d_{max} > H_F$, " CONFIRM LIQUID SPILLS ARE OK" , "FREEBOARD IS OK")

H_{Fcheck} = " CONFIRM LIQUID SPILLS ARE OK"

NOTE: REFER TO ASCE 7-05 SECTION 15.7.6.1.2 AND TABLE
OR MINIMUM FREEBOARD REQUIREMENTS

9. COMPUTE DYNAMIC LATERAL FORCES: *APPENDIX A - STEP 13*

REFERENCE SECTION 4.1.1

$P_W := C_i \cdot I \cdot \left(\frac{\varepsilon \cdot W_W}{R_i} \right)$ $P_W = 826.1 \cdot kip$ *EQ (4-1)*

$P_r := C_i \cdot I \cdot \left(\frac{W_r}{R_i} \right)$ $P_r = 1.85 \times 10^3 \cdot kip$ *EQ (4-2)*

$P_i := C_i \cdot I \cdot \left(\frac{W_i}{R_i} \right)$ $P_i = 1.7 \times 10^4 \cdot kip$ *EQ (4-3)*

$P_c := C_c \cdot I \cdot \left(\frac{W_c}{R_c} \right)$ $P_c = 0 \cdot kip$ *EQ (4-4)*

DETERMINE BASE SHEAR (V_b) **NOTE: DYNAMIC EARTH PRESSURES NOT INCLUDED. PRESSURE CAN BE COMBINED BY SRSS PER EQUATION (4-5)**

$V_b := \sqrt{(P_i + P_W + P_r)^2 + P_c^{\,2}}$ $V_b = 1.97 \times 10^4 \cdot kip$ *EQ (4-5)*

10. COMPUTE BENDING AND OVERTURNING MOMENTS: *APPENDIX A - STEP 14*

REFERENCE SECTION 4.1.3

$M_W := P_W \cdot h_w$ $M_W = 1.65 \times 10^4 \cdot ft \cdot kip$ *EQ (4-6)*

$M_r := P_r \cdot h_r$ $(M_r) = 7.57 \times 10^4 \cdot ft \cdot kip$ *EQ (4-7)*

$M_i := P_i \cdot h_i$ $M_i = 3.65 \times 10^5 \cdot ft \cdot kip$ *EQ (4-8)*

$M_c := P_c \cdot h_c$ $M_c = 0 \cdot ft \cdot kip$ *EQ (4-9)*

DETERMINE MOMENT EXCLUDING BASE PRESSURE (EBP)

$M_b := \sqrt{(M_i + M_W + M_r)^2 + M_c^{\,2}}$ $M_b = 4.57 \times 10^5 \cdot ft \cdot kip$ *EQ (4-10)*

DETERMINE OVERTURNING MOMENT AT BASE INCLUDING BASE PRESSURE (IBP)

$M'_i := P_i \cdot h'_i$ $M'_i = 7.37 \times 10^5 \cdot ft \cdot kip$ *EQ (4-11)*

$M'_c := P_c \cdot h'_c$ $M'_c = 0 \cdot ft \cdot kip$ *EQ (4-12)*

$M_o := \sqrt{(M'_i + M_W + M_r)^2 + M'^{\,2}_c}$ $M_o = 8.29 \times 10^5 \cdot ft \cdot kip$ *EQ (4-13)*

11. COMPUTE VERTICAL AMPLIFICATION FACTOR: *APPENDIX A - STEP 15*

REFERENCE SECTION 9.4.3

$$T_V := 2\cdot\pi\cdot\sqrt{\frac{\gamma_L\cdot D\cdot H_L^{\;2}}{2\cdot g\cdot t_w\cdot E_c}} \qquad T_V = 0.13\,s$$ *EQ (9-31)*

$$C_t := \begin{cases} S_{DS} & \text{if } T_V \le T_S \\ \dfrac{S_{D1}\cdot sec}{T_V} & \text{otherwise} \end{cases} \qquad C_t = 1$$ *EQ (9-39)* *EQ (9-40)*

12. COMPUTE HYDRODYNAMIC PRESSURE: *APPENDIX A - STEP 16*

REFERENCE SECTION 4.1.4

$$u_v := \max\left(C_t\cdot I\cdot\frac{b}{R_i}, 0.2\cdot S_{DS}\right) \qquad u_v = 0.42 \qquad i := 0..10$$ *EQ (4-15)*

$$y_i := (1 - .1\cdot i)\cdot H_L \qquad q_{hy_i} := \gamma_L\cdot(H_L - y_i) \qquad p_{hy_i} := u_v\cdot q_{hy_i}$$ *EQ (4-14)*

Height	q_{hy} (ksf)	p_{hy} (ksf)	
43.00	0.00	0.00	Top
38.70	0.30	0.13	
34.40	0.60	0.25	
30.10	0.90	0.38	
25.80	1.20	0.50	
21.50	1.51	0.63	
17.20	1.81	0.75	
12.90	2.11	0.88	
8.60	2.41	1.00	
4.30	2.71	1.13	
0.00	3.01	1.25	Bottom

$$\left(\frac{y}{ft} \quad \frac{q_{hy}}{ksf} \quad \frac{p_{hy}}{ksf}\right)$$

13. COMPUTE VERTICAL DISTRIBUTION OF PRESSURES: *APPENDIX A - STEP 17*

REFERENCE SECTION 5.3.3. AND R5.3.3

$$P_{wy} := \frac{P_W}{2H_W} \qquad P_{wy} = 10.33\cdot\frac{kip}{ft}$$

$$p_{wy} := \frac{P_{wy}}{\pi\cdot\frac{D}{2}} \qquad p_{wy} = 0.06\cdot ksf$$

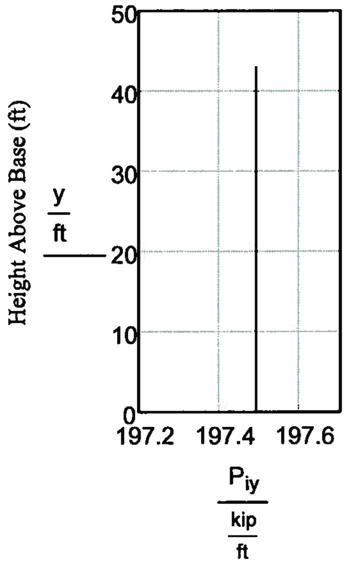
COMPUTE THE IMPULSIVE WATER PRESSURE (p_{iy}):

$$P_{iy_i} := \frac{\frac{P_i}{2}\cdot\left[4\cdot H_L - 6\cdot h_i - (6H_L - 12\cdot h_i)\cdot\frac{y_i}{H_L}\right]}{H_L^{\,2}}$$

$$p_{iy_i} := \frac{(2\cdot P_{iy_i})\cdot\cos(0)}{\pi\cdot\frac{D}{2}}$$

Height	P_{iy} (kip/ft)	p_{iy} (ksf)	
43.00	197.49	2.29	Top
38.70	197.49	2.29	
34.40	197.49	2.29	
30.10	197.49	2.29	
25.80	197.49	2.29	
21.50	197.49	2.29	
17.20	197.49	2.29	
12.90	197.49	2.29	
8.60	197.49	2.29	
4.30	197.49	2.29	
0.00	197.49	2.29	Bottom

$$\left(\frac{y}{ft}\quad \frac{P_{iy}}{\frac{kip}{ft}}\quad \frac{p_{iy}}{ksf}\right)$$

