BYU ENGINEERING
Civil & Construction Engineering

CAPSTONE

SPANISH FORK PEDESTRIAN BRIDGE
PROJECT ID: CEEN_CPST_013

by

Team Cedar
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A Capstone Project Final Report

Submitted to

Taylor Nordquist
AGEC INC.

Department of Civil and Construction Engineering
Brigham Young University

April 17, 2023

BYU ENGINEERING
Civil & Construction Engineering

CAPSTONE

April 17, 2023
BYU Engineering
Civil and Construction Engineering
240 EB
Provo, UT 84602

Attn: Taylor Nordquist
AGEC Inc.
E: TaylorN@agecinc.com

Re: BYU Capstone Final Report
Spanish Fork Pedestrian Bridge
Spanish Fork, UT 84660
Capstone Project #013

Dear Mr. Nordquist,

We have completed the final report for the Spanish Fork Pedestrian Bridge project. The extent of this report is in compliance with the BYU Capstone agreement and includes a geotechnical section as well as a bridge foundation design section. Recommendations for the project are provided for earthwork consideration, design of shallow foundations and deep foundations, slope stability, pavement design, design loading, and anchor bolt design.

We appreciate the opportunity to work on this project and are grateful for the experience we gained by doing so.

Sincerely,

Team Cedar
Nathan Niederhauser
Sarah Partington
Kayla Wolfley

Table of Contents

Cover Page 1
Letter of Introduction 2
Table of Contents 3
List of Figures 5
List of Tables 5
Introduction 6
Schedule 7
Assumptions & Limitations 8
Design, Analysis, and Results 10
Phase 1: Geotechnical Report 11
Site Conditions 12
Earthworks 12
Grading 12
Drainage 14
Bearing Capacity 14
Groundwater 14
Seismic 15
Liquefaction 15
Slope Stability 16
Bridge Scour 16
Pavement Design 17
General comments 18
Phase 2: Structural Report 19
Bridge Layout 20
Structural Design Loads 20
Footings and Foundations 22
Shallow Foundation Design 22
Deep Foundation Design 25

Recommendation ... 26
Related Issues ... 27
Lessons Learned ... 29
Conclusions ... 30
Conclusion and Recommendations ... 31
Appendices ... 32
Appendix A ... 32
Appendix B ... 35
Appendix C ... 45

List of Figures

Figure 1 Plan View of Foundation Option 1 - Individual Piers 24
Figure 2 Section View of Foundation Option 1- Individual Piers 25
Figure 3 Plan View of Foundation Option 2 - Continuous Foundation Wall 26
Figure 4 Section View of Option 2 - Continuous Foundation Wall 26
Figure 5 Section View of Option 3 - Deep Foundation 27
Figure 6 Boring Location Map 36
Figure 7 Boring Logs 38
Figure 8 Grain Size Distribution Plots 40
Figure 9 Plasticity Chart with B-6 @ 9, B-6 @and B-6@19 plotted 42
Figure 10 100-year flood map 43
Figure 11 Slope Stability 45
Figure 12 Structural Calculations Option 1 55
Figure 13 Anchor Design Option 1 59
Figure 14 Structural Calculations Option 2 64
Figure 15 Anchor Design Option 2 68
Figure 16 Details for Shallow FoundationsC 70

List of Tables

Table 1 Project timeline including accomplishments and challenges. 7
Table 2 Fill Lift thickness, Compaction and Moisture content requirements. 13
Table 3 Fill Requirements 14
Table 4 Ground water level at each boring site. 15
Table 5 Seismic Considerations 16
Table 6 Required physical properties of riprap. 17
Table 7 Required gradation limits of riprap. 18
Table 8 Pavement Design section and required thickness. 19
Table 9 LRFD load combinations. 22
Table 10 Recommendations 32
Table 11 D-Values 41
Table 12 200 sieve washes results. 41
Table 13 B-6 @9, B-6 @14 and B-6@19's Atterberg Limit test results and classification. 42

Introduction

This report includes a geotechnical report and structural foundation report for a pedestrian bridge to be built in Spanish Fork, UT near 8650 S 1100 E. The geotechnical report is based upon samples taken from boring holes drilled on November 11, 2022. It contains information and recommendations related to earthworks (grading, drainage, and bearing capacity), groundwater, seismic analysis, liquefaction, slope stability, bridge scour, and pavement design. Maps showing the site and boring locations are shown in Appendix B along with all boring logs and laboratory results.

The structural foundation report for the bridge contains alternative designs for the cast-in-place concrete bridge foundations. Both deep and shallow foundations have been considered, and environmental concerns such as concrete cost and the natural terrain have been addressed in design. Assumed live and dead loads used in the bridge analysis and design are also explained in the report. Because the bridge is prefabricated, its design will not be included in this report.

Team Cedar has provided work for this Capstone project "as is" in accordance with generally accepted geotechnical and structural engineering practices in the area. Project results cannot be construed as work performed by licensed professionals and cannot be used as "stamped deliverables" without first being reviewed, approved, and stamped by a qualified and relevant licensed professional engineer.

Schedule

Table 1 Project timeline including accomplishments and challenges.

Date	Milestone	Notes on Accomplishments/ Challenges
9/12/2022	Formation of Capstone Group	Decided on team name
9/19/2022	Received Team Assignment	Read through assignment to gain a general understanding of the scope of the project
10/17/2022	Capstone Kickoff Dinner	Met Project Mentor
11/11/2022	Drilling Site Visit	Filled out boring log for samples. Brought samples to the BYU soils lab. Completed a general survey of area to obtain elevation and slope data
11/14/2022	Completed Scope of Work	Turned in our completed Scope of Work and sent to mentor.
11/28/2022	Start Completing Phase 1: Geotechnical Report	Initiated soil testing, calculations, and analysis. Started compiling the report. Faced challenging concepts we needed further guidance on. Resolved challenges associated with missing soil sample.
1/23/2023	Met with Dr. Rollins	Got further guidance on the geotechnical report and became better equipped to face many of the technical challenges we were facing.
2/6/2022	Opened Shelby Tube	Encountered sluff in the Shelby tube that made it challenging to run the tests we intended to. Ran the tests we could.
2/21/2023	Started Phase 2: Structural Report	Met with our structural mentor to get needed information and discuss challenges
3/6/2023	Finished rough draft of Geotechnical Report and obtained loading information	Began fine tuning final draft of geotechnical report. Obtained loading information to move forward with the foundation design.
3/13/2023	Finished the Shallow and Deep Foundation Design	Had trouble finding free software for foundation design that would fit our needs. Eventually, a demo version of Enercalc was found.
3/20/2023	Finished Phase 2: Structural Report	Team now finished both phases of our project. Final report was fine-tuned and delivered to our mentor for review.
3/24/2023	Meet with Mentor for Report Feedback	Will apply feedback before submitting our final deliverable.

Assumptions & Limitations

This report has been prepared in accordance with generally accepted soil and foundations engineering practices with the occasional modification for student use. Limitations include any data that could not be obtained before the end of the semester and therefore was assumed for the scope of the project. This report is also limited by the students' level of knowledge and experience.

The recommendations given are based on soil obtained from two borings as shown Appendix B and soil testing conducted at Brigham Young University. Because the study was confined to two borings, subsurface conditions may differ significantly from the results of drilling.

Groundwater levels may also vary from the levels recorded in this report depending on the time of year and the year-on-year changes to the groundwater table.

Assumptions for the layering of the soil were determined by using the shallowest depths for each layer recorded from the log and by assuming that all fine-grained soils are clay. In calculating the density of each layer, the lowest friction angle calculated from the SPT blowcounts was used, along with the US Navy 11.13 graph to then determine the dry density of each layer. Moist and saturated densities were then calculated accordingly.

The bearing capacity of the soil used assumptions of an N value of 22 based off the lowest N value from the running average of N(60) values. Additionally, an assumed phi value of 35 was used for the structural fill. Final calculations assumed a width of 0.5 feet and depth of 1 foot.

All soils calculations were assumed to have a factor of safety of 3.

When the team took the samples back to BYU's soil lab, sample B-5@4 was found to be missing. As a result, the properties of this sample were assumed to be like surrounding samples. Additionally, the material gathered in the Shelby tube was insufficient to run certain soils testing and thus aspects of that layer were limited to a pocket penetrometer reading.

Students assumed unverified preliminary loadings provided by mentors at Consor Engineering. Additionally, it was assumed that seismic design must be considered for Spanish Fork.

There were limited design tools available to the students while designing the foundations. Ultimately, a Demo version of Enercalc was used for the foundation design and Simpson Strong Tie’s Anchor Designer was used to design anchors for the bridge into the concrete. Because Team Cedar did not have the plans for the prefabricated bridge, the analysis was preliminary, and the anchor designs especially may not reflect what the finished bridge designs show. Concrete breakout in shear was not evaluated for the anchor design and the response of the foundation designs to lateral forces were both outside the scope of this project and should be investigated before completion of the ultimate foundation design.

Design, Analysis & Results

The design, analysis, and results for this project are found in the geotechnical report and structural report presented in the following pages.

Phase one: Geotechnical Report

Site Conditions

The site is located in Spanish Fork, UT near 8650 S 1100 E. Two boring holes were drilled which will be referred to as B-05 and B-06 in the report. B-05 was located at 40.075207 N, -111.629274 E and B-06 at 40.074953 N, -111.629295 E. There was an existing asphalt trail next to B-05 and private property near B-06. At both boring holes, vegetation covered the soil and there were relatively flat grades. The Spanish Fork River runs between the two boring holes. The ground slopes a max of 2.2 feet vertically to 1 foot horizontally a few feet away from both boring holes to the river which lies 10 - 20 feet lower than the elevation of the boring hole locations. An existing vehicle road is the only structure within significant distance of the boring holes and will remain in place during the construction of the pedestrian bridge as well as afterward.

Earthworks

A. Grading

All grades must provide effective drainage away from proposed structures and direct water towards designed drainage control systems during and after construction. Based on the soil encountered onsite and the analysis of it, we provide the following recommendations.

1. Subgrade Preparation: Existing unsuitable fill, topsoil, vegetation, debris, organics, and other unsuitable material should be removed within 5 feet of the proposed footings to reduce likelihood of differential settlement. Removed fill should be replaced with fill to meet the standards detailed in the “Fill Material Types” section. A geotechnical engineer should observe footing excavation prior to structural fill or concrete placement.

2. Excavation: If excavation is required beneath the water table, dewatering should occur. The water level should remain below the base of the excavation during fill and concrete installment.

   If there is excavation of the existing fill, natural clay, silt and/or sand, the temporary unretained slopes should be 1 ½ horizontal to 1 vertical or flatter.

Additional evaluation of excavation slopes may be required by a qualified engineer during the construction process to ensure safe working conditions.

3. Compaction: Existing fill should be removed and replaced with fill to meet the following standards per ASTM D 1557 and 2018 IBC.

Table 2 Fill Lift thickness, Compaction and Moisture content requirements.

Item	Description
Fill Lift Thickness	Loose thickness to be 4" or less if hand-operated compaction equipment is used. A loose thickness of 12" or less is acceptable if a smooth wheel roller or other heavy equipment is used.
Compaction	95% of the material's maximum dry density
Moisture Content	Within 2% of optimum moisture content as determined by the modified Proctor test at the time of placement and compaction

Structural fill should be frequently tested for conformance with compaction requirements.

4. Fill Material Types: Materials used for structural and general fill should meet the following material requirements per UDOT Standard Specification.

Table 3 Fill Requirements

<table>
<tr><th rowspan="3">Fill type*</th><th rowspan="3">Application</th><th colspan="3">Requirements</th></tr>
<tr><th colspan="2">Gradation</th><th rowspan="2">Plasticity</th></tr>
<tr><th>Size</th><th>% Finer by weight</th></tr>
<tr><td>MSE Backfill</td><td>MSE Reinforced zone</td><td colspan="3">UDOT Standard Specifications Section 02056</td></tr>
<tr><td>Borrow</td><td>Embankment fill</td><td colspan="3">UDOT Special Provision 02832S</td></tr>
<tr><td rowspan="3">Structural fill**</td><td rowspan="3">Required for all fill placed under foundations and pavements</td><td>3-inch</td><td>100</td><td rowspan="3">Liquid limit 30 max
Plasticity Index 6 max</td></tr>
<tr><td>No. 4 Sieve</td><td>25-60</td></tr>
<tr><td>No. 200</td><td>15 max</td></tr>
<tr><td rowspan="2">Stabilization fill</td><td rowspan="2">Pumping or deflecting subgrades. To be used in combination with geotextiles</td><td>4-inch</td><td>100</td><td rowspan="2">Non- Plastic; Coarse Angular Rock</td></tr>
<tr><td>No 200</td><td>5 max</td></tr>
<tr><td>General fill</td><td>Used in non-structural areas and as cover around the perimeter of structures not deeper than 2 feet.</td><td colspan="3">Onsite Native Soils</td></tr>
<tr><td colspan="5">*All fill should consist of approved material that are free of organic matter and debris. Frozen material should not be used, and fill should not be placed on a frozen subgrade. A sample of each material type should be submitted to the geotechnical engineer for evaluation.
**Structural fill placed beneath the water table should consist of free- draining gravel with less than 5% passing the No. 200 sieve with a filter fabric between the free- draining gravel and natural soil.</td></tr>
</table>

5. <u>Construction:</u> This report does not reflect methods or consideration for construction of the project. Furthermore, those associated with the design process do not assume the safety of the construction process. All construction considerations and project site safety should be assumed by the contractor. Any questions or modifications during the construction process should be addressed to a licensed engineer and are beyond the scope of this report.

B. Drainage:

Adequate draining should be maintained throughout the lifetime of the structure, as water retained next to the structure may result in soil movements greater than those discussed in this report. Drainage should be incorporated into structural designs to direct water away from structures and wall faces to prevent hydrostatic pressures from developing.

C. Bearing Capacity

The allowable bearing capacity of footings was calculated to be 2500 psf for footings with a base width greater than or equal to 0.5 feet and an embedment greater than or equal to 30 inches for frost depth. Footings should bear on undisturbed native soil or structural fill extending down to the undisturbed native soil. Settlement for the allowable bearing capacity is expected to be less than one inch.

D. Lateral Earth Pressures

The limiting factor for later earth pressure against the shallow foundation footings is a horizontal seismic force of 93 kips. The active, at-rest, and passive lateral earth pressures are 180, 1284, and 2907 lbs/ft respectively.

Groundwater

Groundwater was encountered onsite while drilling bore holes. While the bore holes remained open, the ground water levels were observed. On the south end of the site, in boring hole B-5, ground water was found at 12 feet below ground level (table 4). On the north side of the site, in boring hole B-6, ground water was found at 9 feet below ground level.

Table 4 Ground water level at each boring site.

Site	Groundwater level (ft below ground level)
B-5	12
B-6	9

Groundwater fluctuations naturally occur due to seasonal variations in precipitation, runoff, irrigation, and other factors not present at the time the borings were performed. Thus, groundwater levels during construction and throughout the life of the pedestrian bridge may be higher or lower than the levels noted in this report.

Seismic

The seismic design maps created by SEAOC and OSHPD based on the National Seismic Hazard Map database were searched to find the following geotechnical parameters. The peak ground acceleration (PGA) and spectral accelerations for both 0.2 seconds (S_s) and 1 second (S_1) intervals were found in accordance with ASCE 7-16. These values should be adjusted for site effects where appropriate.

Table 5 Seismic Considerations

Description	Values
AASHTO LRFD Seismic Site Classification	D
Site Latitude	40.075
Site Longitude	-111.629
Peak Ground Aceleration (PGA psf)	0.646
S_s Spectral Acceleration for a Short Period (0.2 Sec) - Site Class D	1.421
S_1 Spectral Acceleration for a 1-Second Period (1.0 Sec) - Site Class D	0.529
F_a Site Coefficient for a Short Period	1.2
F_{PGA} Site Amplification Factor at PGA	1.2

The nearest fault is the Provo section of the Wasatch Fault, the nearest segment of which is located approximately 1.3 miles from the site.

Liquefaction

The northern side of the river is shown as having high liquefaction potential and the southern side is shown as having low to very low liquefaction potential (Christenson, Shaw, 2008). An in-depth liquefaction analysis was beyond the scope of this report.

Slope Stability

Our analysis of both slopes under the bridge indicates that the proposed loadings from the bridge abutments will maintain a factor of safety against slope failure of 1.4 or higher for both slopes.

Bridge Scour

The designs for this bridge include options for a spread footing or deep foundation design at each end of the bridge. Accordingly, we do not anticipate placing a pier or any type of foundation in the water and therefore bridge scour to the foundations will not occur from the river. Hence, the only place where scour could occur would be along the embankment under the bridge.

We calculated from the Federal Emergency Management Agency that a 100-year flood would raise the elevation of stream water to 4642 feet. This would raise the water level 14 feet from the bottom of the streambed. To prevent against scour to the slope under the abutments, we recommend either placing riprap to an elevation of 14 feet on the slope and 25 feet laterally on either side of the bridge or using concrete slope paving for similar dimensions. Additional study of the stability of the slope with concrete paving and possible retaining walls should be considered should this option be chosen.

Requirements for the specifications of the riprap can be found below according to UDOT Standard Specifications Section 02373.

Table 6 Required physical properties of riprap.

Physical Properties		
Property	**Value**	**Test Method**
Specific Gravity	2.5 min	AASHTO T 85
Absorption	2% max	AASHTO T 85
Soundness of Aggregate using Sodium Sulfate or Magnesium Sulfate	12% max or 17.5% max	AASHTO T 104
Resistance to Degradation	40% max	AASHTO T 96

Table 7 Required gradation limits of riprap.

Riprap Gradation Limits	
Rock Diameter Range (ft)	Percent of Gradation Smaller Than
$1.5D_{50}$ to $1.7D_{50}$	100
$1.2D_{50}$ to $1.4D_{50}$	85
$1.0D_{50}$ to $1.15D_{50}$	50
$0.4D_{50}$ to $0.6D_{50}$	15
$0.1D_{50}$	10

Deep Foundation Recommendations

A deep foundation recommendation was provided per request of the client. The proposed design includes two cast-in place piers on each side of the bridge, to which the anchor bolts would connect. The piers have a diameter of two feet and a depth of 32.5 feet with no belled-out bottom feature. This design results in an allowable skin friction resistance force of 175 tons.

Pavement Design

Pavement sections were designed in accordance with AASHTO and designed for pedestrian, bike, and small maintenance vehicle traffic. Note that loads produced by vehicles larger than a standard pickup truck carrying maintenance materials were not included in the design.

It was calculated that there would be approximately 0.94 ESALs/year with the assumption that one maintenance vehicle would cross the bridge each month. The pedestrian bridge is next to a standard roadway bridge, so it is unlikely that many vehicles will use the trail bridge as opposed to the main road.

Using AASHTO's pavement design equations and UDOT's General Guidelines for Trail Thickness, the following pavement section was created.

Table 8 Pavement Design section and required thickness.

Pavement Section	Thickness (in)
Hot Mix Asphalt Topping	3
Compacted Aggregate Base	6
Subbase	NA
Subgrade	NA

Pavement should be sloped to prevent water from accumulating on the trail as water accumulation of the trail can cause early deterioration of the pavement. The aggregate base should be designed to allow for drainage beneath the pavement as well.

General Comments

The recommendations, analysis, and result of this report are based on our understanding of the scope of the project and data collected from drilling. Weather, variations in subsurface conditions, and other parameters outside of the scope or control of this project may require modification to original designs. Such modifications should be solved through the retention of a licensed geotechnical engineer.

Additionally, anything that has not been stated as a specific finding is outside the scope of this report. This includes environmental analyses and if such concerns of environmental hazards are warranted, an environmental agency should be contacted to conduct a thorough analysis.

Information contained in this report is intended for the use of AGEC and their discretion only.

This report is independent of all contractor and construction procedures. It is also not a risk assessment report or to be used as a precise estimation for construction costs. Variations and unspecified costs can occur outside the scope of this project, which is intended for design purposes only.

Phase Two: Structural Report

The following structural report contains solutions for the concrete foundations of a prefabricated steel pedestrian bridge to be built in Spanish Fork near the Poplar Lane Trailhead. The bridge design will be performed by other organizations. The soil properties and bearing capacities used in the design of the foundations were taken from the geotechnical report presented in Phase 1 of this document. Two shallow foundation options and a deep foundation option will be presented, and an ultimate recommendation will be provided. The students in Team Cedar are not professional engineers and the contents of this report should be reviewed and approved by a licensed engineer before use in the field.

Bridge Layout

Based on drawings received from the prefabricated bridge designer and specifications provided by Spanish Fork City, the bridge was taken to be 80' long and 12' wide. It was assumed that the bridge structure will consist of steel trusses and have a 4" thick concrete topping on the surface of the deck. Deviation in the final design of the bridge from these assumptions will require updated calculations.

Structural Design Loads

The following loads are preliminary and reflect a 10' wide bridge. Due to uncertainty in the ultimate bridge design, these loads were not scaled up for a 12' bridge for the foundation design. If the prefabricated bridge plans show a 12' wide bridge, these loads should be recalculated.

Dead Load (DL)
The bridge structure shall be designed for the total bridge wight including the final concrete deck system.

Pedestrian Loading (PL)
The bridge structure shall be designed for a uniform pedestrian loading of 36 K.

Vehicle loading (VL)
The bridge structure and deck system shall be designed for a small maintenance truck. The vehicle load shall not be placed in combination with the pedestrian load.

Wind load (WS)
Pedestrian bridges shall be designed for wind loads as specified in AASHTO signs, Articles 3.8 and 3.9. The loading shall be based on a wind speed of 110 mph and applied over the exposed area.

Snow loading (SL)
The bridge structure shall be designed for the total snow load of 18 kips.

Seismic Loading (EQ)
The bridge structure shall be designed for the horizontal and vertical seismic loadings of 93 kips and 38 kips respectively.

Fatigue Loads (FL)
There is no need to consider fatigue loads to be considered in this case.

Thermal loads (TU)
There is no need to consider thermal loads as the bridge will have slip connections on one end.

The LRFD load combination that results in the highest design load is the governing combination. This project’s design load resulted from load combination 6 and was 225 kips.

Table 9 LRFD load combinations.

LC	LRFD load combinations	where
1	1.4D	D= Dead Load
2	1.2D+1.6L+.5(Lr or S or R)	L= Live Load
3	1.2D+1.6(Lr or S or R) + (L or .5W)	Lr= Roof live load
4	1.2D+W+L+.5(LR or S or R)	S snow load
5	0.9D+W	W= wind load
6	1.2D+Ev+Eh+L+.2S	R= rain load
7	0.9D-Ev+Eh	E= seismic load (vertical and horizontal)

Footings and Foundations

Shallow Foundation Design

The shallow foundation design includes concrete walls and footings, as well as anchors for the bridge and anchor reinforcement where required. Per Utah code, frost depth was taken to be 30" and the minimum spot footing size of 20"x20" was considered during design. Two designs for the concrete abutments on either side of the bridge will be presented. Because Team Cedar didn't have access to the designs of the prefabricated bridge, the designs are based on assumed preliminary loading cases and should be compared with the actual bridge design.

Both designs utilize 4000 psi concrete as well as Grade 60 #5 rebar. Note that concrete breakout due to shear forces analysis was outside of the scope of this project.

Option 1: Individual Piers

The first design is for a four-point bearing system, where the bridge is supported by four individual concrete piers, one at each corner of the bridge. The two piers sharing a side of the bridge also share a concrete footing due to the size of footings needed to distribute the load over the soil so that its bearing capacity is sufficient.

The square concrete piers are to be 16" tall and 22" in width. They will be reinforced with Gr. 60 #5 rebar as shown in Detail 2. The concrete footing is to be 16" tall and have a length and width of 16' and 4', respectively. See Detail 1 for more information and for rebar spacing. The bottom of the footing is to be placed 30" below grade such that the tops of the piers are approximately 2" above grade.

Anchors to attach the steel bridge to the concrete foundation should be provided as shown in Detail 3 (Appendix C).

