State of Colorado

Cazier, Tim <tim.cazier@state.co.us>

FW: CDRMS - Cresson Review COCDRMS101

Dan Overton <DOverton@enganalytics.com> Tue, Oct 9, 2012 at 4:01 PM
To: "Cazier, Tim" <Tim.Cazier@state.co.us>, Chris Lidstone <CDL@lidstone.com>
Cc: "Kaldenbach, Tom" <Tom.Kaldenbach@state.co.us>

Tim,

The following documents were listed as the references for our review.

AMEC (2011). "Cripple Creek & Victor Gold Mining Company, Squaw Gulch Valley Leach Facility Design" Prepared for Cripple Creek and Victor Gold Mining Company, September 1.

This is appendix 9 of the application and I assume you have this.

AMEC (2012a). "Cripple Creek & Victor Gold Mining Company Squaw Gulch Overburden Storage Area Including Mill Platform Stability Evaluation" Prepared for Cripple Creek and Victor Gold Mining Company, January 5.

This is appendix 7 of the application and I assume you have this.

AMEC (2012b). "Mill Foundation Recommendations – Cripple Creek & Victor Gold Mine, Teller County, Colorado"; letter to Ron Roberts (CC&V) from David Weidinger, P.E. and Kimberly Morrison P.E., R.G (AMEC). February 29.

This is attached.

AMEC (2012c). "Overburden/Structural Fill – Test Fill Summary;" memorandum to Ron Roberts and Jim Smith (CC&V) from Joseph D. Hickey and Jay Janney-Moore, P.E. (AMEC), April, 11.

This is attached.

AMEC (2012d). "Mill Platform Machine Vibration Effects"; letter to Timm Comer (CC&V) from David Weidinger, P.E. and Jay N. Janney-Moore, P.E. (AMEC) , September 20.

This is attached.

Cripple Creek & Victor Gold Mining Company (2012). " Cresson Project Permit M-1980-244 Mine Life Extension 2 Application, Exhibit U, Designated Mining Operation Environmental Protection Plan". February 28.

This is Volume 1 of the application and I assume you have this.

FLSMIDTH (2012). "Mill Mat Foundation Design" July 16.

This is attached

Let me know if you need anything else.

Dan Overton

Main 970-488-3111 | Fax 970-488-3112 | Cell 970-481-0578

doverton@enganalytics.com

From: Cazier, Tim [mailto:Tim.Cazier@state.co.us]
Sent: Wednesday, October 03, 2012 10:10 AM
To: Chris Lidstone; Dan Overton
Cc: Kaldenbach, Tom
Subject: RE: CDRMS - Cresson Review COCDRMS101

Chris, Dan:

Please accept the Division's gratitude for your prompt and diligent review of the submittal from AMEC, we appreciate your efforts.

As Tom alludes to in his email below, I need to get all documents pertinent to your review scanned/transferred to our electronic document storage system. I only need those documents that were considered final or perhaps supplemental. Documents that were considered "draft" or "preliminary" don't need to be in our system.

Based on the emails I saw going back and forth late last month, I believe there were at least 3 versions of the submittal from AMEC that you used for your review. We only need the final version, and any supplemental information they sent before or after their final submittal. Also, any documents submitted from FLSmidth and/or CC&V directly to you that may have factored into your review, but that you did not receive from us.

If you have these documents in pdf format, that would be preferred, but we can also obviously scan hard copies into our system as well.

In order to reduce the possibility of these documents falling through the proverbial "crack", I would appreciate it if you could get them to me by this Friday (10/5/2012) if possible, but by next Friday (10/12/2012) at the latest. If you have any questions as to what should or should not be included, please give me a call or send me an email.

Thanks again for your efforts.

Tim Cazier, P.E.

Environmental Protection Specialist

Colorado Division of Reclamation, Mining and Safety

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tim.cazier@state.co.us

From: Kaldenbach, Tom
Sent: Monday, October 01, 2012 1:12 PM
To: Chris Lidstone; Dan Overton
Cc: Cazier, Tim
Subject: RE: CDRMS - Cresson Review COCDRMS101

[Quoted text hidden]

Email Note

4 attachments

1125G_Mill Complex S&F Rev1.pdf
2694K

Testfill Memo.pdf
625K

Mill Platform Machine Vibrations _3_.pdf
318K

C-005b Rev. 0 Mill Mat Foundation Design CC&V 11021 (Reduced).pdf
14976K

Memorandum

To: Ron Roberts – CC&V

Jim Smith – CC&V

From: Joseph D. Hickey - AMEC

Jay Janney-Moore, P.E. - AMEC

Date: April 11, 2012

Re: Overburden/Structural Fill – Test Fill Summary

Introduction

This memo summarizes the test fill performed on overburden/structural fill materials intended for use in the construction of the Mill Site foundation. The test fill was performed in accordance with the Mill Site Earthworks project specifications, section 2205 on March 26 and 27, 2012. Overburden/Structural fill material was delivered by CC&V Mine Operations and placed in three lifts in a test area encompassing 100 feet by 80 feet located within the Mill Site Earthworks footprint. The fill placed is considered to be a rock fill consisting of primarily “shot rock” delivered by the Mine Operations. The purpose of the test fill was to determine a workable compacted lift thickness and to record settlement characteristics of the overburden/structural fill as the fill was being compacted and placed. Foresight West Surveying provided the necessary survey data needed to determine the settlement characteristics for each lift.

Test Fill Performance

Overburden/Structural fill material was placed in three 3.3-foot loose lifts in an area designated by Joseph Hickey (AMEC-Project Resident). The material for the test fill was hauled from the Dump #4 area which is the intended borrow source for the Mill Site foundation earthworks. The test area was located on previously placed and compacted fill. The fill was loaded, hauled, placed and compacted in the same manner as expected for the Mill Site Earthworks project.

The overburden/structural fill material was hauled using CAT 777 haul trucks loaded by a CAT 993 front-end loader. Each 3.3-foot loose lift was placed using a CAT D-8T dozer to spread the hauled material for each lift. During fill placement, the test area received compaction effort from the haul truck and dozer traffic. After each loose lift was established, a CAT 563 vibratory smooth drum compactor (10-ton) static rolled the entire lift surface with one pass. A “pass” is defined as a single pass by the compactor over a specified area travelling either forward or backward. Five control points were then marked by Foresight West Surveying and surveyed using a surveyor’s level to establish a “start” elevation. The entire lift was then rolled using the

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vibratory method with the CAT 563 compactor in two-pass intervals to a maximum of 10 passes. Survey level readings were performed after each two-pass interval. A summary of the survey data is included with this memo.

The average settlement after 4 passes was 0.1 feet and after 10 passes was 0.15 feet. The completed height of the compacted fill assuming the lift thicknesses were 3.3 feet thick would be approximately 9.6 feet assuming that 4 passes would be performed on each lift.

Once the test fill was completed, a visual observation of the fill was performed noting any “rock pockets”, “depressions”, or “segregation”. Our observations indicate the completed fill was found to be firm and un-yielding and exhibited a uniform, smooth, dense appearance. A trench was excavated in the middle of the pad and a sample was collected for laboratory testing. Laboratory testing included testing for the material index properties to determine the soil classification. The overburden/structural fill was classified as a “poorly graded gravel” (GP) with less than 1% minus #200 sieve and the sample was non-plastic (Sample # OVTF-1-R). The laboratory test report is included with this memo.

Conclusions and Recommendations

Based on our field observations and survey data provided by Foresight West Surveying, a compacted lift thickness of 3 feet is adequate for the overburden/structural fill placement. While most of the settlement is expected to occur due to equipment trafficking the surface during fill placement, approximately 55% of the final settlement can be achieved by routing heavy equipment traffic evenly throughout the fill area and a minimum of 4 passes with a 10-ton vibratory smooth drum compactor for each lift. The final lift thickness may need to be adjusted slightly to achieve the desired final elevation. If the final lift thickness is greater than 3.3 feet loose lift then additional passes with the vibratory compactor should be performed. AMEC should provide periodic observation of the overburden/structural fill for project compliance.

Sincerely,

AMEC Earth and Environmental, Inc.

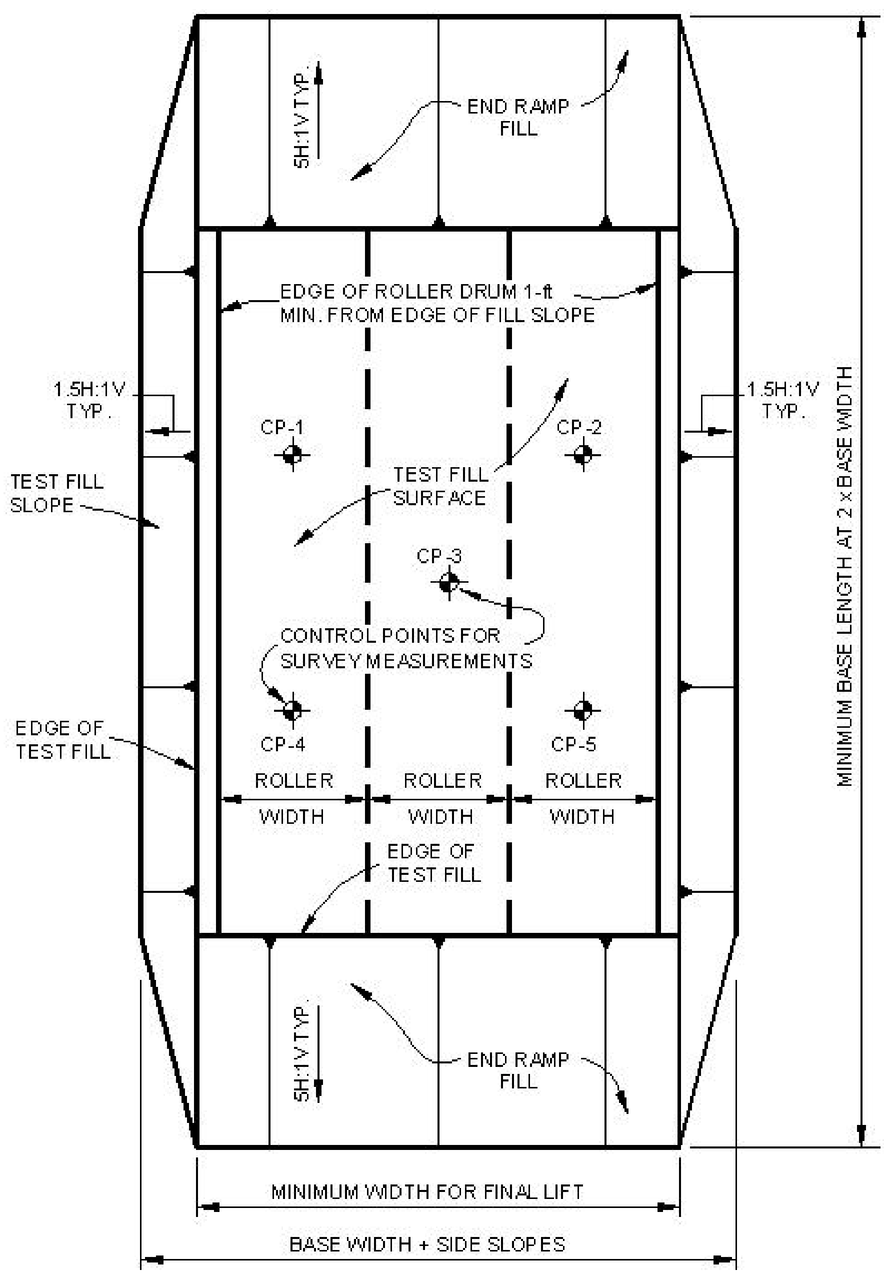
Joseph D. Hickey

Resident CQA Supervisor

Jay Janney-Moore, P.E.

Certifying Engineer / Project Manager

8.0 ATTACHMENT A

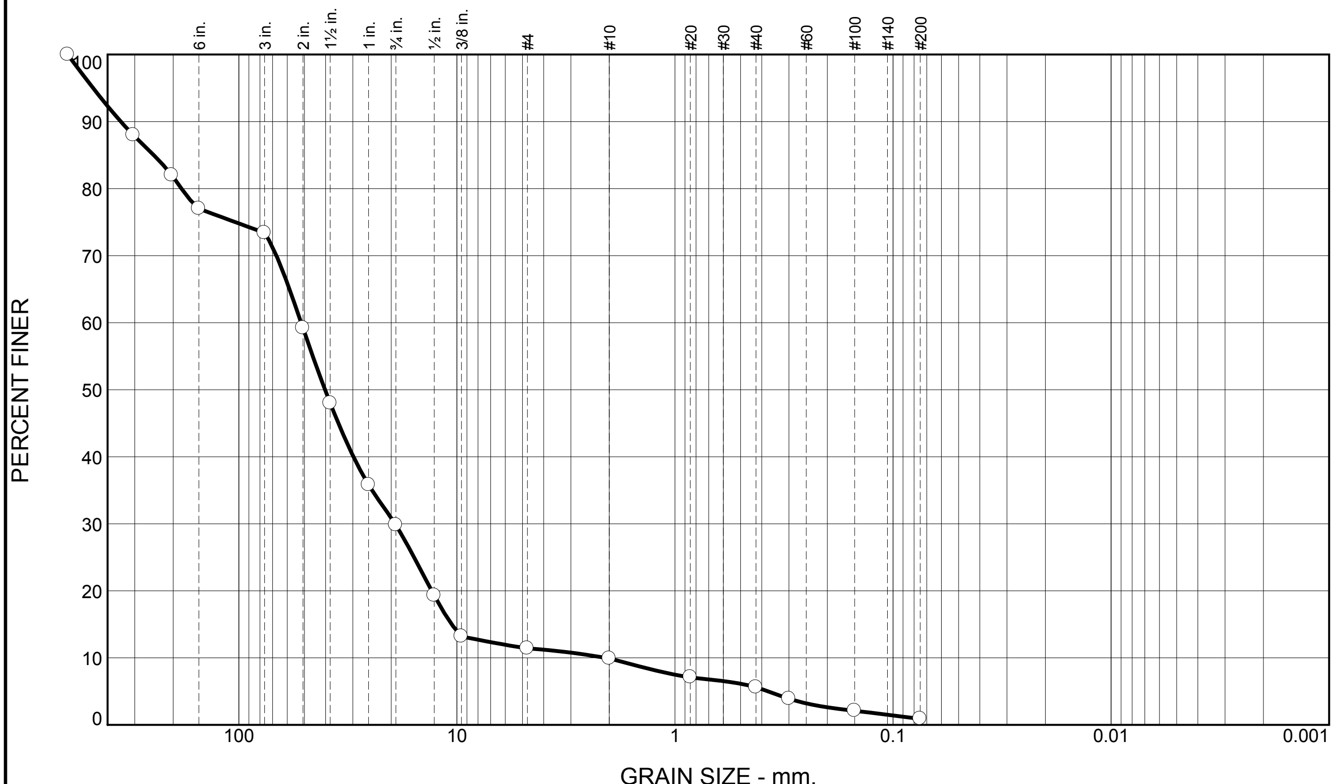


Cripple Creek & Victor Gold Mining Company
Mill Site Earthworks
Test Fill Survey Data

Test Fill #1		Recorded Settlement (ft.)				
Lift Number	Number of Passes	Control Point #1	Control Point #2	Control Point #3	Control Point #4	Control Point #5
1	Start	-	-	-	-	-
1	2	-0.10	-0.08	-0.10	0.00	-0.03
1	4	-0.01	-0.09	-0.04	-0.08	-0.09
1	6	-0.05	-0.01	-0.05	-0.05	-0.04
1	8	-0.02	-0.01	-0.01	-0.07	-0.01
1	10	-0.01	-0.01	-0.02	-0.02	0.00
2	Start	-	-	-	-	-
2	2	-0.08	-0.04	-0.04	-0.05	-0.02
2	4	0.00	-0.07	-0.04	-0.03	-0.06
2	6	0.00	-0.02	-0.02	-0.03	-0.02
2	8	-0.04	-0.02	-0.01	-0.02	-0.02
2	10	-0.01	-0.02	-0.04	0.00	-0.03
3	Start	-	-	-	-	-
3	2	-0.04	-0.06	-0.04	-0.06	-0.08
3	4	-0.06	-0.06	-0.04	-0.02	-0.05
3	6	-0.06	-0.06	-0.07	-0.05	-0.07
3	8	-0.04	-0.06	-0.03	-0.01	-0.04
3	10	-0.04	-0.02	-0.02	-0.02	-0.02

Survey data provided by Foresight West Surveying, Inc.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
26.6	43.6	18.4	1.5	4.3	4.7	0.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
24	100.0		
12	88.0		
8	82.0		
6	77.0		
3	73.4		
2	59.2		
1.5	48.0		
1	35.8		
.75	29.8		
.5	19.3		
.375	13.2		
#4	11.4		
#10	9.9		
#20	7.1		
#40	5.6		
#50	3.9		
#100	2.1		
#200	0.9		

* (no specification provided)

Material Description

Brown poorly graded gravel

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 347.7705 D_{85}= 245.4762 D_{60}= 51.7981
D_{50}= 40.2305 D_{30}= 19.2225 D_{15}= 10.5574
D_{10}= 2.0826 C_u= 24.87 C_c= 3.43

Classification

USCS= GP AASHTO= A-1-a

Remarks

Location: N 55,240.6 E 36,330.2
Sample Number: OVTF-1-R **Depth:** 9720' **Date:** 3/27/2012

AMEC Earth & Environmental, Inc. Englewood, CO	Client: Project: Project No: Figure OVTF-1-R

Tested By: BM/AR **Checked By:** JDH

TEST FILL PHOTOGRAPHS

Photo #1: JDH: Placing a lift of Overburden Fill material

Photo #2: JDH: Test fill compaction

Photo #3: JDH: Surveying of the test fill

Photo #4: JDH: Excavation of the test trench

February 29, 2012

Mr. Ron Roberts
CC&V Projects
Cripple Creek & Victor Gold Mining Co.
P.O. Box 191
Victor, CO 80860

Re: Mill Foundation Recommendations
Cripple Creek & Victor Gold Mine, Teller County, Colorado

Dear Ron:

AMEC Environment and Infrastructure, Inc. (AMEC) has prepared this letter report presenting foundation recommendations for the proposed Mill to be located adjacent to the Load-Out Bin (LOB). It is AMEC's understanding that the mill site will be constructed using mine waste provided by the mine. Construction of the mill site pad is ongoing, with an anticipated completion date of Q4 2012. The foundation recommendations presented herein are provided to support engineering design for the Mill foundations, and are based on our on-site experience with similar fills. The assumptions presented herein should be verified during construction of the mill site.

1.0 BACKGROUND

A portion of the currently permitted and approved Squaw Gulch OSA (SGOSA) will be constructed as the platform of the proposed milling facility as part of the Mine Life Extension 2 (MLE2) Project. The new Mill Platform, referred herein as the Mill Platform Overburden Storage Area (MPOSA) will be constructed out of overburden from the Cresson Project and within an area currently permitted and approved for overburden placement as part of the SGOSA approved under Amendment No. 9 to Permit M-1980 (Amendment No. 9). The current configuration of the MPOSA consists of a lined mill platform area. The engineered fill underlying the mill platform area will consist of the following, from bottom (native ground) to top (finished grade): overburden fill; a liner system consisting of soil liner fill, 80-mil low linear density polyethylene (LLDPE) geomembrane liner, and drain cover fill; select overburden material; and a low volume solution collection fill. The overburden fill underlying the liner system will have a maximum thickness of 175 feet with a maximum thickness overlying the liner system of 150 feet. Final configuration of the MPOSA is shown on Figure 1 and consists of 2H:1V side slopes along the north, west and south sides of the Mill Platform and buttress along the northeast and east by the existing SGOSA and LOB, respectively. Overburden fill placement within the MPOSA shall be compacted and monitored by a method specification technique as outlined in USACE (1994) and summarized in the technical specification attached to this letter (Attachment 1).

2.0 GEOTECHNICAL FIELD EXPLORATION

Several field explorations have been conducted in the vicinity of the MPOSA, as shown by Figure 2. Field programs with exploration locations within in the limits of the MPOSA include test pits excavated as part of Golder Associates' 2004 exploration, Smith Williams Consultants' (SWC) June 2007 exploration, and AMEC's June/July 2010 exploration. From the field explorations conducted, the subsurface consists of a thin (0-15 feet) veneer of granular soil consisting of sandy gravels and silts overlying competent bedrock. Bedrock is predominately the Cripple Creek Lapilli breccia, which generally consists of a massive, structureless, matrix-supported breccia that is poorly sorted, typical of diatremal crater fill breccia.

3.0 LABORATORY TESTING PROGRAM

Additional laboratory testing was conducted as part of this soil and foundation exploration, including index and chemical testing was performed on the Cresson Project ore to be used as structural fill for the MPOSA. Index testing included sieve analysis (ASTM D422) and Atterberg limits (ASTM D4318), while the chemical testing included water soluble sulfates, chloride content, pH, and resistivity testing (ASA 10-3). Shear strength testing of the Cresson Ore and interface shear testing of the liner were previously conducted by Golder Associates (2004).

3.1 Index Testing

In order to identify soils and classify them into categories of similar engineering properties, the Unified Soil Classification System (USCS - ASTM D2487) is used. This system is based on index property tests, including the determination of liquid limits, plastic limits, and grain size distribution. Table 1 contains a summary of index testing results for the soils. Laboratory data results are referenced in Attachment 2.

Table 1: Summary of Laboratory Testing

Sample	USCS	Material Description	Gradation			Atterberg Limits			Chemical Analysis					
			Gravel	Sand	Fines	PL	LL	PI	Water Soluble Sulfates		Electric Resistivity	Chloride Content		pH
									ppm	%	ohm-cm	ppm	%	
Structural Fill	GP-GC	Poorly Graded Gravel with Silty Clay and Sand	63	28	9	17	24	7	115	0.57	700	65	0.33	4.1

UCSC – Uniform Soil Classification System
PL – Plasticity Limit
LL – Liquid Limit
PI – Plasticity Index

Laboratory gradations were completed on one (1) sample of soil and resulted in 9 percent passing the No. 200 sieve, with sand and gravel consisting of 28 and 63 percent, respectively. Atterberg limits testing on the portion of material passing the No. 40 sieve indicated a plasticity index of 7 with a liquid limit of 24. The soil classified as a poorly graded gravel with silty clay and sand (GP-GC).

3.2 Chemical Characterization

Water-soluble sulfate tests were conducted on a sample of Cresson Project overburden structural fill to assess the potential for deterioration of concrete elements including footings, foundation walls, retaining walls, culverts, pipes, and surface slabs. The concentration of water-soluble sulfates measured in the soil sample was 115 parts per million (ppm) or 0.57%. This concentration of water-soluble sulfates represents a severe degree of sulfate attack on concrete exposed to these materials. The degree of attack is based on a range of negligible, positive, considerable, and severe as presented in the U.S. Bureau of Reclamation Concrete Manual (1988).

Resistivity tests measure the relative rate of movement of ions through the soil, which reflects the corrosiveness of the soil. The results from the resistivity tests indicate that the spent ore has a resistivity value of 665 ohm-cm. Based on correlations presented in Roberge (2000), these materials are considered to have resistivity values that are indicative of extreme corrosion potential.

Paste pH values taken from the same bulk sample showed that the material has a pH value of 4.1 standard units (SU). Based on these results and correlations presented in the FHWA document Durability/Corrosion of Soil Reinforced Structures (1990), the on-site materials have slightly akaline pH values indicating negligible to mildly aggressive corrosivity.

Based on the above testing, summarized in Table 1 and referenced in Attachment 2, a corrosion specialist should be contacted for associated protective design parameters.

4.0 SUBSURFACE CONDITIONS

4.1 General

The MPOSA is adjacent to the SGOSA and is believed to exhibit similar subsurface characteristics. A literature review of previous field explorations within the SGOSA was conducted in order to verify material properties used in previous stability analysis within the gulch. For the stability evaluation summarized in this report, material properties consistent with previous amendments were used for similar materials. The literature review is discussed and laboratory results are given to provide validation that the material properties used in the stability analysis are reliable values.

An initial site exploration for the Squaw Gulch Valley Leach Facility (SGVLF) area was conducted by Golder (2007). This exploration focused on the general subsurface conditions within the footprint of the proposed SGVLF. In addition, the report presents the results of a clay borrow investigation completed in Squaw Gulch, Vindicator Valley, Globe Hill, and Bull Hill areas.

SWC completed an extensive geotechnical field exploration to characterize the subsurface materials within the Squaw Gulch area for design of the proposed SGVLF. The geotechnical exploration included test pit excavation and geotechnical boring advancement in critical areas of the SGVLF. Test pits totaling 123 were excavated from May 25 through June 6, 2007 within the Squaw Gulch and Bull Hill areas. A summary of the results of the geotechnical laboratory tests completed by SWC are presented in Attachment 2.

AMEC completed an additional geotechnical field exploration to further characterize the area of the proposed SGVLF foundation. The geotechnical exploration included the excavation of 65 test pits. These test pits were excavated from June 15 through 26, 2010 within the SGVLF footprint. The test pits were excavated by Conley Construction using a Case 9040B track hoe. AMEC personnel supervised and logged each test pit and collected soil samples for subsequent geotechnical laboratory testing. The results of the AMEC geotechnical laboratory tests are presented in Attachment 2.

The subsurface conditions underlying the MPOSA consists of granular soils consisting of gravelly sand and silts overlying competent bedrock. The depth to bedrock varies across the site, but is expected to be between 0 and 15 feet. Groundwater was not encountered within the project location.

4.2 Underground Mine Workings

Portions of the area beneath the proposed MPOSA and SGVLF were previously mined by historic underground means. Historic underground mine development was generally undertaken from shafts and occurred at various elevations. The historic underground working levels generally followed veins that were typically less than 12 feet wide (cross-sectional dimension of drifts and laterals). In some workings, open stope mining methods were used that followed ore veins upward from the working level excavations.

Surface disturbances from caving of the historic underground workings are visually evident in some areas within Squaw Gulch. These surface disturbances are primarily evident in the central gulch area. In many areas, the historic underground structures may have remained open. There is no evidence that any of the excavations were backfilled with mine development material, although some of the excavations were indicated on the historical mining plans as having collapsed and caved.

Remediation of historic underground workings is required to ensure the stability of the foundation of the MPOSA. Remediation measures are detailed in the Mill Platform Earthworks construction drawing set (AMEC, 2012) issued for construction January 24, 2012 and are the responsibility of the earthworks contractor. Remediation involves backfilling the historic mine workings with a coarse backfill and, in some cases, capping with a cemented fill or geogrid. These measures, combined with the overburden structural fill placed as part of the MPOSA grading, should provide adequate bridging of existing historic mine workings by the stress influence of the mill platform foundations.

4.3 Seismicity

Based on the seismic evaluation approved as part of Amendment No. 9, a peak ground acceleration (PGA) of 0.14g was selected for the OSA/VLF during operations, and a PGA of 0.08g was selected for the OSA/VLF at closure. No change to these values was warranted for this design.

5.0 FOUNDATION RECOMMENDATIONS

The following sections present the recommendations for design of the foundations for the MPOSA project elements.

5.1 General Foundation Design Recommendations

AMEC makes the following general design recommendations:

- Structural fill materials with less than 30 percent rock materials above 3/4-inch size shall be placed in maximum 12-inch loose lifts, and compacted to 98 percent of the maximum dry density as defined by a standard Proctor (ASTM D698) within +/- 2 percent of the optimum moisture content. Structural fill materials containing more than 30 percent rock materials above 3/4-inch size (rock fill) shall be compacted and monitored by a method specification technique as outlined in USACE (1994) and summarized in the attached technical specification (Attachment 1). Low Volume Solution Collection Fill is required to be placed a minimum of 8 feet from final grade and shall be placed in maximum 12-inch loose lifts and compacted to 98 percent of the maximum dry density as defined by a standard Proctor

(ASTM D698) within +/- 2 percent of the optimum moisture content. A gradation specification for the Low Volume Solution Collection Fill is provided in Section 6. The compaction equipment shall consist of a minimum 10-ton (static drum weight) vibratory smooth-drum compactor. Maximum rock size for rock fill shall be two-thirds of the compacted lift thickness, unless otherwise approved.

- General construction considerations are summarized in Section 6.0 of this letter.
- If used, column and strip footings should have minimum widths of 36 and 16 inches, respectively.
- For frost protection, the minimum footing depth is 4 feet below exterior grade (IBC, 2009) considering that frost heave resistant soils will be utilized in the founding fill.
- Foundations should be designed for seismic loading according to the International Building Code (IBC, 2009), with the following parameters:
  - Site Class D (stiff soil profile);
  - S_s = 0.200 (spectral response acceleration at short periods, Site Class B);
  - S_1 = 0.065 (spectral response acceleration at 1 second period, Site Class B);
  - SM_s = 0.321 (maximum considered spectral response acceleration at short periods, Site Class D);
  - SM_1 = 0.156 (maximum considered spectral response acceleration at 1 second period, Site Class D);
  - SD_s = 0.213 (design spectral response acceleration at short periods, Site Class D); and
  - SD_1 = 0.104 (design spectral response acceleration at 1 second period, Site Class D).
- Sulfate resistant concrete may be required, as the results of chemical characterization testing indicate a positive corrosion potential (i.e. ASTM C150 Type II modified Portland Cement). A corrosion specialist should be consulted to determine the most suitable type of concrete.
- Sliding friction at the bottom of the footings founded on compacted native materials or structural fill can be taken as 0.35 times the vertical dead load.
- Anticipated foundation conditions and construction activities described herein should be verified in the field by an engineer or project resident. If conditions vary significantly from those presented herein, modifications to the foundation design parameters may be required.
- Fill placed adjacent to structures or the primary containment system shall be graded to allow drainage away from the structure.

5.2 Specific Foundation Recommendations

Specific recommendations for the design of foundations are presented in this section. The allowable bearing capacities were estimated based on typical performance of compacted structural fill with a high rock content. In general, mill foundations are sensitive to differential settlement; therefore, these foundations should be sited in areas where the likelihood of differential settlements can be minimized (e.g. on dense to very dense materials).

Ultimate (gross), net, and allowable bearing capacities were developed for the foundation materials. The bearing capacity values are determined to satisfy two basic criteria: 1) prevent shear failure of the supporting soils; and 2) prevent excessive settlements that could damage the structure.

The bearing capacities and estimated settlements were developed based on experience at the site with similar fills. As indicated previously, field verification of compaction will be required to confirm the structural fill is being compacted sufficiently. Ultimate bearing capacities were developed using the Meyerhof (1951) equations and the general relationships presented in Bowles (1996). Net bearing capacities were calculated from the ultimate bearing capacities by subtracting the overburden pressure at the foundation depth. The net bearing capacity values presented herein do not include the weight of the foundation. Allowable bearing capacities (ultimate and net allowable) were calculated by applying a factor of safety of 3.0 to the ultimate and net bearing capacity values. For this report, the gross allowable bearing capacity is equal to the gross bearing capacity divided by a factor of safety of 3.0, and was used as the basis to size foundations that prevent shear failure of the supporting soil. The net allowable bearing capacity is equal to the net bearing capacity divided by a factor of safety of 3.0, and was used as the basis to size foundations to prevent excessive settlements. The foundation settlements were calculated using the elastic equations presented in Bowles (1996) and were limited to 1 inch or less based on the net allowable bearing capacity. The allowable bearing capacities are presented in Figure 3.

The allowable bearing capacity is based on a 1-inch maximum total settlement. Differential settlements are not anticipated to exceed two thirds of the total settlement. Negligible settlements of lightly loaded floor slabs are anticipated. As such, differential settlements between floor slabs and adjacent foundations will be approximately equal to the total foundation settlements presented.

To avoid overlapping stresses from adjacent footings that are placed at different elevations, any footing which is at a higher elevation should be positioned so its base is at or below a plane drawn upward at 1H:1V (horizontal to vertical) from the base of the lower footing.

The recommended allowable static bearing pressures provided in the following sections for foundations may be increased by one third for use with short-term loads such as those from wind or earthquakes.

6.0 CONSTRUCTION CONSIDERATIONS

6.1 Site Grading – General

Site grading, as described in this section, includes major excavations and fills necessary to bring the site to the proposed elevations, including fill to support buildings, foundations, floor slabs, backfill of foundations, and access roads.

Some of the on-site soils contain a significant percentage of silt, clay, and fine sand that make them particularly sensitive to moisture with regard to fill placement. These soils may also degrade to slurrylike consistency when subjected to construction traffic or otherwise disturbed in wet conditions. Therefore, fine grading should be suspended during periods of wet weather at the discretion of the on-site engineer.

Site grading of the MPOSA is outlined in greater detail in the AMEC Construction Drawings titled Mill Site Earthworks which were issued for construction on January 24, 2012. The construction drawings detail the liner configuration and limits of various construction materials within the OSA.

6.2 Site Preparation

Any existing uncontrolled or unconsolidated fills should be removed to expose the natural undisturbed native soils and replaced with Structural Fill to the limits of the Overburden Material as detailed in the Mill Site Earthworks Construction Drawings.

After stripping or over-excavation, exposed soil surfaces under slabs, tanks, and foundations should be moisture conditioned and compacted prior to fill placement. Care should be taken to avoid disturbing subgrade soils and supporting soils that will remain in place. Areas that become softened or loosened during construction should be moisture conditioned and recompacted or removed and replaced with compacted Structural Fill. The final (i.e. upper) 8 feet of the MSOSA grading consists of Low Volume Solution Collection Fill as detailed in the Mill Site Earthworks Construction Drawings (AMEC, 2012) and is the bearing material for the Mill foundations.

Structural Fill shall conform to the following (per Section 2200.0 of the Project Specifications):

U.S. Standard Sieve Size	Percent Passing by Dry Weight
24 – inch	100
No. 200	0 – 25
Plasticity Index:	30 maximum

Low Volume Solution Collection Fill shall conform to the following (per Section 2200.0 of the Project Specifications):

U.S. Standard Sieve Size	Percent Passing by Dry Weight
1 – inch	100
3/8 – inch	40 – 70
No. 4	5 – 55
No. 200	0 – 10
Plasticity Index:	0

6.3 Temporary Excavations

Construction may require temporary excavations into native soil and in existing fills. Safe, stable construction slopes are the responsibility of the contractor and depend on the ground and site conditions encountered at the time of construction.

6.4 Control of Surface and Groundwater

The contractor is responsible for control of all surface water runoff during construction, so that foundation excavations and subgrade remain essentially dry and protected against damage from water.

7.0 Stability Analysis

Slope stability of the Mill Platform was conducted to check the global slope stability with respect to the foundation loads recommended in this report. For each potential failure mode considered, slope stability was evaluated according to Spencer's Method of Analysis (Spencer's Method). Spencer's Method considers potential failure masses as rigid bodies divided into adjacent regions or "slices" separated by vertical boundary planes and is based on limit equilibrium, i.e., the method calculates the shear strengths that would be required to just maintain equilibrium, and then calculates a Factor of Safety (FOS) by dividing the available shear strength by the required shear strength. Consequently, the FOS calculated by Spencer's Method indicates the percentage by which the available shear strength exceeds, or falls short of, that required to maintain equilibrium. Therefore, an FOS equal to or in excess of 1.0 indicates stability and those less than 1.0 indicate instability. The greater the mathematical difference between the FOS and 1.0, the larger the "margin of safety" (for an FOS in excess of 1.0), or the more extreme the likelihood of failure (for an FOS less than 1.0).

The stability analyses were conducted using SLIDE V5.0 (RocScience, 2007), a commercially available computer program, with the input parameters presented in this section. For both the deep and shallow circular or block failure modes, the SLIDE critical surface search routine was initially used to evaluate the least stable failure surface. The program automatically iterates through a variety of potential failure surfaces, calculates the safety factor for static and pseudo-static conditions for each surface according to Spencer's Method, and selects the surface with the minimum FOS, commonly referred to as the critical surface. Static analyses were conducted with no applied horizontal forces, while pseudo-static analyses modeled design seismic conditions by incorporating a constant horizontal force. For the pseudo-static analyses, a conservative design coefficient of 0.14g (which is equal to the currently approved PGA for the Cresson Project) was used in the slope stability models, which is consistent with that used for Amendment Nos. 6, 7, 8 and 9 (CC&V 1993, 1998, 2000, 2008). For the postclosure configuration, AMEC used the PGA of 0.08g, which is also consistent with Amendment Nos. 6, 7, 8, and 9 (CC&V 1993, 1998, 2000, 2008).

7.1 Input Parameters

7.1.1 Conceptual Model

Stability analyses were performed on two critical cross-sections. The locations of the cross-sections under consideration are shown on Figure 1. Each cross-section was evaluated with a distributed load equal to the maximum allowable bearing capacity, 7000 psf, as shown on Figure 3, to simulate the presence of the mill foundations. The setback distance of the foundation load to the slope crest was evaluated with respect to slope stability and the required minimum distance was found to be 100 feet.

At the time of the site explorations, groundwater was not encountered in the test pits that overlap the proposed MPOSA area. Therefore a water surface was not modeled in the stability evaluation.

The following material properties were used in the models and are summarized in Table 2 below:

Low Volume Solution Collection Fill Material – The low volume solution collection fill material is modeled as a well graded sandy gravel, with an average bulk unit weight of 120 pounds per cubic foot (pcf). The gravelly sand is assumed to have a shear strength defined by a linear Mohr-Coulomb envelope, with an internal angle of friction of 36 degrees and zero cohesion. These values are consistent with published values for similar material (Bowles, 1996).

Overburden Material – The overburden material is modeled as a coarse rockfill, with an average bulk unit weight of 125 pcf. The rockfill is assumed to have a shear strength defined by a linear Mohr-Coulomb envelope, with an internal angle of friction of 39 degrees and zero cohesion. These values are consistent with that used in previous amendments.

Drain Cover Material – The drain cover material is modeled as a coarse, poorly graded gravel, with an average bulk unit weight of 120 pcf. The gravel is assumed to have a shear strength defined by a linear Mohr-Coulomb envelope, with an internal angle of friction of 40 degrees and zero cohesion. These values are consistent with published values for similar material (Bowles, 1996).

Composite Liner – The composite liner is located beneath the Low Volume Solution Fill Material and is used in the collection and diversion of effluent. Shear strength testing on representative clay/geomembrane linersrface shows conducted for CC&V resulted in friction angles ranging between 15 and 27 degrees. The liner material was modeled with a friction angle of 18 degrees, cohesion of zero, and density of 100 pcf. These values are consistent with those used in previous amendments.

Unconsolidated Foundation Material – The upper 10 ft of the native ground underlying the rockfill was conservatively modeled as soil, eventhough some areas will have bedrock at or near the ground surface. In areas where the previous geotechnical explorations encountered unconsolidated materials within or near the footprint of the proposed SGOSA or MPOSA, the material consisted mostly of sands and gravels with minor amounts of clay. The unconsolidated foundation material for both the MPOSA and the SGOSA was conservatively modeled with a bulk unit weight of 115 pcf, friction angle of 32 degrees, and zero cohesion.

Native Bedrock – According to the available subsurface information, the native bedrock within the area of the SGOSA consists predominately of unweathered, competent granodiorite. The bedrock was modeled with a bulk unit weight of 140 pcf, cohesion of 5,000 pounds per square foot (psf), and a friction angle of 45 degrees.

Table 2. Stability Evaluation Material Properties

Material Description	Material Properties Used in SLIDE 5.0		
	Unit Weight (pcf)	**Friction Angle (deg)**	**Cohesion (psf)**
Low Volume Solution Collection Fill	120	36	0
Overburden Material	125	39	0
Drain Cover Material	120	40	0
Composite Liner	100	18	0
Unconsolidated Foundation Material	115	32	0
Native Bedrock	140	45	5,000

7.2 Stability Results

The stability analysis results are shown on Figures 4 and 5 and summarized in Table 3, while locations of the cross-sections can be viewed on Figure 1.

Table 3. Stability Evaluation Results

Section (Location)	Type of Failure Modeled	Static Factor of Safety	Pseudo-static Factor of Safety	
			0.08g	**0.14g**
A	Circular (shallow)	2.8	2.2	1.8
	Circular (deep)	1.7	1.2	1.3
	Block	1.5	1.0	1.2
B	Circular (shallow)	2.2	1.8	1.6
	Circular (deep)	1.7	1.4	1.2
	Block	1.7	1.4	1.2

As evidenced above, the stability analyses indicate that each of the surfaces evaluated are stable under both static and seismic loading conditions as the computed factors of safety meet or exceed the prescriptive values of 1.5 and 1.0, respectively, under static and psuedostatic conditions. Although minimal deformation is anticipated due to seismic events, some minor maintenance and repair may be necessary due to localized zones of sloughing material. The minimum required setback distance for mill foundations from the crest of slopes is 100 feet. Slope stability should be reevaluated once mill foundation locations and anticipated loads are finalized.

8.0 USE OF THIS REPORT

This letter report has been prepared in accordance with generally accepted soil and foundation engineering practices in this area for use by the client for design purposes. If during construction, soil, rock, and groundwater conditions appear to be different from those described herein, this office should be promptly advised so that re-evaluation of the recommendations may be made. We recommend on-site observation of excavations and foundation bearing strata by a soils engineer.

AMEC appreciates the opportunity to provide continued engineering and construction support to CC&V. If you have any questions or comments, please contact the undersigned at (303) 935-6505.

Sincerely,

AMEC Environment & Infrastructure, Inc.

David Weidinger, P.E.
Project Engineer

Reviewed by:

Kimberly Morrison, P.E., R.G.
Associate, Project Sponsor

Jay Janney-Moore, P.E.
Project Manager

JWH:kfm

<u>Attachments:</u>
Figures
Attachment 1 – Compaction Specification
Attachment 2 – Laboratory Testing Results

9.0 References

Barton, N.R., R. Lien, J. Lunde, 1974. Engineering classification of rock masses for the design of tunnel support, *Rock Mech*. 6(4), 189-239.

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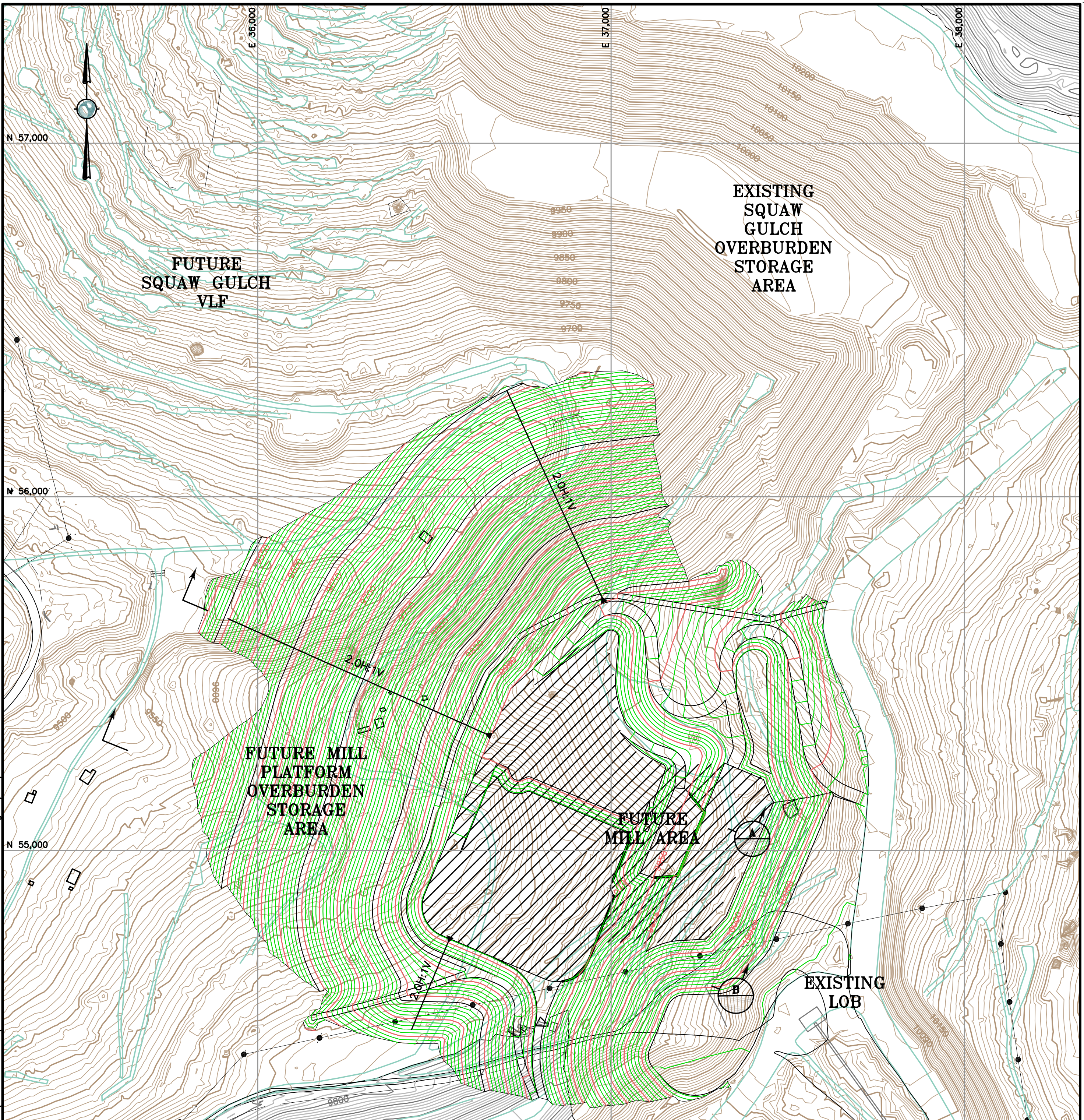
Figures



LEGEND:

9200 EXISTING GROUND SURFACE CONTOUR AND EL, FEET (AERIAL SURVEY)

9200 EXISTING GROUND SURFACE CONTOUR AND EL, FEET (LAND SURVEY)

9200 PROPOSED SQUAW GULCH MILL PLATFORM GROUND SURFACE CONTOUR AND EL. FEET

DAYLIGHT LINE

EXISTING UNIMPROVED ROAD/TRAILS

EXISTING DRAINAGES

EXISTING POWER CABLE

STATE HIGHWAY 67

FUTURE MILL AREA

200 0 200 400 FEET

CLIENT	CRIPPLE CREEK & VICTOR GOLD MINING COMPANY
PROJECT	MILL FOUNDATION RECOMMENDATIONS
TITLE	SITE LAYOUT AND STABILITY ANALYSIS SECTION LOCATIONS

amec

DESIGNED BY	DMW	CHECKED BY	JWH	DATE	
DRAWN BY	DMW	APPROVED BY	JNM	2/24/12	
FILENAME	74201125G_F01	FIGURE No.	1	REV	A

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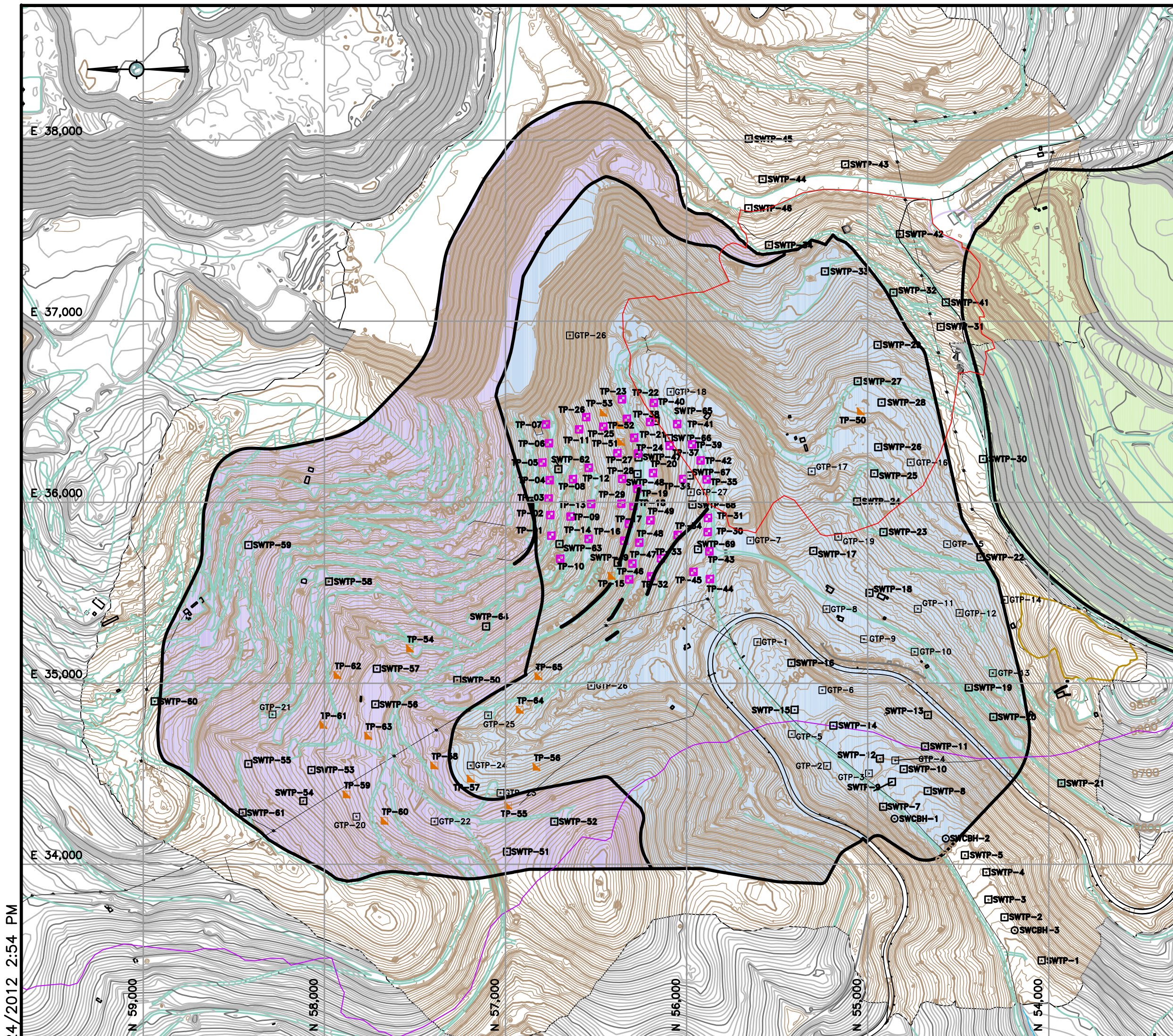

LEGEND:

- EXISTING GROUND SURFACE CONTOUR EL, FEET (AERIAL SURVEY)
- EXISTING GROUND SURFACE CONTOUR EL, FEET (LAND SURVEY)
- MILL PLATFORM LIMITS
- PHASE BOUNDARY
- GTP-18 — GOLDER ASSOCIATES TEST PIT 2004
- SWTP-34 — SMITH WILLIAMS TEST PIT JUNE 2007
- SWCBH-2 — SMITH WILLIAMS BOREHOLE JUNE 2007
- TP-65 — AMEC TEST PIT JULY 2010
- TP-45 — AMEC TEST PIT JUNE 2010
- PHASE 1
- PHASE 2
- CRESSON VLF

NOTE:

1. FOR GEOTECHNICAL INVESTIGATION DATA, REFER TO APPENDIX B OF THE REPORT.

500 0 500 1000 FEET

REFERENCE:

EXISTING GROUND TOPOGRAPHY WAS CREATED BY COMBINING THE FOLLOWING FILES RECV FROM FORESIGHT WEST SURVEYING, INC.:
SQUAW GULCH BASE TOPO – PHASE 1 – REVISED.DWG
(RECV MARCH 14, 2010)
SQUAW GULCH BASE TOPO – PHASE 2.DWG
(RECV APRIL 24, 2010)
SQUAW GULCH BASE TOPO – PHASE 3.DWG
(RECV MAY 4, 2010)
CCV TOPO EXPANSION 12-29-10 NORTH AREA.DWG
(RECV JANUARY 13, 2011)
CCV TOPO EXPANSION 01-28-11 SOUTH AREA.DWG
(RECV JANUARY 28, 2011)
SH67 TOPO 7-07-11.DWG
(RECV JULY 11, 2011)
VLF2 TOPO EXPANSION 8-05-11.DWG
(RECV AUGUST 9, 2011)
09028-COMOSITE-TOPO MLE LIMITS.DWG
(RECV MAY 28, 2010 FROM CC&V)

CLIENT	CRIPPLE CREEK & VICTOR GOLD MINING COMPANY
PROJECT	MILL PLATFORM RECOMMENDATIONS
TITLE	HISTORICAL GEOTECHNICAL EXPLORATION LAYOUT

amec

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DRAWN BY	DMW	APPROVED BY	JNM	2/24/12
CADD FILENAME			FIGURE No.	REV
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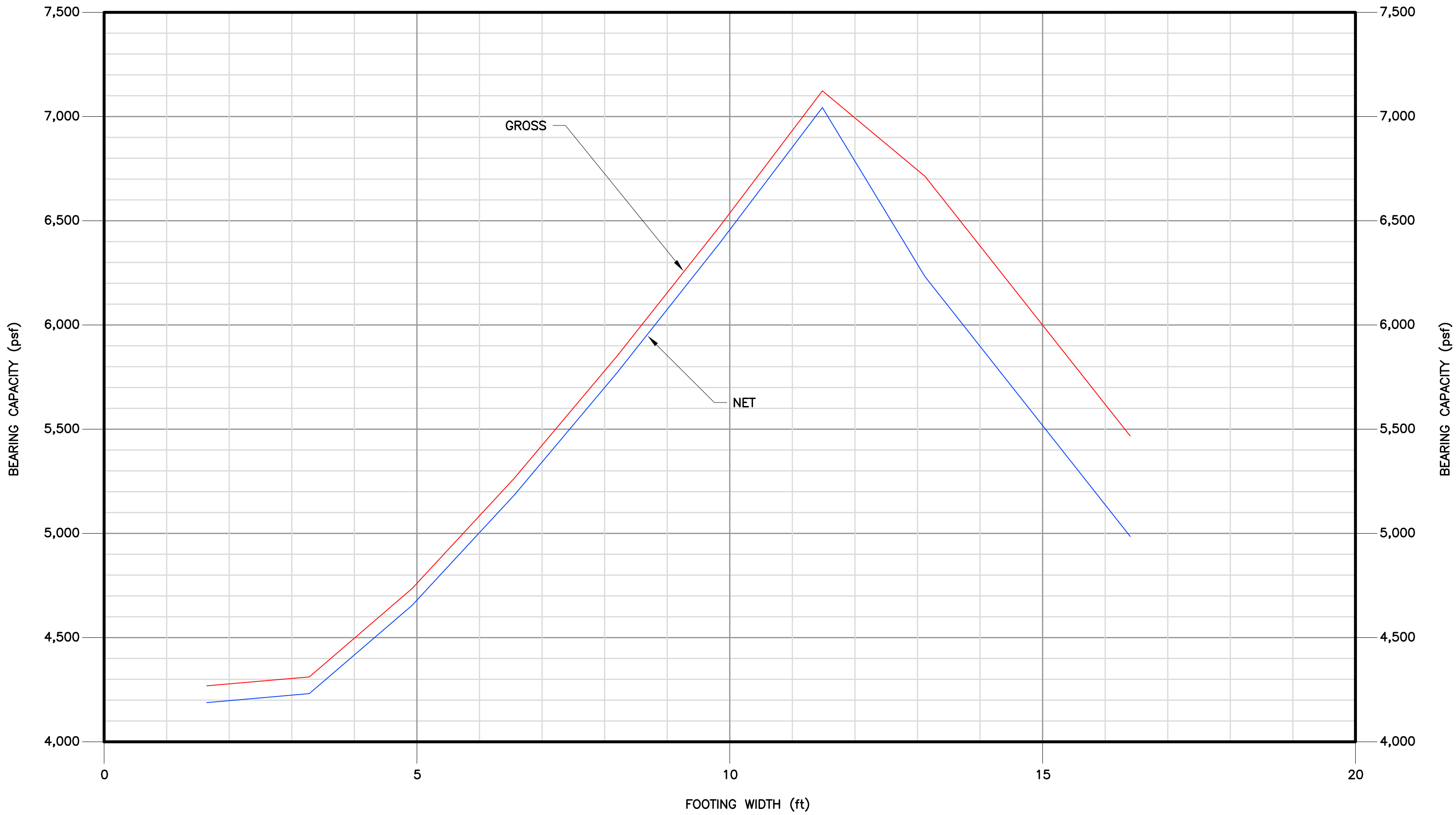

NOTES:

1. 4ft. MINIMUM FOUNDATION BURIAL DEPTH
2. NO GROUNDWATER INFLUENCE
3. NO INCLINED FOOTINGS
4. 1in. MAX SETTLEMENT

CLIENT	CRIPPLE CREEK & VICTOR GOLD MINING CO.				
PROJECT	MILL FOUNDATION RECOMMENDATIONS				
TITLE	ALLOWABLE BEARING CAPACITIES				
amec	DESIGNED BY	DMW	CHECKED BY	JWH	DATE
	DRAWN BY	DMW	APPROVED BY	JWH	2/24/12
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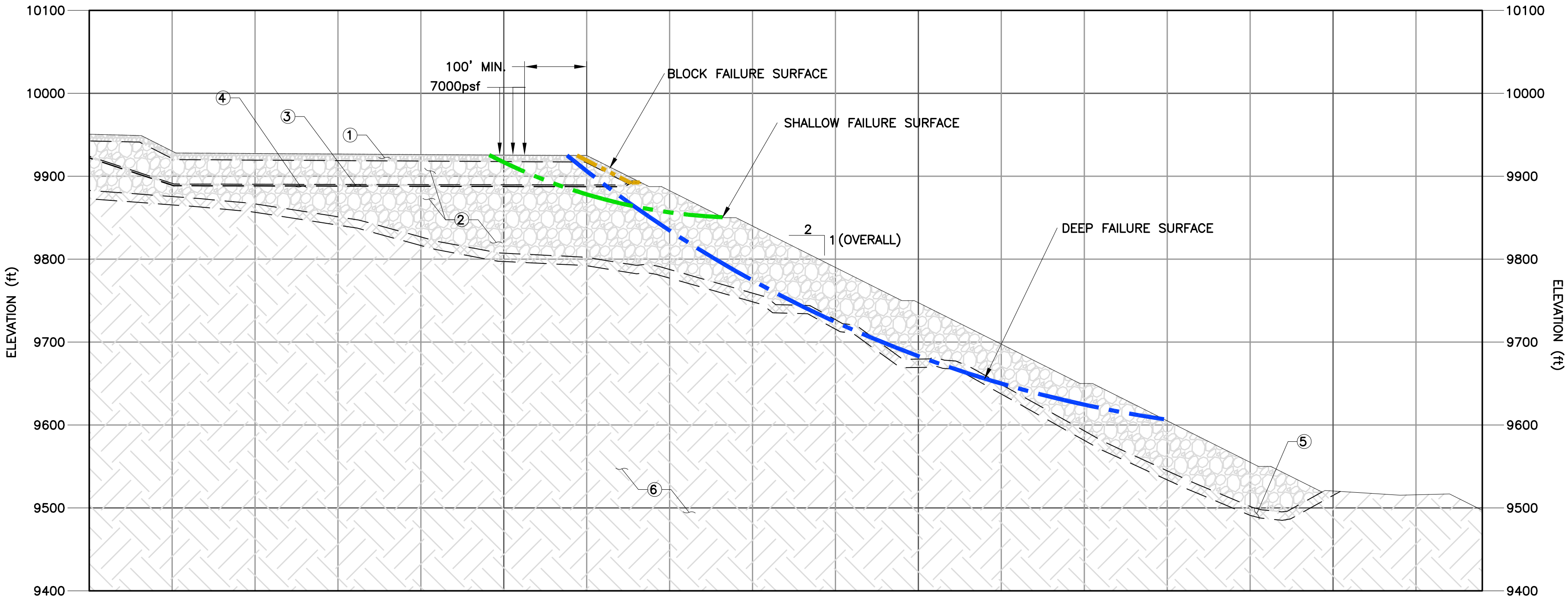

SECTION A

MATERIAL PROPERTIES

ZONE	MATERIAL	MOIST UNIT WEIGHT (lb/ft^3)	TOTAL STRESS ANALYSIS	
			FRICTION ANGLE (DEGREES)	COHESION (lb/ft^2)
①	LOW VOLUME SOLUTION COLLECTION FILL	120	36	0
②	OVERBURDEN MATERIAL	125	39	0
③	DRAIN COVER MATERIAL	120	40	0
④	COMPOSITE LINER	100	18	0
⑤	UNCONSOLIDATED FOUNDATION MATERIAL	115	32	0
⑥	NATIVE BEDROCK	140	45	5000

SECTION A STABILITY RESULTS

ANALYSIS	STATIC FACTOR OF SAFETY	PSEUDOSTATIC FACTOR OF SAFETY	
		0.08g	0.14g
SHALLOW CIRCULAR	2.8	2.2	1.8
DEEP CIRCULAR	1.7	1.2	1.3
BLOCK	1.5	1.0	1.2

NOTES:

1. SLOPE STABILITY EVALUATION CONDUCTED WITH A 7,000psf LOAD APPLIED TO THE TOP OF THE SLOPE TO SIMULATE MAXIMUM ALLOWABLE FOUNDATION BEARING PRESSURE.