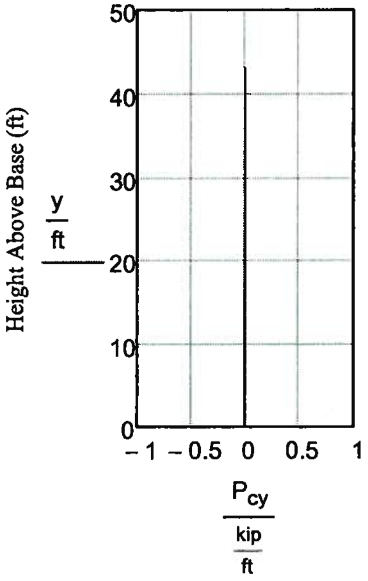


COMPUTE THE CONVECTIVE WATER PRESSURE (p_{cy}):

$$P_{cy_i} := \frac{\frac{P_c}{2}\cdot\left[4\cdot H_L - 6\cdot h_c - \left(6H_L - 12\cdot h_c\right)\cdot\frac{y_i}{H_L}\right]}{H_L^{\,2}} \qquad p_{cy_i} := \frac{\left(16\cdot P_{cy_i}\right)\cdot\cos(0)}{9\pi\cdot\frac{D}{2}}$$

Height	P_{cy} (kip/ft)	p_{cy} (ksf)	
43.00	0.00	0.00	Top
38.70	0.00	0.00	
34.40	0.00	0.00	
30.10	0.00	0.00	
25.80	0.00	0.00	
21.50	0.00	0.00	
17.20	0.00	0.00	
12.90	0.00	0.00	
8.60	0.00	0.00	
4.30	0.00	0.00	
0.00	0.00	0.00	Bottom

$$\left(\frac{y}{ft} \quad \frac{P_{cy}}{\frac{kip}{ft}} \quad \frac{p_{cy}}{ksf}\right)$$



14. CALCULATE THE HOOP FORCES:

APPENDIX A - STEP 18

REFERENCE SECTION 6.2

$$N_{y_i} := \sqrt{\left(p_{iy_i}\cdot\frac{D}{2} + p_{wy}\cdot\frac{D}{2}\right)^2 + \left(p_{cy_i}\cdot\frac{D}{2}\right)^2 + \left(p_{hy_i}\cdot\frac{D}{2}\right)^2}$$

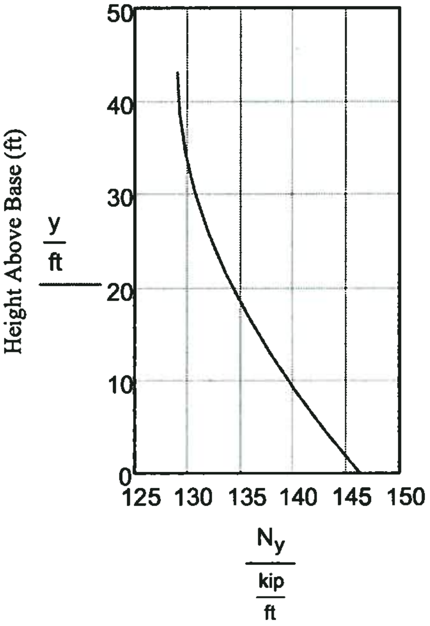
Ultimate Hoop Force *EQ (6-1)*

$$\sigma_{y_i} := \frac{N_{y_i}}{t_w}$$

Ultimate Hoop Stress *EQ (6-2)*

Height	N_y (kip/ft)	σ_y (psi)	
43.00	129.01	895.93	Top
38.70	129.20	897.21	
34.40	129.75	901.03	
30.10	130.66	907.38	
25.80	131.93	916.19	
21.50	133.54	927.39	
17.20	135.49	940.90	
12.90	137.75	956.62	
8.60	140.32	974.44	
4.30	143.17	994.26	
0.00	146.30	1015.95	Bottom

$$\left(\frac{y}{ft} \quad \frac{N_y}{\frac{kip}{ft}} \quad \frac{\sigma_y}{psi}\right)$$



NOTE ABOVE FORCES ARE FOR A FREE BASE AND SHOULD BE ADJUSTED TO ACCOUNT FOR BASE RESTRAINT PER SECTION R6.2.

NOTE: DYNAMIC EARTH PRESSURES NOT INCLUDED. PRESSURE CAN BE COMBINED BY SRSS PER EQUATION (4-5)

ADDITIONAL DESIGN OUTPUT

$V_b = 1.97\times 10^4\cdot kip$ BASE SHEAR

$M_b = 4.57\times 10^5\cdot ft\cdot kip$ OTM EXCLUDING BASE PRESSURE

$M_o = 8.29\times 10^5\cdot ft\cdot kip$ OTM INCLUDING BASE PRESSURE

H_{Fcheck} = " CONFIRM LIQUID SPILLS ARE OK"

INPUT: ***NOTE - ALL REFERENCES ARE TO ACI 350.3-06 UNLESS NOTED OTHERWISE***

$TYPE := 2$ TANK TYPE (USE 2 FOR NONFLEXIBLE CONNECTION AND 3 FOR FLEXIBLE) PER ACI 350.3 FIGURE R2.1.1

$H_L := 36ft$ DESIGNED DEPTH OF STORED LIQUID

$H_W := 40ft$ WALL HEIGHT

$D := 110ft$ INSIDE DIAMETER OF CIRCULAR TANK

$t_w := 15in$ AVERAGE WALL THICKNESS

$t_r := 24in$ AVERAGE ROOF THICKNESS

$\gamma_L := 70\frac{lbf}{ft^3}$ SPECIFIC WEIGHT OF CONTAINED LIQUID

$\gamma_C := 150\frac{lbf}{ft^3}$ SPECIFIC WEIGHT OF CONCRETE

$f'_c := 4000psi$ CONCRETE COMPRESSIVE STRENGTH

$I := 1.25$ IMPORTANCE FACTOR *TABLE 4.1.1(a)*

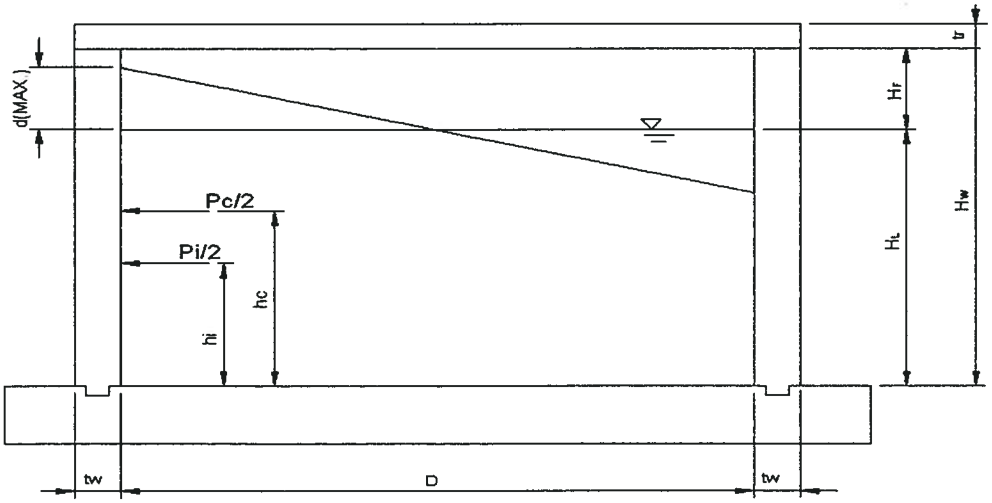
$S_{DS} := 1$ BASED ON THE GEOTECHNICAL REPORT

$S_{D1} := 0.6$ BASED ON THE GEOTECHNICAL REPORT

$R_i := 2$ ***NOTE: THIS VALUE GIVES ULTIMATE LOAD*** *Table 4.1.1(b)*

$R_c := 1$ ***NOTE: THIS VALUE GIVES ULTIMATE LOAD*** *Table 4.1.1(b)*

$b := \frac{2}{3}$ RATIO OF VERTICAL TO HORIZONTAL DESIGN ACCELERATION *Section 4.1.4*



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THE FOLLOWING INPUT IS NOT REQUIRED UNLESS YOU ARE DOING A FLEXIBLE BASE CONNECTION PER ACI 350.3. TYPICALLY WILL ONLY BE USED BY DENVER OFFICE