Plan View:

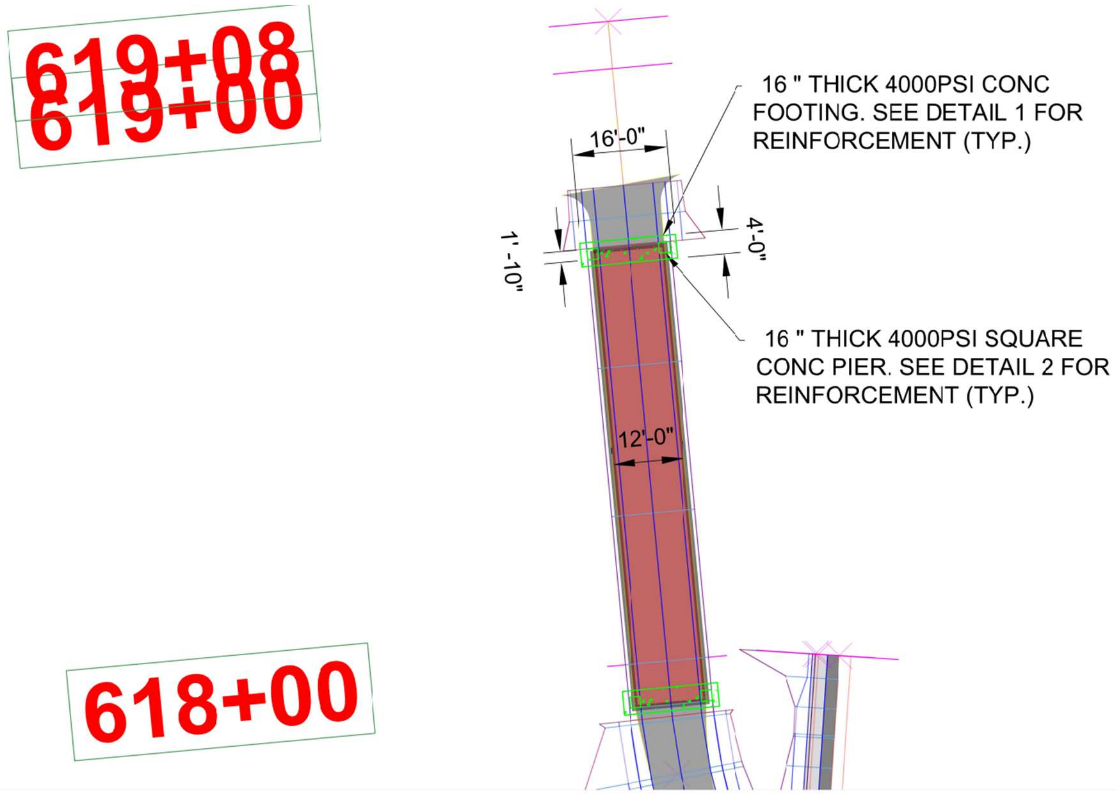


Figure 1 Plan view of foundation option 1- individual piers

Section View:

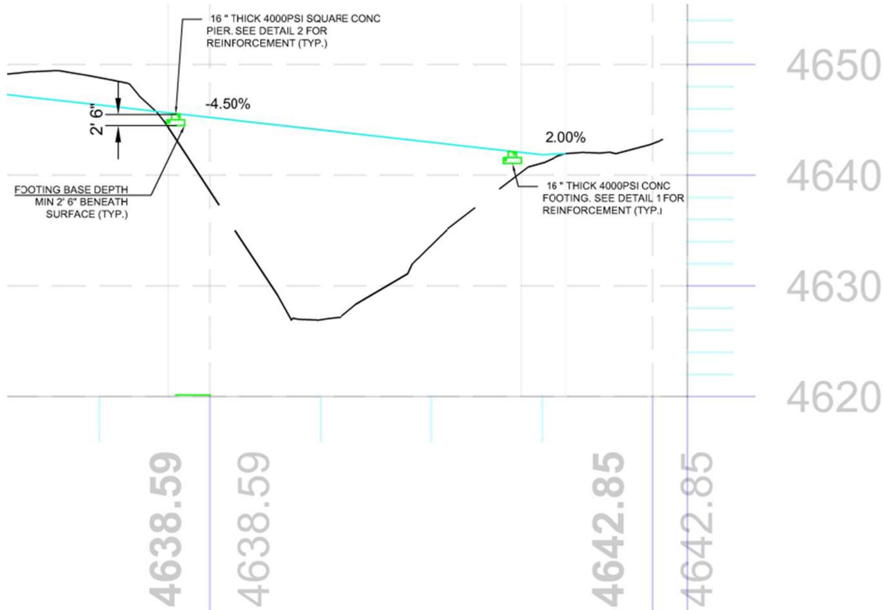


Figure 2 Section view of foundation option 1- individual piers

Option 2: Continuous Foundation Wall

The second design is for concrete abutments on each side of the bridge that span the full bridge width, with the bridge load being distributed uniformly across a 12’ wall. This was simulated in software as a point load over 2’ increments, so the total load on the abutment was divided by five to simulate the behavior of a uniform load as opposed to a single point load.

The concrete wall is to be 3’ tall and 12” wide, with an additional 6” extending above grade. Vertical Gr. 60 #5 rebar is to be spaced at 16” O.C. The 12” thick footing below is to be 5’ wide and match the length of the wall. Gr. 60 #5 rebar is to be placed at 12” O.C. See Detail 4.

Anchors to attach the steel bridge to the concrete foundation should be provided as shown in Detail 5.

Plan view

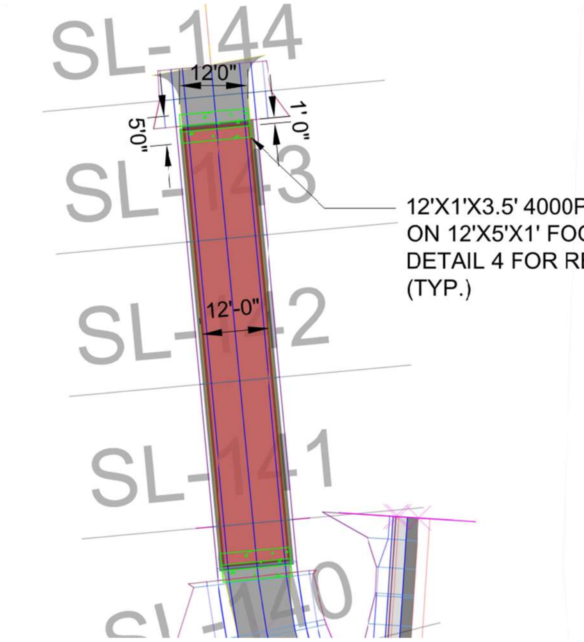


Figure 3 Plan view of foundation option 2- continuous foundation wall

Section View

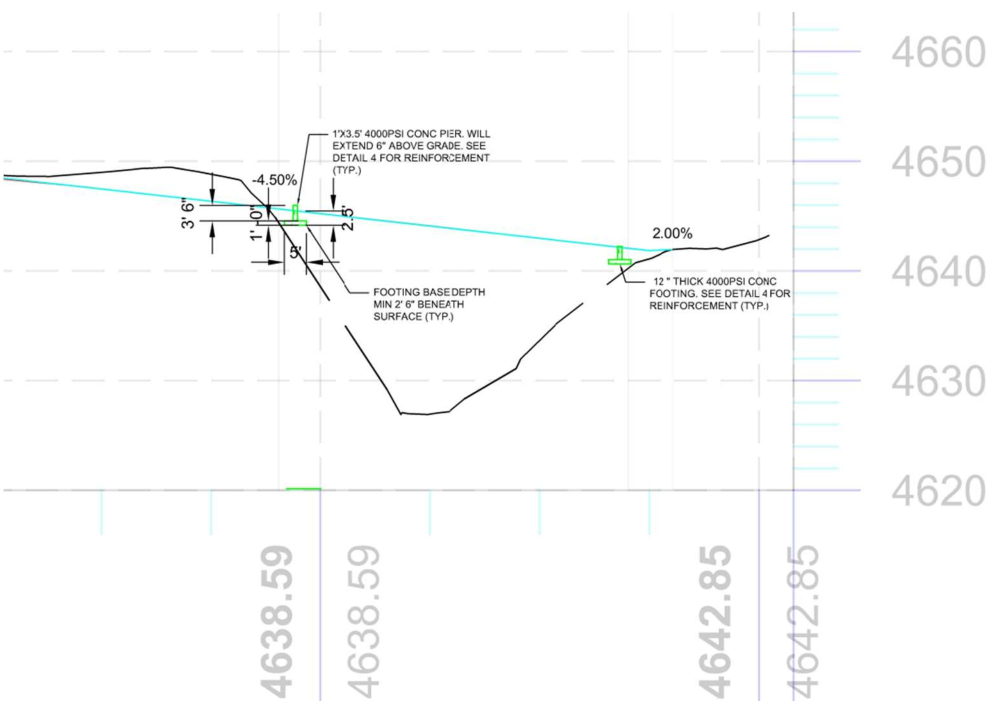


Figure 4 Section view of option 2- continuous foundation wall

Option 3: Deep Foundation Design

The deep foundation design includes concrete auger cast in place piles with a radius of 2 feet and a depth of 32.5 feet. Attached to the end of these are anchor bolts for which the loading of the bridge rests. Design loadings are based on assumed loading cases and will need to be compared with the actual bridge design. Structural fill will be required at the depths specified in the geotechnical report to prevent lateral movement.

Section View

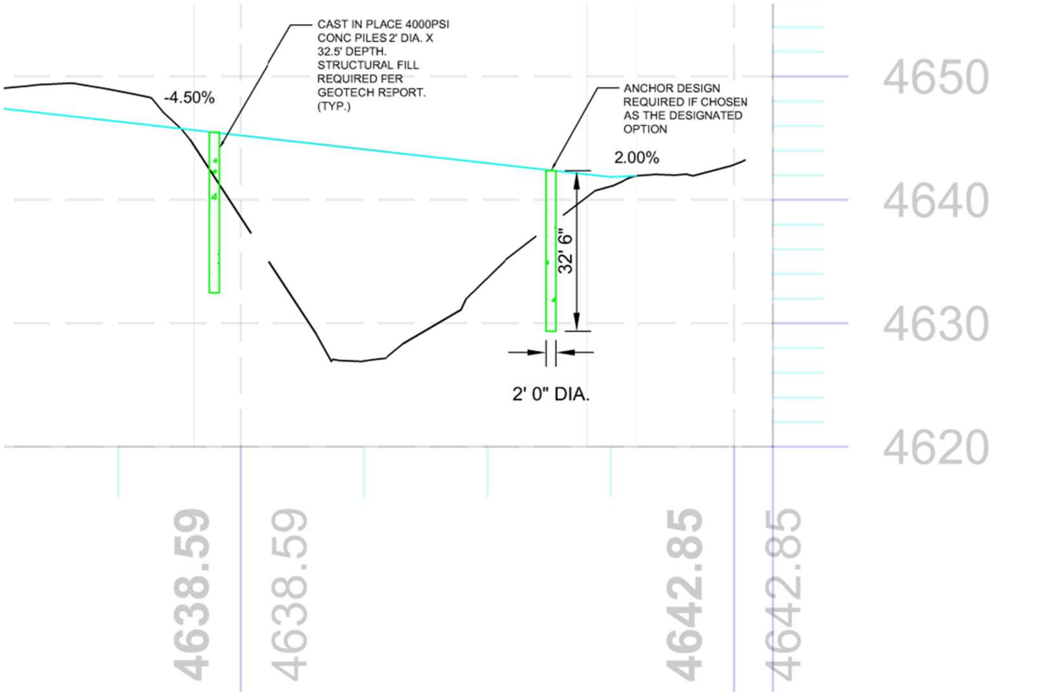


Figure 5 section view of option 3- Deep Foundation

Recommendation

While a deep foundation option was provided, it is not recommended due to its high expense and relative complexity. Of the two shallow foundation designs, Team Cedar recommends using the individual concrete piers option. This provides more simplicity in anchor design and uses much less concrete. This option is also more readily adaptable to bridge design and load changes. The proposed foundation and anchor design should be reviewed for conformance with the final bridge design and design loads provided by the steel bridge fabricator.

Related Issues

The prefabricated steel pedestrian bridge in Spanish Fork, Utah will have significant impacts on public health and safety, and social and environmental factors. There is a potential for positive economic impacts as well. This proposed location of the bridge will be as part of a trail network for both pedestrians and cyclists that is popular with residents of the city and nearby areas.

In an area such as Utah with high population density, may people don't have large yards that give them access to enjoying the natural environment. Spending time in nature, as well as exercising, are critical for physical, mental, and emotional health, and hiking and walking trails are a popular way to do this. While walking or running around one's neighborhood provides exercise, many people prefer going somewhere with more variety and leaving the areas they are exposed to every day. The new pedestrian bridge will provide better access to the trail as well as an expansion of the trail system, providing more opportunities for people to get outside and improve their quality of life and health. Many people use the existing trail system for walking, running, and cycling, and expanding the system will provide those opportunities to more people.

Furthermore, safety will be improved by giving a separate bridge specifically designed primarily for non-vehicle traffic. Currently, there is only a narrow vehicle bridge across the river that has very narrow shoulders and isn't a safe place for pedestrians to cross, especially once the trail system extends to the other side of the river and there is more traffic. The proposed pedestrian bridge will keep people off the vehicle bridge and protect them from potential harm.

Socially, trail systems are a popular gathering place for running or walking groups as well as individuals. People with limited opportunities to interact with others rely on the groups that they're a part of to give them a feeling of connection with other people and reduce feelings of isolation. The expanded trail system and new bridge will draw more people to the area and encourage people to come together and enjoy one another's company as well as the beautiful scenery along the path. More extensive trails also bring with them the potential for more visitors from outside the area, which could boost the economy of the nearby area as people stop at restaurants or fill up on gas.

Effects of the bridge design don't end with people – the natural environment will also be affected. Care was taken in bridge foundation design to provide the most economical solutions while still meeting design criteria in order to minimize the carbon footprint of the project. While some soil will be disturbed by excavation and heavy equipment and some of the existing vegetation will be removed, the creation of a trail system implies an investment in the existing ecosystem and demonstrates a desire to preserve it so that people can enjoy and appreciate it. Much of the soil to be excavated will be structural fill that was placed there when the road bridge was built, and the existing riverbanks will not be modified; the bridge was designed around it.

The Spanish Fork pedestrian bridge will have positive social, economic, and public health repercussions while minimizing effects on the natural environment and preserving it for years to come. The trail system is open access, so people of any background will be able to enjoy it. It is a little out of the way, so it may be hard to access without a personal vehicle, so Team Cedar recommends that Spanish Fork city looks into ways to make the trail system accessible to those in the population without vehicles so that it can be more equitable and so the benefits will be available to all.

Lessons Learned

Our capstone project was unique because it required both a geotechnical and structural report. However, our group was well suited to the challenge with members experienced in the fields of geotechnical and structural engineering. Because of this exceptional blend of experience, we took this as an opportunity to learn from each other during the project. Our most important lesson learned was to know the process behind what each field does when generating their respective reports.

Another important lesson that we learned was how to acquire knowledge we didn't know. Some examples include reaching out to our mentor, Dr. Rollins to learn more about liquefaction, contacting various professors to understand how to perform a bridge scour analysis, and asking questions to Taylor during meetings to know how we could produce a quality product. We also learned how to work with limited information, when we learned that our Shelby tube was mostly sluff and very little native sample. We solved this by performing the tests that were still possible and having a pocket penetrometer on hand to use to estimate the data we would have received, had we had a full Shelby tube sample.

Other lessons that we learned included facing challenges of unexpected events such as sickness due to COVID and how to work as a team despite not meeting in person and coordinating with various schedules. We proudly did what we could and still met our self-imposed deadlines. Similarly, we learned to overcome challenges of lack of software by researching free software and working with the resources that we could find. And we showed resilience by learning how to navigate situations with lack of communication and patiently contacting the right people until we were able to obtain necessary information.

Overall, this project provided invaluable growth and learning about engineering practices in the geotechnical and structural fields. Our knowledge gained prepared us for our careers and establishing ourselves as professional engineers. We will be forever grateful for the many lessons learned and will use them to go about doing good in the world.

Conclusions

A summary of the conclusions drawn from our research and analysis can be easily referenced in the Recommendations section directly below. Through this capstone project, Team Cedar has learned common practices in producing a geotechnical report and structural report, how to accurately perform soil testing, how to design for bridge scour and slope stability, how to design a structural footing and foundation, and how to design adequate anchorage. Additionally, the team learned valuable lessons of teamwork, communication, time management, and technical writing. Overall, the construction of the pedestrian bridge in Spanish fork, Utah will not only serve to benefit the people of the community for years to come, but will positively impact Team Cedar into their careers with the knowledge and experience it offered.

Conclusion and Recommendations

Table 10 Conclusion and Recommendations

Topic	Conclusions and Recommendations
Subsurface Conditions	- Existing fill was found to extend to a depth of 5.5 feet at both bore hole locations. - Native soil primarily consisted of lean clay with variable amounts of sand, silt, and gravel often found in lenses.
Earthwork	- Remove existing fill within 5 feet of the edge of proposed footings and replace with proper structural fill for shallow foundation designs. - Wet or disturbed clay during construction should also be removed. - Proper grading and compaction techniques, which are included in the report, should be followed. - Active, at-rest, and passive lateral earth pressures are 180, 1284, and 2907 lbs/ft respectively.
Groundwater	- Groundwater levels were found to be at 12 feet and 9 feet for B-5 and B-6, respectively.
Shallow Foundations	- Allowable bearing capacity is 2500 psf for embedment greater than 30 inches. - Settlement is expected to be less than 1 inch
Slope Stability and Scour	- Proposed loadings from the bridge abutments will maintain a factor of safety against slope failure of 1.4 or higher for both slopes. - Rip rap or concrete paving should be used to the height of the bridge foundations and extending 25 feet laterally
Pavement Design	- Asphalt concrete or similar mixture for trails should be constructed as follows: - Hot mix asphalt topping of 3 inches - Compacted aggregate base of 6 inches
Design Loads	- 226 Kips per abutment
Foundation Design	- Provide a continuous footing and two individual piers as shown in Details 1 and 2
Anchor Bolt Design	- Provide J-bolts as shown in Detail 3

Appendix A

Sarah Partington

sarahcpartington@gmail.com | 502-548-7291 | www.linkedin.com/in/sarah-partington-17823b210

Education

BS in Civil Engineering Apr 2023 *Brigham Young University* Provo, UT

- ***GPA*** : 3.77 / 4.00
- ***Relevant coursework*** : Statics; Dynamics; Mechanics of Materials; Geomatics; Engineering Drafting; Structural Analysis; Fluid Mechanics, Concrete, Masonry, and Asphalt; Metals, Woods, and Composites; Technical Writing; Reinforced Concrete; Soil Mechanics; Environmental Engineering
- ***Winter 2023 coursework***: Structural Steel Design; Portland Cement Design and Analysis

Technical Skills

- AutoCAD and Revit
- Microsoft Excel and Visual Basic
- Python
- Risa 2D and 3D
- Enercalc

Experience

Research Assistant *Brigham Young University* September 2022 – Current

- Used FEMA P-58 methodology and PACT software to create a fragility analysis for a stand-alone timber structure
- Wrote technical reports to present results and conclusions of research

Engineer in Training *Acute Engineering* January 2022 – Current

- Developed knowledge of safety in design and construction through creating structural plans for homes
- Increased technical knowledge of building codes and the engineering process
- Improved interpersonal skills through working with a team

Teacher at Provo Missionary Training Center *MTC* May 2021 – November 2021

- Developed teaching and communication skills through teaching the Korean language and training others how to teach

Engineering Drafting TA *Brigham Young University* January 2019 – April 2019

- Developed presentation skills through teaching a lecture weekly about AutoCAD and Revit
- Prepared lessons, created and graded assignments, wrote and graded tests

Volunteer Work

Korean-speaking Volunteer *Religious Organization* July 2019 – December 2020

Busan, South Korea; St George, UT

- Developed a strong work ethic and time management skills through working ten hours a day and teaching English as a second language weekly
- Trained new volunteers and set an expectation for hard work and finding creative ways to solve problems

Kayla Wolfley

(801)-664-9717 · Wolfley.Kayla@gmail.com

EDUCATION

Brigham Young University **3.72 GPA** Anticipated Graduation Apr 2023
B.S. in Civil and Construction Engineering *Provo, UT*

- **Related Coursework:** Virtual Design and Construction, Steel Design, Structural Analysis, Sustainable Infrastructure, Engineering Drafting with CAD Application,
- **Academic Awards:** Simpson Strong Tie Structural Engineering Scholarship, BYU Academic Scholarship, J.R. and Shauna Larsen –UG Scholarship, Billy R. Nichols Scholarship, Regents Exemplary Scholarship

Skills

- AutoCAD
- Revit
- BIM- Building Information Modeling
- BlueBeam
- MS Excel
- Visual Basic for Applications (VBA)

PROFESSIONAL EXPERIENCE

Kimley-Horn & Associates May 2022- Aug 2022
Development Services Intern *Pleasanton, CA*

- Designed and completed over 20 sets of construction document packages using AutoCAD and BlueBeam
- Demonstrated AutoCAD proficiency by creating shortcuts that increased production efficiency
- Awarded 4 teamwork awards for going above and beyond to complete projects
- Obtained city permits and communicated between clients and cities to ensure a timely construction process
- Initiated and completed a guide to quickly train future interns and new hires

Acute Engineering May 2021- Present
Production Engineer *Orem, UT*

- Performed structural analysis on diverse light-frame structures
- Created thorough and detailed framing models via AutoCAD, Bluebeam, and Excel
- Resolved inquiries and onsite problems through communication with clients, builders, and city inspectors
- Prioritized tasks for efficient execution by establishing daily feedback loops and time management tools
- Generated over 25 custom details by referencing code publications and product tables

LEADERSHIP

American Society of Civil Engineers (ASCE) Student Chapter Jan 2021- Dec 2022
Vice President *Provo, UT*

- Inspired vision by planning and facilitating 10 weekly seminars with 180 student attendees and nationally renown guest speakers
- Drove attendance up 350% for monthly activities through thoughtful planning and precise execution

Women in Civil Engineering (WCE) Dec 2020-May 2021
Club Liaison *Provo, UT*

- Coordinated 2 meaningful activities per month to support women studying Civil Engineering at BYU
- Established momentum for WCE to increase female underclassmen retention by 20%

VOLUNTEER EXPERIENCE

- Mentor 12 young women with mental illness residing at the Utah State Hospital through activities twice a week *(Aug 2022- Present)*
- Served impoverished areas in West Virginia for 18 months via addiction recovery programs and 15 hours of community service weekly *(2018-2019)*

Nathan Niederhauser

(913) 291-5001 · nlniederhauser@att.net · linkedin.com/in/Nathan-niederhauser-163056245

EDUCATION

Brigham Young University — April 2023
Bachelor of Science: Civil Engineering, Emphasis in Geotechnical Engineering — Provo, UT
Minor in Mathematics

- 3.68 GPA
- Awarded with academic scholarships from BYU and Hallmark
- Participated in local and national ASCE organizations

EXPERIENCE

Terracon — June 2021-Present
Geotechnical Engineering Intern — Midvale, UT

- Performed instrumentation in active construction sites with piezometers, monometers, inclinometers, drill logging, pile testing, percolation testing, and water level readings
- Engaged in high quality material lab testing with hydrometers, Atterberg limits, sieves, proctors, compaction testing, and consolidation testing
- Transcribed drill logs and lab results resulting in on-time deliverable reports for multi-million dollar projects
- Presented changes for entry-level employees to company leadership that were successfully implemented
- Prepared proposals for project managers that resulted in accepted contracts
- Aided project managers in preparing GeoReports including figures, calculations, and analyses, which were rated above 85% quality and delivered on-time
- Assisted Phoenix office with redesign of I-17 by catching the project up to its scheduled delivery dates and successfully standardizing the conventions for the new rock coring logs

BYU Off-Campus Housing — April 2020-June2021
Receptionist — Provo, UT

- Answered approximately 50 calls daily with legal implications
- Managed the organizational maintenance of office vehicles for quarterly due dates
- Assisted managers in successfully writing new housing policies for the university resulting in improved relationships between students and landlords

VOLUNTEER EXPERIENCE

Relay for Life — September 2014-March 2017
District Committee Chair — Overland Park, Kansas

- Organized physical facility arrangements for 2500 attendees
- Raised over $10,000 personally
- Directed meetings with students that resulted in raising a quarter million dollars each year

Church of Jesus Christ of Latter-day Saints — June 2017-May 2019
Volunteer Representative — Gouda, The Netherlands

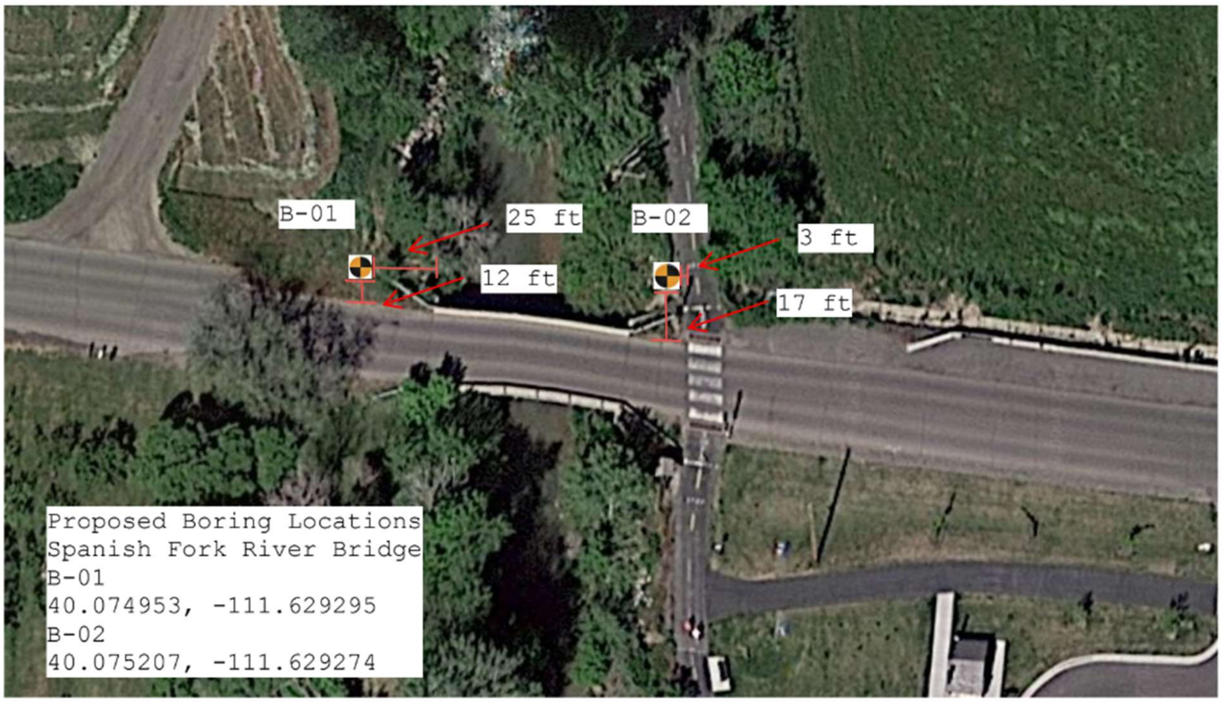
- Travelled abroad in the countries of Belgium and The Netherlands full-time
- Trained and mentored 48 other volunteers in their responsibilities to set and achieve weekly metrics

SKILLS/ACHIEVEMENTS

- Passed FE Civil exam to be certified as an Engineer in Training
- Advanced Computer Application Proficiency with gINT, ArcGIS, VBA, MS Word, MS Excel
- Intermediate Computer Application Proficiency with AutoCAD, Revit
- Basic Computer Application Proficiency with R, Python
- Experienced with ProjectXchange and associated pricing tools
- Professional Working Proficiency in Dutch and Flemish (speaking, writing, reading)
- Eagle Scout

Appendix B

Boring Location Map



We feel that this will be the best locations for boring locations. We took into account ground vegetation, elevation, rig accessibility, possible utilities, and property lines.