CLIENT	CRIPPLE CREEK & VICTOR GOLD MINING CO.
PROJECT	MILL FOUNDATION RECOMMENDATIONS
TITLE	SECTION A SLOPE STABILITY RESULTS

amec

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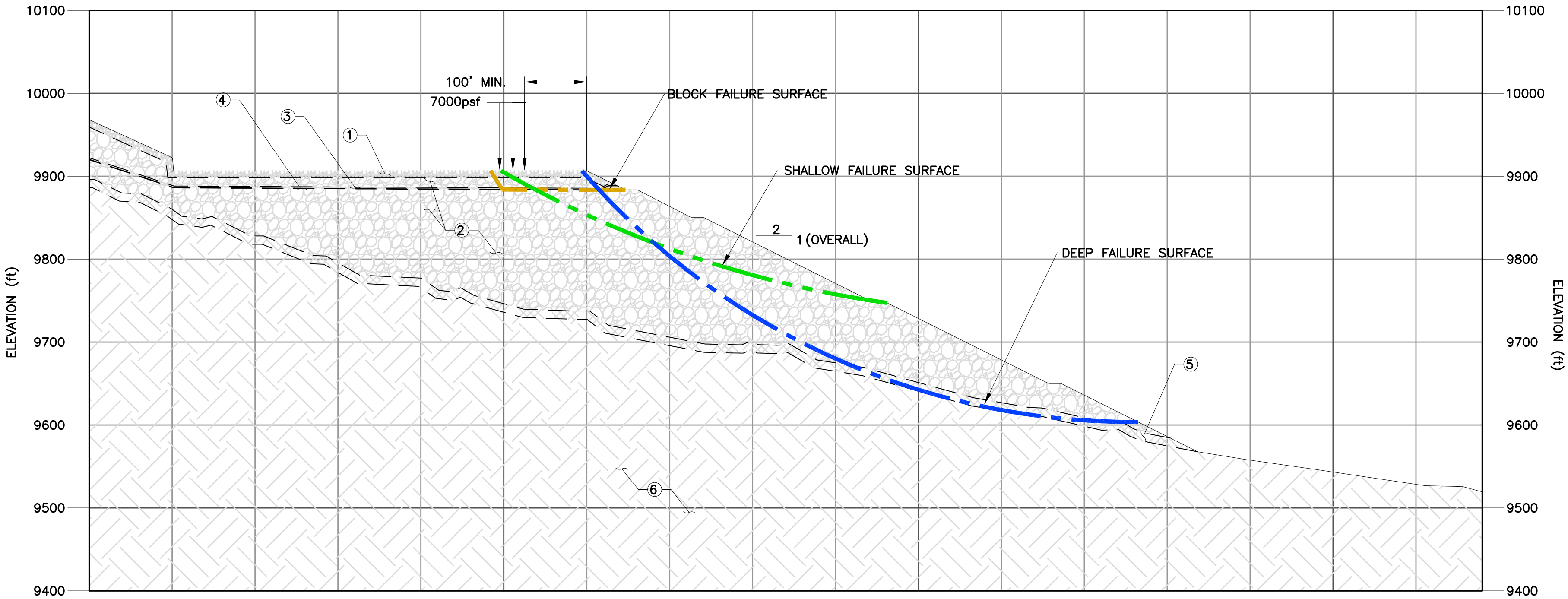

SECTION B

MATERIAL PROPERTIES

ZONE	MATERIAL	MOIST UNIT WEIGHT (lb/ft³)	TOTAL STRESS ANALYSIS	
			FRICTION ANGLE (DEGREES)	COHESION (lb/ft²)
①	LOW VOLUME SOLUTION COLLECTION FILL	120	36	0
②	OVERBURDEN MATERIAL	125	39	0
③	DRAIN COVER MATERIAL	120	40	0
④	COMPOSITE LINER	100	18	0
⑤	UNCONSOLIDATED FOUNDATION MATERIAL	115	32	0
⑥	NATIVE BEDROCK	140	45	5000

SECTION B STABILITY RESULTS

ANALYSIS	STATIC FACTOR OF SAFETY	PSEUDOSTATIC FACTOR OF SAFETY	
		0.08g	0.14g
SHALLOW CIRCULAR	2.2	1.8	1.6
DEEP CIRCULAR	1.7	1.4	1.2
BLOCK	1.7	1.4	1.2

NOTES:

1. SLOPE STABILITY EVALUATION CONDUCTED WITH A 7,000psf LOAD APPLIED TO THE TOP OF THE SLOPE TO SIMULATE MAXIMUM ALLOWABLE FOUNDATION BEARING PRESSURE.

CLIENT	CRIPPLE CREEK & VICTOR GOLD MINING CO.
PROJECT	MILL FOUNDATION RECOMMENDATIONS
TITLE	SECTION B SLOPE STABILITY RESULTS

amec

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FILENAME	74201125G_F5	FIGURE No.	5	REV A

Attachment 1

Technical Specification for Placement and Compaction of Overburden Fill

CRIPPLE CREEK & VICTOR GOLD MINE MPOSA EARTHWORKS TELLER COUNTY, CO PROJECT NO.: 1125G	**SPECIFICATION** TECHNICAL SPECIFICATIONS FOR PLACEMENT AND COMPACTION OF COARSE GRANULAR FILL	PAGE 1 OF 9 DOC. NO.: TEST FILL TECH SPECS.DOC DATE: (ORIGINAL) 2/29/12 REVISION: 0 DATE: 2/29/12

THIS TITLE SHEET IS THE FIRST PAGE OF THE DOCUMENT AND IS A RECORD OF EACH ISSUE OR REVISION.

		APPROVALS				
REV	DATE	DESIGN MANAGER	PROJECT MANAGER	ORIGINATOR	PAGES	REMARKS
0	2/29/12	JJM	JJM	DMW	9	Issued for Construction

DOCUMENT APPROVAL

☐ APPROVED WITHOUT COMMENTS
☐ APPROVED AS NOTED
☐ NOT APPROVED – RESUBMIT

Approved by Owner ____________ Date ________

DOCUMENT ISSUED FOR:

☒ ENTIRE DOCUMENT ISSUED THIS REVISION

☐ REVISED PAGES ONLY ISSUED THIS REVISION

☐ REVIEW AND COMMENT
☐ CLIENT APPROVAL
☐ INQUIRY/BID
☐ DESIGN
☐ PURCHASE
☐ CONSTRUCTION

TABLE OF CONTENTS

1.0 LOCATION & TEST FILL PREPARATION

Material containing more than 30-percent rock materials above ¾ inch size (rock fill) shall be, spread, placed, and compacted using procedures based on the results of a test fill. The type of compaction equipment, number of passes, and maximum rock size and loose lift thickness will be approved by the Engineer in writing based on the acceptable test fill performance. The Contractor shall outline his proposed procedures for moisture conditioning and fill placement and submit them to the Engineer for review and approval.

If the location of the test fill overlies a soil or weathered rock foundation, it must be thoroughly stripped of organics and compacted prior to fill placement until no further settlement is observed. A rockfill base pad (or leveling course), 2 to 3 ft thick, should be placed on the foundation (whether soil or rock) prior to placing the first test lift in order to ensure that all foundation depressions and undulations are filled and a level surface is obtained. Placement of the rockfill base pad should be in at least two lifts, where permissible, with compactive effort applied until negligible settlements are observed from level readings made on its surface. Where a base pad is not required, a minimum 10 passes of the vibratory roller that will be used in the test fill, shall be completed.

An important consideration for any test fill program requires a close simulation of actual construction procedures and equipment to be used in the project fill.

2.0 MATERIAL HANDLING

Test fill materials may be delivered directly to the site from the borrow pit or stockpiled for future use in the test fill. However, stockpiling may produce changes in the gradation of the rock reaching the fill because of double-handling (loading and hauling). For this reason, stockpiling should be avoided unless it is anticipated in the project construction.

3.0 CONSTRUCTION METHODOLOGY

Individual test sections shall be of sufficient size so the compactive effort does not induce lateral bulging of the fill. The recommended dimensions to avoid this occurrence require a width of 30 to 50 ft with a length of 50 to 80 ft, if feasible. Maximum particle sizes equal to 2/3 of the lift thickness are acceptable.

For material, which does not degrade through compaction to the extent that it must be considered as soil, vibratory rollers are the most commonly used piece of equipment. It has been determined that for sound rock, four passes of a 10 ton vibratory roller upon layer thicknesses averaging about 3.3 ft, have become standard practice. Loose lift thicknesses for gravels have ranged between 1 to 3 ft depending on particle size and percentage of material passing the U.S. Standard No. 200 sieve sizes. Fill comprised of soft, weaker rocks and fines require thinner lifts on the order of 18 in. to 2 ft and increased compactive effort. Again, site-specific equipment shall be used to perform the test fill construction.

Compactive equipment shall be operated at a speed which will result in a minimum of 6 to 8 impacts per lineal foot of roller travel. Follow manufacturer's recommendations for operations speed versus frequency of impacts to obtain the most efficient compaction. Adjust these variables to provide the optimum rolling procedures for the material. Maintain the same amplitude and frequency during compaction of the test fill.

Four or five layers (lifts) are usually sufficient to provide enough data to establish the compaction specification for any one type of rock fill. An individual test section or lane of a test fill shall contain one type of material, consistent lift thicknesses, compaction by similar equipment and the same number of passes. The data from the constructed lifts shall then be used to obtain a settlement curve for each test section.

4.0 MEASUREMENTS

Prior to establishing control points for settlement measurements, a leveling pass shall be completed on the un-compacted lift surface with the vibratory roller, with the vibratory unit turned off. This will provide a smooth surface upon which to clearly establish control points and confirm the lift thickness. Clearly mark the control points with a cross of contrasting spray paint to determine subsequent level readings. Record the amount of settlement after every two passes of the compactor, to a maximum of 25 passes. In general, the minimum number of passes will be that number required to achieve 80-percent of the total settlement obtained after ten complete passes of the compaction equipment. A minimum of five control points is required for each lift, as shown by the example in Attachment A. The grid pattern will be chosen to provide a good representative assessment of the overall settlement of the lift surface. There shall be no less than three points on any one line of the grid and the edges of the grid shall be no closer than 10 ft from any outside edge of the test section. Avoid access ramps when making settlement readings.

Upon cessation of compactive effort and the final lift survey, the surface of the lift shall be covered with a sacrificial marker so that individual lifts can be identified in subsequent test excavations.

5.0 VISUAL OBSERVATIONS

The representative of the Engineer will carry out visual observations of the construction procedures and material behaviour. Index testing shall be completed subsequent to the test fill completion.

6.0 INSPECTION OF TRENCHES AND PITS

Excavate observation pits or inspection trenches to expose a cross section of each test section or lane in order that the in-situ characteristics of the compacted fill can be observed by the representative of the Engineer. Information recorded from these excavations will include:

- The compacted lift thickness,
- The distribution of fines within the lift,
- The overall appearance of each lift (segregation, voids, stability, etc).

7.0 EVALUATION

The Engineer will keep complete records of test fill construction, measurements and observations. After completion of the test fill program, an as-built report will be completed, consisting of the following:

- Locations of borrow sources and description of borrow materials,
- Description of foundation preparation and treatment before leveling pad construction,
- Materials used in, and construction of the leveling pad,
- Description of each test fill, including: materials, layout and compaction equipment,
- Thickness of loose and compacted lifts,
- Locations of tests including control point layout,
- Description of tests and measurements performed,
- Laboratory test results,
- Description of inspection pits or trenches and their locations, and
- Results of visual observations in inspection pits or trenches.

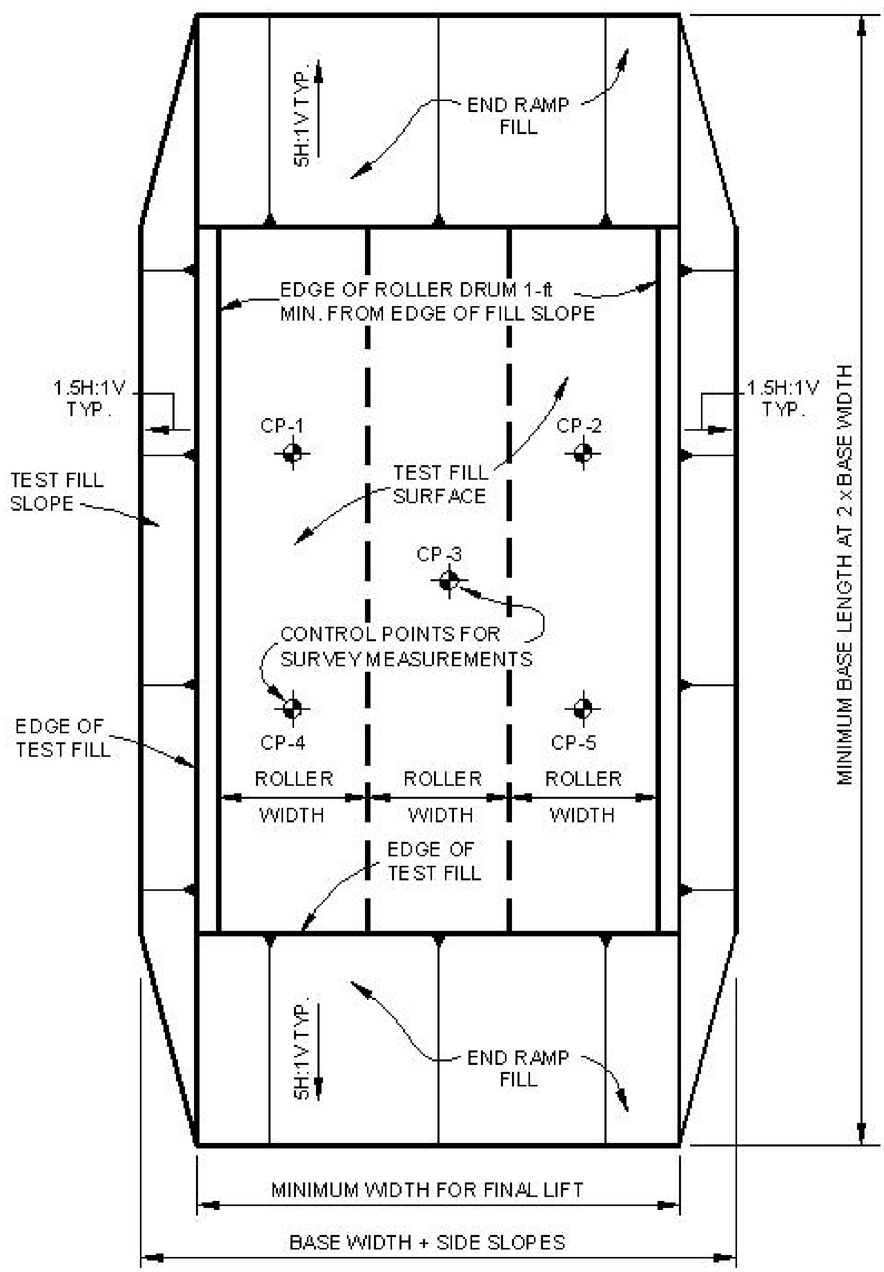
Settlement data will be used to determine the best combination of loose-lift thickness, number of passes and roller type (compaction effort) to achieve the specified densities. The settlement readings will be expressed as a percentage of the loose-lift thickness. For each lift thickness, the Engineer will plot settlement on the y-axis and number of passes on the x-axis, as shown by the example on Attachment B. The most effective compaction procedure will be determined by the

Engineer and the Contractor. Acceptance of the compaction procedure by the Engineer does not release the Contractor from his obligation to achieve specified densities.

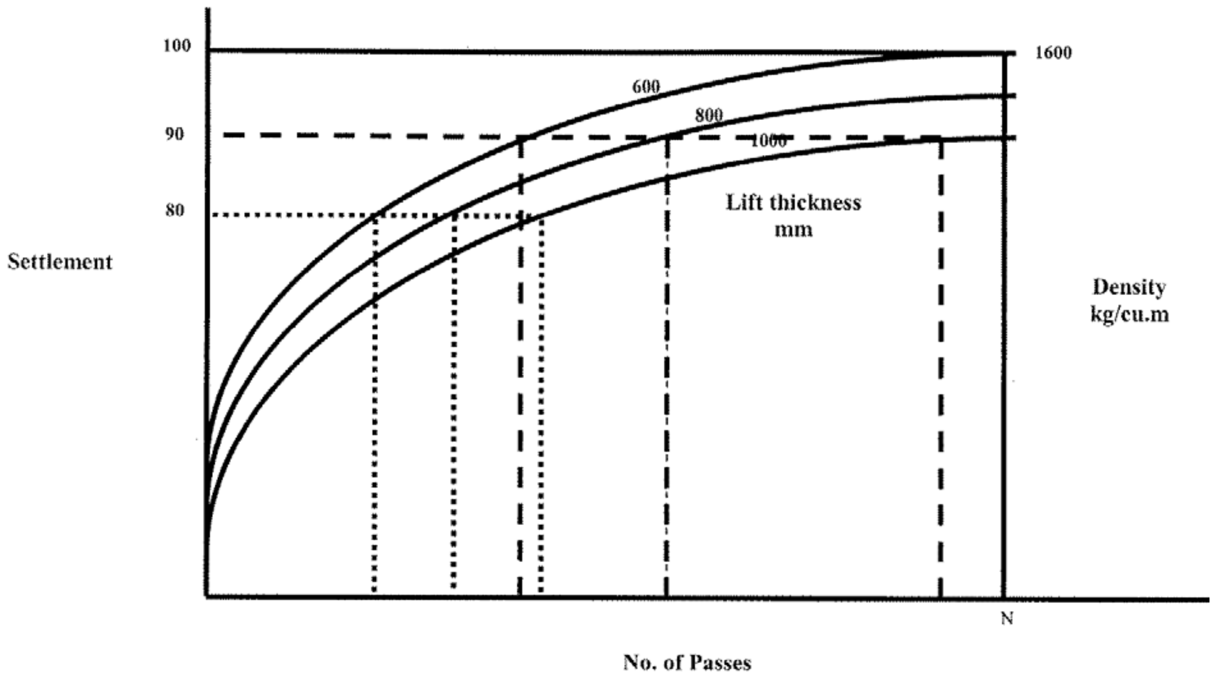
The report will conclude with an analysis of the field measurements and observations, and the preparation of performance specifications for compaction including:

- Type and size of compaction equipment,
- Number of passes required, and
- Maximum loose lift thickness.

8.0 ATTACHMENT A



9.0 ATTACHMENT B



10.0 REFERENCES

U.S. Army Corps of Engineers (USACE)
EM1110-2-2301 Engineering and Design – Test Quarries and Test Fills

Attachment 2

Laboratory Testing Results

Attachment 2.1 – AMEC Laboratory Test Data

Attachment 2.2 – SWC Laboratory Test Data

Attachment 2.1 – AMEC Laboratory Test Data

AMEC Laboratory Test Data Summary

Sample No.	Date Tested	Elev. (ft)	Natural Moisture (%)	Specification (% passing) / Grain Size Distribution (% passing)							Atterberg Plasticity Index:			Moisture Density		Permeability @ OMC		Permeability 1.5% Above OMC	
				6	2	1	0.375	#4	#40	#200	Liquid Limit	Plastic Limit	Plastic Index	Maximum Dry Density (pcf)	Optimum Moisture (%)	Permeability k (cm/sec) 5 PSI	20PSI	Permeability k (cm/sec) 5 PSI	20PSI
TP-2	6/15/2010	8'	N/T	100.0	92.8	81.8	69.8	67.9	57.0	44.9	55	20	35	N/T	N/T	N/T		N/T	
TP-5	6/15/2010	8.5'	N/T	100.0	100.0	81.4	73.3	69.9	51.6	30.9	37	17	20	N/T	N/T	N/T		N/T	
TP-7	6/15/2010	15'	N/T	100.0	98.6	77.1	66.4	63.4	49.5	33.5	39	16	23	N/T	N/T	N/T		N/T	
TP-11	6/16/2010	10'	N/T	100.0	100.0	90.2	81.9	75.5	56.0	39.3	39	16	23	N/T	N/T	N/T		N/T	
TP-12	6/16/2010	11'	N/T	100.0	100.0	92.1	65.3	59.1	40.9	28.7	44	17	27	N/T	N/T	N/T		N/T	
TP-13	6/16/2010	10.5'	12.5	100.0	81.8	50.7	35.1	29.9	21.5	17.1	55	21	34	N/T	N/T	N/T		N/T	
TP-18	6/16/2010	10.5'	12.1	100.0	92.5	83.7	72.8	66.2	45.2	32.6	38	14	24	122.6	10.2	5.6E-05	3.0E-06	8.0E-07	N/T
TP-19	6/17/2010	11'	15.0	100.0	88.2	74.8	63.4	57.8	42.5	32.6	38	13	25	N/T	N/T	N/T		N/T	
TP-21	6/17/2010	7'	16.0	100.0	92.5	82.4	70.1	63.8	46.1	32.9	38	16	22	N/T	N/T	N/T		N/T	
TP-23	6/17/2010	19'	14.3	100.0	92.1	82.6	71.3	64.6	47.7	36.5	36	14	22	121.2	10.8	5.5E-05	2.3E-06	N/T	
TP-24	6/17/2010	3'	13.0	100.0	95.7	84.8	74.2	68.0	47.8	34.6	40	14	26	N/T	N/T	N/T		N/T	
TP-25	6/17/2010	8'	13.9	100.0	94.8	81.7	71.0	63.9	42.8	30.7	37	16	21	N/T	N/T	N/T		N/T	
TP-26	6/17/2010	6.5'	N/T	100.0	96.1	86.0	73.6	67.0	46.3	30.6	41	16	25	N/T	N/T	N/T		N/T	
TP-27	6/17/2010	17'	16.3	100.0	91.8	80.4	70.2	64.9	44.1	31.3	44	17	27	N/T	N/T	N/T		N/T	
TP-30	6/21/2010	6.5'	14.4	100.0	88.8	75.2	60.4	54.8	39.4	30.0	38	15	23	N/T	N/T	N/T		N/T	
TP-30	6/21/2010	13.5'	16.1	100.0	85.5	73.5	62.3	57.8	42.4	32.2	39	18	21	121.3	10.1	N/T		N/T	
TP-31	6/21/2010	22.5'	13.3	100.0	96.6	83.3	70.5	62.9	45.9	36.3	36	15	21	N/T	N/T	N/T		N/T	
TP-32	6/21/2010	8.5'	12.0	100.0	92.5	80.7	66.1	58.4	36.2	25.5	37	17	20	N/T	N/T	N/T		N/T	
TP-33	6/21/2010	11'	15.1	100.0	84.0	71.0	56.3	50.4	30.3	22.7	46	21	25	122.4	9.9	N/T		N/T	
TP-34	6/21/2010	8'	15.9	100.0	94.3	84.1	74.0	67.8	48.8	36.2	40	16	24	N/T	N/T	N/T		N/T	
TP-35	6/21/2010	12'	17.7	100.0	86.8	79.3	72.8	68.1	53.1	43.0	45	13	32	118.8	10.9	N/T		N/T	
TP-36	6/21/2010	7'	13.4	100.0	92.8	79.2	65.5	59.8	43.0	31.6	38	19	19	120.8	10.4	N/T		N/T	
TP-37	6/21/2010	16'	13.4	100.0	95.2	76.7	64.2	58.7	44.3	34.6	39	16	23	N/T	N/T	N/T		N/T	
TP-38	6/21/2010	19'	11.9	100.0	96.0	80.0	67.8	63.0	44.4	32.0	33	19	14	123.9	9.9	2.2E-04	6.0E-05	N/T	
TP-39	6/21/2010	9.5'	13.8	100.0	95.9	84.1	75.7	71.5	56.6	43.7	37	16	21	N/T	N/T	4.6E-05	5.1E-08	N/T	
TP-39	6/21/2010	14'	20.8	100.0	100.0	97.6	93.8	91.1	82.9	69.4	37	14	23	112.5	13.6	N/T		N/T	
TP-41	6/22/2010	9'	17.0	100.0	94.3	89.8	78.6	73.7	57.7	42.1	28	17	11	N/T	N/T	N/T		N/T	
TP-42	6/22/2010	8.5'	16.2	100.0	90.5	76.2	68.7	63.5	50.3	39.0	34	14	20	N/T	N/T	N/T		N/T	
TP-43	6/22/2010	10'	14.9	100.0	93.7	79.8	68.0	62.3	46.1	34.4	35	15	20	N/T	N/T	N/T		N/T	
TP-44	6/22/2010	14'	15.5	100.0	97.7	89.1	76.0	68.8	48.6	35.5	32	20	12	121.5	9.8	2.1E-04	1.3E-04	N/T	
TP-45	6/22/2010	14'	12.4	100.0	86.8	73.1	61.5	56.2	38.8	29.2	40	14	26	N/T	N/T	N/T		N/T	
TP-48	6/22/2010	10'	15.3	100.0	96.4	85.5	66.4	58.7	34.7	23.4	44	16	28	N/T	N/T	N/T		N/T	
TP-49	6/22/2010	14'	10.2	100.0	93.9	82.0	69.0	61.8	40.6	28.6	36	15	21	122.2	9.7	2.7E-04	8.6E-05	N/T	
TP-57	6/23/2010	15'	12.7	100.0	90.2	80.2	68.9	61.4	35.2	23.7	30	16	14	122.7	10.1	N/T		N/T	
TP-60	6/23/2010	16'	N/T	100.0	100.0	93.6	74.4	64.4	37.8	25.0	30	16	14	N/T	N/T	N/T		N/T	
TP-64	6/24/2010	10'	16.1	100.0	91.2	82.7	72.1	66.1	42.3	27.2	40	14	26	120.5	10.0	N/T		N/T	
TP-65	6/24/2010	9.5'	18.4	100.0	100.0	98.6	92.2	85.3	62.7	49.7	40	15	25	114.8	13.2	N/T		N/T	
PCS-1-R	4/15/2010	-	7.8	100.0	73.5	66.8	59.2	55.1	39.7	28.2	39	14	25	N/T	N/T	N/T		N/T	
PCS-2-R	5/4/2010	-	12.3	100.0	93.3	84.4	73.6	67.4	49.2	37	37	13	24	121.2	9.8	N/T		6.9E-06	8.8E-07
PCS-3-R	5/20/2010	-	11.5	100.0	89.4	83.3	71.6	63.0	40.5	26	33	15	18	123.4	10.1	N/T		N/T	

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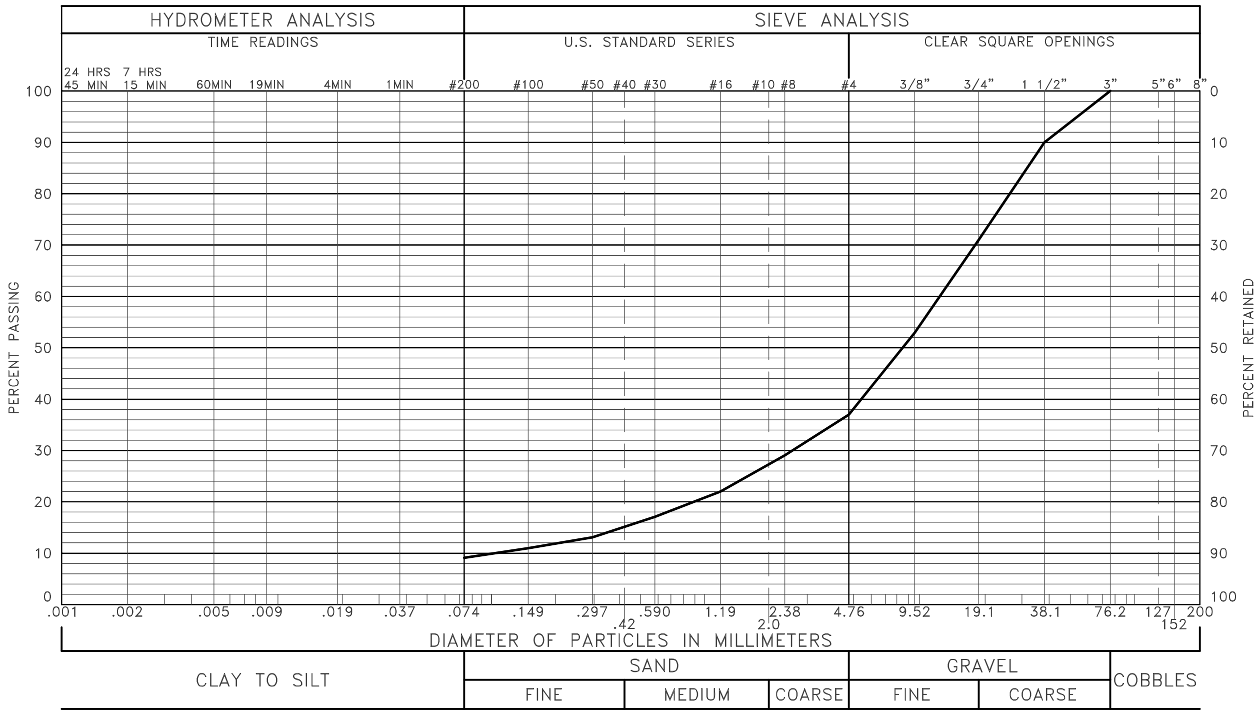
and Winter Park/Fraser, Colorado

TABLE 1
SUMMARY OF LABORATORY TEST RESULTS

PROJECT NO.: 12-1-158 (DV108-00130/12-900)
PROJECT NAME: Knight Piesold/CC & V (AMEC)
P.O.#10194
DATE RECEIVED: 02-03-12

SAMPLE LOCATION	DATE TESTED	GRADATION		PERCENT PASSING No. 200 SIEVE	ATTERBERG LIMITS		WATER SOLUBLE SULFATES		MINIMUM ELECTRICAL RESISTIVITY ohm-cm	CHLORIDE CONTENT OF SOIL		pH	SOIL OR BEDROCK TYPE
		GRAVEL (%)	SAND (%)		LIQUID LIMIT (%)	PLASTICITY INDEX (%)	ppm	%		ppm	%		
CC & V	02-08-12	63	28	9	24	7	115	0.57	700	65	0.33	4.1	POORLY GRADED GRAVEL WITH SILTY CLAY AND SAND (GP-GC)



SIEVE SIZE	PERCENT PASSING	SPECIFIED PERCENT PASSING
3"	100	
1-1/2"	90	
3/4"	71	
3/8"	53	
#4	37	
#8	29	
#16	22	
#30	17	
#50	13	
#100	11	
#200	9	

GRAVEL 63 % SAND 28 % SILT AND CLAY 9 %

LIQUID LIMIT 24 PLASTICITY INDEX 7

SAMPLE OF: Poorly Graded Gravel with Silty Clay and Sand (GP-GC)

FROM: CC & V

DATE SAMPLED: 02-03-12 DATE RECEIVED: 02-03-12 DATE TESTED: 02-08-12

February 14, 2012 - 03:00pm
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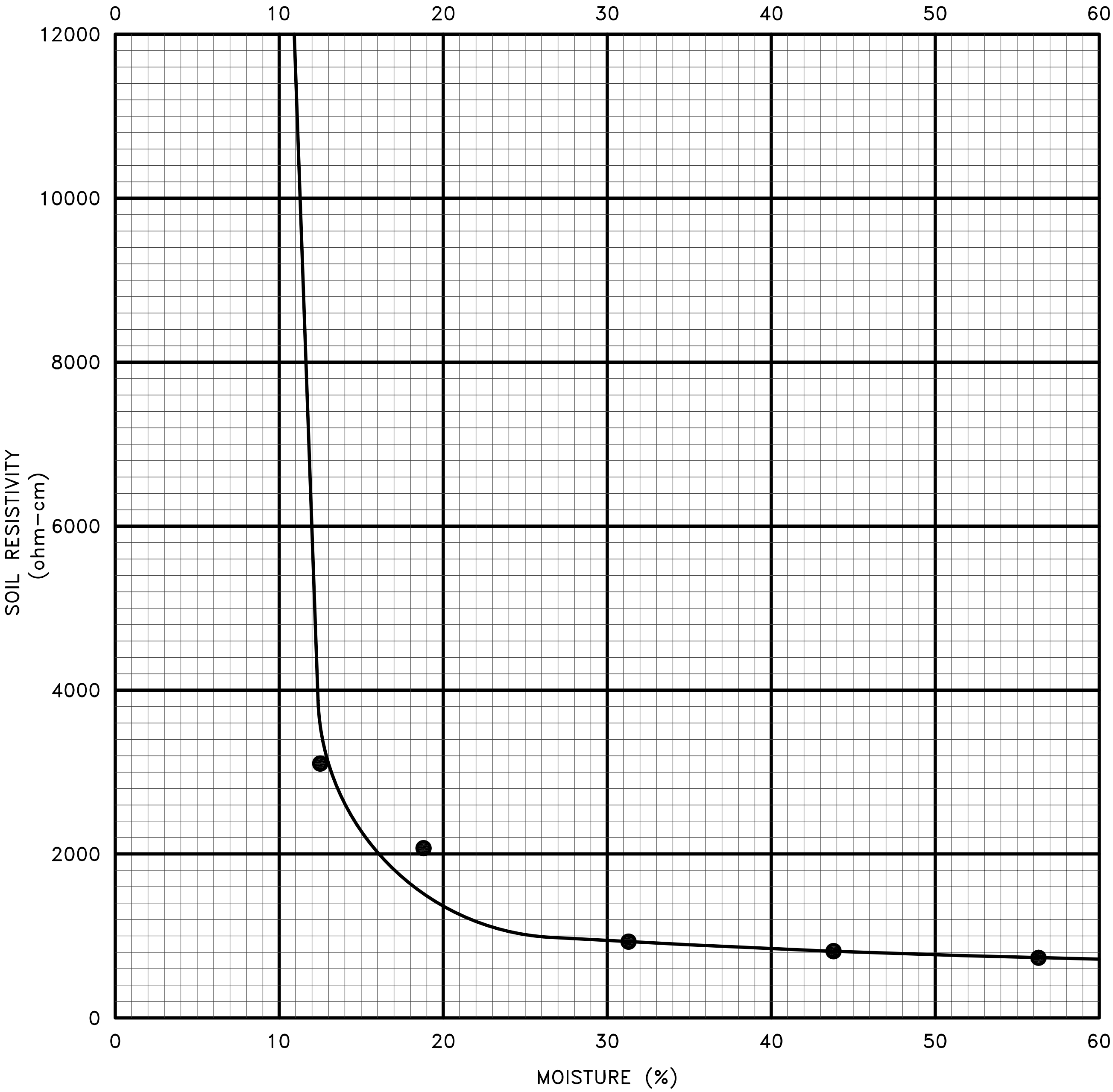
12-1-158	Kumar & Associates	GRADATION TEST RESULTS	Fig. 1



CURVE SYMBOL	SAMPLE IDENTIFICATION	SOIL OR BEDROCK TYPE	MINIMUM RESISTIVITY (ohm–cm)
●	CC & V	Poorly Graded Gravel with Silty Clay and Sand (GP–GC)	665

Mar 31, 11Y – 9:40am
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12–1–158	Kumar & Associates	LABORATORY RESISTIVITY RESULTS	Fig. 2

Attachment 2.2 – SWC Laboratory Test Data

SWC LABORATORY TEST DATA SUMMARY

Sample Name	Lab #	Depth	Material Description	Grain Size Analysis - Percent Passing: 6"	3"	2"	1.5"	1"	3/4"	1/2"	3/8"	#4	#10	#20	#30	#50	#100	#200	.002mm	Specific Gravity	Atterberg Limits: Plastic Limit	Liquid Limit	Plasticity Index	Natural Density (pcf)	Standard Proctor: Max. Dry Density (pcf)	Optimum Moisture (%)	Permeability (cm/sec) Remold Data: Initial Dry Density (pcf)	Initial Mois. Cont (%)	Compaction (%)	Confining Pressure: 5 psi	20 psi	40 psi
Squaw Gulch Geotechnical Samples																																
BH-1	7-125-62	10.0'-10.25'	Brown Clayey sand with gravel	-	-	-	-	100.0	91.8	87.0	81.9	72.3	56.3	39.6	33.9	25.6	20.6	17.4	-	-	22	34	12	111	-	-	-	-	-	-	-	-
BH-1	7-125-63	10.5'	Brown Silty sand with gravel	-	-	-	-	-	-	100.0	98.0	82.2	62.3	42.6	36.8	27.5	21.1	16.7	-	-	26	34	8	104.8	-	-	-	-	-	-	-	-
BH-2	7-125-66	5.0'-5.25'	Brown Silty sand	-	-	-	-	-	100.0	93.2	90.6	86.6	80.8	74.0	71.0	61.6	51.8	43.7	-	-	25	33	8	89.2	-	-	-	-	-	-	-	-
BH-2	7-125-67	5.25'-5.5'	Brown Well-graded sand with silt and gravel	-	-	-	100.0	83.6	75.7	72.6	69.0	59.5	43.0	27.1	22.3	15.4	11.8	9.5	-	-	NP	NP	NP	97.4	-	-	-	-	-	-	-	-
SWTP-2	7-125-27	2.0'	Brown Clayey sand with gravel	-	100.0	90.2	90.2	84.1	81.8	76.6	73.8	65.8	49.1	32.9	30.1	27	25.4	22.6	-	-	20	33	13	-	-	-	-	-	-	-	-	-
SWTP-3	7-125-1	3.0'	Brown Silty sand with gravel	-	100.0	87.1	82.3	77.0	74.2	70.6	68.7	63.1	56.0	48.5	45.4	38.0	30.1	24.0	-	-	30	39	9	-	-	-	-	-	-	-	-	-
SWTP-3	7-125-28	9.0'	Brown Silty sand with gravel	-	-	-	100.0	97.2	91.2	82.0	78.4	64.4	47.3	34.2	30.6	23.5	18.4	14.2	-	-	29	48	19	-	-	-	-	-	-	-	-	-
SWTP-4	7-125-30	8.0'	Brown Silty gravel with sand	-	100.0	89.9	89.9	75.8	68.1	60.6	56.6	46.2	32.9	24.5	21.9	18.5	16.2	13.8	-	-	30	38	8	-	-	-	-	-	-	-	-	-
SWTP-4	7-125-29	3.0'	Brown Poorly graded sand/ silt & gravel	-	-	-	100.0	63.6	88.2	82.9	78.6	68.2	47.6	59.6	24.4	17.9	14.4	11.6	-	-	NP	NP	NP	-	-	-	-	-	-	-	-	-
SWTP-5	7-125-31	5.5'	Brown Clayey sand with gravel	-	-	-	100.0	96.8	96.0	88.3	85.7	82.4	77.3	72.1	69.8	63.3	54.3	43.0	-	-	20	30	10	-	-	-	-	-	-	-	-	-
SWTP-6	7-125-2	8.0'	Brown Clayey gravel with sand	100.0	96.9	88.8	81.1	67.9	60.8	53.5	51.1	47.7	42.8	37.3	35.3	31.6	28.5	25.0	-	-	20	30	10	-	-	-	-	-	-	-	-	-
SWTP-7	7-125-32	10.0'	Brown Clayey sand with gravel	-	100.0	92.0	88.8	87.1	86.4	83.9	81.1	75.2	62.7	44.3	38.7	30.1	24.7	21.0	-	-	21	30	9	-	-	-	-	-	-	-	-	-
SWTP-8	7-125-3	3.5'	Dark Brown lean clay with gravel	-	-	100.0	99.1	97.8	95.8	91.1	89.6	85.6	84.3	82.9	82.2	80.7	79.0	76.3	-	-	16	29	13	-	-	-	-	-	-	-	-	-
SWTP-8	7-125-33	12.0'	Brown Silty Clayey gravel with sand	-	100.0	93.3	93.3	94.1	79.4	68.7	63.7	53.6	45.4	38.7	36.6	32.5	29.3	25.3	-	-	18	24	6	-	-	-	-	-	-	-	-	-
SWTP-8	7-125-34	3.5'	Brown Silty gravel with sand	-	-	100.0	85.5	85.5	79.9	71.0	59.3	53.1	47.9	42.7	40.6	36.2	32.0	27.3	-	-	NP	NP	NP	59.5	-	-	-	-	-	-	-	-
SWTP-10	7-125-35	10.0'	Brown Clayey sand with gravel	-	-	100.0	97.3	94.0	87.5	78.5	73.7	62.7	52.7	44.6	41.4	36.1	32.5	28.7	-	-	16	28	12	-	-	-	-	-	-	-	-	-
SWTP-12	7-125-36	8.0'	Brown Clayey sand with gravel	-	-	100.0	96.1	93.7	89.8	85.9	83.5	69.2	58.0	50.1	47.2	42.8	39.8	36.7	-	-	21	41	20	-	-	-	-	-	-	-	-	-
SWTP-15	7-125-4	4.5'	Brown Clayey gravel with sand	-	100.0	89.9	85.4	76.6	71.4	64.8	60.8	55.1	44.0	34.0	30.4	24.9	21.2	17.7	-	-	19	30	11	-	-	-	-	-	-	-	-	-
SWTP-17	7-125-37	9.0'	Brown Clayey gravel with sand	-	-	100.0	85.3	78.9	74.1	63.3	58.2	47.0	34.6	25.7	23.1	18.4	15.4	13.3	-	-	15	24	9	-	-	-	-	-	-	-	-	-
SWTP-18	7-125-5	4.0'	Brown Clayey gravel with sand	-	100.0	89.4	82.0	74.7	70.1	62.7	58.2	46.8	39.5	31.6	28.7	23.5	19.4	16.6	-	-	18	26	8	-	-	-	-	-	-	-	-	-
SWTP-23	7-125-38	3.0'	Brown Clayey gravel with sand	-	100.0	92.5	77.8	67.3	62.8	57.8	55.2	46.5	37.8	30.7	28.3	23.5	19.5	16.2	-	-	18	26	8	-	-	-	-	-	-	-	-	-
SWTP-25	7-125-39	6.0'	Brown Silty, Clayey sand with gravel	-	100.0	86.3	84.4	82.4	80.0	75.9	74.8	63.1	51.3	41.3	37.9	31.7	27.0	23.1	-	-	18	25	7	-	-	-	-	-	-	-	-	-
SWTP-27	7-125-6	4.0'	Brown Clayey gravel with sand	-	100.0	91.1	86.6	80.0	73.1	61.8	54.2	45.7	26.6	31.0	29.0	25.9	24.0	21.7	-	-	18	29	11	-	-	-	-	-	-	-	-	-
SWTP-27	7-125-40	11.0'	Brown Clayey sand with gravel	-	100.0	90.7	82.5	79.3	78.1	76.2	75.3	67.4	59.3	50.8	47.6	41.1	36.6	31.7	-	-	16	27	11	-	-	-	-	-	-	-	-	-
SWTP-28	7-125-41	6.5'	Brown Clayey sand with sand	-	100.0	95.2	95.2	88.9	86.3	78.9	75.4	62.4	50.6	41.1	37.9	33.2	30.0	26.1	-	-	20	31	11	-	-	-	-	-	-	-	-	-
SWTP-29	7-125-42	4.0'	Brown Silty, Clayey sand with gravel	-	100.0	92.2	83.1	79.2	75.4	69.4	64.5	58.7	48.0	37.7	33.3	26.4	21.7	16.3	-	-	18	22	4	-	-	-	-	-	-	-	-	-
SWTP-30	7-125-43	6.0'	Brown Silty sand with gravel	-	-	100.0	93.8	87.5	81.8	75.1	72.3	69.5	61.3	47.7	43.4	33.8	24.3	17.7	-	-	NP	NP	NP	-	-	-	-	-	-	-	-	-
SWTP-35	7-125-44	3.5'	Brown Clayey sand with gravel	-	-	100.0	91.6	83.7	77.9	68.9	64.9	59.2	50.4	42.4	39.8	34.6	29.9	25.0	-	-	20	31	11	-	-	-	-	-	-	-	-	-
SWTP-36	7-125-7	4.0'	Brown Clayey gravel with sand	-	100.0	99.1	96.1	91.3	87.0	81.8	78.8	61.7	53.9	47.1	44.5	38.9	33.5	28.7	-	-	14	36	22	-	-	-	-	-	-	-	-	-
SWTP-47	7-125-8	3.0'	Brown Clayey gravel with sand	100.0	96.6	88.0	81.6	74.5	70.5	65.6	64.0	55.0	50.1	45.3	43.3	39.0	34.9	30.5	-	-	16	39	23	-	-	-	-	-	-	-	-	-
SWTP-48	7-125-45	5.0'	Brown Clayey gravel with sand	-	100.0	90.4	78.5	65.4	62.7	57.6	54.1	49.2	43.1	37.9	36.2	32.8	29.0	23.7	-	-	13	37	24	-	-	-	-	-	-	-	-	-
SWTP-53	7-125-46	6.0'	Brown Clayey sand with gravel	-	-	-	100.0	97.9	95.1	89.2	86.2	78.0	68.4	57.8	53.9	45.8	38.0	31.5	-	-	15	23	8	-	-	-	-	-	-	-	-	-
SWTP-56	7-125-47	6.0'	Brown Clayey gravel with sand	-	-	100.0	88.0	83.1	73.8	64.7	62.2	55.7	48.8	42.4	40.0	35.7	32.1	27.1	-	-	19	29	10	-	-	-	-	-	-	-	-	-
SWTP-65	7-125-48	4.5'	Brown Clayey sand with gravel	-	-	100.0	97.8	94.1	90.2	83.4	78.7	71.4	61.4	53.8	50.8	44.9	39.5	32.7	-	-	17	25	8	-	-	-	-	-	-	-	-	-
SWTP-68	7-125-49	8.0'	Brown Clayey sand with gravel	-	-	-	100.0	94.9	87.7	83.6	79.2	71.5	63.9	57.3	54.5	49.6	45.3	39.7	-	-	18	35	17	-	-	-	-	-	-	-	-	-
Bull Hill Area Geotechnical Samples																																
SWTP-70	7-125-9	5.0'	Brown Clayey sand with gravel	-	100.0	98.5	98.5	96.3	95.9	94.5	93.1	75.4	62.2	54.6	51.6	46.4	42.3	39.5	-	-	23	36	13	-	110.2	17.9	104.7	18.3	95	1.9E-06	4.0E-07	-
SWTP-71	7-125-50	2.0'	Brown Silty clayey sand with gravel	-	-	-	100.0	96.6	95.4	92.4	88.5	81.2	67.0	55.9	52.3	46.9	43.2	37.3	-	-	18	24	6	-	-	-	115.5	14.5	95	2.2E-07	-	-
SWTP-75	7-125-51	4.0'	Brown Clayey sand with gravel	-	-	-	100.0	95.9	93.9	85.9	82.3	78.1	69.9	61.3	58.3	52.0	46.5	41.1	-	-	18	26	8	-	-	-	114.2	14.6	95	1.5E-07	-	-
SWTP-78	7-125-10	4.0'	Brown Sandy fat clay	-	100.0	97.5	94.1	91.9	90.5	88.0	86.8	86.4	79.9	76.5	75.0	72.3	70.2	67.6	-	-	15	56	41	-	-	-	-	-	-	-	-	-
SWTP-79	7-125-52	8.0'	Brown Clayey gravel with sand	-	100.0	90.6	81.5	76.3	74.7	72.9	71.6	67.5	61.8	56.6	54.9	51.2	47.3	43.3	-	-	17	40	23	-	-	-	-	-	-	-	-	-
SWTP-85	7-125-11	7.0'	Brown Clayey gravel with sand	-	-	100.0	98.5	95.4	86.2	78.0	66.0	60.0	58.2	54.7	52.5	47.0	41.9	38.4	-	-	21	29	8	-	118.8	13.7	112.9	14.7	95	7.2E-07	-	-
SWTP-85	7-125-53	21.0'	Brown Clayey gravel with sand	-	100.0	95.0	81.8	78.3	76.7	72.6	70.2	65.8	58.8	52.7	50.5	45.7	41.3	37.0	-	-	18	32	14	-	-	-	-	-	-	-	-	-
SWTP-86	7-125-54	7.0'	Brown Clayey sand with gravel	-	100.0	96.3	93.9	86.5	83.2	77.4	73.5	66.5	57.1	51.0	47.8	41.9	37.1	30.2	-	-	19	27	8	-	-	-	-	-	-	-	-	-
SWTP-87	7-125-55	10.0'	Brown Silty sand	-	-	-	100.0	95.9	92.7	91.2	88.7	88.1	83.7	63.2	56.5	43.1	32.8	27.1	-	-	27	40	13	-	-	-	105.6	16	95	1.6E-06	6.4E-07	-
SWTP-88	7-125-12	4.0'	Brown Sandy silt	-	-	-	-	-	100.0	99.8	99.5	98.3	96.6	93.6	92.0	88.1	79.1	59.5	-	-	NP	NP	NP	-	-	-	-	-	-	-	-	-
SWTP-88	7-125-56	10.0'	Brown Silty gravel with sand	-	-	100.0	87.2	74.3	71.3	64.9	63.0	59.9	54.0	47.6	45.2	40.9	37	32.4	-	-	16	25	9	-	-	-	-	-	-	-	-	-
SWTP-89	7-125-57	4.0'	Brown Lean clay	-	-	-	-	-	-	-	-	-	-	-	100	99.9	99.5	97.9	-	-	23	35	12	-	-	-	-	-	-	-	-	-
SWTP-91	7-125-13	5.0'	Brown Silty sand with gravel	-	100.0	99.1	97.3	93.0	91.7	88.4	76.1	59.2	47.2	40.4	37.1	30.3	23.1	18.1	-	-	26	32	6	-	-	-	-	-	-	-	-	-
SWTP-94	7-125-14	8.0'	Brown Clayey sand with gravel	-	100.0	97.7	97.0	94.4	90.2	84.9	82.2	76.1	67.0	58.0	55.1	48.0	38.9	31.0	24.6	-	18	45	27	-	119	13.9	113.59	13.9	95	2.4E-07	-	-
SWTP-96	7-125-58	10.0'	Brown Clayey sand with gravel	-	-	100.0	91.3	88.1	85.8	83.7	81.6	77.0	70.3	63.1	60.2	54.3	47.3	40.5	-	-	14	35	22	-	-	-	-	-	-	-	-	-
SWTP-98	7-125-15	3.0'	Brown Clayey sand with gravel	-	100.0	98.4	96.0	91.7	88.3	81.3	76.8	67.3	56.1	46.5	43.5	38.4	34.1	27.2	9.7	2.580	21	29	8	-	124	11	118.45	11.0	95	1.0E-05	3.3E-06	-
SWTP-99	7-125-16	12.0'	Brown Sandy lean clay with gravel	100.0	92.7	91.0	89.6	84.8	81.4	78.5	76.8	70.8	65.0	60.8	59.5	55.8	51.5	47.0	23.9	2.645	21	45	24	-	111.4	15.6	105.79	15.6	95	1.2E-05	2.4E-07	-
SWTP-103	7-125-17	14.0'	Brown Clayey Sand	-	-	-	-	-	100.0	99.7	99.4	87.7	76.2	66.2	62.4	52.8	37.3	23.2	13.7	2.657	25	40	15	-	110.9	16.9	105.54	16.9	95	3.7E-06	2.3E-06	-
SWTP-107	7-125-59	9.0'	Brown Clayey sand with gravel	-	-	100.0	98.3	94.1	90.6	85.5	81.3	74.3	61.1	46.6	42.1	33.6	27.3	22.3	-	-	18	26	8	-	-	-	-	-	-	-	-	-
SWTP-107	7-125-60	15.0'	Brown Poorly graded gravel	100.0	74.6	69.3	21.3	12.8	10.5	8.7	8.3	6.3	4.9	3.7	3.2	2.4	1.8	1.3	-	-	14	23	9	-	-	-	-	-	-	-	-	-
SWTP-113	7-125-18	8.0'	Brown Clayey sand with gravel	-	100.0	95.0	92.5	88.1	86.3	82.4	80.6	74.4	66.6	59.6	56.7	50.2	42.4	35.4	17.8	-	17	36	19	-	121.1	13.6	115.42	13.6	95	2.1E-08	1.1E-08	-
SWTP-118	7-125-19	0.0'-10.0'	Brown Clayey gravel with sand	-	-	97.1	95.4	88.3	83.0	74.6	69.2	58.5	45.5	36.3	33.1	26.9	22.1	18.5	-	-	18	29	11	-	-	-	-	-	-	-	-	-
SWTP-119	7-125-20	0.0'-10.0'	Brown Clayey gravel with sand	-	100.0	94.3	92.7	87.0	82.0	73.0	67.3	45.2	31.5	24.1	21.8	17.9	14.9	12.3	-	-	19	35	16	-	-	-	-	-	-	-	-	-
SWTP-120	7-125-21	0.0'-10.0'	Brown Clayey gravel with sand	-	100.0	98.1	95.1	89.2	82.6	72.3	64.7	44.7	35.6	28.1	25.2	20.7	17.4	14.6	-	-	18	34	16	-	-	-	-	-	-	-	-	-
SWTP-121	7-125-22	0.0'-6.0'	Brown Poorly graded sand/ silt & gravel	-	100.0	95.3	91.4	80.5	68.7	53.3	44.9	35.5	26.7	19.7	17.5	14.3	12.0	10.3	-	-	19	35	16	-	-	-	-	-	-	-	-	-
SWTP-122	7-125-23	0.0'-10.0'	Brown Silty gravel with sand	-	-	100.0	97.4	90.8	84.6	74.5	66.9	44.6	36.3	28.3	25.6	20.6	16.9	14.2	-	-	20	13	33	-	-	-	-	-	-	-	-	-
SWTP-123	7-125-24	0.0'-10.0'	Brown Poorly graded sand/ silt & gravel	-	100.0	96.9	90.3	80.0	72.4	62.2	55.2	36.3	27.3	20.0	17.8	14.2	11.5	9.5	-	-	20	40	20	-	-	-	-	-	-	-	-	-
N.Mine Stpl	7-125-26	N/A	Brown Clayey gravel with sand	-	-	100.0	96.9	88.2	82.1	74.4	70.4	63.9	54.0	43.4	39.6	34.1	30.6	28.0	-	-	15	34	19	-	129.8	10.5	122.4	10.5	95	2.7E-06	1.9E-07	-
S.Mine Stpl	7-125-25	N/A	Brown Clayey gravel with sand	-	100.0	98.0	94.9	87.6	83.4	78.7	76.3	66.7	59.1	50.8	47.7	41.9	37.2	33.6	-	-	17	30	13	-	126	10.5	119.3	11.2	95	6.9E-05	3.9E-05	2.8E-05

FLSMIDTH

CALCULATION COVER SHEET

JOB NUMBER	CLIENT	PROJECT	CALC. NUMBER
11021	CC&V	High Grade Ore	C-005b

TITLE/SUBJECT:

Mill Mat Foundation Design

STATEMENT OF PROBLEM:

Design Mat foundation for Ball and Rod Mill and Primary Sump.