$A_s := .5in^2$ CROSS SECTIONAL AREA OF REINFORCEMENT

$E_s := 29000000psi$ MODULUS OF ELASTICITY OF REINFORCEMENT

$L_c := 18in$ EFFECTIVE LENGTH OF BASE CABLE OR STRAND

$S_c := 24in$ CENTER TO CENTER SPACING BETWEEN INDIVIDUAL CABLE LOOPS

$\alpha := 45$ ANGLE OF BASE CABLE OR STRAND WITH HORIZONTAL, DEGREE

$G_p := 500psi$ SHEAR MODULUS OF BEARING PAD (ONLY APPPLIES FOR TYPE 3 BASES

$w_p := 18in$ WIDTH OF ELASTOMERIC BEARING PAD

$L_p := 36in$ LENGTH OF INDIVIDUAL BEARING PADS

$t_p := .25in$ THICKNESS OF ELASTOMERIC BEARING PAD

$S_p := 36in$ CENTER TO CENTER SPACING BETWEEN INDIVIDUAL BEARING PADS

CALCULATIONS

1. CALCULATE THE TOTAL WALL AND ROOF WEIGHT:

APPENDIX A - STEP 5

$W_W := \pi \cdot (D + t_w) \cdot H_W \cdot t_w \cdot \gamma_C$ $W_W = 2.62 \times 10^3 \cdot kip$

$W_r := \frac{\pi}{4} \cdot (D + 2 \cdot t_w)^2 \cdot t_r \cdot \gamma_C$ $W_r = 2.98 \times 10^3 \cdot kip$

$W_L := \frac{\pi}{4} \cdot D^2 \cdot H_L \cdot \gamma_L$ $W_L = 2.39 \times 10^4 \cdot kip$ TOTAL MASS OF STORED LIQUID,

Determine effective mass coefficient *SECTION 9.6.2*

$$\varepsilon := \min\left[1, 0.0151 \cdot \left(\frac{D}{H_L}\right)^2 - 0.1908 \cdot \left(\frac{D}{H_L}\right) + 1.021\right] \quad \varepsilon = 0.58$$

EQ (9-45)

2. CALCULATE THE EQUIVALENT MASS OF THE IMPULSIVE (W_i) AND CONVECTIVE (W_c) COMPONENT OF THE STORED LIQUID : *APPENDIX A - STEP 6*

REFERENCE SECTION 9.3.1

$$W_i := \frac{\tanh\left[0.866\cdot\left(\frac{D}{H_L}\right)\right]}{0.866\cdot\left(\frac{D}{H_L}\right)}\cdot W_L \qquad W_i = 8.96\times10^{3}\cdot kip \qquad \textit{EQ (9-15)}$$

$$W_c := 0.230\cdot\left(\frac{D}{H_L}\right)\cdot\tanh\left[3.68\cdot\left(\frac{H_L}{D}\right)\right]\cdot W_L \qquad W_c = 1.41\times10^{4}\cdot kip \qquad \textit{EQ (9-16)}$$

3. COMPUTE HEIGHTS TO CENTER OF GRAVITY: *APPENDIX A - STEP 7*

EXCLUDING BASE PRESSURE (EBP) REFERENCE SECTION 9.3.2

$$h_w := \frac{H_W}{2} \qquad h_w = 20\cdot ft$$

$$h_r := H_W + \frac{t_r}{2} \qquad h_r = 41\cdot ft$$

$$h_i := \begin{cases} \left[0.5 - \left[0.09375\cdot\left(\frac{D}{H_L}\right)\right]\right]\cdot H_L & \text{if } \frac{D}{H_L} < 1.333 \\ 0.375\cdot H_L & \text{otherwise} \end{cases} \qquad h_i = 13.5\cdot ft \qquad \textit{EQ (9-17)} \quad \textit{EQ (9-18)}$$

$$h_c := \left[1 - \left(\frac{\cosh\left(3.68\cdot\frac{H_L}{D}\right) - 1}{3.68\cdot\frac{H_L}{D}\cdot\sinh\left(3.68\cdot\frac{H_L}{D}\right)}\right)\right]\cdot H_L \qquad h_c = 19.9\cdot ft \qquad \textit{EQ (9-19)}$$

INCLUDING BASE PRESSURE (IBP) REFERENCE SECTION 9.3.3

$$h'_i := \begin{cases} 0.45\cdot H_L & \text{if } \frac{D}{H_L} < 0.75 \\ \left[\left(\frac{0.866\cdot\frac{D}{H_L}}{2\cdot\tanh\left(0.866\cdot\frac{D}{H_L}\right)}\right) - \frac{1}{8}\right]\cdot H_L & \text{otherwise} \end{cases} \qquad h'_i = 43.61\cdot ft \qquad \textit{EQ (9-20)} \quad \textit{EQ (9-21)}$$

$$h'_c := \left[1 - \left(\frac{\cosh\left(3.68\cdot\frac{H_L}{D}\right) - 2.01}{3.68\cdot\frac{H_L}{D}\cdot\sinh\left(3.68\cdot\frac{H_L}{D}\right)}\right)\right]\cdot H_L$$

EQ (9-22)

$h'_c = 39.8\cdot ft$

4. CALCULATE COMBINED NATURAL FREQUENCY OF VIBRATION (ϕ_i) : *APPENDIX A - STEP 8*

REFERENCE SECTION 9.3.4

$$C_W := 0.09375 + 0.2039\cdot\left(\frac{H_L}{D}\right) - 0.1034\cdot\left(\frac{H_L}{D}\right)^2 - 0.1253\cdot\left(\frac{H_L}{D}\right)^3 + 0.1267\cdot\left(\frac{H_L}{D}\right)^4 - 0.03186\cdot\left(\frac{H_L}{D}\right)^5$$

$C_W = 0.15$ *Figure 9.3.4(a)*

$C_l := C_W\cdot 10\cdot\sqrt{\frac{t_w}{\frac{D}{2}}}$ $C_l = 0.22$ *EQ (9-24)*

$E_c := 57000\frac{lbf^{0.5}}{in}\cdot\sqrt{f'_c}$ $E_c = 3.6\times 10^6\cdot psi$ *ACI 318 Section 8.5.1*

$\omega_i := C_l\cdot\frac{1}{H_L}\cdot\sqrt{\frac{E_c}{\frac{\gamma_C}{g}}}$ $\omega_i = 64.67\cdot\frac{1}{sec}$ *EQ (9-23)*

5. CALCULATE COMBINED NATURAL FREQUENCY OF VIBRATION (ϕ_c) : *APPENDIX A - STEP 9*

REFERENCE SECTION 9.3.4

$\lambda := \sqrt{3.68\cdot g\cdot\tanh\left[3.68\cdot\left(\frac{H_L}{D}\right)\right]}$ $\lambda = 9.94\cdot\frac{ft^{0.5}}{sec}$ *EQ (9-29)*

$\omega_c := \frac{\lambda}{\sqrt{D}}$ $\omega_c = 0.95\cdot\frac{1}{sec}$ *EQ (9-28)*

6. CALCULATE COMBINED NATURAL PERIODS OF VIBRATION (T AND T_c):

REFERENCE SECTION 9.3.4 *APPENDIX A - STEP 10*

$k_a := \left(\frac{A_s\cdot E_s\cdot\cos(\alpha)^2}{L_c\cdot S_c}\right) + \left(\frac{2\cdot G_p\cdot w_p\cdot L_p}{t_p\cdot S_p}\right)$ $k_a = 1.17\times 10^4\cdot\frac{kip}{ft^2}$ *EQ (9-27)*

$$T_i := \left| \begin{array}{l} \text{if } \ TYPE = 3 \\ \quad \left| \begin{array}{ll} 1.25\text{sec} \ \text{ if } \ \sqrt{\dfrac{8\cdot\pi\cdot\left(W_W + W_r + W_i\right)}{g\cdot D\cdot k_a}} > 1.25\text{sec} \\ \sqrt{\dfrac{8\cdot\pi\cdot\left(W_W + W_r + W_i\right)}{g\cdot D\cdot k_a}} \ \text{ otherwise} \end{array} \right. \\ \dfrac{2\cdot\pi}{\omega_i} \ \text{ otherwise} \end{array} \right.$$