Figure 6 Boring Location Map

Boring Logs

BYU ENGINEERING Civil & Construction Engineering	Client: AGEC	BORING LOG
	Project: Spanish Fork Pedestrian Bridge	Boring No. B-05
	Address: 8650 S 1100 E, Spanish Fork, UT	Page: 1 of 1

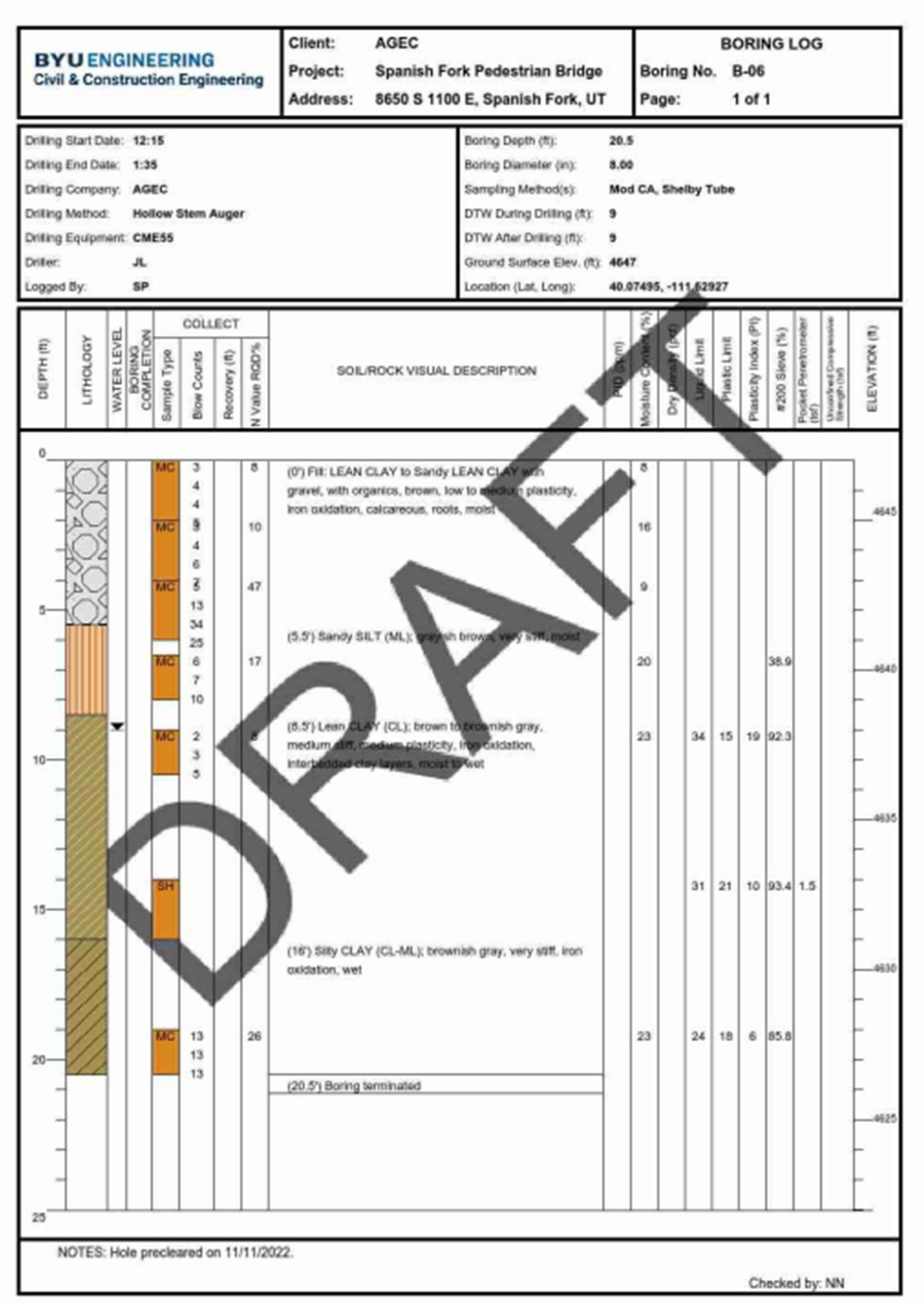
Drilling Start Date:	10:23	Boring Depth (ft):	20.5
Drilling End Date:	12:10	Boring Diameter (in):	8.00
Drilling Company:	AGEC	Sampling Method(s):	Mod CA
Drilling Method:	Hollow Stem Auger	DTW During Drilling (ft):	12.5
Drilling Equipment:	CME55	DTW After Drilling (ft):	12
Driller:	JL	Ground Surface Elev. (ft):	4639
Logged By:	SP	Location (Lat, Long):	40.07518, -111.62945

DEPTH (ft)	LITHOLOGY	WATER LEVEL	BORING COMPLETION	Sample Type	Blow Counts	Recovery (ft)	N Value RQD%	SOIL/ROCK VISUAL DESCRIPTION	PID (ppm)	Moisture Content (%)	Dry Density (pcf)	Liquid Limit	Plastic Limit	Plasticity Index (PI)	#200 Sieve (%)	Pocket Penetrometer (tsf)	Unconfined Compressive Strength (tsf)	ELEVATION (ft)
0				MC	8, 19, 11		30	(0') Fill: Sandy LEAN CLAY to Poorly Graded GRAVEL with Sand, brown, moist		11								
				MC	[illegible], 4, 7		11			7								
5				MC	[illegible], 6, 6		12											4635
					5			(5.5') Sandy SILT (ML); medium stiff to stiff, grayish brown, iron oxidation, roots, moist										
				MC	3, 3, 5		8			5					15.3			
10				MC	3, 2, 3		5			19					7.7			4630
								(12.5') Poorly graded GRAVEL with silt (GP-GM); with sand, medium dense to dense, grayish brown, wet										
15				MC	4, 27, 14		41			9					1.4			4625
20				MC	8, 13, 11		24			8					8.5			4620
								(20.5') Boring terminated										
25																		4615

DRAFT

NOTES: Hole precleared on 11/11/2022.

Checked by: NN



BYU ENGINEERING
Civil & Construction Engineering

Client: AGEC
Project: Spanish Fork Pedestrian Bridge
Address: 8650 S 1100 E, Spanish Fork, UT

BORING LOG
Boring No. B-06
Page: 1 of 1

Drilling Start Date:	12:15	Boring Depth (ft):	20.5
Drilling End Date:	1:35	Boring Diameter (in):	8.00
Drilling Company:	AGEC	Sampling Method(s):	Mod CA, Shelby Tube
Drilling Method:	Hollow Stem Auger	DTW During Drilling (ft):	9
Drilling Equipment:	CME55	DTW After Drilling (ft):	9
Driller:	JL	Ground Surface Elev. (ft):	4647
Logged By:	SP	Location (Lat, Long):	40.07495, -111.62927

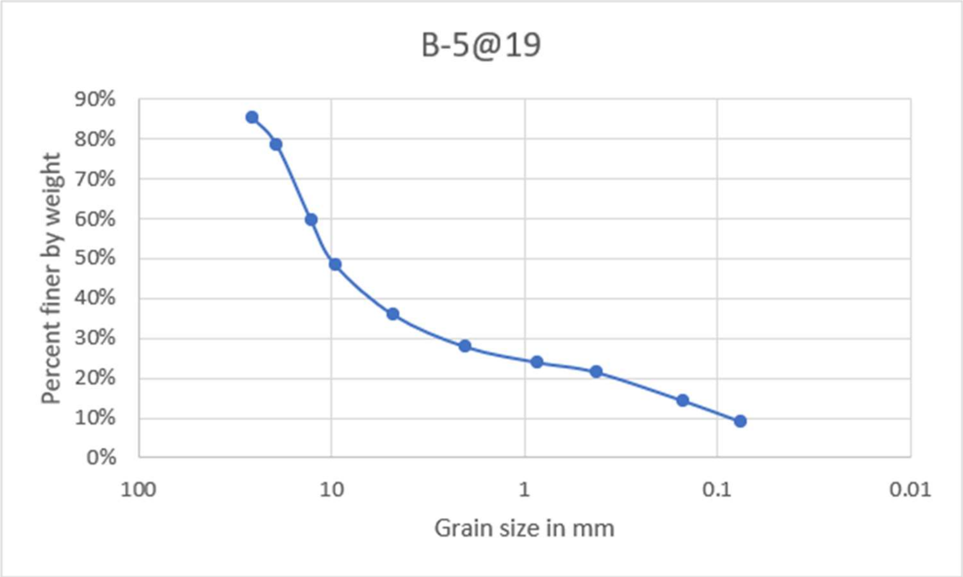
Sample Type	Blow Counts	N Value RQD%	SOIL/ROCK VISUAL DESCRIPTION	Moisture Content (%)	Liquid Limit	Plastic Limit	Plasticity Index (PI)	#200 Sieve (%)	Pocket Penetrometer (tsf)
MC	3 4 4	8	(0') Fill: LEAN CLAY to Sandy LEAN CLAY with gravel, with organics, brown, low to medium plasticity, iron oxidation, calcareous, roots, moist	8					
MC	3 4 6	10		16					
MC	7 13 34	47		9					
	25		(5.5') Sandy SILT (ML); grayish brown, very stiff, moist						
MC	6 7 10	17		20				38.9	
MC	2 3 5	8	(8.5') Lean CLAY (CL); brown to brownish gray, medium stiff, medium plasticity, iron oxidation, interbedded clay layers, moist to wet	23	34	15	19	92.3	
SH					31	21	10	93.4	1.5
			(16') Silty CLAY (CL-ML); brownish gray, very stiff, iron oxidation, wet						
MC	13 13 13	26		23	24	18	6	85.8	
			(20.5') Boring terminated						

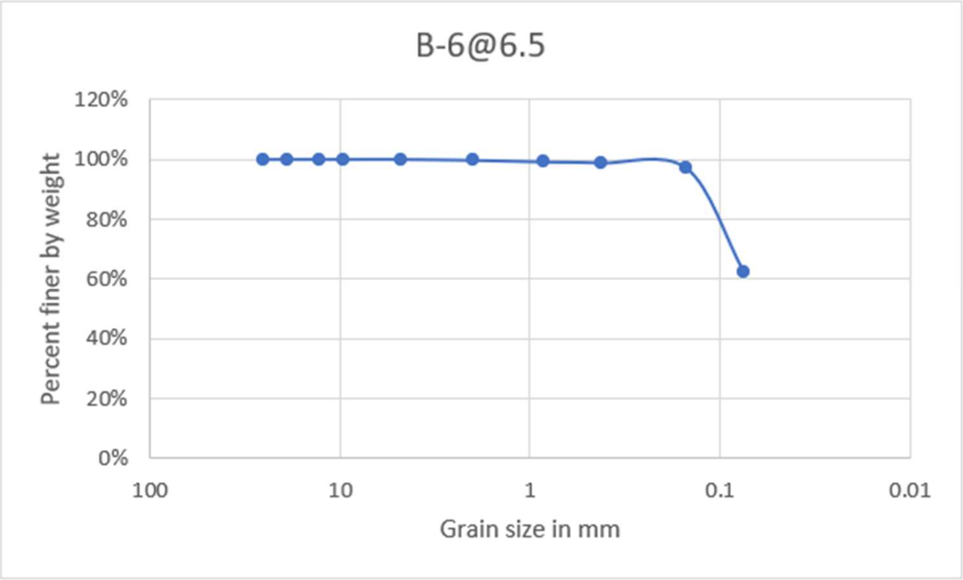
NOTES: Hole precleared on 11/11/2022.

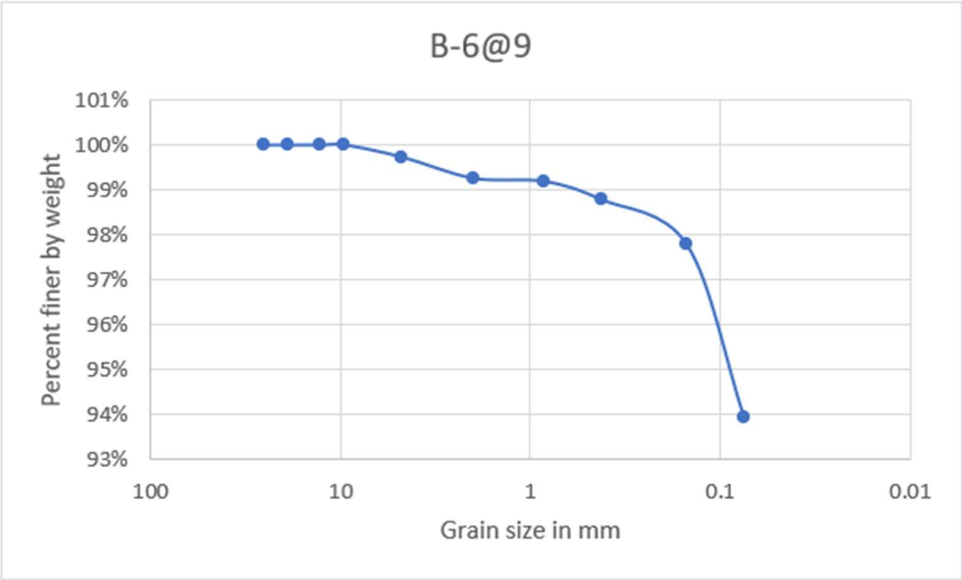
Checked by: NN

Figure 7 Boring Logs

Grain-size Distribution Curves







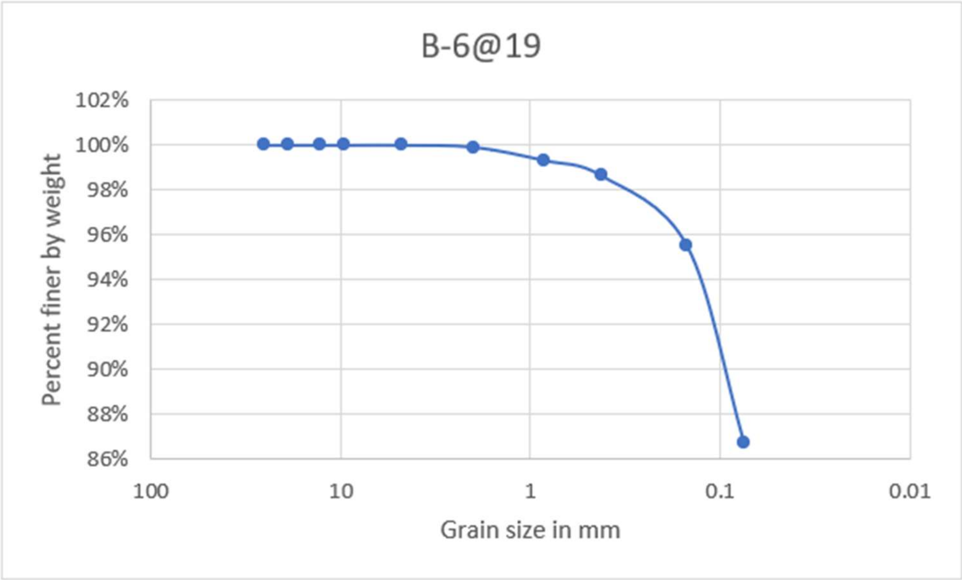


Figure 8 Grain Size Distribution Plots

D-Value Tables

Table 11 D-Values

B-5

Depth	D100	D60	D30	D10	%Cobbles	%Gravel	%Sand
6.5	0.85	0.15	0.10	-	0%	0%	83%
9	2	0.27	0.15	0.08	0%	0%	90%
14	-	11.01	1.68	0.36	0%	42%	57%
19	-	12.70	2.77	0.09	0%	52%	39%

B-6

Depth	D100	D60	D30	D10	%Cobbles	%Gravel	%Sand
6.5	2	-	-	-	0%	0%	38%
9	4.75	-	-	-	0%	0%	6%
19	2	-	-	-	0%	0%	13%

200 Sieve Washes

Table 12 200 sieve washes results.

Sample	Tare weight (g)	Mass of dry soil+tare (g)	Mass after wash +tare (g)	dry unit weight pre 200 wash	dry unit wight after 200 wash.	Mass of washed fines (g)	Mass of washed fines (%)
B-5@6.5	266.6	441.4	414.6	174.8	148	26.8	15.3
B-5@9	152.1	378.3	360.8	226.2	208.7	17.5	7.7
B-5@14	152	510	505.1	358	353.1	4.9	1.4
B-5@19	348.8	664.3	637.4	315.5	288.6	26.9	8.5
B-6@6.5	215.3	380	316	164.7	100.7	64	38.9
B-6@9	188.7	338.8	200.3	150.1	11.6	138.5	92.3
B-6@14	266.5	422.3	276.8	155.8	10.3	145.5	93.4
B-6@19	196.4	315.4	213.3	119	16.9	102.1	85.8

Atterberg Limits Results

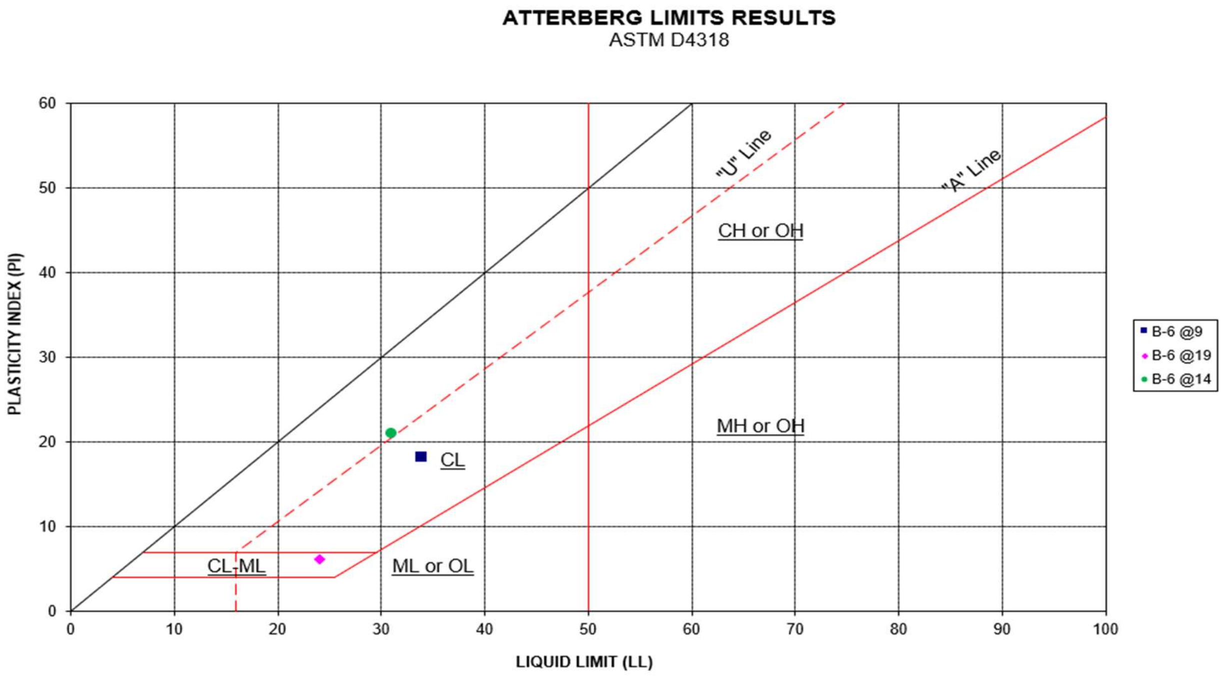


Figure 9 Plasticity chart with B-6 @ 9, B-6 @and B-6@19 plotted

Table 13 B-6 @9, B-6 @14 and B-6@19's Atterberg Limit test results and classification.

Symbol	Boring ID	Depth (ft)	LL	PL	PI	Fines	USCS	Description
■	B-6 @9	9-10.5	34	15	19	94%	CL	Lean Clay
●	B-6 @14	14-16	31	21	10	94%	CL	Lean Clay
◆	B-6 @19	19-20.5	24	18	6	87%	CL-ML	Silty Clay