P.E. SEAL

COLORADO LICENSED
EDWARD CARTER SUMMERS
45828
7-16-12
PROFESSIONAL ENGINEER

SOURCES OF DATA, FORMULA & REFERENCES:

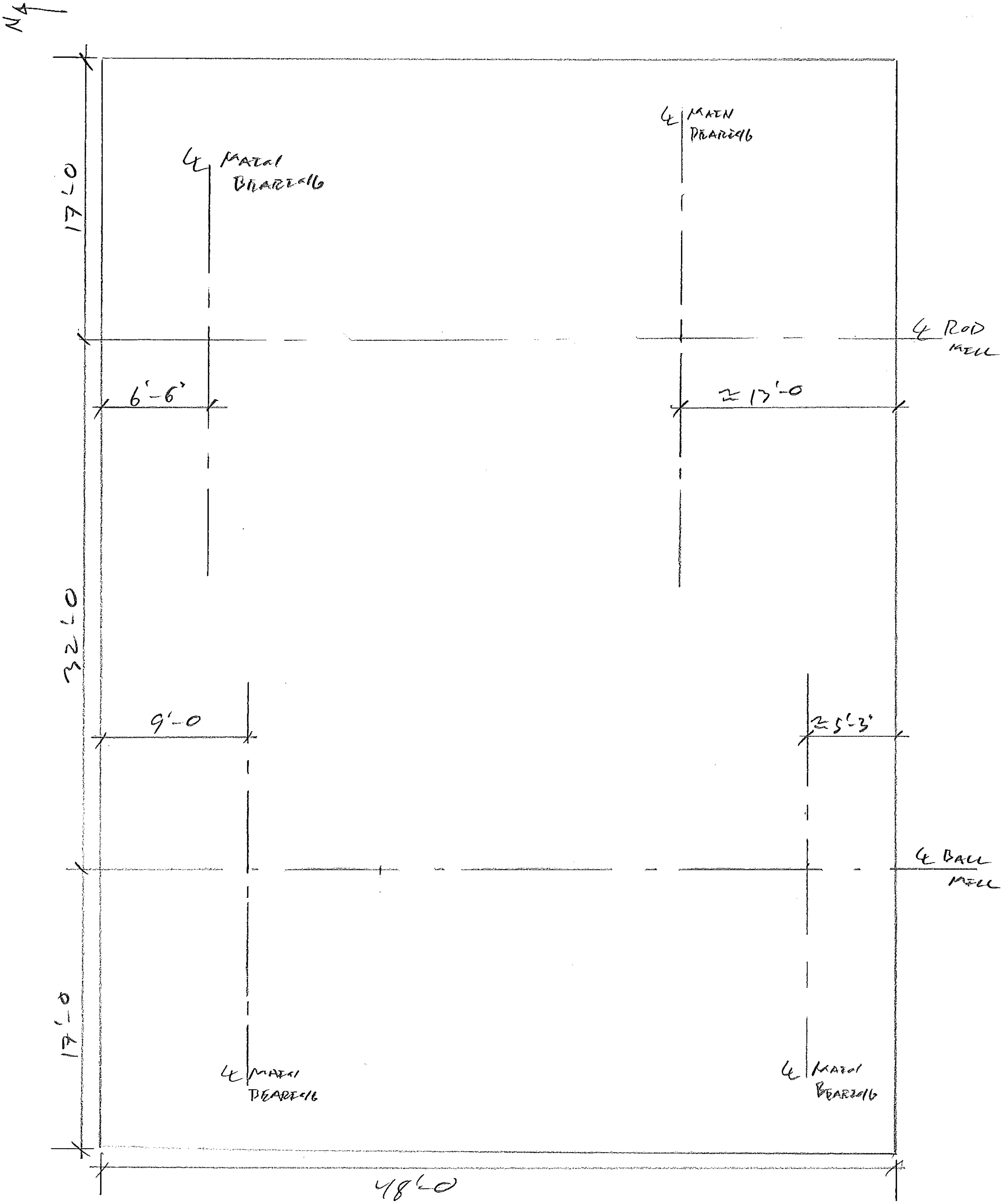
Autodesk Robot Structural Analysis 2012
Dyna6 Simulation
IBC 2009
ACI 318-08
ASCE 7-05
AMEC Mill Foundation Recommendations letter dated February 29, 2012

CONCLUSIONS & RECOMMENDATIONS:

See details in report

REV	DATE	DESCRIPTION/STATUS	CALC BY	CHKD BY	DWG./SPECS REVISED	QA REVIEW
A	6/5/2012	Ready for Check	ECS	WC		
0	7/16/2012	Issued for Permit	ECS	WC		

FLSmidth	PROJECT: CCEV HIGH GRADE ORE	PROJ NO. 11021	
		CALC NO. C-005	
	SUBJECT: MILL MAT FOUNDATION	BY ECS	DATE 11-3-11
		CHK	DATE
		SHEET OF	REV



ROD MILL

Foundation Center of Gravity

Using CL Main Gear & CL Rod Mill as Axis Origin

γ = 150 pcf

	Pedestal Dimensions			Weight	Center of Gravity			
Pedestal	**L_x (ft)**	**L_y (ft)**	**H (ft)**	**F (kip)**	**X (ft)**	**Y (ft)**	**F*X (k*ft)**	**F*Y (k*ft)**
A	4.0	9.5	19.7	112.4	0.8	0.0	84.3	0.0
B	4.0	9.5	19.7	112.4	-29.3	0.0	-3289.4	0.0
$(C/D)_1$	4.0	2.7	19.7	31.6	0.8	6.1	23.7	191.9
$(C/D)_2$	1.2	1.3	19.7	4.5	-2.4	6.5	-10.7	28.9
$(C/D)_3$	5.2	6.1	19.7	92.9	0.2	10.5	15.6	971.6
$(C/D)_4$	3.3	1.6	19.7	15.6	-4.1	12.5	-63.7	195.8
$(C/D)_5$	1.5	6.1	19.7	27.0	-6.5	10.5	-175.4	282.3
$(C/D)_6$	3.3	4.5	16.6	37.2	-4.1	9.7	-152.1	360.0
E_1	3.9	6.1	18.1	64.3	-9.2	10.3	-591.3	664.3
E_2	3.6	6.9	19.1	71.1	-12.9	10.7	-919.4	763.9
F	9.1	5.0	18.8	128.2	-19.3	11.8	-2472.6	1517.5
G	4.5	5.0	19.4	65.5	-26.1	11.8	-1707.4	774.6
H	2.5	2.5	19.9	18.7	-4.1	-11.9	-76.2	-222.6
J	3.0	4.0	13.8	24.9	-9.1	0.0	-227.0	0.0
K	5.5	9.5	13.8	108.3	-25.3	0.0	-2735.1	0.0
			Resultants	**914.4**	**-13.4**	**6.0**	**-12296.7**	**5528.3**

Equipment Center of Gravity

Using CL Main Gear & CL Rod Mill as Axis Origin

	Weight	Center of Gravity			
Location	**F (kip)**	**X (ft)**	**Y (ft)**	**F*X (k*ft)**	**F*Y (k*ft)**
A	493.0	0.0	0.0	0.0	0.0
B	462.0	-28.5	0.0	-13174.2	0.0
C	3.4	-1.7	10.3	-5.8	34.9
D	6.1	-6.4	10.3	-39.3	62.7
E	6.4	-12.9	10.7	-83.2	69.1
F	17.0	-19.3	11.8	-327.8	201.2
G	2.2	-26.0	11.8	-55.9	25.4
H_1	8.8	-3.9	12.5	-34.5	110.0
H_2	8.8	-3.9	-11.9	-34.5	-105.0
Resultants	**1007.7**	**-13.7**	**0.4**	**-13755.2**	**398.3**

BALL MILL

Foundation Center of Gravity

Using CL Main Gear & CL Ball Mill as Axis Origin

γ = 150 pcf

	Pedestal Dimensions			Weight	Center of Gravity			
Pedestal	**L_x (ft)**	**L_y (ft)**	**H (ft)**	**F (kip)**	**X (ft)**	**Y (ft)**	**F*X (k*ft)**	**F*Y (k*ft)**
A	4.5	9.5	19.7	126.5	1.0	0.0	126.5	0.0
B	4.5	9.5	19.7	126.4	-34.8	0.0	-4396.0	0.0
$(C/D)_1$	4.5	10.2	19.7	135.2	1.0	-9.8	135.2	-1328.6
$(C/D)_2$	1.5	3.7	19.7	17.1	-1.8	-7.2	-30.1	-123.6
$(C/D)_3$	1.5	6.4	19.7	29.3	-2.0	-11.7	-59.2	-342.5
$(C/D)_4$	2.7	1.8	19.7	14.5	-4.1	-14.0	-59.4	-202.3
$(C/D)_5$	1.7	6.4	19.7	31.6	-6.3	-11.7	-198.5	-370.0
$(C/D)_6$	2.7	4.6	16.6	30.3	-4.1	-10.8	-124.7	-327.2
E_1	4.9	6.4	18.1	84.7	-9.5	-11.7	-807.9	-990.5
E_2	3.0	6.9	19.1	59.2	-13.5	-12.1	-797.4	-713.4
E_3	1.8	5.0	19.1	26.3	-15.9	-13.6	-417.6	-357.0
F/G	15.6	5.0	18.8	219.5	-24.6	-13.6	-5399.6	-2981.6
H	2.5	2.5	19.9	18.7	-4.1	13.3	-76.6	247.1
J	3.0	4.0	13.8	24.9	-9.0	0.0	-224.2	0.0
K	5.5	9.5	13.8	108.3	-30.8	0.0	-3330.6	0.0
			Resultants	**1052.3**	**-14.9**	**-7.1**	**-15660.2**	**-7489.5**

Equipment Center of Gravity

Using CL Main Gear & CL Rod Mill as Axis Origin

	Weight	Center of Gravity			
Location	**F (kip)**	**X (ft)**	**Y (ft)**	**F*X (k*ft)**	**F*Y (k*ft)**
A	537.0	0.0	0.0	0.0	0.0
B	497.0	-33.8	0.0	-16781.6	0.0
C	4.5	-2.0	-11.7	-9.1	-52.6
D	8.6	-6.3	-11.7	-54.0	-100.6
E	13.0	-13.5	-12.1	-175.2	-156.7
F	31.0	-20.9	-13.6	-646.5	-421.1
G	3.0	-29.4	-13.6	-88.3	-40.8
H_1	8.8	-4.1	13.3	-36.2	116.6
H_2	8.8	-4.1	-14.0	-36.2	-123.1
Resultants	**1111.7**	**-16.0**	**-0.7**	**-17826.9**	**-778.3**

Sump

Foundation Center of Gravity

Using CL Sump & CL Sump as Axis Origin

γ = 150 pcf

	Dimensions			Weight	Center of Gravity			
Item	**L_x (ft)**	**L_y (ft)**	**H (ft)**	**F (kip)**	**X (ft)**	**Y (ft)**	**F*X (k*ft)**	**F*Y (k*ft)**
Wall 1	19.0	1.0	12.75	36.3	0.0	8.0	0.0	290.7
Wall 2	19.0	1.0	12.75	36.3	0.0	-8.0	0.0	-290.7
Wall 3	1.0	16.0	12.00	28.8	9.5	0.0	273.6	0.0
Wall 4	1.0	16.0	12.75	30.6	-9.5	0.0	-290.7	0.0
Foundation	13.5	18.0	3.25	118.5	-3.8	0.0	-444.2	0.0
			Resultants	**250.5**	**-1.8**	**0.0**	**-461.3**	**0.0**

COMBINED CENTER OF GRAVITY

Translation Vector

	X (ft)	Y (ft)
Rod Mill	-11.0	-16.0
Ball Mill	-18.8	16.0
Sump	-27.0	3.3

Foundation Center of Gravity

Using CL Mat & CL Mat as Axis Origin

γ = 150 pcf

	Weight	**Center of Gravity**			
	F (kip)	**X (ft)**	**Y (ft)**	**F*X (k*ft)**	**F*Y (k*ft)**
Rod Mill	914.4	2.4	-22.0	2238.6	-20158.2
Ball Mill	1052.3	14.9	7.1	15660.2	7489.5
Mat	1900.8	0.0	0.0	0.0	0.0
Sump	250.5	-25.2	3.3	-6303.2	814.2
Resultants	**4118.0**	**2.8**	**-2.9**	**11595.6**	**-11854.5**

Equipment Center of Gravity

Using CL Mat & CL Mat as Axis Origin

	Weight	**Center of Gravity**			
Location	**F (kip)**	**X (ft)**	**Y (ft)**	**F*X (k*ft)**	**F*Y (k*ft)**
Rod Mill	1007.7	2.7	-16.4	2670.8	-16521.2
Ball Mill	1111.7	-2.7	16.7	-3039.7	18565.5
Resultants	**2119.4**	**-0.2**	**1.0**	**-368.9**	**2044.3**

Foundation Mass/ Rod Mill Mass Ratio = 4.09
Foundation Mass/ Ball Mill Mass Ratio = 3.70

FLSmidth	PROJECT	CC&V High Grade Ore	PROJ NO.	11021	
			CALC NO.	C-005	
	SCOPE	~~Ball~~ Mill Foundation	BY ECS	DATE	16-Jul-12
			CHK	DATE	
			SHEET	OF	REV

Using Corner Mat as Axis Origin

DYNA 6.0
INPUT DATA

Translation Vector

	X (ft)	Y (ft)
Rod Mill	-35.0	-49.0
Ball Mill	-42.8	-17.0
Sump	49.5	21.25

Pedestal Mass Input

	Item	Corner X (ft)	Corner Y (ft)	Corner Z (ft)	Length X (ft)	Width Y (ft)	Height Z (ft)	Density (Slug/ft^3)
Rod Mill	A	33.75	44.25	4.00	4.00	9.50	19.72	4.66
	B	3.73	44.25	4.00	4.00	9.50	19.72	4.66
	(C/D)1	33.75	53.75	4.00	4.00	2.67	19.72	4.66
	(C/D)2	32.03	54.83	4.00	1.17	1.29	19.72	4.66
	(C/D)3	32.59	56.42	4.00	5.16	6.08	19.72	4.66
	(C/D)4	29.25	60.75	4.00	3.33	1.58	19.72	4.66
	(C/D)5	27.75	56.42	4.00	1.50	6.08	19.72	4.66
	(C/D)6	29.25	56.42	4.00	3.33	4.50	16.55	4.66
	E1	23.85	56.29	4.00	3.90	6.08	18.08	4.66
	E2	20.27	56.29	4.00	3.58	6.92	19.11	4.66
	F	11.17	58.33	4.00	9.10	5.00	18.78	4.66
	G	6.67	58.33	4.00	4.50	5.00	19.40	4.66
	H	29.67	35.82	4.00	2.50	2.50	19.90	4.66
	J	24.37	47.00	4.00	3.00	4.00	13.81	4.66
	K	6.98	44.25	4.00	5.50	9.50	13.81	4.66
Ball Mill	A	41.52	12.25	4.00	4.50	9.50	19.72	4.66
	B	5.75	12.25	4.00	4.50	9.50	19.72	4.66
	(C/D)1	41.52	2.09	4.00	4.50	10.16	19.72	4.66
	(C/D)2	40.23	7.89	4.00	1.54	3.74	19.72	4.66
	(C/D)3	39.98	2.09	4.00	1.54	6.42	19.72	4.66
	(C/D)4	37.33	2.09	4.00	2.67	1.83	19.72	4.66
	(C/D)5	35.66	2.09	4.00	1.67	6.42	19.72	4.66
	(C/D)6	37.33	3.93	4.00	2.67	4.58	16.55	4.66
	E1	30.80	2.09	4.00	4.86	6.42	18.08	4.66
	E2	27.80	1.51	4.00	3.00	6.88	19.11	4.66
	E3	25.96	0.92	4.00	1.83	5.00	19.11	4.66
	F/G	10.38	0.92	4.00	15.58	5.00	18.78	4.66
	H	37.41	29.00	4.00	2.50	2.50	19.90	4.66
	J	32.25	15.00	4.00	3.00	4.00	13.81	4.66
	K	9.25	12.25	4.00	5.50	9.50	13.81	4.66
Sump	Wall 1	40.50	36.75	3.25	19.00	1.00	12.75	4.66
	Wall 2	40.50	21.75	3.25	19.00	1.00	12.75	4.66
	Wall 3	59.50	21.75	3.25	1.00	16.00	12.75	4.66
	Wall 4	40.50	21.75	4.00	1.00	16.00	2.00	4.66
	Foundation	48.00	20.75	0.00	13.50	18.00	3.25	4.66
	Mat	0.00	0.00	0.00	48.00	66.00	4.00	4.66

Equipment Dynamic Forces - Case 1 (Mill Frequency)

	Item	X (ft)	Y (ft)	Z (ft)	Fx (slug)	Fy (slug)	Fz (slug)
Rod Mill	A	35.0	49.0	23.7	234.7	984.5	-785.7
	B	6.5	49.0	23.7	0.0	1382.0	1031.1
	C	33.3	59.3	23.7	0.0	-857.1	962.7
	D	28.6	59.3	23.7	-234.7	-798.1	-962.7
	E	22.1	59.7	23.1	0.0	0.0	0.0
	F	15.7	60.8	22.8	0.0	0.0	0.0
	G	9.0	60.8	23.4	0.0	0.0	0.0
Ball Mill	A	42.8	17.0	23.7	493.1	1031.1	-1077.6
	B	9.0	17.0	23.7	0.0	1826.1	1397.5
	C	40.7	5.3	23.7	0.0	-944.1	-1267.1
	D	36.5	5.3	23.7	-493.1	-1102.5	-1229.8
	E	29.3	4.9	23.1	0.0	0.0	0.0
	F	21.9	3.4	22.8	0.0	0.0	0.0
	G	13.3	3.4	22.8	0.0	0.0	0.0

Equipment Dynamic Forces - Case 2 (Motor Frequency)

	Item	X (ft)	Y (ft)	Z (ft)	Fx (slug)	Fy (slug)	Fz (slug)
Rod Mill	A	35.0	49.0	23.7	0.0	0.0	0.0
	B	6.5	49.0	23.7	0.0	0.0	0.0
	C	33.3	59.3	23.7	0.0	0.0	0.0
	D	28.6	59.3	23.7	0.0	0.0	0.0
	E	22.1	59.7	23.1	0.0	0.0	0.0
	F	15.7	60.8	22.8	0.0	0.0	109.5
	G	9.0	60.8	23.4	0.0	0.0	40.4
Ball Mill	A	42.8	17.0	23.7	0.0	0.0	0.0
	B	9.0	17.0	23.7	0.0	0.0	0.0
	C	40.7	5.3	23.7	0.0	0.0	0.0
	D	36.5	5.3	23.7	0.0	0.0	0.0
	E	29.3	4.9	23.1	0.0	0.0	1054.3
	F	21.9	3.4	22.8	0.0	0.0	486.0
	G	13.3	3.4	22.8	0.0	0.0	0.0

Equipment Masses

	Item	X (ft)	Y (ft)	Z (ft)	Fx (slug)	Fy (slug)	Fz (slug)
Rod Mill	A	35.0	49.0	23.72	0	0	15311
	B	6.5	49.0	23.72	0	0	14348
	C	33.3	59.3	23.72	0	0	106
	D	28.6	59.3	23.72	0	0	189
	E	22.1	59.7	23.11	0	0	200
	F	15.7	60.8	22.78	0	0	528
	G	9.0	60.8	23.40	0	0	67
Ball Mill	A	42.8	17.0	23.72	0	0	16677
	B	9.0	17.0	23.72	0	0	15435
	C	40.7	5.3	23.72	0	0	140
	D	36.5	5.3	23.72	0	0	267
	E	29.3	4.9	23.11	0	0	404
	F	21.9	3.4	22.78	0	0	963
	G	13.3	3.4	22.78	0	0	93

OUTPUT - CASE 1 (MILL VIBRATION)

```
*************************************************
*                                               *
*       D Y N A 6   S I M U L A T I O N         *
*                                               *
*         Copyright (c) Western - 2011          *
*            RUN DATE -  2012/ 7/10             *
*            TIME     -     15: 2:40            *
*            REVISION -  Jan.21/201             *
*                                               *
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Mill Mat Foundation

DATA ECHO
****

GRAVITATIONAL CONSTANT SET TO 32.20 ft/s**2
****

FREQUENCY UNITS : RPM
****

LENGTH UNITS : ft
****

FORCE UNITS : lb
****

MASS UNITS : slug
****

RESPONSE TO BE PLOTTED
****

STIFFNESS AND DAMPING CONSTANTS TO BE PRINTED
****

DAMPING SAFETY FACTOR -   2.00
****

FOUNDATION TYPE - HALF-SPACE
****

RECTANGULAR FOUNDATION -   48.000 ft BY 66.000 ft
****

MASS CONSTANTS
****

```
TOTAL MASS OF FOOTING  ......... 1.9265E+05  slug
MASS MOMENT ABOUT X-AXIS  ...... 9.0643E+07  slug.ft**2
MASS MOMENT ABOUT Y-AXIS  ...... 6.0555E+07  slug.ft**2
MASS MOMENT ABOUT Z-AXIS  ...... 1.1716E+08  slug.ft**2
CROSS PRODUCT X-Y  .............-7.8857E+06  slug.ft**2
CROSS PRODUCT X-Z  .............-1.3754E+06  slug.ft**2
CROSS PRODUCT Y-Z  .............-5.4366E+05  slug.ft**2
```

COORDINATES OF BASE CENTRE

****

X-COORD. OF BASE CENTRE REL. TO C.G. .. -1.448 ft
Y-COORD. OF BASE CENTRE REL. TO C.G. .. 1.134 ft
Z-COORD. OF BASE CENTRE REL. TO C.G. .. 11.007 ft

SOIL
****

SOIL CONSTANTS NUMBER OF SIDE LAYERS - 1
****

LAYER NO.	LAYER DEPTH ft	SHEAR WAVE VELOCITY ft/s	UNIT WEIGHT lb/ft**3	POISSON'S RATIO	MATERIAL DAMPING
1	6.000	1200.00	120.00	0.250	0.100

HALF-SPACE SOIL
****

SHEAR WAVE VELOCITY ft/s	UNIT WEIGHT lb/ft**3	POISSON'S RATIO	MATERIAL DAMPING
1.20E+03	120.00	0.250	0.100

HARMONIC LOAD (QUADRATIC)
****

MAXIMUM FREQUENCY .... 20.000 RPM
MINIMUM FREQUENCY .... 10.000 RPM
STEP FREQUENCY .... 1.000 RPM
FORCE IN X-DIRECTION .... 0.00E+00 slug.ft
FORCE IN Y-DIRECTION .... 1.52E+03 slug.ft
FORCE IN Z-DIRECTION .... -1.93E+03 slug.ft
MOMENT ABOUT X-AXIS .... 4.95E+04 slug.ft**2
MOMENT ABOUT Y-AXIS .... 9.71E+04 slug.ft**2
MOMENT ABOUT Z-AXIS .... -6.81E+04 slug.ft**2
♀

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*                                               *
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*                                               *
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*            REVISION -  Jan.21/201             *
*                                               *
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Mill Mat Foundation

RESULTS
****

FREQUENCY - 10.000 RPM
****

```
STIFFNESS CONSTANTS (K)
***********************

HORIZONTAL TRANSLATION  (X) ...  8.806E+08  lb/ft
HORIZONTAL TRANSLATION  (Y) ...  8.806E+08  lb/ft
VERTICAL TRANSLATION  (Z) .....  9.580E+08  lb/ft
ROTATION ABOUT  (X) ...........  1.027E+12  lb.ft/rad
ROTATION ABOUT  (Y) ...........  6.900E+11  lb.ft/rad
TORSION ABOUT  (Z) ............  1.415E+12  lb.ft/rad
CROSS-STIFFNESS (YZ PLANE) ....  9.386E+09  lb/rad
CROSS-STIFFNESS (XZ PLANE) .... -9.386E+09  lb/rad

DAMPING CONSTANTS (C)
*********************

HORIZONTAL TRANSLATION  (X) ...  5.358E+07  lb/ft/s
HORIZONTAL TRANSLATION  (Y) ...  5.358E+07  lb/ft/s
VERTICAL TRANSLATION  (Z) .....  5.997E+07  lb/ft/s
ROTATION ABOUT  (X) ...........  5.032E+10  lb.ft/rad/s
ROTATION ABOUT  (Y) ...........  3.417E+10  lb.ft/rad/s
TORSION ABOUT  (Z) ............  6.777E+10  lb.ft/rad/s
CROSS-DAMPING (YZ PLANE) ......  5.607E+08  lb/rad/s
CROSS-DAMPING (XZ PLANE) ...... -5.607E+08  lb/rad/s


FREQUENCY  -     11.000    RPM
*********


STIFFNESS CONSTANTS (K)
***********************

HORIZONTAL TRANSLATION  (X) ...  8.805E+08  lb/ft
HORIZONTAL TRANSLATION  (Y) ...  8.805E+08  lb/ft
VERTICAL TRANSLATION  (Z) .....  9.579E+08  lb/ft
ROTATION ABOUT  (X) ...........  1.027E+12  lb.ft/rad
ROTATION ABOUT  (Y) ...........  6.899E+11  lb.ft/rad
TORSION ABOUT  (Z) ............  1.415E+12  lb.ft/rad
CROSS-STIFFNESS (YZ PLANE) ....  9.385E+09  lb/rad
CROSS-STIFFNESS (XZ PLANE) .... -9.385E+09  lb/rad

DAMPING CONSTANTS (C)
*********************

HORIZONTAL TRANSLATION  (X) ...  4.976E+07  lb/ft/s
HORIZONTAL TRANSLATION  (Y) ...  4.976E+07  lb/ft/s
VERTICAL TRANSLATION  (Z) .....  5.580E+07  lb/ft/s
ROTATION ABOUT  (X) ...........  4.587E+10  lb.ft/rad/s
ROTATION ABOUT  (Y) ...........  3.118E+10  lb.ft/rad/s
TORSION ABOUT  (Z) ............  6.164E+10  lb.ft/rad/s
CROSS-DAMPING (YZ PLANE) ......  5.199E+08  lb/rad/s
CROSS-DAMPING (XZ PLANE) ...... -5.199E+08  lb/rad/s


FREQUENCY  -     12.000    RPM
*********


STIFFNESS CONSTANTS (K)
***********************
```

```
HORIZONTAL TRANSLATION  (X) ...  8.805E+08  lb/ft
HORIZONTAL TRANSLATION  (Y) ...  8.805E+08  lb/ft
VERTICAL TRANSLATION  (Z) .....  9.577E+08  lb/ft
ROTATION ABOUT  (X) ...........  1.027E+12  lb.ft/rad
ROTATION ABOUT  (Y) ...........  6.898E+11  lb.ft/rad
TORSION ABOUT  (Z) ............  1.415E+12  lb.ft/rad
CROSS-STIFFNESS (YZ PLANE) ....  9.384E+09  lb/rad
CROSS-STIFFNESS (XZ PLANE) .... -9.384E+09  lb/rad

DAMPING CONSTANTS (C)
*********************

HORIZONTAL TRANSLATION  (X) ...  4.657E+07  lb/ft/s
HORIZONTAL TRANSLATION  (Y) ...  4.657E+07  lb/ft/s
VERTICAL TRANSLATION  (Z) .....  5.234E+07  lb/ft/s
ROTATION ABOUT  (X) ...........  4.216E+10  lb.ft/rad/s
ROTATION ABOUT  (Y) ...........  2.869E+10  lb.ft/rad/s
TORSION ABOUT  (Z) ............  5.653E+10  lb.ft/rad/s
CROSS-DAMPING (YZ PLANE) ......  4.860E+08  lb/rad/s
CROSS-DAMPING (XZ PLANE) ...... -4.860E+08  lb/rad/s


FREQUENCY  -     13.000    RPM
*********


STIFFNESS CONSTANTS (K)
***********************

HORIZONTAL TRANSLATION  (X) ...  8.804E+08  lb/ft
HORIZONTAL TRANSLATION  (Y) ...  8.804E+08  lb/ft
VERTICAL TRANSLATION  (Z) .....  9.576E+08  lb/ft
ROTATION ABOUT  (X) ...........  1.027E+12  lb.ft/rad
ROTATION ABOUT  (Y) ...........  6.898E+11  lb.ft/rad
TORSION ABOUT  (Z) ............  1.415E+12  lb.ft/rad
CROSS-STIFFNESS (YZ PLANE) ....  9.383E+09  lb/rad
CROSS-STIFFNESS (XZ PLANE) .... -9.383E+09  lb/rad

DAMPING CONSTANTS (C)
*********************

HORIZONTAL TRANSLATION  (X) ...  4.387E+07  lb/ft/s
HORIZONTAL TRANSLATION  (Y) ...  4.387E+07  lb/ft/s
VERTICAL TRANSLATION  (Z) .....  4.940E+07  lb/ft/s
ROTATION ABOUT  (X) ...........  3.902E+10  lb.ft/rad/s
ROTATION ABOUT  (Y) ...........  2.658E+10  lb.ft/rad/s
TORSION ABOUT  (Z) ............  5.221E+10  lb.ft/rad/s
CROSS-DAMPING (YZ PLANE) ......  4.572E+08  lb/rad/s
CROSS-DAMPING (XZ PLANE) ...... -4.572E+08  lb/rad/s


FREQUENCY  -     14.000    RPM
*********


STIFFNESS CONSTANTS (K)
***********************

HORIZONTAL TRANSLATION  (X) ...  8.803E+08  lb/ft
HORIZONTAL TRANSLATION  (Y) ...  8.803E+08  lb/ft
VERTICAL TRANSLATION  (Z) .....  9.575E+08  lb/ft
ROTATION ABOUT  (X) ...........  1.027E+12  lb.ft/rad
ROTATION ABOUT  (Y) ...........  6.897E+11  lb.ft/rad
```

```
TORSION ABOUT  (Z) ............  1.415E+12  lb.ft/rad
CROSS-STIFFNESS (YZ PLANE) ....  9.383E+09  lb/rad
CROSS-STIFFNESS (XZ PLANE) .... -9.383E+09  lb/rad

DAMPING CONSTANTS (C)
*********************

HORIZONTAL TRANSLATION  (X) ...  4.156E+07  lb/ft/s
HORIZONTAL TRANSLATION  (Y) ...  4.156E+07  lb/ft/s
VERTICAL TRANSLATION  (Z) .....  4.688E+07  lb/ft/s
ROTATION ABOUT  (X) ...........  3.633E+10  lb.ft/rad/s
ROTATION ABOUT  (Y) ...........  2.477E+10  lb.ft/rad/s
TORSION ABOUT  (Z) ............  4.851E+10  lb.ft/rad/s
CROSS-DAMPING (YZ PLANE) ......  4.326E+08  lb/rad/s
CROSS-DAMPING (XZ PLANE) ...... -4.326E+08  lb/rad/s


FREQUENCY  -     15.000    RPM
*********


STIFFNESS CONSTANTS (K)
***********************

HORIZONTAL TRANSLATION  (X) ...  8.803E+08  lb/ft
HORIZONTAL TRANSLATION  (Y) ...  8.803E+08  lb/ft
VERTICAL TRANSLATION  (Z) .....  9.573E+08  lb/ft
ROTATION ABOUT  (X) ...........  1.027E+12  lb.ft/rad
ROTATION ABOUT  (Y) ...........  6.896E+11  lb.ft/rad
TORSION ABOUT  (Z) ............  1.414E+12  lb.ft/rad
CROSS-STIFFNESS (YZ PLANE) ....  9.382E+09  lb/rad
CROSS-STIFFNESS (XZ PLANE) .... -9.382E+09  lb/rad

DAMPING CONSTANTS (C)
*********************

HORIZONTAL TRANSLATION  (X) ...  3.955E+07  lb/ft/s
HORIZONTAL TRANSLATION  (Y) ...  3.955E+07  lb/ft/s
VERTICAL TRANSLATION  (Z) .....  4.470E+07  lb/ft/s
ROTATION ABOUT  (X) ...........  3.400E+10  lb.ft/rad/s
ROTATION ABOUT  (Y) ...........  2.321E+10  lb.ft/rad/s
TORSION ABOUT  (Z) ............  4.530E+10  lb.ft/rad/s
CROSS-DAMPING (YZ PLANE) ......  4.112E+08  lb/rad/s
CROSS-DAMPING (XZ PLANE) ...... -4.112E+08  lb/rad/s


FREQUENCY  -     16.000    RPM
*********


STIFFNESS CONSTANTS (K)
***********************

HORIZONTAL TRANSLATION  (X) ...  8.802E+08  lb/ft
HORIZONTAL TRANSLATION  (Y) ...  8.802E+08  lb/ft
VERTICAL TRANSLATION  (Z) .....  9.572E+08  lb/ft
ROTATION ABOUT  (X) ...........  1.026E+12  lb.ft/rad
ROTATION ABOUT  (Y) ...........  6.895E+11  lb.ft/rad
TORSION ABOUT  (Z) ............  1.414E+12  lb.ft/rad
CROSS-STIFFNESS (YZ PLANE) ....  9.381E+09  lb/rad
CROSS-STIFFNESS (XZ PLANE) .... -9.381E+09  lb/rad

DAMPING CONSTANTS (C)
```

****

```
HORIZONTAL TRANSLATION  (X) ...  3.780E+07  lb/ft/s
HORIZONTAL TRANSLATION  (Y) ...  3.780E+07  lb/ft/s
VERTICAL TRANSLATION  (Z) .....  4.280E+07  lb/ft/s
ROTATION ABOUT  (X) ...........  3.197E+10  lb.ft/rad/s
ROTATION ABOUT  (Y) ...........  2.184E+10  lb.ft/rad/s
TORSION ABOUT  (Z) ............  4.250E+10  lb.ft/rad/s
CROSS-DAMPING (YZ PLANE) ......  3.925E+08  lb/rad/s
CROSS-DAMPING (XZ PLANE) ...... -3.925E+08  lb/rad/s
```

FREQUENCY -   17.000   RPM
****

STIFFNESS CONSTANTS (K)
****

```
HORIZONTAL TRANSLATION  (X) ...  8.801E+08  lb/ft
HORIZONTAL TRANSLATION  (Y) ...  8.801E+08  lb/ft
VERTICAL TRANSLATION  (Z) .....  9.570E+08  lb/ft
ROTATION ABOUT  (X) ...........  1.026E+12  lb.ft/rad
ROTATION ABOUT  (Y) ...........  6.894E+11  lb.ft/rad
TORSION ABOUT  (Z) ............  1.414E+12  lb.ft/rad
CROSS-STIFFNESS (YZ PLANE) ....  9.380E+09  lb/rad
CROSS-STIFFNESS (XZ PLANE) .... -9.380E+09  lb/rad
```

DAMPING CONSTANTS (C)
****

```
HORIZONTAL TRANSLATION  (X) ...  3.625E+07  lb/ft/s
HORIZONTAL TRANSLATION  (Y) ...  3.625E+07  lb/ft/s
VERTICAL TRANSLATION  (Z) .....  4.111E+07  lb/ft/s
ROTATION ABOUT  (X) ...........  3.017E+10  lb.ft/rad/s
ROTATION ABOUT  (Y) ...........  2.063E+10  lb.ft/rad/s
TORSION ABOUT  (Z) ............  4.002E+10  lb.ft/rad/s
CROSS-DAMPING (YZ PLANE) ......  3.760E+08  lb/rad/s
CROSS-DAMPING (XZ PLANE) ...... -3.760E+08  lb/rad/s
```

FREQUENCY -   18.000   RPM
****

STIFFNESS CONSTANTS (K)
****

```
HORIZONTAL TRANSLATION  (X) ...  8.801E+08  lb/ft
HORIZONTAL TRANSLATION  (Y) ...  8.801E+08  lb/ft
VERTICAL TRANSLATION  (Z) .....  9.569E+08  lb/ft
ROTATION ABOUT  (X) ...........  1.026E+12  lb.ft/rad
ROTATION ABOUT  (Y) ...........  6.893E+11  lb.ft/rad
TORSION ABOUT  (Z) ............  1.414E+12  lb.ft/rad
CROSS-STIFFNESS (YZ PLANE) ....  9.380E+09  lb/rad
CROSS-STIFFNESS (XZ PLANE) .... -9.380E+09  lb/rad
```

DAMPING CONSTANTS (C)
****

```
HORIZONTAL TRANSLATION  (X) ...  3.488E+07  lb/ft/s
HORIZONTAL TRANSLATION  (Y) ...  3.488E+07  lb/ft/s
VERTICAL TRANSLATION  (Z) .....  3.962E+07  lb/ft/s
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```
ROTATION ABOUT  (X) ...........  2.858E+10  lb.ft/rad/s
ROTATION ABOUT  (Y) ...........  1.956E+10  lb.ft/rad/s
TORSION ABOUT  (Z) ............  3.783E+10  lb.ft/rad/s
CROSS-DAMPING (YZ PLANE) ......  3.614E+08  lb/rad/s
CROSS-DAMPING (XZ PLANE) ...... -3.614E+08  lb/rad/s


FREQUENCY  -     19.000   RPM
*********


STIFFNESS CONSTANTS (K)
***********************

HORIZONTAL TRANSLATION   (X) ...  8.800E+08  lb/ft
HORIZONTAL TRANSLATION   (Y) ...  8.800E+08  lb/ft
VERTICAL TRANSLATION  (Z) .....  9.572E+08  lb/ft
ROTATION ABOUT  (X) ...........  1.026E+12  lb.ft/rad
ROTATION ABOUT  (Y) ...........  6.892E+11  lb.ft/rad
TORSION ABOUT  (Z) ............  1.414E+12  lb.ft/rad
CROSS-STIFFNESS (YZ PLANE) ....  9.379E+09  lb/rad
CROSS-STIFFNESS (XZ PLANE) .... -9.379E+09  lb/rad

DAMPING CONSTANTS (C)
*********************

HORIZONTAL TRANSLATION   (X) ...  3.365E+07  lb/ft/s
HORIZONTAL TRANSLATION   (Y) ...  3.365E+07  lb/ft/s
VERTICAL TRANSLATION  (Z) .....  3.828E+07  lb/ft/s
ROTATION ABOUT  (X) ...........  2.715E+10  lb.ft/rad/s
ROTATION ABOUT  (Y) ...........  1.860E+10  lb.ft/rad/s
TORSION ABOUT  (Z) ............  3.586E+10  lb.ft/rad/s
CROSS-DAMPING (YZ PLANE) ......  3.483E+08  lb/rad/s
CROSS-DAMPING (XZ PLANE) ...... -3.483E+08  lb/rad/s


FREQUENCY  -     20.000   RPM
*********


STIFFNESS CONSTANTS (K)
***********************

HORIZONTAL TRANSLATION   (X) ...  8.799E+08  lb/ft
HORIZONTAL TRANSLATION   (Y) ...  8.799E+08  lb/ft
VERTICAL TRANSLATION  (Z) .....  9.576E+08  lb/ft
ROTATION ABOUT  (X) ...........  1.026E+12  lb.ft/rad
ROTATION ABOUT  (Y) ...........  6.891E+11  lb.ft/rad
TORSION ABOUT  (Z) ............  1.413E+12  lb.ft/rad
CROSS-STIFFNESS (YZ PLANE) ....  9.378E+09  lb/rad
CROSS-STIFFNESS (XZ PLANE) .... -9.378E+09  lb/rad

DAMPING CONSTANTS (C)
*********************

HORIZONTAL TRANSLATION   (X) ...  3.254E+07  lb/ft/s
HORIZONTAL TRANSLATION   (Y) ...  3.254E+07  lb/ft/s
VERTICAL TRANSLATION  (Z) .....  3.707E+07  lb/ft/s
ROTATION ABOUT  (X) ...........  2.587E+10  lb.ft/rad/s
ROTATION ABOUT  (Y) ...........  1.774E+10  lb.ft/rad/s
TORSION ABOUT  (Z) ............  3.410E+10  lb.ft/rad/s
CROSS-DAMPING (YZ PLANE) ......  3.365E+08  lb/rad/s
CROSS-DAMPING (XZ PLANE) ...... -3.365E+08  lb/rad/s
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************************************************
*                                              *
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*                                              *
*          Copyright (c) Western - 2011        *
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*             TIME     -     15: 2:40          *
*             REVISION -  Jan.21/201           *
*                                              *
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Mill Mat Foundation

RESULTS
****

FOOTING RESPONSE AMPLITUDES

FREQ. RPM	TRANS. X DIRECTION (ft)	TRANS. Y DIRECTION (ft)	VERTICAL DIRECTION (ft)	ROT ABOUT X AXIS (rad)	ROT ABOUT Y AXIS (rad)	TORSIONAL Z AXIS (rad)
10.00	1.94E-06	1.58E-06	1.91E-06	3.68E-08	1.76E-07	5.45E-08
11.00	2.34E-06	1.91E-06	2.31E-06	4.45E-08	2.13E-07	6.60E-08
12.00	2.79E-06	2.27E-06	2.75E-06	5.30E-08	2.53E-07	7.86E-08
13.00	3.27E-06	2.67E-06	3.23E-06	6.22E-08	2.97E-07	9.22E-08
14.00	3.80E-06	3.09E-06	3.75E-06	7.21E-08	3.45E-07	1.07E-07
15.00	4.36E-06	3.55E-06	4.30E-06	8.28E-08	3.96E-07	1.23E-07
16.00	4.96E-06	4.04E-06	4.89E-06	9.43E-08	4.50E-07	1.40E-07
17.00	5.60E-06	4.56E-06	5.52E-06	1.06E-07	5.08E-07	1.58E-07
18.00	6.28E-06	5.12E-06	6.19E-06	1.19E-07	5.70E-07	1.77E-07
19.00	7.00E-06	5.70E-06	6.90E-06	1.33E-07	6.35E-07	1.97E-07
20.00	7.76E-06	6.32E-06	7.64E-06	1.47E-07	7.04E-07	2.19E-07

MAXIMA OF FOOTING RESPONSE AMPLITUDES
****

				FREQ. RPM
MAX. TRANS. IN X-DIRECTION	-	7.759E-06	ft	20.00
MAX. TRANS. IN Y-DIRECTION	-	6.316E-06	ft	20.00
MAX. TRANS. IN Z-DIRECTION	-	7.639E-06	ft	20.00
MAX. ROT. ABOUT X AXIS	-	1.474E-07	rad	20.00
MAX. ROT. ABOUT Y AXIS	-	7.042E-07	rad	20.00
MAX. ROT. ABOUT Z AXIS	-	2.185E-07	rad	20.00

♀

FOOTING RESPONSE CURVE

CURVE-X= TRANS X-DIRECTION   CURVE-Y= TRANS Y-DIRECTION
CURVE-Z= TRANS Z-DIRECTION

```
 FREQ.
  RPM                   DISPLACEMENT (ft)
         1.00E-06  2.40E-06  3.80E-06  5.20E-06  6.60E-06  8.00E-06
  10.0     +---Y--Z--+---------+---------+---------+---------+
  11.0     I       Y ZX
```

```
   12.0      I         Y    Z
   13.0      I            Y    Z
   14.0      I               Y    Z
   15.0      I                  Y     Z
   16.0      I                      Y     Z
   17.0      I                         Y      ZX
   18.0      I                             Y       ZX
   19.0      I                                  Y       ZX
   20.0      +                                      Y        ZX
```

```
                    FOOTING RESPONSE CURVE
                    ----------------------
   CURVE-X= ROT ABOUT X AXIS       CURVE-Y= ROT ABOUT Y AXIS
                  CURVE-Z= ROT ABOUT Z AXIS
 FREQ.
  RPM                        ROTATION (rad)
          0.00E+00  1.60E-07  3.20E-07  4.80E-07  6.40E-07  8.00E-07
   10.0   +-XZ------+Y--------+---------+---------+---------+
   11.0   I   XZ         Y
   12.0   I   X Z           Y
   13.0   I    X Z             Y
   14.0   I     X Z               Y
   15.0   I     X  Z                 Y
   16.0   I      X  Z                   Y
   17.0   I       X  Z                      Y
   18.0   I       X   Z                         Y
   19.0   I        X   Z                            Y
   20.0   +         X    Z                              Y
```

DYNA 6.0 Results Stiffness Table (Case 1)

7/16/2012

Frequency (rpm)	Horizontal Stiffness X (lb/ft)	Horizontal Damping X (lb/ft/S)	Horizontal Stiffness Y (lb/ft)	Horizontal Damping Y (lb/ft/S)	Vertical Stiffness Z (lb/ft)	Vertical Damping Z (lb/ft/S)
10	8.81E+08	5.36E+07	8.81E+08	5.36E+07	9.58E+08	6.00E+07
11	8.81E+08	4.98E+07	8.81E+08	4.98E+07	9.58E+08	5.58E+07
12	8.81E+08	4.66E+07	8.81E+08	4.66E+07	9.58E+08	5.23E+07
13	8.80E+08	4.39E+07	8.80E+08	4.39E+07	9.58E+08	4.94E+07
14	8.80E+08	4.16E+07	8.80E+08	4.16E+07	9.58E+08	4.69E+07
15	8.80E+08	3.96E+07	8.80E+08	3.96E+07	9.57E+08	4.47E+07
16	8.80E+08	3.78E+07	8.80E+08	3.78E+07	9.57E+08	4.28E+07
17	8.80E+08	3.63E+07	8.80E+08	3.63E+07	9.57E+08	4.11E+07
18	8.80E+08	3.49E+07	8.80E+08	3.49E+07	9.57E+08	3.96E+07
19	8.80E+08	3.37E+07	8.80E+08	3.37E+07	9.57E+08	3.83E+07
20	8.80E+08	3.25E+07	8.80E+08	3.25E+07	9.58E+08	3.71E+07

Frequency (rpm)	Rocking Stiffness X (lb/ft/Rad)	Rocking Damping X (lb.ft/Rad/S)	Rocking Stiffness Y (lb/ft/Rad)	Rocking Damping Y (lb.ft/Rad/S)	Torsional Stiffness Z (lb/ft/Rad)	Torsional Damping Z (lb.ft/Rad/S)
10	1.03E+12	5.03E+10	6.90E+11	3.42E+10	1.42E+12	6.78E+10
11	1.03E+12	4.59E+10	6.90E+11	3.12E+10	1.42E+12	6.16E+10
12	1.03E+12	4.22E+10	6.90E+11	2.87E+10	1.42E+12	5.65E+10
13	1.03E+12	3.90E+10	6.90E+11	2.66E+10	1.42E+12	5.22E+10
14	1.03E+12	3.63E+10	6.90E+11	2.48E+10	1.42E+12	4.85E+10
15	1.03E+12	3.40E+10	6.90E+11	2.32E+10	1.41E+12	4.53E+10
16	1.03E+12	3.20E+10	6.90E+11	2.18E+10	1.41E+12	4.25E+10
17	1.03E+12	3.02E+10	6.89E+11	2.06E+10	1.41E+12	4.00E+10
18	1.03E+12	2.86E+10	6.89E+11	1.96E+10	1.41E+12	3.78E+10
19	1.03E+12	2.72E+10	6.89E+11	1.86E+10	1.41E+12	3.59E+10
20	1.03E+12	2.59E+10	6.89E+11	1.77E+10	1.41E+12	3.41E+10

DYNA 6.0 Results Response Table (Case 1)

7/16/2012

Frequency(rpm)	Translational Response at CG - X (in)	Translational Response at CG - Y (in)	Translational Response at CG - Z (in)	Rotational Response at CG - X (Rad)	Rotational Response at CG - Y (Rad)	Rotational Response at CG - Z (Rad)
10	2.33E-05	1.90E-05	2.29E-05	3.68E-08	1.76E-07	5.45E-08
11	2.81E-05	2.29E-05	2.77E-05	4.45E-08	2.13E-07	6.60E-08
12	3.35E-05	2.72E-05	3.30E-05	5.30E-08	2.53E-07	7.86E-08
13	3.92E-05	3.20E-05	3.88E-05	6.22E-08	2.97E-07	9.22E-08
14	4.56E-05	3.72E-05	4.50E-05	7.21E-08	3.45E-07	1.07E-07
15	5.23E-05	4.26E-05	5.16E-05	8.28E-08	3.96E-07	1.23E-07
16	5.95E-05	4.85E-05	5.87E-05	9.43E-08	4.50E-07	1.40E-07
17	6.72E-05	5.47E-05	6.64E-05	1.06E-07	5.09E-07	1.58E-07
18	7.54E-05	6.14E-05	7.43E-05	1.19E-07	5.70E-07	1.77E-07
19	8.40E-05	6.84E-05	8.28E-05	1.33E-07	6.35E-07	1.97E-07
20	9.31E-05	7.58E-05	9.17E-05	1.47E-07	7.04E-07	2.19E-07

CASE 2
- MOTOR VIBRATION

```
**************************************************
*                                                *
*       D Y N A 6   S I M U L A T I O N          *
*                                                *
*         Copyright (c) Western - 2011           *
*            RUN DATE -  2012/ 7/10              *
*            TIME     -    15: 7:17              *
*            REVISION -  Jan.21/201              *
*                                                *
**************************************************
```

Mill Mat Foundation

DATA ECHO
****

GRAVITATIONAL CONSTANT SET TO 32.20 ft/s**2
****

FREQUENCY UNITS : Hertz
****

LENGTH UNITS : ft
****

FORCE UNITS : lb
****

MASS UNITS : slug
****

RESPONSE TO BE PLOTTED
****

STIFFNESS AND DAMPING CONSTANTS TO BE PRINTED
****

DAMPING SAFETY FACTOR -   2.00
****

FOUNDATION TYPE - HALF-SPACE
****

RECTANGULAR FOUNDATION -   48.000 ft   BY 66.000 ft
****

MASS CONSTANTS
****

```
TOTAL MASS OF FOOTING  ......... 1.9265E+05  slug
MASS MOMENT ABOUT X-AXIS  ...... 9.0643E+07  slug.ft**2
MASS MOMENT ABOUT Y-AXIS  ...... 6.0555E+07  slug.ft**2
MASS MOMENT ABOUT Z-AXIS  ...... 1.1716E+08  slug.ft**2
CROSS PRODUCT X-Y  .............-7.8857E+06  slug.ft**2
CROSS PRODUCT X-Z  .............-1.3754E+06  slug.ft**2
CROSS PRODUCT Y-Z  .............-5.4366E+05  slug.ft**2
```

COORDINATES OF BASE CENTRE

```
**************************

X-COORD. OF BASE CENTRE REL. TO C.G.  ..    -1.448  ft
Y-COORD. OF BASE CENTRE REL. TO C.G.  ..     1.134  ft
Z-COORD. OF BASE CENTRE REL. TO C.G.  ..    11.007  ft


SOIL
****

SOIL CONSTANTS  NUMBER OF SIDE LAYERS -   1
**************

LAYER  LAYER  SHEAR WAVE   UNIT    POISSON'S  MATERIAL
 NO.   DEPTH   VELOCITY   WEIGHT     RATIO     DAMPING
        ft       ft/s    lb/ft**3

  1    6.000   1200.00    120.00     0.250      0.100

HALF-SPACE SOIL
***************

SHEAR WAVE    UNIT    POISSON'S  MATERIAL
 VELOCITY    WEIGHT     RATIO     DAMPING
   ft/s     lb/ft**3

 1.20E+03     120.00   0.250      0.100


HARMONIC LOAD (QUADRATIC)
*************

MAXIMUM FREQUENCY  ...........     69.000 Hertz
MINIMUM FREQUENCY  ...........     51.000 Hertz
STEP FREQUENCY ...............      1.000 Hertz
FORCE IN X-DIRECTION  .........  0.00E+00 slug.ft
FORCE IN Y-DIRECTION  .........  0.00E+00 slug.ft
FORCE IN Z-DIRECTION  .........  1.69E+03 slug.ft
MOMENT ABOUT X-AXIS  .......... -3.79E+04 slug.ft**2
MOMENT ABOUT Y-AXIS  .......... -6.04E+02 slug.ft**2
MOMENT ABOUT Z-AXIS  ..........  0.00E+00 slug.ft**2
♀


************************************************
*                                              *
*        D Y N A 6   S I M U L A T I O N       *
*                                              *
*         Copyright (c) Western - 2011         *
*            RUN DATE -  2012/ 7/10            *
*            TIME     -    15: 7:17            *
*            REVISION -  Jan.21/201            *
*                                              *
************************************************

Mill Mat Foundation

                                        RESULTS
                                        *******


FREQUENCY  -    51.000  Hertz
*********
```

```
STIFFNESS CONSTANTS (K)
***********************

HORIZONTAL TRANSLATION  (X) ...  5.920E+08  lb/ft
HORIZONTAL TRANSLATION  (Y) ...  5.920E+08  lb/ft
VERTICAL TRANSLATION  (Z) .....  2.227E+08  lb/ft
ROTATION ABOUT  (X) ...........  3.435E+11  lb.ft/rad
ROTATION ABOUT  (Y) ...........  2.630E+11  lb.ft/rad
TORSION ABOUT  (Z) ............  6.955E+11  lb.ft/rad
CROSS-STIFFNESS (YZ PLANE) ....  6.434E+09  lb/rad
CROSS-STIFFNESS (XZ PLANE) .... -6.434E+09  lb/rad

DAMPING CONSTANTS (C)
*********************

HORIZONTAL TRANSLATION  (X) ...  1.053E+07  lb/ft/s
HORIZONTAL TRANSLATION  (Y) ...  1.053E+07  lb/ft/s
VERTICAL TRANSLATION  (Z) .....  1.513E+07  lb/ft/s
ROTATION ABOUT  (X) ...........  7.518E+09  lb.ft/rad/s
ROTATION ABOUT  (Y) ...........  4.657E+09  lb.ft/rad/s
TORSION ABOUT  (Z) ............  6.864E+09  lb.ft/rad/s
CROSS-DAMPING (YZ PLANE) ......  1.048E+08  lb/rad/s
CROSS-DAMPING (XZ PLANE) ...... -1.048E+08  lb/rad/s


FREQUENCY  -    52.000  Hertz
*********


STIFFNESS CONSTANTS (K)
***********************

HORIZONTAL TRANSLATION  (X) ...  5.855E+08  lb/ft
HORIZONTAL TRANSLATION  (Y) ...  5.855E+08  lb/ft
VERTICAL TRANSLATION  (Z) .....  2.127E+08  lb/ft
ROTATION ABOUT  (X) ...........  3.383E+11  lb.ft/rad
ROTATION ABOUT  (Y) ...........  2.597E+11  lb.ft/rad
TORSION ABOUT  (Z) ............  6.906E+11  lb.ft/rad
CROSS-STIFFNESS (YZ PLANE) ....  6.369E+09  lb/rad
CROSS-STIFFNESS (XZ PLANE) .... -6.369E+09  lb/rad

DAMPING CONSTANTS (C)
*********************

HORIZONTAL TRANSLATION  (X) ...  1.052E+07  lb/ft/s
HORIZONTAL TRANSLATION  (Y) ...  1.052E+07  lb/ft/s
VERTICAL TRANSLATION  (Z) .....  1.513E+07  lb/ft/s
ROTATION ABOUT  (X) ...........  7.519E+09  lb.ft/rad/s
ROTATION ABOUT  (Y) ...........  4.658E+09  lb.ft/rad/s
TORSION ABOUT  (Z) ............  6.866E+09  lb.ft/rad/s
CROSS-DAMPING (YZ PLANE) ......  1.047E+08  lb/rad/s
CROSS-DAMPING (XZ PLANE) ...... -1.047E+08  lb/rad/s


FREQUENCY  -    53.000  Hertz
*********


STIFFNESS CONSTANTS (K)
***********************
```

```
HORIZONTAL TRANSLATION  (X) ...  5.792E+08  lb/ft
HORIZONTAL TRANSLATION  (Y) ...  5.792E+08  lb/ft
VERTICAL TRANSLATION  (Z) .....  2.030E+08  lb/ft
ROTATION ABOUT  (X) ...........  3.332E+11  lb.ft/rad
ROTATION ABOUT  (Y) ...........  2.565E+11  lb.ft/rad
TORSION ABOUT  (Z) ............  6.853E+11  lb.ft/rad
CROSS-STIFFNESS (YZ PLANE) ....  6.306E+09  lb/rad
CROSS-STIFFNESS (XZ PLANE) .... -6.306E+09  lb/rad

DAMPING CONSTANTS (C)
*********************

HORIZONTAL TRANSLATION  (X) ...  1.052E+07  lb/ft/s
HORIZONTAL TRANSLATION  (Y) ...  1.052E+07  lb/ft/s
VERTICAL TRANSLATION  (Z) .....  1.513E+07  lb/ft/s
ROTATION ABOUT  (X) ...........  7.521E+09  lb.ft/rad/s
ROTATION ABOUT  (Y) ...........  4.659E+09  lb.ft/rad/s
TORSION ABOUT  (Z) ............  6.867E+09  lb.ft/rad/s
CROSS-DAMPING (YZ PLANE) ......  1.047E+08  lb/rad/s
CROSS-DAMPING (XZ PLANE) ...... -1.047E+08  lb/rad/s


FREQUENCY  -    54.000  Hertz
*********


STIFFNESS CONSTANTS (K)
***********************

HORIZONTAL TRANSLATION  (X) ...  5.728E+08  lb/ft
HORIZONTAL TRANSLATION  (Y) ...  5.728E+08  lb/ft
VERTICAL TRANSLATION  (Z) .....  1.933E+08  lb/ft
ROTATION ABOUT  (X) ...........  3.281E+11  lb.ft/rad
ROTATION ABOUT  (Y) ...........  2.532E+11  lb.ft/rad
TORSION ABOUT  (Z) ............  6.804E+11  lb.ft/rad
CROSS-STIFFNESS (YZ PLANE) ....  6.242E+09  lb/rad
CROSS-STIFFNESS (XZ PLANE) .... -6.242E+09  lb/rad

DAMPING CONSTANTS (C)
*********************

HORIZONTAL TRANSLATION  (X) ...  1.052E+07  lb/ft/s
HORIZONTAL TRANSLATION  (Y) ...  1.052E+07  lb/ft/s
VERTICAL TRANSLATION  (Z) .....  1.513E+07  lb/ft/s
ROTATION ABOUT  (X) ...........  7.522E+09  lb.ft/rad/s
ROTATION ABOUT  (Y) ...........  4.660E+09  lb.ft/rad/s
TORSION ABOUT  (Z) ............  6.869E+09  lb.ft/rad/s
CROSS-DAMPING (YZ PLANE) ......  1.047E+08  lb/rad/s
CROSS-DAMPING (XZ PLANE) ...... -1.047E+08  lb/rad/s


FREQUENCY  -    55.000  Hertz
*********


STIFFNESS CONSTANTS (K)
***********************

HORIZONTAL TRANSLATION  (X) ...  5.665E+08  lb/ft
HORIZONTAL TRANSLATION  (Y) ...  5.665E+08  lb/ft
VERTICAL TRANSLATION  (Z) .....  1.838E+08  lb/ft
ROTATION ABOUT  (X) ...........  3.230E+11  lb.ft/rad
ROTATION ABOUT  (Y) ...........  2.500E+11  lb.ft/rad
```

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TORSION ABOUT  (Z) ............  6.756E+11  lb.ft/rad
CROSS-STIFFNESS (YZ PLANE) ....  6.179E+09  lb/rad
CROSS-STIFFNESS (XZ PLANE) .... -6.179E+09  lb/rad

DAMPING CONSTANTS (C)
*********************

HORIZONTAL TRANSLATION  (X) ...  1.051E+07  lb/ft/s
HORIZONTAL TRANSLATION  (Y) ...  1.051E+07  lb/ft/s
VERTICAL TRANSLATION  (Z) .....  1.513E+07  lb/ft/s
ROTATION ABOUT  (X) ...........  7.523E+09  lb.ft/rad/s
ROTATION ABOUT  (Y) ...........  4.661E+09  lb.ft/rad/s
TORSION ABOUT  (Z) ............  6.870E+09  lb.ft/rad/s
CROSS-DAMPING (YZ PLANE) ......  1.046E+08  lb/rad/s
CROSS-DAMPING (XZ PLANE) ...... -1.046E+08  lb/rad/s


FREQUENCY  -    56.000  Hertz
*********


STIFFNESS CONSTANTS (K)
***********************

HORIZONTAL TRANSLATION  (X) ...  5.601E+08  lb/ft
HORIZONTAL TRANSLATION  (Y) ...  5.601E+08  lb/ft
VERTICAL TRANSLATION  (Z) .....  1.741E+08  lb/ft
ROTATION ABOUT  (X) ...........  3.180E+11  lb.ft/rad
ROTATION ABOUT  (Y) ...........  2.468E+11  lb.ft/rad
TORSION ABOUT  (Z) ............  6.708E+11  lb.ft/rad
CROSS-STIFFNESS (YZ PLANE) ....  6.115E+09  lb/rad
CROSS-STIFFNESS (XZ PLANE) .... -6.115E+09  lb/rad

DAMPING CONSTANTS (C)
*********************

HORIZONTAL TRANSLATION  (X) ...  1.051E+07  lb/ft/s
HORIZONTAL TRANSLATION  (Y) ...  1.051E+07  lb/ft/s
VERTICAL TRANSLATION  (Z) .....  1.513E+07  lb/ft/s
ROTATION ABOUT  (X) ...........  7.524E+09  lb.ft/rad/s
ROTATION ABOUT  (Y) ...........  4.661E+09  lb.ft/rad/s
TORSION ABOUT  (Z) ............  6.871E+09  lb.ft/rad/s
CROSS-DAMPING (YZ PLANE) ......  1.046E+08  lb/rad/s
CROSS-DAMPING (XZ PLANE) ...... -1.046E+08  lb/rad/s


FREQUENCY  -    57.000  Hertz
*********


STIFFNESS CONSTANTS (K)
***********************

HORIZONTAL TRANSLATION  (X) ...  5.537E+08  lb/ft
HORIZONTAL TRANSLATION  (Y) ...  5.537E+08  lb/ft
VERTICAL TRANSLATION  (Z) .....  1.643E+08  lb/ft
ROTATION ABOUT  (X) ...........  3.129E+11  lb.ft/rad
ROTATION ABOUT  (Y) ...........  2.437E+11  lb.ft/rad
TORSION ABOUT  (Z) ............  6.660E+11  lb.ft/rad
CROSS-STIFFNESS (YZ PLANE) ....  6.051E+09  lb/rad
CROSS-STIFFNESS (XZ PLANE) .... -6.051E+09  lb/rad

DAMPING CONSTANTS (C)
```

****

```
HORIZONTAL TRANSLATION  (X) ...  1.051E+07  lb/ft/s
HORIZONTAL TRANSLATION  (Y) ...  1.051E+07  lb/ft/s
VERTICAL TRANSLATION  (Z) .....  1.513E+07  lb/ft/s
ROTATION ABOUT  (X) ...........  7.525E+09  lb.ft/rad/s
ROTATION ABOUT  (Y) ...........  4.662E+09  lb.ft/rad/s
TORSION ABOUT  (Z) ............  6.872E+09  lb.ft/rad/s
CROSS-DAMPING (YZ PLANE) ......  1.046E+08  lb/rad/s
CROSS-DAMPING (XZ PLANE) ...... -1.046E+08  lb/rad/s
```

FREQUENCY -   58.000 Hertz
****

STIFFNESS CONSTANTS (K)
****

```
HORIZONTAL TRANSLATION  (X) ...  5.473E+08  lb/ft
HORIZONTAL TRANSLATION  (Y) ...  5.473E+08  lb/ft
VERTICAL TRANSLATION  (Z) .....  1.546E+08  lb/ft
ROTATION ABOUT  (X) ...........  3.079E+11  lb.ft/rad
ROTATION ABOUT  (Y) ...........  2.405E+11  lb.ft/rad
TORSION ABOUT  (Z) ............  6.612E+11  lb.ft/rad
CROSS-STIFFNESS (YZ PLANE) ....  5.987E+09  lb/rad
CROSS-STIFFNESS (XZ PLANE) .... -5.987E+09  lb/rad
```

DAMPING CONSTANTS (C)
****

```
HORIZONTAL TRANSLATION  (X) ...  1.051E+07  lb/ft/s
HORIZONTAL TRANSLATION  (Y) ...  1.051E+07  lb/ft/s
VERTICAL TRANSLATION  (Z) .....  1.513E+07  lb/ft/s
ROTATION ABOUT  (X) ...........  7.526E+09  lb.ft/rad/s
ROTATION ABOUT  (Y) ...........  4.663E+09  lb.ft/rad/s
TORSION ABOUT  (Z) ............  6.873E+09  lb.ft/rad/s
CROSS-DAMPING (YZ PLANE) ......  1.046E+08  lb/rad/s
CROSS-DAMPING (XZ PLANE) ...... -1.046E+08  lb/rad/s
```

FREQUENCY -   59.000 Hertz
****

STIFFNESS CONSTANTS (K)
****

```
HORIZONTAL TRANSLATION  (X) ...  5.408E+08  lb/ft
HORIZONTAL TRANSLATION  (Y) ...  5.408E+08  lb/ft
VERTICAL TRANSLATION  (Z) .....  1.449E+08  lb/ft
ROTATION ABOUT  (X) ...........  3.029E+11  lb.ft/rad
ROTATION ABOUT  (Y) ...........  2.371E+11  lb.ft/rad
TORSION ABOUT  (Z) ............  6.564E+11  lb.ft/rad
CROSS-STIFFNESS (YZ PLANE) ....  5.923E+09  lb/rad
CROSS-STIFFNESS (XZ PLANE) .... -5.923E+09  lb/rad
```

DAMPING CONSTANTS (C)
****

```
HORIZONTAL TRANSLATION  (X) ...  1.050E+07  lb/ft/s
HORIZONTAL TRANSLATION  (Y) ...  1.050E+07  lb/ft/s
VERTICAL TRANSLATION  (Z) .....  1.513E+07  lb/ft/s
```