EQ (9-26)

$T_i = 0.1\cdot\text{sec}$ EQ (9-25)

$$T_c := \frac{2\pi}{\omega_c}$$

$T_c = 6.63\cdot\text{sec}$ EQ (9-30)

7. CALCULATE THE SEISMIC RESPONSE COEFFICIENTS (C_i AND C_c): *APPENDIX A - STEP 11*

REFERENCE SECTION 9.4.1

$$T_S := \frac{S_{D1}}{S_{DS}}\cdot\text{sec}$$

$T_S = 0.6\cdot\text{sec}$ EQ (9-34)

$$C_i := \left| \begin{array}{l} S_{DS} \ \text{ if } \ T_i \le T_S \\ \min\left(\dfrac{S_{D1}\cdot\text{sec}}{T_i}, S_{DS}\right) \ \text{ otherwise} \end{array} \right.$$

EQ (9-32)

$C_i = 1$ EQ (9-33)

$$C_c := \left| \begin{array}{l} \min\left(\dfrac{1.5S_{D1}\cdot\text{sec}}{T_c}, 1.5\cdot S_{DS}\right) \ \text{ if } \ T_c \le \dfrac{1.6\text{sec}^2}{T_S} \\ \dfrac{2.4S_{DS}\cdot 1\text{sec}^2}{T_c{}^2} \ \text{ otherwise} \end{array} \right.$$

EQ (9-37)

$C_c = 0.05$ EQ (9-38)

8. CALCULATE THE WAVE DEPTH : *APPENDIX A - STEP 12*

REFERENCE SECTION 7.1

$$d_{max} := \left(\frac{D}{2}\right)\cdot C_c\cdot I$$

$d_{max} = 3.76\cdot\text{ft}$ EQ (7-2)

CALCULATE THE FREEBOARD:

$H_F := H_W - H_L$ $H_F = 4\cdot\text{ft}$

$H_{Fcheck} :=$ if($d_{max} > H_F$, " CONFIRM LIQUID SPILLS ARE OK" , "FREEBOARD IS OK")

$H_{Fcheck} =$ "FREEBOARD IS OK"

NOTE: REFER TO ASCE 7-05 SECTION 15.7.6.1.2 AND TABLE 15.7-3 FOR MINIMUM FREEBOARD REQUIREMENTS

APPENDIX A - STEP 13

9. COMPUTE DYNAMIC LATERAL FORCES

REFERENCE SECTION 4.1.1

$P_W := C_i \cdot I \cdot \left(\frac{\varepsilon \cdot W_W}{R_i}\right)$ $P_W = 948.54 \cdot kip$ *EQ (4-1)*

$P_r := C_i \cdot I \cdot \left(\frac{W_r}{R_i}\right)$ $P_r = 1.86 \times 10^3 \cdot kip$ *EQ (4-2)*

$P_i := C_i \cdot I \cdot \left(\frac{W_i}{R_i}\right)$ $P_i = 5.6 \times 10^3 \cdot kip$ *EQ (4-3)*

$P_c := C_c \cdot I \cdot \left(\frac{W_c}{R_c}\right)$ $P_c = 959.77 \cdot kip$ *EQ (4-4)*

DETERMINE BASE SHEAR (V_b) **NOTE: DYNAMIC EARTH PRESSURES NOT INCLUDED. PRESSURE CAN BE COMBINED BY SRSS PER EQUATION (4-5)**

$V_b := \sqrt{\left(P_i + P_W + P_r\right)^2 + P_c^{\,2}}$ $V_b = 8.47 \times 10^3 \cdot kip$ *EQ (4-5)*

APPENDIX A - STEP 14

10. COMPUTE BENDING AND OVERTURNING MOMENTS

REFERENCE SECTION 4.1.3

$M_W := P_W \cdot h_w$ $M_W = 1.9 \times 10^4 \cdot ft \cdot kip$ *EQ (4-6)*

$M_r := P_r \cdot h_r$ $\left(M_r\right) = 7.64 \times 10^4 \cdot ft \cdot kip$ *EQ (4-7)*

$M_i := P_i \cdot h_i$ $M_i = 7.56 \times 10^4 \cdot ft \cdot kip$ *EQ (4-8)*

$M_c := P_c \cdot h_c$ $M_c = 1.91 \times 10^4 \cdot ft \cdot kip$ *EQ (4-9)*

DETERMINE MOMENT EXCLUDING BASE PRESSURE (EBP)

$M_b := \sqrt{\left(M_i + M_W + M_r\right)^2 + M_c^{\,2}}$ $M_b = 1.72 \times 10^5 \cdot ft \cdot kip$ *EQ (4-10)*

DETERMINE OVERTURNING MOMENT AT BASE INCLUDING BASE PRESSURE (IBP)

$M'_i := P_i \cdot h'_i$ $M'_i = 2.44 \times 10^5 \cdot ft \cdot kip$ *EQ (4-11)*

$M'_c := P_c \cdot h'_c$ $M'_c = 3.82 \times 10^4 \cdot ft \cdot kip$ *EQ (4-12)*

$M_o := \sqrt{\left(M'_i + M_W + M_r\right)^2 + M'^{\,2}_c}$ $M_o = 3.42 \times 10^5 \cdot ft \cdot kip$ *EQ (4-13)*

11. COMPUTE VERTICAL AMPLIFICATION FACTOR:

APPENDIX A - STEP 15

REFERENCE SECTION 9.4.3

$$T_V := 2\cdot\pi\cdot\sqrt{\frac{\gamma_L\cdot D\cdot {H_L}^2}{2\cdot g\cdot t_w\cdot E_c}} \qquad T_V = 0.1\,s \qquad \text{EQ (9-31)}$$

$$C_t := \left| \begin{array}{ll} S_{DS} \text{ if } T_V \le T_S \\ \dfrac{S_{D1}\cdot sec}{T_V} \text{ otherwise} \end{array} \right. \qquad C_t = 1$$

EQ (9-39)

EQ (9-40)

12. COMPUTE HYDRODYNAMIC PRESSURE:

APPENDIX A - STEP 16

REFERENCE SECTION 4.1.4

$$u_v := \max\left(C_t\cdot I\cdot\frac{b}{R_i}, 0.2\cdot S_{DS}\right) \qquad u_v = 0.42 \qquad i := 0 .. 10$$

EQ (4-15)

$$y_i := (1 - .1\cdot i)\cdot H_L \qquad q_{hy_i} := \gamma_L\cdot(H_L - y_i) \qquad p_{hy_i} := u_v\cdot q_{hy_i}$$

EQ (4-14)

Height	q_{hy} (ksf)	p_{hy} (ksf)	
36.00	0.00	0.00	Top
32.40	0.25	0.11	
28.80	0.50	0.21	
25.20	0.76	0.32	
21.60	1.01	0.42	
18.00	1.26	0.53	
14.40	1.51	0.63	
10.80	1.76	0.74	
7.20	2.02	0.84	
3.60	2.27	0.95	
0.00	2.52	1.05	Bottom

$$\left(\frac{y}{ft} \quad \frac{q_{hy}}{ksf} \quad \frac{p_{hy}}{ksf}\right)$$

13. COMPUTE VERTICAL DISTRIBUTION OF PRESSURES:

APPENDIX A - STEP 17

REFERENCE SECTION 5.3.3. AND R5.3.3

$$P_{wy} := \frac{P_W}{2H_W} \qquad P_{wy} = 11.86\cdot\frac{kip}{ft}$$

$$p_{wy} := \frac{P_{wy}}{\pi\cdot\frac{D}{2}} \qquad p_{wy} = 0.069\cdot ksf$$

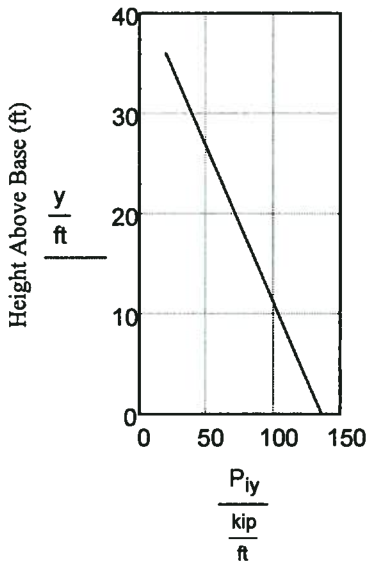
COMPUTE THE IMPULSIVE WATER PRESSURE (p_{iy}):

$$P_{iy_i} := \frac{\frac{P_i}{2}\cdot\left[4\cdot H_L - 6\cdot h_i - \left(6H_L - 12\cdot h_i\right)\cdot\frac{y_i}{H_L}\right]}{{H_L}^2}$$

$$p_{iy_i} := \frac{\left(2\cdot P_{iy_i}\right)\cdot\cos(0)}{\pi\cdot\frac{D}{2}}$$