FEMA 100 Year Flood Map

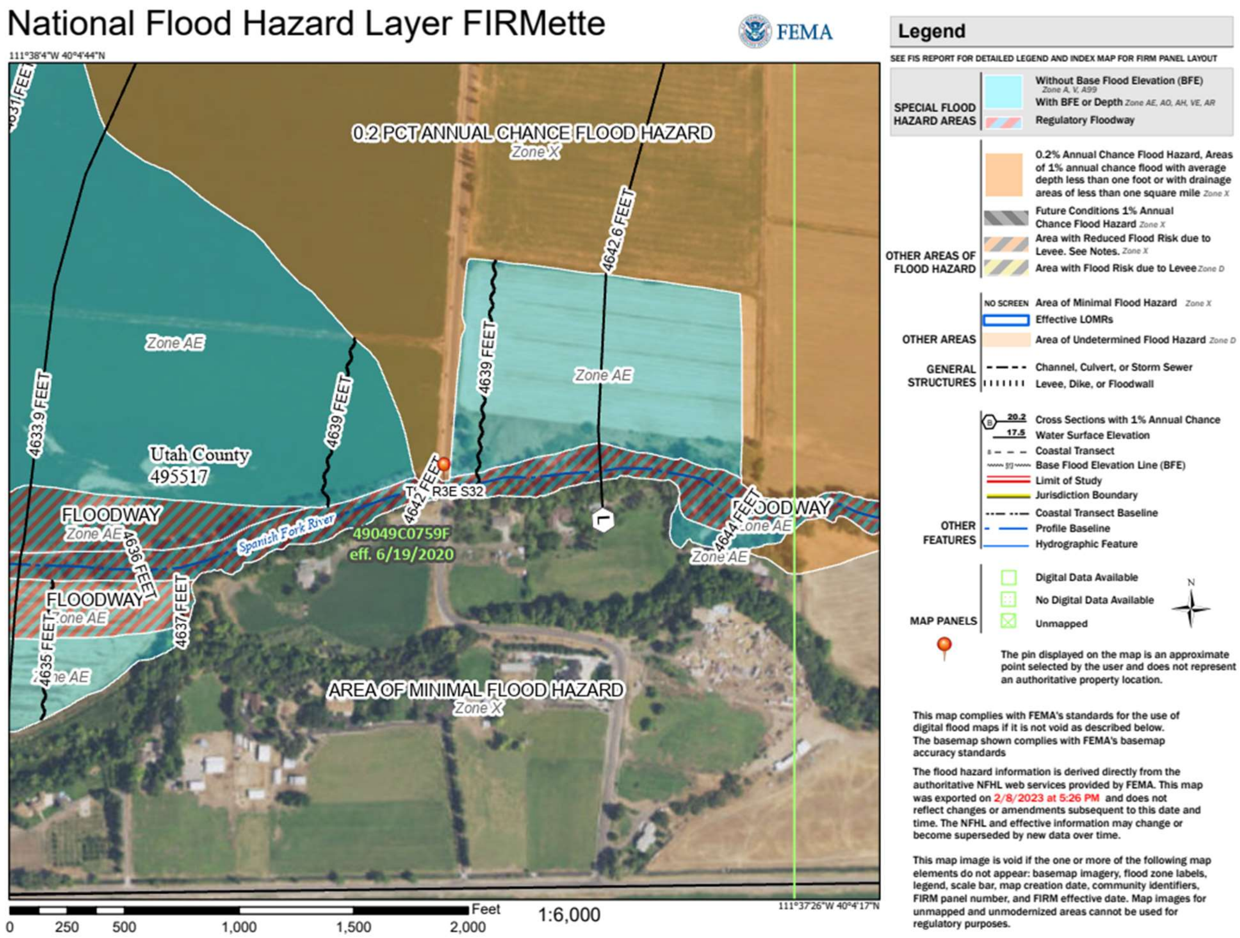
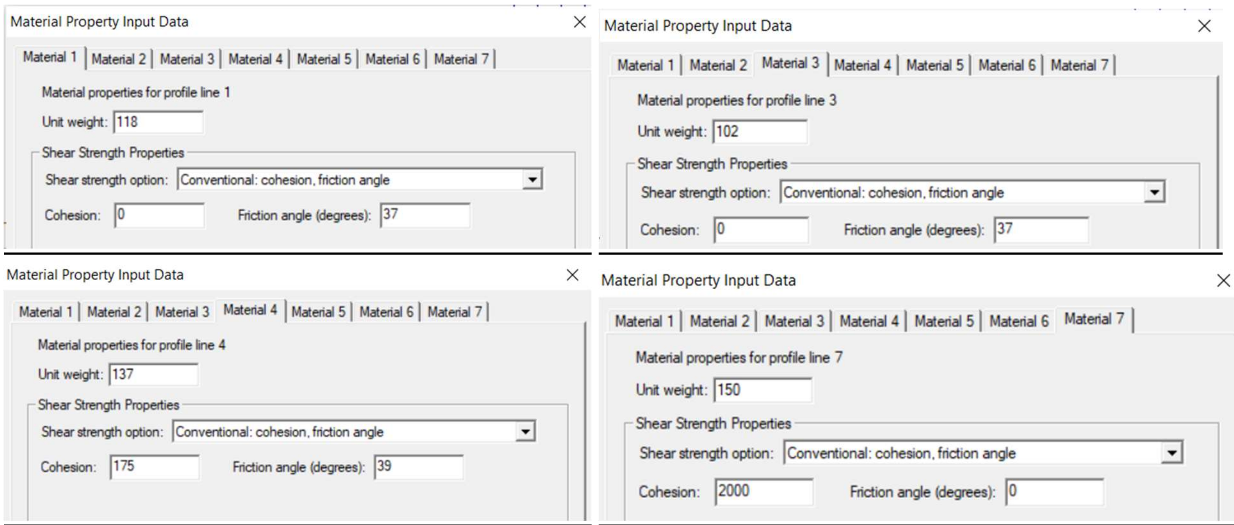
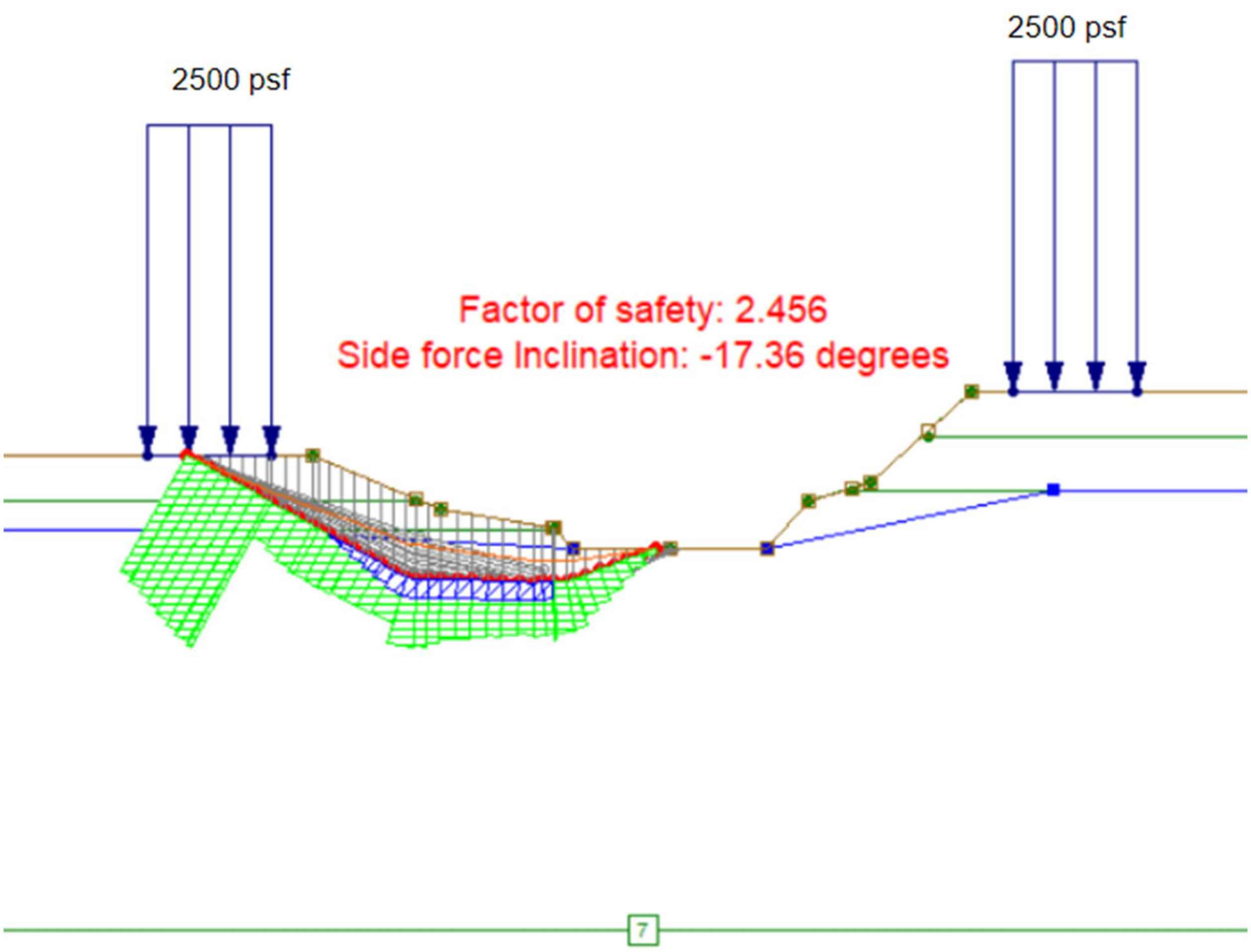


Figure 10 100-year flood map.

Slope Stability





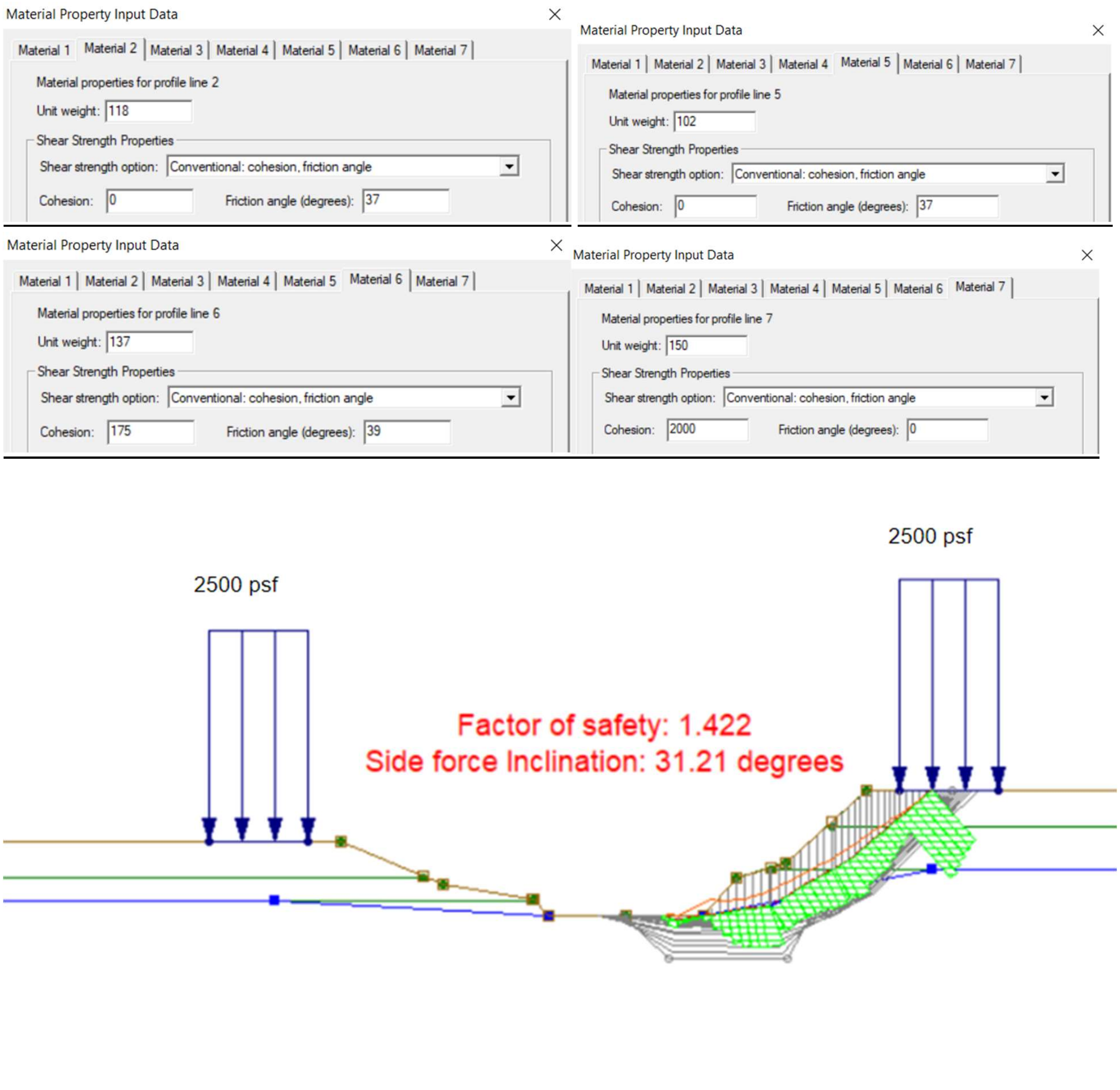


Figure 11 Slope Stability

Appendix C

Two individual piers - Structural Calculations

Combined Footing — Project File: capstone.ec6

LIC# : -Unassigned-, Build:20.22.10.27 — UNLICENSED DEMO USER, DEMO EXPIRES IN 29 DAYS — (c) ENERCALC INC 1983-2022

DESCRIPTION: --None--

Code References

Calculations per ACI 318-11, IBC 2012, CBC 2013, ASCE 7-10
Load Combinations Used : IBC 2021

General Information

Material Properties

f'c : Concrete 28 day strength		4.0	ksi
fy : Rebar Yield		60.0	ksi
Ec : Concrete Elastic Modulus		3,605.0	ksi
Concrete Density		150.0	pcf
ϕ : Phi Values	Flexure :	0.90	
	Shear :	0.750	

Analysis/Design Settings

Calculate footing weight as dead load ?	Yes
Calculate Pedestal weight as dead load ?	No
Min Steel % Bending Reinf (based on 'd')	
Min Allow % Temp Reinf (based on thick)	0.00180
Min. Overturning Safety Factor	1.0 : 1
Min. Sliding Safety Factor	1.0 : 1

Soil Information

Allowable Soil Bearing	2.50	ksf
Increase Bearing By Footing Weight	No	
Soil Passive Sliding Resistance	250.0	pcf
(Uses entry for "Footing base depth below soil surface" for force)		
Coefficient of Soil/Concrete Friction	0.350	

Soil Bearing Increase

Footing base depth below soil surface	2.50	ft
Increases based on footing Depth . . .		
Allowable pressure increase per foot		ksf
when base of footing is below		ft
Increases based on footing Width . . .		
Allowable pressure increase per foot		ksf
when maximum length or width is greater than		ft
Maximum Allowed Bearing Pressure	10.0	ksf
(A value of zero implies no limit)		
Adjusted Allowable Soil Bearing	2.50	ksf
(Allowable Soil Bearing adjusted for footing weight and depth & width increases as specified by user.)		

Dimensions & Reinforcing

Distance Left of Column #1	=	2.0	ft
Between Columns	=	12.0	ft
Distance Right of Column #2	=	2.0	ft
Total Footing Length	=	16.0	ft
Footing Width	=	4.0	ft
Footing Thickness	=	16.0	in
Rebar Center to Concrete Edge @ Top	=	3.0	in
Rebar Center to Concrete Edge @ Bottom	=	3.0	in

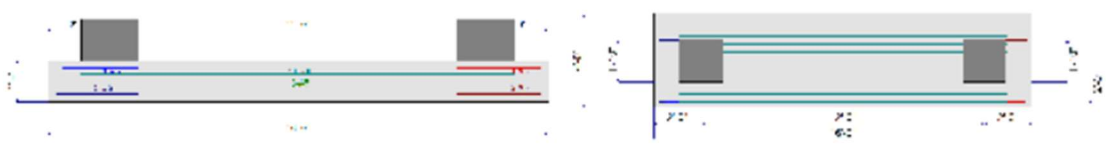
Pedestal dimensions...

		Col #1	Col #2	
Sq. Dim.	=	22.0	22.0	in
Height	=	16.0	16.0	in

	Count	Size #	As Provided	As Req'd
Bars left of Col #1				
Bottom Bars	5.0	5	1.550	1.382 in^2
Top Bars	3.0	5	0.930	0.0 in^2
Bars Btwn Cols				
Bottom Bars	3.0	5	0.930	0.0 in^2
Top Bars	11.0	5	3.410	3.201 in^2
Bars Right of Col #2				
Bottom Bars	5.0	5	1.550	1.382 in^2
Top Bars	3.0	5	0.930	0.0 in^2

Applied Loads

		D	Lr	L	S	W	E	H	
Applied @ Left Column									
Axial Load Downward	=	23.0		18.0	9.0	7.0	46.50		k
Moment (+CW)	=								k-ft
Shear (+X)	=								k
Applied @ Right Column									
Axial Load Downward	=	23.0		18.0	9.0	7.0	46.50		k
Moment (+CW)	=								k-ft
Shear (+X)	=								k
Overburden	=								



Combined Footing

Project File: capstone.ec6

LIC# : --Unassigned--, Build:20.22.10.27 UNLICENSED DEMO USER, DEMO EXPIRES IN 29 DAYS (c) ENERCALC INC 1983-20

DESCRIPTION: --None--

DESIGN SUMMARY

Design OK

Factor of Safety		Item	Applied	Capacity	Governing Load Combination
PASS	No OTM	Overturning	0.0 k-ft	0.0 k-ft	No OTM
PASS	No Sliding	Sliding	0.0 k	23.024 k	No Sliding
PASS	No Uplift	Uplift	0.0 k	0.0 k	No Uplift

Utilization Ratio		Item	Applied	Capacity	Governing Load Combination
PASS	0.9258	Soil Bearing	2.314 ksf	2.50 ksf	+D+0.750L+0.750S+0.5250E
PASS	0.7551	1-way Shear - Col #1	71.635 psi	94.868 psi	+1.20D+0.50L+0.70S+E
PASS	0.7551	1-way Shear - Col #2	71.635 psi	94.868 psi	+1.20D+0.50L+0.70S+E
PASS	0.1911	2-way Punching - Col #1	36.252 psi	189.737 psi	+1.20D+0.50L+0.70S+E
PASS	0.1911	2-way Punching - Col #2	36.252 psi	189.737 psi	+1.20D+0.50L+0.70S+E
PASS	No Bending	Flexure - Left of Col #1 - Top	0.0 k-ft	0.0 k-ft	N/A
PASS	0.07349	Flexure - Left of Col #1 - Bottom	6.517 k-ft	88.688 k-ft	+1.20D+0.50L+0.70S+E
PASS	0.9417	Flexure - Between Cols - Top	-178.80 k-ft	189.866 k-ft	+1.20D+0.50L+0.70S+E
PASS	No Bending	Flexure - Between Cols - Bottom	0.0 k-ft	0.0 k-ft	N/A
PASS	No Bending	Flexure - Right of Col #2 - Top	0.0 k-ft	0.0 k-ft	N/A
PASS	0.07349	Flexure - Right of Col #2 - Bottom	6.517 k-ft	88.688 k-ft	+1.20D+0.50L+0.70S+E

Soil Bearing

Load Combination...	Total Bearing	Eccentricity from Ftg CL	Actual Soil Bearing Stress @ Left Edge	Actual Soil Bearing Stress @ Right Edge	Allowable	Actual / Allow Ratio
D Only	58.80 k	0.000 ft	0.92 ksf	0.92 ksf	2.50 ksf	0.368
+D+L	94.80 k	0.000 ft	1.48 ksf	1.48 ksf	2.50 ksf	0.593
+D+S	76.80 k	0.000 ft	1.20 ksf	1.20 ksf	2.50 ksf	0.480
+D+0.750L	85.80 k	0.000 ft	1.34 ksf	1.34 ksf	2.50 ksf	0.536
+D+0.750L+0.750S	99.30 k	0.000 ft	1.55 ksf	1.55 ksf	2.50 ksf	0.621
+D+0.60W	67.20 k	0.000 ft	1.05 ksf	1.05 ksf	2.50 ksf	0.420
+D+0.70E	123.90 k	0.000 ft	1.94 ksf	1.94 ksf	2.50 ksf	0.774
+D+0.750L+0.450W	92.10 k	0.000 ft	1.44 ksf	1.44 ksf	2.50 ksf	0.576
+D+0.750L+0.750S+0.450W	105.60 k	0.000 ft	1.65 ksf	1.65 ksf	2.50 ksf	0.660
+D+0.750L+0.750S+0.5250E	148.13 k	0.000 ft	2.31 ksf	2.31 ksf	2.50 ksf	0.926
+0.60D+0.60W	43.68 k	0.000 ft	0.68 ksf	0.68 ksf	2.50 ksf	0.273
+0.60D+0.70E	100.38 k	0.000 ft	1.57 ksf	1.57 ksf	2.50 ksf	0.627

Overturning Stability

Load Combination...	Moments about Left Edge k-ft Overturning	Resisting	Ratio	Moments about Right Edge k-ft Overturning	Resisting	Ratio
D Only	0.00	0.00	999.000	0.00	0.00	999.000
+D+L	0.00	0.00	999.000	0.00	0.00	999.000
+D+S	0.00	0.00	999.000	0.00	0.00	999.000
+D+0.750L	0.00	0.00	999.000	0.00	0.00	999.000
+D+0.750L+0.750S	0.00	0.00	999.000	0.00	0.00	999.000
+D+0.60W	0.00	0.00	999.000	0.00	0.00	999.000
+D+0.70E	0.00	0.00	999.000	0.00	0.00	999.000
+D+0.750L+0.450W	0.00	0.00	999.000	0.00	0.00	999.000
+D+0.750L+0.750S+0.450W	0.00	0.00	999.000	0.00	0.00	999.000
+D+0.750L+0.750S+0.5250E	0.00	0.00	999.000	0.00	0.00	999.000
+0.60D+0.60W	0.00	0.00	999.000	0.00	0.00	999.000
+0.60D+0.70E	0.00	0.00	999.000	0.00	0.00	999.000

Sliding Stability

Load Combination...	Sliding Force	Resisting Force	Sliding SafetyRatio
D Only	0.00 k	23.02 k	999
+D+L	0.00 k	35.62 k	999
+D+S	0.00 k	29.32 k	999
+D+0.750L	0.00 k	32.47 k	999
+D+0.750L+0.750S	0.00 k	37.20 k	999
+D+0.60W	0.00 k	25.96 k	999
+D+0.70E	0.00 k	45.61 k	999
+D+0.750L+0.450W	0.00 k	34.88 k	999

Combined Footing

Project File: capstone.ec6

LIC# : --Unassigned--, Build:20.22.10.27 UNLICENSED DEMO USER, DEMO EXPIRES IN 29 DAYS (c) ENERCALC INC 1983-20

DESCRIPTION: --None--

Sliding Stability

Load Combination...	Sliding Force	Resisting Force	Sliding SafetyRatio
+D+0.750L+0.750S+0.450W	0.00 k	39.40 k	999
+D+0.750L+0.750S+0.5250E	0.00 k	54.29 k	999
+0.60D+0.60W	0.00 k	17.73 k	999
+0.60D+0.70E	0.00 k	37.58 k	999

Z-Axis Footing Flexure - Maximum Values for Load Combination

Load Combination...	Mu (ft-k)	Distance from left (ft)	Tension Side	As Req'd (in^2)	Governed by	Actual As (in^2)	Phi*Mn (ft-k)	Mu / PhiMr
+0.60D+0.70E	0.000	0.000	0	0.000	0	0.000	0.000	0.000
+0.60D+0.70E	0.000	0.040	0	0.000	0	0.000	0.000	0.000
+1.20D+0.50L+0.70S+E	0.036	0.080	Bottom	1.382	Min Temp %	1.550	88.688	0.000
+1.20D+0.50L+0.70S+E	0.080	0.120	Bottom	1.382	Min Temp %	1.550	88.688	0.001
+1.20D+0.50L+0.70S+E	0.143	0.160	Bottom	1.382	Min Temp %	1.550	88.688	0.002
+1.20D+0.50L+0.70S+E	0.223	0.200	Bottom	1.382	Min Temp %	1.550	88.688	0.003
+1.20D+0.50L+0.70S+E	0.322	0.240	Bottom	1.382	Min Temp %	1.550	88.688	0.004
+1.20D+0.50L+0.70S+E	0.438	0.280	Bottom	1.382	Min Temp %	1.550	88.688	0.005
+1.20D+0.50L+0.70S+E	0.572	0.320	Bottom	1.382	Min Temp %	1.550	88.688	0.006
+1.20D+0.50L+0.70S+E	0.724	0.360	Bottom	1.382	Min Temp %	1.550	88.688	0.008
+1.20D+0.50L+0.70S+E	0.894	0.400	Bottom	1.382	Min Temp %	1.550	88.688	0.010
+1.20D+0.50L+0.70S+E	1.082	0.440	Bottom	1.382	Min Temp %	1.550	88.688	0.012
+1.20D+0.50L+0.70S+E	1.287	0.480	Bottom	1.382	Min Temp %	1.550	88.688	0.015
+1.20D+0.50L+0.70S+E	1.511	0.520	Bottom	1.382	Min Temp %	1.550	88.688	0.017
+1.20D+0.50L+0.70S+E	1.752	0.560	Bottom	1.382	Min Temp %	1.550	88.688	0.020
+1.20D+0.50L+0.70S+E	2.011	0.600	Bottom	1.382	Min Temp %	1.550	88.688	0.023
+1.20D+0.50L+0.70S+E	2.289	0.640	Bottom	1.382	Min Temp %	1.550	88.688	0.026
+1.20D+0.50L+0.70S+E	2.584	0.680	Bottom	1.382	Min Temp %	1.550	88.688	0.029
+1.20D+0.50L+0.70S+E	2.897	0.720	Bottom	1.382	Min Temp %	1.550	88.688	0.033
+1.20D+0.50L+0.70S+E	3.227	0.760	Bottom	1.382	Min Temp %	1.550	88.688	0.036
+1.20D+0.50L+0.70S+E	3.576	0.800	Bottom	1.382	Min Temp %	1.550	88.688	0.040
+1.20D+0.50L+0.70S+E	3.943	0.840	Bottom	1.382	Min Temp %	1.550	88.688	0.044
+1.20D+0.50L+0.70S+E	4.327	0.880	Bottom	1.382	Min Temp %	1.550	88.688	0.049
+1.20D+0.50L+0.70S+E	4.729	0.920	Bottom	1.382	Min Temp %	1.550	88.688	0.053
+1.20D+0.50L+0.70S+E	5.149	0.960	Bottom	1.382	Min Temp %	1.550	88.688	0.058
+1.20D+0.50L+0.70S+E	5.587	1.000	Bottom	1.382	Min Temp %	1.550	88.688	0.063
+1.20D+0.50L+0.70S+E	6.043	1.040	Bottom	1.382	Min Temp %	1.550	88.688	0.068
+1.20D+0.50L+0.70S+E	6.517	1.080	Bottom	1.382	Min Temp %	1.550	88.688	0.073
+1.20D+0.50L+0.70S+E	6.976	1.120	Bottom	1.382	Min Temp %	1.550	88.688	0.079
+1.20D+0.50L+0.70S+E	7.375	1.160	Bottom	1.382	Min Temp %	1.550	88.688	0.083
+1.20D+0.50L+0.70S+E	7.714	1.200	Bottom	1.382	Min Temp %	1.550	88.688	0.087
+1.20D+0.50L+0.70S+E	7.993	1.240	Bottom	1.382	Min Temp %	1.550	88.688	0.090
+1.20D+0.50L+0.70S+E	8.212	1.280	Bottom	1.382	Min Temp %	1.550	88.688	0.093
+1.20D+0.50L+0.70S+E	8.370	1.320	Bottom	1.382	Min Temp %	1.550	88.688	0.094
+1.20D+0.50L+0.70S+E	8.468	1.360	Bottom	1.382	Min Temp %	1.550	88.688	0.095
+1.20D+0.50L+0.70S+E	8.507	1.400	Bottom	1.382	Min Temp %	1.550	88.688	0.096
+1.20D+0.50L+0.70S+E	8.485	1.440	Bottom	1.382	Min Temp %	1.550	88.688	0.096
+1.20D+0.50L+0.70S+E	8.403	1.480	Bottom	1.382	Min Temp %	1.550	88.688	0.095
+1.20D+0.50L+0.70S+E	8.260	1.520	Bottom	1.382	Min Temp %	1.550	88.688	0.093
+1.20D+0.50L+0.70S+E	8.058	1.560	Bottom	1.382	Min Temp %	1.550	88.688	0.091
+1.20D+0.50L+0.70S+E	7.795	1.600	Bottom	1.382	Min Temp %	1.550	88.688	0.088
+1.20D+0.50L+0.70S+E	7.473	1.640	Bottom	1.382	Min Temp %	1.550	88.688	0.084
+1.20D+0.50L+0.70S+E	7.090	1.680	Bottom	1.382	Min Temp %	1.550	88.688	0.080
+1.20D+0.50L+0.70S+E	6.647	1.720	Bottom	1.382	Min Temp %	1.550	88.688	0.075
+1.20D+0.50L+0.70S+E	6.144	1.760	Bottom	1.382	Min Temp %	1.550	88.688	0.069
+1.20D+0.50L+0.70S+E	5.581	1.800	Bottom	1.382	Min Temp %	1.550	88.688	0.063
+1.20D+0.50L+0.70S+E	4.957	1.840	Bottom	1.382	Min Temp %	1.550	88.688	0.056
+1.20D+0.50L+0.70S+E	4.274	1.880	Bottom	1.382	Min Temp %	1.550	88.688	0.048
+1.20D+0.50L+0.70S+E	3.530	1.920	Bottom	1.382	Min Temp %	1.550	88.688	0.040
+1.20D+0.50L+0.70S+E	2.726	1.960	Bottom	1.382	Min Temp %	1.550	88.688	0.031
+1.20D+0.50L+0.70S+E	1.862	2.000	Bottom	1.382	Min Temp %	0.930	53.690	0.035
+1.20D+0.50L+0.70S+E	0.938	2.040	Bottom	1.382	Min Temp %	0.930	53.690	0.017
+1.20D+0.50L+0.70S+E	-0.046	2.080	Top	1.382	Min Temp %	3.410	189.866	0.000
+1.20D+0.50L+0.70S+E	-1.090	2.120	Top	1.382	Min Temp %	3.410	189.866	0.006
+1.20D+0.50L+0.70S+E	-2.195	2.160	Top	1.382	Min Temp %	3.410	189.866	0.012
+1.20D+0.50L+0.70S+E	-3.359	2.200	Top	1.382	Min Temp %	3.410	189.866	0.018