```
ROTATION ABOUT  (X) ...........  7.527E+09  lb.ft/rad/s
ROTATION ABOUT  (Y) ...........  4.664E+09  lb.ft/rad/s
TORSION ABOUT  (Z) ............  6.874E+09  lb.ft/rad/s
CROSS-DAMPING (YZ PLANE) ......  1.045E+08  lb/rad/s
CROSS-DAMPING (XZ PLANE) ...... -1.045E+08  lb/rad/s


FREQUENCY  -    60.000  Hertz
*********


STIFFNESS CONSTANTS (K)
***********************

HORIZONTAL TRANSLATION  (X) ...  5.344E+08  lb/ft
HORIZONTAL TRANSLATION  (Y) ...  5.344E+08  lb/ft
VERTICAL TRANSLATION  (Z) .....  1.352E+08  lb/ft
ROTATION ABOUT  (X) ...........  2.979E+11  lb.ft/rad
ROTATION ABOUT  (Y) ...........  2.340E+11  lb.ft/rad
TORSION ABOUT  (Z) ............  6.517E+11  lb.ft/rad
CROSS-STIFFNESS (YZ PLANE) ....  5.859E+09  lb/rad
CROSS-STIFFNESS (XZ PLANE) .... -5.859E+09  lb/rad

DAMPING CONSTANTS (C)
*********************

HORIZONTAL TRANSLATION  (X) ...  1.050E+07  lb/ft/s
HORIZONTAL TRANSLATION  (Y) ...  1.050E+07  lb/ft/s
VERTICAL TRANSLATION  (Z) .....  1.513E+07  lb/ft/s
ROTATION ABOUT  (X) ...........  7.528E+09  lb.ft/rad/s
ROTATION ABOUT  (Y) ...........  4.664E+09  lb.ft/rad/s
TORSION ABOUT  (Z) ............  6.875E+09  lb.ft/rad/s
CROSS-DAMPING (YZ PLANE) ......  1.045E+08  lb/rad/s
CROSS-DAMPING (XZ PLANE) ...... -1.045E+08  lb/rad/s


FREQUENCY  -    61.000  Hertz
*********


STIFFNESS CONSTANTS (K)
***********************

HORIZONTAL TRANSLATION  (X) ...  5.280E+08  lb/ft
HORIZONTAL TRANSLATION  (Y) ...  5.280E+08  lb/ft
VERTICAL TRANSLATION  (Z) .....  1.255E+08  lb/ft
ROTATION ABOUT  (X) ...........  2.929E+11  lb.ft/rad
ROTATION ABOUT  (Y) ...........  2.308E+11  lb.ft/rad
TORSION ABOUT  (Z) ............  6.470E+11  lb.ft/rad
CROSS-STIFFNESS (YZ PLANE) ....  5.795E+09  lb/rad
CROSS-STIFFNESS (XZ PLANE) .... -5.795E+09  lb/rad

DAMPING CONSTANTS (C)
*********************

HORIZONTAL TRANSLATION  (X) ...  1.050E+07  lb/ft/s
HORIZONTAL TRANSLATION  (Y) ...  1.050E+07  lb/ft/s
VERTICAL TRANSLATION  (Z) .....  1.513E+07  lb/ft/s
ROTATION ABOUT  (X) ...........  7.529E+09  lb.ft/rad/s
ROTATION ABOUT  (Y) ...........  4.665E+09  lb.ft/rad/s
TORSION ABOUT  (Z) ............  6.875E+09  lb.ft/rad/s
CROSS-DAMPING (YZ PLANE) ......  1.045E+08  lb/rad/s
CROSS-DAMPING (XZ PLANE) ...... -1.045E+08  lb/rad/s
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FREQUENCY  -    62.000  Hertz
*********


STIFFNESS CONSTANTS (K)
***********************

HORIZONTAL TRANSLATION  (X) ...  5.215E+08  lb/ft
HORIZONTAL TRANSLATION  (Y) ...  5.215E+08  lb/ft
VERTICAL TRANSLATION  (Z) .....  1.158E+08  lb/ft
ROTATION ABOUT  (X) ...........  2.879E+11  lb.ft/rad
ROTATION ABOUT  (Y) ...........  2.277E+11  lb.ft/rad
TORSION ABOUT  (Z) ............  6.423E+11  lb.ft/rad
CROSS-STIFFNESS (YZ PLANE) ....  5.731E+09  lb/rad
CROSS-STIFFNESS (XZ PLANE) .... -5.731E+09  lb/rad

DAMPING CONSTANTS (C)
*********************

HORIZONTAL TRANSLATION  (X) ...  1.050E+07  lb/ft/s
HORIZONTAL TRANSLATION  (Y) ...  1.050E+07  lb/ft/s
VERTICAL TRANSLATION  (Z) .....  1.513E+07  lb/ft/s
ROTATION ABOUT  (X) ...........  7.530E+09  lb.ft/rad/s
ROTATION ABOUT  (Y) ...........  4.665E+09  lb.ft/rad/s
TORSION ABOUT  (Z) ............  6.876E+09  lb.ft/rad/s
CROSS-DAMPING (YZ PLANE) ......  1.045E+08  lb/rad/s
CROSS-DAMPING (XZ PLANE) ...... -1.045E+08  lb/rad/s


FREQUENCY  -    63.000  Hertz
*********


STIFFNESS CONSTANTS (K)
***********************

HORIZONTAL TRANSLATION  (X) ...  5.151E+08  lb/ft
HORIZONTAL TRANSLATION  (Y) ...  5.151E+08  lb/ft
VERTICAL TRANSLATION  (Z) .....  1.061E+08  lb/ft
ROTATION ABOUT  (X) ...........  2.829E+11  lb.ft/rad
ROTATION ABOUT  (Y) ...........  2.246E+11  lb.ft/rad
TORSION ABOUT  (Z) ............  6.376E+11  lb.ft/rad
CROSS-STIFFNESS (YZ PLANE) ....  5.667E+09  lb/rad
CROSS-STIFFNESS (XZ PLANE) .... -5.667E+09  lb/rad

DAMPING CONSTANTS (C)
*********************

HORIZONTAL TRANSLATION  (X) ...  1.050E+07  lb/ft/s
HORIZONTAL TRANSLATION  (Y) ...  1.050E+07  lb/ft/s
VERTICAL TRANSLATION  (Z) .....  1.513E+07  lb/ft/s
ROTATION ABOUT  (X) ...........  7.530E+09  lb.ft/rad/s
ROTATION ABOUT  (Y) ...........  4.666E+09  lb.ft/rad/s
TORSION ABOUT  (Z) ............  6.877E+09  lb.ft/rad/s
CROSS-DAMPING (YZ PLANE) ......  1.044E+08  lb/rad/s
CROSS-DAMPING (XZ PLANE) ...... -1.044E+08  lb/rad/s


FREQUENCY  -    64.000  Hertz
*********
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```
STIFFNESS CONSTANTS (K)
***********************

HORIZONTAL TRANSLATION  (X) ...  5.087E+08  lb/ft
HORIZONTAL TRANSLATION  (Y) ...  5.087E+08  lb/ft
VERTICAL TRANSLATION  (Z) .....  9.645E+07  lb/ft
ROTATION ABOUT  (X) ...........  2.780E+11  lb.ft/rad
ROTATION ABOUT  (Y) ...........  2.215E+11  lb.ft/rad
TORSION ABOUT  (Z) ............  6.329E+11  lb.ft/rad
CROSS-STIFFNESS (YZ PLANE) ....  5.602E+09  lb/rad
CROSS-STIFFNESS (XZ PLANE) .... -5.602E+09  lb/rad

DAMPING CONSTANTS (C)
*********************

HORIZONTAL TRANSLATION  (X) ...  1.049E+07  lb/ft/s
HORIZONTAL TRANSLATION  (Y) ...  1.049E+07  lb/ft/s
VERTICAL TRANSLATION  (Z) .....  1.513E+07  lb/ft/s
ROTATION ABOUT  (X) ...........  7.531E+09  lb.ft/rad/s
ROTATION ABOUT  (Y) ...........  4.666E+09  lb.ft/rad/s
TORSION ABOUT  (Z) ............  6.877E+09  lb.ft/rad/s
CROSS-DAMPING (YZ PLANE) ......  1.044E+08  lb/rad/s
CROSS-DAMPING (XZ PLANE) ...... -1.044E+08  lb/rad/s


FREQUENCY  -    65.000  Hertz
*********


STIFFNESS CONSTANTS (K)
***********************

HORIZONTAL TRANSLATION  (X) ...  5.022E+08  lb/ft
HORIZONTAL TRANSLATION  (Y) ...  5.022E+08  lb/ft
VERTICAL TRANSLATION  (Z) .....  8.679E+07  lb/ft
ROTATION ABOUT  (X) ...........  2.730E+11  lb.ft/rad
ROTATION ABOUT  (Y) ...........  2.183E+11  lb.ft/rad
TORSION ABOUT  (Z) ............  6.283E+11  lb.ft/rad
CROSS-STIFFNESS (YZ PLANE) ....  5.538E+09  lb/rad
CROSS-STIFFNESS (XZ PLANE) .... -5.538E+09  lb/rad

DAMPING CONSTANTS (C)
*********************

HORIZONTAL TRANSLATION  (X) ...  1.049E+07  lb/ft/s
HORIZONTAL TRANSLATION  (Y) ...  1.049E+07  lb/ft/s
VERTICAL TRANSLATION  (Z) .....  1.513E+07  lb/ft/s
ROTATION ABOUT  (X) ...........  7.531E+09  lb.ft/rad/s
ROTATION ABOUT  (Y) ...........  4.667E+09  lb.ft/rad/s
TORSION ABOUT  (Z) ............  6.878E+09  lb.ft/rad/s
CROSS-DAMPING (YZ PLANE) ......  1.044E+08  lb/rad/s
CROSS-DAMPING (XZ PLANE) ...... -1.044E+08  lb/rad/s


FREQUENCY  -    66.000  Hertz
*********


STIFFNESS CONSTANTS (K)
***********************

HORIZONTAL TRANSLATION  (X) ...  4.958E+08  lb/ft
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HORIZONTAL TRANSLATION  (Y) ...  4.958E+08  lb/ft
VERTICAL TRANSLATION  (Z) .....  7.714E+07  lb/ft
ROTATION ABOUT  (X) ...........  2.681E+11  lb.ft/rad
ROTATION ABOUT  (Y) ...........  2.152E+11  lb.ft/rad
TORSION ABOUT  (Z) ............  6.237E+11  lb.ft/rad
CROSS-STIFFNESS (YZ PLANE) ....  5.474E+09  lb/rad
CROSS-STIFFNESS (XZ PLANE) .... -5.474E+09  lb/rad

DAMPING CONSTANTS (C)
*********************

HORIZONTAL TRANSLATION  (X) ...  1.049E+07  lb/ft/s
HORIZONTAL TRANSLATION  (Y) ...  1.049E+07  lb/ft/s
VERTICAL TRANSLATION  (Z) .....  1.513E+07  lb/ft/s
ROTATION ABOUT  (X) ...........  7.532E+09  lb.ft/rad/s
ROTATION ABOUT  (Y) ...........  4.667E+09  lb.ft/rad/s
TORSION ABOUT  (Z) ............  6.878E+09  lb.ft/rad/s
CROSS-DAMPING (YZ PLANE) ......  1.044E+08  lb/rad/s
CROSS-DAMPING (XZ PLANE) ...... -1.044E+08  lb/rad/s


FREQUENCY  -    67.000  Hertz
*********


STIFFNESS CONSTANTS (K)
***********************

HORIZONTAL TRANSLATION  (X) ...  4.893E+08  lb/ft
HORIZONTAL TRANSLATION  (Y) ...  4.893E+08  lb/ft
VERTICAL TRANSLATION  (Z) .....  6.749E+07  lb/ft
ROTATION ABOUT  (X) ...........  2.631E+11  lb.ft/rad
ROTATION ABOUT  (Y) ...........  2.121E+11  lb.ft/rad
TORSION ABOUT  (Z) ............  6.190E+11  lb.ft/rad
CROSS-STIFFNESS (YZ PLANE) ....  5.409E+09  lb/rad
CROSS-STIFFNESS (XZ PLANE) .... -5.409E+09  lb/rad

DAMPING CONSTANTS (C)
*********************

HORIZONTAL TRANSLATION  (X) ...  1.049E+07  lb/ft/s
HORIZONTAL TRANSLATION  (Y) ...  1.049E+07  lb/ft/s
VERTICAL TRANSLATION  (Z) .....  1.513E+07  lb/ft/s
ROTATION ABOUT  (X) ...........  7.533E+09  lb.ft/rad/s
ROTATION ABOUT  (Y) ...........  4.668E+09  lb.ft/rad/s
TORSION ABOUT  (Z) ............  6.879E+09  lb.ft/rad/s
CROSS-DAMPING (YZ PLANE) ......  1.044E+08  lb/rad/s
CROSS-DAMPING (XZ PLANE) ...... -1.044E+08  lb/rad/s


FREQUENCY  -    68.000  Hertz
*********


STIFFNESS CONSTANTS (K)
***********************

HORIZONTAL TRANSLATION  (X) ...  4.829E+08  lb/ft
HORIZONTAL TRANSLATION  (Y) ...  4.829E+08  lb/ft
VERTICAL TRANSLATION  (Z) .....  5.785E+07  lb/ft
ROTATION ABOUT  (X) ...........  2.582E+11  lb.ft/rad
ROTATION ABOUT  (Y) ...........  2.091E+11  lb.ft/rad
TORSION ABOUT  (Z) ............  6.144E+11  lb.ft/rad
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CROSS-STIFFNESS (YZ PLANE) ....  5.345E+09  lb/rad
CROSS-STIFFNESS (XZ PLANE) .... -5.345E+09  lb/rad

DAMPING CONSTANTS (C)
*********************

HORIZONTAL TRANSLATION  (X) ...  1.049E+07  lb/ft/s
HORIZONTAL TRANSLATION  (Y) ...  1.049E+07  lb/ft/s
VERTICAL TRANSLATION  (Z) .....  1.513E+07  lb/ft/s
ROTATION ABOUT  (X) ...........  7.533E+09  lb.ft/rad/s
ROTATION ABOUT  (Y) ...........  4.668E+09  lb.ft/rad/s
TORSION ABOUT  (Z) ............  6.879E+09  lb.ft/rad/s
CROSS-DAMPING (YZ PLANE) ......  1.044E+08  lb/rad/s
CROSS-DAMPING (XZ PLANE) ...... -1.044E+08  lb/rad/s


FREQUENCY  -    69.000  Hertz
*********


STIFFNESS CONSTANTS (K)
***********************

HORIZONTAL TRANSLATION  (X) ...  4.764E+08  lb/ft
HORIZONTAL TRANSLATION  (Y) ...  4.764E+08  lb/ft
VERTICAL TRANSLATION  (Z) .....  4.822E+07  lb/ft
ROTATION ABOUT  (X) ...........  2.533E+11  lb.ft/rad
ROTATION ABOUT  (Y) ...........  2.060E+11  lb.ft/rad
TORSION ABOUT  (Z) ............  6.098E+11  lb.ft/rad
CROSS-STIFFNESS (YZ PLANE) ....  5.281E+09  lb/rad
CROSS-STIFFNESS (XZ PLANE) .... -5.281E+09  lb/rad

DAMPING CONSTANTS (C)
*********************

HORIZONTAL TRANSLATION  (X) ...  1.048E+07  lb/ft/s
HORIZONTAL TRANSLATION  (Y) ...  1.048E+07  lb/ft/s
VERTICAL TRANSLATION  (Z) .....  1.513E+07  lb/ft/s
ROTATION ABOUT  (X) ...........  7.533E+09  lb.ft/rad/s
ROTATION ABOUT  (Y) ...........  4.668E+09  lb.ft/rad/s
TORSION ABOUT  (Z) ............  6.880E+09  lb.ft/rad/s
CROSS-DAMPING (YZ PLANE) ......  1.043E+08  lb/rad/s
CROSS-DAMPING (XZ PLANE) ...... -1.043E+08  lb/rad/s
♀

*************************************************
*                                               *
*        D Y N A 6   S I M U L A T I O N        *
*                                               *
*       Copyright (c) Western - 2011            *
*          RUN DATE -  2012/ 7/10               *
*          TIME     -    15: 7:17               *
*          REVISION -  Jan.21/201               *
*                                               *
*************************************************

Mill Mat Foundation

                                 RESULTS
                                 *******

                        FOOTING RESPONSE AMPLITUDES
```

FREQ. Hertz	TRANS. X DIRECTION (ft)	TRANS. Y DIRECTION (ft)	VERTICAL DIRECTION (ft)	ROT ABOUT X AXIS (rad)	ROT ABOUT Y AXIS (rad)	TORSIONAL Z AXIS (rad)
51.00	7.81E-05	7.35E-04	8.59E-03	4.20E-04	4.51E-05	5.29E-06
52.00	7.63E-05	7.19E-04	8.59E-03	4.20E-04	4.50E-05	5.26E-06
53.00	7.47E-05	7.04E-04	8.60E-03	4.19E-04	4.50E-05	5.24E-06
54.00	7.31E-05	6.89E-04	8.60E-03	4.19E-04	4.50E-05	5.22E-06
55.00	7.16E-05	6.75E-04	8.60E-03	4.19E-04	4.50E-05	5.20E-06
56.00	7.02E-05	6.62E-04	8.60E-03	4.19E-04	4.49E-05	5.18E-06
57.00	6.88E-05	6.49E-04	8.61E-03	4.19E-04	4.49E-05	5.16E-06
58.00	6.75E-05	6.37E-04	8.61E-03	4.19E-04	4.49E-05	5.15E-06
59.00	6.63E-05	6.25E-04	8.61E-03	4.19E-04	4.49E-05	5.13E-06
60.00	6.50E-05	6.14E-04	8.61E-03	4.19E-04	4.49E-05	5.12E-06
61.00	6.39E-05	6.03E-04	8.62E-03	4.19E-04	4.49E-05	5.10E-06
62.00	6.27E-05	5.93E-04	8.62E-03	4.19E-04	4.48E-05	5.09E-06
63.00	6.17E-05	5.82E-04	8.62E-03	4.19E-04	4.48E-05	5.08E-06
64.00	6.06E-05	5.73E-04	8.62E-03	4.19E-04	4.48E-05	5.07E-06
65.00	5.96E-05	5.63E-04	8.62E-03	4.19E-04	4.48E-05	5.05E-06
66.00	5.86E-05	5.54E-04	8.63E-03	4.19E-04	4.48E-05	5.04E-06
67.00	5.77E-05	5.45E-04	8.63E-03	4.19E-04	4.48E-05	5.03E-06
68.00	5.68E-05	5.37E-04	8.63E-03	4.19E-04	4.48E-05	5.02E-06
69.00	5.59E-05	5.28E-04	8.63E-03	4.19E-04	4.48E-05	5.02E-06

MAXIMA OF FOOTING RESPONSE AMPLITUDES
****

				FREQ. Hertz
MAX. TRANS. IN X-DIRECTION	-	7.806E-05	ft	51.00
MAX. TRANS. IN Y-DIRECTION	-	7.349E-04	ft	51.00
MAX. TRANS. IN Z-DIRECTION	-	8.631E-03	ft	69.00
MAX. ROT. ABOUT X AXIS	-	4.197E-04	rad	51.00
MAX. ROT. ABOUT Y AXIS	-	4.507E-05	rad	51.00
MAX. ROT. ABOUT Z AXIS	-	5.288E-06	rad	51.00

♀

FOOTING RESPONSE CURVE

```
    CURVE-X= TRANS X-DIRECTION      CURVE-Y= TRANS Y-DIRECTION
                      CURVE-Z= TRANS Z-DIRECTION
 FREQ.
 Hertz                       DISPLACEMENT (ft)
          0.00E+00  1.80E-03  3.60E-03  5.40E-03  7.20E-03  9.00E-03
  51.0      X---Y-----+---------+---------+---------+-------Z-+
  52.0      X   Y                                           Z
  53.0      X   Y                                           Z
  54.0      X   Y                                           Z
  55.0      X   Y                                           Z
  56.0      X   Y                                           Z
  57.0      X   Y                                           Z
  58.0      X   Y                                           Z
  59.0      X  Y                                            Z
  60.0      X  Y                                            Z
  61.0      X  Y                                            Z
  62.0      X  Y                                            Z
  63.0      X  Y                                            Z
  64.0      X  Y                                            Z
```

```
   65.0      X  Y                                                Z
   66.0      X  Y                                                Z
   67.0      X  Y                                                Z
   68.0      X  Y                                                Z
   69.0      X  Y                                                Z
```