Height	P_{iy} (kip/ft)	p_{iy} (ksf)	
36.00	19.44	0.23	Top
32.40	31.11	0.36	
28.80	42.78	0.50	
25.20	54.44	0.63	
21.60	66.11	0.77	
18.00	77.78	0.90	
14.40	89.44	1.04	
10.80	101.11	1.17	
7.20	112.78	1.31	
3.60	124.44	1.44	
0.00	136.11	1.58	Bottom

$$\begin{pmatrix} \frac{y}{ft} & \frac{P_{iy}}{\frac{kip}{ft}} & \frac{p_{iy}}{ksf} \end{pmatrix}$$



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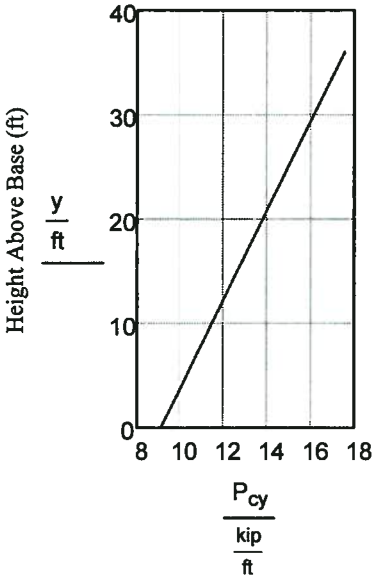
COMPUTE THE CONVECTIVE WATER PRESSURE (p_{cy}):

$$P_{cy_i} := \frac{\frac{P_c}{2}\cdot\left[4\cdot H_L - 6\cdot h_c - \left(6H_L - 12\cdot h_c\right)\cdot\frac{y_i}{H_L}\right]}{H_L^{\ 2}}$$

$$p_{cy_i} := \frac{\left(16\cdot P_{cy_i}\right)\cdot\cos(0)}{9\pi\cdot\frac{D}{2}}$$

Height	P_{cy} (kip/ft)	p_{cy} (ksf)	
36.00	17.55	0.18	Top
32.40	16.71	0.17	
28.80	15.86	0.16	
25.20	15.02	0.15	
21.60	14.17	0.15	
18.00	13.33	0.14	
14.40	12.49	0.13	
10.80	11.64	0.12	
7.20	10.80	0.11	
3.60	9.95	0.10	
0.00	9.11	0.09	Bottom

$$\left(\frac{y}{ft}\quad \frac{P_{cy}}{\frac{kip}{ft}}\quad \frac{p_{cy}}{ksf}\right)$$



14. CALCULATE THE HOOP FORCES:

APPENDIX A - STEP 18

REFERENCE SECTION 6.2

$$N_{y_i} := \sqrt{\left(p_{iy_i}\cdot\frac{D}{2} + p_{wy}\cdot\frac{D}{2}\right)^2 + \left(p_{cy_i}\cdot\frac{D}{2}\right)^2 + \left(p_{hy_i}\cdot\frac{D}{2}\right)^2}$$

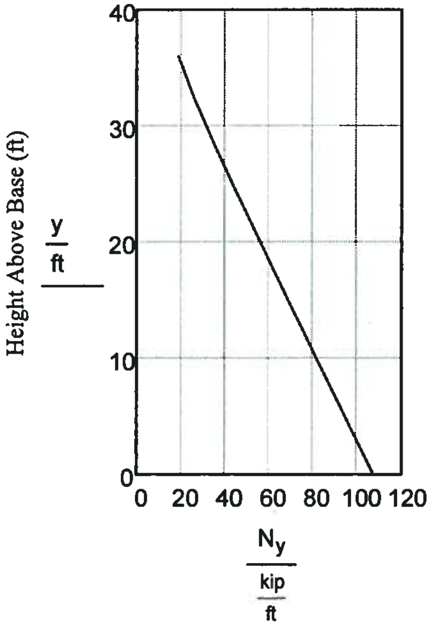
Ultimate Hoop Force *EQ (6-1)*

$$\sigma_{y_i} := \frac{N_{y_i}}{t_w}$$

Ultimate Hoop Stress *EQ (6-2)*

Height	N_y (kip/ft)	σ_y (psi)	
36.00	18.96	105.35	Top
32.40	26.05	144.74	
28.80	34.28	190.47	
25.20	43.01	238.92	
21.60	51.97	288.74	
18.00	61.08	339.31	
14.40	70.26	390.35	
10.80	79.50	441.69	
7.20	88.78	493.24	
3.60	98.09	544.94	
0.00	107.41	596.75	Bottom

$$\left(\frac{y}{ft} \quad \frac{N_y}{\frac{kip}{ft}} \quad \frac{\sigma_y}{psi}\right)$$



NOTE ABOVE FORCES ARE FOR A FREE BASE AND SHOULD BE ADJUSTED TO ACCOUNT FOR BASE RESTRAINT PER SECTION R6.2.

NOTE: DYNAMIC EARTH PRESSURES NOT INCLUDED. PRESSURE CAN BE COMBINED BY SRSS PER EQUATION (4-5)

ADDITIONAL DESIGN OUTPUT

$V_b = 8.47 \times 10^3 \cdot kip$ BASE SHEAR

$M_b = 1.72 \times 10^5 \cdot ft \cdot kip$ OTM EXCLUDING BASE PRESSURE

$M_o = 3.42 \times 10^5 \cdot ft \cdot kip$ OTM INCLUDING BASE PRESSURE

H_{Fcheck} = "FREEBOARD IS OK"

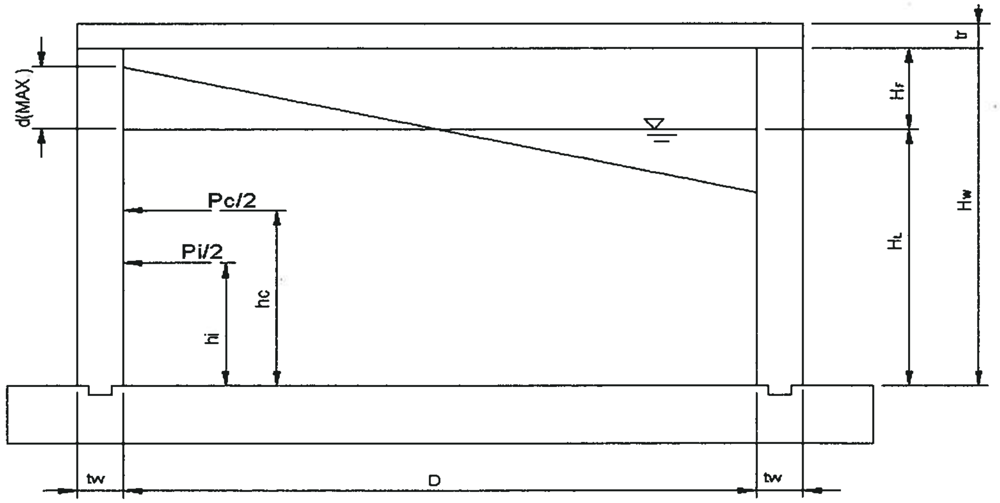
BROWN AND CALDWELL

San Jose Digester 12
Submerged Case
(No Convective Force)