Combined Footing

Project File: capstone.ec6

LIC# : --Unassigned--, Build:20.22.10.27 UNLICENSED DEMO USER, DEMO EXPIRES IN 29 DAYS (c) ENERCALC INC 1983-20

DESCRIPTION: --None--

Z-Axis Footing Flexure - Maximum Values for Load Combination

Load Combination...	Mu (ft-k)	Distance from left (ft)	Tension Side	As Req'd (in^2)	Governed by	Actual As (in^2)	Phi*Mn (ft-k)	Mu / PhiMn
+1.20D+0.50L+0.70S+E	-4.584	2.240	Top	1.382	Min Temp %	3.410	189.866	0.024
+1.20D+0.50L+0.70S+E	-5.869	2.280	Top	1.382	Min Temp %	3.410	189.866	0.031
+1.20D+0.50L+0.70S+E	-7.214	2.320	Top	1.382	Min Temp %	3.410	189.866	0.038
+1.20D+0.50L+0.70S+E	-8.619	2.360	Top	1.382	Min Temp %	3.410	189.866	0.045
+1.20D+0.50L+0.70S+E	-10.085	2.400	Top	1.382	Min Temp %	3.410	189.866	0.053
+1.20D+0.50L+0.70S+E	-11.610	2.440	Top	1.382	Min Temp %	3.410	189.866	0.061
+1.20D+0.50L+0.70S+E	-13.196	2.480	Top	1.382	Min Temp %	3.410	189.866	0.070
+1.20D+0.50L+0.70S+E	-14.841	2.520	Top	1.382	Min Temp %	3.410	189.866	0.078
+1.20D+0.50L+0.70S+E	-16.547	2.560	Top	1.382	Min Temp %	3.410	189.866	0.087
+1.20D+0.50L+0.70S+E	-18.313	2.600	Top	1.382	Min Temp %	3.410	189.866	0.096
+1.20D+0.50L+0.70S+E	-20.140	2.640	Top	1.382	Min Temp %	3.410	189.866	0.106
+1.20D+0.50L+0.70S+E	-22.026	2.680	Top	1.382	Min Temp %	3.410	189.866	0.116
+1.20D+0.50L+0.70S+E	-23.972	2.720	Top	1.382	Min Temp %	3.410	189.866	0.126
+1.20D+0.50L+0.70S+E	-25.979	2.760	Top	1.382	Min Temp %	3.410	189.866	0.137
+1.20D+0.50L+0.70S+E	-28.046	2.800	Top	1.382	Min Temp %	3.410	189.866	0.148
+1.20D+0.50L+0.70S+E	-30.173	2.840	Top	1.382	Min Temp %	3.410	189.866	0.159
+1.20D+0.50L+0.70S+E	-32.380	2.880	Top	1.382	Min Temp %	3.410	189.866	0.170
+1.20D+0.50L+0.70S+E	-34.607	2.920	Top	1.382	Min Temp %	3.410	189.866	0.182
+1.20D+0.50L+0.70S+E	-36.869	2.960	Top	1.382	Min Temp %	3.410	189.866	0.194
+1.20D+0.50L+0.70S+E	-39.113	3.000	Top	1.382	Min Temp %	3.410	189.866	0.206
+1.20D+0.50L+0.70S+E	-41.339	3.040	Top	1.382	Min Temp %	3.410	189.866	0.218
+1.20D+0.50L+0.70S+E	-43.547	3.080	Top	1.382	Min Temp %	3.410	189.866	0.229
+1.20D+0.50L+0.70S+E	-45.737	3.120	Top	1.382	Min Temp %	3.410	189.866	0.241
+1.20D+0.50L+0.70S+E	-47.909	3.160	Top	1.382	Min Temp %	3.410	189.866	0.252
+1.20D+0.50L+0.70S+E	-50.064	3.200	Top	1.382	Min Temp %	3.410	189.866	0.264
+1.20D+0.50L+0.70S+E	-52.201	3.240	Top	1.382	Min Temp %	3.410	189.866	0.275
+1.20D+0.50L+0.70S+E	-54.319	3.280	Top	1.382	Min Temp %	3.410	189.866	0.286
+1.20D+0.50L+0.70S+E	-56.420	3.320	Top	1.382	Min Temp %	3.410	189.866	0.297
+1.20D+0.50L+0.70S+E	-58.503	3.360	Top	1.382	Min Temp %	3.410	189.866	0.308
+1.20D+0.50L+0.70S+E	-60.569	3.400	Top	1.401	Min ACI 10.5	3.410	189.866	0.319
+1.20D+0.50L+0.70S+E	-62.616	3.440	Top	1.449	Min ACI 10.5	3.410	189.866	0.330
+1.20D+0.50L+0.70S+E	-64.645	3.480	Top	1.497	Min ACI 10.5	3.410	189.866	0.340
+1.20D+0.50L+0.70S+E	-66.657	3.520	Top	1.545	Min ACI 10.5	3.410	189.866	0.351
+1.20D+0.50L+0.70S+E	-68.650	3.560	Top	1.592	Min ACI 10.5	3.410	189.866	0.362
+1.20D+0.50L+0.70S+E	-70.626	3.600	Top	1.638	Min ACI 10.5	3.410	189.866	0.372
+1.20D+0.50L+0.70S+E	-72.584	3.640	Top	1.684	Min ACI 10.5	3.410	189.866	0.382
+1.20D+0.50L+0.70S+E	-74.524	3.680	Top	1.730	Min ACI 10.5	3.410	189.866	0.393
+1.20D+0.50L+0.70S+E	-76.446	3.720	Top	1.776	Min ACI 10.5	3.410	189.866	0.403
+1.20D+0.50L+0.70S+E	-78.350	3.760	Top	1.821	Min ACI 10.5	3.410	189.866	0.413
+1.20D+0.50L+0.70S+E	-80.237	3.800	Top	1.866	Min ACI 10.5	3.410	189.866	0.423
+1.20D+0.50L+0.70S+E	-82.105	3.840	Top	1.910	Min ACI 10.5	3.410	189.866	0.432
+1.20D+0.50L+0.70S+E	-83.956	3.880	Top	1.954	Min ACI 10.5	3.410	189.866	0.442
+1.20D+0.50L+0.70S+E	-85.788	3.920	Top	1.998	Min ACI 10.5	3.410	189.866	0.452
+1.20D+0.50L+0.70S+E	-87.603	3.960	Top	2.041	Min ACI 10.5	3.410	189.866	0.461
+1.20D+0.50L+0.70S+E	-89.400	4.000	Top	2.080	Min ACI 10.5	3.410	189.866	0.471
+1.20D+0.50L+0.70S+E	-91.179	4.040	Top	2.080	Min ACI 10.5	3.410	189.866	0.480
+1.20D+0.50L+0.70S+E	-92.940	4.080	Top	2.080	Min ACI 10.5	3.410	189.866	0.490
+1.20D+0.50L+0.70S+E	-94.664	4.120	Top	2.080	Min ACI 10.5	3.410	189.866	0.499
+1.20D+0.50L+0.70S+E	-96.409	4.160	Top	2.080	Min ACI 10.5	3.410	189.866	0.508
+1.20D+0.50L+0.70S+E	-98.117	4.200	Top	2.080	Min ACI 10.5	3.410	189.866	0.517
+1.20D+0.50L+0.70S+E	-99.806	4.240	Top	2.080	Min ACI 10.5	3.410	189.866	0.526
+1.20D+0.50L+0.70S+E	-101.478	4.280	Top	2.080	Min ACI 10.5	3.410	189.866	0.534
+1.20D+0.50L+0.70S+E	-103.132	4.320	Top	2.080	Min ACI 10.5	3.410	189.866	0.543
+1.20D+0.50L+0.70S+E	-104.768	4.360	Top	2.080	Min ACI 10.5	3.410	189.866	0.552
+1.20D+0.50L+0.70S+E	-106.386	4.400	Top	2.080	Min ACI 10.5	3.410	189.866	0.560
+1.20D+0.50L+0.70S+E	-107.986	4.440	Top	2.080	Min ACI 10.5	3.410	189.866	0.569
+1.20D+0.50L+0.70S+E	-109.569	4.480	Top	2.080	Min ACI 10.5	3.410	189.866	0.577
+1.20D+0.50L+0.70S+E	-111.133	4.520	Top	2.080	Min ACI 10.5	3.410	189.866	0.585
+1.20D+0.50L+0.70S+E	-112.680	4.560	Top	2.080	Min ACI 10.5	3.410	189.866	0.593
+1.20D+0.50L+0.70S+E	-114.209	4.600	Top	2.080	Min ACI 10.5	3.410	189.866	0.602
+1.20D+0.50L+0.70S+E	-115.719	4.640	Top	2.080	Min ACI 10.5	3.410	189.866	0.609
+1.20D+0.50L+0.70S+E	-117.212	4.680	Top	2.080	Min ACI 10.5	3.410	189.866	0.617
+1.20D+0.50L+0.70S+E	-118.687	4.720	Top	2.091	Min ACI 10.5	3.410	189.866	0.625

Combined Footing

Project File: capstone.ec6

DESCRIPTION: --None--

Z-Axis Footing Flexure - Maximum Values for Load Combination

Load Combination...	Mu (ft-k)	Distance from left (ft)	Tension Side	As Req'd (in^2)	Governed by	Actual As (in^2)	Phi*Mn (ft-k)	Mu / PhiMr
+1.20D+0.50L+0.70S+E	-120.145	4.760	Top	2.117	Min ACI 10.5	3.410	189.866	0.633
+1.20D+0.50L+0.70S+E	-121.584	4.800	Top	2.143	Min ACI 10.5	3.410	189.866	0.640
+1.20D+0.50L+0.70S+E	-123.005	4.840	Top	2.169	Min ACI 10.5	3.410	189.866	0.648
+1.20D+0.50L+0.70S+E	-124.409	4.880	Top	2.195	Min ACI 10.5	3.410	189.866	0.655
+1.20D+0.50L+0.70S+E	-125.795	4.920	Top	2.220	Min ACI 10.5	3.410	189.866	0.663
+1.20D+0.50L+0.70S+E	-127.163	4.960	Top	2.245	Min ACI 10.5	3.410	189.866	0.670
+1.20D+0.50L+0.70S+E	-128.513	5.000	Top	2.270	Min ACI 10.5	3.410	189.866	0.677
+1.20D+0.50L+0.70S+E	-129.845	5.040	Top	2.294	Min for Bending	3.410	189.866	0.684
+1.20D+0.50L+0.70S+E	-131.159	5.080	Top	2.318	Min ACI 10.5	3.410	189.866	0.691
+1.20D+0.50L+0.70S+E	-132.455	5.120	Top	2.342	Min ACI 10.5	3.410	189.866	0.698
+1.20D+0.50L+0.70S+E	-133.733	5.160	Top	2.365	Min ACI 10.5	3.410	189.866	0.704
+1.20D+0.50L+0.70S+E	-134.994	5.200	Top	2.388	Min ACI 10.5	3.410	189.866	0.711
+1.20D+0.50L+0.70S+E	-136.237	5.240	Top	2.411	Min ACI 10.5	3.410	189.866	0.718
+1.20D+0.50L+0.70S+E	-137.461	5.280	Top	2.434	Min ACI 10.5	3.410	189.866	0.724
+1.20D+0.50L+0.70S+E	-138.668	5.320	Top	2.456	Min ACI 10.5	3.410	189.866	0.730
+1.20D+0.50L+0.70S+E	-139.857	5.360	Top	2.478	Min ACI 10.5	3.410	189.866	0.737
+1.20D+0.50L+0.70S+E	-141.029	5.400	Top	2.499	Min ACI 10.5	3.410	189.866	0.743
+1.20D+0.50L+0.70S+E	-142.182	5.440	Top	2.520	Min ACI 10.5	3.410	189.866	0.749
+1.20D+0.50L+0.70S+E	-143.317	5.480	Top	2.541	Min ACI 10.5	3.410	189.866	0.755
+1.20D+0.50L+0.70S+E	-144.435	5.520	Top	2.562	Min ACI 10.5	3.410	189.866	0.761
+1.20D+0.50L+0.70S+E	-145.534	5.560	Top	2.582	Min ACI 10.5	3.410	189.866	0.767
+1.20D+0.50L+0.70S+E	-146.616	5.600	Top	2.602	Min ACI 10.5	3.410	189.866	0.772
+1.20D+0.50L+0.70S+E	-147.680	5.640	Top	2.622	Min ACI 10.5	3.410	189.866	0.778
+1.20D+0.50L+0.70S+E	-148.726	5.680	Top	2.641	Min ACI 10.5	3.410	189.866	0.783
+1.20D+0.50L+0.70S+E	-149.754	5.720	Top	2.660	Min ACI 10.5	3.410	189.866	0.789
+1.20D+0.50L+0.70S+E	-150.764	5.760	Top	2.679	Min ACI 10.5	3.410	189.866	0.794
+1.20D+0.50L+0.70S+E	-151.757	5.800	Top	2.697	Min ACI 10.5	3.410	189.866	0.799
+1.20D+0.50L+0.70S+E	-152.731	5.840	Top	2.715	Min ACI 10.5	3.410	189.866	0.804
+1.20D+0.50L+0.70S+E	-153.688	5.880	Top	2.733	Min ACI 10.5	3.410	189.866	0.809
+1.20D+0.50L+0.70S+E	-154.626	5.920	Top	2.750	Min ACI 10.5	3.410	189.866	0.814
+1.20D+0.50L+0.70S+E	-155.547	5.960	Top	2.767	Min ACI 10.5	3.410	189.866	0.819
+1.20D+0.50L+0.70S+E	-156.450	6.000	Top	2.784	Min ACI 10.5	3.410	189.866	0.824
+1.20D+0.50L+0.70S+E	-157.335	6.040	Top	2.800	Min ACI 10.5	3.410	189.866	0.829
+1.20D+0.50L+0.70S+E	-158.202	6.080	Top	2.816	Min ACI 10.5	3.410	189.866	0.833
+1.20D+0.50L+0.70S+E	-159.052	6.120	Top	2.832	Min ACI 10.5	3.410	189.866	0.838
+1.20D+0.50L+0.70S+E	-159.883	6.160	Top	2.848	Min ACI 10.5	3.410	189.866	0.842
+1.20D+0.50L+0.70S+E	-160.697	6.200	Top	2.863	Min ACI 10.5	3.410	189.866	0.846
+1.20D+0.50L+0.70S+E	-161.492	6.240	Top	2.878	Min ACI 10.5	3.410	189.866	0.851
+1.20D+0.50L+0.70S+E	-162.270	6.280	Top	2.892	Min ACI 10.5	3.410	189.866	0.855
+1.20D+0.50L+0.70S+E	-163.030	6.320	Top	2.906	Min ACI 10.5	3.410	189.866	0.859
+1.20D+0.50L+0.70S+E	-163.772	6.360	Top	2.920	Min ACI 10.5	3.410	189.866	0.863
+1.20D+0.50L+0.70S+E	-164.496	6.400	Top	2.934	Min ACI 10.5	3.410	189.866	0.866
+1.20D+0.50L+0.70S+E	-165.202	6.440	Top	2.947	Min ACI 10.5	3.410	189.866	0.870
+1.20D+0.50L+0.70S+E	-165.891	6.480	Top	2.960	Min ACI 10.5	3.410	189.866	0.874
+1.20D+0.50L+0.70S+E	-166.561	6.520	Top	2.972	Min for Bending	3.410	189.866	0.877
+1.20D+0.50L+0.70S+E	-167.214	6.560	Top	2.984	Min ACI 10.5	3.410	189.866	0.881
+1.20D+0.50L+0.70S+E	-167.849	6.600	Top	2.996	Min ACI 10.5	3.410	189.866	0.884
+1.20D+0.50L+0.70S+E	-168.465	6.640	Top	3.008	Min ACI 10.5	3.410	189.866	0.887
+1.20D+0.50L+0.70S+E	-169.064	6.680	Top	3.019	Min ACI 10.5	3.410	189.866	0.890
+1.20D+0.50L+0.70S+E	-169.645	6.720	Top	3.030	Min for Bending	3.410	189.866	0.894
+1.20D+0.50L+0.70S+E	-170.209	6.760	Top	3.040	Min ACI 10.5	3.410	189.866	0.896
+1.20D+0.50L+0.70S+E	-170.754	6.800	Top	3.050	Min ACI 10.5	3.410	189.866	0.899
+1.20D+0.50L+0.70S+E	-171.281	6.840	Top	3.060	Min ACI 10.5	3.410	189.866	0.902
+1.20D+0.50L+0.70S+E	-171.791	6.880	Top	3.070	Min for Bending	3.410	189.866	0.905
+1.20D+0.50L+0.70S+E	-172.283	6.920	Top	3.079	Min ACI 10.5	3.410	189.866	0.907
+1.20D+0.50L+0.70S+E	-172.757	6.960	Top	3.088	Min ACI 10.5	3.410	189.866	0.910
+1.20D+0.50L+0.70S+E	-173.213	7.000	Top	3.096	Min ACI 10.5	3.410	189.866	0.912
+1.20D+0.50L+0.70S+E	-173.651	7.040	Top	3.105	Min for Bending	3.410	189.866	0.915
+1.20D+0.50L+0.70S+E	-174.071	7.080	Top	3.113	Min ACI 10.5	3.410	189.866	0.917
+1.20D+0.50L+0.70S+E	-174.473	7.120	Top	3.120	Min ACI 10.5	3.410	189.866	0.919
+1.20D+0.50L+0.70S+E	-174.857	7.160	Top	3.127	Min ACI 10.5	3.410	189.866	0.921
+1.20D+0.50L+0.70S+E	-175.224	7.200	Top	3.134	Min ACI 10.5	3.410	189.866	0.923
+1.20D+0.50L+0.70S+E	-175.573	7.240	Top	3.141	Min ACI 10.5	3.410	189.866	0.925

Combined Footing

Project File: capstone.ec6

LIC# : --Unassigned--, Build:20.22.10.27 UNLICENSED DEMO USER, DEMO EXPIRES IN 29 DAYS (c) ENERCALC INC 1983-20

DESCRIPTION: --None--

Z-Axis Footing Flexure - Maximum Values for Load Combination

Load Combination...	Mu (ft-k)	Distance from left (ft)	Tension Side	As Req'd (in^2)	Governed by	Actual As (in^2)	Phi*Mn (ft-k)	Mu / PhiMr
+1.20D+0.50L+0.70S+E	-175.903	7.280	Top	3.147	Min ACI 10.5	3.410	189.866	0.926
+1.20D+0.50L+0.70S+E	-176.216	7.320	Top	3.153	Min ACI 10.5	3.410	189.866	0.928
+1.20D+0.50L+0.70S+E	-176.511	7.360	Top	3.158	Min ACI 10.5	3.410	189.866	0.930
+1.20D+0.50L+0.70S+E	-176.789	7.400	Top	3.164	Min ACI 10.5	3.410	189.866	0.931
+1.20D+0.50L+0.70S+E	-177.048	7.440	Top	3.168	Min ACI 10.5	3.410	189.866	0.932
+1.20D+0.50L+0.70S+E	-177.289	7.480	Top	3.173	Min ACI 10.5	3.410	189.866	0.934
+1.20D+0.50L+0.70S+E	-177.513	7.520	Top	3.177	Min ACI 10.5	3.410	189.866	0.935
+1.20D+0.50L+0.70S+E	-177.718	7.560	Top	3.181	Min ACI 10.5	3.410	189.866	0.936
+1.20D+0.50L+0.70S+E	-177.906	7.600	Top	3.185	Min for Bending	3.410	189.866	0.937
+1.20D+0.50L+0.70S+E	-178.076	7.640	Top	3.188	Min ACI 10.5	3.410	189.866	0.938
+1.20D+0.50L+0.70S+E	-178.228	7.680	Top	3.191	Min ACI 10.5	3.410	189.866	0.939
+1.20D+0.50L+0.70S+E	-178.362	7.720	Top	3.193	Min ACI 10.5	3.410	189.866	0.939
+1.20D+0.50L+0.70S+E	-178.478	7.760	Top	3.195	Min ACI 10.5	3.410	189.866	0.940
+1.20D+0.50L+0.70S+E	-178.577	7.800	Top	3.197	Min ACI 10.5	3.410	189.866	0.941
+1.20D+0.50L+0.70S+E	-178.657	7.840	Top	3.199	Min ACI 10.5	3.410	189.866	0.941
+1.20D+0.50L+0.70S+E	-178.720	7.880	Top	3.200	Min ACI 10.5	3.410	189.866	0.941
+1.20D+0.50L+0.70S+E	-178.764	7.920	Top	3.201	Min ACI 10.5	3.410	189.866	0.942
+1.20D+0.50L+0.70S+E	-178.791	7.960	Top	3.201	Min ACI 10.5	3.410	189.866	0.942
+1.20D+0.50L+0.70S+E	-178.800	8.000	Top	3.201	Min ACI 10.5	3.410	189.866	0.942
+1.20D+0.50L+0.70S+E	-178.791	8.040	Top	3.201	Min ACI 10.5	3.410	189.866	0.942
+1.20D+0.50L+0.70S+E	-178.764	8.080	Top	3.201	Min ACI 10.5	3.410	189.866	0.942
+1.20D+0.50L+0.70S+E	-178.720	8.120	Top	3.200	Min ACI 10.5	3.410	189.866	0.941
+1.20D+0.50L+0.70S+E	-178.657	8.160	Top	3.199	Min ACI 10.5	3.410	189.866	0.941
+1.20D+0.50L+0.70S+E	-178.577	8.200	Top	3.197	Min ACI 10.5	3.410	189.866	0.941
+1.20D+0.50L+0.70S+E	-178.478	8.240	Top	3.195	Min ACI 10.5	3.410	189.866	0.940
+1.20D+0.50L+0.70S+E	-178.362	8.280	Top	3.193	Min ACI 10.5	3.410	189.866	0.939
+1.20D+0.50L+0.70S+E	-178.228	8.320	Top	3.191	Min ACI 10.5	3.410	189.866	0.939
+1.20D+0.50L+0.70S+E	-178.076	8.360	Top	3.188	Min ACI 10.5	3.410	189.866	0.938
+1.20D+0.50L+0.70S+E	-177.906	8.400	Top	3.185	Min ACI 10.5	3.410	189.866	0.937
+1.20D+0.50L+0.70S+E	-177.718	8.440	Top	3.181	Min ACI 10.5	3.410	189.866	0.936
+1.20D+0.50L+0.70S+E	-177.513	8.480	Top	3.177	Min ACI 10.5	3.410	189.866	0.935
+1.20D+0.50L+0.70S+E	-177.289	8.520	Top	3.173	Min ACI 10.5	3.410	189.866	0.934
+1.20D+0.50L+0.70S+E	-177.048	8.560	Top	3.168	Min ACI 10.5	3.410	189.866	0.932
+1.20D+0.50L+0.70S+E	-176.789	8.600	Top	3.164	Min ACI 10.5	3.410	189.866	0.931
+1.20D+0.50L+0.70S+E	-176.511	8.640	Top	3.158	Min ACI 10.5	3.410	189.866	0.930
+1.20D+0.50L+0.70S+E	-176.216	8.680	Top	3.153	Min ACI 10.5	3.410	189.866	0.928
+1.20D+0.50L+0.70S+E	-175.903	8.720	Top	3.147	Min ACI 10.5	3.410	189.866	0.926
+1.20D+0.50L+0.70S+E	-175.573	8.760	Top	3.141	Min ACI 10.5	3.410	189.866	0.925
+1.20D+0.50L+0.70S+E	-175.224	8.800	Top	3.134	Min ACI 10.5	3.410	189.866	0.923
+1.20D+0.50L+0.70S+E	-174.857	8.840	Top	3.127	Min ACI 10.5	3.410	189.866	0.921
+1.20D+0.50L+0.70S+E	-174.473	8.880	Top	3.120	Min ACI 10.5	3.410	189.866	0.919
+1.20D+0.50L+0.70S+E	-174.071	8.920	Top	3.113	Min ACI 10.5	3.410	189.866	0.917
+1.20D+0.50L+0.70S+E	-173.651	8.960	Top	3.105	Min ACI 10.5	3.410	189.866	0.915
+1.20D+0.50L+0.70S+E	-173.213	9.000	Top	3.096	Min ACI 10.5	3.410	189.866	0.912
+1.20D+0.50L+0.70S+E	-172.757	9.040	Top	3.088	Min ACI 10.5	3.410	189.866	0.910
+1.20D+0.50L+0.70S+E	-172.283	9.080	Top	3.079	Min ACI 10.5	3.410	189.866	0.907
+1.20D+0.50L+0.70S+E	-171.791	9.120	Top	3.070	Min ACI 10.5	3.410	189.866	0.905
+1.20D+0.50L+0.70S+E	-171.281	9.160	Top	3.060	Min ACI 10.5	3.410	189.866	0.902
+1.20D+0.50L+0.70S+E	-170.754	9.200	Top	3.050	Min ACI 10.5	3.410	189.866	0.899
+1.20D+0.50L+0.70S+E	-170.209	9.240	Top	3.040	Min ACI 10.5	3.410	189.866	0.896
+1.20D+0.50L+0.70S+E	-169.645	9.280	Top	3.030	Min ACI 10.5	3.410	189.866	0.894
+1.20D+0.50L+0.70S+E	-169.064	9.320	Top	3.019	Min ACI 10.5	3.410	189.866	0.890
+1.20D+0.50L+0.70S+E	-168.465	9.360	Top	3.008	Min ACI 10.5	3.410	189.866	0.887
+1.20D+0.50L+0.70S+E	-167.849	9.400	Top	2.996	Min ACI 10.5	3.410	189.866	0.884
+1.20D+0.50L+0.70S+E	-167.214	9.440	Top	2.984	Min ACI 10.5	3.410	189.866	0.881
+1.20D+0.50L+0.70S+E	-166.561	9.480	Top	2.972	Min ACI 10.5	3.410	189.866	0.877
+1.20D+0.50L+0.70S+E	-165.891	9.520	Top	2.960	Min ACI 10.5	3.410	189.866	0.874
+1.20D+0.50L+0.70S+E	-165.202	9.560	Top	2.947	Min ACI 10.5	3.410	189.866	0.870
+1.20D+0.50L+0.70S+E	-164.496	9.600	Top	2.934	Min ACI 10.5	3.410	189.866	0.866
+1.20D+0.50L+0.70S+E	-163.772	9.640	Top	2.920	Min ACI 10.5	3.410	189.866	0.863
+1.20D+0.50L+0.70S+E	-163.030	9.680	Top	2.906	Min ACI 10.5	3.410	189.866	0.859
+1.20D+0.50L+0.70S+E	-162.270	9.720	Top	2.892	Min ACI 10.5	3.410	189.866	0.855
+1.20D+0.50L+0.70S+E	-161.492	9.760	Top	2.878	Min ACI 10.5	3.410	189.866	0.851