```
                         FOOTING RESPONSE CURVE
                         ----------------------
    CURVE-X= ROT ABOUT X AXIS       CURVE-Y= ROT ABOUT Y AXIS
                      CURVE-Z= ROT ABOUT Z AXIS
  FREQ.
  Hertz                        ROTATION (rad)
            0.00E+00  1.00E-04  2.00E-04  3.00E-04  4.00E-04  5.00E-04
   51.0      +Z---Y----+---------+---------+---------+-X-------+
   52.0      IZ   Y                                  X
   53.0      IZ   Y                                  X
   54.0      IZ  Y                                   X
   55.0      IZ  Y                                   X
   56.0      IZ  Y                                   X
   57.0      IZ  Y                                   X
   58.0      IZ  Y                                   X
   59.0      IZ  Y                                   X
   60.0      IZ  Y                                   X
   61.0      +Z  Y                                   X
   62.0      IZ  Y                                   X
   63.0      IZ  Y                                   X
   64.0      IZ  Y                                   X
   65.0      IZ  Y                                   X
   66.0      IZ  Y                                   X
   67.0      IZ  Y                                   X
   68.0      IZ  Y                                   X
   69.0      IZ  Y                                   X
```

DYNA 6.0 Results Stiffness Table (Case 2)

7/16/2012

Frequency (Hz)	Horizontal Stiffness X (lb/ft)	Horizontal Damping X (lb/ft/S)	Horizontal Stiffness Y (lb/ft)	Horizontal Damping Y (lb/ft/S)	Vertical Stiffness Z (lb/ft)	Vertical Damping Z (lb/ft/S)
51	5.92E+08	1.05E+07	5.92E+08	1.05E+07	2.23E+08	1.51E+07
52	5.86E+08	1.05E+07	5.86E+08	1.05E+07	2.13E+08	1.51E+07
53	5.79E+08	1.05E+07	5.79E+08	1.05E+07	2.03E+08	1.51E+07
54	5.73E+08	1.05E+07	5.73E+08	1.05E+07	1.93E+08	1.51E+07
55	5.67E+08	1.05E+07	5.67E+08	1.05E+07	1.84E+08	1.51E+07
56	5.60E+08	1.05E+07	5.60E+08	1.05E+07	1.74E+08	1.51E+07
57	5.54E+08	1.05E+07	5.54E+08	1.05E+07	1.64E+08	1.51E+07
58	5.47E+08	1.05E+07	5.47E+08	1.05E+07	1.55E+08	1.51E+07
59	5.41E+08	1.05E+07	5.41E+08	1.05E+07	1.45E+08	1.51E+07
60	5.34E+08	1.05E+07	5.34E+08	1.05E+07	1.35E+08	1.51E+07
61	5.28E+08	1.05E+07	5.28E+08	1.05E+07	1.26E+08	1.51E+07
62	5.22E+08	1.05E+07	5.22E+08	1.05E+07	1.16E+08	1.51E+07
63	5.15E+08	1.05E+07	5.15E+08	1.05E+07	1.06E+08	1.51E+07
64	5.09E+08	1.05E+07	5.09E+08	1.05E+07	9.65E+07	1.51E+07
65	5.02E+08	1.05E+07	5.02E+08	1.05E+07	8.68E+07	1.51E+07
66	4.96E+08	1.05E+07	4.96E+08	1.05E+07	7.71E+07	1.51E+07
67	4.89E+08	1.05E+07	4.89E+08	1.05E+07	6.75E+07	1.51E+07
68	4.83E+08	1.05E+07	4.83E+08	1.05E+07	5.79E+07	1.51E+07
69	4.76E+08	1.05E+07	4.76E+08	1.05E+07	4.82E+07	1.51E+07

Frequency (Hz)	Rocking Stiffness X (lb/ft/Rad)	Rocking Damping X (lb.ft/Rad/S)	Rocking Stiffness Y (lb/ft/Rad)	Rocking Damping Y (lb.ft/Rad/S)	Torsional Stiffness Z (lb/ft/Rad)	Torsional Damping Z (lb.ft/Rad/S)
51	3.33E+11	7.35E+09	2.53E+11	4.49E+09	6.95E+11	6.86E+09
52	3.28E+11	7.35E+09	2.50E+11	4.49E+09	6.90E+11	6.86E+09
53	3.23E+11	7.35E+09	2.47E+11	4.49E+09	6.85E+11	6.86E+09
54	3.18E+11	7.36E+09	2.44E+11	4.50E+09	6.80E+11	6.86E+09
55	3.13E+11	7.36E+09	2.40E+11	4.50E+09	6.75E+11	6.87E+09
56	3.08E+11	7.36E+09	2.37E+11	4.50E+09	6.71E+11	6.87E+09
57	3.03E+11	7.36E+09	2.34E+11	4.50E+09	6.66E+11	6.87E+09
58	2.99E+11	7.36E+09	2.31E+11	4.50E+09	6.61E+11	6.87E+09
59	2.94E+11	7.36E+09	2.28E+11	4.50E+09	6.56E+11	6.87E+09
60	2.89E+11	7.36E+09	2.25E+11	4.50E+09	6.52E+11	6.87E+09
61	2.84E+11	7.36E+09	2.22E+11	4.50E+09	6.47E+11	6.87E+09
62	2.79E+11	7.36E+09	2.19E+11	4.50E+09	6.42E+11	6.87E+09
63	2.74E+11	7.36E+09	2.16E+11	4.50E+09	6.37E+11	6.87E+09
64	2.69E+11	7.36E+09	2.13E+11	4.50E+09	6.33E+11	6.87E+09
65	2.64E+11	7.37E+09	2.10E+11	4.50E+09	6.28E+11	6.87E+09
66	2.60E+11	7.37E+09	2.07E+11	4.50E+09	6.23E+11	6.87E+09
67	2.55E+11	7.37E+09	2.04E+11	4.50E+09	6.19E+11	6.87E+09
68	2.50E+11	7.37E+09	2.01E+11	4.50E+09	6.14E+11	6.88E+09
69	2.45E+11	7.37E+09	1.98E+11	4.50E+09	6.10E+11	6.88E+09

DYNA 6.0 Results Response Table (Case 2)

7/16/2012

Frequency(Hz)	Translational Response at CG - X (in)	Translational Response at CG - Y (in)	Translational Response at CG - Z (in)	Rotational Response at CG - X (Rad)	Rotational Response at CG - Y (Rad)	Rotational Response at CG - Z (Rad)
51	5.56E-04	6.20E-03	8.95E-02	3.72E-04	3.37E-05	3.60E-06
52	5.44E-04	6.06E-03	8.95E-02	3.72E-04	3.37E-05	3.58E-06
53	5.32E-04	5.94E-03	8.96E-02	3.72E-04	3.36E-05	3.57E-06
54	5.21E-04	5.81E-03	8.96E-02	3.72E-04	3.36E-05	3.56E-06
55	5.10E-04	5.70E-03	8.96E-02	3.72E-04	3.36E-05	3.54E-06
56	4.99E-04	5.58E-03	8.96E-02	3.71E-04	3.36E-05	3.53E-06
57	4.90E-04	5.47E-03	8.96E-02	3.71E-04	3.35E-05	3.52E-06
58	4.80E-04	5.36E-03	8.96E-02	3.71E-04	3.35E-05	3.51E-06
59	4.70E-04	5.27E-03	8.96E-02	3.71E-04	3.35E-05	3.50E-06
60	4.62E-04	5.17E-03	8.96E-02	3.71E-04	3.35E-05	3.49E-06
61	4.54E-04	5.08E-03	8.96E-02	3.71E-04	3.34E-05	3.48E-06
62	4.45E-04	4.99E-03	8.96E-02	3.71E-04	3.34E-05	3.48E-06

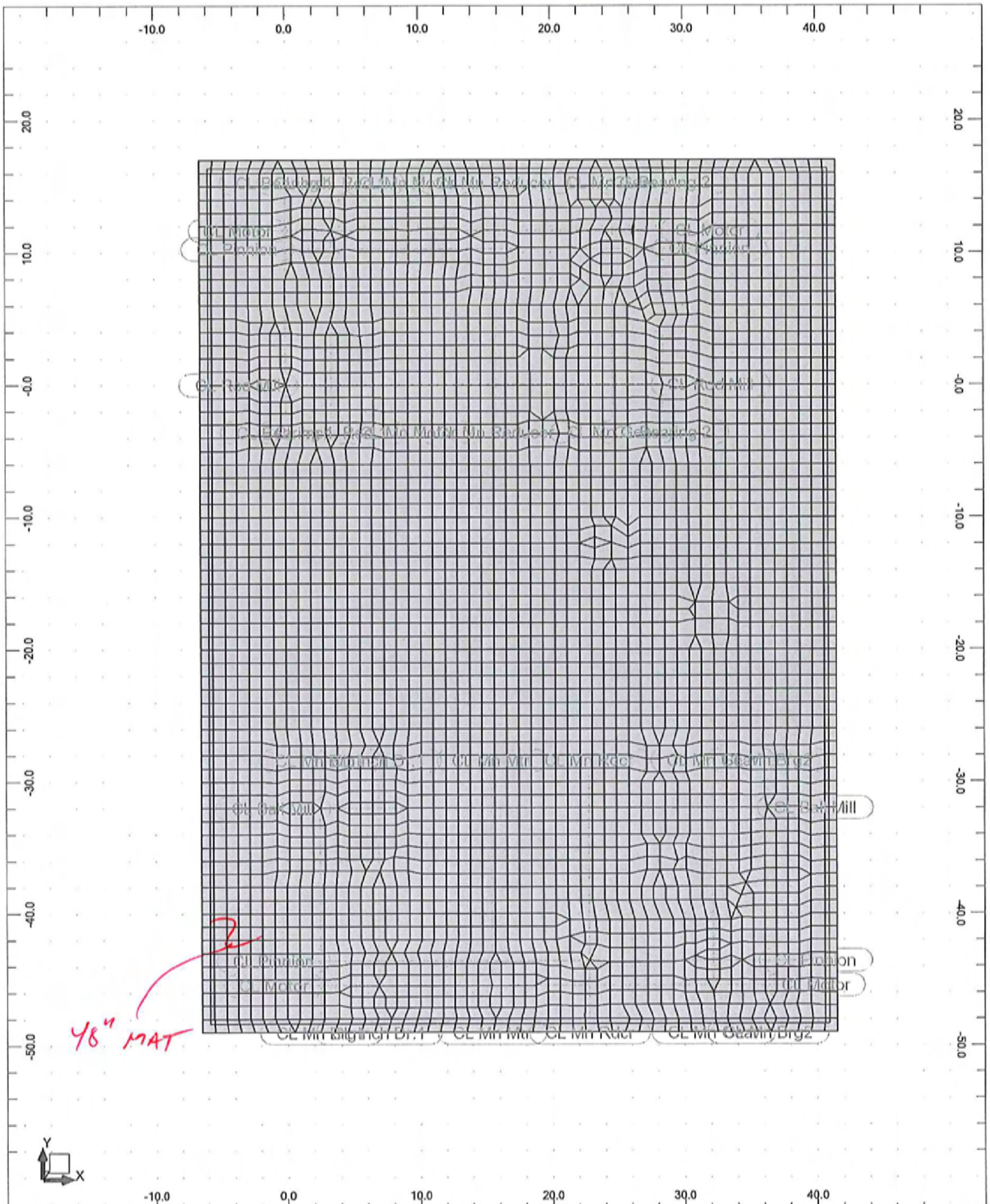
FLSMIDTH

7158 S. FLSmidth Drive
Midvale, UT 84047-5559

Engineer: **Ed Summers**
Calc No..: **C-005** Job.:**11021**
Project: **Mill Mat rev.1**
Client: **CC&V**

View - Cases: 1 (Self Weight)

MILL MAT - FINITE ELEMENTS



Date : 16/07/12
File: **Mill Mat rev.1.rtd**

Page : **1**
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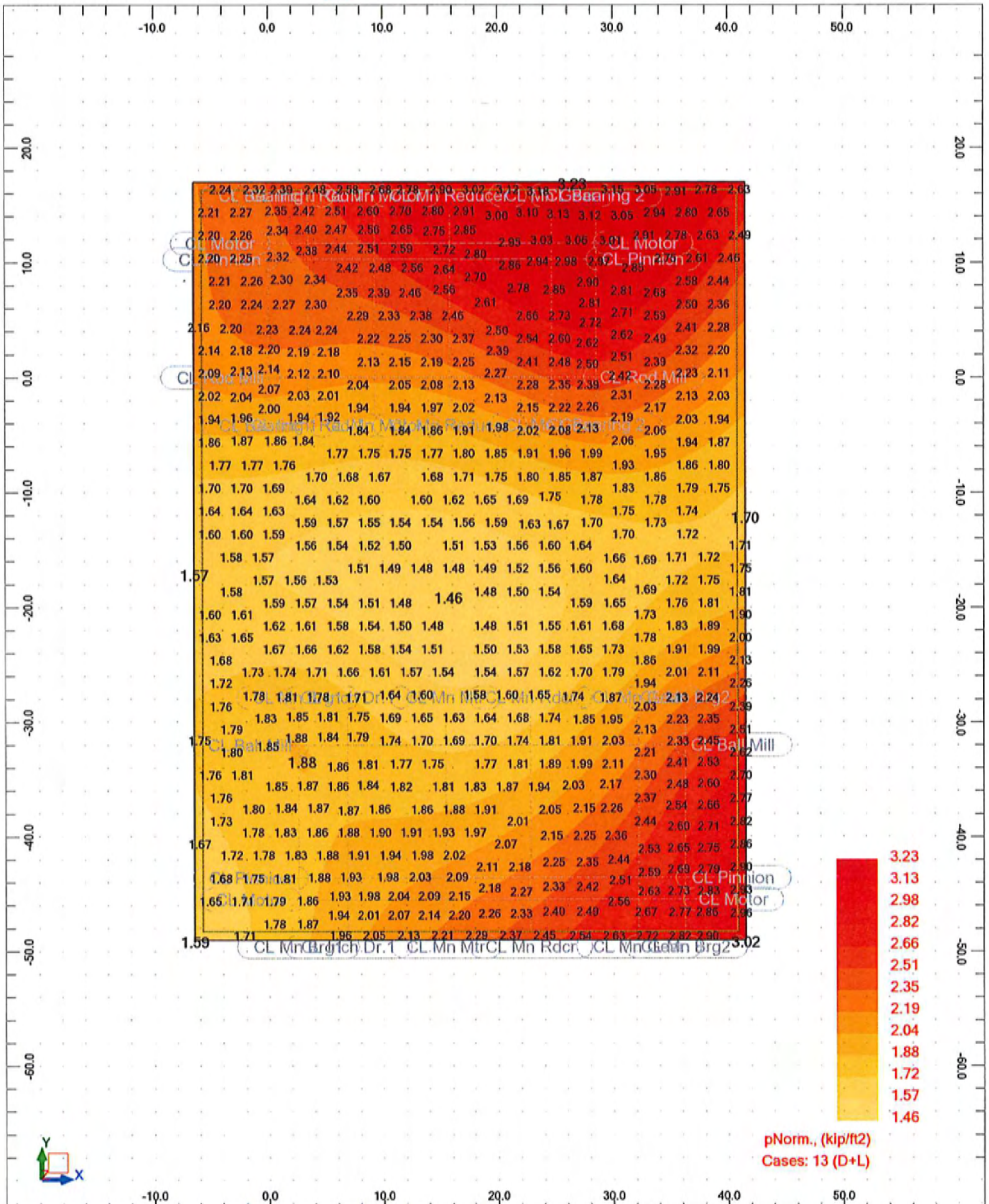
FLSmidth

7158 S. FLSmidth Drive
Midvale, UT 84047-5559

Engineer: **Ed Summers**
Calc No..: **C-005** Job.:**11021**
Project: **Mill Mat rev.1**
Client: **CC&V**

View - pNorm. (kip/ft2) Cases: 13 (D+L)

BEARING PRESSURE



Date : 16/07/12
File: **Mill Mat rev.1.rtd**

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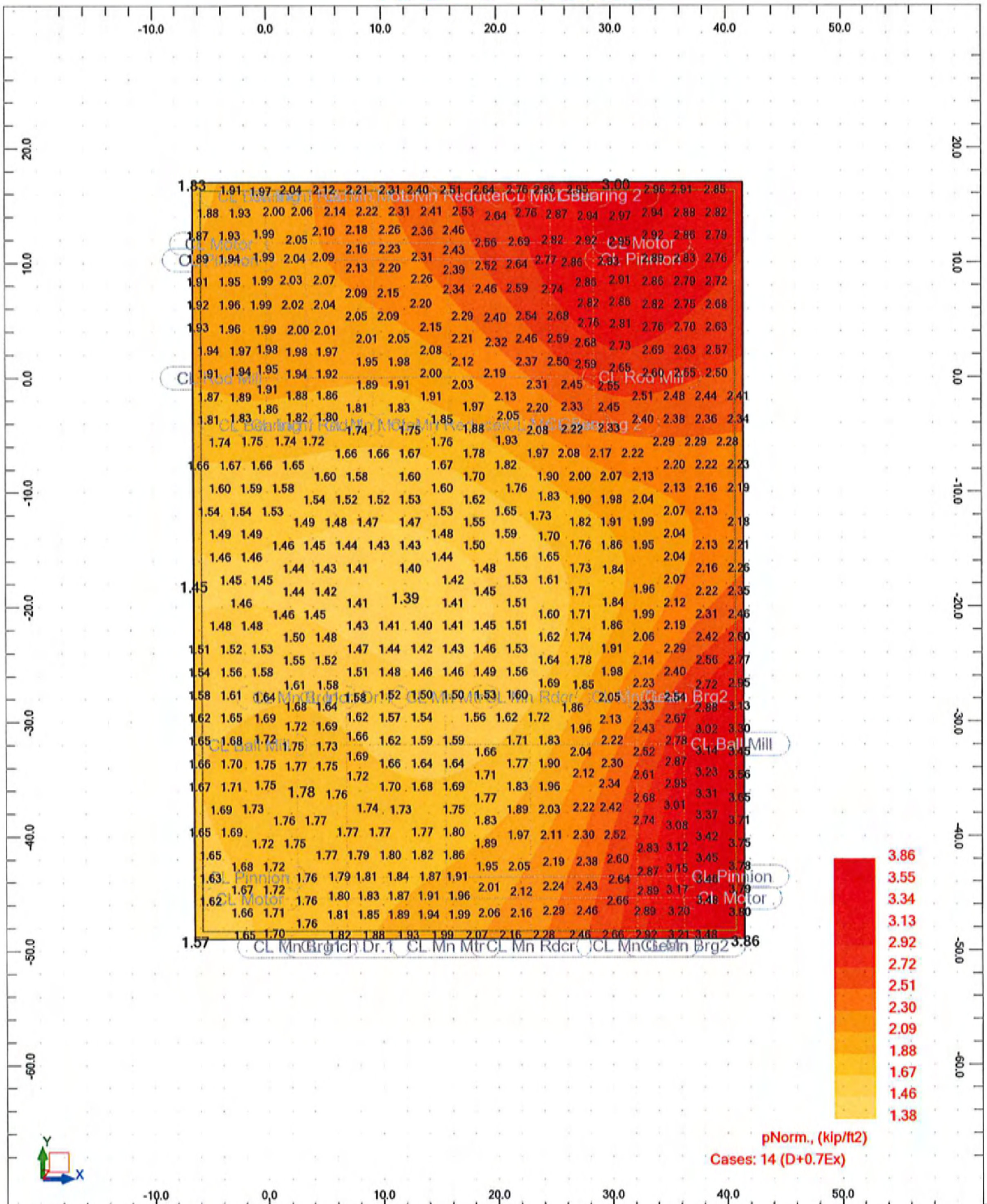
FLSMIDTH

7158 S. FLSmidth Drive
Midvale, UT 84047-5559

Engineer: **Ed Summers**
Calc No..: **C-005** Job.:**11021**
Project: **Mill Mat rev.1**
Client: **CC&V**

View - pNorm. (kip/ft2) Cases: 14 (D+0.7Ex)

BEARING PRESSURE



Date : 16/07/12
File: **Mill Mat rev.1.rtd**

Page : **1**
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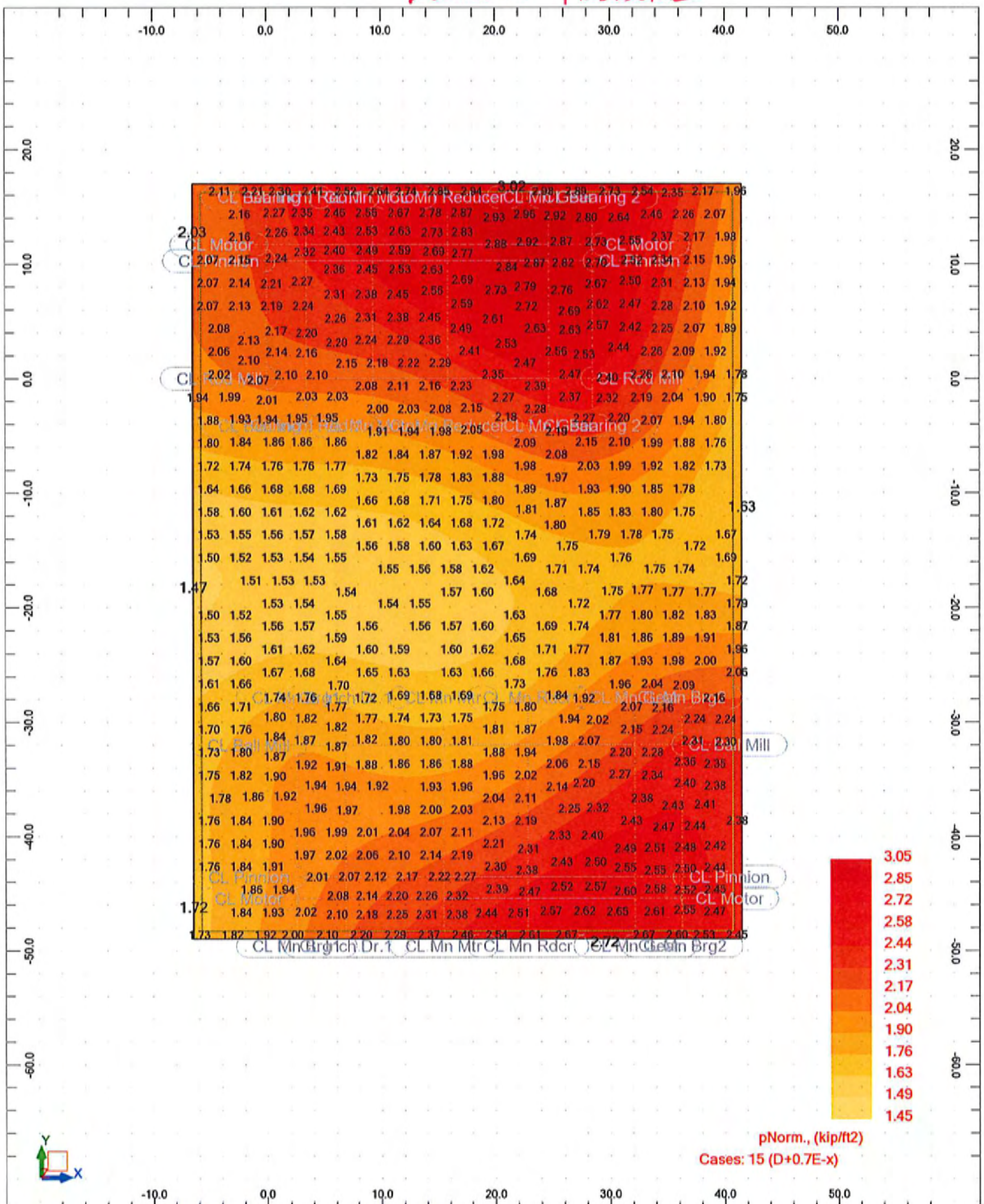
7158 S. FLSmidth Drive
Midvale, UT 84047-5559

Engineer: **Ed Summers**
Calc No..: **C-005** Job.:**11021**
Project: **Mill Mat rev.1**
Client: **CC&V**

View - pNorm. (kip/ft2) Cases: 15 (D+0.7E-x)

BEARING PRESSURE



Date : 16/07/12
File: **Mill Mat rev.1.rtd**

Page : **1**
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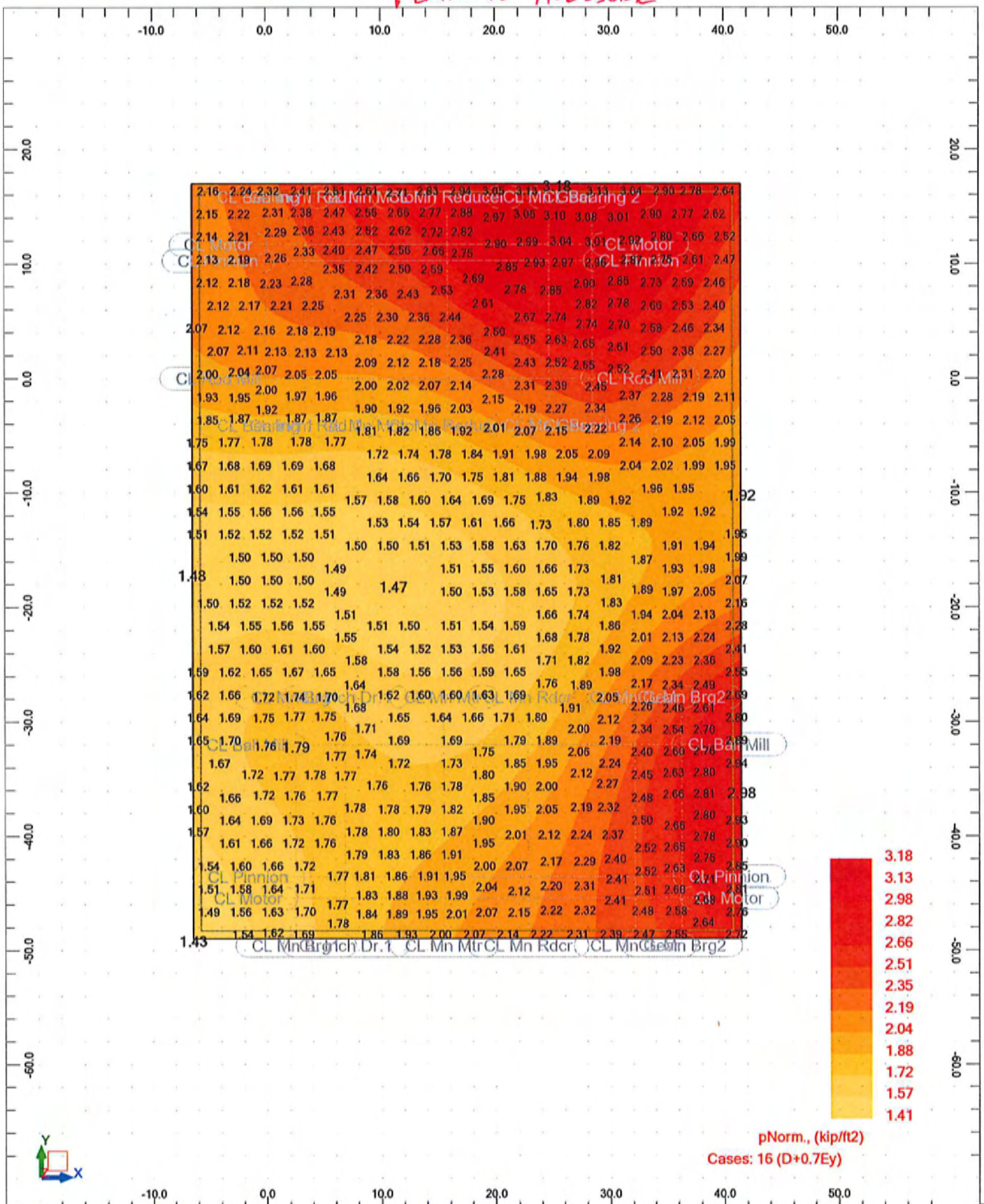
FLSMIDTH

7158 S. FLSmidth Drive
Midvale, UT 84047-5559

Engineer: **Ed Summers**
Calc No..: **C-005** Job.:**11021**
Project: **Mill Mat rev.1**
Client: **CC&V**

View - pNorm. (kip/ft2) Cases: 16 (D+0.7Ey)

BEARING PRESSURE



Date : 16/07/12
File: **Mill Mat rev.1.rtd**

Page : **1**
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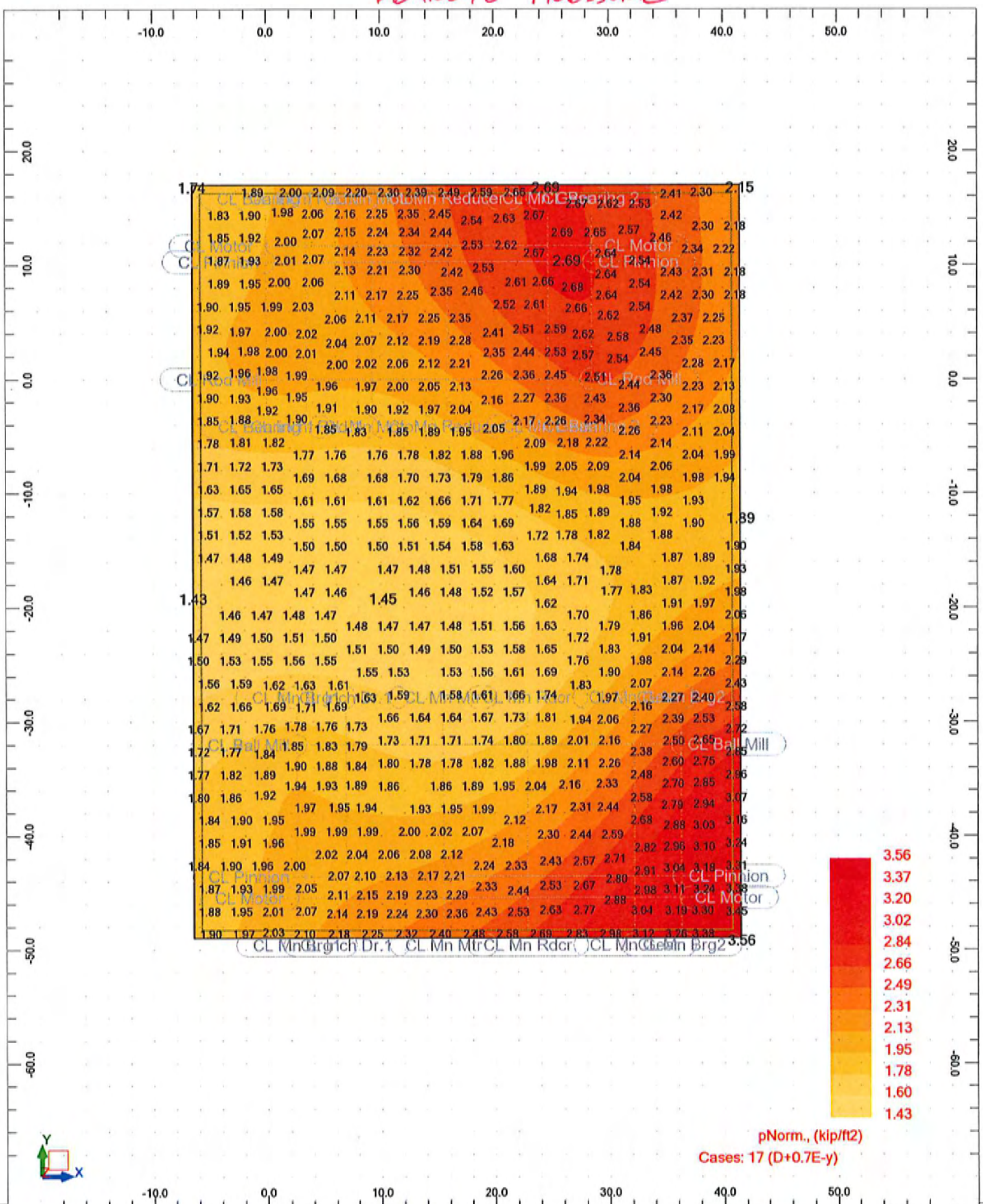
View - pNorm. (kip/ft2) Cases: 17 (D+0.7E-y)

BEARING PRESSURE



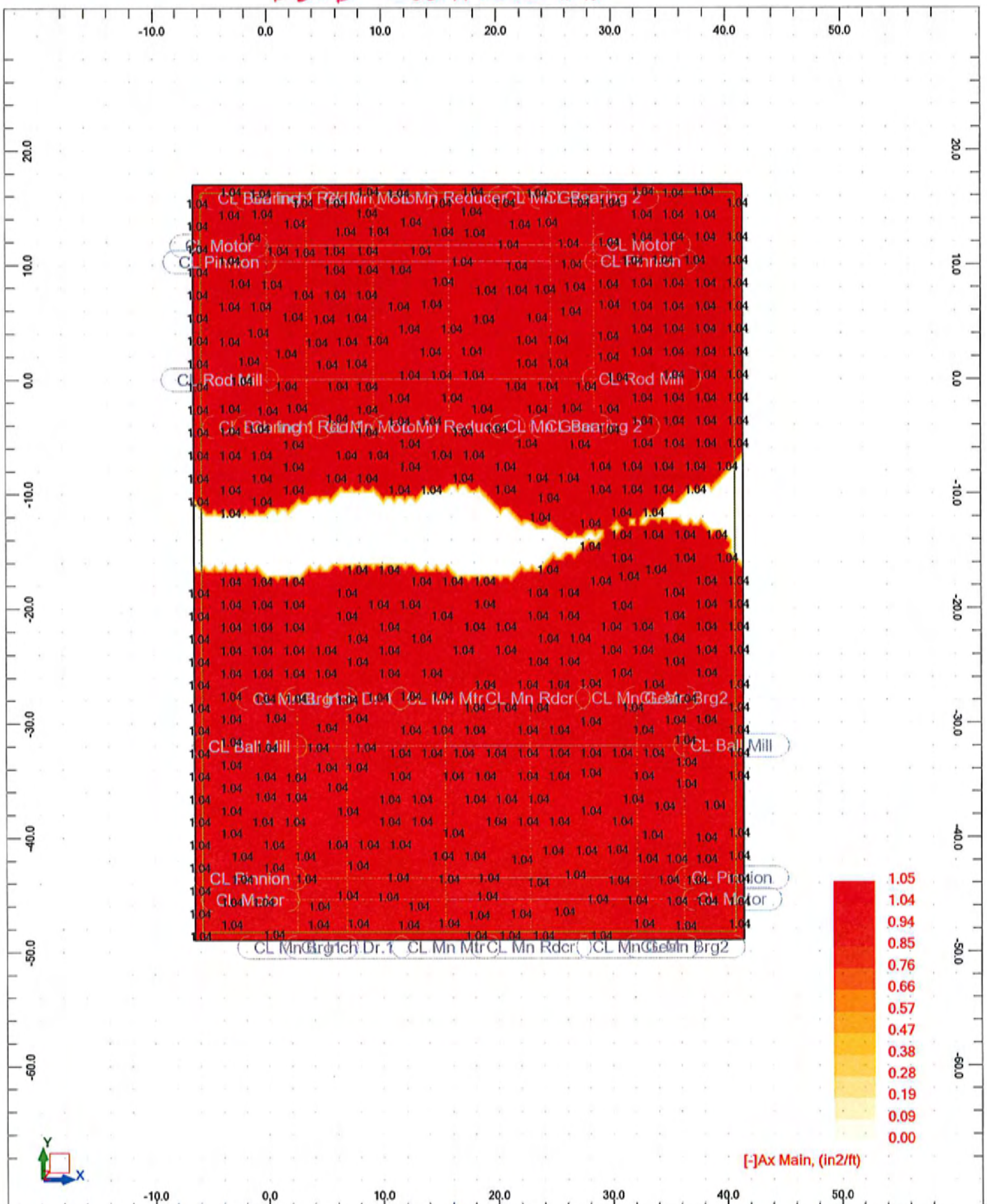
FLSMIDTH

7158 S. FLSmidth Drive
Midvale, UT 84047-5559

Engineer: **Ed Summers**
Calc No..: **C-005** Job.:**11021**
Project: **Mill Mat rev.1**
Client: **CC&V**

View - [-]Ax Main (in2/ft)

REQD REINFORCEMENT



Date : 16/07/12
File: **Mill Mat rev.1.rtd**

Page : **1**
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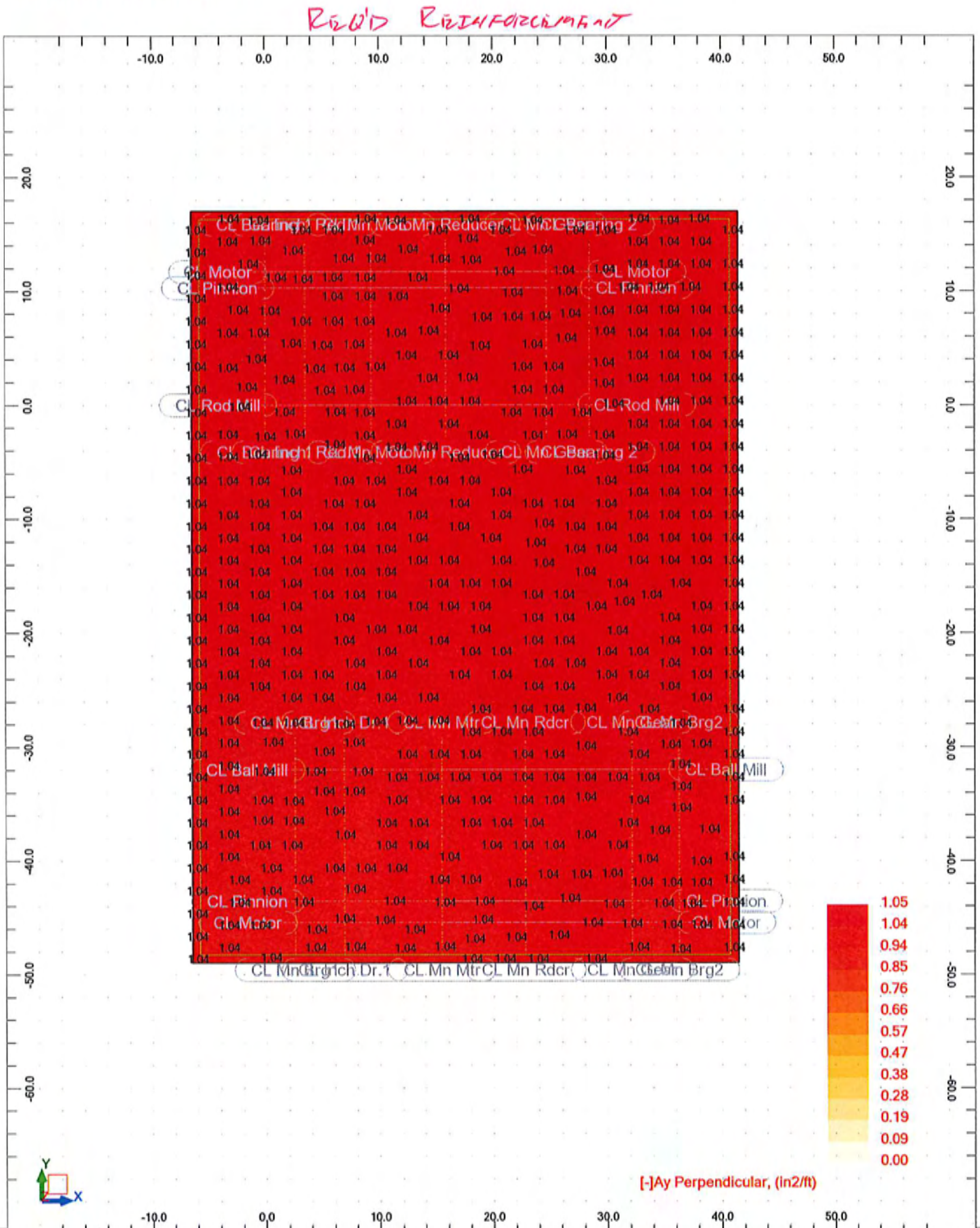
7158 S. FLSmidth Drive
Midvale, UT 84047-5559

Engineer: **Ed Summers**
Calc No..: **C-005** Job.:**11021**
Project: **Mill Mat rev.1**
Client: **CC&V**

View - [-]Ay Perpendicular (in2/ft)



Date : 16/07/12
File: **Mill Mat rev.1.rtd**

Page : **1**
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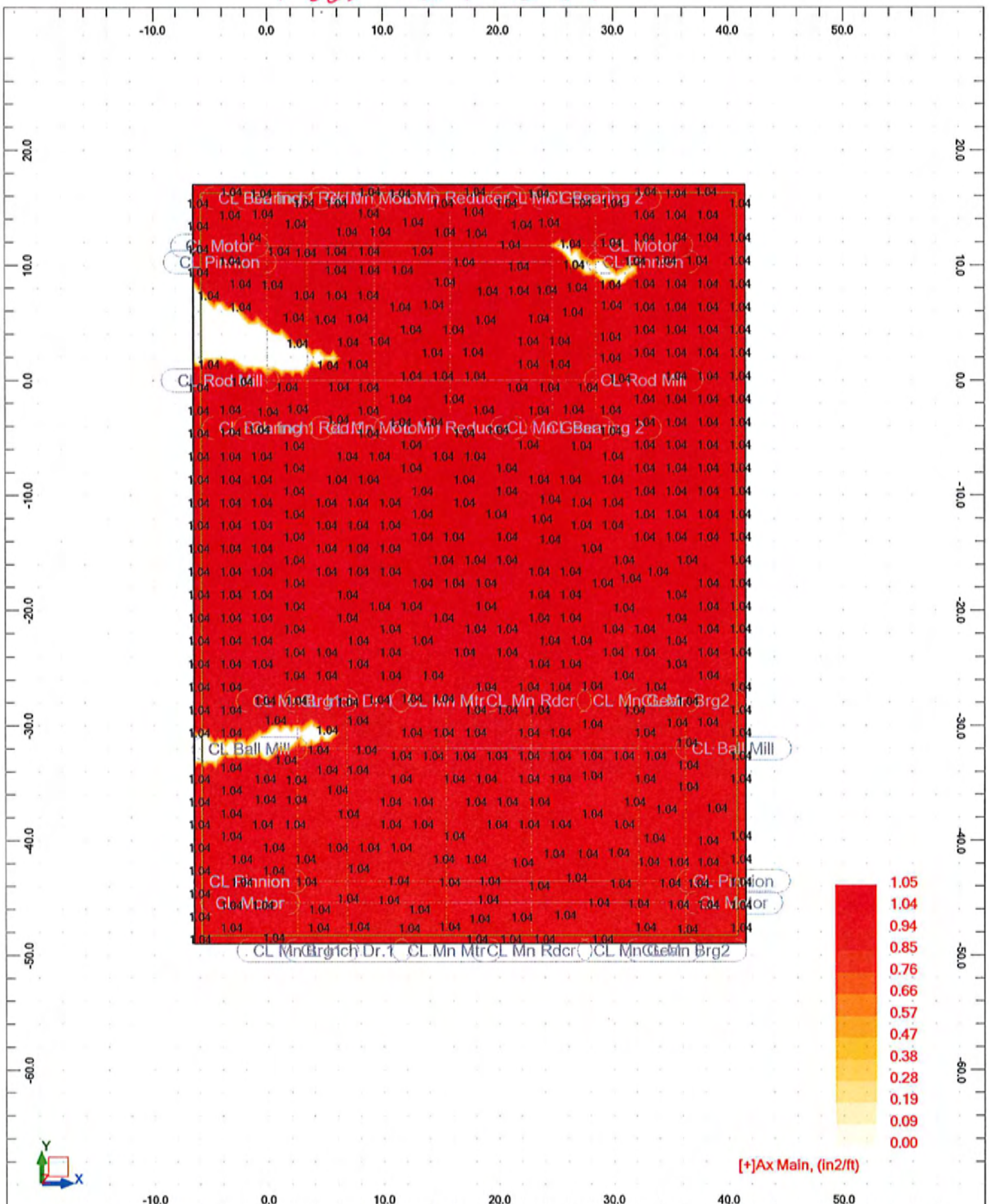
7158 S. FLSmidth Drive
Midvale, UT 84047-5559

Engineer: **Ed Summers**
Calc No..: **C-005** Job.:**11021**
Project: **Mill Mat rev.1**
Client: **CC&V**

View - [+]Ax Main (in2/ft)

REQ'D REINFORCEMENT



Date : 16/07/12
File: **Mill Mat rev.1.rtd**

Page : **1**
Robot 2012 © AutoDesk

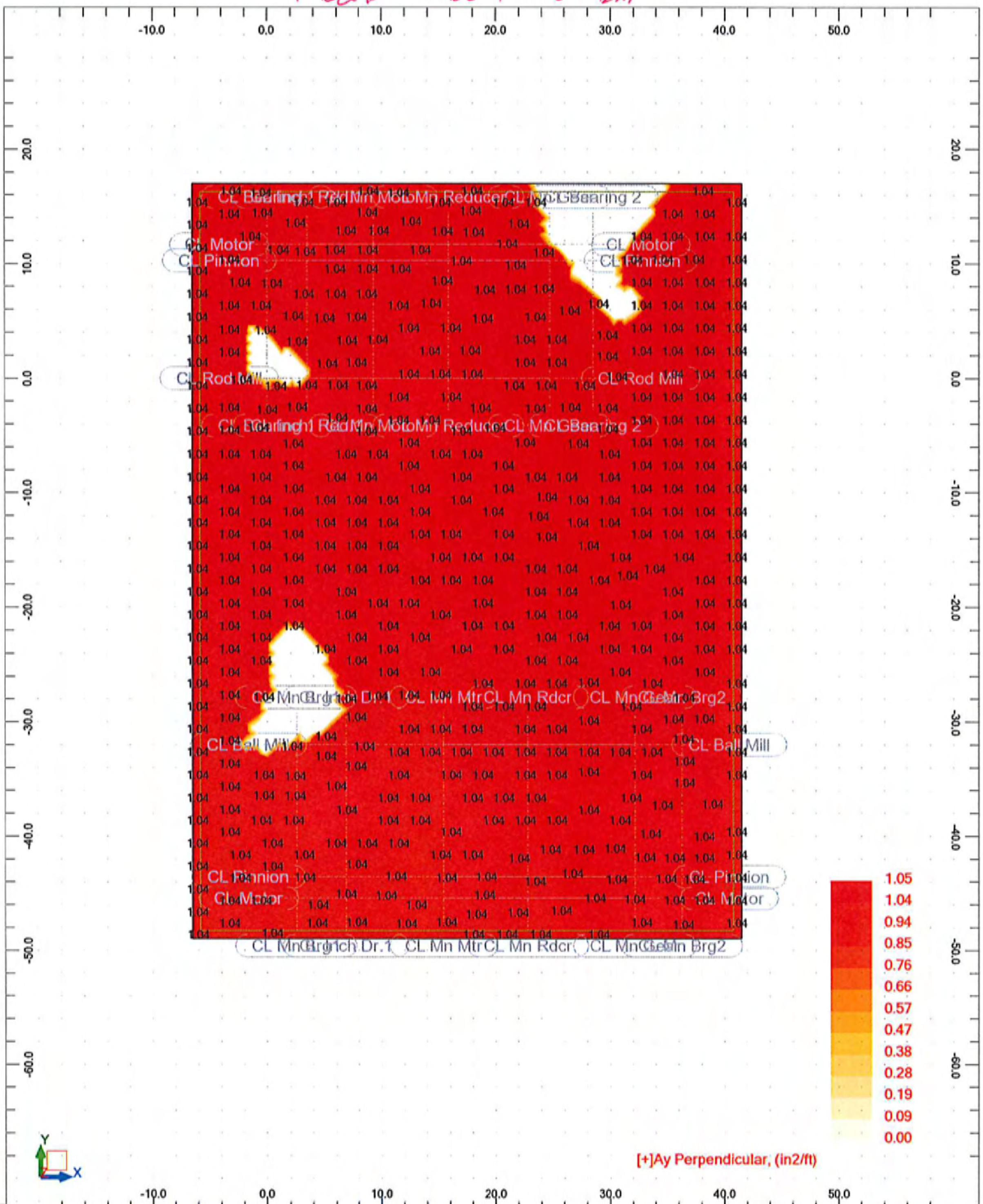
FLSMIDTH

7158 S. FLSmidth Drive
Midvale, UT 84047-5559

Engineer: **Ed Summers**
Calc No..: **C-005** Job.:**11021**
Project: **Mill Mat rev.1**
Client: **CC&V**

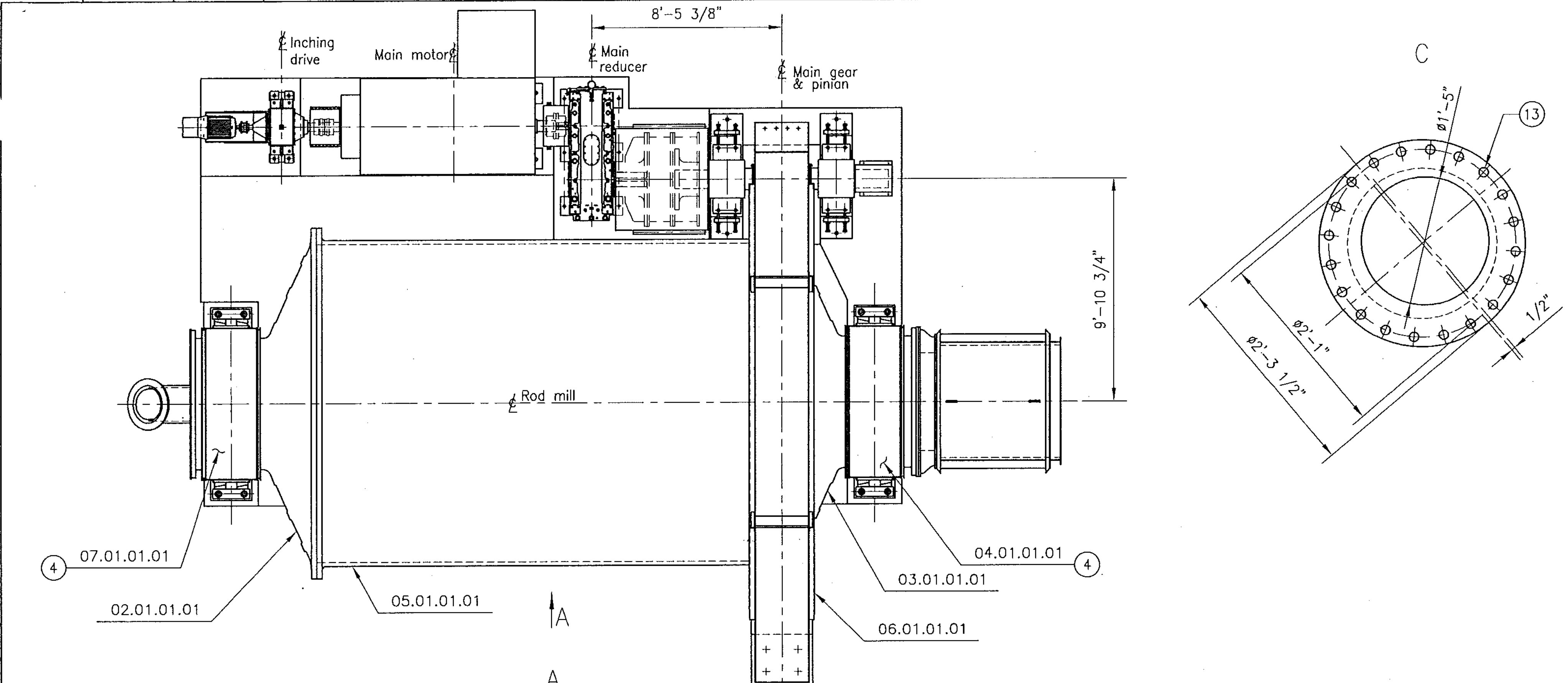
View - [+]Ay Perpendicular (in2/ft)

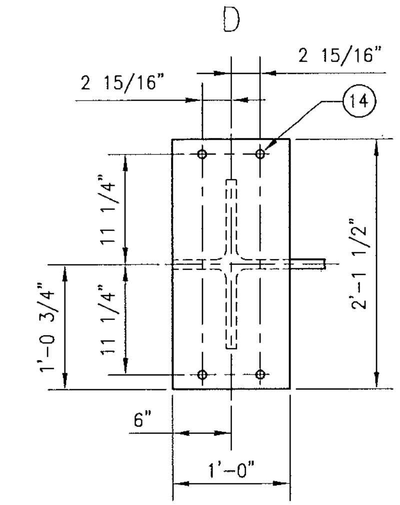
REQ'D REINFORCEMENT



Date : 16/07/12
File: **Mill Mat rev.1.rtd**

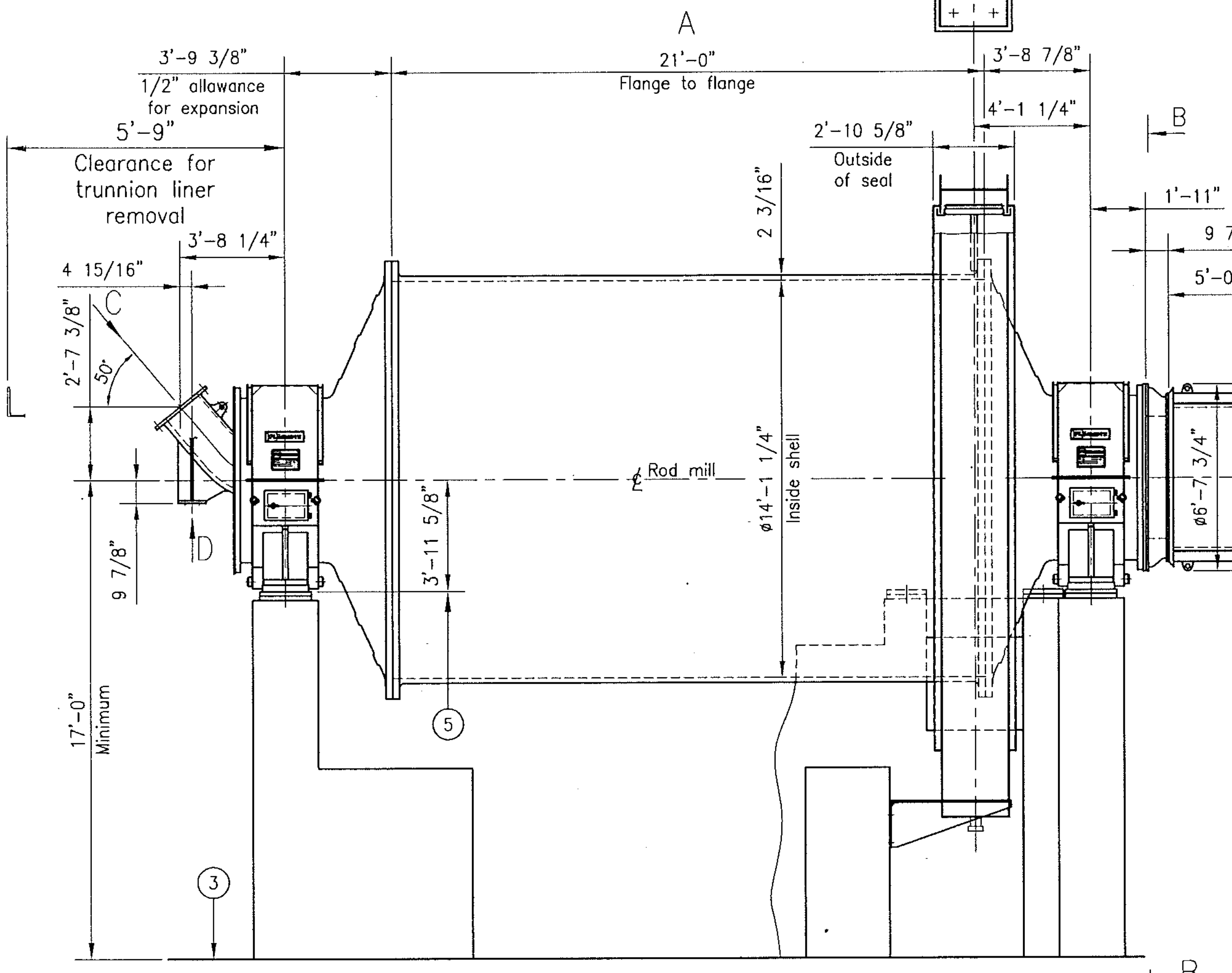
Page : **1**
Robot 2012 © AutoDesk

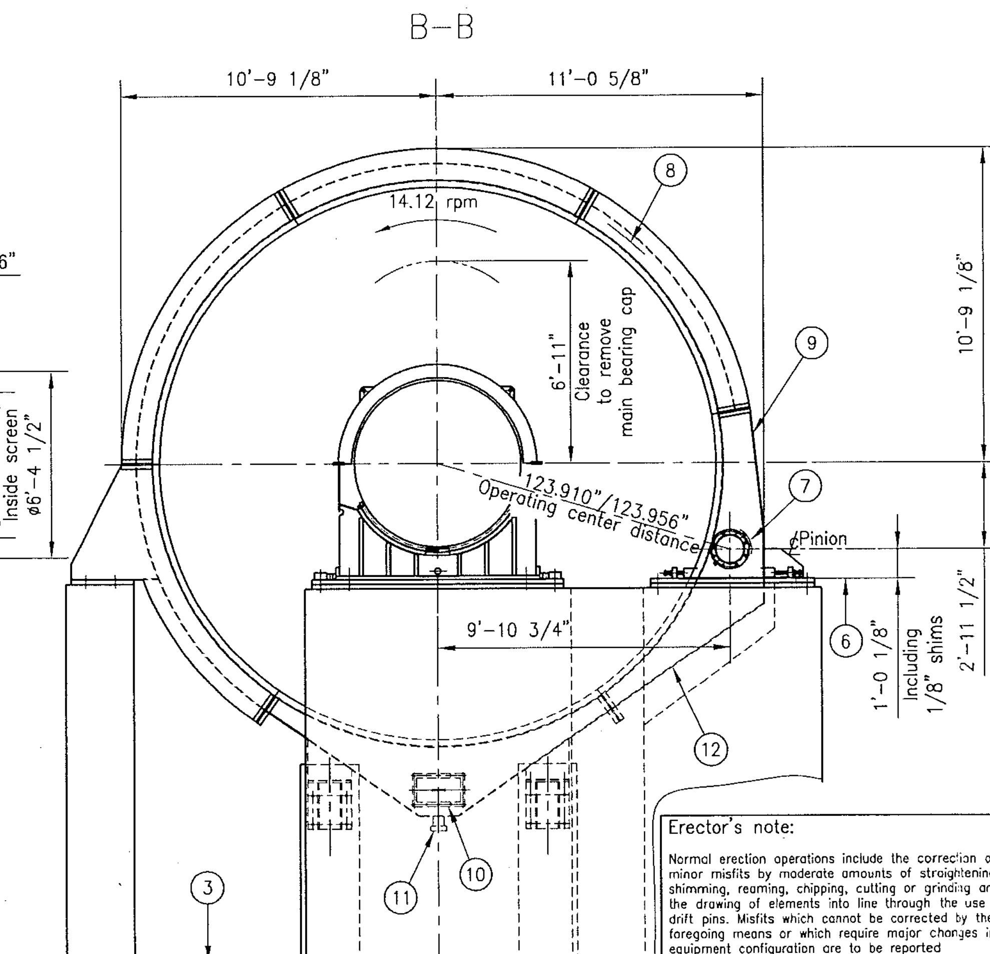




Project: High grade mill project
PO number: PR-11-100
Equipment: Rod mill
Equipment No.: 1720-647-003

FLSmidth
CERTIFIED FOR CONSTRUCTION
SIGNATURE
DATE 23 Apr 12





14. 4 x ø 1 1/8" holes, 1 3/16" grip.
13. 20 x ø 1 1/4" holes equally spaced and straddle centerlines, 1 1/4" grip.
12. This section of the gear guard is to be in place before assembling the main gear or pinion shaft.
11. 4" NPT pipe drain.
10. Clean out port (farside).
9. Gear spray system.
8. Main gear 266 teeth 2'-0" face.
7. Main pinion 18 teeth 2'-1/2" face.
6. Finish machined surface for pillow blocks.
5. Finish machined surface for main bearing.
4. 68" x 24" main bearing.
3. Reference line.
2. Use only "Certified print" for final setting.
1. All dimensions are in inches.

Erector's note:

Normal erection operations include the correction of minor misfits by moderate amounts of straightening, shimming, reaming, chipping, cutting or grinding and the drawing of elements into line through the use of drift pins. Misfits which cannot be corrected by the foregoing means or which require major changes in equipment configuration are to be reported immediately to the supplier by the erector, to enable the supplier either to correct the misfit or to approve the most efficient and economic method of correction to be implemented.

Scale:	Drawn	Appr.	Appr. Date	Zone/Descr.: General revision
5/16"=1'	IBA	SPN	23-Apr-12	

Cripple Creek & Victor Gold Mining Co – Cripple Creek, CO, USA

321 Rod mill
Rod mill 4.3m Dia. x 6.4m
Plan and elevation
Outline and Load Drawing

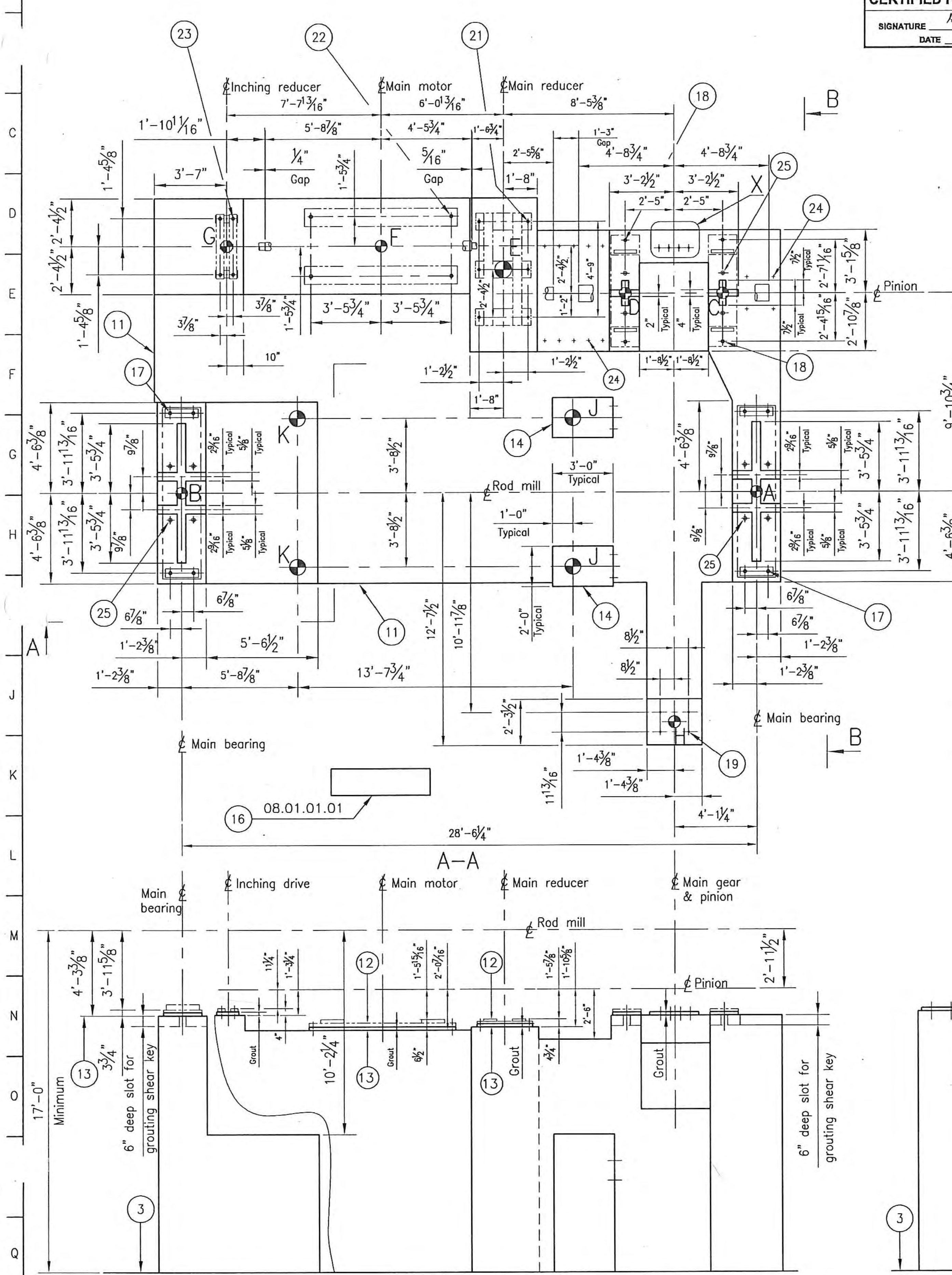
FLSmidth No.: 10269298 Ver.: 2.0

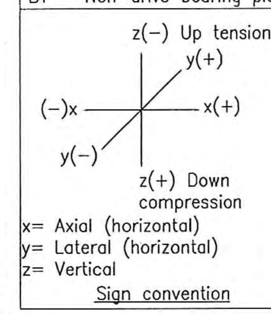
FLSMIDTH
CERTIFIED FOR CONSTRUCTION
SIGNATURE [signature]
DATE 23 Apr 12

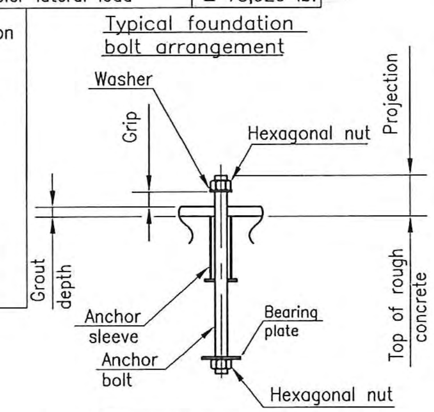
Foundation loads

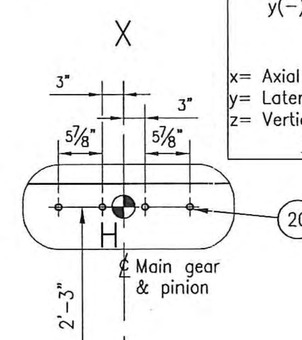
Based on 40% total charge including 40% Rods and metal liners
CCW rotation when facing discharge end

	Mass	Dynamic
AX – Drive bearing pier axial load	0	7,557 lb.
AY – Drive bearing pier lateral load	0	31,700 lb.
AZ – Drive bearing pier vertical load	493,000 lb.	–25,300 lb.
BX – Non-drive bearing pier axial load	0	0
BY – Non-drive bearing pier lateral load	0	44,500 lb.
BZ – Non-drive bearing pier vertical load	462,000 lb.	33,200 lb.
CX – Pinion pier axial load	0	0
CY – Pinion pier lateral load	0	27,600 lb.
CZ – Pinion pier vertical load	3,400 lb.	31,000 lb.
DX – Pinion pier axial load	0	–7,557 lb.
DY – Pinion pier lateral load	0	25,700 lb.
DZ – Pinion pier vertical load	6,100 lb.	–31,000 lb.
EX – Main reducer pier axial load	0	0
EY – Main reducer pier lateral load	0	0
EZ – Main reducer pier vertical load	6,430 Lb.	±10,850 lb.
FX – Main motor pier axial load	0	0
FY – Main motor pier lateral load	0	0
FZ – Main motor pier vertical load	17,000 Lb.	±3,525 lb.
GZ – Inching drive pier vertical load	2,150 Lb.	1,300 lb.
HZ – Gear guard pier vertical load (load per point)	8,800 Lb.	0
Jacking loads:		
JZ – Lift empty mill (load per point)	147,000 lb.	
KZ – Lift empty mill (load per point)	63,000 lb.	
JZ – Lift loaded mill (load per point)	290,500 lb.	
KZ – Lift loaded mill (load per point)	150,000 lb.	
Seismic loads (IBC 2003 Site class D)		
AX – Drive bearing pier axial load	± 152,800 lb.	
AY – Drive bearing pier lateral load	± 78,880 lb.	
BX – Non-drive bearing pier axial load	0	
BY – Non-drive bearing pier lateral load	± 73,920 lb.	

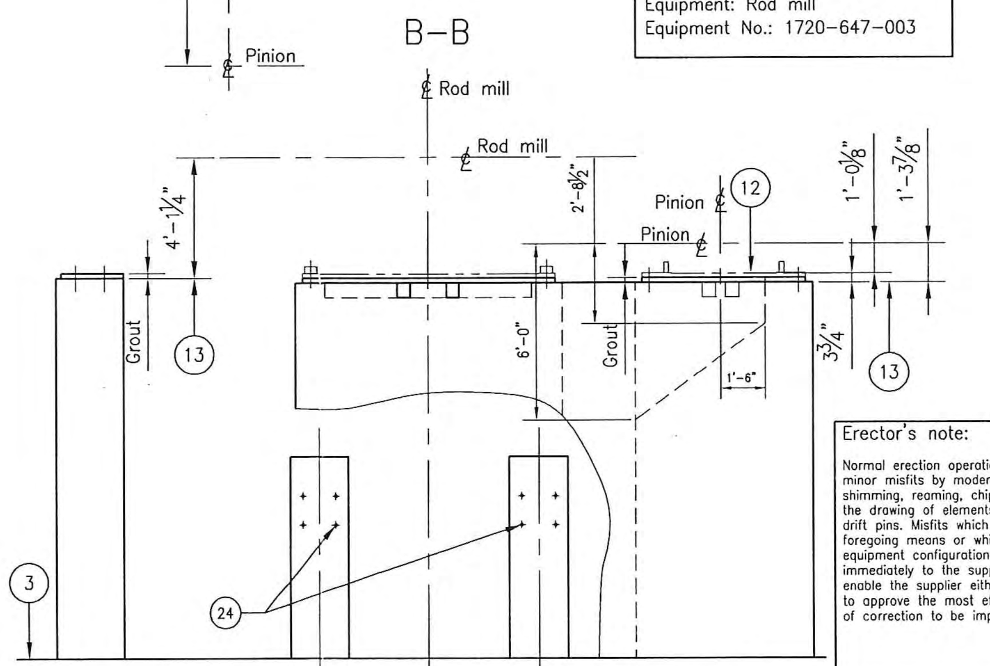








Project: High grade mill project
PO number: PR-11-100
Equipment: Rod mill
Equipment No.: 1720-647-003



29. Anchor bolts are to be located within 1/8" of the indicated position. Tolerance must not be accumulative.
28. Direction of dynamic loads are reversed during start-up and shut down.
27. Dynamic loads are based on 100% motor output torque. Foundation design shall consider starting and overload forces equal to motor pull out torque and not less than 200% of rated torque.
26. Operating WR^2 of mill referred to motor shaft is 4800 lb/ft^2 WR^2 includes 35% total charge including 35% rods, metal liners, pinion, clutch, reducer, and coupling.
25. Red head wedge anchor Cat. No. WS3470 (by others). Use to achieve soleplate flatness. Location to be established using the soleplates as templates.
24. Red head sleeve anchor Cat. No. HN3424 (by others). See note 10
23. 4 foundation bolts ø 1 1/2" x 2" grip, 7 1/4" projection.
22. 4 foundation bolts ø 1 3/4" x 2 3/8" grip, 8" projection.
21. 6 foundation bolts ø 1 1/4" x 1 1/2" grip, 6 1/2" projection.
20. 4 foundation bolts ø 3/4" x 5/8" grip, 5" projection.
19. 4 foundation bolts ø 3/4" x 1/2" grip, 4 1/2" projection.
18. 2 foundation bolts ø 2" x 2" grip, 7 1/4" projection.
17. 4 foundation bolts ø 2" x 4 3/4" grip, 10" projection.
16. Main bearing and pinion bearing lubrication system.
15. Foundation designer must provide adequate support for jacking cradle assembly. See jacking cradle assembly 10271541 for location.
14. Jacking pads.
13. Top of rough concrete.
12. Finish machined surface of soleplate.
11. It is suggested to tie the main drive end bearing and drive piers together as shown using an integral reinforced concrete foundation. All foundations should be tied together using an integral reinforced sub surface concrete mat. The mat is to be structurally capable of carrying all static and dynamic loads.
10. The location for the sleeve type anchors must be established using the guards and gear guard support brackets as templates at field installation. The maximum clearance between guards and stationary objects is 1/2" (anchors supplied by others).
9. Grout shall be high quality, non shrinking and have mechanical properties suitable for the static and dynamic loads specified. A pourable epoxy resin compound is recommended.
8. Allow for grout on top of mill bearing and drive piers as shown (approximately 2").
7. The foundation is to be designed so that no natural frequencies fall in the range of 53 Hz – 72 Hz. This is to ensure that no significant resonance occurs with the girth gear / pinion meshing frequency of 62.6 Hz.
6. Foundation bolts, nuts, washers, anchor sleeves and bearing plates are not supplied by FLSmidth mill group, unless specifically ordered.
5. Anchor bolts to be set in anchor sleeve to allow for adjustment.
4. Depth of foundation depends on nature of soil.
3. Reference line.
2. Use only "Certified print" for final setting.
1. All dimensions are in inches.

Important : Equipment foundations are the responsibility of the purchaser and shall be designed to meet the duty service, soil conditions and the specified operating loads. Foundation dimensions Shown by FLSmidth Inc. are intended to define the interface and battery limits for the equipment supplied and are not intended to imply or represent the final foundation design.

Erector's note:

Normal erection operations include the correction of minor misfits by moderate amounts of shimming, reaming, chipping, cutting or grinding and the drawing of elements into line through the use of drift pins. Misfits which cannot be corrected by the foregoing means or which require major changes in equipment configuration are to be reported immediately to the supplier by the erector, to enable the supplier either to correct the misfit or to approve the most efficient and economic method of correction to be implemented.

Scale:	Drawn	Appr.	Appr. Date	Zone/Descr.: General revision
5/16"=1'	IBA	SPN	23-Apr-12	

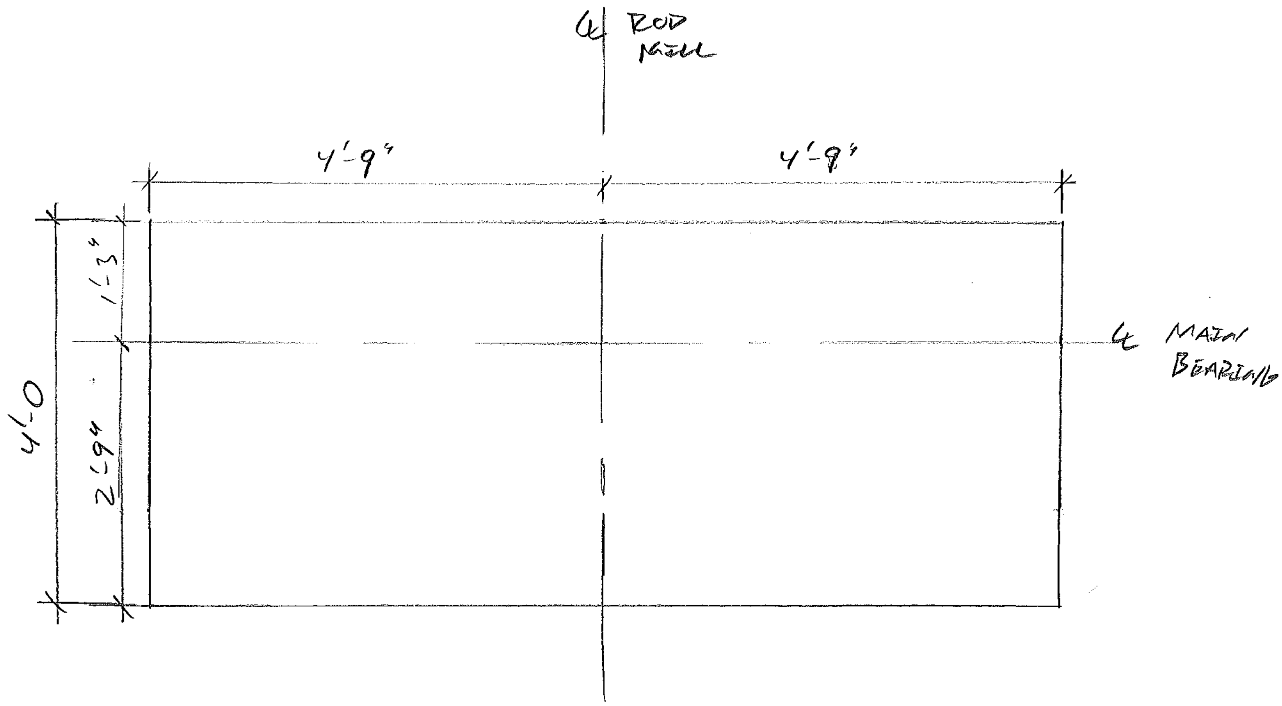
Cripple Creek & Victor Gold Mining Co – Cripple Creek, CO, USA

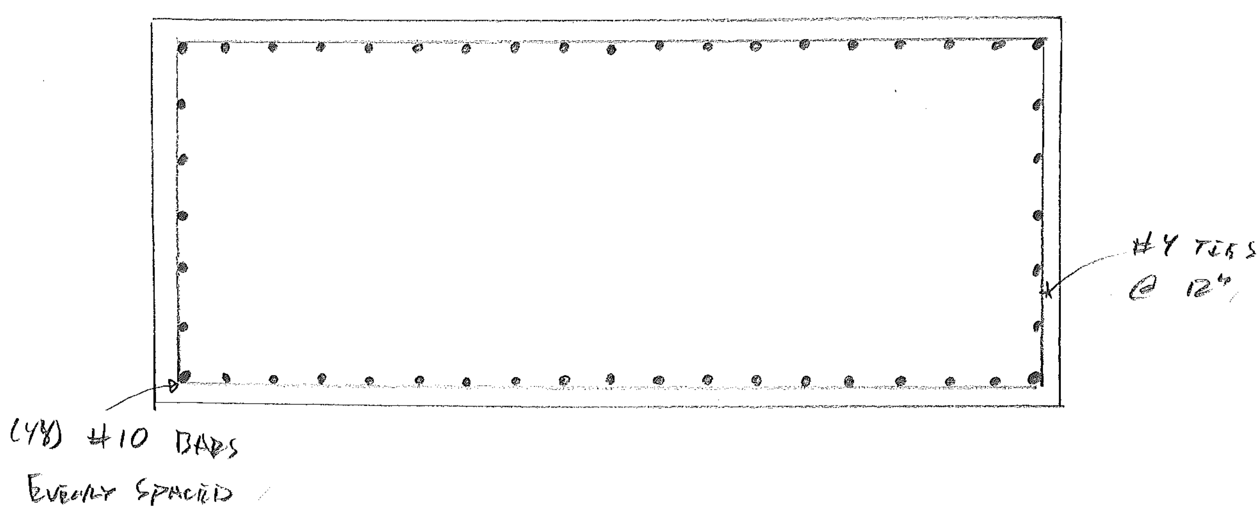
321 Rod mill
Rod mill 4.3m Dia. x 6.4m
Foundation and loads
Outline and Load Drawing

FLSMIDTH No.: 10269299 Ver.: 2.0

FLSMIDTH	PROJECT CC&V HIGH GRADE ORE	PROJ NO. 11021
		CALC NO. C-005
	SUBJECT ROD MILL FOUNDATION	BY ECS DATE 10-25-11
		CHK DATE
		SHEET OF REV

PEDESTAL A/B DESIGN





USE #5 @ 12"
EACH WAY
FOR TOP MAT

Concrete Pedestal Natural Period of Vibration
Pedestal A/B

Pedestal Dimensions:

$L_x := 4ft + 0in = 48\,in$ — Pedestal Length X Direction

$L_y := 9ft + 6in = 114\,in$ — Pedestal Length Y Direction

$H := 19ft + 3.375in = 231.375\,in$ — Pedestal Height

Concrete Properties:

$\gamma_c := 145pcf$ — Concrete Unit Weight

$f_c := 4000psi$ — Concrete Compressive Strength

$E := 57000psi \cdot \sqrt{\frac{f_c}{psi}} = 3.605 \times 10^3\,ksi$ — Concrete Modulus of Elasticity

Loads and Masses:

$m := L_x \cdot L_y \cdot H \cdot \frac{\gamma_c}{g} = 1.062 \times 10^5\,lb$ — Pedestal Mass

$F_x := 7557lb$ $\quad F_y := 44500lb$ — Applied Mass

$m_x := F_x + 0.23m = 3.199 \times 10^4\,lb$ $\quad m_y := F_y + 0.23m = 6.894 \times 10^4\,lb$ — Equivalent Mass

Dynamic Properties:

$I_x := \frac{L_x^3 \cdot L_y}{12} = 1.051 \times 10^6\,in^4$ $\quad I_y := \frac{L_x \cdot L_y^3}{12} = 5.926 \times 10^6\,in^4$ — Moment of Inertia

$k_x := \frac{(3 \cdot E \cdot I_x)}{H^3} = 1.101 \times 10^4\,\frac{kip}{ft}$ $\quad k_y := \frac{(3 \cdot E \cdot I_y)}{H^3} = 6.209 \times 10^4\,\frac{kip}{ft}$ — Stiffness Factor

$\omega_x := \sqrt{\frac{k_x}{0.23m}} = 120.392\,Hz$ $\quad \omega_y := \sqrt{\frac{k_y}{0.23m}} = 285.931\,Hz$ — Natural Frequency without added Mass

$\omega_{x.} := \sqrt{\frac{k_x}{m_x}} = 105.217\,Hz$ $\quad \omega_{y.} := \sqrt{\frac{k_y}{m_y}} = 170.235\,Hz$ — Natural Frequency with added Mass

```
OOOOOOO    OOOOO    OOOOO    OOOOO    OOOOO   OO
OO    OO  OO    OO  OO    OO  OO    OO  OO    OO  OO
OO    OO  OO    OO  OO    OO  OO    OO  OO    OO  OO
OO    OO  OO        OO    OO  OO        OO    OO  OO
OO    OO  OO        OOOOOOO   OO        OO    OO  OO
OOOOOOO   OO    OO  OO    OO  OO    OO  OO    OO  OO
OO        OO    OO  OO    OO  OO    OO  OO    OO  OO
OO         OOOOO    OO    OO   OOOOO     OOOOO    OOOOO   (TM)
```

===
Computer program for the Strength Design of Reinforced Concrete Sections
===

General Information:
====================

File Name: P:\11021\116 - Calculations\116.d - Arch_Civil_Struc\C-005 Grinding Area Concrete
Project: CC&V High Grade Ore
Column: A/B Engineer: ECS
Code: ACI 318-02 Units: English

Run Option: Investigation Slenderness: Not considered
Run Axis: Biaxial Column Type: Architectural

Material Properties:
====================

f'c = 4 ksi fy = 60 ksi
Ec = 3605 ksi Es = 29000 ksi
Ultimate strain = 0.003 in/in
Beta1 = 0.85

Section:
========

Rectangular: Width = 48 in Depth = 114 in

Gross section area, Ag = 5472 in^2
Ix = 5.92618e+006 in^4 Iy = 1.05062e+006 in^4
Xo = 0 in Yo = 0 in

Reinforcement:
==============

Rebar Database: ASTM A615

Size	Diam (in)	Area (in^2)	Size	Diam (in)	Area (in^2)	Size	Diam (in)	Area (in^2)
# 3	0.38	0.11	# 4	0.50	0.20	# 5	0.63	0.31
# 6	0.75	0.44	# 7	0.88	0.60	# 8	1.00	0.79
# 9	1.13	1.00	# 10	1.27	1.27	# 11	1.41	1.56
# 14	1.69	2.25	# 18	2.26	4.00			

Confinement: Tied; #3 ties with #7 bars, #4 with larger bars.
phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.65

Layout: Rectangular
Pattern: Equal Bar Spacing (Cover to transverse reinforcement)
Total steel area, As = 55.88 in^2 at 1.02%
44 #10 Cover = 2 in

Load Combinations:
==================

U1 = 1.400*Dead + 0.000*Live + 0.000*Wind + 0.000*EarthQuake
U2 = 1.200*Dead + 1.600*Live + 0.000*Wind + 0.000*EarthQuake
U3 = 1.200*Dead + 1.000*Live + 0.000*Wind + 0.000*EarthQuake
U4 = 1.200*Dead + 0.000*Live + 0.800*Wind + 0.000*EarthQuake
U5 = 1.200*Dead + 1.000*Live + 1.600*Wind + 0.000*EarthQuake
U6 = 0.900*Dead + 0.000*Live + 1.600*Wind + 0.000*EarthQuake
U7 = 1.200*Dead + 0.000*Live - 0.800*Wind + 0.000*EarthQuake
U8 = 1.200*Dead + 1.000*Live - 1.600*Wind + 0.000*EarthQuake
U9 = 0.900*Dead + 0.000*Live - 1.600*Wind + 0.000*EarthQuake
U10 = 1.200*Dead + 1.000*Live + 0.000*Wind + 1.000*EarthQuake
U11 = 0.900*Dead + 0.000*Live + 0.000*Wind + 1.000*EarthQuake
U12 = 1.200*Dead + 1.000*Live + 0.000*Wind - 1.000*EarthQuake
U13 = 0.900*Dead + 0.000*Live + 0.000*Wind - 1.000*EarthQuake

Service Loads:
==============

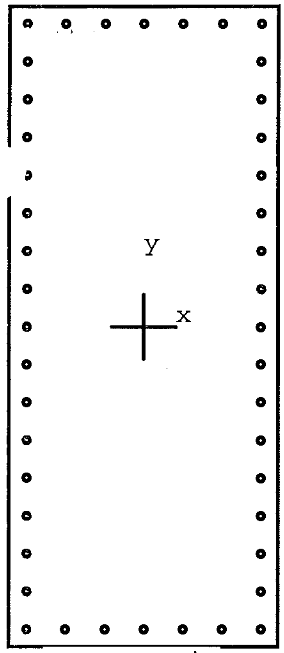
No.	Load Case	Axial Load kip	Mx @ Top k-ft	Mx @ Bot k-ft	My @ Top k-ft	My @ Bot k-ft
1	Dead	493.0	369.8	369.8	0.0	0.0
	Live	-25.3	0.0	856.6	0.0	145.5
	Wind	0.0	0.0	0.0	0.0	0.0
	E.Q.	0.0	0.0	1538.5	0.0	2926.0

Factored Loads and Moments with Corresponding Capacities: (see user's manual for notation)
===

NOTE: Each loading combination includes the following cases:
First line - at column top
Second line - at column bottom

No.	Load Combo	Pu kip	Mux k-ft	Muy k-ft	fMnx k-ft	fMny k-ft	fMn/Mu
1	1 U1	690.2	517.6	0.0	15274.1	0.0	29.507
2		690.2	-517.6	0.0	-15274.1	-0.0	29.507
3	1 U2	551.1	443.7	0.0	14812.7	0.0	33.384
4		551.1	-1814.3	-232.8	-14126.1	-1812.2	7.786
5	1 U3	566.3	443.7	0.0	14864.8	0.0	33.502
6		566.3	-1300.3	-145.5	-14303.5	-1600.2	11.000
7	1 U4	591.6	443.7	0.0	14949.5	0.0	33.693
8		591.6	-443.7	0.0	-14949.5	-0.0	33.693
9	1 U5	566.3	443.7	0.0	14864.8	0.0	33.502
10		566.3	-1300.3	-145.5	-14303.5	-1600.2	11.000
11	1 U6	443.7	332.8	0.0	14441.4	0.0	43.397
12		443.7	-332.8	0.0	-14441.4	-0.0	43.397
13	1 U7	591.6	443.7	0.0	14949.5	0.0	33.693
14		591.6	-443.7	0.0	-14949.5	-0.0	33.693
15	1 U8	566.3	443.7	0.0	14864.8	0.0	33.502
16		566.3	-1300.3	-145.5	-14303.5	-1600.2	11.000
17	1 U9	443.7	332.8	0.0	14441.4	0.0	43.397
18		443.7	-332.8	0.0	-14441.4	-0.0	43.397
19	1 U10	566.3	443.7	0.0	14864.8	0.0	33.502
20		566.3	-2838.8	-3071.5	-5442.0	-5888.0	1.917
21	1 U11	443.7	332.8	0.0	14441.4	0.0	43.397
22		443.7	-1871.3	-2926.0	-3731.7	-5835.1	1.994
23	1 U12	566.3	443.7	0.0	14864.8	0.0	33.502
24		566.3	238.2	2780.5	538.4	6285.1	2.260
25	1 U13	443.7	332.8	0.0	14441.4	0.0	43.397
26		443.7	1205.7	2926.0	2445.8	5935.5	2.029

*** Program completed as requested! ***



Code: ACI 318-02

Units: English

Run axis: Biaxial

Run option: Investigation

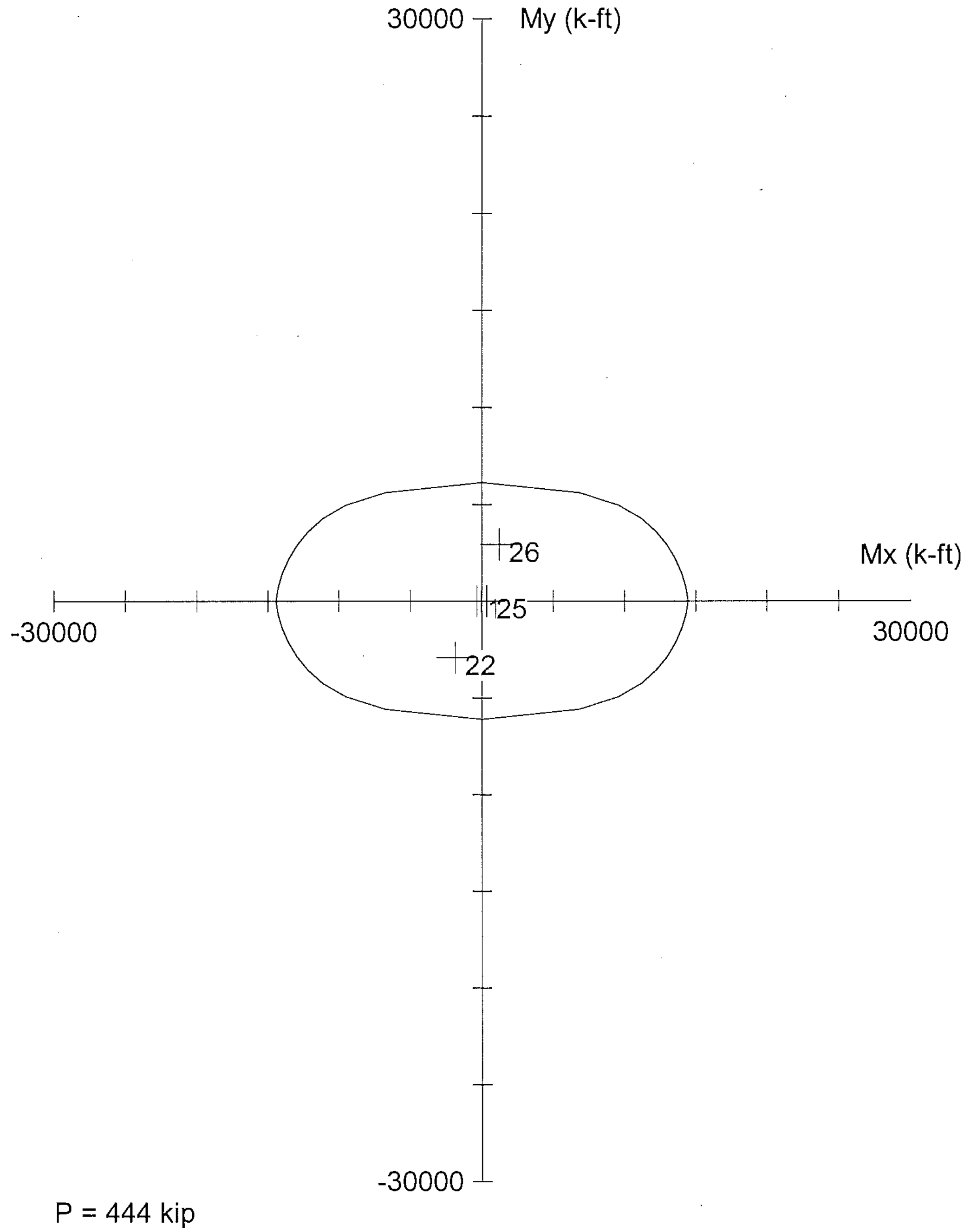
Slenderness: Not considered

Column type: Architectural

Bars: ASTM A615

Date: 10/25/11

Time: 15:38:24



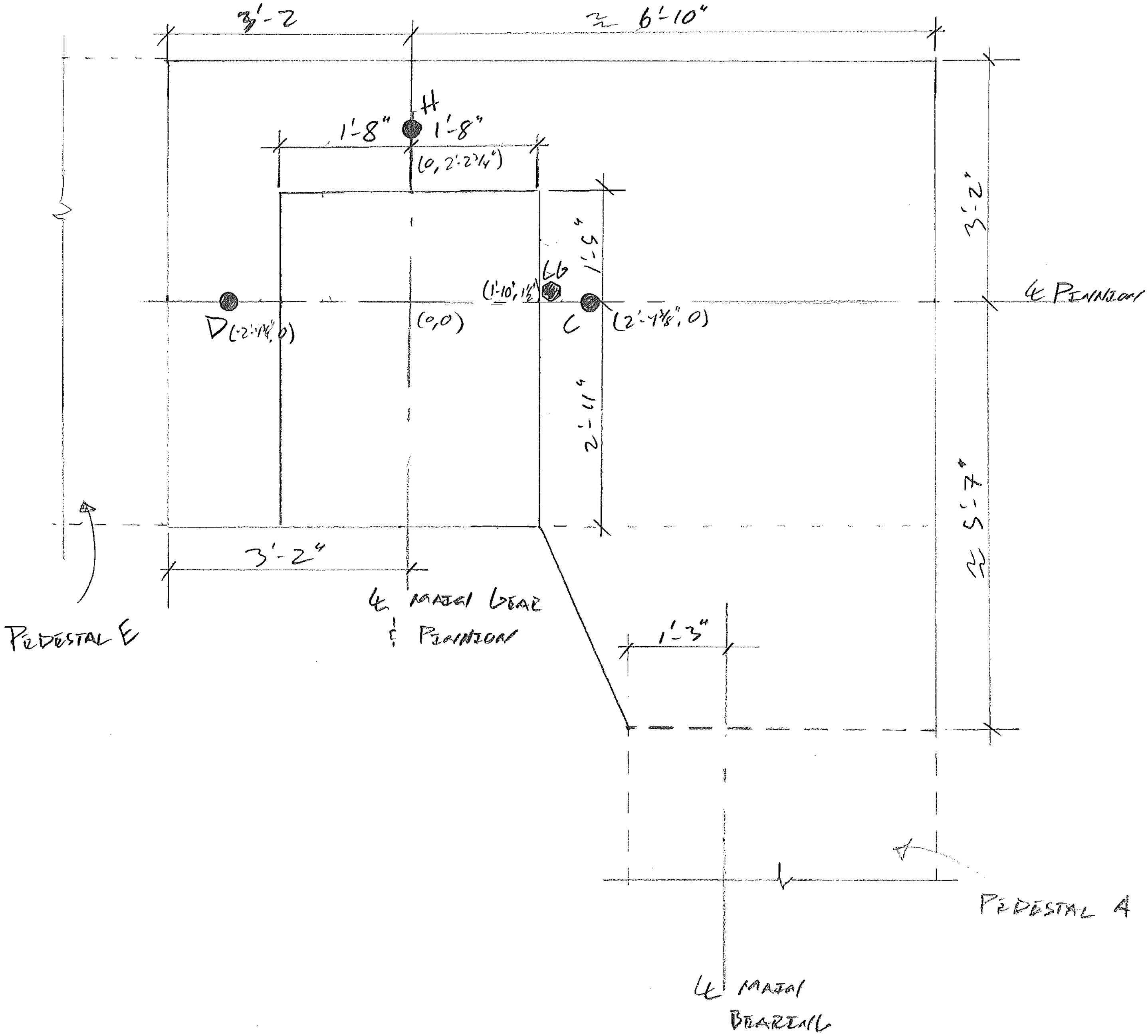
pcaColumn v3.63 - Licensed to: FLSmidth

File: P:\11021\116 - Calculations\116.d - Arch_Civil_Struc\C-005 Grinding Area Concrete\Column A-B.col

Project: CC&V High Grade Ore

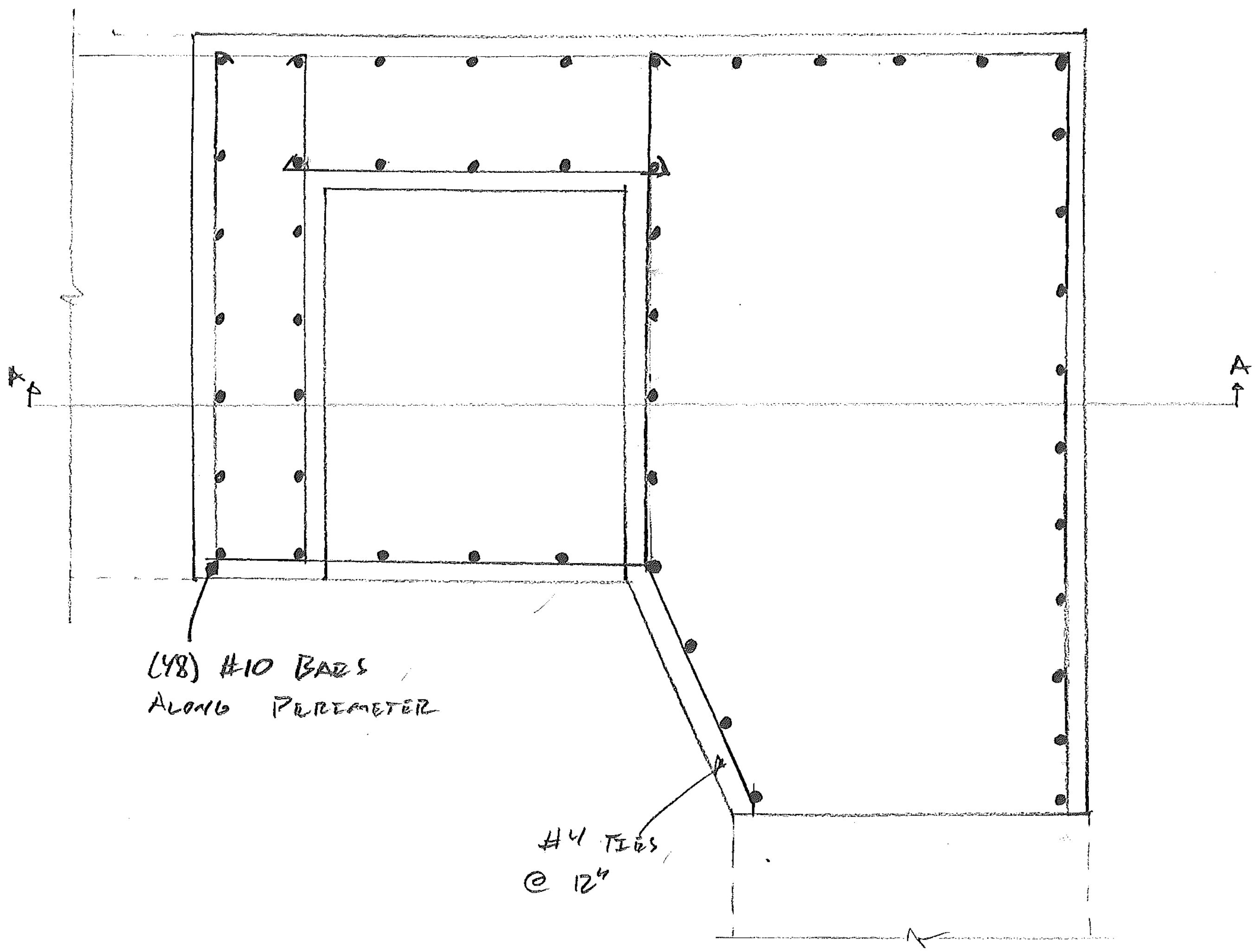
Column: A/B		Engineer: ECS	
f'c = 4 ksi	fy = 60 ksi	Ag = 5472 in^2	44 #10 bars
Ec = 3605 ksi	Es = 29000 ksi	As = 55.88 in^2	Rho = 1.02%
fc = 3.4 ksi	fc = 3.4 ksi	Xo = 0.00 in	Ix = 5.92618e+006 in^4
ı = 0.003 in/in		Yo = 0.00 in	Iy = 1.05062e+006 in^4
Beta1 = 0.85		Clear spacing = 5.46 in	Clear cover = 2.50 in
Confinement: Tied	phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.65		

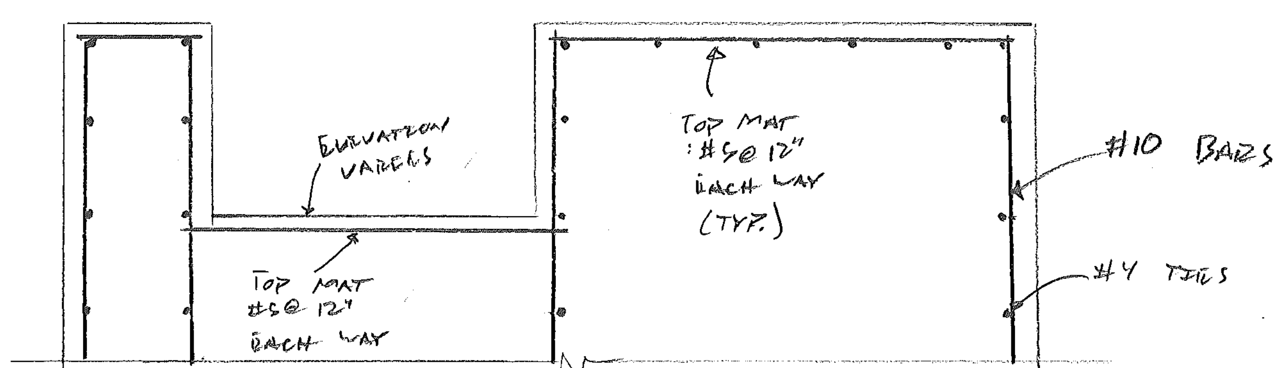
PEDESTAL C/D DESIGN



FLSmidth	PROJECT CC & V High Grade Ore	PROJ NO. 11021
	SUBJECT Rod Mill Foundation	CALC NO. C-005
		BY ECS DATE 10-26-11
		CHK DATE
		SHEET OF REV

PEDESTAL L/D DESIGN:





A-A

Pedestal C/D Loading

Pedestal Height (ft): 19.25

Load Locations:

Using CL Main Gear & CL Pinnion as Axis Origin

	X (ft)	Y (ft)
Pedestal Center of Gravity	1.83	0.13

Location	Coordinates		Eccentricity	
	X (ft)	Y (ft)	e_x (ft)	e_y (ft)
C	2.36	0.00	0.53	-0.13
D	-2.36	0.00	-4.20	-0.13
H	0.00	2.23	-1.83	2.10

Dead Load:

Location	F_x (kip)	F_y (kip)	F_z (kip)	M_x (k*ft)		M_y (k*ft)	
				Top	Bot	Top	Bot
C	0.0	0.0	3.4	-0.4	-0.4	1.8	1.8
D	0.0	0.0	6.1	-0.8	-0.8	-25.6	-25.6
H	0.0	0.0	8.8	18.5	18.5	-16.1	-16.1
Result	**0.0**	**0.0**	**18.3**	**17.3**	**17.3**	**-39.9**	**-39.9**

Live Load:

Location	F_x (kip)	F_y (kip)	F_z (kip)	M_x (k*ft)		M_y (k*ft)	
				Top	Bot	Top	Bot
C	0.0	27.6	31.0	-3.9	527.4	16.5	16.5
D	-7.6	25.7	-31.0	3.9	498.6	130.1	-15.3
H	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Result	**-7.6**	**53.3**	**0.0**	**0.0**	**1026.0**	**146.6**	**1.1**

Concrete Pedestal Natural Period of Vibration
Pedestal C/D

Pedestal Dimensions:

$L_x := 10ft + 0in = 120\ in$ — Pedestal Length X Direction

$L_y := 6ft + 1in = 73\ in$ — Pedestal Length Y Direction

$H := 19ft + 3.375in = 231.375\ in$ — Pedestal Height

Concrete Properties:

$\gamma_c := 145pcf$ — Concrete Unit Weight

$f_c := 4000psi$ — Concrete Compressive Strength

$E := 57000psi \cdot \sqrt{\frac{f_c}{psi}} = 3.605 \times 10^3\ ksi$ — Concrete Modulus of Elasticity

Loads and Masses:

$m := L_x \cdot L_y \cdot H \cdot \frac{\gamma_c}{g} = 1.701 \times 10^5\ lb$ — Pedestal Mass

$F_x := 7557lb$ $\quad F_y := 53300lb$ — Applied Mass

$m_x := F_x + 0.23m = 4.667 \times 10^4\ lb$ $\quad m_y := F_y + 0.23m = 9.242 \times 10^4\ lb$ — Equivalent Mass

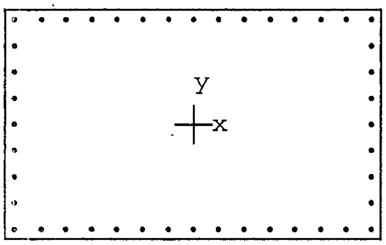
Dynamic Properties:

$I_x := \frac{L_x^3 \cdot L_y}{12} = 1.051 \times 10^7\ in^4$ $\quad I_y := \frac{L_x \cdot L_y^3}{12} = 3.89 \times 10^6\ in^4$ — Moment of Inertia

$k_x := \frac{(3 \cdot E \cdot I_x)}{H^3} = 1.101 \times 10^5\ \frac{kip}{ft}$ $\quad k_y := \frac{(3 \cdot E \cdot I_y)}{H^3} = 4.076 \times 10^4\ \frac{kip}{ft}$ — Stiffness Factor

$\omega_x := \sqrt{\frac{k_x}{0.23m}} = 300.98\ Hz$ $\quad \omega_y := \sqrt{\frac{k_y}{0.23m}} = 183.096\ Hz$ — Natural Frequency without added Mass

$\omega_{x.} := \sqrt{\frac{k_x}{m_x}} = 275.54\ Hz$ $\quad \omega_{y.} := \sqrt{\frac{k_y}{m_y}} = 119.121\ Hz$ — Natural Frequency with added Mass



120 x 73 in

Code: ACI 318-02

Units: English

Run axis: Biaxial

Run option: Investigation

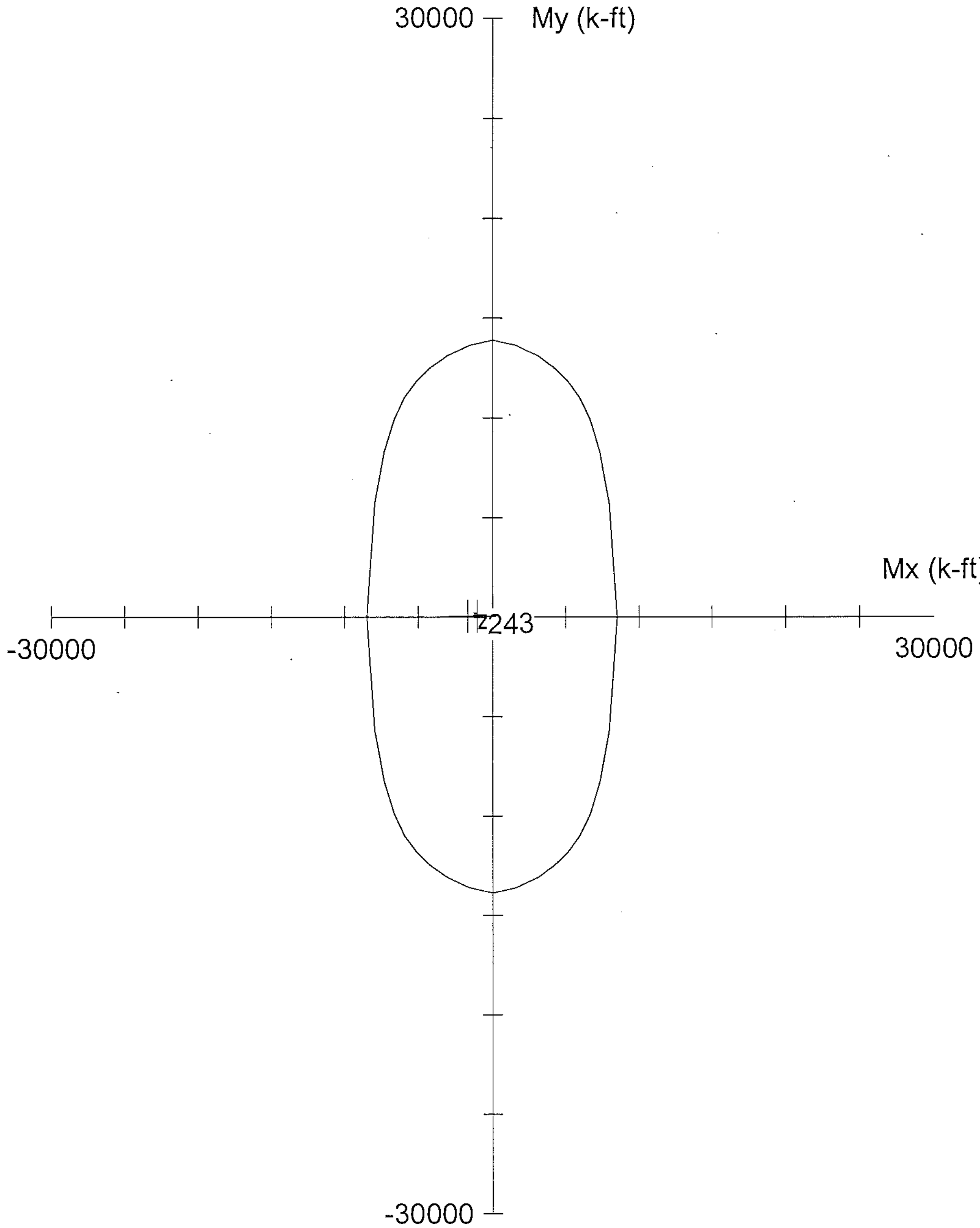
Slenderness: Not considered

Column type: Architectural

Bars: ASTM A615

Date: 10/26/11

Time: 12:32:40



P = 22 kip

pcaColumn v3.63 - Licensed to: FLSmidth

File: P:\11021\116 - Calculations\116.d - Arch_Civil_Struc\C-005 Grinding Area Concrete\Column C-D.col

Project: CC&V High Grade Ore

Column: A/B		Engineer: ECS	
f'c = 4 ksi	fy = 60 ksi	Ag = 8760 in^2	44 #10 bars
Ec = 3605 ksi	Es = 29000 ksi	As = 55.88 in^2	Rho = 0.64%
fc = 3.4 ksi	fc = 3.4 ksi	Xo = 0.00 in	Ix = 3.89017e+006 in^4
[illegible] = 0.003 in/in		Yo = 0.00 in	Iy = 1.0512e+007 in^4
Beta1 = 0.85		Clear spacing = 6.85 in	Clear cover = 2.50 in
Confinement: Tied	phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.65		