Circular Tank - Hydrodynamic Slosh per
ACI 350.3-06
REV 0, 09/10/2010

INPUT: ***NOTE - ALL REFERENCES ARE TO ACI 350.3-06 UNLESS NOTED OTHERWISE***

$\mathrm{TYPE} := 3$	TANK TYPE (USE 2 FOR NONFLEXIBLE CONNECTION AND 3 FOR FLEXIBLE) PER ACI 350.3 FIGURE R2.1.1	
$H_L := 43\mathrm{ft}$	DESIGNED DEPTH OF STORED LIQUID	
$H_W := 40\mathrm{ft}$	WALL HEIGHT	
$D := 110\mathrm{ft}$	INSIDE DIAMETER OF CIRCULAR TANK	
$t_w := 15\mathrm{in}$	AVERAGE WALL THICKNESS	
$t_r := 24\mathrm{in}$	AVERAGE ROOF THICKNESS	
$\gamma_L := 70\frac{\mathrm{lbf}}{\mathrm{ft}^3}$	SPECIFIC WEIGHT OF CONTAINED LIQUID	
$\gamma_C := 150\frac{\mathrm{lbf}}{\mathrm{ft}^3}$	SPECIFIC WEIGHT OF CONCRETE	
$f'_c := 4000\mathrm{psi}$	CONCRETE COMPRESSIVE STRENGTH	
$I := 1.25$	IMPORTANCE FACTOR	*TABLE 4.1.1(a)*
$S_{DS} := 1$	BASED ON THE GEOTECHNICAL REPORT	
$S_{D1} := .60$	BASED ON THE GEOTECHNICAL REPORT	
$R_i := 2$	***NOTE: THIS VALUE GIVES ULTIMATE LOAD***	*Table 4.1.1(b)*
$R_c := 1$	***NOTE: THIS VALUE GIVES ULTIMATE LOAD***	*Table 4.1.1(b)*
$b := \frac{2}{3}$	RATIO OF VERTICAL TO HORIZONTAL DESIGN ACCELERATION	*Section 4.1.4*



Client: San Jose
Client Number: 136242
Task Number: 410

Date Started: Sep. 10, 2010
Last Modified:
Calc. By: E. Wilkins
Checked: E. Quiroz

P:\EWilkins\San Jose Digester Analysis\

THE FOLLOWING INPUT IS NOT REQUIRED UNLESS YOU ARE DOING A FLEXIBLE BASE CONNECTION PER ACI 350.3. TYPICALLY WILL ONLY BE USED BY DENVER OFFICE

$A_s := .5in^2$ CROSS SECTIONAL AREA OF REINFORCEMENT

$E_s := 29000000psi$ MODULUS OF ELASTICITY OF REINFORCEMENT

$L_c := 18in$ EFFECTIVE LENGTH OF BASE CABLE OR STRAND

$S_c := 24in$ CENTER TO CENTER SPACING BETWEEN INDIVIDUAL CABLE LOOPS

$\alpha := 45$ ANGLE OF BASE CABLE OR STRAND WITH HORIZONTAL, DEGREE

$G_p := 500psi$ SHEAR MODULUS OF BEARING PAD (ONLY APPPLIES FOR TYPE 3 BASES

$w_p := 18in$ WIDTH OF ELASTOMERIC BEARING PAD

$L_p := 36in$ LENGTH OF INDIVIDUAL BEARING PADS

$t_p := .25in$ THICKNESS OF ELASTOMERIC BEARING PAD

$S_p := 36in$ CENTER TO CENTER SPACING BETWEEN INDIVIDUAL BEARING PADS

CALCULATIONS

1. CALCULATE THE TOTAL WALL AND ROOF WEIGHT : *APPENDIX A - STEP 5*

$W_W := \pi \cdot (D + t_w) \cdot H_W \cdot t_w \cdot \gamma_C$ $W_W = 2.62 \times 10^3 \cdot kip$

$W_r := \frac{\pi}{4} \cdot (D + 2 \cdot t_w)^2 \cdot t_r \cdot \gamma_C$ $W_r = 2.98 \times 10^3 \cdot kip$

$W_L := \frac{\pi}{4} \cdot D^2 \cdot H_L \cdot \gamma_L$ $W_L = 2.86 \times 10^4 \cdot kip$ TOTAL MASS OF STORED LIQUID,

Determine effective mass coefficient *SECTION 9.6.2*

$$\varepsilon := \min\left[1, 0.0151 \cdot \left(\frac{D}{H_L}\right)^2 - 0.1908 \cdot \left(\frac{D}{H_L}\right) + 1.021\right] \qquad \varepsilon = 0.63$$ *EQ (9-45)*

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2. CALCULATE THE EQUIVALENT MASS OF THE IMPULSIVE (W_i) AND CONVECTIVE (W_c) COMPONENT OF THE STORED LIQUID :

APPENDIX A - STEP 6

REFERENCE SECTION 9.3.1

$W_i := 0.95 \cdot W_L$ $\qquad W_i = 2.72 \times 10^4 \cdot kip$ $\qquad$ *EQ (9-15)*

$W_c := 0 \cdot W_L$ $\qquad W_c = 0 \cdot kip$ $\qquad$ *EQ (9-16)*

3. COMPUTE HEIGHTS TO CENTER OF GRAVITY:

APPENDIX A - STEP 7

EXCLUDING BASE PRESSURE (EBP) REFERENCE SECTION 9.3.2

$h_w := \frac{H_W}{2}$ $\qquad h_w = 20 \cdot ft$

$h_r := H_W + \frac{t_r}{2}$ $\qquad h_r = 41 \cdot ft$

$h_i := \frac{H_L}{2}$ $\qquad h_i = 21.5 \cdot ft$ $\qquad$ *EQ (9-17)*

EQ (9-18)

$h_c := 0 \cdot H_L$ $\qquad h_c = 0 \cdot ft$ $\qquad$ *EQ (9-19)*

INCLUDING BASE PRESSURE (IBP) REFERENCE SECTION 9.3.3

$$h'_i := \begin{vmatrix} 0.45 \cdot H_L \quad \text{if} \quad \frac{D}{H_L} < 0.75 \\ \left[\left(\frac{0.866 \cdot \frac{D}{H_L}}{2 \cdot \tanh\left(0.866 \cdot \frac{D}{H_L}\right)}\right) - \frac{1}{8}\right] \cdot H_L \quad \text{otherwise} \end{vmatrix}$$

EQ (9-20)

EQ (9-21)

$h'_i = 43.4 \cdot ft$

$$h'_c := \left[1 - \left(\frac{\cosh\left(3.68\cdot\frac{H_L}{D}\right) - 2.01}{3.68\cdot\frac{H_L}{D}\cdot\sinh\left(3.68\cdot\frac{H_L}{D}\right)}\right)\right]\cdot H_L$$

EQ (9-22)

$h'_c = 39.75\cdot ft$

4. CALCULATE COMBINED NATURAL FREQUENCY OF VIBRATION (ω_i) : *APPENDIX A - STEP 8*

REFERENCE SECTION 9.3.4

$$C_W := 0.09375 + 0.2039\cdot\left(\frac{H_L}{D}\right) - 0.1034\cdot\left(\frac{H_L}{D}\right)^2 - 0.1253\cdot\left(\frac{H_L}{D}\right)^3 + 0.1267\cdot\left(\frac{H_L}{D}\right)^4 - 0.03186\cdot\left(\frac{H_L}{D}\right)^5$$

$C_W = 0.15$ *Figure 9.3.4(a)*

$C_l := C_W\cdot 10\cdot\sqrt{\frac{t_w}{\frac{D}{2}}}$ $C_l = 0.23$ *EQ (9-24)*

$E_c := 57000\frac{lbf^{0.5}}{in}\cdot\sqrt{f'_c}$ $E_c = 3.6\times 10^6\cdot psi$ *ACI 318 Section 8.5.1*