Combined Footing

Project File: capstone.ec6

LIC# : --Unassigned--, Build:20.22.10.27 UNLICENSED DEMO USER, DEMO EXPIRES IN 29 DAYS (c) ENERCALC INC 1983-20

DESCRIPTION: --None--

Z-Axis Footing Flexure - Maximum Values for Load Combination

Load Combination...	Mu (ft-k)	Distance from left (ft)	Tension Side	As Req'd (in^2)	Governed by	Actual As (in^2)	Phi*Mn (ft-k)	Mu / PhiMr
+1.20D+0.50L+0.70S+E	-160.697	9.800	Top	2.863	Min for Bending	3.410	189.866	0.846
+1.20D+0.50L+0.70S+E	-159.883	9.840	Top	2.848	Min ACI 10.5	3.410	189.866	0.842
+1.20D+0.50L+0.70S+E	-159.052	9.880	Top	2.832	Min ACI 10.5	3.410	189.866	0.838
+1.20D+0.50L+0.70S+E	-158.202	9.920	Top	2.816	Min ACI 10.5	3.410	189.866	0.833
+1.20D+0.50L+0.70S+E	-157.335	9.960	Top	2.800	Min ACI 10.5	3.410	189.866	0.829
+1.20D+0.50L+0.70S+E	-156.450	10.000	Top	2.784	Min ACI 10.5	3.410	189.866	0.824
+1.20D+0.50L+0.70S+E	-155.547	10.040	Top	2.767	Min for Bending	3.410	189.866	0.819
+1.20D+0.50L+0.70S+E	-154.626	10.080	Top	2.750	Min ACI 10.5	3.410	189.866	0.814
+1.20D+0.50L+0.70S+E	-153.688	10.120	Top	2.733	Min ACI 10.5	3.410	189.866	0.809
+1.20D+0.50L+0.70S+E	-152.731	10.160	Top	2.715	Min ACI 10.5	3.410	189.866	0.804
+1.20D+0.50L+0.70S+E	-151.757	10.200	Top	2.697	Min ACI 10.5	3.410	189.866	0.799
+1.20D+0.50L+0.70S+E	-150.764	10.240	Top	2.679	Min ACI 10.5	3.410	189.866	0.794
+1.20D+0.50L+0.70S+E	-149.754	10.280	Top	2.660	Min ACI 10.5	3.410	189.866	0.789
+1.20D+0.50L+0.70S+E	-148.726	10.320	Top	2.641	Min ACI 10.5	3.410	189.866	0.783
+1.20D+0.50L+0.70S+E	-147.680	10.360	Top	2.622	Min ACI 10.5	3.410	189.866	0.778
+1.20D+0.50L+0.70S+E	-146.616	10.400	Top	2.602	Min ACI 10.5	3.410	189.866	0.772
+1.20D+0.50L+0.70S+E	-145.534	10.440	Top	2.582	Min ACI 10.5	3.410	189.866	0.767
+1.20D+0.50L+0.70S+E	-144.435	10.480	Top	2.562	Min ACI 10.5	3.410	189.866	0.761
+1.20D+0.50L+0.70S+E	-143.317	10.520	Top	2.541	Min ACI 10.5	3.410	189.866	0.755
+1.20D+0.50L+0.70S+E	-142.182	10.560	Top	2.520	Min ACI 10.5	3.410	189.866	0.749
+1.20D+0.50L+0.70S+E	-141.029	10.600	Top	2.499	Min ACI 10.5	3.410	189.866	0.743
+1.20D+0.50L+0.70S+E	-139.857	10.640	Top	2.478	Min ACI 10.5	3.410	189.866	0.737
+1.20D+0.50L+0.70S+E	-138.668	10.680	Top	2.456	Min ACI 10.5	3.410	189.866	0.730
+1.20D+0.50L+0.70S+E	-137.461	10.720	Top	2.434	Min ACI 10.5	3.410	189.866	0.724
+1.20D+0.50L+0.70S+E	-136.237	10.760	Top	2.411	Min ACI 10.5	3.410	189.866	0.718
+1.20D+0.50L+0.70S+E	-134.994	10.800	Top	2.388	Min ACI 10.5	3.410	189.866	0.711
+1.20D+0.50L+0.70S+E	-133.733	10.840	Top	2.365	Min ACI 10.5	3.410	189.866	0.704
+1.20D+0.50L+0.70S+E	-132.455	10.880	Top	2.342	Min ACI 10.5	3.410	189.866	0.698
+1.20D+0.50L+0.70S+E	-131.159	10.920	Top	2.318	Min ACI 10.5	3.410	189.866	0.691
+1.20D+0.50L+0.70S+E	-129.845	10.960	Top	2.294	Min ACI 10.5	3.410	189.866	0.684
+1.20D+0.50L+0.70S+E	-128.513	11.000	Top	2.270	Min ACI 10.5	3.410	189.866	0.677
+1.20D+0.50L+0.70S+E	-127.163	11.040	Top	2.245	Min ACI 10.5	3.410	189.866	0.670
+1.20D+0.50L+0.70S+E	-125.795	11.080	Top	2.220	Min ACI 10.5	3.410	189.866	0.663
+1.20D+0.50L+0.70S+E	-124.409	11.120	Top	2.195	Min ACI 10.5	3.410	189.866	0.655
+1.20D+0.50L+0.70S+E	-123.005	11.160	Top	2.169	Min ACI 10.5	3.410	189.866	0.648
+1.20D+0.50L+0.70S+E	-121.584	11.200	Top	2.143	Min ACI 10.5	3.410	189.866	0.640
+1.20D+0.50L+0.70S+E	-120.145	11.240	Top	2.117	Min ACI 10.5	3.410	189.866	0.633
+1.20D+0.50L+0.70S+E	-118.687	11.280	Top	2.091	Min ACI 10.5	3.410	189.866	0.625
+1.20D+0.50L+0.70S+E	-117.212	11.320	Top	2.080	Min ACI 10.5	3.410	189.866	0.617
+1.20D+0.50L+0.70S+E	-115.719	11.360	Top	2.080	Min ACI 10.5	3.410	189.866	0.609
+1.20D+0.50L+0.70S+E	-114.209	11.400	Top	2.080	Min ACI 10.5	3.410	189.866	0.602
+1.20D+0.50L+0.70S+E	-112.680	11.440	Top	2.080	Min ACI 10.5	3.410	189.866	0.593
+1.20D+0.50L+0.70S+E	-111.133	11.480	Top	2.080	Min ACI 10.5	3.410	189.866	0.585
+1.20D+0.50L+0.70S+E	-109.569	11.520	Top	2.080	Min ACI 10.5	3.410	189.866	0.577
+1.20D+0.50L+0.70S+E	-107.986	11.560	Top	2.080	Min ACI 10.5	3.410	189.866	0.569
+1.20D+0.50L+0.70S+E	-106.386	11.600	Top	2.080	Min ACI 10.5	3.410	189.866	0.560
+1.20D+0.50L+0.70S+E	-104.768	11.640	Top	2.080	Min ACI 10.5	3.410	189.866	0.552
+1.20D+0.50L+0.70S+E	-103.132	11.680	Top	2.080	Min ACI 10.5	3.410	189.866	0.543
+1.20D+0.50L+0.70S+E	-101.478	11.720	Top	2.080	Min ACI 10.5	3.410	189.866	0.534
+1.20D+0.50L+0.70S+E	-99.806	11.760	Top	2.080	Min ACI 10.5	3.410	189.866	0.526
+1.20D+0.50L+0.70S+E	-98.117	11.800	Top	2.080	Min ACI 10.5	3.410	189.866	0.517
+1.20D+0.50L+0.70S+E	-96.409	11.840	Top	2.080	Min ACI 10.5	3.410	189.866	0.508
+1.20D+0.50L+0.70S+E	-94.684	11.880	Top	2.080	Min ACI 10.5	3.410	189.866	0.499
+1.20D+0.50L+0.70S+E	-92.940	11.920	Top	2.080	Min ACI 10.5	3.410	189.866	0.490
+1.20D+0.50L+0.70S+E	-91.179	11.960	Top	2.080	Min ACI 10.5	3.410	189.866	0.480
+1.20D+0.50L+0.70S+E	-89.400	12.000	Top	2.080	Min ACI 10.5	3.410	189.866	0.471
+1.20D+0.50L+0.70S+E	-87.603	12.040	Top	2.041	Min ACI 10.5	3.410	189.866	0.461
+1.20D+0.50L+0.70S+E	-85.788	12.080	Top	1.998	Min ACI 10.5	3.410	189.866	0.452
+1.20D+0.50L+0.70S+E	-83.956	12.120	Top	1.954	Min ACI 10.5	3.410	189.866	0.442
+1.20D+0.50L+0.70S+E	-82.105	12.160	Top	1.910	Min ACI 10.5	3.410	189.866	0.432
+1.20D+0.50L+0.70S+E	-80.237	12.200	Top	1.866	Min ACI 10.5	3.410	189.866	0.423
+1.20D+0.50L+0.70S+E	-78.350	12.240	Top	1.821	Min ACI 10.5	3.410	189.866	0.413
+1.20D+0.50L+0.70S+E	-76.446	12.280	Top	1.776	Min ACI 10.5	3.410	189.866	0.403

Combined Footing

Project File: capstone.ec6

DESCRIPTION: --None--

Z-Axis Footing Flexure - Maximum Values for Load Combination

Load Combination...	Mu (ft-k)	Distance from left (ft)	Tension Side	As Req'd (in^2)	Governed by	Actual As (in^2)	Phi*Mn (ft-k)	Mu / PhiMr
+1.20D+0.50L+0.70S+E	-74.524	12.320	Top	1.730	Min ACI 10.5	3.410	189.866	0.393
+1.20D+0.50L+0.70S+E	-72.584	12.360	Top	1.684	Min ACI 10.5	3.410	189.866	0.382
+1.20D+0.50L+0.70S+E	-70.626	12.400	Top	1.638	Min ACI 10.5	3.410	189.866	0.372
+1.20D+0.50L+0.70S+E	-68.650	12.440	Top	1.592	Min ACI 10.5	3.410	189.866	0.362
+1.20D+0.50L+0.70S+E	-66.657	12.480	Top	1.545	Min ACI 10.5	3.410	189.866	0.351
+1.20D+0.50L+0.70S+E	-64.645	12.520	Top	1.497	Min ACI 10.5	3.410	189.866	0.340
+1.20D+0.50L+0.70S+E	-62.616	12.560	Top	1.449	Min ACI 10.5	3.410	189.866	0.330
+1.20D+0.50L+0.70S+E	-60.569	12.600	Top	1.401	Min ACI 10.5	3.410	189.866	0.319
+1.20D+0.50L+0.70S+E	-58.503	12.640	Top	1.382	Min Temp %	3.410	189.866	0.308
+1.20D+0.50L+0.70S+E	-56.420	12.680	Top	1.382	Min Temp %	3.410	189.866	0.297
+1.20D+0.50L+0.70S+E	-54.319	12.720	Top	1.382	Min Temp %	3.410	189.866	0.286
+1.20D+0.50L+0.70S+E	-52.201	12.760	Top	1.382	Min Temp %	3.410	189.866	0.275
+1.20D+0.50L+0.70S+E	-50.064	12.800	Top	1.382	Min Temp %	3.410	189.866	0.264
+1.20D+0.50L+0.70S+E	-47.909	12.840	Top	1.382	Min Temp %	3.410	189.866	0.252
+1.20D+0.50L+0.70S+E	-45.737	12.880	Top	1.382	Min Temp %	3.410	189.866	0.241
+1.20D+0.50L+0.70S+E	-43.547	12.920	Top	1.382	Min Temp %	3.410	189.866	0.229
+1.20D+0.50L+0.70S+E	-41.339	12.960	Top	1.382	Min Temp %	3.410	189.866	0.218
+1.20D+0.50L+0.70S+E	-39.113	13.000	Top	1.382	Min Temp %	3.410	189.866	0.206
+1.20D+0.50L+0.70S+E	-36.869	13.040	Top	1.382	Min Temp %	3.410	189.866	0.194
+1.20D+0.50L+0.70S+E	-34.607	13.080	Top	1.382	Min Temp %	3.410	189.866	0.182
+1.20D+0.50L+0.70S+E	-32.360	13.120	Top	1.382	Min Temp %	3.410	189.866	0.170
+1.20D+0.50L+0.70S+E	-30.173	13.160	Top	1.382	Min Temp %	3.410	189.866	0.159
+1.20D+0.50L+0.70S+E	-28.046	13.200	Top	1.382	Min Temp %	3.410	189.866	0.148
+1.20D+0.50L+0.70S+E	-25.979	13.240	Top	1.382	Min Temp %	3.410	189.866	0.137
+1.20D+0.50L+0.70S+E	-23.972	13.280	Top	1.382	Min Temp %	3.410	189.866	0.126
+1.20D+0.50L+0.70S+E	-22.026	13.320	Top	1.382	Min Temp %	3.410	189.866	0.116
+1.20D+0.50L+0.70S+E	-20.140	13.360	Top	1.382	Min Temp %	3.410	189.866	0.106
+1.20D+0.50L+0.70S+E	-18.313	13.400	Top	1.382	Min Temp %	3.410	189.866	0.096
+1.20D+0.50L+0.70S+E	-16.547	13.440	Top	1.382	Min Temp %	3.410	189.866	0.087
+1.20D+0.50L+0.70S+E	-14.841	13.480	Top	1.382	Min Temp %	3.410	189.866	0.078
+1.20D+0.50L+0.70S+E	-13.196	13.520	Top	1.382	Min Temp %	3.410	189.866	0.070
+1.20D+0.50L+0.70S+E	-11.610	13.560	Top	1.382	Min Temp %	3.410	189.866	0.061
+1.20D+0.50L+0.70S+E	-10.085	13.600	Top	1.382	Min Temp %	3.410	189.866	0.053
+1.20D+0.50L+0.70S+E	-8.619	13.640	Top	1.382	Min Temp %	3.410	189.866	0.045
+1.20D+0.50L+0.70S+E	-7.214	13.680	Top	1.382	Min Temp %	3.410	189.866	0.038
+1.20D+0.50L+0.70S+E	-5.869	13.720	Top	1.382	Min Temp %	3.410	189.866	0.031
+1.20D+0.50L+0.70S+E	-4.584	13.760	Top	1.382	Min Temp %	3.410	189.866	0.024
+1.20D+0.50L+0.70S+E	-3.359	13.800	Top	1.382	Min Temp %	3.410	189.866	0.018
+1.20D+0.50L+0.70S+E	-2.195	13.840	Top	1.382	Min Temp %	3.410	189.866	0.012
+1.20D+0.50L+0.70S+E	-1.090	13.880	Top	1.382	Min Temp %	3.410	189.866	0.006
+1.20D+0.50L+0.70S+E	-0.046	13.920	Top	1.382	Min Temp %	3.410	189.866	0.000
+1.20D+0.50L+0.70S+E	0.938	13.960	Bottom	1.382	Min Temp %	0.930	53.690	0.017
+1.20D+0.50L+0.70S+E	1.862	14.000	Bottom	1.382	Min Temp %	0.930	53.690	0.035
+1.20D+0.50L+0.70S+E	2.726	14.040	Bottom	1.382	Min Temp %	1.550	88.688	0.031
+1.20D+0.50L+0.70S+E	3.530	14.080	Bottom	1.382	Min Temp %	1.550	88.688	0.040
+1.20D+0.50L+0.70S+E	4.274	14.120	Bottom	1.382	Min Temp %	1.550	88.688	0.048
+1.20D+0.50L+0.70S+E	4.957	14.160	Bottom	1.382	Min Temp %	1.550	88.688	0.056
+1.20D+0.50L+0.70S+E	5.581	14.200	Bottom	1.382	Min Temp %	1.550	88.688	0.063
+1.20D+0.50L+0.70S+E	6.144	14.240	Bottom	1.382	Min Temp %	1.550	88.688	0.069
+1.20D+0.50L+0.70S+E	6.647	14.280	Bottom	1.382	Min Temp %	1.550	88.688	0.075
+1.20D+0.50L+0.70S+E	7.090	14.320	Bottom	1.382	Min Temp %	1.550	88.688	0.080
+1.20D+0.50L+0.70S+E	7.473	14.360	Bottom	1.382	Min Temp %	1.550	88.688	0.084
+1.20D+0.50L+0.70S+E	7.795	14.400	Bottom	1.382	Min Temp %	1.550	88.688	0.088
+1.20D+0.50L+0.70S+E	8.058	14.440	Bottom	1.382	Min Temp %	1.550	88.688	0.091
+1.20D+0.50L+0.70S+E	8.260	14.480	Bottom	1.382	Min Temp %	1.550	88.688	0.093
+1.20D+0.50L+0.70S+E	8.403	14.520	Bottom	1.382	Min Temp %	1.550	88.688	0.095
+1.20D+0.50L+0.70S+E	8.485	14.560	Bottom	1.382	Min Temp %	1.550	88.688	0.096
+1.20D+0.50L+0.70S+E	8.507	14.600	Bottom	1.382	Min Temp %	1.550	88.688	0.096
+1.20D+0.50L+0.70S+E	8.468	14.640	Bottom	1.382	Min Temp %	1.550	88.688	0.095
+1.20D+0.50L+0.70S+E	8.370	14.680	Bottom	1.382	Min Temp %	1.550	88.688	0.094
+1.20D+0.50L+0.70S+E	8.212	14.720	Bottom	1.382	Min Temp %	1.550	88.688	0.093
+1.20D+0.50L+0.70S+E	7.993	14.760	Bottom	1.382	Min Temp %	1.550	88.688	0.090
+1.20D+0.50L+0.70S+E	7.714	14.800	Bottom	1.382	Min Temp %	1.550	88.688	0.087

Combined Footing

Project File: capstone.ec6

LIC# : --Unassigned--, Build:20.22.10.27 UNLICENSED DEMO USER, DEMO EXPIRES IN 29 DAYS (c) ENERCALC INC 1983-20

DESCRIPTION: --None--

Z-Axis Footing Flexure - Maximum Values for Load Combination

Load Combination...	Mu (ft-k)	Distance from left (ft)	Tension Side	As Req'd (in^2)	Governed by	Actual As (in^2)	Phi*Mn (ft-k)	Mu / PhiMr
+1.20D+0.50L+0.70S+E	7.375	14.840	Bottom	1.382	Min Temp %	1.550	88.688	0.083
+1.20D+0.50L+0.70S+E	6.976	14.880	Bottom	1.382	Min Temp %	1.550	88.688	0.079
+1.20D+0.50L+0.70S+E	6.517	14.920	Bottom	1.382	Min Temp %	1.550	88.688	0.073
+1.20D+0.50L+0.70S+E	6.043	14.960	Bottom	1.382	Min Temp %	1.550	88.688	0.068
+1.20D+0.50L+0.70S+E	5.587	15.000	Bottom	1.382	Min Temp %	1.550	88.688	0.063
+1.20D+0.50L+0.70S+E	5.149	15.040	Bottom	1.382	Min Temp %	1.550	88.688	0.058
+1.20D+0.50L+0.70S+E	4.729	15.080	Bottom	1.382	Min Temp %	1.550	88.688	0.053
+1.20D+0.50L+0.70S+E	4.327	15.120	Bottom	1.382	Min Temp %	1.550	88.688	0.049
+1.20D+0.50L+0.70S+E	3.943	15.160	Bottom	1.382	Min Temp %	1.550	88.688	0.044
+1.20D+0.50L+0.70S+E	3.576	15.200	Bottom	1.382	Min Temp %	1.550	88.688	0.040
+1.20D+0.50L+0.70S+E	3.227	15.240	Bottom	1.382	Min Temp %	1.550	88.688	0.036
+1.20D+0.50L+0.70S+E	2.897	15.280	Bottom	1.382	Min Temp %	1.550	88.688	0.033
+1.20D+0.50L+0.70S+E	2.584	15.320	Bottom	1.382	Min Temp %	1.550	88.688	0.029
+1.20D+0.50L+0.70S+E	2.289	15.360	Bottom	1.382	Min Temp %	1.550	88.688	0.026
+1.20D+0.50L+0.70S+E	2.011	15.400	Bottom	1.382	Min Temp %	1.550	88.688	0.023
+1.20D+0.50L+0.70S+E	1.752	15.440	Bottom	1.382	Min Temp %	1.550	88.688	0.020
+1.20D+0.50L+0.70S+E	1.511	15.480	Bottom	1.382	Min Temp %	1.550	88.688	0.017
+1.20D+0.50L+0.70S+E	1.287	15.520	Bottom	1.382	Min Temp %	1.550	88.688	0.015
+1.20D+0.50L+0.70S+E	1.082	15.560	Bottom	1.382	Min Temp %	1.550	88.688	0.012
+1.20D+0.50L+0.70S+E	0.894	15.600	Bottom	1.382	Min Temp %	1.550	88.688	0.010
+1.20D+0.50L+0.70S+E	0.724	15.640	Bottom	1.382	Min Temp %	1.550	88.688	0.008
+1.20D+0.50L+0.70S+E	0.572	15.680	Bottom	1.382	Min Temp %	1.550	88.688	0.006
+1.20D+0.50L+0.70S+E	0.438	15.720	Bottom	1.382	Min Temp %	1.550	88.688	0.005
+1.20D+0.50L+0.70S+E	0.322	15.760	Bottom	1.382	Min Temp %	1.550	88.688	0.004
+1.20D+0.50L+0.70S+E	0.223	15.800	Bottom	1.382	Min Temp %	1.550	88.688	0.003
+1.20D+0.50L+0.70S+E	0.143	15.840	Bottom	1.382	Min Temp %	1.550	88.688	0.002
+1.20D+0.50L+0.70S+E	0.080	15.880	Bottom	1.382	Min Temp %	1.550	88.688	0.001
+1.20D+0.50L+0.70S+E	0.036	15.920	Bottom	1.382	Min Temp %	1.550	88.688	0.000
+1.20D+0.50L+0.70S+E	0.000	15.960	0	0.000	0	0.000	0.000	0.000
+1.20D+0.50L+0.70S+E	0.000	16.000	0	0.000	0	0.000	0.000	0.000

	One Way Shear			Punching Shear		
Load Combination...	Phi Vn	vu @ Col #1	vu @ Col #2	Phi Vn	vu @ Col #1	vu @ Col #2
+1.40D	94.87 psi	25.80 psi	25.80 psi	189.74 psi	13.07 psi	13.07 psi
+1.20D+1.60L	94.87 psi	45.19 psi	45.19 psi	189.74 psi	22.88 psi	22.88 psi
+1.20D+1.60L+0.50S	94.87 psi	48.80 psi	48.80 psi	189.74 psi	24.70 psi	24.70 psi
+1.20D+0.50L	94.87 psi	29.33 psi	29.33 psi	189.74 psi	14.85 psi	14.85 psi
+1.20D+0.50W	94.87 psi	24.92 psi	24.92 psi	189.74 psi	12.62 psi	12.62 psi
+1.20D+0.50L+1.60S	94.87 psi	40.87 psi	40.87 psi	189.74 psi	20.69 psi	20.69 psi
+1.20D+1.60S+0.50W	94.87 psi	36.46 psi	36.46 psi	189.74 psi	18.46 psi	18.46 psi
+1.20D+0.50L+W	94.87 psi	34.94 psi	34.94 psi	189.74 psi	17.69 psi	17.69 psi
+1.20D+0.50L+0.50S+W	94.87 psi	38.54 psi	38.54 psi	189.74 psi	19.51 psi	19.51 psi
+1.20D+0.50L+0.70S+E	94.87 psi	71.63 psi	71.63 psi	189.74 psi	36.25 psi	36.25 psi
+0.90D+W	94.87 psi	22.20 psi	22.20 psi	189.74 psi	11.24 psi	11.24 psi
+0.90D+E	94.87 psi	53.85 psi	53.85 psi	189.74 psi	27.25 psi	27.25 psi

Concrete Column Project File: capstone.ec6

LIC# : --Unassigned--, Build:20.22.10.27 UNLICENSED DEMO USER, DEMO EXPIRES IN 29 DAYS (c) ENERCALC INC 1983-20

Code References

Calculations per ACI 318-11, IBC 2012, CBC 2013, ASCE 7-10
Load Combinations Used : IBC 2021

General Information

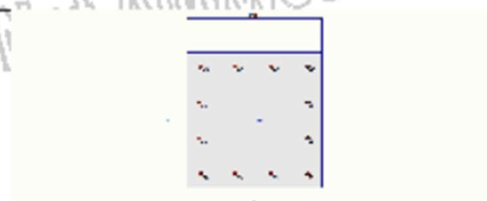
f'c : Concrete 28 day streng = 4.0 ksi
E = 3,605.0 ksi
Density = 150.0 pcf
β = 0.850
fy - Main Rebar = 60.0 ksi
E - Main Rebar = 29,000.0 ksi
Allow. Reinforcing Limits ASTM A615 Bars Used
Min. Reinf. = 0.0 %
Max. Reinf. = 5.0 %

Overall Column Height = 1.330 ft
End Fixity
Brace condition for deflection (buckling) along colur
X-X (width) axis :
Y-Y (depth) axis :

Column Cross Section

Column Dimensions : 22.0in Square Column, Column Edge to Rebar Edge Cover = 2.0in

Column Reinforcing : 4 - #5 bars @ corners,, 2 - #5 bars top & bottom between corner bars, 2 - #5 bars left & right between corner



Applied Loads

Entered loads are factored per load combinations specified by user.