```
OOOOOOO   OOOOO   OOOOO   OOOOO   OOOOO  OO
OO   OO OO   OO OO   OO OO   OO OO   OO OO
OO   OO OO   OO OO   OO OO   OO OO   OO OO
OO   OO OO      OO   OO OO      OO   OO OO
OO   OO OO      OOOOOOO OO      OO   OO OO
OOOOOOO OO   OO OO   OO OO   OO OO   OO OO
OO      OO   OO OO   OO OO   OO OO   OO OO
OO        OOOOO  OO   OO  OOOOO   OOOOO  OOOOO  (TM)
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===
Computer program for the Strength Design of Reinforced Concrete Sections
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General Information:
====================

File Name: P:\11021\116 - Calculations\116.d - Arch_Civil_Struc\C-005 Grinding Area Concrete
Project: CC&V High Grade Ore
Column: A/B Engineer: ECS
Code: ACI 318-02 Units: English

Run Option: Investigation Slenderness: Not considered
Run Axis: Biaxial Column Type: Architectural

Material Properties:
====================

f'c = 4 ksi fy = 60 ksi
Ec = 3605 ksi Es = 29000 ksi
Ultimate strain = 0.003 in/in
Beta1 = 0.85

Section:
========

Rectangular: Width = 120 in Depth = 73 in

Gross section area, Ag = 8760 in^2
Ix = 3.89017e+006 in^4 Iy = 1.0512e+007 in^4
Xo = 0 in Yo = 0 in

Reinforcement:
==============

Rebar Database: ASTM A615

Size	Diam (in)	Area (in^2)	Size	Diam (in)	Area (in^2)	Size	Diam (in)	Area (in^2)
# 3	0.38	0.11	# 4	0.50	0.20	# 5	0.63	0.31
# 6	0.75	0.44	# 7	0.88	0.60	# 8	1.00	0.79
# 9	1.13	1.00	# 10	1.27	1.27	# 11	1.41	1.56
# 14	1.69	2.25	# 18	2.26	4.00			

Confinement: Tied; #3 ties with #7 bars, #4 with larger bars.
phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.65

Layout: Rectangular
Pattern: Equal Bar Spacing (Cover to transverse reinforcement)
Total steel area, As = 55.88 in^2 at 0.64%
44 #10 Cover = 2 in

Load Combinations:
==================

U1 = 1.400*Dead + 0.000*Live + 0.000*Wind + 0.000*EarthQuake
U2 = 1.200*Dead + 1.600*Live + 0.000*Wind + 0.000*EarthQuake
U3 = 1.200*Dead + 1.000*Live + 0.000*Wind + 0.000*EarthQuake
U4 = 1.200*Dead + 0.000*Live + 0.800*Wind + 0.000*EarthQuake
U5 = 1.200*Dead + 1.000*Live + 1.600*Wind + 0.000*EarthQuake
U6 = 0.900*Dead + 0.000*Live + 1.600*Wind + 0.000*EarthQuake
U7 = 1.200*Dead + 0.000*Live - 0.800*Wind + 0.000*EarthQuake
U8 = 1.200*Dead + 1.000*Live - 1.600*Wind + 0.000*EarthQuake
U9 = 0.900*Dead + 0.000*Live - 1.600*Wind + 0.000*EarthQuake
U10 = 1.200*Dead + 1.000*Live + 0.000*Wind + 1.000*EarthQuake
U11 = 0.900*Dead + 0.000*Live + 0.000*Wind + 1.000*EarthQuake
U12 = 1.200*Dead + 1.000*Live + 0.000*Wind - 1.000*EarthQuake
U13 = 0.900*Dead + 0.000*Live + 0.000*Wind - 1.000*EarthQuake

Service Loads:
==============

No.	Load Case	Axial Load kip	Mx @ Top k-ft	Mx @ Bot k-ft	My @ Top k-ft	My @ Bot k-ft
1	Dead	18.3	17.3	17.3	-39.9	-39.9
	Live	0.0	0.0	1026.0	146.6	1.1
	Wind	0.0	0.0	0.0	0.0	0.0
	E.Q.	0.0	0.0	0.0	0.0	0.0

Factored Loads and Moments with Corresponding Capacities: (see user's manual for notation)
==

NOTE: Each loading combination includes the following cases:
First line - at column top
Second line - at column bottom

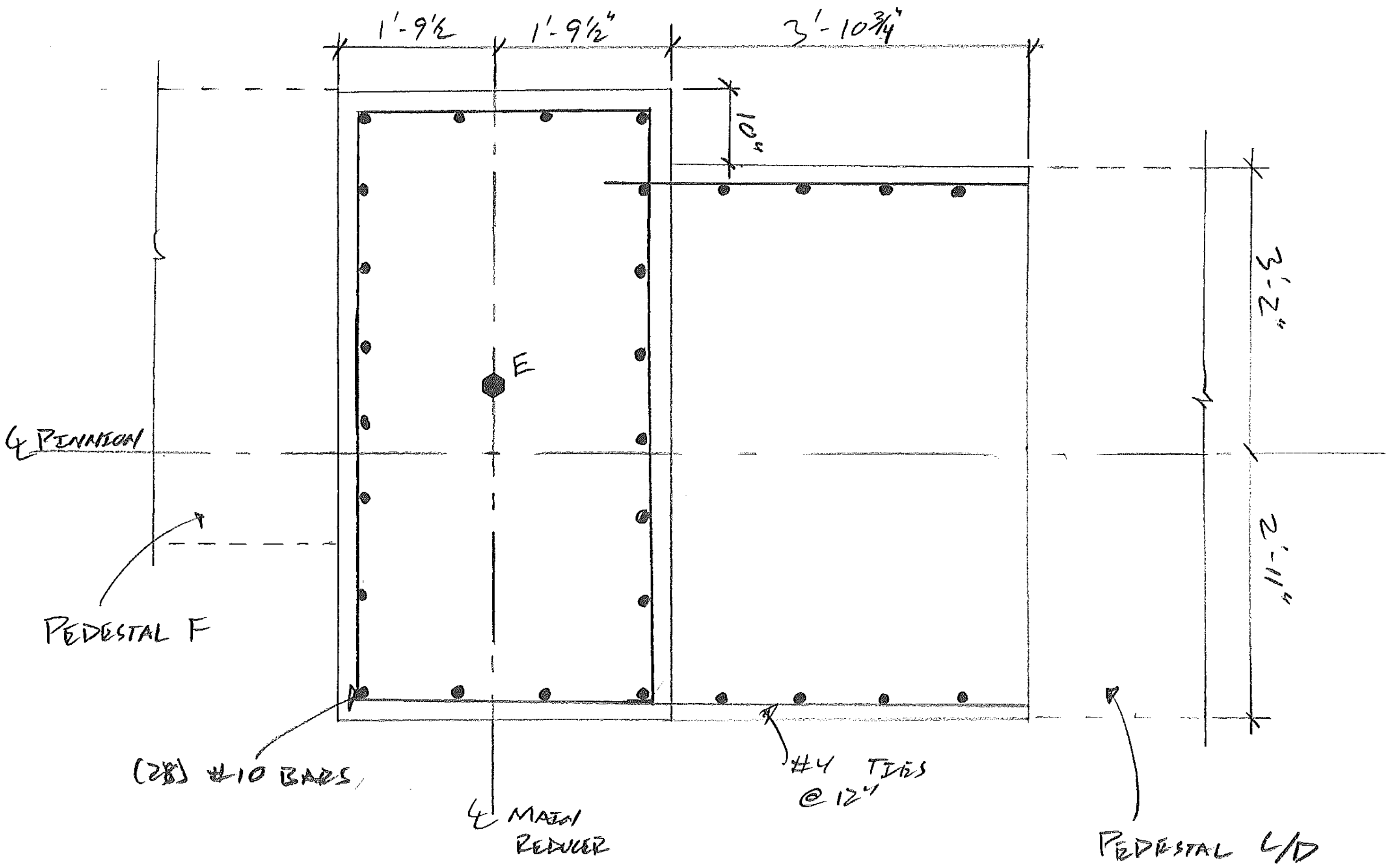
No.	Load Combo	Pu kip	Mux k-ft	Muy k-ft	fMnx k-ft	fMny k-ft	fMn/Mu
1	1 U1	25.6	24.2	-55.9	5135.3	-11843.8	212.027
2		25.6	-24.2	55.9	-5135.3	11843.8	212.027
3	1 U2	22.0	20.8	186.7	1515.9	13631.4	73.020
4		22.0	-1662.4	46.1	-8472.7	235.1	5.097
5	1 U3	22.0	20.8	98.7	2777.7	13209.0	133.803
6		22.0	-1046.8	46.8	-8459.9	378.1	8.082
7	1 U4	22.0	20.8	-47.9	5130.6	-11833.1	247.140
8		22.0	-20.8	47.9	-5130.6	11833.1	247.140
9	1 U5	22.0	20.8	98.7	2777.7	13209.0	133.803
10		22.0	-1046.8	46.8	-8459.9	378.1	8.082
11	1 U6	16.5	15.6	-35.9	5123.6	-11816.9	329.069
12		16.5	-15.6	35.9	-5123.6	11816.9	329.069
13	1 U7	22.0	20.8	-47.9	5130.6	-11833.1	247.140
14		22.0	-20.8	47.9	-5130.6	11833.1	247.140
15	1 U8	22.0	20.8	98.7	2777.7	13209.0	133.803
16		22.0	-1046.8	46.8	-8459.9	378.1	8.082
17	1 U9	16.5	15.6	-35.9	5123.6	-11816.9	329.069
18		16.5	-15.6	35.9	-5123.6	11816.9	329.069
19	1 U10	22.0	20.8	98.7	2777.7	13209.0	133.803
20		22.0	-1046.8	46.8	-8459.9	378.1	8.082
21	1 U11	16.5	15.6	-35.9	5123.6	-11816.9	329.069
22		16.5	-15.6	35.9	-5123.6	11816.9	329.069
23	1 U12	22.0	20.8	98.7	2777.7	13209.0	133.803
24		22.0	-1046.8	46.8	-8459.9	378.1	8.082
25	1 U13	16.5	15.6	-35.9	5123.6	-11816.9	329.069
26		16.5	-15.6	35.9	-5123.6	11816.9	329.069

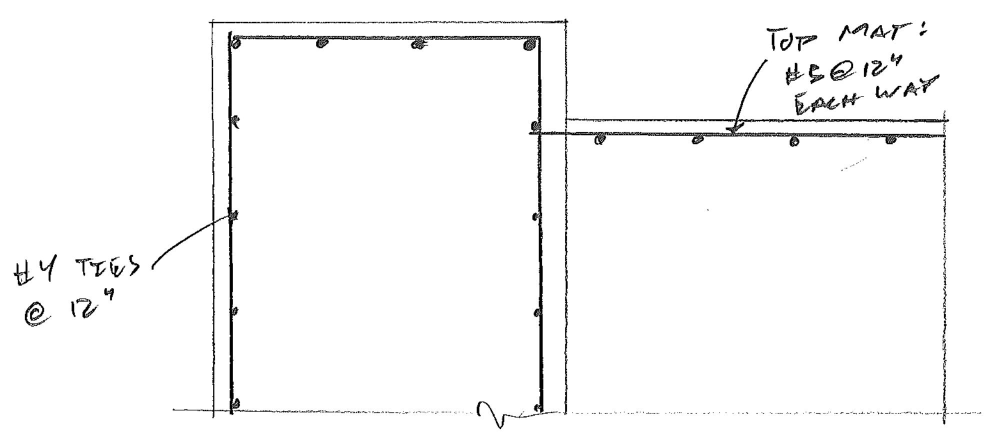
*** Program completed as requested! ***

FLSMIDTH

PROJECT	PROJ NO. 11021
CC&V HIGH GRADE ORE	CALC NO. C-005
SUBJECT ROD MILL FOUNDATION	BY ECS DATE 10-26-11
	CHK DATE
	SHEET OF REV

PEDESTAL E DESIGN





ELEVATION

Concrete Pedestal Natural Period of Vibration
Pedestal E

Pedestal Dimensions:

$L_x := 3ft + 7in = 43\,in$ — Pedestal Length X Direction

$L_y := 6ft + 11in = 83\,in$ — Pedestal Length Y Direction

$H := 19ft + 1.375in = 229.375\,in$ — Pedestal Height

Concrete Properties:

$\gamma_c := 145pcf$ — Concrete Unit Weight

$f_c := 4000psi$ — Concrete Compressive Strength

$E := 57000psi\cdot\sqrt{\frac{f_c}{psi}} = 3.605\times10^3\,ksi$ — Concrete Modulus of Elasticity

Loads and Masses:

$m := L_x\cdot L_y\cdot H\cdot\frac{\gamma_c}{g} = 6.869\times10^4\,lb$ — Pedestal Mass

$F_x := 0lb$ $\quad F_y := 0lb$ — Applied Mass

$m_x := F_x + 0.23m = 1.58\times10^4\,lb$ $\quad m_y := F_y + 0.23m = 1.58\times10^4\,lb$ — Equivalent Mass

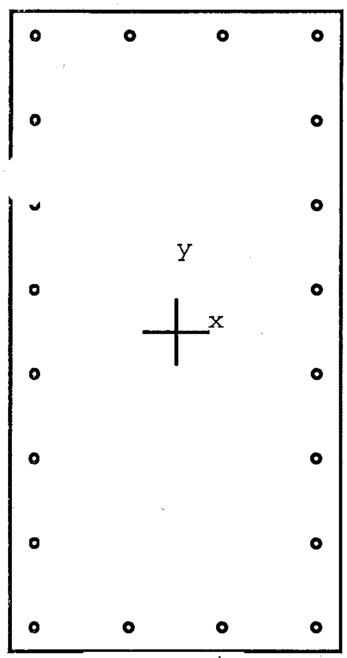
Dynamic Properties:

$I_x := \frac{L_x^3\cdot L_y}{12} = 5.499\times10^5\,in^4$ $\quad I_y := \frac{L_x\cdot L_y^3}{12} = 2.049\times10^6\,in^4$ — Moment of Inertia

$k_x := \frac{(3\cdot E\cdot I_x)}{H^3} = 5.914\times10^3\,\frac{kip}{ft}$ $\quad k_y := \frac{(3\cdot E\cdot I_y)}{H^3} = 2.203\times10^4\,\frac{kip}{ft}$ — Stiffness Factor

$\omega_x := \sqrt{\frac{k_x}{0.23m}} = 109.74\,Hz$ $\quad \omega_y := \sqrt{\frac{k_y}{0.23m}} = 211.824\,Hz$ — Natural Frequency without added Mass

$\omega_{x.} := \sqrt{\frac{k_x}{m_x}} = 109.74\,Hz$ $\quad \omega_{y.} := \sqrt{\frac{k_y}{m_y}} = 211.824\,Hz$ — Natural Frequency with added Mass



43 x 83 in

Code: ACI 318-02

Units: English

Run axis: Biaxial

Run option: Investigation

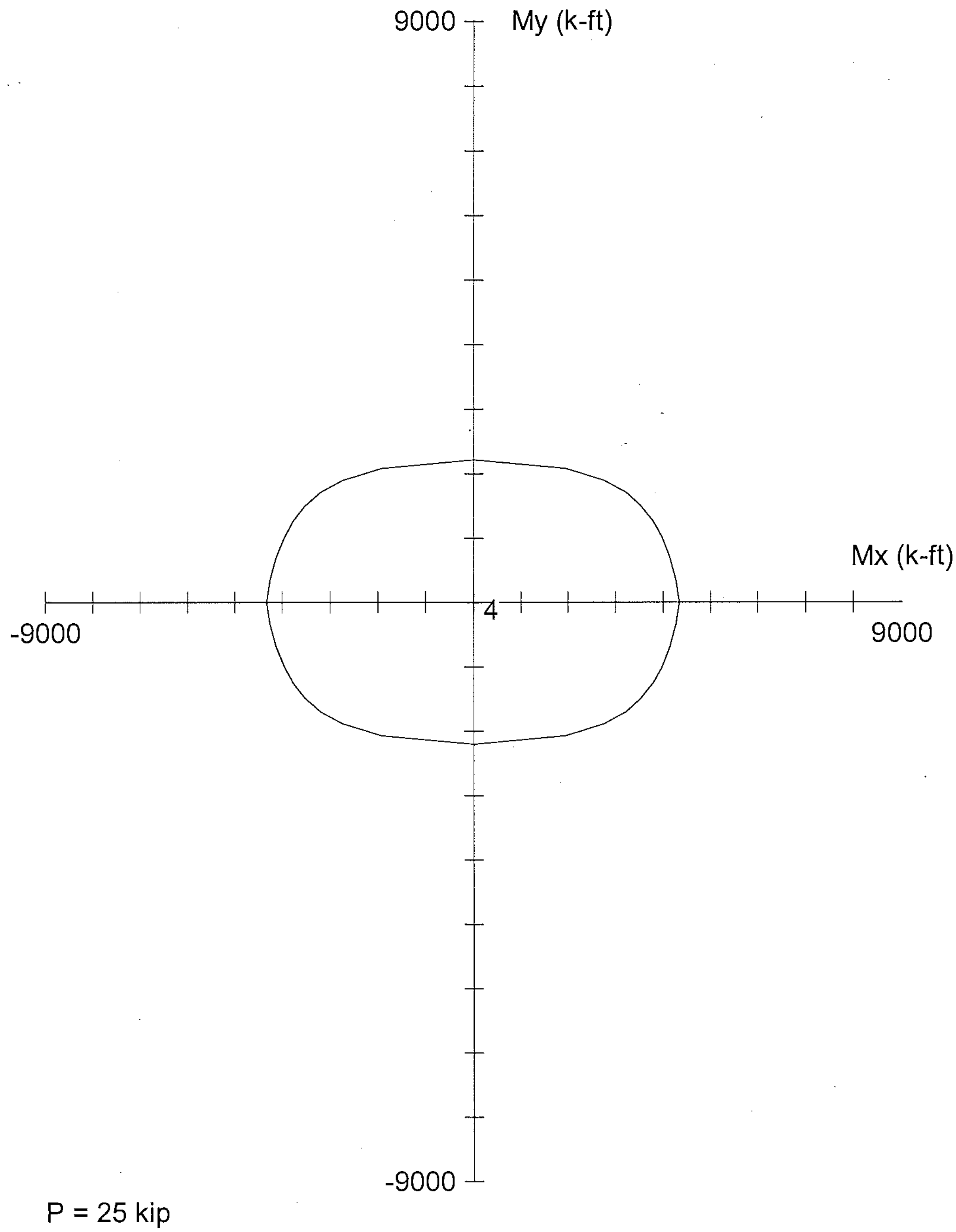
Slenderness: Not considered

Column type: Architectural

Bars: ASTM A615

Date: 10/26/11

Time: 14:15:35



pcaColumn v3.63 - Licensed to: FLSmidth

File: P:\11021\116 - Calculations\116.d - Arch_Civil_Struc\C-005 Grinding Area Concrete\Column E.col

Project: CC&V High Grade Ore

Column: A/B		Engineer: ECS	
f'c = 4 ksi	fy = 60 ksi	Ag = 3569 in^2	20 #10 bars
Ec = 3605 ksi	Es = 29000 ksi	As = 25.40 in^2	Rho = 0.71%
fc = 3.4 ksi	fc = 3.4 ksi	Xo = 0.00 in	Ix = 2.0489e+006 in^4
ı = 0.003 in/in		Yo = 0.00 in	Iy = 549923 in^4
Beta1 = 0.85		Clear spacing = 9.69 in	Clear cover = 2.50 in
Confinement: Tied	phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.65		

```
OOOOOOO   OOOOO    OOOOO    OOOOO    OOOOO   OO
OO   OO  OO   OO  OO   OO  OO   OO  OO   OO  OO
OO   OO  OO   OO  OO   OO  OO   OO  OO   OO  OO
OO   OO  OO       OO   OO  OO       OO   OO  OO
OO   OO  OO       OOOOOOO  OO       OO   OO  OO
OOOOOOO  OO   OO  OO   OO  OO   OO  OO   OO  OO
OO       OO   OO  OO   OO  OO   OO  OO   OO  OO
OO        OOOOO   OO   OO   OOOOO    OOOOO   OOOOO   (TM)
```

===
Computer program for the Strength Design of Reinforced Concrete Sections
===

General Information:
====================

File Name: P:\11021\116 - Calculations\116.d - Arch_Civil_Struc\C-005 Grinding Area Concrete
Project: CC&V High Grade Ore
Column: A/B Engineer: ECS
Code: ACI 318-02 Units: English

Run Option: Investigation Slenderness: Not considered
Run Axis: Biaxial Column Type: Architectural

Material Properties:
====================

f'c = 4 ksi fy = 60 ksi
Ec = 3605 ksi Es = 29000 ksi
Ultimate strain = 0.003 in/in
Beta1 = 0.85

Section:
========

Rectangular: Width = 43 in Depth = 83 in

Gross section area, Ag = 3569 in^2
Ix = 2.0489e+006 in^4 Iy = 549923 in^4
Xo = 0 in Yo = 0 in

Reinforcement:
==============

Rebar Database: ASTM A615

Size	Diam (in)	Area (in^2)	Size	Diam (in)	Area (in^2)	Size	Diam (in)	Area (in^2)
# 3	0.38	0.11	# 4	0.50	0.20	# 5	0.63	0.31
# 6	0.75	0.44	# 7	0.88	0.60	# 8	1.00	0.79
# 9	1.13	1.00	# 10	1.27	1.27	# 11	1.41	1.56
# 14	1.69	2.25	# 18	2.26	4.00			

Confinement: Tied; #3 ties with #7 bars, #4 with larger bars.
phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.65

Layout: Rectangular
Pattern: Equal Bar Spacing (Cover to transverse reinforcement)
Total steel area, As = 25.40 in^2 at 0.71%
20 #10 Cover = 2 in

Load Combinations:
==================

```
U1  = 1.400*Dead + 0.000*Live + 0.000*Wind + 0.000*EarthQuake
U2  = 1.200*Dead + 1.600*Live + 0.000*Wind + 0.000*EarthQuake
U3  = 1.200*Dead + 1.000*Live + 0.000*Wind + 0.000*EarthQuake
U4  = 1.200*Dead + 0.000*Live + 0.800*Wind + 0.000*EarthQuake
U5  = 1.200*Dead + 1.000*Live + 1.600*Wind + 0.000*EarthQuake
U6  = 0.900*Dead + 0.000*Live + 1.600*Wind + 0.000*EarthQuake
U7  = 1.200*Dead + 0.000*Live - 0.800*Wind + 0.000*EarthQuake
U8  = 1.200*Dead + 1.000*Live - 1.600*Wind + 0.000*EarthQuake
U9  = 0.900*Dead + 0.000*Live - 1.600*Wind + 0.000*EarthQuake
U10 = 1.200*Dead + 1.000*Live + 0.000*Wind + 1.000*EarthQuake
U11 = 0.900*Dead + 0.000*Live + 0.000*Wind + 1.000*EarthQuake
U12 = 1.200*Dead + 1.000*Live + 0.000*Wind - 1.000*EarthQuake
U13 = 0.900*Dead + 0.000*Live + 0.000*Wind - 1.000*EarthQuake
```

Service Loads:
==============

No.	Load Case	Axial Load kip	Mx @ Top k-ft	Mx @ Bot k-ft	My @ Top k-ft	My @ Bot k-ft
1	Dead	6.4	0.0	0.0	0.0	0.0
	Live	10.9	0.0	0.0	0.0	0.0
	Wind	0.0	0.0	0.0	0.0	0.0
	E.Q.	0.0	0.0	0.0	0.0	0.0
2	Dead	6.4	0.0	0.0	0.0	0.0
	Live	-10.9	0.0	0.0	0.0	0.0
	Wind	0.0	0.0	0.0	0.0	0.0
	E.Q.	0.0	0.0	0.0	0.0	0.0

Factored Loads and Moments with Corresponding Capacities: (see user's manual for notation)
==

NOTE: Each loading combination includes the following cases:
First line - at column top
Second line - at column bottom

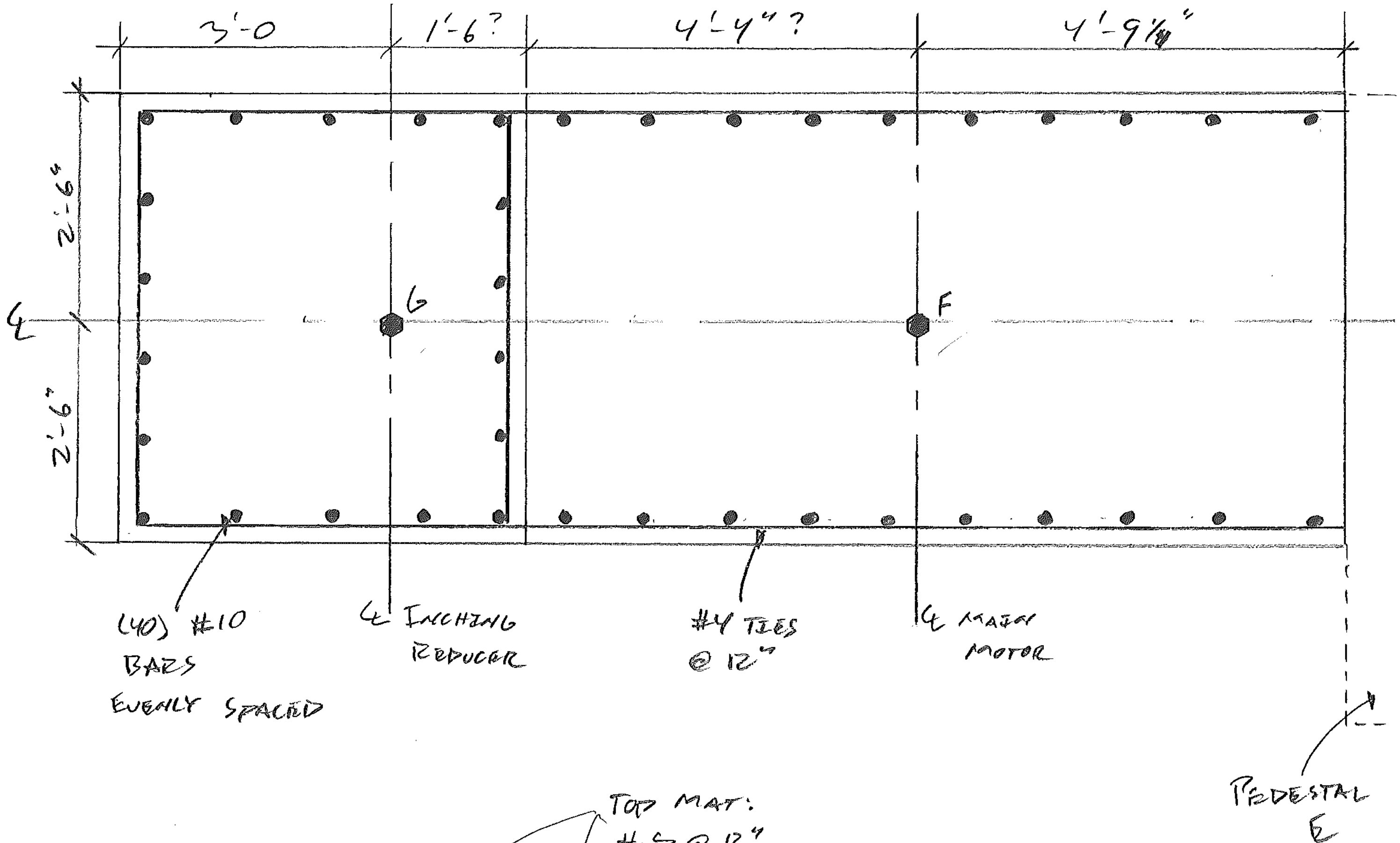
No.	Load Combo	Pu kip	Mux k-ft	Muy k-ft	fMnx k-ft	fMny k-ft	fMn/Mu
1	1 U1	9.0	0.0	0.0	4292.9	0.0	999.999
2		9.0	0.0	0.0	4292.9	0.0	999.999
3	1 U2	25.1	0.0	0.0	4336.0	0.0	999.999
4		25.1	0.0	0.0	4336.0	0.0	999.999
5	1 U3	18.6	0.0	0.0	4318.5	0.0	999.999
6		18.6	0.0	0.0	4318.5	0.0	999.999
7	1 U4	7.7	0.0	0.0	4289.4	0.0	999.999
8		7.7	0.0	0.0	4289.4	0.0	999.999
9	1 U5	18.6	0.0	0.0	4318.5	0.0	999.999
10		18.6	0.0	0.0	4318.5	0.0	999.999
11	1 U6	5.8	0.0	0.0	4284.2	0.0	999.999
12		5.8	0.0	0.0	4284.2	0.0	999.999
13	1 U7	7.7	0.0	0.0	4289.4	0.0	999.999
14		7.7	0.0	0.0	4289.4	0.0	999.999
15	1 U8	18.6	0.0	0.0	4318.5	0.0	999.999
16		18.6	0.0	0.0	4318.5	0.0	999.999
17	1 U9	5.8	0.0	0.0	4284.2	0.0	999.999
18		5.8	0.0	0.0	4284.2	0.0	999.999
19	1 U10	18.6	0.0	0.0	4318.5	0.0	999.999
20		18.6	0.0	0.0	4318.5	0.0	999.999
21	1 U11	5.8	0.0	0.0	4284.2	0.0	999.999
22		5.8	0.0	0.0	4284.2	0.0	999.999
23	1 U12	18.6	0.0	0.0	4318.5	0.0	999.999
24		18.6	0.0	0.0	4318.5	0.0	999.999
25	1 U13	5.8	0.0	0.0	4284.2	0.0	999.999
26		5.8	0.0	0.0	4284.2	0.0	999.999
27	2 U1	9.0	0.0	0.0	4292.9	0.0	999.999
28		9.0	0.0	0.0	4292.9	0.0	999.999
29	2 U2	-9.6	0.0	0.0	4242.7	0.0	999.999
30		-9.6	0.0	0.0	4242.7	0.0	999.999
31	2 U3	-3.1	0.0	0.0	4260.3	0.0	999.999
32		-3.1	0.0	0.0	4260.3	0.0	999.999
33	2 U4	7.7	0.0	0.0	4289.4	0.0	999.999
34		7.7	0.0	0.0	4289.4	0.0	999.999
35	2 U5	-3.1	0.0	0.0	4260.3	0.0	999.999
36		-3.1	0.0	0.0	4260.3	0.0	999.999
37	2 U6	5.8	0.0	0.0	4284.2	0.0	999.999
38		5.8	0.0	0.0	4284.2	0.0	999.999
39	2 U7	7.7	0.0	0.0	4289.4	0.0	999.999
40		7.7	0.0	0.0	4289.4	0.0	999.999
41	2 U8	-3.1	0.0	0.0	4260.3	0.0	999.999
42		-3.1	0.0	0.0	4260.3	0.0	999.999

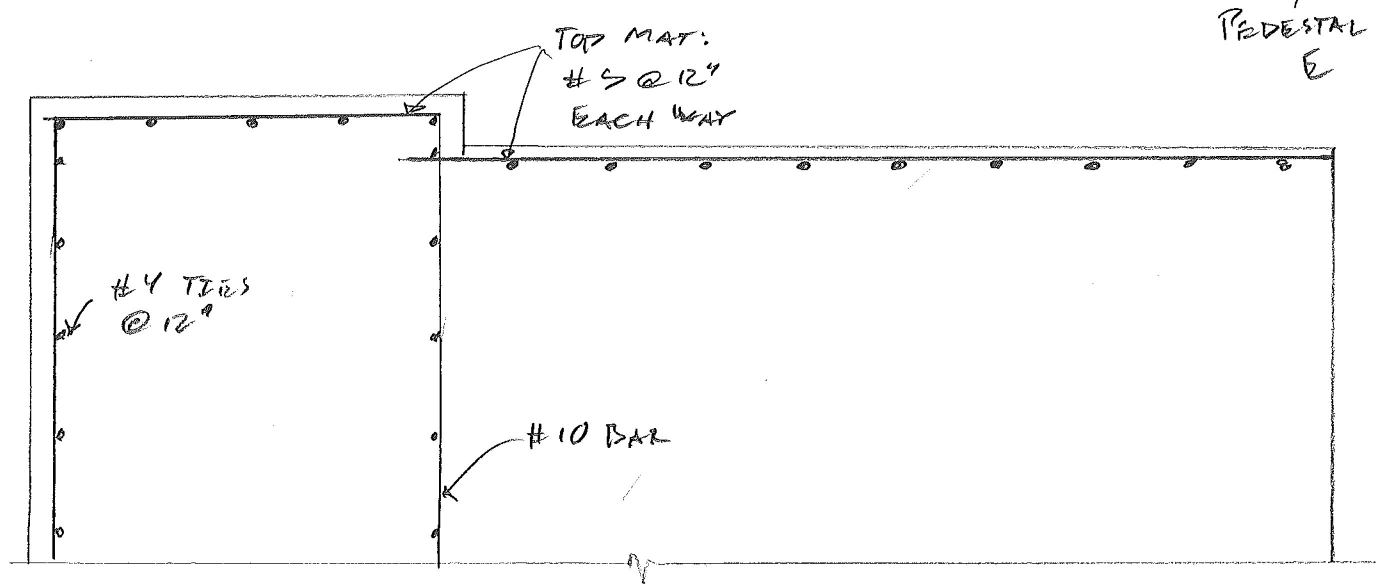
43	2 U9	5.8	0.0	0.0	4284.2	0.0	999.999
44		5.8	0.0	0.0	4284.2	0.0	999.999
45	2 U10	-3.1	0.0	0.0	4260.3	0.0	999.999
46		-3.1	0.0	0.0	4260.3	0.0	999.999
47	2 U11	5.8	0.0	0.0	4284.2	0.0	999.999
48		5.8	0.0	0.0	4284.2	0.0	999.999
49	2 U12	-3.1	0.0	0.0	4260.3	0.0	999.999
50		-3.1	0.0	0.0	4260.3	0.0	999.999
51	2 U13	5.8	0.0	0.0	4284.2	0.0	999.999
52		5.8	0.0	0.0	4284.2	0.0	999.999

*** Program completed as requested! ***

FLSmidth	PROJECT CC&V HIGH GRADE ORE	PROJ NO. 11021
		CALC NO. C-005
	SUBJECT ROD MILL FOUNDATION	BY ECS DATE 10-27-11
		CHK DATE
		SHEET OF REV

PEDESTAL F/G DESIGN





ELEVATION

Pedestal F/G Loading

Pedestal Height (ft): 18.75

Load Locations:

Using CL Main Motor & CL Pedestal

	X (ft)	Y (ft)
Pedestal Center of Gravity	-2.03	0.00

Location	Coordinates		Eccentricity	
	X (ft)	Y (ft)	e_x (ft)	e_y (ft)
G	-5.83	0.00	-3.80	0.00
F	0.00	0.00	2.03	0.00

Dead Load:

Location	F_x (kip)	F_y (kip)	F_z (kip)	M_x (k*ft)		M_y (k*ft)	
				Top	Bot	Top	Bot
G	0.0	0.0	17.0	0.0	0.0	-64.6	-64.6
F	0.0	0.0	2.2	0.0	0.0	4.4	4.4
Result	**0.0**	**0.0**	**19.2**	**0.0**	**0.0**	**-60.3**	**-60.3**

Live Load:

Location	F_x (kip)	F_y (kip)	F_z (kip)	M_x (k*ft)		M_y (k*ft)	
				Top	Bot	Top	Bot
G	0.0	0.0	3.5	0.0	0.0	-13.4	-13.4
F	0.0	0.0	1.1	0.0	0.0	2.3	2.3
Result	**0.0**	**0.0**	**4.7**	**0.0**	**0.0**	**-11.1**	**-11.1**

```
0000000    00000    00000    00000    00000   00
00     00 00     00 00    00 00    00 00   00 00
00     00 00     00 00    00 00    00 00   00 00
00     00 00        00    00 00       00   00 00
00     00 00        0000000  00       00   00 00
0000000   00     00 00    00 00    00 00   00 00
00        00     00 00    00 00    00 00   00 00
00         00000    00    00  00000    00000   00000  (TM)
```

==
Computer program for the Strength Design of Reinforced Concrete Sections
==

General Information:

File Name: P:\11021\116 - Calculations\116.d - Arch_Civil_Struc\C-005 Grinding Area Concrete
Project: CC&V High Grade Ore
Column: A/B   Engineer: ECS
Code: ACI 318-02   Units: English

Run Option: Investigation   Slenderness: Not considered
Run Axis: Biaxial   Column Type: Architectural

Material Properties:

f'c = 4 ksi   fy = 60 ksi
Ec = 3605 ksi   Es = 29000 ksi
Ultimate strain = 0.003 in/in
Beta1 = 0.85

Section:

Rectangular: Width = 163.25 in   Depth = 60 in

Gross section area, Ag = 9795 in^2
Ix = 2.9385e+006 in^4   Iy = 2.17535e+007 in^4
Xo = 0 in   Yo = 0 in

Reinforcement:

Rebar Database: ASTM A615

Size	Diam (in)	Area (in^2)	Size	Diam (in)	Area (in^2)	Size	Diam (in)	Area (in^2)
# 3	0.38	0.11	# 4	0.50	0.20	# 5	0.63	0.31
# 6	0.75	0.44	# 7	0.88	0.60	# 8	1.00	0.79
# 9	1.13	1.00	# 10	1.27	1.27	# 11	1.41	1.56
# 14	1.69	2.25	# 18	2.26	4.00			

Confinement: Tied; #3 ties with #7 bars, #4 with larger bars.
phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.65

Layout: Rectangular
Pattern: Equal Bar Spacing (Cover to transverse reinforcement)
Total steel area, As = 50.80 in^2 at 0.52%
40 #10 Cover = 2 in

Load Combinations:

```
U1  = 1.400*Dead + 0.000*Live + 0.000*Wind + 0.000*EarthQuake
U2  = 1.200*Dead + 1.600*Live + 0.000*Wind + 0.000*EarthQuake
U3  = 1.200*Dead + 1.000*Live + 0.000*Wind + 0.000*EarthQuake
U4  = 1.200*Dead + 0.000*Live + 0.800*Wind + 0.000*EarthQuake
U5  = 1.200*Dead + 1.000*Live + 1.600*Wind + 0.000*EarthQuake
U6  = 0.900*Dead + 0.000*Live + 1.600*Wind + 0.000*EarthQuake
U7  = 1.200*Dead + 0.000*Live - 0.800*Wind + 0.000*EarthQuake
U8  = 1.200*Dead + 1.000*Live - 1.600*Wind + 0.000*EarthQuake
U9  = 0.900*Dead + 0.000*Live - 1.600*Wind + 0.000*EarthQuake
U10 = 1.200*Dead + 1.000*Live + 0.000*Wind + 1.000*EarthQuake
U11 = 0.900*Dead + 0.000*Live + 0.000*Wind + 1.000*EarthQuake
U12 = 1.200*Dead + 1.000*Live + 0.000*Wind - 1.000*EarthQuake
U13 = 0.900*Dead + 0.000*Live + 0.000*Wind - 1.000*EarthQuake
```

Service Loads:
==============

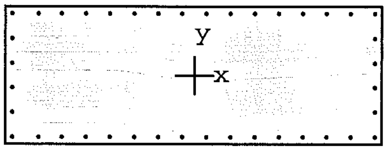
No.	Load Case	Axial Load kip	Mx @ Top k-ft	Mx @ Bot k-ft	My @ Top k-ft	My @ Bot k-ft
1	Dead	19.2	0.0	0.0	-60.3	-60.3
	Live	4.7	0.0	0.0	-11.1	-11.1
	Wind	0.0	0.0	0.0	0.0	0.0
	E.Q.	0.0	0.0	0.0	0.0	0.0

Factored Loads and Moments with Corresponding Capacities: (see user's manual for notation)
==

NOTE: Each loading combination includes the following cases:
First line - at column top
Second line - at column bottom

No.	Load Combo	Pu kip	Mux k-ft	Muy k-ft	fMnx k-ft	fMny k-ft	fMn/Mu
1	1 U1	26.9	0.0	-84.4	0.0	-16996.6	201.334
2		26.9	0.0	84.4	-0.0	16996.6	201.334
3	1 U2	30.6	0.0	-90.1	0.0	-17015.4	188.808
4		30.6	0.0	90.1	-0.0	17015.4	188.808
5	1 U3	27.7	0.0	-83.5	0.0	-17001.0	203.702
6		27.7	0.0	83.5	-0.0	17001.0	203.702
7	1 U4	23.0	0.0	-72.4	0.0	-16976.4	234.610
8		23.0	0.0	72.4	-0.0	16976.4	234.610
9	1 U5	27.7	0.0	-83.5	0.0	-17001.0	203.702
10		27.7	0.0	83.5	-0.0	17001.0	203.702
11	1 U6	17.3	0.0	-54.3	0.0	-16946.4	312.260
12		17.3	0.0	54.3	-0.0	16946.4	312.260
13	1 U7	23.0	0.0	-72.4	0.0	-16976.4	234.610
14		23.0	0.0	72.4	-0.0	16976.4	234.610
15	1 U8	27.7	0.0	-83.5	0.0	-17001.0	203.702
16		27.7	0.0	83.5	-0.0	17001.0	203.702
17	1 U9	17.3	0.0	-54.3	0.0	-16946.4	312.260
18		17.3	0.0	54.3	-0.0	16946.4	312.260
19	1 U10	27.7	0.0	-83.5	0.0	-17001.0	203.702
20		27.7	0.0	83.5	-0.0	17001.0	203.702
21	1 U11	17.3	0.0	-54.3	0.0	-16946.4	312.260
22		17.3	0.0	54.3	-0.0	16946.4	312.260
23	1 U12	27.7	0.0	-83.5	0.0	-17001.0	203.702
24		27.7	0.0	83.5	-0.0	17001.0	203.702
25	1 U13	17.3	0.0	-54.3	0.0	-16946.4	312.260
26		17.3	0.0	54.3	-0.0	16946.4	312.260

*** Program completed as requested! ***



163.25 x 60 in

Code: ACI 318-02

Units: English

Run axis: Biaxial

Run option: Investigation

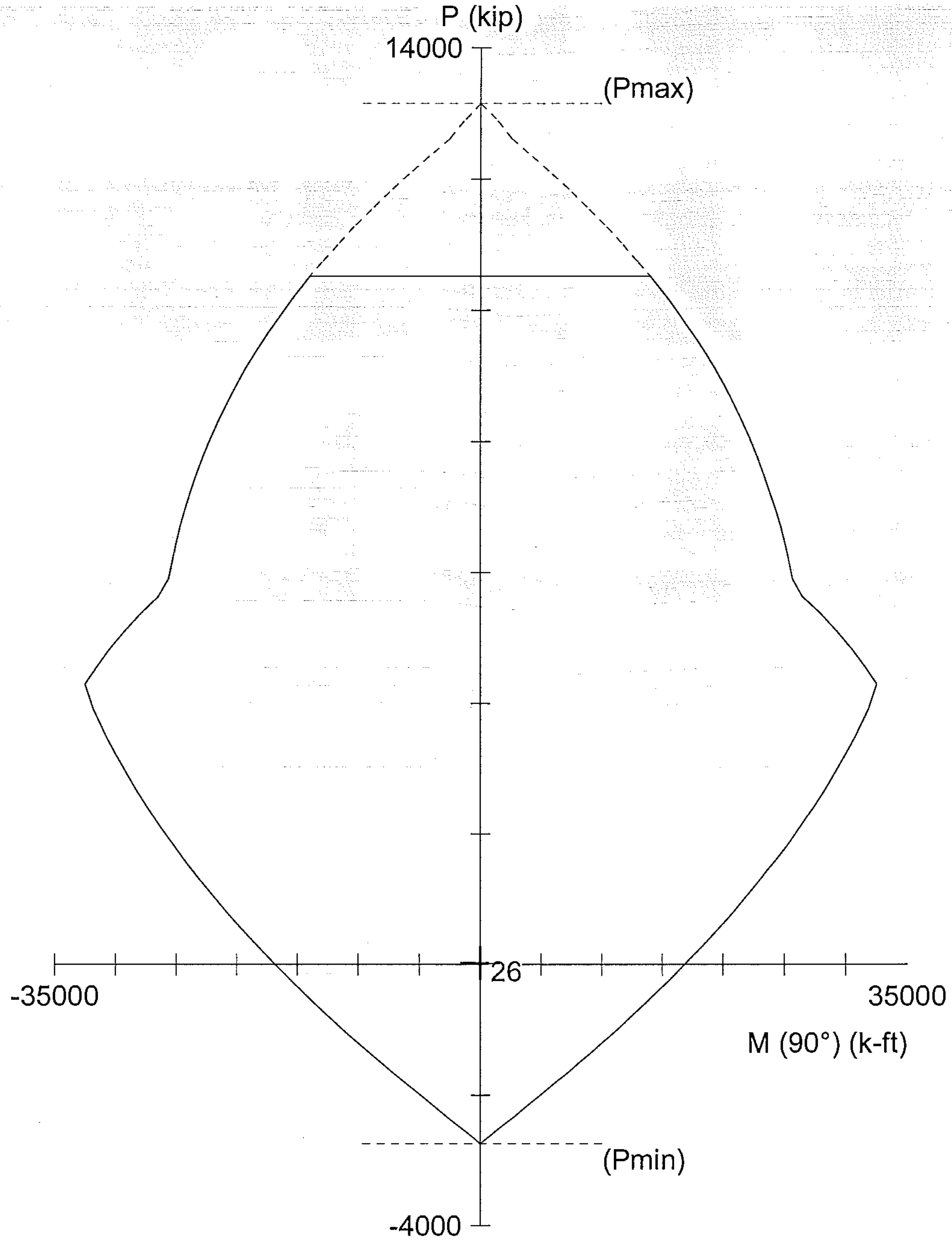
Slenderness: Not considered

Column type: Architectural

Bars: ASTM A615

Date: 10/27/11

Time: 09:03:04



pcaColumn v3.63 - Licensed to: FLSmidth

File: P:\11021\116 - Calculations\116.d - Arch_Civil_Struc\C-005 Grinding Area Concrete\Column G.col

Project: CC&V High Grade Ore

Column: A/B		Engineer: ECS	
f'c = 4 ksi	fy = 60 ksi	Ag = 9795 in^2	40 #10 bars
Ec = 3605 ksi	Es = 29000 ksi	As = 50.80 in^2	Rho = 0.52%
fc = 3.4 ksi	fc = 3.4 ksi	Xo = 0.00 in	Ix = 2.9385e+006 in^4
ı = 0.003 in/in		Yo = 0.00 in	Iy = 2.17535e+007 in^4
Beta1 = 0.85		Clear spacing = 9.19 in	Clear cover = 2.50 in
Confinement: Tied	phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.65		

Concrete Pedestal Natural Period of Vibration
Pedestal F/G

Pedestal Dimensions:

$L_x := 13ft + 7.25in = 163.25\,in$ — Pedestal Length X Direction

$L_y := 5ft + 0in = 60\,in$ — Pedestal Length Y Direction

$H := 18ft + 9.375in = 225.375\,in$ — Pedestal Height

Concrete Properties:

$\gamma_c := 145pcf$ — Concrete Unit Weight

$f_c := 4000psi$ — Concrete Compressive Strength

$E := 57000psi \cdot \sqrt{\frac{f_c}{psi}} = 3.605 \times 10^3\,ksi$ — Concrete Modulus of Elasticity

Loads and Masses:

$m := L_x \cdot L_y \cdot H \cdot \frac{\gamma_c}{g} = 1.852 \times 10^5\,lb$ — Pedestal Mass

$F_x := 0lb$ $\quad F_y := 0lb$ — Applied Mass

$m_x := F_x + 0.23m = 4.261 \times 10^4\,lb$ $\quad m_y := F_y + 0.23m = 4.261 \times 10^4\,lb$ — Equivalent Mass

Dynamic Properties:

$I_x := \frac{L_x^3 \cdot L_y}{12} = 2.175 \times 10^7\,in^4$ $\quad I_y := \frac{L_x \cdot L_y^3}{12} = 2.939 \times 10^6\,in^4$ — Moment of Inertia

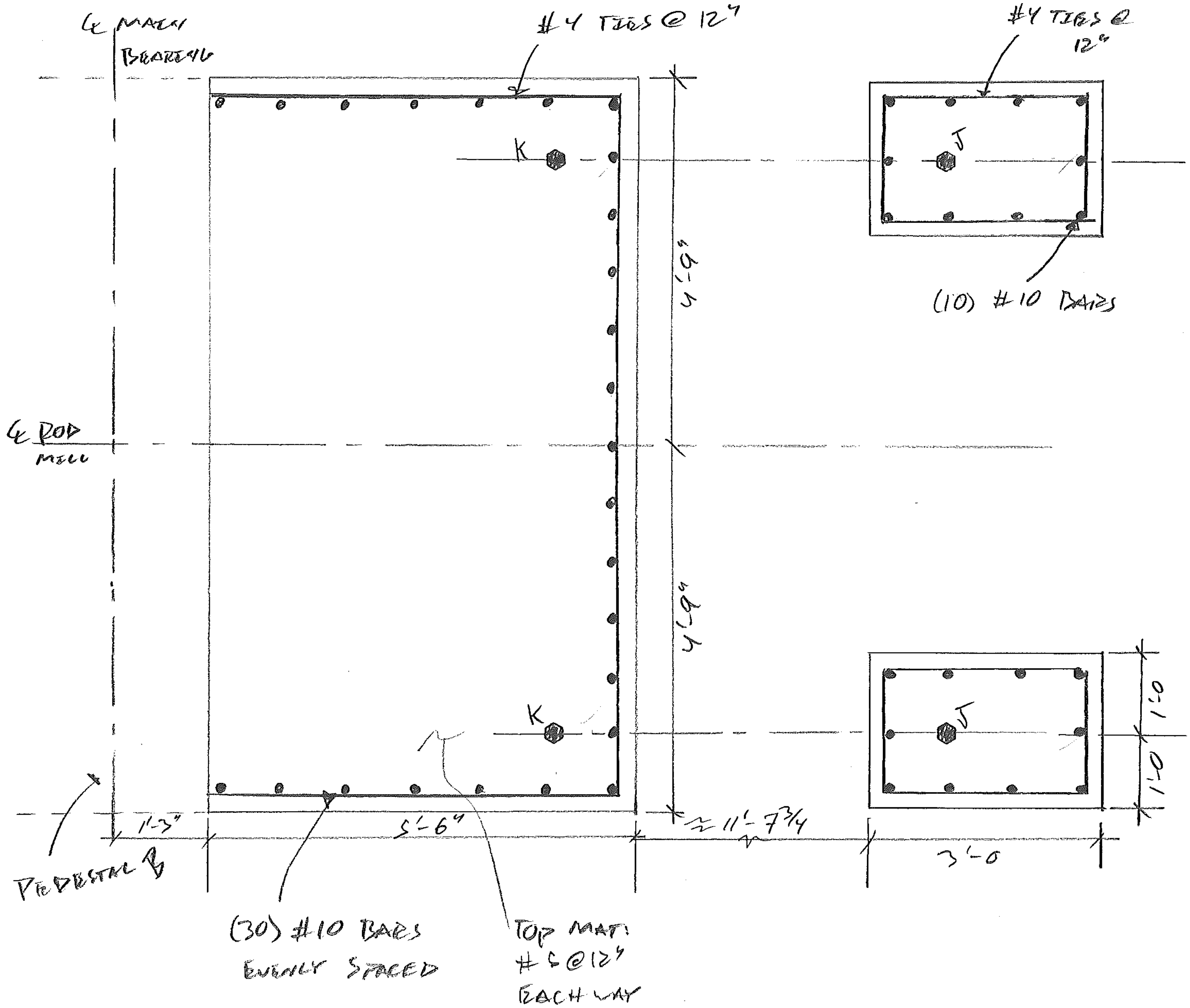
$k_x := \frac{(3 \cdot E \cdot I_x)}{H^3} = 2.466 \times 10^5\,\frac{kip}{ft}$ $\quad k_y := \frac{(3 \cdot E \cdot I_y)}{H^3} = 3.331 \times 10^4\,\frac{kip}{ft}$ — Stiffness Factor