$\omega_i := C_l\cdot\frac{1}{H_L}\cdot\sqrt{\frac{E_c}{\frac{\gamma_c}{g}}}$ $\omega_i = 56.54\cdot\frac{1}{sec}$ *EQ (9-23)*

5. CALCULATE COMBINED NATURAL FREQUENCY OF VIBRATION (ω_c) : *APPENDIX A - STEP 9*

REFERENCE SECTION 9.3.4

$\lambda := \sqrt{3.68\cdot g\cdot\tanh\left[3.68\cdot\left(\frac{H_L}{D}\right)\right]}$ $\lambda = 10.28\cdot\frac{ft^{0.5}}{sec}$ *EQ (9-29)*

$\omega_c := \frac{\lambda}{\sqrt{D}}$ $\omega_c = 0.98\cdot\frac{1}{sec}$ *EQ (9-28)*

6. CALCULATE COMBINED NATURAL PERIODS OF VIBRATION (T_i AND T_c):

REFERENCE SECTION 9.3.4 *APPENDIX A - STEP 10*

$k_a := \left(\frac{A_s\cdot E_s\cdot\cos(\alpha)^2}{L_c\cdot S_c}\right) + \left(\frac{2\cdot G_p\cdot w_p\cdot L_p}{t_p\cdot S_p}\right)$ $k_a = 1.17\times 10^4\cdot\frac{kip}{ft^2}$ *EQ (9-27)*

$$T_i := \begin{cases} \begin{cases} 1.25\text{sec} & \text{if } \sqrt{\dfrac{8\cdot\pi\cdot(W_W + W_r + W_i)}{g\cdot D\cdot k_a}} > 1.25\text{sec} \\ \sqrt{\dfrac{8\cdot\pi\cdot(W_W + W_r + W_i)}{g\cdot D\cdot k_a}} & \text{otherwise} \end{cases} & \text{if TYPE} = 3 \\ \dfrac{2\cdot\pi}{\omega_i} & \text{otherwise} \end{cases}$$

EQ (9-26)

$T_i = 0.14\cdot\text{sec}$ *EQ (9-25)*

$$T_c := \frac{2\pi}{\omega_c}$$

$T_c = 6.41\cdot\text{sec}$ *EQ (9-30)*

7. CALCULATE THE SEISMIC RESPONSE COEFFICIENTS (C_I AND C_c): *APPENDIX A - STEP 11*

REFERENCE SECTION 9.4.1

$$T_S := \frac{S_{D1}}{S_{DS}}\cdot\text{sec}$$

$T_S = 0.6\cdot\text{sec}$ *EQ (9-34)*

$$C_i := \begin{cases} S_{DS} & \text{if } T_i \le T_S \\ \min\left(\dfrac{S_{D1}\cdot\text{sec}}{T_i}, S_{DS}\right) & \text{otherwise} \end{cases}$$

EQ (9-32)

$C_i = 1$ *EQ (9-33)*

$$C_c := \begin{cases} \min\left(\dfrac{1.5S_{D1}\cdot\text{sec}}{T_c}, 1.5\cdot S_{DS}\right) & \text{if } T_c \le \dfrac{1.6\text{sec}^2}{T_S} \\ \dfrac{2.4S_{DS}\cdot 1\text{sec}^2}{T_c^{\,2}} & \text{otherwise} \end{cases}$$

EQ (9-37)

$C_c = 0.06$ *EQ (9-38)*

8. CALCULATE THE WAVE DEPTH : *APPENDIX A - STEP 12*

REFERENCE SECTION 7.1

$$d_{max} := \left(\frac{D}{2}\right)\cdot C_c\cdot I$$

$d_{max} = 4.02\cdot\text{ft}$ *EQ (7-2)*

CALCULATE THE FREEBOARD:

$H_F := H_W - H_L$ $H_F = -3\cdot\text{ft}$

H_{Fcheck} := if($d_{max} > H_F$, " CONFIRM LIQUID SPILLS ARE OK" , "FREEBOARD IS OK")

H_{Fcheck} = " CONFIRM LIQUID SPILLS ARE OK"

NOTE: REFER TO ASCE 7-05 SECTION 15.7.6.1.2 AND TABLE
OR MINIMUM FREEBOARD REQUIREMENTS

APPENDIX A - STEP 13

9. COMPUTE DYNAMIC LATERAL FORCES:

REFERENCE SECTION 4.1.1

$P_W := C_i \cdot I \cdot \left(\frac{\varepsilon \cdot W_W}{R_i}\right)$ $P_W = 1.03 \times 10^3 \cdot kip$ *EQ (4-1)*

$P_r := C_i \cdot I \cdot \left(\frac{W_r}{R_i}\right)$ $P_r = 1.86 \times 10^3 \cdot kip$ *EQ (4-2)*

$P_i := C_i \cdot I \cdot \left(\frac{W_i}{R_i}\right)$ $P_i = 1.7 \times 10^4 \cdot kip$ *EQ (4-3)*

$P_c := C_c \cdot I \cdot \left(\frac{W_c}{R_c}\right)$ $P_c = 0 \cdot kip$ *EQ (4-4)*

DETERMINE BASE SHEAR (V_b) **NOTE: DYNAMIC EARTH PRESSURES NOT INCLUDED. PRESSURE CAN BE COMBINED BY SRSS PER EQUATION (4-5)**

$V_b := \sqrt{(P_i + P_W + P_r)^2 + P_c^2}$ $V_b = 1.99 \times 10^4 \cdot kip$ *EQ (4-5)*

10. COMPUTE BENDING AND OVERTURNING MOMENTS: *APPENDIX A - STEP 14*

REFERENCE SECTION 4.1.3

$M_W := P_W \cdot h_w$ $M_W = 2.07 \times 10^4 \cdot ft \cdot kip$ *EQ (4-6)*

$M_r := P_r \cdot h_r$ $(M_r) = 7.64 \times 10^4 \cdot ft \cdot kip$ *EQ (4-7)*

$M_i := P_i \cdot h_i$ $M_i = 3.65 \times 10^5 \cdot ft \cdot kip$ *EQ (4-8)*

$M_c := P_c \cdot h_c$ $M_c = 0 \cdot ft \cdot kip$ *EQ (4-9)*

DETERMINE MOMENT EXCLUDING BASE PRESSURE (EBP)

$M_b := \sqrt{(M_i + M_W + M_r)^2 + M_c^2}$ $M_b = 4.62 \times 10^5 \cdot ft \cdot kip$ *EQ (4-10)*

DETERMINE OVERTURNING MOMENT AT BASE INCLUDING BASE PRESSURE (IBP)

$M'_i := P_i \cdot h'_i$ $M'_i = 7.37 \times 10^5 \cdot ft \cdot kip$ *EQ (4-11)*

$M'_c := P_c \cdot h'_c$ $M'_c = 0 \cdot ft \cdot kip$ *EQ (4-12)*

$M_o := \sqrt{(M'_i + M_W + M_r)^2 + M'_c{}^2}$ $M_o = 8.34 \times 10^5 \cdot ft \cdot kip$ *EQ (4-13)*

11. COMPUTE VERTICAL AMPLIFICATION FACTOR:

APPENDIX A - STEP 15

REFERENCE SECTION 9.4.3

$$T_V := 2\cdot\pi\cdot\sqrt{\frac{\gamma_L\cdot D\cdot {H_L}^2}{2\cdot g\cdot t_w\cdot E_c}} \qquad T_V = 0.12\,s$$

EQ (9-31)

$$C_t := \begin{cases} S_{DS} & \text{if } T_V \le T_S \\ \dfrac{S_{D1}\cdot sec}{T_V} & \text{otherwise} \end{cases} \qquad C_t = 1$$

EQ (9-39)

EQ (9-40)

12. COMPUTE HYDRODYNAMIC PRESSURE:

APPENDIX A - STEP 16

REFERENCE SECTION 4.1.4

$$u_v := \max\left(C_t\cdot I\cdot\frac{b}{R_i}, 0.2\cdot S_{DS}\right) \qquad u_v = 0.42 \qquad i := 0\,..\,10$$