Column self weight included : 670.54 lbs * Dead Load Factor
AXIAL LOADS . . .
Axial Load at 1.330 ft above base, D = 23.0, L = 18.0, S = 9.0, W = 7.0, E = 46.250 k

DESIGN SUMMARY

Load Combination 0.0
Location of max.above base 0.0 ft

Maximum Stress Ratio 0.0 : 1
Ratio = (Pu^2+Mu^2)^.5 / (PhiPn^2+PhiMn^2)^.5
Pu = 0.0 k φ * Pn = 0.0 k
Mu-x = 0.0 k-ft φ * Mn-x = 0.0 k-ft
Mu-y = 0.0 k-ft φ * Mn-y = 0.0 k-ft
Mu Angle = deg
Mu at Angle = k-ft φMn at Angle = k-ft
Pn & Mn values located at Pu-Mu vector intersection with capacity curv

Column Capacities . . .
Pnmax : Nominal Max. Compressive Axial Capa 1,856.15 k
Pnmin : Nominal Min. Tension Axial Capacity k
φ Pn, max : Usable Compressive Axial Capacity 965.20 k
φ Pn, min : Usable Tension Axial Capacity k

Maximum SERVICE Load Reactions .
Top along Y-Y 0.0 k Bottom along Y-Y 0.0 k
Top along X-X 0.0 k Bottom along X-X 0.0 k

Maximum SERVICE Load Deflections . . .
Along Y-Y 0.0 in at 0.0 ft above base
for load combination :
Along X-X 0.0 in at 0.0 ft above base
for load combination :

General Section Informatic φ = 0.650 β = 0.850 θ = 0.80
ρ : % Reinforcing 0.7686 % Rebar % Ok
Reinforcing Area 3.720 in^2
Concrete Area 484.0 in^2

Governing Load Combination Results

Governing Factored Load Combination	Moment X-X	Moment Y-Y	Dist. from base ft	Axial Load k Pu	φ * Pn	Bending Analysis k-ft δx	δx * Mux	δy	δy * Muy	Alpha (deg)	δ Mu	φ Mn	Utilization Ratio

Figure 12 Structural Calculations Option 1

SIMPSON Strong-Tie® Anchor Designer™ Software
Version 3.1.2301.3

Company:		Date:	3/6/2023
Engineer:		Page:	1/5
Project:			
Address:			
Phone:			
E-mail:			

1.Project information

Customer company:
Customer contact name:
Customer e-mail:
Comment:

Project description:
Location:
Fastening description:

2. Input Data & Anchor Parameters

General
Design method:ACI 318-19
Units: Imperial units

Anchor Information:
Anchor type: Cast-in-place
Material: F1554 Grade 36
Diameter (inch): 1.125
Effective Embedment depth, h_{ef} (inch): 5.375
Anchor category: -
Anchor ductility: Yes
h_{min} (inch): 7.25
C_{min} (inch): 6.75
S_{min} (inch): 6.75

Base Material
Concrete: Normal-weight
Concrete thickness, h (inch): 16.00
State: Cracked
Compressive strength, f'_c (psi): 4000
$\Psi_{c,V}$: 1.0
Reinforcement condition: Supplementary reinforcement not present
Supplemental edge reinforcement: Not applicable
Reinforcement provided at corners: Yes
Ignore concrete breakout in tension: No
Ignore concrete breakout in shear: Yes
Ignore 6do requirement: No
Build-up grout pad: No

Base Plate
Length x Width x Thickness (inch): 12.00 x 12.00 x 0.25

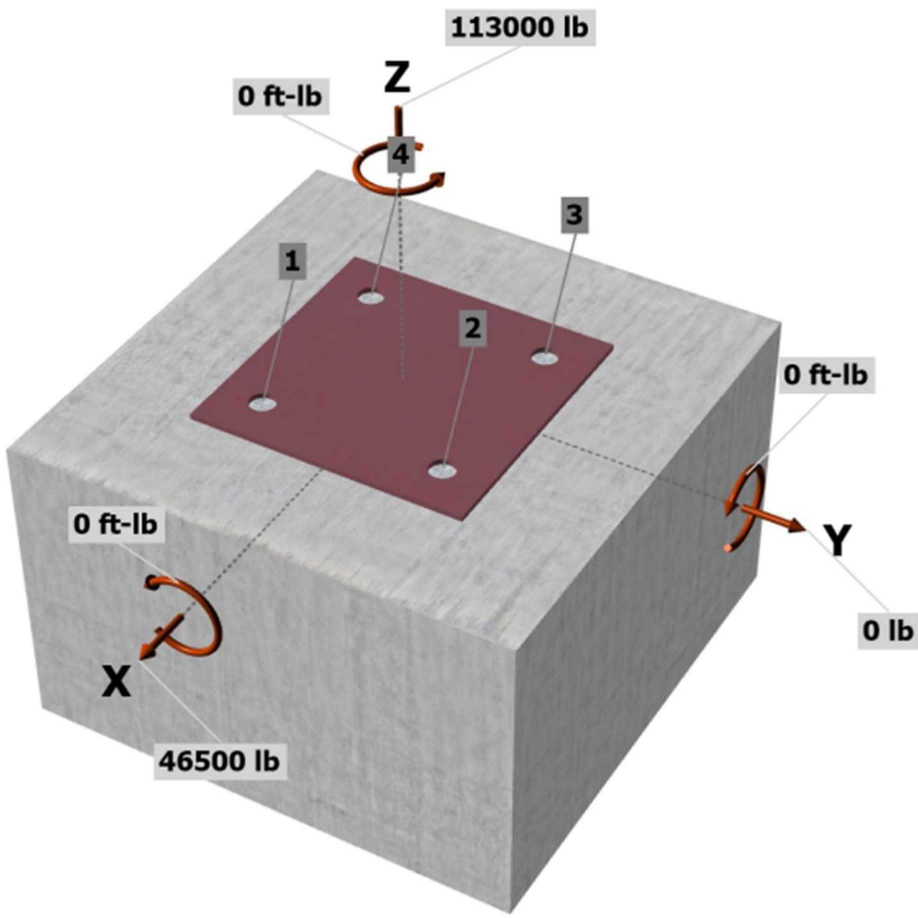
Recommended Anchor
Anchor Name: J- or L-Bolt - 1 1/8"Ø J- or L-Bolt, F1554 Gr. 36

Load and Geometry
Load factor source: ACI 318 Section 5.3
Load combination: not set
Seismic design: No
Anchors subjected to sustained tension: Not applicable
Apply entire shear load at front row: No
Anchors only resisting wind and/or seismic loads: No

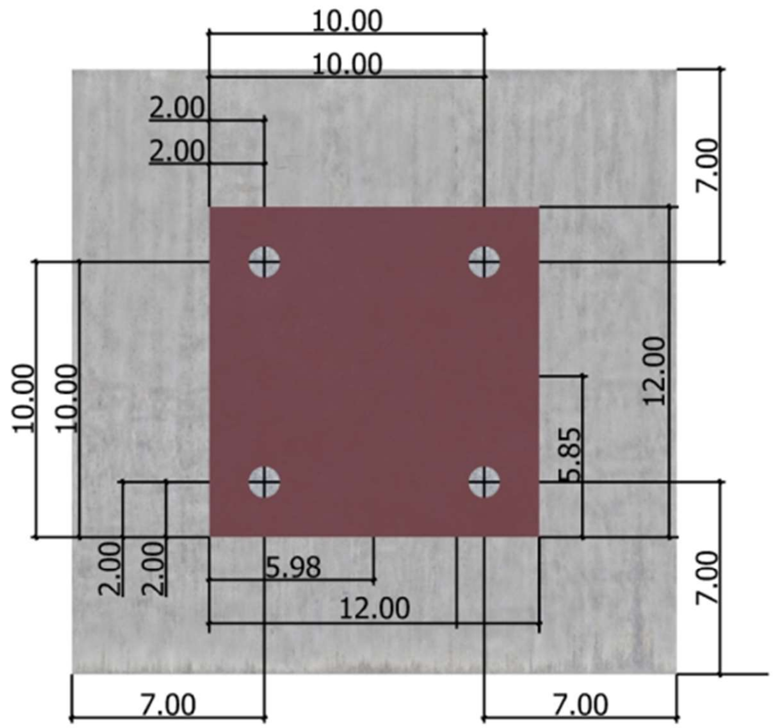
Strength level loads:

N_{ua} [lb]: -113000
V_{uax} [lb]: 46500
V_{uay} [lb]: 0
M_{ux} [ft-lb]: 0
M_{uy} [ft-lb]: 0
M_{uz} [ft-lb]: 0

<Figure 1>



<Figure 2>


10.00
10.00
2.00
2.00
7.00
12.00
5.85
10.00
10.00
2.00
2.00
5.98
12.00
7.00
7.00
7.00

3. Resulting Anchor Forces

Anchor	Tension load, N_{ua} (lb)	Shear load x, V_{uax} (lb)	Shear load y, V_{uay} (lb)	Shear load combined, $\sqrt{(V_{uax})^2+(V_{uay})^2}$ (lb)
1	0.0	11660.5	35.5	11660.5
2	0.0	11589.5	35.5	11589.6
3	0.0	11589.5	-35.5	11589.6
4	0.0	11660.5	-35.5	11660.5
Sum	0.0	46500.0	0.0	46500.2

Maximum concrete compression strain (‰): 0.20
Maximum concrete compression stress (psi): 854
Resultant tension force (lb): 0
Resultant compression force (lb): 113000
Eccentricity of resultant tension forces in x-axis, e'_{Nx} (inch): 0.00
Eccentricity of resultant tension forces in y-axis, e'_{Ny} (inch): 0.00
Eccentricity of resultant shear forces in x-axis, e'_{Vx} (inch): 0.00
Eccentricity of resultant shear forces in y-axis, e'_{Vy} (inch): 0.00

8. Steel Strength of Anchor in Shear (Sec. 17.7.1)

V_{sa} (lb)	ϕ_{grout}	ϕ	$\phi_{grout}\phi V_{sa}$ (lb)
26550	1.0	0.65	17258

10. Concrete Pryout Strength of Anchor in Shear (Sec. 17.7.3)

$\phi V_{cp} = \phi k_{cp} N_{cb} = \phi k_{cp}(A_{Nc} / A_{Nco}) \Psi_{ed,N} \Psi_{c,N} \Psi_{cp,N} N_b$ (Sec. 17.5.1.2 & Eq. 17.7.3.1a)

k_{cp}	A_{Nc} (in^2)	A_{Nco} (in^2)	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	ϕ	ϕV_{cp} (lb)
2.0	121.00	260.02	0.960	1.000	1.000	18915	0.70	11836

11. Results

Interaction of Tensile and Shear Forces (Sec. 17.8)

Shear	Factored Load, V_{ua} (lb)	Design Strength, $øV_n$ (lb)	Ratio	Status
Steel	11661	17258	0.68	Pass
Pryout	**11661**	**11836**	**0.99**	**Pass (Governs)**

1 1/8"Ø J- or L-Bolt, F1554 Gr. 36 with hef = 5.375 inch meets the selected design criteria.

12. Warnings

- Concrete breakout strength in shear has not been evaluated against applied shear load(s) per designer option. Refer to ACI 318 Section 17.5.2.1 for conditions where calculations of the concrete breakout strength may not be required.

- Designer must exercise own judgement to determine if this design is suitable.

Figure 13 Anchor Design Option 1

One Concrete Foundation Wall

Wall Footing

Project File: capstone.ec6

LIC# : --Unassigned--, Build:20.22.10.27 UNLICENSED DEMO USER, DEMO EXPIRES IN 29 DAYS (c) ENERCALC INC 1983-2022

DESCRIPTION: --None--

Code References

Calculations per ACI 318-11, IBC 2012, CBC 2013, ASCE 7-10
Load Combinations Used : IBC 2021

General Information

Material Properties

f'c : Concrete 28 day strength	=	4.0 ksi
fy : Rebar Yield	=	60.0 ksi
Ec : Concrete Elastic Modulus	=	3,122.0 ksi
Concrete Density	=	150.0 pcf
φ Values Flexure	=	0.90
Shear	=	0.750

Analysis Settings

Min Steel % Bending Reinf.	=	
Min Allow % Temp Reinf.	=	0.00180
Min. Overturning Safety Factor	=	1.0 : 1
Min. Sliding Safety Factor	=	1.0 : 1
AutoCalc Footing Weight as DL	:	Yes

Soil Design Values

Allowable Soil Bearing	=	2.50 ksf
Increase Bearing By Footing Weight	=	No
Soil Passive Resistance (for Sliding)	=	250.0 pcf
Soil/Concrete Friction Coeff.	=	0.350

Increases based on footing Depth

Reference Depth below Surface	=	2.5 ft
Allow. Pressure Increase per foot of depth when base footing is below	=	ksf ft

Increases based on footing Width

Allow. Pressure Increase per foot of width	=	ksf
when footing is wider than	=	ft
Adjusted Allowable Bearing Pressure	=	2.50 ksf

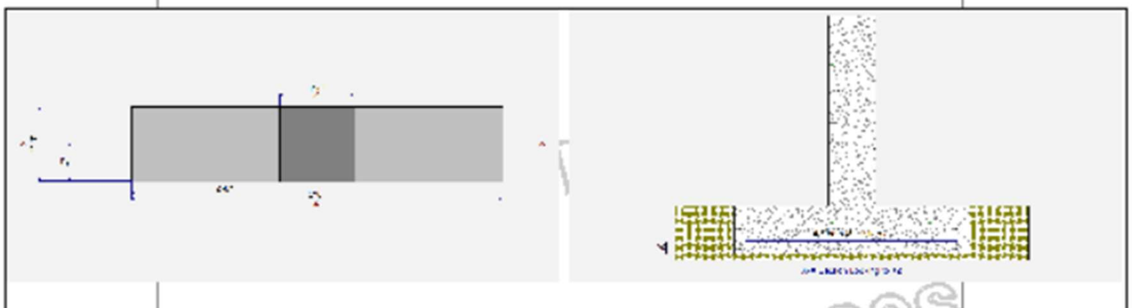
Dimensions

Footing Width	=	5.0 ft
Wall Thickness	=	12 in
Wall center offset from center of footing	=	0 in
Footing Thickness	=	12.0 in
Rebar Centerline to Edge of Concrete... at Bottom of footing	=	3.0 in

Reinforcing

Bars along X-X Axis

Bar spacing	=	12.00
Reinforcing Bar Size	=	# 5



Applied Loads

		D	Lr	L	S	W	E	H	
P : Column Load	=	3.830		3.0	1.50	1.170	7.750		k
OB : Overburden	=								ksf
V-x	=								k
M-zz	=								k-ft
Vx applied	=		in above top of footing						

Wall Footing

Project File: capstone.ec6

LIC# : --Unassigned--, Build:20.22.10.27 UNLICENSED DEMO USER, DEMO EXPIRES IN 29 DAYS (c) ENERCALC INC 1983-20

DESCRIPTION: --None--

DESIGN SUMMARY

Design OK

	Factor of Safety	Item	Applied	Capacity	Governing Load Combination
PASS	n/a	Overturning - Z-Z	0.0 k-ft	0.0 k-ft	No Overturning
PASS	n/a	Sliding - X-X	0.0 k	0.0 k	No Sliding
PASS	n/a	Uplift	0.0 k	0.0 k	No Uplift

	Utilization Ratio	Item	Applied	Capacity	Governing Load Combination
PASS	0.9619	Soil Bearing	2.405 ksf	2.50 ksf	+D+0.750L+0.750S+0.5
PASS	0.5163	Z Flexure (+X)	6.318 k-ft	12.237 k-ft	+1.20D+0.50L+0.70S+E
PASS	0.3881	Z Flexure (-X)	4.749 k-ft	12.237 k-ft	+0.90D+E
PASS	0.4008	1-way Shear (+X)	38.027 psi	94.868 psi	+1.20D+0.50L+0.70S+E
PASS	0.4008	1-way Shear (-X)	38.027 psi	94.868 psi	+1.20D+0.50L+0.70S+E

Detailed Results

Soil Bearing

Rotation Axis & Load Combination...	Gross Allowable	Xecc	Actual Soil Bearing Stress -X	Actual Soil Bearing Stress +X	Actual / Allowable Ratio
, D Only	2.50 ksf	0.0 in	0.9160 ksf	0.9160 ksf	0.366
, +D+L	2.50 ksf	0.0 in	1.516 ksf	1.516 ksf	0.606
, +D+S	2.50 ksf	0.0 in	1.216 ksf	1.216 ksf	0.486
, +D+0.750L	2.50 ksf	0.0 in	1.366 ksf	1.366 ksf	0.546
, +D+0.750L+0.750S	2.50 ksf	0.0 in	1.591 ksf	1.591 ksf	0.636
, +D+0.60W	2.50 ksf	0.0 in	1.056 ksf	1.056 ksf	0.423
, +D+0.70E	2.50 ksf	0.0 in	2.001 ksf	2.001 ksf	0.800
, +D+0.750L+0.450W	2.50 ksf	0.0 in	1.471 ksf	1.471 ksf	0.589
, +D+0.750L+0.750S+0.450W	2.50 ksf	0.0 in	1.696 ksf	1.696 ksf	0.679
, +D+0.750L+0.750S+0.5250E	2.50 ksf	0.0 in	2.405 ksf	2.405 ksf	0.962
, +0.60D+0.60W	2.50 ksf	0.0 in	0.690 ksf	0.690 ksf	0.276
, +0.60D+0.70E	2.50 ksf	0.0 in	1.635 ksf	1.635 ksf	0.654

Overturning Stability

Units : k-ft

Rotation Axis & Load Combination...	Overturning Moment	Resisting Moment	Stability Ratio	Status
Footing Has NO Overturning				

Sliding Stability

Force Application Axis Load Combination...	Sliding Force	Resisting Force	Sliding SafetyRatio	Status
Footing Has NO Sliding				

Footing Flexure

Flexure Axis & Load Combination	Mu k-ft	Which Side ?	Tension @ Bot or Top ?	As Req'd in^2	Gvrn. As in^2	Actual As in^2	Phi*Mn k-ft	Status
, +1.40D	2.565	-X	Bottom	0.2592	Min Temp %	0.31	12.237	OK
, +1.40D	2.565	+X	Bottom	0.2592	Min Temp %	0.31	12.237	OK
, +1.20D+1.60L	4.118	-X	Bottom	0.2592	Min Temp %	0.31	12.237	OK
, +1.20D+1.60L	4.118	+X	Bottom	0.2592	Min Temp %	0.31	12.237	OK
, +1.20D+1.60L+0.50S	4.418	-X	Bottom	0.2592	Min Temp %	0.31	12.237	OK
, +1.20D+1.60L+0.50S	4.418	+X	Bottom	0.2592	Min Temp %	0.31	12.237	OK
, +1.20D+0.50L	2.798	-X	Bottom	0.2592	Min Temp %	0.31	12.237	OK
, +1.20D+0.50L	2.798	+X	Bottom	0.2592	Min Temp %	0.31	12.237	OK
, +1.20D+0.50W	2.432	-X	Bottom	0.2592	Min Temp %	0.31	12.237	OK
, +1.20D+0.50W	2.432	+X	Bottom	0.2592	Min Temp %	0.31	12.237	OK
, +1.20D+0.50L+1.60S	3.758	-X	Bottom	0.2592	Min Temp %	0.31	12.237	OK
, +1.20D+0.50L+1.60S	3.758	+X	Bottom	0.2592	Min Temp %	0.31	12.237	OK
, +1.20D+1.60S+0.50W	3.392	-X	Bottom	0.2592	Min Temp %	0.31	12.237	OK
, +1.20D+1.60S+0.50W	3.392	+X	Bottom	0.2592	Min Temp %	0.31	12.237	OK
, +1.20D+0.50L+W	3.266	-X	Bottom	0.2592	Min Temp %	0.31	12.237	OK
, +1.20D+0.50L+W	3.266	+X	Bottom	0.2592	Min Temp %	0.31	12.237	OK
, +1.20D+0.50L+0.50S+W	3.566	-X	Bottom	0.2592	Min Temp %	0.31	12.237	OK
, +1.20D+0.50L+0.50S+W	3.566	+X	Bottom	0.2592	Min Temp %	0.31	12.237	OK
, +1.20D+0.50L+0.70S+E	6.318	-X	Bottom	0.2592	Min Temp %	0.31	12.237	OK
, +1.20D+0.50L+0.70S+E	6.318	+X	Bottom	0.2592	Min Temp %	0.31	12.237	OK

Concrete Slender Wall

Project File: capstone.ec6

LIC# : --Unassigned--, Build:20.22.10.27 UNLICENSED DEMO USER, DEMO EXPIRES IN 29 DAYS (c) ENERCALC INC 1983-2022

DESCRIPTION: --None--

Code References

Calculations per ACI 318-11 Sec 14.8, IBC 2012, CBC 2013, ASCE 7-10
Load Combinations Used : IBC 2021

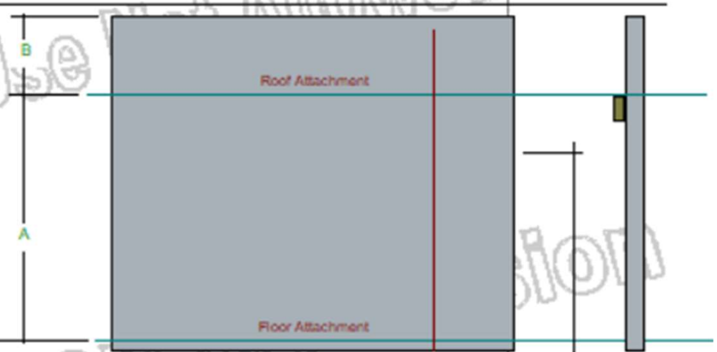
General Information

f'c : Concrete 28 day strength	= 4 ksi	Wall Thickness	12 in	Temp Diff across thickness	= deg F
Fy : Rebar Yield	= 60.0 ksi	Rebar at wall center		Min Allow Out-of-Plane Defl Ratio =	L/ 0.0
Ec : Concrete Elastic Modulus	= 3,122.0 ksi	Rebar "d" distance	6.0 in		/2 for Cantilever
λ : Lt Wt Conc Factor	= 1.0	Lower Level Rebar . . .		Min allow As/bd	= 0.0020
Fr : Rupture Modulus	= 316.228 psi	Bar Size	# 5	Using Stiff. Reduction Factor per ACI 318-14	
Max Allow As/bd	= 0.01806	Bar Spacing	16.0 in		Section 11.8.3
Max Pu/Ag = f'c *	= 0.060				
Concrete Density	= 150 pcf				
Width of Design Strip	= 12.0 in				

One-Story Wall Dimensions

A Clear Height = 3 ft
B Parapet height = 0.5 ft

Wall Support Condition Top Free, Bottom Fix



Vertical Loads

Vertical Uniform Loads . . .	(Applied per foot of Strip Width)		DL : Dead	Lr : Roof Live	Lf : Floor Live	S : Snow	W : Wind
Ledger Load	Eccentricity	6.750 in					k/ft
Concentric Load			3.83		3	1.5	1.17 k/ft

Lateral Loads

Wind Loads :
Full area WIND load 15.0 psf

Seismic Loads :
Wall Weight Seismic Load Input Method : Direct entry of Lateral Wall Weight
Seismic Wall Lateral Load 25.0 psf

Fp 1.0 = 25.0 psf

Concrete Slender Wall

Project File: capstone.ec6

LIC# : --Unassigned--, Build:20.22.10.27 UNLICENSED DEMO USER, DEMO EXPIRES IN 29 DAYS (c) ENERCALC INC 1983-20

DESCRIPTION: --None--

DESIGN SUMMARY

Results reported for "Strip Width" of 12.0 in

	Governing Load Combination . . .	Actual Values . . .		Allowable Values . . .	
PASS	Moment Capacity Check	Maximum Bending Stress Ratio	0.4946		
	+1.40D	Max Mu	3.016 k-ft	Phi * Mn	6.099 k-ft
PASS	Service Deflection Check	Actual Defl. Ratio L/	17498	Allowable Defl. Ratio	150.0
	+D+0.70E	Max Deflection	0.004115 in		/2 for Cantilever
PASS	Axial Load Check	Max Pu / Ag	103.250 psi	Max. Allow. Defl.	0.480 in
	+1.40D	Location	0.050 ft	0.06 * f'c	240.0 psi
PASS	Reinforcing Limit Check				
	OK per ACI 318 Section 11.7	Actual As/bd	0.003229	Max Allow As/bd	0.01806

Maximum Reactions . . *for Load Combination...*

Top Horizontal		0.0 k
Base Horizontal	E Only	0.08750 k
Vertical Reaction	+D+0.750L+0.750S+0.450W	12.087 k

Design Maximum Combinations - Moments

Results reported for "Strip Width" = 12 in.