$\omega_x := \sqrt{\frac{k_x}{0.23m}} = 431.55\,Hz$ $\quad \omega_y := \sqrt{\frac{k_y}{0.23m}} = 158.61\,Hz$ — Natural Frequency without added Mass

$\omega_{x.} := \sqrt{\frac{k_x}{m_x}} = 431.55\,Hz$ $\quad \omega_{y.} := \sqrt{\frac{k_y}{m_y}} = 158.61\,Hz$ — Natural Frequency with added Mass

FLSMIDTH	PROJECT: CC&V HIGH GRADE ORE	PROJ NO. 11021
		CALC NO. C-005
	SUBJECT: ROD MILL FOUNDATION	BY ECS DATE 10-27-11
		CHK DATE
		SHEET OF REV

PEDESTAL J/K DESIGN



Concrete Pedestal Natural Period of Vibration
Pedestal J

Pedestal Dimensions:

$L_x := 3ft + 0in = 36\,in$ — Pedestal Length X Direction

$L_y := 2ft + 0in = 24\,in$ — Pedestal Length Y Direction

$H := 13ft + 9.75in = 165.75\,in$ — Pedestal Height

Concrete Properties:

$\gamma_c := 145pcf$ — Concrete Unit Weight

$f_c := 4000psi$ — Concrete Compressive Strength

$E := 57000psi \cdot \sqrt{\frac{f_c}{psi}} = 3.605 \times 10^3\,ksi$ — Concrete Modulus of Elasticity

Loads and Masses:

$m := L_x \cdot L_y \cdot H \cdot \frac{\gamma_c}{g} = 1.202 \times 10^4\,lb$ — Pedestal Mass

$F_x := 0lb$ $F_y := 0lb$ — Applied Mass

$m_x := F_x + 0.23m = 2.764 \times 10^3\,lb$ $m_y := F_y + 0.23m = 2.764 \times 10^3\,lb$ — Equivalent Mass

Dynamic Properties:

$I_x := \frac{L_x^3 \cdot L_y}{12} = 9.331 \times 10^4\,in^4$ $I_y := \frac{L_x \cdot L_y^3}{12} = 4.147 \times 10^4\,in^4$ — Moment of Inertia

$k_x := \frac{(3 \cdot E \cdot I_x)}{H^3} = 2.659 \times 10^3\,\frac{kip}{ft}$ $k_y := \frac{(3 \cdot E \cdot I_y)}{H^3} = 1.182 \times 10^3\,\frac{kip}{ft}$ — Stiffness Factor

$\omega_x := \sqrt{\frac{k_x}{0.23m}} = 175.948\,Hz$ $\omega_y := \sqrt{\frac{k_y}{0.23m}} = 117.299\,Hz$ — Natural Frequency without added Mass

$\omega_{x.} := \sqrt{\frac{k_x}{m_x}} = 175.948\,Hz$ $\omega_{y.} := \sqrt{\frac{k_y}{m_y}} = 117.299\,Hz$ — Natural Frequency with added Mass

```
OOOOOOO    OOOOO    OOOOO    OOOOO    OOOOO   OO
OO   OO  OO   OO  OO   OO  OO   OO  OO   OO  OO
OO   OO  OO   OO  OO   OO  OO   OO  OO   OO  OO
OO   OO  OO       OO   OO  OO       OO   OO  OO
OO   OO  OO       OOOOOOO  OO       OO   OO  OO
OOOOOOO  OO   OO  OO   OO  OO   OO  OO   OO  OO
OO       OO   OO  OO   OO  OO   OO  OO   OO  OO
OO        OOOOO   OO   OO   OOOOO    OOOOO   OOOOO  (TM)
```

===
Computer program for the Strength Design of Reinforced Concrete Sections
===

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General Information:
====================
File Name: P:\11021\116 - Calculations\116.d - Arch_Civil_Struc\C-005 Grinding Area Concrete
Project: CC&V High Grade Ore
Column: A/B Engineer: ECS
Code: ACI 318-02 Units: English

Run Option: Investigation Slenderness: Not considered
Run Axis: Biaxial Column Type: Architectural

Material Properties:
====================
f'c = 4 ksi fy = 60 ksi
Ec = 3605 ksi Es = 29000 ksi
Ultimate strain = 0.003 in/in
Beta1 = 0.85

Section:
========
Rectangular: Width = 36 in Depth = 24 in

Gross section area, Ag = 864 in^2
Ix = 41472 in^4 Iy = 93312 in^4
Xo = 0 in Yo = 0 in

Reinforcement:
==============
Rebar Database: ASTM A615

Size	Diam (in)	Area (in^2)	Size	Diam (in)	Area (in^2)	Size	Diam (in)	Area (in^2)
# 3	0.38	0.11	# 4	0.50	0.20	# 5	0.63	0.31
# 6	0.75	0.44	# 7	0.88	0.60	# 8	1.00	0.79
# 9	1.13	1.00	# 10	1.27	1.27	# 11	1.41	1.56
# 14	1.69	2.25	# 18	2.26	4.00			

Confinement: Tied; #3 ties with #7 bars, #4 with larger bars.
phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.65

Layout: Rectangular
Pattern: Equal Bar Spacing (Cover to transverse reinforcement)
Total steel area, As = 15.24 in^2 at 1.76%
12 #10 Cover = 2 in

Load Combinations:
=================
```
U1  = 1.400*Dead + 0.000*Live + 0.000*Wind + 0.000*EarthQuake
U2  = 1.200*Dead + 1.600*Live + 0.000*Wind + 0.000*EarthQuake
U3  = 1.200*Dead + 1.000*Live + 0.000*Wind + 0.000*EarthQuake
U4  = 1.200*Dead + 0.000*Live + 0.800*Wind + 0.000*EarthQuake
U5  = 1.200*Dead + 1.000*Live + 1.600*Wind + 0.000*EarthQuake
U6  = 0.900*Dead + 0.000*Live + 1.600*Wind + 0.000*EarthQuake
U7  = 1.200*Dead + 0.000*Live - 0.800*Wind + 0.000*EarthQuake
U8  = 1.200*Dead + 1.000*Live - 1.600*Wind + 0.000*EarthQuake
U9  = 0.900*Dead + 0.000*Live - 1.600*Wind + 0.000*EarthQuake
U10 = 1.200*Dead + 1.000*Live + 0.000*Wind + 1.000*EarthQuake
U11 = 0.900*Dead + 0.000*Live + 0.000*Wind + 1.000*EarthQuake
U12 = 1.200*Dead + 1.000*Live + 0.000*Wind - 1.000*EarthQuake
U13 = 0.900*Dead + 0.000*Live + 0.000*Wind - 1.000*EarthQuake
```

Service Loads:

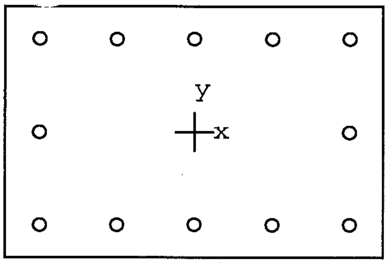
No.	Load Case	Axial Load kip	Mx @ Top k-ft	Mx @ Bot k-ft	My @ Top k-ft	My @ Bot k-ft
1	Dead	147.0	0.0	0.0	73.5	73.5
	Live	143.0	0.0	0.0	71.5	71.5
	Wind	0.0	0.0	0.0	0.0	0.0
	E.Q.	0.0	0.0	0.0	0.0	0.0

Factored Loads and Moments with Corresponding Capacities: (see user's manual for notation)

NOTE: Each loading combination includes the following cases:
First line - at column top
Second line - at column bottom

No.	Load Combo	Pu kip	Mux k-ft	Muy k-ft	fMnx k-ft	fMny k-ft	fMn/Mu
1	1 U1	205.8	0.0	102.9	-0.0	1188.1	11.546
2		205.8	0.0	-102.9	0.0	-1188.1	11.546
3	1 U2	405.2	0.0	202.6	-0.0	1339.6	6.612
4		405.2	0.0	-202.6	0.0	-1339.6	6.612
5	1 U3	319.4	0.0	159.7	-0.0	1282.1	8.028
6		319.4	0.0	-159.7	0.0	-1282.1	8.028
7	1 U4	176.4	0.0	88.2	-0.0	1162.8	13.184
8		176.4	0.0	-88.2	0.0	-1162.8	13.184
9	1 U5	319.4	0.0	159.7	-0.0	1282.1	8.028
10		319.4	0.0	-159.7	0.0	-1282.1	8.028
11	1 U6	132.3	0.0	66.2	-0.0	1124.4	16.997
12		132.3	0.0	-66.2	0.0	-1124.4	16.997
13	1 U7	176.4	0.0	88.2	-0.0	1162.8	13.184
14		176.4	0.0	-88.2	0.0	-1162.8	13.184
15	1 U8	319.4	0.0	159.7	-0.0	1282.1	8.028
16		319.4	0.0	-159.7	0.0	-1282.1	8.028
17	1 U9	132.3	0.0	66.2	-0.0	1124.4	16.997
18		132.3	0.0	-66.2	0.0	-1124.4	16.997
19	1 U10	319.4	0.0	159.7	-0.0	1282.1	8.028
20		319.4	0.0	-159.7	0.0	-1282.1	8.028
21	1 U11	132.3	0.0	66.2	-0.0	1124.4	16.997
22		132.3	0.0	-66.2	0.0	-1124.4	16.997
23	1 U12	319.4	0.0	159.7	-0.0	1282.1	8.028
24		319.4	0.0	-159.7	0.0	-1282.1	8.028
25	1 U13	132.3	0.0	66.2	-0.0	1124.4	16.997
26		132.3	0.0	-66.2	0.0	-1124.4	16.997

*** Program completed as requested! ***



36 x 24 in

Code: ACI 318-02

Units: English

Run axis: Biaxial

Run option: Investigation

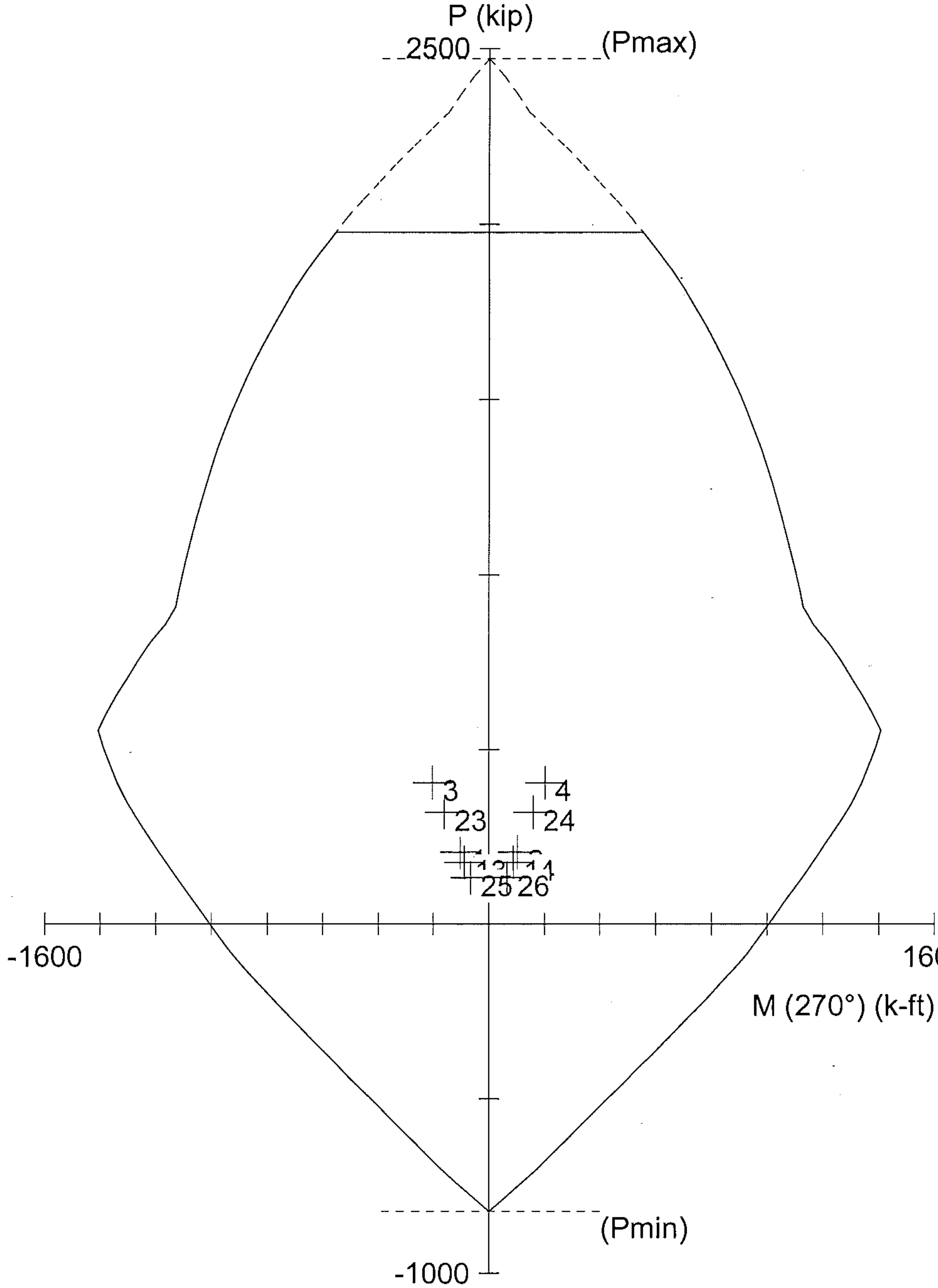
Slenderness: Not considered

Column type: Architectural

Bars: ASTM A615

Date: 10/27/11

Time: 09:17:09



pcaColumn v3.63 - Licensed to: FLSmidth

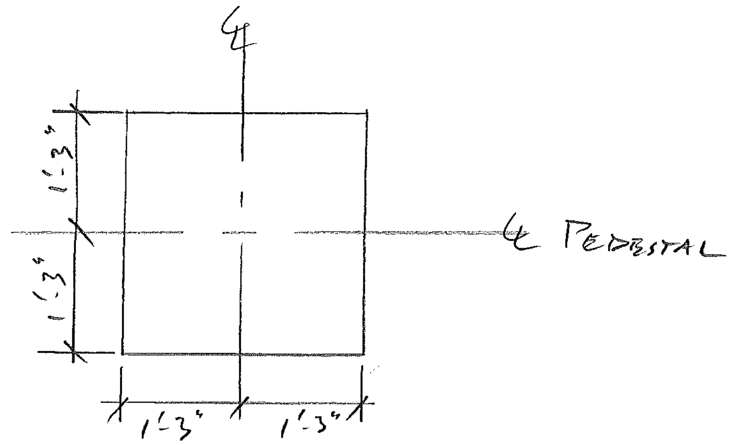
File: P:\11021\116 - Calculations\116.d - Arch_Civil_Struc\C-005 Grinding Area Concrete\Column J.col

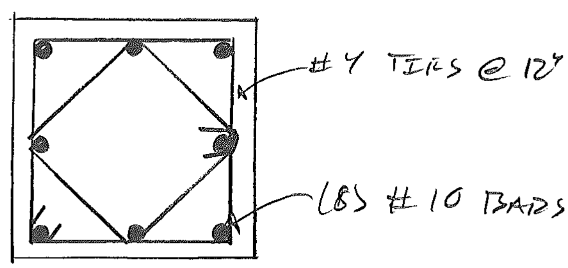
Project: CC&V High Grade Ore

Column: A/B		Engineer: ECS	
f'c = 4 ksi	fy = 60 ksi	Ag = 864 in^2	12 #10 bars
Ec = 3605 ksi	Es = 29000 ksi	As = 15.24 in^2	Rho = 1.76%
fc = 3.4 ksi	fc = 3.4 ksi	Xo = 0.00 in	Ix = 41472 in^4
ı = 0.003 in/in		Yo = 0.00 in	Iy = 93312 in^4
Beta1 = 0.85		Clear spacing = 6.16 in	Clear cover = 2.50 in
Confinement: Tied	phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.65		

	PROJECT CC & V HIGH GRADE ORE	PROJ NO. 11021 CALC NO. C-005
FLSMIDTH	SUBJECT ROD MILL FOUNDATION	BY BCS DATE 10-27-11 CHK DATE SHEET OF REV

PEDESTAL H DESIGN





Concrete Pedestal Natural Period of Vibration
Pedestal H

Pedestal Dimensions:

$L_x := 2ft + 6in = 30\,in$ — Pedestal Length X Direction

$L_y := 2ft + 6in = 30\,in$ — Pedestal Length Y Direction

$H := 19ft + 10.75in = 238.75\,in$ — Pedestal Height

Concrete Properties:

$\gamma_c := 145pcf$ — Concrete Unit Weight

$f_c := 4000psi$ — Concrete Compressive Strength

$E := 57000psi \cdot \sqrt{\frac{f_c}{psi}} = 3.605 \times 10^3\,ksi$ — Concrete Modulus of Elasticity

Loads and Masses:

$m := L_x \cdot L_y \cdot H \cdot \frac{\gamma_c}{g} = 1.803 \times 10^4\,lb$ — Pedestal Mass

$F_x := 0lb$ $\quad F_y := 0lb$ — Applied Mass

$m_x := F_x + 0.23m = 4.147 \times 10^3\,lb$ $\quad m_y := F_y + 0.23m = 4.147 \times 10^3\,lb$ — Equivalent Mass

Dynamic Properties:

$I_x := \frac{L_x^3 \cdot L_y}{12} = 6.75 \times 10^4\,in^4$ $\quad I_y := \frac{L_x \cdot L_y^3}{12} = 6.75 \times 10^4\,in^4$ — Moment of Inertia

$k_x := \frac{(3 \cdot E \cdot I_x)}{H^3} = 643.696\,\frac{kip}{ft}$ $\quad k_y := \frac{(3 \cdot E \cdot I_y)}{H^3} = 643.696\,\frac{kip}{ft}$ — Stiffness Factor

$\omega_x := \sqrt{\frac{k_x}{0.23m}} = 70.668\,Hz$ $\quad \omega_y := \sqrt{\frac{k_y}{0.23m}} = 70.668\,Hz$ — Natural Frequency without added Mass

$\omega_{x.} := \sqrt{\frac{k_x}{m_x}} = 70.668\,Hz$ $\quad \omega_{y.} := \sqrt{\frac{k_y}{m_y}} = 70.668\,Hz$ — Natural Frequency with added Mass

WITHIN RESONANCE RANGE. OK FOR GUARD SUPPORT

```
OOOOOOO    OOOOO    OOOOO    OOOOO    OOOOO   OO
OO    OO  OO   OO  OO   OO  OO   OO  OO   OO  OO
OO    OO  OO   OO  OO   OO  OO   OO  OO   OO  OO
OO    OO  OO       OO   OO  OO       OO   OO  OO
OO    OO  OO       OOOOOOO  OO       OO   OO  OO
OOOOOOO   OO   OO  OO   OO  OO   OO  OO   OO  OO
OO        OO   OO  OO   OO  OO   OO  OO   OO  OO
OO         OOOOO   OO   OO   OOOOO    OOOOO   OOOOO  (TM)
```

==
Computer program for the Strength Design of Reinforced Concrete Sections
==

Licensee stated above acknowledges that Portland Cement Association (PCA) is not and cannot be responsible for either the accuracy or adequacy of the material supplied as input for processing by the pcaColumn(tm) computer program. Furthermore, PCA neither makes any warranty expressed nor implied with respect to the correctness of the output prepared by the pcaColumn(tm) program.Although PCA has endeavored to produce pcaColumn(tm) error free, the program is not and can't be certified infallible. The final and only responsibility for analysis, design and engineering documents is the licensees. Accordingly, PCA disclaims all responsibility in contract, negligence or other tort for any analysis, design or engineering documents prepared in connection with the use of the pcaColumn(tm) program.

General Information:
====================

File Name: P:\11021\116 - Calculations\116.d - Arch_Civil_Struc\C-005 Grinding Area Concrete
Project: CC&V High Grade Ore
Column: A/B Engineer: ECS
Code: ACI 318-02 Units: English

Run Option: Investigation Slenderness: Not considered
Run Axis: Biaxial Column Type: Architectural

Material Properties:
====================

f'c = 4 ksi fy = 60 ksi
Ec = 3605 ksi Es = 29000 ksi
Ultimate strain = 0.003 in/in
Beta1 = 0.85

Section:
========

Rectangular: Width = 30 in Depth = 30 in

Gross section area, Ag = 900 in^2
Ix = 67500 in^4 Iy = 67500 in^4
Xo = 0 in Yo = 0 in

Reinforcement:
==============

Rebar Database: ASTM A615

Size	Diam (in)	Area (in^2)	Size	Diam (in)	Area (in^2)	Size	Diam (in)	Area (in^2)
# 3	0.38	0.11	# 4	0.50	0.20	# 5	0.63	0.31
# 6	0.75	0.44	# 7	0.88	0.60	# 8	1.00	0.79
# 9	1.13	1.00	# 10	1.27	1.27	# 11	1.41	1.56
# 14	1.69	2.25	# 18	2.26	4.00			

Confinement: Tied; #3 ties with #7 bars, #4 with larger bars.
phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.65

Layout: Rectangular
Pattern: Equal Bar Spacing (Cover to transverse reinforcement)
Total steel area, As = 10.16 in^2 at 1.13%
8 #10 Cover = 2 in

Load Combinations:
==================

U1 = 1.400*Dead + 0.000*Live + 0.000*Wind + 0.000*EarthQuake
U2 = 1.200*Dead + 1.600*Live + 0.000*Wind + 0.000*EarthQuake
U3 = 1.200*Dead + 1.000*Live + 0.000*Wind + 0.000*EarthQuake
U4 = 1.200*Dead + 0.000*Live + 0.800*Wind + 0.000*EarthQuake
U5 = 1.200*Dead + 1.000*Live + 1.600*Wind + 0.000*EarthQuake
U6 = 0.900*Dead + 0.000*Live + 1.600*Wind + 0.000*EarthQuake
U7 = 1.200*Dead + 0.000*Live - 0.800*Wind + 0.000*EarthQuake
U8 = 1.200*Dead + 1.000*Live - 1.600*Wind + 0.000*EarthQuake
U9 = 0.900*Dead + 0.000*Live - 1.600*Wind + 0.000*EarthQuake
U10 = 1.200*Dead + 1.000*Live + 0.000*Wind + 1.000*EarthQuake
U11 = 0.900*Dead + 0.000*Live + 0.000*Wind + 1.000*EarthQuake
U12 = 1.200*Dead + 1.000*Live + 0.000*Wind - 1.000*EarthQuake
U13 = 0.900*Dead + 0.000*Live + 0.000*Wind - 1.000*EarthQuake

Service Loads:

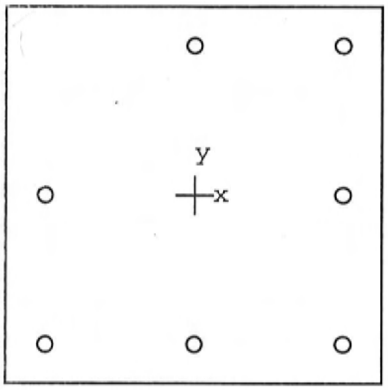
No.	Load Case	Axial Load kip	Mx @ Top k-ft	Mx @ Bot k-ft	My @ Top k-ft	My @ Bot k-ft
1	Dead	8.8	0.0	0.0	0.0	0.0
	Live	0.0	0.0	0.0	0.0	0.0
	Wind	0.0	0.0	0.0	0.0	0.0
	E.Q.	0.0	0.0	0.0	0.0	0.0

Factored Loads and Moments with Corresponding Capacities: (see user's manual for notation)

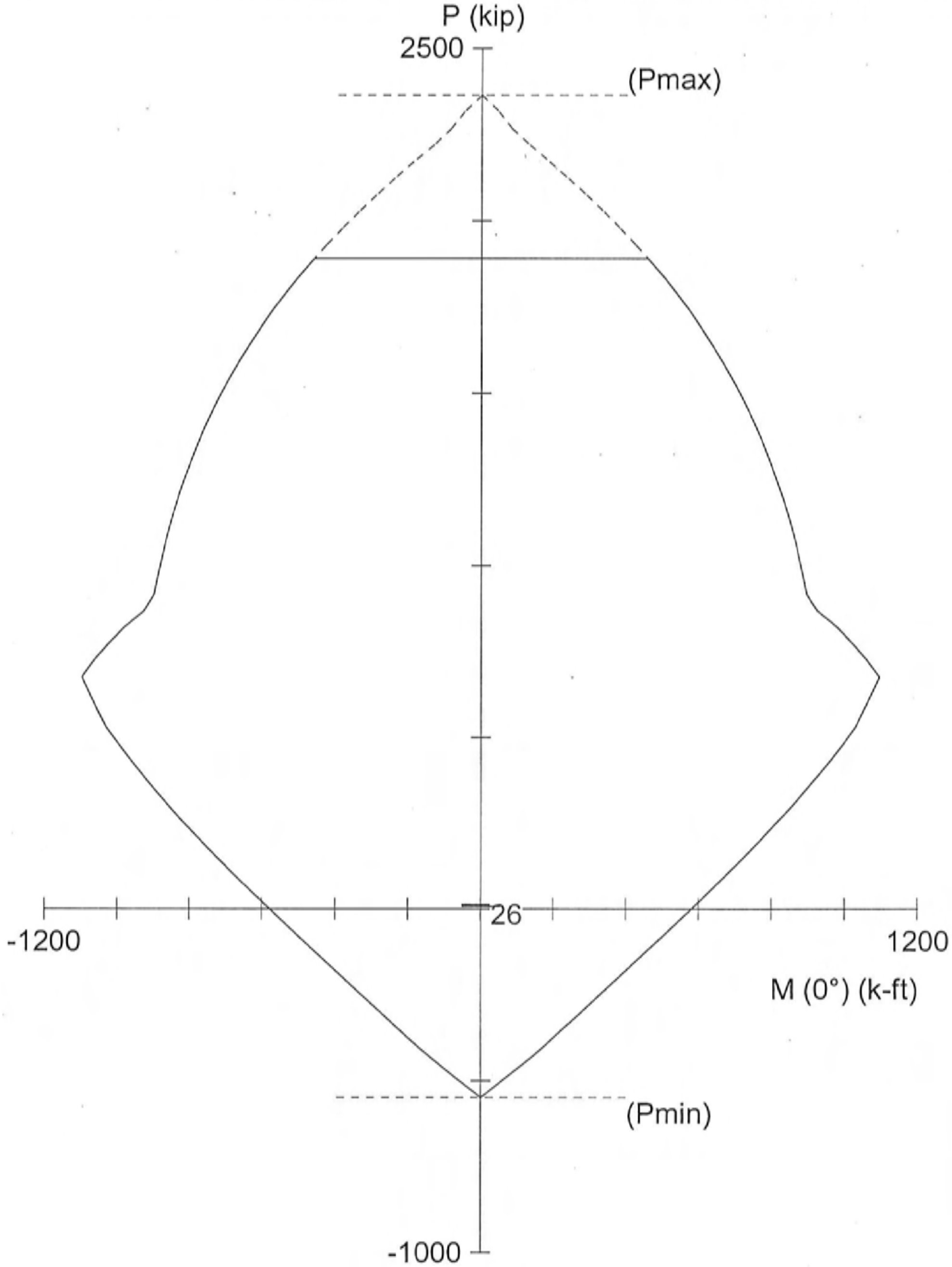
NOTE: Each loading combination includes the following cases:
First line - at column top
Second line - at column bottom

No.	Load Combo	Pu kip	Mux k-ft	Muy k-ft	fMnx k-ft	fMny k-ft	fMn/Mu
1	1 U1	12.3	0.0	0.0	592.1	0.0	999.999
2		12.3	0.0	0.0	592.1	0.0	999.999
3	1 U2	10.6	0.0	0.0	590.4	0.0	999.999
4		10.6	0.0	0.0	590.4	0.0	999.999
5	1 U3	10.6	0.0	0.0	590.4	0.0	999.999
6		10.6	0.0	0.0	590.4	0.0	999.999
7	1 U4	10.6	0.0	0.0	590.4	0.0	999.999
8		10.6	0.0	0.0	590.4	0.0	999.999
9	1 U5	10.6	0.0	0.0	590.4	0.0	999.999
10		10.6	0.0	0.0	590.4	0.0	999.999
11	1 U6	7.9	0.0	0.0	587.8	0.0	999.999
12		7.9	0.0	0.0	587.8	0.0	999.999
13	1 U7	10.6	0.0	0.0	590.4	0.0	999.999
14		10.6	0.0	0.0	590.4	0.0	999.999
15	1 U8	10.6	0.0	0.0	590.4	0.0	999.999
16		10.6	0.0	0.0	590.4	0.0	999.999
17	1 U9	7.9	0.0	0.0	587.8	0.0	999.999
18		7.9	0.0	0.0	587.8	0.0	999.999
19	1 U10	10.6	0.0	0.0	590.4	0.0	999.999
20		10.6	0.0	0.0	590.4	0.0	999.999
21	1 U11	7.9	0.0	0.0	587.8	0.0	999.999
22		7.9	0.0	0.0	587.8	0.0	999.999
23	1 U12	10.6	0.0	0.0	590.4	0.0	999.999
24		10.6	0.0	0.0	590.4	0.0	999.999
25	1 U13	7.9	0.0	0.0	587.8	0.0	999.999
26		7.9	0.0	0.0	587.8	0.0	999.999

*** Program completed as requested! ***



30 x 30 in



Code: ACI 318-02

Units: English

Run axis: Biaxial

Run option: Investigation

Slenderness: Not considered

Column type: Architectural

Bars: ASTM A615

Date: 10/27/11

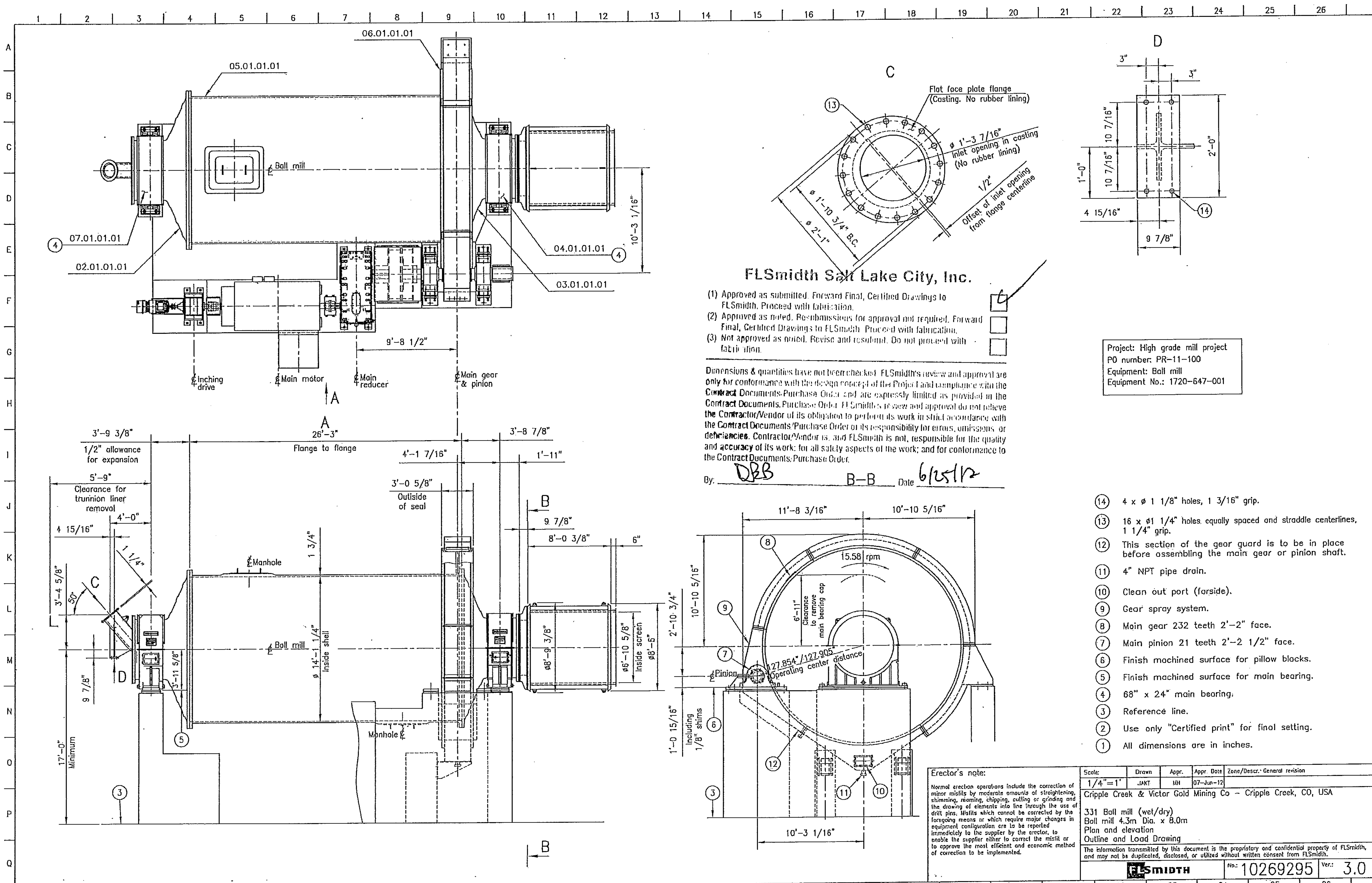
Time: 10:07:33

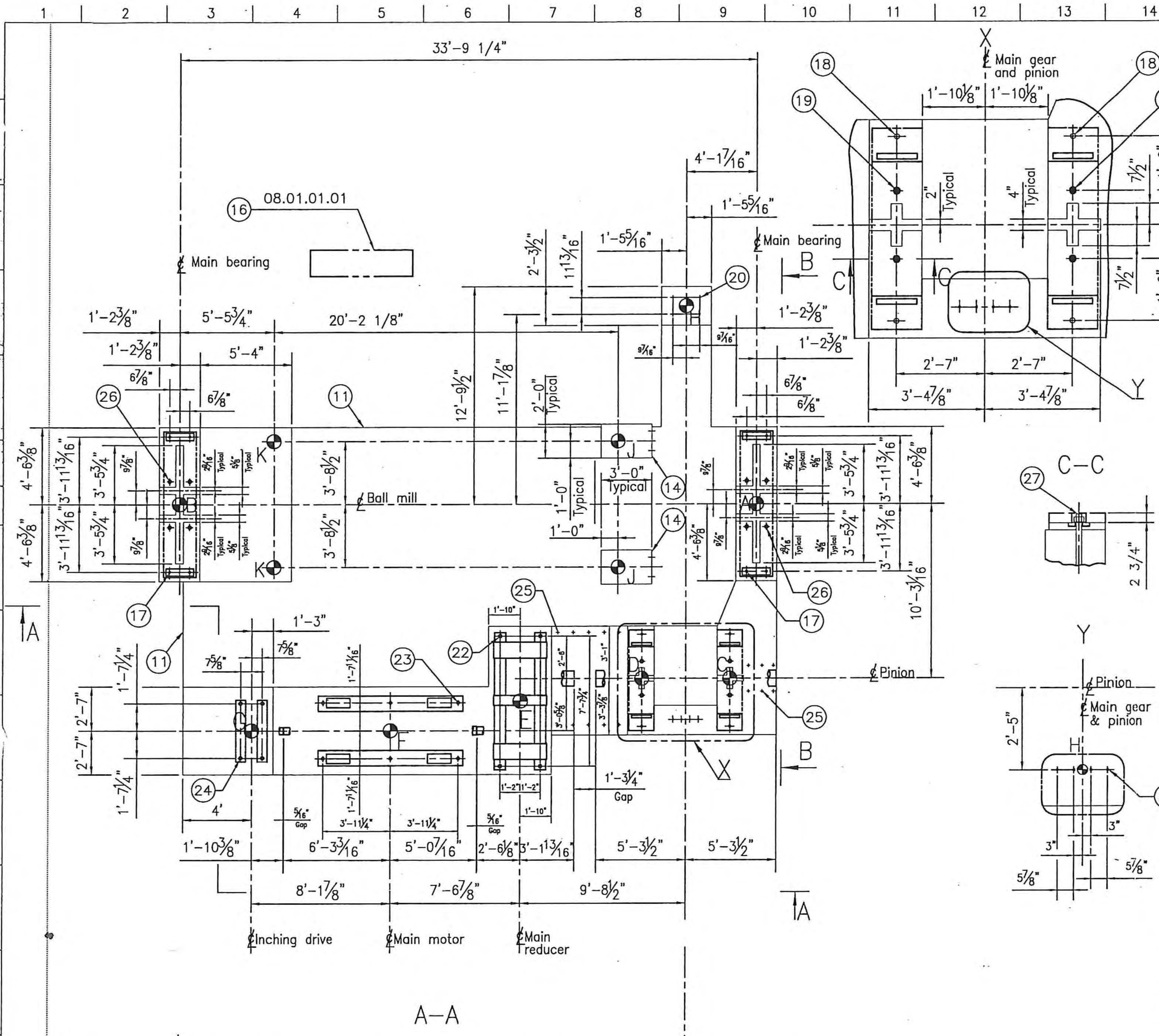
pcaColumn v3.63 - Licensed to: FLSmidth

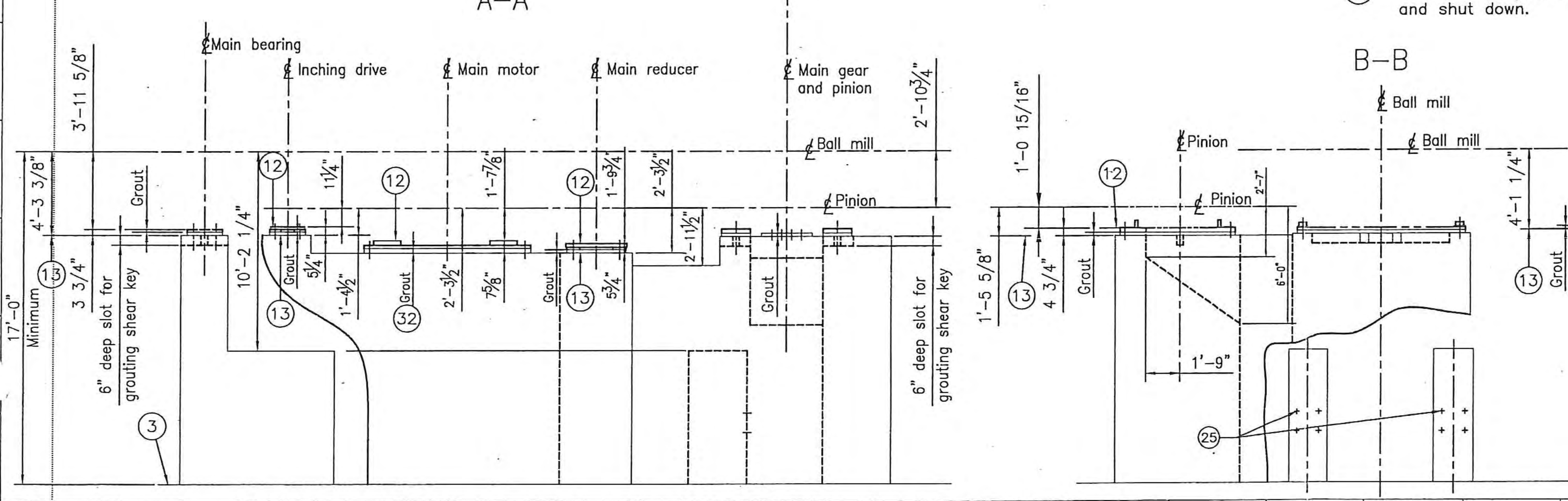
File: P:\11021\116 - Calculations\116.d - Arch_Civil_Struc\C-005 Grinding Area Concrete\Column H.col

Project: CC&V High Grade Ore

Column: A/B		Engineer: ECS	
f'c = 4 ksi	fy = 60 ksi	Ag = 900 in^2	8 #10 bars
Ec = 3605 ksi	Es = 29000 ksi	As = 10.16 in^2	Rho = 1.13%
fc = 3.4 ksi	fc = 3.4 ksi	Xo = 0.00 in	Ix = 67500 in^4
[illegible] = 0.003 in/in		Yo = 0.00 in	Iy = 67500 in^4
Beta1 = 0.85		Clear spacing = 10.59 in	Clear cover = 2.50 in
Confinement: Tied	phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.65		


06.01.01.01
05.01.01.01
07.01.01.01
02.01.01.01
04.01.01.01
03.01.01.01
Ball mill
10'-3 1/16"
9'-8 1/2"
Inching drive
Main motor
Main reducer
Main gear & pinion
A
26'-3"
Flange to flange
3'-9 3/8"
1/2" allowance for expansion
5'-9"
Clearance for trunnion liner removal
4'-0"
4 15/16"
4'-1 7/16"
3'-0 5/8"
Outside of seal
3'-8 7/8"
1'-11"
9 7/8"
8'-0 3/8"
6"
1 3/4"
Manhole
3'-4 5/8"
50°
ø 14'-1 1/4" Inside shell
ø8'-9 3/8"
ø6'-10 5/8" Inside screen
ø8'-5"
3'-11 5/8"
9 7/8"
17'-0" Minimum
C
Flat face plate flange
(Casting. No rubber lining)
ø 1'-3 7/16" inlet opening in casting (No rubber lining)
1/2" Offset of inlet opening from flange centerline
ø 1'-10 3/4" B.C.
ø 2'-1"
D
3"
3"
10 7/16"
10 7/16"
1'-0"
2'-0"
4 15/16"
9 7/8"
FLSmidth Salt Lake City, Inc.
(1) Approved as submitted. Forward Final, Certified Drawings to FLSmidth. Proceed with fabrication.
(2) Approved as noted. Resubmissions for approval not required. Forward Final, Certified Drawings to FLSmidth. Proceed with fabrication.
(3) Not approved as noted. Revise and resubmit. Do not proceed with fabrication.
Dimensions & quantities have not been checked. FLSmidth's review and approval are only for conformance with the design concept of the Project and compliance with the Contract Documents/Purchase Order and are expressly limited as provided in the Contract Documents/Purchase Order. FLSmidth's review and approval do not relieve the Contractor/Vendor of its obligation to perform its work in strict accordance with the Contract Documents/Purchase Order or its responsibility for errors, omissions or deficiencies. Contractor/Vendor is, and FLSmidth is not, responsible for the quality and accuracy of its work; for all safety aspects of the work; and for conformance to the Contract Documents/Purchase Order.
By: DBB
Date 6/25/12
Project: High grade mill project
PO number: PR-11-100
Equipment: Ball mill
Equipment No.: 1720-647-001
B-B
11'-8 3/16"
10'-10 5/16"
15.58 rpm
10'-10 5/16"
2'-10 3/4"
6'-11" Clearance to remove main bearing cap
127.854"/127.905" Operating center distance
Pinion
1'-0 15/16" Including 1/8" shims
10'-3 1/16"
(14) 4 x ø 1 1/8" holes, 1 3/16" grip.
(13) 16 x ø1 1/4" holes equally spaced and straddle centerlines, 1 1/4" grip.
(12) This section of the gear guard is to be in place before assembling the main gear or pinion shaft.
(11) 4" NPT pipe drain.
(10) Clean out port (farside).
(9) Gear spray system.
(8) Main gear 232 teeth 2'-2" face.
(7) Main pinion 21 teeth 2'-2 1/2" face.
(6) Finish machined surface for pillow blocks.
(5) Finish machined surface for main bearing.
(4) 68" x 24" main bearing.
(3) Reference line.
(2) Use only "Certified print" for final setting.
(1) All dimensions are in inches.
Erector's note:
Normal erection operations include the correction of minor misfits by moderate amounts of straightening, shimming, reaming, chipping, cutting or grinding and the drawing of elements into line through the use of drift pins. Misfits which cannot be corrected by the foregoing means or which require major changes in equipment configuration are to be reported immediately to the supplier by the erector, to enable the supplier either to correct the misfit or to approve the most efficient and economic method of correction to be implemented.
Scale: 1/4"=1'
Drawn JAKT
Appr. MH
Appr. Date 07-Jun-12
Zone/Descr.: General revision
Cripple Creek & Victor Gold Mining Co – Cripple Creek, CO, USA
331 Ball mill (wet/dry)
Ball mill 4.3m Dia. x 8.0m
Plan and elevation
Outline and Load Drawing
The information transmitted by this document is the proprietary and confidential property of FLSmidth, and may not be duplicated, disclosed, or utilized without written consent from FLSmidth.
FLSMIDTH
No.: 10269295
Ver.: 3.0

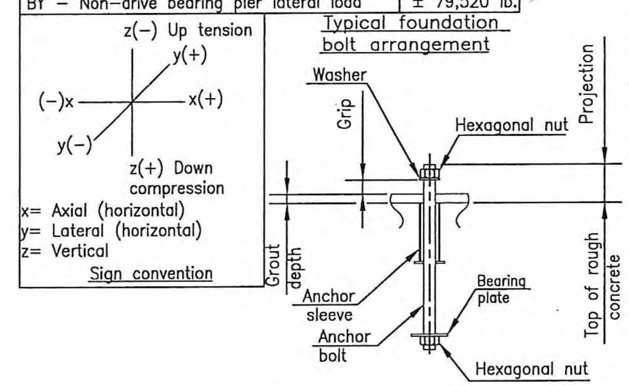




Foundation loads

Based on 40% total charge including 40% balls and metal liners
CW rotation when facing discharge end

	Mass	Dynamic
AX – Drive bearing pier axial load	0	15,878 lb.
AY – Drive bearing pier lateral load	0	33,200 lb.
AZ – Drive bearing pier vertical load	537,000 lb.	-34,700 lb.
BX – Non-drive bearing pier axial load	0	0
BY – Non-drive bearing pier lateral load	0	58,800 lb.
BZ – Non-drive bearing pier vertical load	497,000 lb.	45,000 lb.
CX – Pinion pier axial load	0	0
CY – Pinion pier lateral load	0	-30,400 lb.
CZ – Pinion pier vertical load	4,500 lb.	-40,800 lb.
DX – Pinion pier axial load	0	-15,878 lb.
DY – Pinion pier lateral load	0	-35,500 lb.
DZ – Pinion pier vertical load	8,600 lb.	-39,600 lb.
EX – Main reducer pier axial load	0	0
EY – Main reducer pier lateral load	0	0
EZ – Main reducer pier vertical load	13,000 lb.	±33,947 lb.
FX – Main motor pier axial load	0	0
FY – Main motor pier lateral load	0	0
FZ – Main motor pier vertical load	31,000 lb.	±15,650 lb.
GZ – Inching drive pier vertical load	3,000 lb.	0
HZ – Gear guard pier vertical load (load per point)	8,800 lb.	0
Jacking loads:		
JZ – Lift empty mill (load per point)	149,000 lb.	
KZ – Lift empty mill (load per point)	85,300 lb.	
JZ – Lift loaded mill (load per point)	286,000 lb.	
KZ – Lift loaded mill (load per point)	190,600 lb.	
Seismic loads (IBC 2003 Site class D)		
AX – Drive bearing pier axial load	± 165,440 lb.	
AY – Drive bearing pier lateral load	± 85,920 lb.	
BX – Non-drive bearing pier axial load	0	
BY – Non-drive bearing pier lateral load	± 79,520 lb.	



(29) Dynamic loads are based on 100% motor output torque. Foundation design shall consider starting and overload forces equal to motor pull out torque and not less than 200% of rated torque.

(28) Operating WR^2 of mill referred to motor shaft is 5600 lb/ft^2
WR^2 includes 35% total charge including 35% balls, rubber liners, pinion, clutch, reducer and coupling.

(27) Foundation bolt can not extend above soleplate.

(26) Red head wedge anchor Cat. No. WS3470 (by others). Use to achieve soleplate flatness. Location to be established using the soleplates as templates.

(25) Red head wedge anchor Cat. No. HN3424 (by others). See note (10)

(24) 4 foundation bolts ø2" x 1 1/2" grip, 7 3/4" projection.

(23) 6 foundation bolts ø1 3/4" x 2" grip, 8 1/2" projection.

(22) 4 foundation bolts ø2" x 1 1/2" grip, 7 3/4" projection.

(21) 4 foundation bolts ø3/4" x 5/8" grip, 5" projection.

(20) 4 foundation bolts ø3/4" x 1/2" grip, 4 1/2" projection.

(19) 2 foundation bolts ø1 1/2" x 1" grip, 4 1/4" projection.

(18) 2 foundation bolts ø2" x 3" grip, 8 1/4" projection.

(17) 4 foundation bolts ø2" x 4 3/4" grip, 10" projection.

(16) Main bearing and pinion bearing lubrication system.

(15) Foundation designer must provide adequate support for jacking cradle assembly. See jacking cradle assembly 10271539 for location.

(14) Jacking pads.

(13) Top of rough concrete.

(12) Finish machined surface of soleplate.

(11) It is suggested to tie the main drive end bearing and drive piers together as shown using an integral reinforced concrete foundation. All foundations should be tied together using an integral reinforced sub surface concrete mat. The mat is to be structurally capable of carrying all static and dynamic loads.

(10) The location for the sleeve type anchors must be established using the guards and gear guard support brackets as templates at field installation. The maximum clearance between guards and stationary objects is 1/2" (anchors supplied by others).

(9) Grout shall be high quality, non shrinking and have mechanical properties suitable for the static and dynamic loads specified. A pourable epoxy resin compound is recommended.

(8) Allow for grout on top of mill bearing and drive piers (except main motor) shown (approximately 2").

(7) The foundation is to be designed so that no natural frequencies fall in the range of 51 Hz – 69 Hz. This is to ensure that no significant resonance occurs with the girth gear / pinion meshing frequency of 60.2 Hz.

(6) Foundation bolts, nuts, washers, anchor sleeves and bearing plates are not supplied by FLSmidth mill group, unless specifically ordered.

(5) Anchor bolts to be set in anchor sleeve to allow for adjustment.

(4) Depth of foundation depends on nature of soil.

(3) Reference line.

(2) Use only "Certified print" for final setting.

(1) All dimensions are in inches.

(32) Allow for grout on top of main motor drive piers as shown (approximately 2 3/4").

(31) Anchor bolts are to be located within 1/8" of the indicated position. Tolerance must not be accumulative.

(30) Direction of dynamic loads are reversed during start-up and shut down.

Project: High grade mill project
PO number: PR-11-100
Equipment: Ball mill
Equipment No.: 1720-647-001

Important : Equipment foundations are the responsibility of the purchaser and shall be designed to meet the duty service, soil conditions and the specified operating loads. Foundation dimensions shown by FLSmidth Inc. are intended to define the interface and battery limits for the equipment supplied and are not intended

Erector's note:

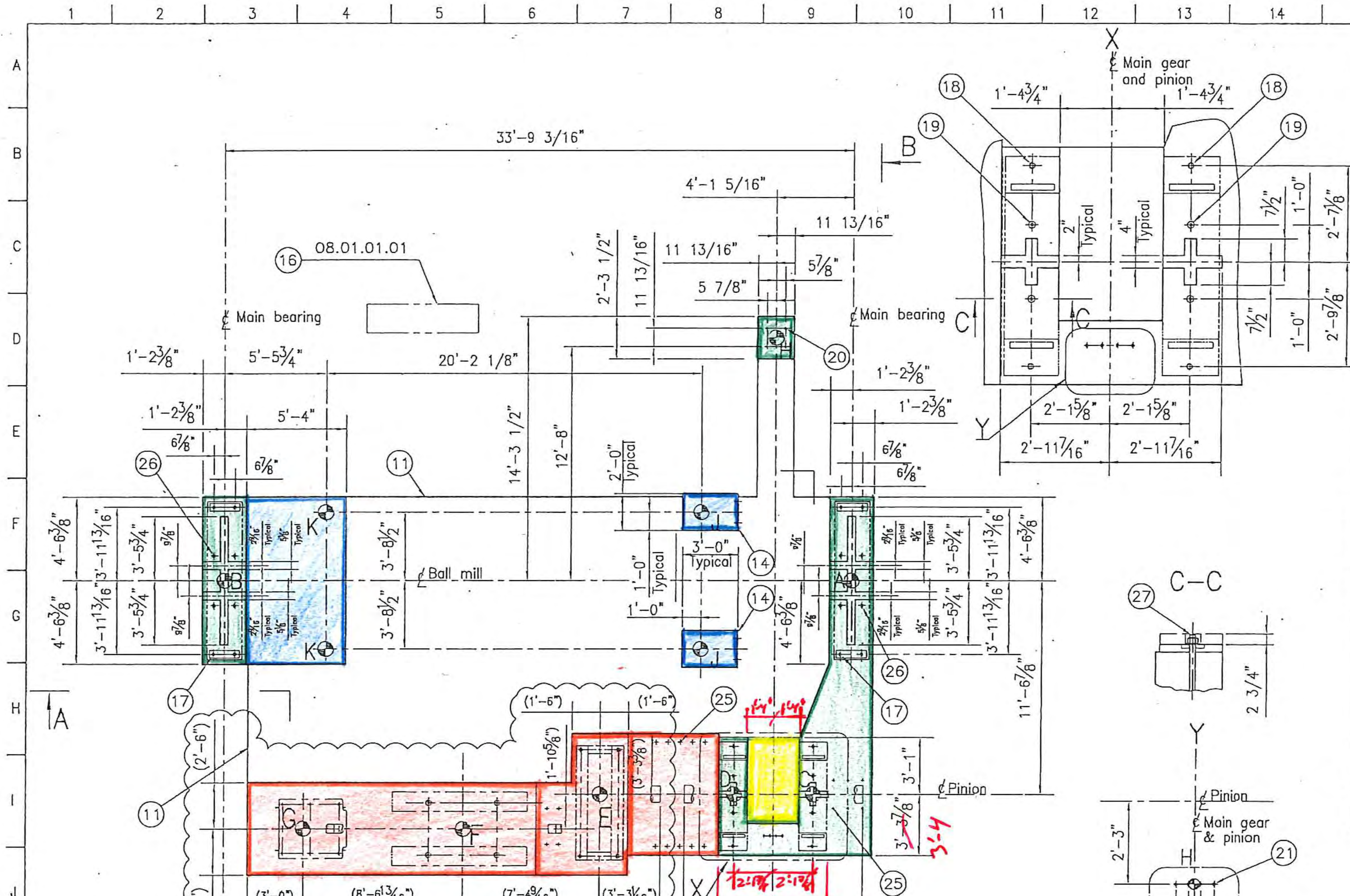
Normal erection operations include the correction of minor misfits by moderate amounts of straightening, shimming, reaming, chipping, cutting or grinding and the drawing of elements into line through the use of drift pins. Misfits which cannot be corrected by the foregoing means or which require major changes in equipment configuration are to be reported immediately to the supplier by the erector, to enable the supplier either to correct the misfit or to approve the most efficient and economic method of correction to be implemented.

Scale:	Drawn	Appr.	Appr. Date	Zone/Descr.: General revision
1/4"=1'	IBA	SPN	23-Apr-12	Reference No. with Q see legend No.

Cripple Creek & Victor Gold Mining Co – Cripple Creek, CO, USA

331 Ball mill (wet/dry)
Ball mill 4.3m Dia. x 8.0m
Foundation and loads
Outline and Load Drawing

FLSMIDTH No.: 10269296 Ver.: 2.0



Foundation loads

Based on 40% total charge including 40% balls and metal liners
CW rotation when facing discharge end

	Mass	Dynamic
AX – Drive bearing pier axial load	0	15,878 lb.
AY – Drive bearing pier lateral load	0	33,200 lb.
AZ – Drive bearing pier vertical load	537,000 lb.	–34,700 lb.
BX – Non–drive bearing pier axial load	0	0
BY – Non–drive bearing pier lateral load	0	58,800 lb.
BZ – Non–drive bearing pier vertical load	497,000 lb.	45,000 lb.
CX – Pinion pier axial load	0	0
CY – Pinion pier lateral load	0	–30,400 lb.
CZ – Pinion pier vertical load	4,500 lb.	–40,800 lb.
DX – Pinion pier axial load	0	–15,878 lb.
DY – Pinion pier lateral load	0	–35,500 lb.
DZ – Pinion pier vertical load	8,600 lb.	–39,600 lb.
EX – Main reducer pier axial load	0	0
EY – Main reducer pier lateral load	0	0
EZ – Main reducer pier vertical load	13,000 lb.	±33,947 lb.
FX – Main motor pier axial load	0	0
FY – Main motor pier lateral load	0	0
FZ – Main motor pier vertical load	31,000 lb.	±15,650 lb.
GZ – Inching drive pier vertical load	3,000 lb.	0
HZ – Gear guard pier vertical load (load per point)	8,800 lb.	0
Jacking loads:		
JZ – Lift empty mill (load per point)	149,000 lb.	"Hold"
KZ – Lift empty mill (load per point)	85,300 lb.	
JZ – Lift loaded mill (load per point)	286,000 lb.	
KZ – Lift loaded mill (load per point)	190,600 lb.	
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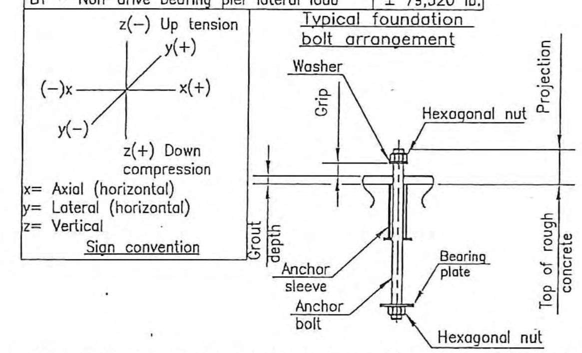
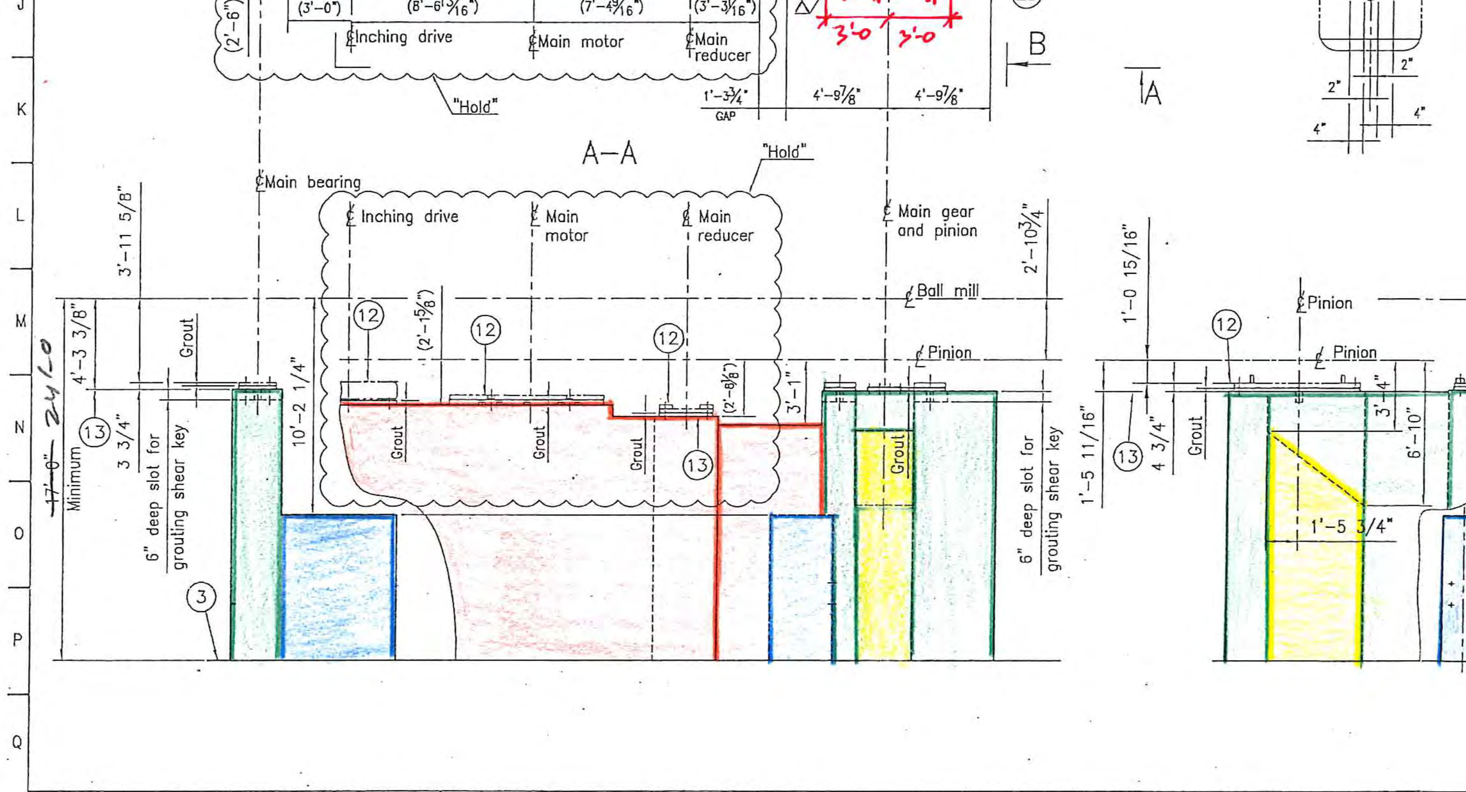
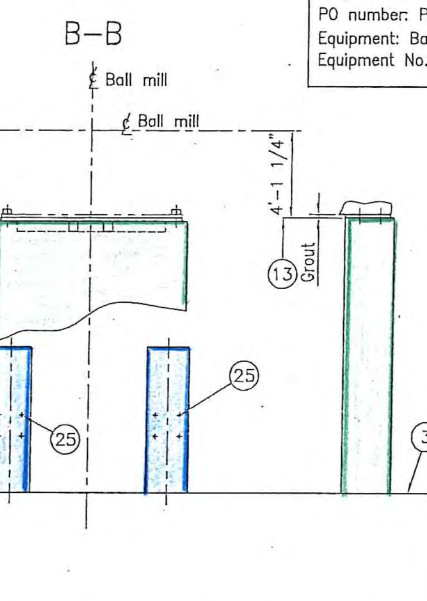
AY – Drive bearing pier lateral load	± 85,920 lb.	
BX – Non–drive bearing pier axial load	0	
BY – Non–drive bearing pier lateral load	± 79,520 lb.	