EQ (4-15)

$$y_i := (1 - .1\cdot i)\cdot H_L \qquad q_{hy_i} := \gamma_L\cdot(H_L - y_i) \qquad p_{hy_i} := u_v\cdot q_{hy_i}$$

EQ (4-14)

Height	q_{hy} (ksf)	p_{hy} (ksf)	
43.00	0.00	0.00	Top
38.70	0.30	0.13	
34.40	0.60	0.25	
30.10	0.90	0.38	
25.80	1.20	0.50	
21.50	1.51	0.63	
17.20	1.81	0.75	
12.90	2.11	0.88	
8.60	2.41	1.00	
4.30	2.71	1.13	
0.00	3.01	1.25	Bottom

$$\left(\frac{y}{ft} \quad \frac{q_{hy}}{ksf} \quad \frac{p_{hy}}{ksf}\right)$$

13. COMPUTE VERTICAL DISTRIBUTION OF PRESSURES:

APPENDIX A - STEP 17

REFERENCE SECTION 5.3.3. AND R5.3.3

$$P_{wy} := \frac{P_W}{2H_W} \qquad P_{wy} = 12.94\cdot\frac{kip}{ft}$$

$$p_{wy} := \frac{P_{wy}}{\pi\cdot\frac{D}{2}} \qquad p_{wy} = 0.075\cdot ksf$$

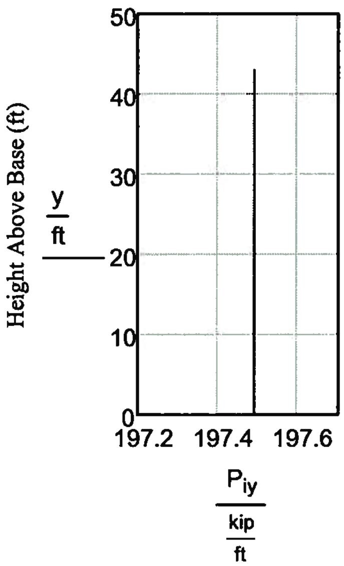
COMPUTE THE IMPULSIVE WATER PRESSURE (p_{iy}):

$$P_{iy_i} := \frac{\frac{P_i}{2}\cdot\left[4\cdot H_L - 6\cdot h_i - \left(6H_L - 12\cdot h_i\right)\cdot\frac{y_i}{H_L}\right]}{H_L^{\,2}}$$

$$p_{iy_i} := \frac{\left(2\cdot P_{iy_i}\right)\cdot\cos(0)}{\pi\cdot\frac{D}{2}}$$

Height	P_{iy} (kip/ft)	p_{iy} (ksf)	
43.00	197.49	2.29	Top
38.70	197.49	2.29	
34.40	197.49	2.29	
30.10	197.49	2.29	
25.80	197.49	2.29	
21.50	197.49	2.29	
17.20	197.49	2.29	
12.90	197.49	2.29	
8.60	197.49	2.29	
4.30	197.49	2.29	
0.00	197.49	2.29	Bottom

$$\left(\frac{y}{ft}\quad \frac{P_{iy}}{\frac{kip}{ft}}\quad \frac{p_{iy}}{ksf}\right)$$

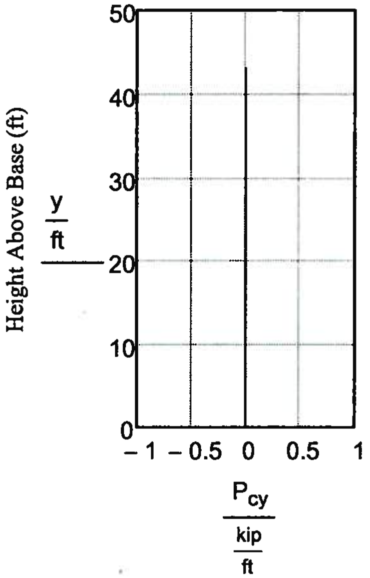


COMPUTE THE CONVECTIVE WATER PRESSURE (p_{cy}):

$$P_{cy_i} := \frac{\frac{P_c}{2}\cdot\left[4\cdot H_L - 6\cdot h_c - \left(6H_L - 12\cdot h_c\right)\cdot\frac{y_i}{H_L}\right]}{H_L^{\ 2}} \qquad p_{cy_i} := \frac{\left(16\cdot P_{cy_i}\right)\cdot\cos(0)}{9\pi\cdot\frac{D}{2}}$$

Height	P_{cy} (kip/ft)	p_{cy} (ksf)	
43.00	0.00	0.00	Top
38.70	0.00	0.00	
34.40	0.00	0.00	
30.10	0.00	0.00	
25.80	0.00	0.00	
21.50	0.00	0.00	
17.20	0.00	0.00	
12.90	0.00	0.00	
8.60	0.00	0.00	
4.30	0.00	0.00	
0.00	0.00	0.00	Bottom

$$\left(\frac{y}{ft} \quad \frac{P_{cy}}{\frac{kip}{ft}} \quad \frac{p_{cy}}{ksf}\right)$$



14. CALCULATE THE HOOP FORCES: *APPENDIX A - STEP 18*

REFERENCE SECTION 6.2

$$N_{y_i} := \sqrt{\left(p_{iy_i}\cdot\frac{D}{2} + p_{wy}\cdot\frac{D}{2}\right)^2 + \left(p_{cy_i}\cdot\frac{D}{2}\right)^2 + \left(p_{hy_i}\cdot\frac{D}{2}\right)^2}$$

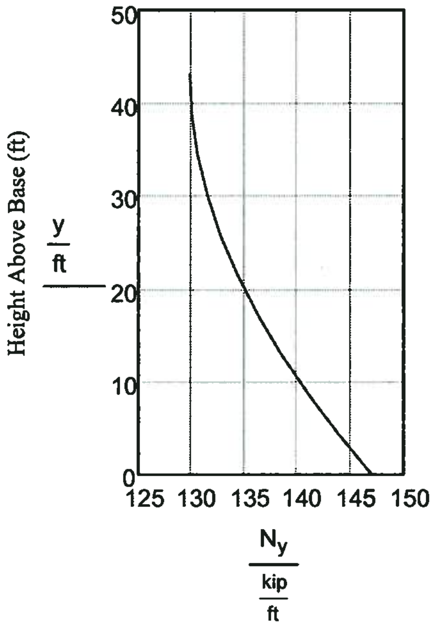
Ultimate Hoop Force *EQ (6-1)*

$$\sigma_{y_i} := \frac{N_{y_i}}{t_w}$$

Ultimate Hoop Stress *EQ (6-2)*

Height	N_y (kip/ft)	σ_y (psi)	
43.00	129.84	721.36	Top
38.70	130.03	722.38	
34.40	130.58	725.42	
30.10	131.48	730.46	
25.80	132.74	737.46	
21.50	134.35	746.37	
17.20	136.28	757.12	
12.90	138.53	769.62	
8.60	141.08	783.80	
4.30	143.92	799.57	
0.00	147.03	816.83	Bottom

$$\left(\frac{y}{ft}\quad \frac{N_y}{\frac{kip}{ft}}\quad \frac{\sigma_y}{psi}\right)$$



NOTE ABOVE FORCES ARE FOR A FREE BASE AND SHOULD BE ADJUSTED TO ACCOUNT FOR BASE RESTRAINT PER SECTION R6.2.

NOTE: DYNAMIC EARTH PRESSURES NOT INCLUDED. PRESSURE CAN BE COMBINED BY SRSS PER EQUATION (4-5)

ADDITIONAL DESIGN OUTPUT

$V_b = 1.99 \times 10^4 \cdot kip$ BASE SHEAR

$M_b = 4.62 \times 10^5 \cdot ft \cdot kip$ OTM EXCLUDING BASE PRESSURE

$M_o = 8.34 \times 10^5 \cdot ft \cdot kip$ OTM INCLUDING BASE PRESSURE

H_{Fcheck} = " CONFIRM LIQUID SPILLS ARE OK"