Load Combination	Axial Load Pu (k)	Axial Load 0.06*f'c*b*t (k)	Mcr (k-ft)	Mu (k-ft)	Phi	Phi Mn (k-ft)	As (in^2)	As Ratio	0.6 * rho bal	Bar 'd'
+1.40D at 0.00 to 0.10	0.000	34.560	7.59	3.02	0.90	6.10	0.233	0.0032	0.0181	6.00
+1.20D+1.60L at 0.00 to 0.10	0.000	34.560	7.59	2.59	0.90	6.10	0.233	0.0032	0.0181	6.00
+1.20D+1.60L+0.50S at 0.00 to 0.10	0.000	34.560	7.59	2.59	0.90	6.10	0.233	0.0032	0.0181	6.00
+1.20D+0.50L at 0.00 to 0.10	0.000	34.560	7.59	2.59	0.90	6.10	0.233	0.0032	0.0181	6.00
+1.20D+0.50W at 0.00 to 0.10	0.000	34.560	7.59	2.63	0.90	6.10	0.233	0.0032	0.0181	6.00
+1.20D+0.50L+1.60S at 0.00 to 0.10	0.000	34.560	7.59	2.59	0.90	6.10	0.233	0.0032	0.0181	6.00
+1.20D+1.60S+0.50W at 0.00 to 0.10	0.000	34.560	7.59	2.63	0.90	6.10	0.233	0.0032	0.0181	6.00
+1.20D+0.50L+W at 0.00 to 0.10	0.000	34.560	7.59	2.68	0.90	6.10	0.233	0.0032	0.0181	6.00
+1.20D+0.50L+0.50S+W at 0.00 to 0.	0.000	34.560	7.59	2.68	0.90	6.10	0.233	0.0032	0.0181	6.00
+1.20D+0.50L+0.70S+E at 0.00 to 0.1	0.000	34.560	7.59	2.74	0.90	6.10	0.233	0.0032	0.0181	6.00
+0.90D+W at 0.00 to 0.10	0.000	34.560	7.59	2.03	0.90	6.10	0.233	0.0032	0.0181	6.00
+0.90D+E at 0.00 to 0.10	0.000	34.560	7.59	2.09	0.90	6.10	0.233	0.0032	0.0181	6.00

Design Maximum Combinations - Deflections

Results reported for "Strip Width" = 12 in.

Load Combination	Axial Load Pu (k)	Moment Values Mcr (k-ft)	Moment Values Mactual (k-ft)	Stiffness I gross (in^4)	Stiffness I cracked (in^4)	Stiffness I effective (in^4)	Deflections Deflection (in)	Deflections Defl. Ratio
D Only at 2.90 to 3.00	0.000	7.59	2.15	1,728.00	60.45	1296.000	0.004	17,982.5
+D+L at 2.90 to 3.00	0.000	7.59	2.15	1,728.00	60.45	1296.000	0.004	17,984.0
+D+S at 2.90 to 3.00	0.000	7.59	2.15	1,728.00	60.45	1296.000	0.004	17,983.2
+D+0.750L at 2.90 to 3.00	0.000	7.59	2.15	1,728.00	60.45	1296.000	0.004	17,983.6
+D+0.750L+0.750S at 2.90 to 3.00	0.000	7.59	2.15	1,728.00	60.45	1296.000	0.004	17,984.1
+D+0.60W at 2.90 to 3.00	0.000	7.59	2.16	1,728.00	60.45	1296.000	0.004	17,730.5
+D+0.70E at 2.90 to 3.00	0.000	7.59	2.16	1,728.00	60.45	1296.000	0.004	17,498.2
+D+0.750L+0.450W at 2.90 to 3.00	0.000	7.59	2.16	1,728.00	60.45	1296.000	0.004	17,793.9
+D+0.750L+0.750S+0.450W at 2.90 to :	0.000	7.59	2.16	1,728.00	60.45	1296.000	0.004	17,794.5
+D+0.750L+0.750S+0.5250E at 2.90 to :	0.000	7.59	2.16	1,728.00	60.45	1296.000	0.004	17,618.5
+0.60D+0.60W at 2.90 to 3.00	0.000	7.59	1.29	1,728.00	60.45	1296.000	0.002	29,274.6
+0.60D+0.70E at 2.90 to 3.00	0.000	7.59	1.29	1,728.00	60.45	1296.000	0.003	28,647.1
	0.000	0.00	0.00	0.00	0.00	0.000	0.000	0.0
	0.000	0.00	0.00	0.00	0.00	0.000	0.000	0.0
W Only at 2.90 to 3.00	0.000	7.59	0.00	1,728.00	60.45	1296.000	0.000	757909.7

Concrete Slender Wall

Project File: capstone.ec6

LIC# : --Unassigned--, Build:20.22.10.27 UNLICENSED DEMO USER, DEMO EXPIRES IN 29 DAYS (c) ENERCALC INC 1983-20

DESCRIPTION: --None--

E Only at 2.90 to 3.00	0.000	7.59	0.00	1,728.00	60.45	1296.000	0.000	454727.7

Reactions - Vertical & Horizontal

Load Combination	Base Horizontal	Top Horizontal	Vertical @ Wall Base
D Only	0.0 k	0.00 k	8.185 k
+D+L	0.0 k	0.00 k	11.185 k
+D+S	0.0 k	0.00 k	9.685 k
+D+0.750L	0.0 k	0.00 k	10.435 k
+D+0.750L+0.750S	0.0 k	0.00 k	11.560 k
+D+0.60W	0.0 k	0.00 k	8.887 k
+D+0.70E	0.1 k	0.00 k	8.185 k
+D+0.750L+0.450W	0.0 k	0.00 k	10.962 k
+D+0.750L+0.750S+0.450W	0.0 k	0.00 k	12.087 k
+D+0.750L+0.750S+0.5250E	0.0 k	0.00 k	11.560 k
+0.60D+0.60W	0.0 k	0.00 k	5.613 k

Reactions - Vertical & Horizontal

Load Combination	Base Horizontal	Top Horizontal	Vertical @ Wall Base
+0.60D+0.70E	0.1 k	0.00 k	4.911 k
L Only	0.0 k	0.00 k	3.000 k
S Only	0.0 k	0.00 k	1.500 k
W Only	0.1 k	0.00 k	1.170 k
E Only	0.1 k	0.00 k	0.000 k

Wall Footing

Project File: capstone.ec6

LIC# : --Unassigned--, Build:20.22.10.27 UNLICENSED DEMO USER, DEMO EXPIRES IN 29 DAYS (c) ENERCALC INC 1983-20

DESCRIPTION: --None--

Footing Flexure

Flexure Axis & Load Combination	Mu k-ft	Which Side ?	Tension @ Bot or Top ?	As Req'd in^2	Gvrn. As in^2	Actual As in^2	Phi*Mn k-ft	Status
, +0.90D+W	2.117	-X	Bottom	0.2592	Min Temp %	0.31	12.237	OK
, +0.90D+W	2.117	+X	Bottom	0.2592	Min Temp %	0.31	12.237	OK
, +0.90D+E	4.749	-X	Bottom	0.2592	Min Temp %	0.31	12.237	OK
, +0.90D+E	4.749	+X	Bottom	0.2592	Min Temp %	0.31	12.237	OK

One Way Shear

Units : k

Load Combination	Vu @ -X	Vu @ +X	Vu:Max	Phi Vn	Vu / Phi*Vn	Status
+1.40D	15.436 psi	15.436 psi	15.436 psi	94.868 psi	0.1627	OK
+1.20D+1.60L	24.787 psi	24.787 psi	24.787 psi	94.868 psi	0.2613	OK
+1.20D+1.60L+0.50S	26.592 psi	26.592 psi	26.592 psi	94.868 psi	0.2803	OK
+1.20D+0.50L	16.842 psi	16.842 psi	16.842 psi	94.868 psi	0.1775	OK
+1.20D+0.50W	14.639 psi	14.639 psi	14.639 psi	94.868 psi	0.1543	OK
+1.20D+0.50L+1.60S	22.62 psi	22.62 psi	22.62 psi	94.868 psi	0.2384	OK
+1.20D+1.60S+0.50W	20.417 psi	20.417 psi	20.417 psi	94.868 psi	0.2152	OK
+1.20D+0.50L+W	19.659 psi	19.659 psi	19.659 psi	94.868 psi	0.2072	OK

Figure 14 Structural Calculations Option 2

SIMPSON Strong-Tie

Anchor Designer™
Software
Version 3.1.2301.3

Company:		Date:	3/14/2023
Engineer:		Page:	1/5
Project:			
Address:			
Phone:			
E-mail:			

1.Project information

Customer company:
Customer contact name:
Customer e-mail:
Comment:

Project description:
Location:
Fastening description:

2. Input Data & Anchor Parameters

General
Design method:ACI 318-19
Units: Imperial units

Anchor Information:
Anchor type: Cast-in-place
Material: F1554 Grade 105
Diameter (inch): 0.500
Effective Embedment depth, h_{ef} (inch): 2.750
Anchor category: -
Anchor ductility: Yes
h_{min} (inch): 4.00
C_{min} (inch): 3.00
S_{min} (inch): 3.00

Base Material
Concrete: Normal-weight
Concrete thickness, h (inch): 30.00
State: Cracked
Compressive strength, f'_c (psi): 4000
$\Psi_{c,V}$: 1.0
Reinforcement condition: Supplementary reinforcement present
Supplemental edge reinforcement: Not applicable
Reinforcement provided at corners: Yes
Ignore concrete breakout in tension: No
Ignore concrete breakout in shear: Yes
Ignore 6do requirement: No
Build-up grout pad: No

Base Plate
Length x Width x Thickness (inch): 10.00 x 8.00 x 0.25

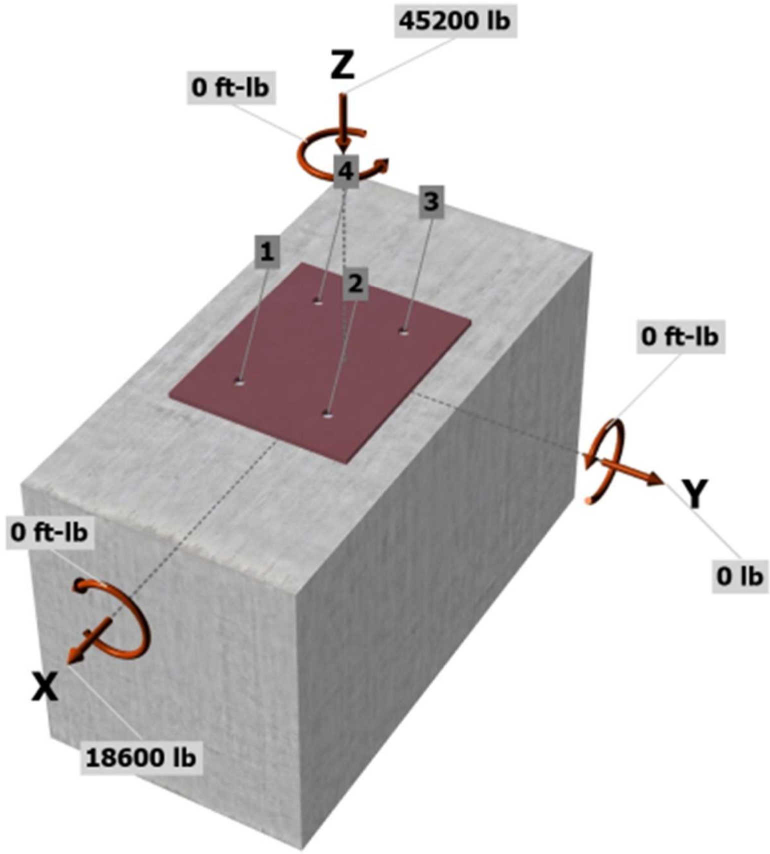
Recommended Anchor
Anchor Name: J- or L-Bolt - 1/2"Ø J- or L-Bolt, F1554 Gr. 105

Load and Geometry
Load factor source: ACI 318 Section 5.3
Load combination: not set
Seismic design: No
Anchors subjected to sustained tension: Not applicable
Apply entire shear load at front row: No
Anchors only resisting wind and/or seismic loads: No

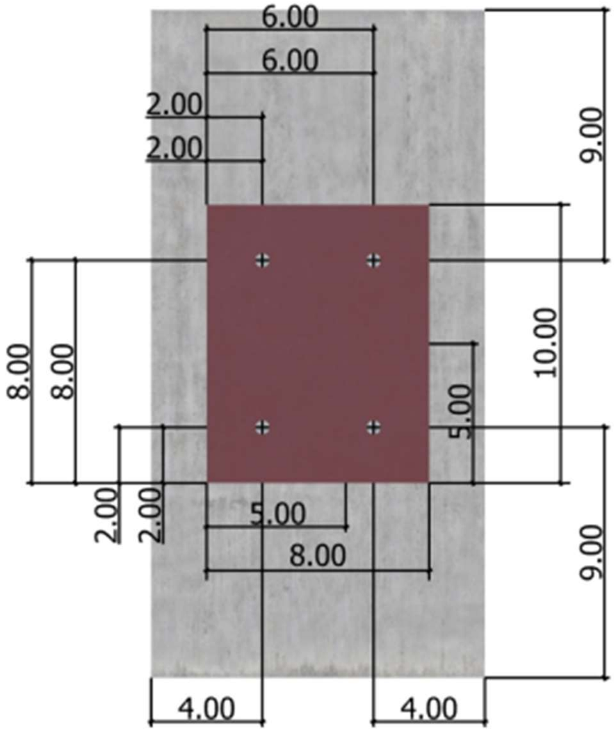
Strength level loads:

N_{ua} [lb]: -45200
V_{uax} [lb]: 18600
V_{uay} [lb]: 0
M_{ux} [ft-lb]: 0
M_{uy} [ft-lb]: 0
M_{uz} [ft-lb]: 0

<Figure 1>



<Figure 2>



3. Resulting Anchor Forces

Anchor	Tension load, N_{ua} (lb)	Shear load x, V_{uax} (lb)	Shear load y, V_{uay} (lb)	Shear load combined, $\sqrt{(V_{uax})^2+(V_{uay})^2}$ (lb)
1	0.0	3934.6	-1073.1	4078.3
2	0.0	5365.4	-1073.1	5471.6
3	0.0	5365.4	1073.1	5471.6
4	0.0	3934.6	1073.1	4078.3
Sum	0.0	18600.0	0.0	19099.9

Maximum concrete compression strain (‰): 0.23
Maximum concrete compression stress (psi): 989
Resultant tension force (lb): 0
Resultant compression force (lb): 45200
Eccentricity of resultant tension forces in x-axis, e'_{Nx} (inch): 0.00
Eccentricity of resultant tension forces in y-axis, e'_{Ny} (inch): 0.00
Eccentricity of resultant shear forces in x-axis, e'_{Vx} (inch): 0.00
Eccentricity of resultant shear forces in y-axis, e'_{Vy} (inch): 0.00

8. Steel Strength of Anchor in Shear (Sec. 17.7.1)

V_{sa} (lb)	ϕ_{grout}	ϕ	$\phi_{grout}\phi V_{sa}$ (lb)
10650	1.0	0.65	6923

10. Concrete Pryout Strength of Anchor in Shear (Sec. 17.7.3)

$\phi V_{cp} = \phi k_{cp} N_{cb} = \phi k_{cp}(A_{Nc} / A_{Nco}) \Psi_{ed,N} \Psi_{c,N} \Psi_{cp,N} N_b$ (Sec. 17.5.1.2 & Eq. 17.7.3.1a)

k_{cp}	A_{Nc} (in^2)	A_{Nco} (in^2)	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	ϕ	ϕV_{cp} (lb)
2.0	42.75	68.06	0.991	1.000	1.000	6922	0.70	6032

11. Results

Interaction of Tensile and Shear Forces (Sec. 17.8)

Shear	Factored Load, V_{ua} (lb)	Design Strength, ϕV_n (lb)	Ratio	Status
Steel	5472	6923	0.79	Pass
Pryout	**5472**	**6032**	**0.91**	**Pass (Governs)**

1/2"Ø J- or L-Bolt, F1554 Gr. 105 with hef = 2.750 inch meets the selected design criteria.

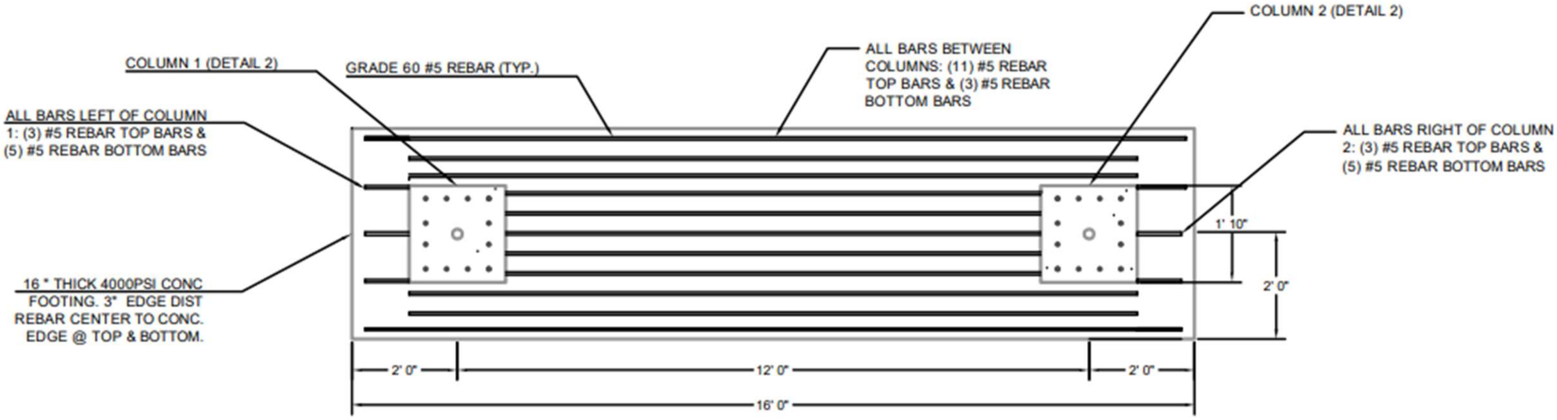
12. Warnings

- Concrete breakout strength in shear has not been evaluated against applied shear load(s) per designer option. Refer to ACI 318 Section 17.5.2.1 for conditions where calculations of the concrete breakout strength may not be required.

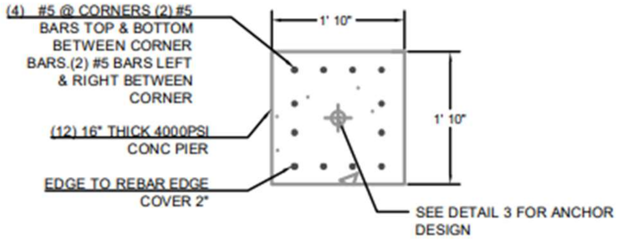
- Designer must exercise own judgement to determine if this design is suitable.

Figure 15 Anchor Design Option 2

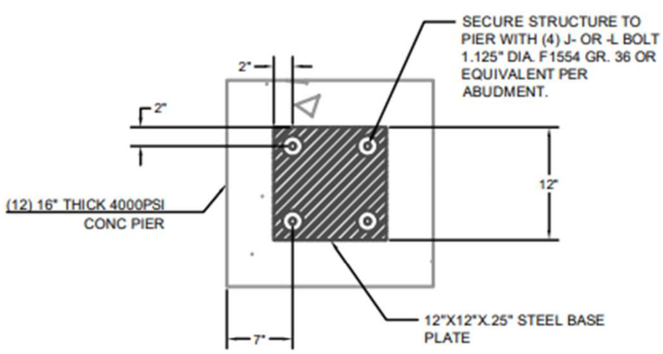
DETAILS FOR RECCOMENDED OPTION:



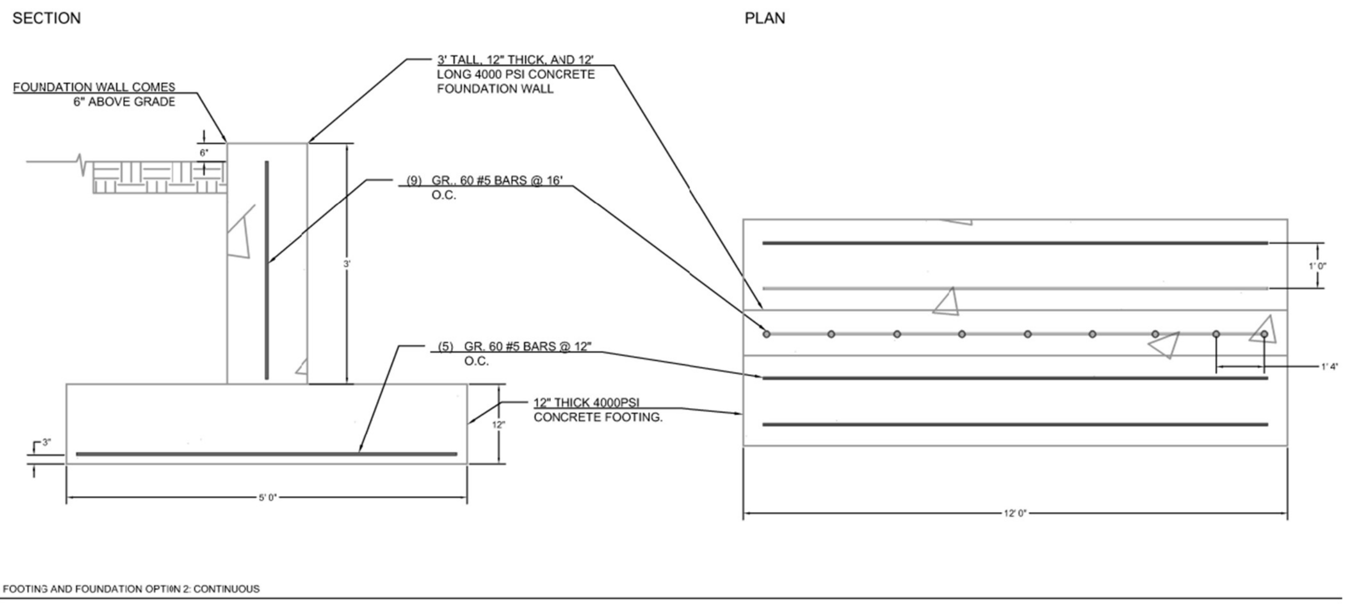
1 CONCRETE FOOTING RECOMMENDATION 1



2 CONCRETE PIER & REINFORCEMENT



3 ANCHOR DESIGN



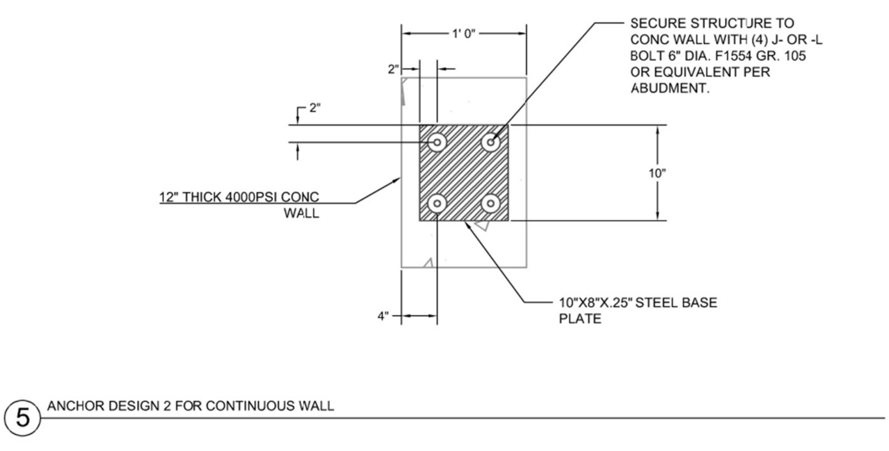


Figure 16 Details for Shallow Foundations