(31) Anchor bolts are to be located within 1/8" of the indicated position. Tolerance must not be accumulative.

(30) Direction of dynamic loads are reversed during start–up and shut down.





Project: High grade mill project
PO number: PR-11-100
Equipment: Ball mill
Equipment No.: 1720-647-001

(29) Dynamic loads are based on 100% motor output torque. Foundation design shall consider starting and overload forces equal to motor pull out torque and not less than 200% of rated torque.

(28) Operating WR^2 of mill referred to motor shaft is 5600 lb/ft^2
WR^2 includes 35% total charge including 35% balls, rubber liners, pinion, clutch, reducer and coupling.

(27) Foundation bolt can not extend above soleplate.

(26) Red head wedge anchor Cat. No. WS3470 (by others). Use to achieve soleplate flatness. Location to be established using the soleplates as templates.

(25) Red head wedge anchor Cat. No. HN3424 (by others). See note

(24) "Later"

(23) "Later"

(22) "Later"

(21) 4 foundation bolts ø3/4" x 5/8" grip, 5" projection.

(20) 4 foundation bolts ø3/4" x 1/2" grip, 4 1/2" projection.

(19) 2 foundation bolts ø1 1/2" x 1" grip, 4 1/4" projection.

(18) 2 foundation bolts ø2" x 3" grip, 8 1/4" projection.

(17) 4 foundation bolts ø2" x 4 3/4" grip, 10" projection.

(16) Main bearing and pinion bearing lubrication system.

(15) Foundation designer must provide adequate support for jacking cradle assembly. See jacking cradle assembly "Later" for location.

(14) Jacking pads.

(13) Top of rough concrete.

(12) Finish machined surface of soleplate.

(11) It is suggested to tie the main drive end bearing and drive piers together as shown using an integral reinforced concrete foundation. All foundations should be tied together using an integral reinforced sub surface concrete mat. The mat is to be structurally capable of carrying all static and dynamic loads.

(10) The location for the sleeve type anchors must be established using the guards and gear guard support brackets as templates at field installation. The maximum clearance between guards and stationary objects is 1/2" (anchors supplied by others).

(9) Grout shall be high quality, non shrinking and have mechanical properties suitable for the static and dynamic loads specified. A pourable epoxy resin compound is recommended.

(8) Allow for grout on top of mill bearing and drive piers (except main motor) shown (approximately 2").

(7) The foundation is to be designed so that no natural frequencies fall in the range of 74 Hz – 100 Hz. This is to ensure that no significant resonance occurs with the girth gear / pinion meshing frequency of 86.7 Hz.

(6) Foundation bolts, nuts, washers, anchor sleeves and bearing plates are not furnished by FLSmidth unless specifically ordered.

(5) Anchor bolts to be set in anchor sleeve to allow for adjustment.

(4) Depth of foundation depends on nature of soil.

(3) Reference line.

(2) Use only "Certified print" for final setting.

(1) All dimensions are in inches.

Important : Equipment foundations are the responsibility of the purchaser and shall be designed to meet the duty service, soil conditions and the specified operating loads. Foundation dimensions shown by FLSmidth Inc. are intended to define the interface and battery limits for the equipment supplied and are not intended

Erector's note:

Normal erection operations include the correction of minor misfits by moderate amounts of straightening, shimming, reaming, chipping, cutting or grinding and the drawing of elements into line through the use of drift pins. Misfits which cannot be corrected by the foregoing means or which require major changes in equipment configuration are to be reported immediately to the supplier by the erector, to enable the supplier either to correct the misfit or to approve the most efficient and economic method of correction to be implemented.

Scale:	Drawn	Appr.	Appr. Date	Zone/Descr.:
1/4"=1'	IBA	MH	14–Oct–11	

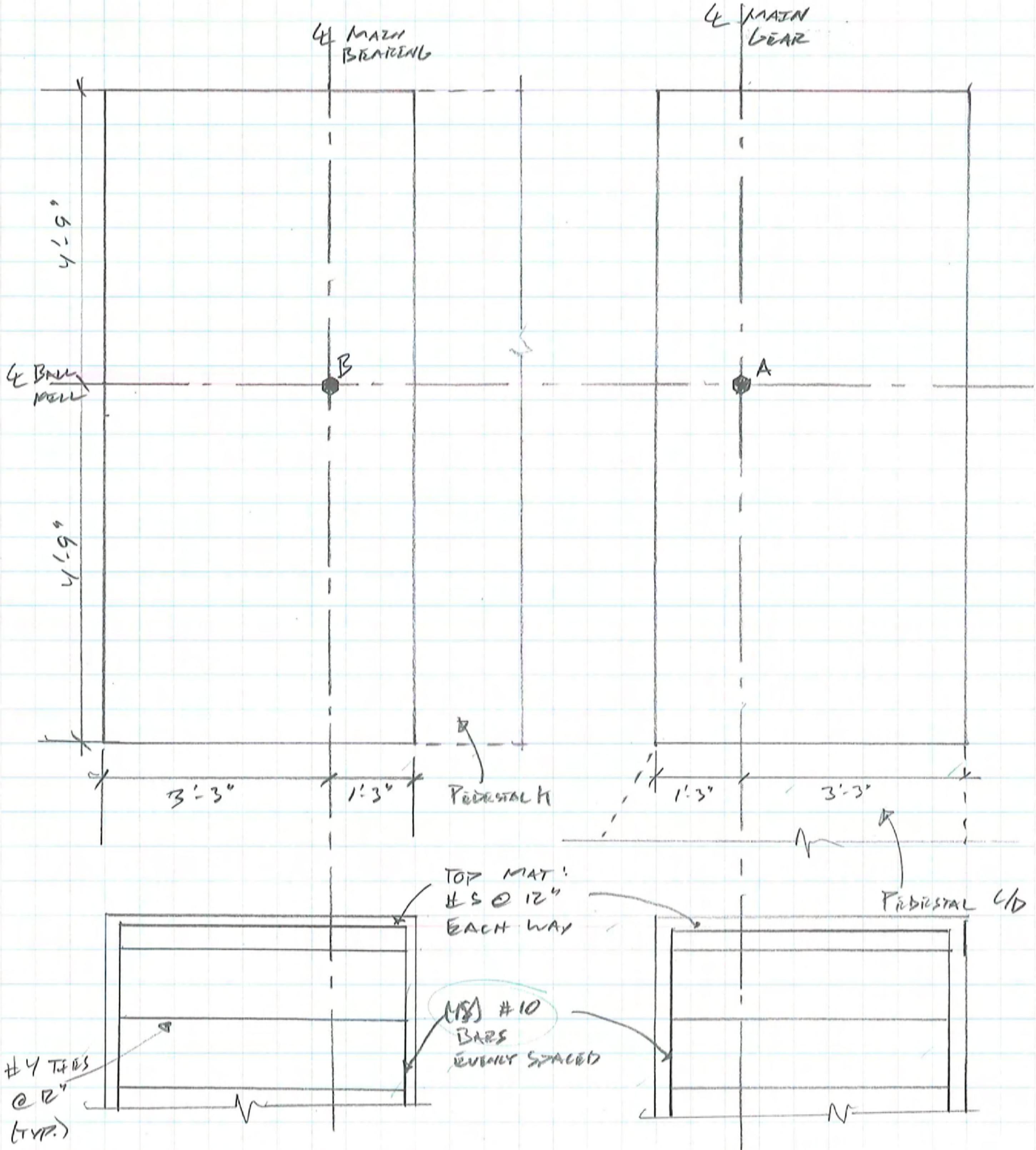
Cripple Creek & Victor Gold Mining Co – Cripple Creek, CO, USA

331 Ball mill (wet/dry)
Ball mill 4.3m Dia. x 8.0m
Foundation and loads
Outline and Load Drawing

FLSMIDTH No.: 10269296 Ver.: 1.0

FLSMIDTH	PROJECT CC & V High Grade Ore	PROJ NO. 11021	
		CALC NO. C-005	
	SUBJECT Ball Mill Foundation	BY ECS	DATE 10-28-11
		CHK	DATE
		SHEET	OF REV

Pedestal A/B Design



Concrete Pedestal Natural Period of Vibration
Pedestal A/B

Pedestal Dimensions:

$L_x := 4ft + 6in = 54\,in$ Pedestal Length X Direction

$L_y := 9ft + 6in = 114\,in$ Pedestal Length Y Direction

$H := 19ft + 8.675in = 236.675\,in$ Pedestal Height

Concrete Properties:

$\gamma_c := 145pcf$ Concrete Unit Weight

$f_c := 4000psi$ Concrete Compressive Strength

$E := 57000psi \cdot \sqrt{\frac{f_c}{psi}} = 3.605 \times 10^3 \cdot ksi$ Concrete Modulus of Elasticity

Loads and Masses:

$m := L_x \cdot L_y \cdot H \cdot \frac{\gamma_c}{g} = 1.223 \times 10^5 \cdot lb$ Pedestal Mass

$F_x := 15878lb$ $F_y := 58800lb$ Applied Mass

$m_x := F_x + 0.23m = 4.4 \times 10^4\,lb$ $m_y := F_y + 0.23m = 8.692 \times 10^4\,lb$ Equivalent Mass

Dynamic Properties:

$I_x := \frac{L_x^3 \cdot L_y}{12} = 1.496 \times 10^6\,in^4$ $I_y := \frac{L_x \cdot L_y^3}{12} = 6.667 \times 10^6 \cdot in^4$ Moment of Inertia

$k_x := \frac{(3 \cdot E \cdot I_x)}{H^3} = 1.464 \times 10^4 \cdot \frac{kip}{ft}$ $k_y := \frac{(3 \cdot E \cdot I_y)}{H^3} = 6.526 \times 10^4 \cdot \frac{kip}{ft}$ Stiffness Factor

$\omega_x := \sqrt{\frac{k_x}{0.23m}} = 129.443 \cdot Hz$ $\omega_y := \sqrt{\frac{k_y}{0.23m}} = 273.269 \cdot Hz$ Natural Frequency without added Mass

$\omega_{x.} := \sqrt{\frac{k_x}{m_x}} = 103.483 \cdot Hz$ $\omega_{y.} := \sqrt{\frac{k_y}{m_y}} = 155.43 \cdot Hz$ Natural Frequency with added Mass

```
0000000    00000    00000    00000    00000   00
00    00 00    00 00    00 00    00 00    00 00
00    00 00    00 00    00 00    00 00    00 00
00    00 00       00    00 00       00    00 00
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00        00000   00    00  00000    00000   00000   (TM)
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==
Computer program for the Strength Design of Reinforced Concrete Sections
==

General Information:
====================

File Name: C:\Users\esum-us\Desktop\Pedestal Design\Column A-B.col
Project: CC&V High Grade Ore
Column: A/B Engineer: ECS
Code: ACI 318-02 Units: English

Run Option: Investigation Slenderness: Not considered
Run Axis: Biaxial Column Type: Architectural

Material Properties:
====================

f'c = 4 ksi fy = 60 ksi
Ec = 3605 ksi Es = 29000 ksi
Ultimate strain = 0.003 in/in
Beta1 = 0.85

Section:
========

Rectangular: Width = 54 in Depth = 114 in

Gross section area, Ag = 6156 in^2
Ix = 6.66695e+006 in^4 Iy = 1.49591e+006 in^4
Xo = 0 in Yo = 0 in

Reinforcement:
==============

Rebar Database: ASTM A615

Size	Diam (in)	Area (in^2)	Size	Diam (in)	Area (in^2)	Size	Diam (in)	Area (in^2)
# 3	0.38	0.11	# 4	0.50	0.20	# 5	0.63	0.31
# 6	0.75	0.44	# 7	0.88	0.60	# 8	1.00	0.79
# 9	1.13	1.00	# 10	1.27	1.27	# 11	1.41	1.56
# 14	1.69	2.25	# 18	2.26	4.00			

Confinement: Tied; #3 ties with #7 bars, #4 with larger bars.
phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.65

Layout: Rectangular
Pattern: Equal Bar Spacing (Cover to transverse reinforcement)
Total steel area, As = 60.96 in^2 at 0.99%
48 #10 Cover = 2 in

Load Combinations:
==================

U1 = 1.400*Dead + 0.000*Live + 0.000*Wind + 0.000*EarthQuake
U2 = 1.200*Dead + 1.600*Live + 0.000*Wind + 0.000*EarthQuake
U3 = 1.200*Dead + 1.000*Live + 0.000*Wind + 0.000*EarthQuake
U4 = 1.200*Dead + 0.000*Live + 0.800*Wind + 0.000*EarthQuake
U5 = 1.200*Dead + 1.000*Live + 1.600*Wind + 0.000*EarthQuake
U6 = 0.900*Dead + 0.000*Live + 1.600*Wind + 0.000*EarthQuake
U7 = 1.200*Dead + 0.000*Live - 0.800*Wind + 0.000*EarthQuake
U8 = 1.200*Dead + 1.000*Live - 1.600*Wind + 0.000*EarthQuake
U9 = 0.900*Dead + 0.000*Live - 1.600*Wind + 0.000*EarthQuake
U10 = 1.200*Dead + 1.000*Live + 0.000*Wind + 1.000*EarthQuake
U11 = 0.900*Dead + 0.000*Live + 0.000*Wind + 1.000*EarthQuake
U12 = 1.200*Dead + 1.000*Live + 0.000*Wind - 1.000*EarthQuake
U13 = 0.900*Dead + 0.000*Live + 0.000*Wind - 1.000*EarthQuake

Service Loads:
==============

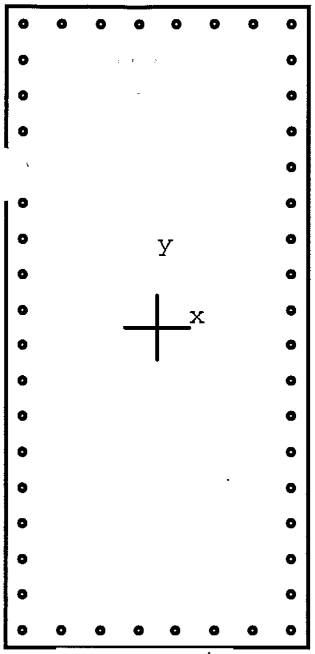
No.	Load Case	Axial Load kip	Mx @ Top k-ft	Mx @ Bot k-ft	My @ Top k-ft	My @ Bot k-ft
1	Dead	497.0	0.0	0.0	497.0	497.0
	Live	45.0	0.0	0.0	45.0	930.0
	Wind	0.0	0.0	0.0	0.0	0.0
	E.Q.	~~85.3~~ 0	0.0	0.0	~~85.3~~ 0	~~3016.0~~ 3263 ok

Factored Loads and Moments with Corresponding Capacities: (see user's manual for notation)
==

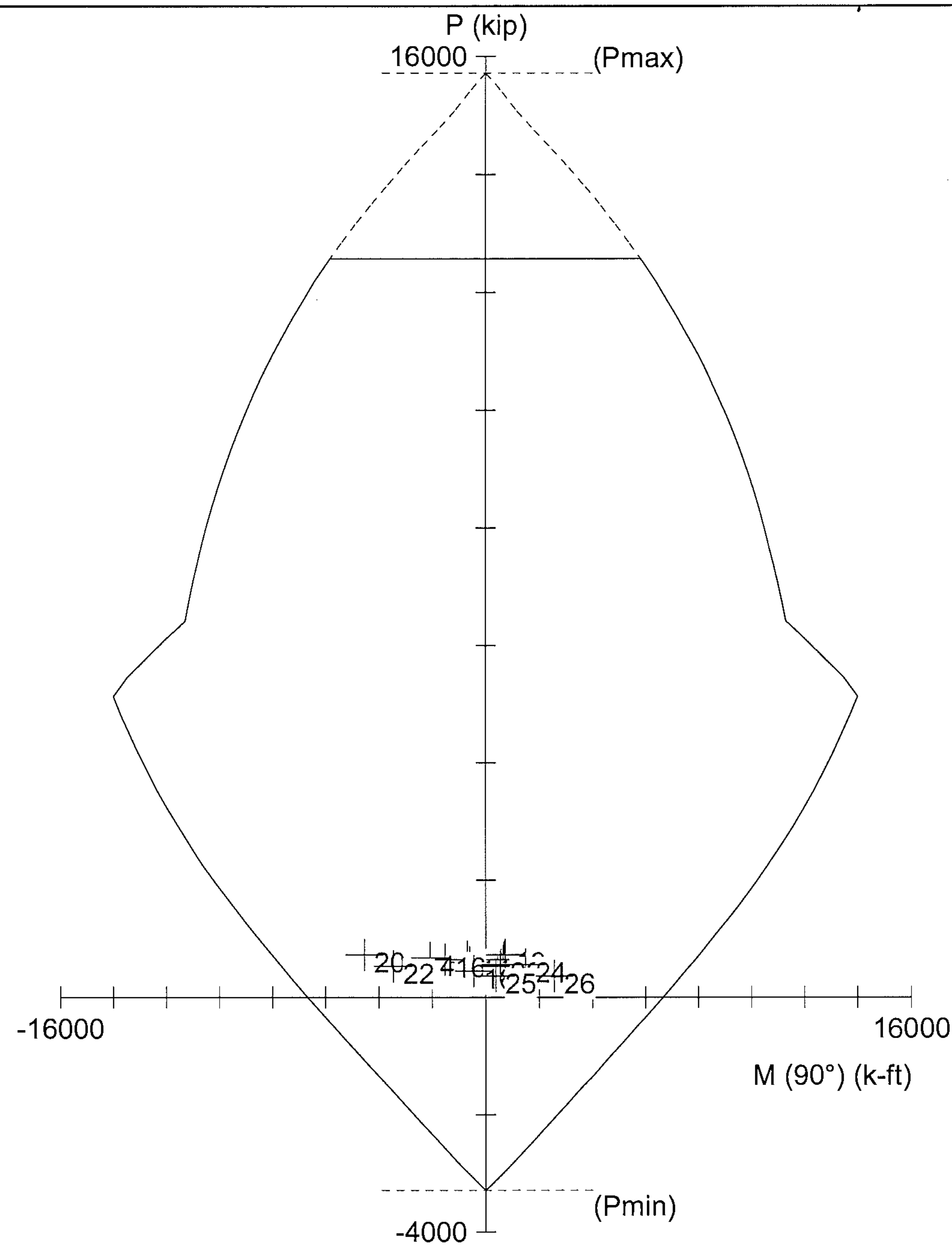
NOTE: Each loading combination includes the following cases:
First line - at column top
Second line - at column bottom

No.	Load Combo	Pu kip	Mux k-ft	Muy k-ft	fMnx k-ft	fMny k-ft	fMn/Mu
1	1 U1	695.8	0.0	695.8	-0.0	7979.6	11.468
2		695.8	0.0	-695.8	0.0	-7979.6	11.468
3	1 U2	668.4	0.0	668.4	-0.0	7929.9	11.864
4		668.4	0.0	-2084.4	0.0	-7929.9	3.804
5	1 U3	641.4	0.0	641.4	-0.0	7880.8	12.287
6		641.4	0.0	-1526.4	0.0	-7880.8	5.163
7	1 U4	596.4	0.0	596.4	-0.0	7798.9	13.077
8		596.4	0.0	-596.4	0.0	-7798.9	13.077
9	1 U5	641.4	0.0	641.4	-0.0	7880.8	12.287
10		641.4	0.0	-1526.4	0.0	-7880.8	5.163
11	1 U6	447.3	0.0	447.3	-0.0	7526.1	16.826
12		447.3	0.0	-447.3	0.0	-7526.1	16.826
13	1 U7	596.4	0.0	596.4	-0.0	7798.9	13.077
14		596.4	0.0	-596.4	0.0	-7798.9	13.077
15	1 U8	641.4	0.0	641.4	-0.0	7880.8	12.287
16		641.4	0.0	-1526.4	0.0	-7880.8	5.163
17	1 U9	447.3	0.0	447.3	-0.0	7526.1	16.826
18		447.3	0.0	-447.3	0.0	-7526.1	16.826
19	1 U10	726.7	0.0	726.7	-0.0	8035.7	11.058
20		726.7	0.0	-4542.4	0.0	-8035.7	1.769
21	1 U11	532.6	0.0	532.6	-0.0	7682.4	14.424
22		532.6	0.0	-3463.3	0.0	-7682.4	2.218
23	1 U12	556.1	0.0	556.1	-0.0	7725.4	13.892
24		556.1	0.0	1489.6	-0.0	7725.4	5.186
25	1 U13	362.0	0.0	362.0	-0.0	7365.2	20.346
26		362.0	0.0	2568.7	-0.0	7365.2	2.867

*** Program completed as requested! ***



54 x 114 in



Code: ACI 318-02

Units: English

Run axis: Biaxial

Run option: Investigation

Slenderness: Not considered

Column type: Architectural

Bars: ASTM A615

Date: 10/28/11

Time: 10:08:56

pcaColumn v3.63 - Licensed to: FLSmidth

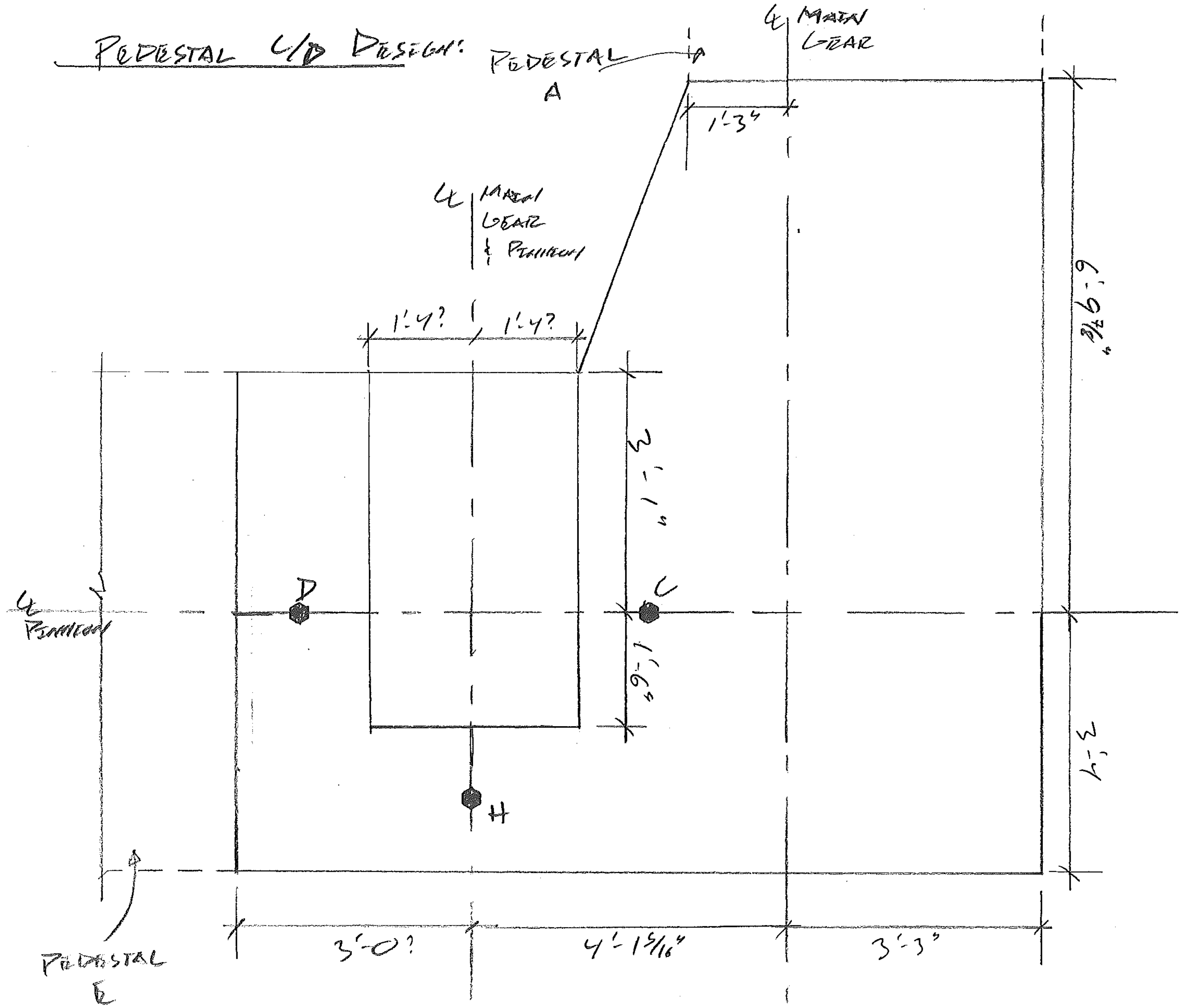
File: C:\Users\esum-us\Desktop\Pedestal Design\Column A-B.col

Project: CC&V High Grade Ore

Column: A/B		Engineer: ECS	
f'c = 4 ksi	fy = 60 ksi	Ag = 6156 in^2	48 #10 bars
Ec = 3605 ksi	Es = 29000 ksi	As = 60.96 in^2	Rho = 0.99%
fc = 3.4 ksi	fc = 3.4 ksi	Xo = 0.00 in	Ix = 6.66695e+006 in^4
εu = 0.003 in/in		Yo = 0.00 in	Iy = 1.49591e+006 in^4
Beta1 = 0.85		Clear spacing = 5.07 in	Clear cover = 2.50 in
Confinement: Tied	phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.65		

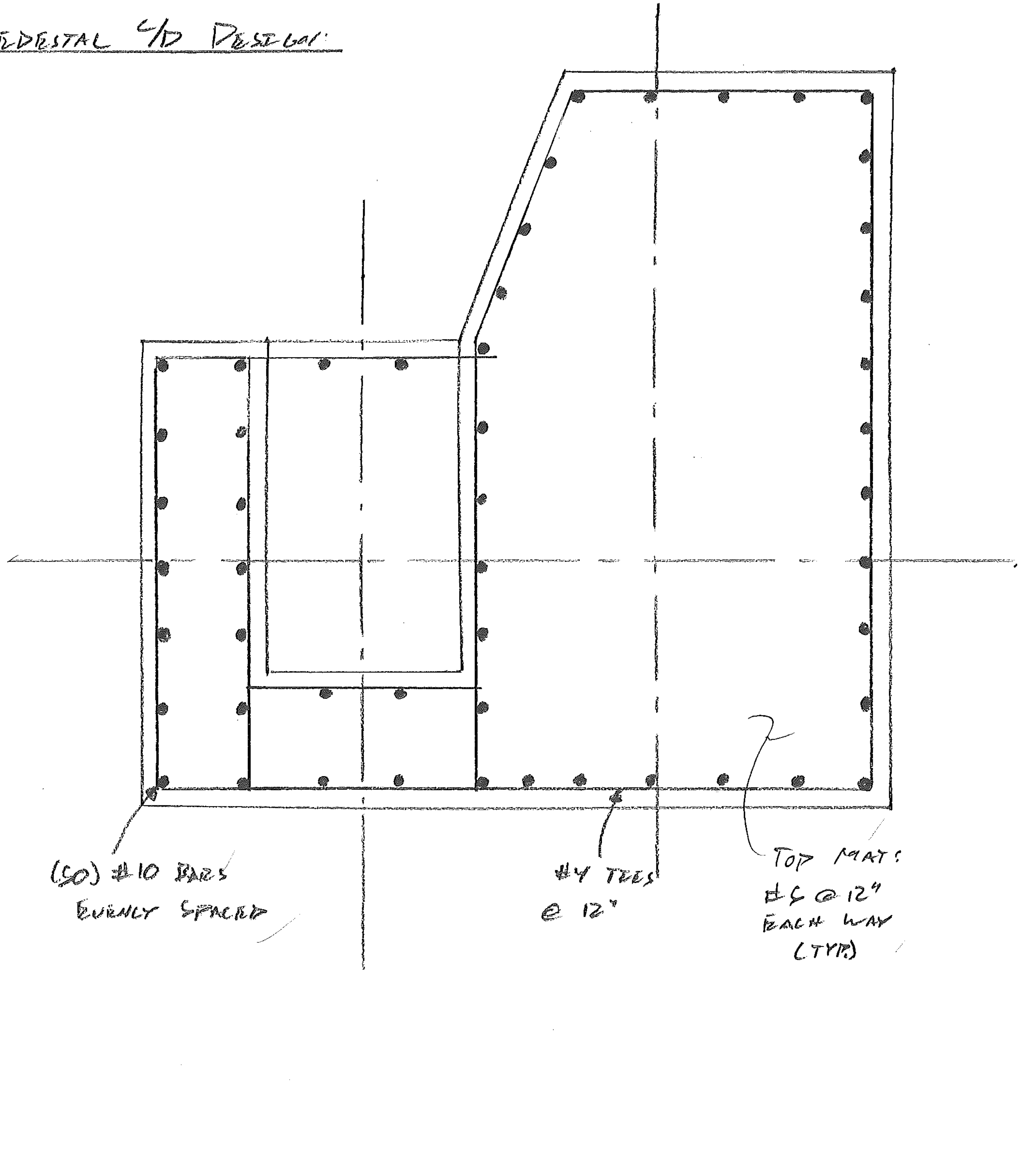
FLSMIDTH	PROJECT CC & V HIGH GRADE ORE	PROJ NO. 11021
		CALC NO. C-005
	SUBJECT BALL MILL FOUNDATION	BY ECS DATE 10-28-11
		CHK DATE
		SHEET OF REV

PEDESTAL C/D DESIGN:



FLSmidth	PROJECT LC & V High Grade Ore	PROJ NO. 11021
		CALC NO. C-005
	SUBJECT Ball Mill Foundation	BY ECS DATE 10-28-11
		CHK DATE
		SHEET OF REV

Pedestal R/D Design:



Concrete Pedestal Natural Period of Vibration
Pedestal C/D

Pedestal Dimensions:

$L_x := 10ft + 5in = 125\ in$ — Pedestal Length X Direction

$L_y := 6ft + 5in = 77\ in$ — Pedestal Length Y Direction

$H := 19ft + 8.875in = 236.875\ in$ — Pedestal Height

Concrete Properties:

$\gamma_c := 145pcf$ — Concrete Unit Weight

$f_c := 4000psi$ — Concrete Compressive Strength

$E := 57000psi \cdot \sqrt{\frac{f_c}{psi}} = 3.605 \times 10^3 \cdot ksi$ — Concrete Modulus of Elasticity

Loads and Masses:

$m := L_x \cdot L_y \cdot H \cdot \frac{\gamma_c}{g} = 1.913 \times 10^5 \cdot lb$ — Pedestal Mass

$F_x := 15900lb$ $\quad F_y := 65900lb$ — Applied Mass

$m_x := F_x + 0.23m = 5.99 \times 10^4\ lb$ $\quad m_y := F_y + 0.23m = 1.099 \times 10^5\ lb$ — Equivalent Mass

Dynamic Properties:

$I_x := \frac{L_x^3 \cdot L_y}{12} = 1.253 \times 10^7\ in^4$ $\quad I_y := \frac{L_x \cdot L_y^3}{12} = 4.756 \times 10^6 \cdot in^4$ — Moment of Inertia

$k_x := \frac{(3 \cdot E \cdot I_x)}{H^3} = 1.224 \times 10^5 \cdot \frac{kip}{ft}$ $\quad k_y := \frac{(3 \cdot E \cdot I_y)}{H^3} = 4.644 \times 10^4 \cdot \frac{kip}{ft}$ — Stiffness Factor

$\omega_x := \sqrt{\frac{k_x}{0.23m}} = 299.131 \cdot Hz$ $\quad \omega_y := \sqrt{\frac{k_y}{0.23m}} = 184.265 \cdot Hz$ — Natural Frequency without added Mass

$\omega_{x.} := \sqrt{\frac{k_x}{m_x}} = 256.376 \cdot Hz$ $\quad \omega_{y.} := \sqrt{\frac{k_y}{m_y}} = 116.594 \cdot Hz$ — Natural Frequency with added Mass

Pedestal C/D Loading

Pedestal Height (ft): 19.67

Load Locations:

Using CL Main Gear & CL Pinnion as Axis Origin

	X (ft)	Y (ft)
Pedestal Center of Gravity	1.15	0.12

Location	Coordinates		Eccentricity	
	X (ft)	Y (ft)	e_x (ft)	e_y (ft)
C	2.20	0.00	1.05	-0.12
D	-2.20	0.00	-3.35	-0.12
H	0.00	2.50	-1.15	2.38

Dead Load:

Location	F_x (kip)	F_y (kip)	F_z (kip)	M_x (k*ft)		M_y (k*ft)	
				Top	Bot	Top	Bot
C	0.0	0.0	4.5	-0.5	-0.5	4.7	4.7
D	0.0	0.0	8.6	-1.0	-1.0	-28.8	-28.8
H	0.0	0.0	8.8	20.9	20.9	-10.1	-10.1
Result	**0.0**	**0.0**	**21.9**	**19.4**	**19.4**	**-34.2**	**-34.2**

Live Load:

Location	F_x (kip)	F_y (kip)	F_z (kip)	M_x (k*ft)		M_y (k*ft)	
				Top	Bot	Top	Bot
C	0.0	-30.4	-40.8	4.9	-593.1	-42.8	-42.8
D	-15.9	-35.5	-39.6	4.8	-693.5	132.7	-179.7
H	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Result	**-15.9**	**-65.9**	**-80.4**	**9.6**	**-1286.6**	**89.8**	**-222.5**

```
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00         00000   00    00   00000    00000   00000  (TM)
```

===
Computer program for the Strength Design of Reinforced Concrete Sections
===

```
General Information:
====================
   File Name: C:\Users\esum-us\Desktop\Pedestal Design\Column C-D.col
   Project:  CC&V High Grade Ore
   Column:   A/B                         Engineer: ECS
   Code:     ACI 318-02                  Units: English

   Run Option: Investigation             Slenderness: Not considered
   Run Axis:   Biaxial                   Column Type: Structural

Material Properties:
====================
   f'c   = 4 ksi                         fy   = 60 ksi
   Ec    = 3605 ksi                      Es   = 29000 ksi
   Ultimate strain = 0.003 in/in
   Beta1 = 0.85

Section:
========
   Rectangular: Width = 125 in           Depth = 77 in

   Gross section area, Ag =  9625 in^2
   Ix =  4.75555e+006 in^4               Iy =  1.25326e+007 in^4
   Xo =  0 in                            Yo =  0 in

Reinforcement:
==============
   Rebar Database: ASTM A615
   Size Diam (in) Area (in^2)  Size Diam (in) Area (in^2)  Size Diam (in) Area (in^2)
   ---- --------- -----------  ---- --------- -----------  ---- --------- -----------
   #  3     0.38        0.11   #  4     0.50        0.20   #  5     0.63        0.31
   #  6     0.75        0.44   #  7     0.88        0.60   #  8     1.00        0.79
   #  9     1.13        1.00   # 10     1.27        1.27   # 11     1.41        1.56
   # 14     1.69        2.25   # 18     2.26        4.00

   Confinement: Tied; #3 ties with #7 bars,  #4 with larger bars.
   phi(a) = 0.8,  phi(b) = 0.9,  phi(c) = 0.65

   Layout: Rectangular
   Pattern: Equal Bar Spacing  (Cover to transverse reinforcement)
   Total steel area, As = 55.88 in^2 at 0.58%
   44 #10   Cover = 2 in

Load Combinations:
=================
   U1  =  1.400*Dead + 0.000*Live + 0.000*Wind + 0.000*EarthQuake
   U2  =  1.200*Dead + 1.600*Live + 0.000*Wind + 0.000*EarthQuake
   U3  =  1.200*Dead + 1.000*Live + 0.000*Wind + 0.000*EarthQuake
   U4  =  1.200*Dead + 0.000*Live + 0.800*Wind + 0.000*EarthQuake
   U5  =  1.200*Dead + 1.000*Live + 1.600*Wind + 0.000*EarthQuake
   U6  =  0.900*Dead + 0.000*Live + 1.600*Wind + 0.000*EarthQuake
   U7  =  1.200*Dead + 0.000*Live - 0.800*Wind + 0.000*EarthQuake
   U8  =  1.200*Dead + 1.000*Live - 1.600*Wind + 0.000*EarthQuake
   U9  =  0.900*Dead + 0.000*Live - 1.600*Wind + 0.000*EarthQuake
   U10 =  1.200*Dead + 1.000*Live + 0.000*Wind + 1.000*EarthQuake
   U11 =  0.900*Dead + 0.000*Live + 0.000*Wind + 1.000*EarthQuake
   U12 =  1.200*Dead + 1.000*Live + 0.000*Wind - 1.000*EarthQuake
   U13 =  0.900*Dead + 0.000*Live + 0.000*Wind - 1.000*EarthQuake
```

Service Loads:

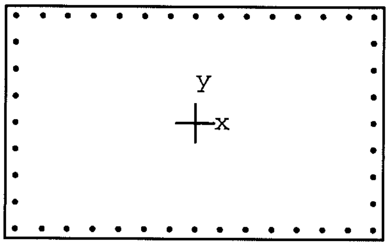
No.	Load Case	Axial Load kip	Mx @ Top k-ft	Mx @ Bot k-ft	My @ Top k-ft	My @ Bot k-ft
1	Dead	21.9	19.4	19.4	-34.2	-34.2
	Live	-80.4	9.6	-1286.6	89.8	-222.5
	Wind	0.0	0.0	0.0	0.0	0.0
	E.Q.	0.0	0.0	0.0	0.0	0.0

Factored Loads and Moments with Corresponding Capacities: (see user's manual for notation)

NOTE: Each loading combination includes the following cases:
First line - at column top
Second line - at column bottom

No.	Load Combo	Pu kip	Mux k-ft	Muy k-ft	fMnx k-ft	fMny k-ft	fMn/Mu
1	1 U1	30.7	27.2	-47.9	6940.1	-12234.7	255.528
2		30.7	-27.2	47.9	-6940.1	12234.7	255.528
3	1 U2	-102.4	38.6	102.6	4950.3	13149.7	128.114
4		-102.4	2035.3	397.0	8633.3	1684.2	4.242
5	1 U3	-54.1	32.9	48.8	7396.6	10968.9	224.957
6		-54.1	1263.3	263.5	8762.6	1828.0	6.936
7	1 U4	26.3	23.3	-41.0	6932.0	-12220.4	297.768
8		26.3	-23.3	41.0	-6932.0	12220.4	297.768
9	1 U5	-54.1	32.9	48.8	7396.6	10968.9	224.957
10		-54.1	1263.3	263.5	8762.6	1828.0	6.936
11	1 U6	19.7	17.5	-30.8	6919.9	-12198.9	396.327
12		19.7	-17.5	30.8	-6919.9	12198.9	396.327
13	1 U7	26.3	23.3	-41.0	6932.0	-12220.4	297.768
14		26.3	-23.3	41.0	-6932.0	12220.4	297.768
15	1 U8	-54.1	32.9	48.8	7396.6	10968.9	224.957
16		-54.1	1263.3	263.5	8762.6	1828.0	6.936
17	1 U9	19.7	17.5	-30.8	6919.9	-12198.9	396.327
18		19.7	-17.5	30.8	-6919.9	12198.9	396.327
19	1 U10	-54.1	32.9	48.8	7396.6	10968.9	224.957
20		-54.1	1263.3	263.5	8762.6	1828.0	6.936
21	1 U11	19.7	17.5	-30.8	6919.9	-12198.9	396.327
22		19.7	-17.5	30.8	-6919.9	12198.9	396.327
23	1 U12	-54.1	32.9	48.8	7396.6	10968.9	224.957
24		-54.1	1263.3	263.5	8762.6	1828.0	6.936
25	1 U13	19.7	17.5	-30.8	6919.9	-12198.9	396.327
26		19.7	-17.5	30.8	-6919.9	12198.9	396.327

*** Program completed as requested! ***



125 x 77 in

Code: ACI 318-02

Units: English

Run axis: Biaxial

Run option: Investigation

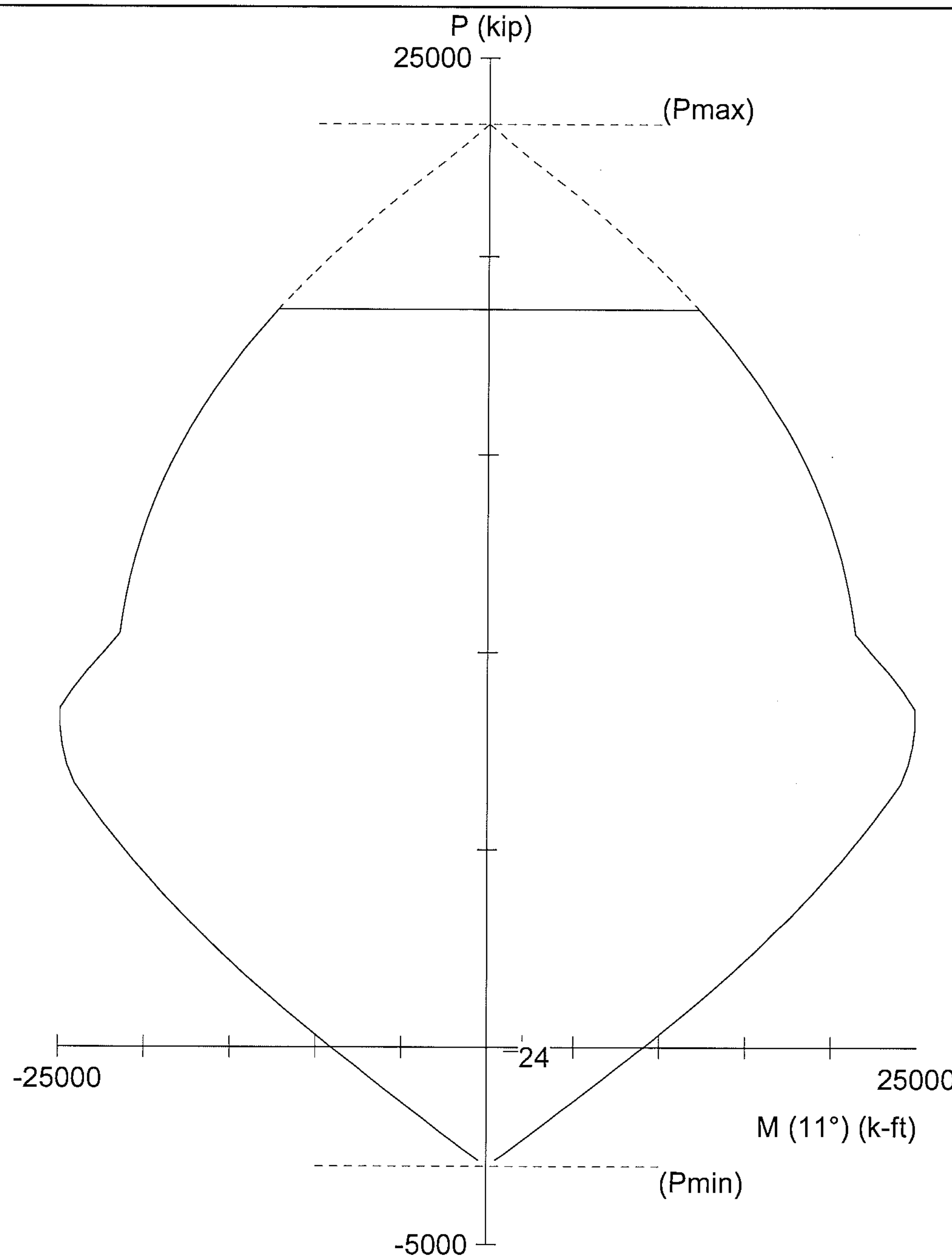
Slenderness: Not considered

Column type: Structural

Bars: ASTM A615

Date: 10/28/11

Time: 12:23:54



pcaColumn v3.63 - Licensed to: FLSmidth

File: C:\Users\esum-us\Desktop\Pedestal Design\Column C-D.col

Project: CC&V High Grade Ore

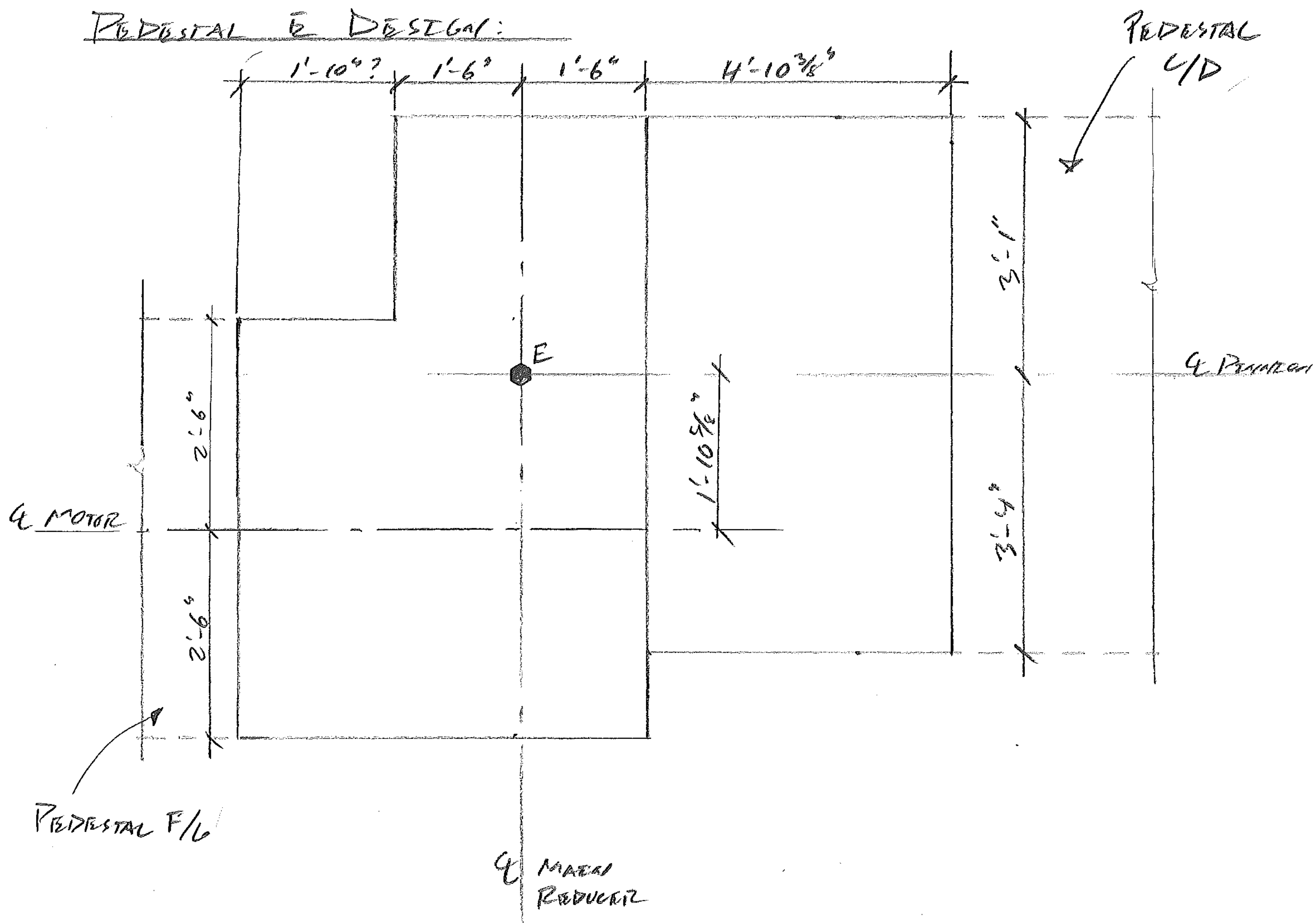
Column: A/B

Engineer: ECS

f'c = 4 ksi	fy = 60 ksi	Ag = 9625 in^2	44 #10 bars
Ec = 3605 ksi	Es = 29000 ksi	As = 55.88 in^2	Rho = 0.58%
fc = 3.4 ksi	fc = 3.4 ksi	Xo = 0.00 in	Ix = 4.75555e+006 in^4
= 0.003 in/in		Yo = 0.00 in	Iy = 1.25326e+007 in^4
Beta1 = 0.85		Clear spacing = 7.21 in	Clear cover = 2.50 in
Confinement: Tied	phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.65		

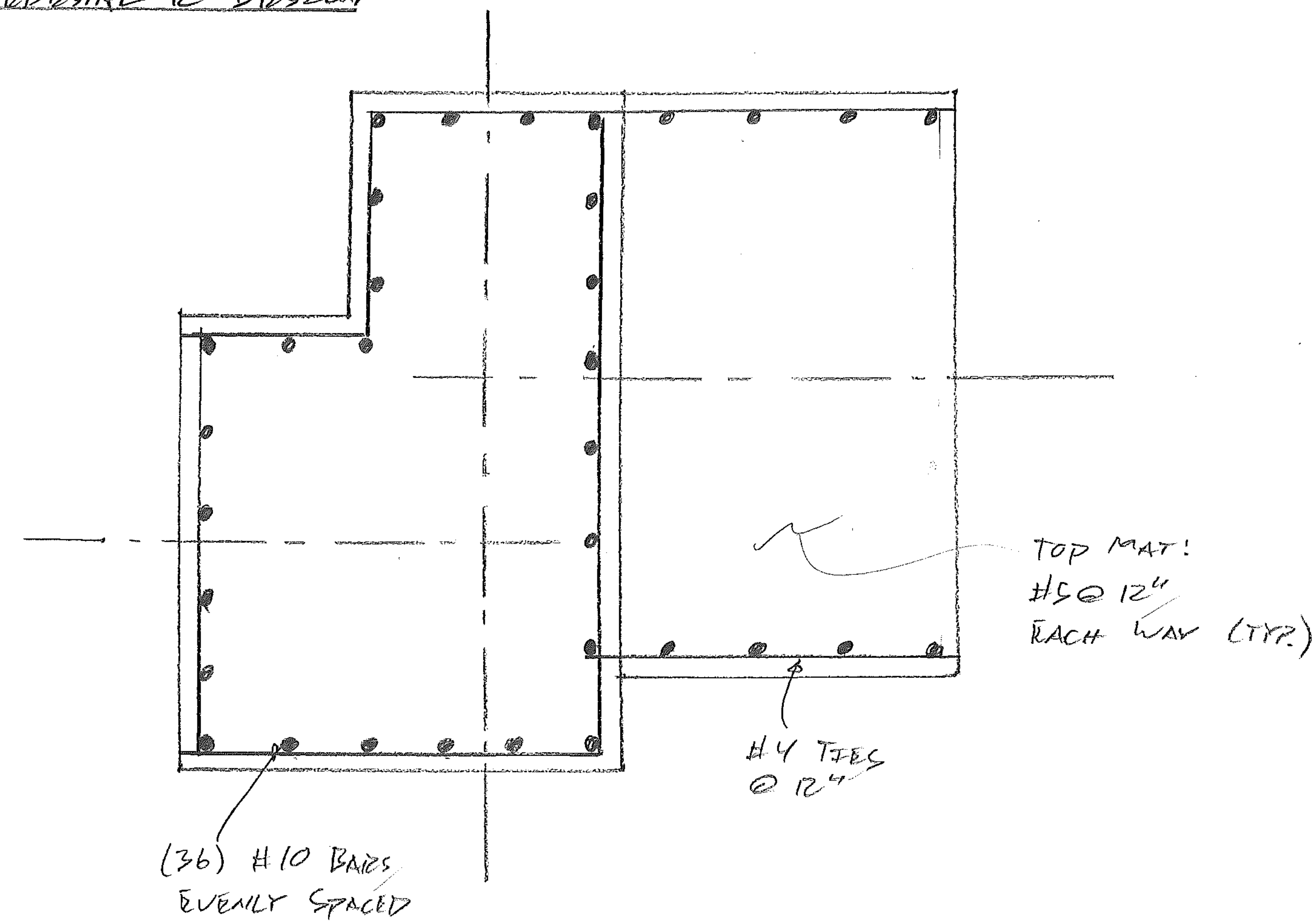
FLSMIDTH	PROJECT: CC&V High Grade Ore	PROJ NO. 11021
		CALC NO. C-005
	SUBJECT: Ball Mill Foundation	BY ECS DATE 10-28-11
		CHK DATE
		SHEET OF REV

Pedestal E Design:



FLSMIDTH	PROJECT CC & V HIGH GRADE ORE	PROJ NO. 11021
		CALC NO. C-005
	SUBJECT BALL MILL FOUNDATION	BY GCS DATE 10-28-11
		CHK DATE
		SHEET OF REV

PEDESTAL E DESIGN



Concrete Pedestal Natural Period of Vibration
Pedestal E

Pedestal Dimensions:

$L_x := 9ft + 6.3125in = 114.313\ in$ — Pedestal Length X Direction

$L_y := 6ft + 5in = 77\ in$ — Pedestal Length Y Direction

$H := 18ft + 5.125in = 221.125\ in$ — Pedestal Height

Concrete Properties:

$\gamma_c := 145pcf$ — Concrete Unit Weight

$f_c := 4000psi$ — Concrete Compressive Strength

$E := 57000psi \cdot \sqrt{\frac{f_c}{psi}} = 3.605 \times 10^3 \cdot ksi$ — Concrete Modulus of Elasticity

Loads and Masses:

$m := L_x \cdot L_y \cdot H \cdot \frac{\gamma_c}{g} = 1.633 \times 10^5 \cdot lb$ — Pedestal Mass

$F_x := 0lb$ $\quad F_y := 0lb$ — Applied Mass

$m_x := F_x + 0.23m = 3.756 \times 10^4\ lb$ $\quad m_y := F_y + 0.23m = 3.756 \times 10^4\ lb$ — Equivalent Mass

Dynamic Properties:

$I_x := \frac{L_x^3 \cdot L_y}{12} = 9.585 \times 10^6\ in^4$ $\quad I_y := \frac{L_x \cdot L_y^3}{12} = 4.349 \times 10^6 \cdot in^4$ — Moment of Inertia

$k_x := \frac{(3 \cdot E \cdot I_x)}{H^3} = 1.15 \times 10^5 \cdot \frac{kip}{ft}$ $\quad k_y := \frac{(3 \cdot E \cdot I_y)}{H^3} = 5.22 \times 10^4 \cdot \frac{kip}{ft}$ — Stiffness Factor

$\omega_x := \sqrt{\frac{k_x}{0.23m}} = 313.912 \cdot Hz$ $\quad \omega_y := \sqrt{\frac{k_y}{0.23m}} = 211.449 \cdot Hz$ — Natural Frequency without added Mass

$\omega_{x.} := \sqrt{\frac{k_x}{m_x}} = 313.912 \cdot Hz$ $\quad \omega_{y.} := \sqrt{\frac{k_y}{m_y}} = 211.449 \cdot Hz$ — Natural Frequency with added Mass

```
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00         00000   00    00  00000    00000   00000   (TM)
```

==
Computer program for the Strength Design of Reinforced Concrete Sections
==

Licensee stated above acknowledges that Portland Cement Association (PCA) is not and cannot be responsible for either the accuracy or adequacy of the material supplied as input for processing by the pcaColumn(tm) computer program. Furthermore, PCA neither makes any warranty expressed nor implied with respect to the correctness of the output prepared by the pcaColumn(tm) program.Although PCA has endeavored to produce pcaColumn(tm) error free, the program is not and can't be certified infallible. The final and only responsibility for analysis, design and engineering documents is the licensees. Accordingly, PCA disclaims all responsibility in contract, negligence or other tort for any analysis, design or engineering documents prepared in connection with the use of the pcaColumn(tm) program.

General Information:
====================
File Name: C:\Users\esum-us\Desktop\Pedestal Design\Column E.col
Project: CC&V High Grade Ore
Column: A/B Engineer: ECS
Code: ACI 318-02 Units: English

Run Option: Investigation Slenderness: Not considered
Run Axis: Biaxial Column Type: Architectural

Material Properties:
====================
f'c = 4 ksi fy = 60 ksi
Ec = 3605 ksi Es = 29000 ksi
Ultimate strain = 0.003 in/in
Beta1 = 0.85

Section:
========
Rectangular: Width = 114.313 in Depth = 77 in

Gross section area, Ag = 8802.1 in^2
Ix = 4.34897e+006 in^4 Iy = 9.58509e+006 in^4
Xo = 0 in Yo = 0 in

Reinforcement:
==============
Rebar Database: ASTM A615

Size	Diam (in)	Area (in^2)	Size	Diam (in)	Area (in^2)	Size	Diam (in)	Area (in^2)
# 3	0.38	0.11	# 4	0.50	0.20	# 5	0.63	0.31
# 6	0.75	0.44	# 7	0.88	0.60	# 8	1.00	0.79
# 9	1.13	1.00	# 10	1.27	1.27	# 11	1.41	1.56
# 14	1.69	2.25	# 18	2.26	4.00			

Confinement: Tied; #3 ties with #7 bars, #4 with larger bars.
phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.65

Layout: Rectangular
Pattern: Equal Bar Spacing (Cover to transverse reinforcement)
Total steel area, As = 45.72 in^2 at 0.52%
36 #10 Cover = 2 in

Load Combinations:
==================
U1 = 1.400*Dead + 0.000*Live + 0.000*Wind + 0.000*EarthQuake
U2 = 1.200*Dead + 1.600*Live + 0.000*Wind + 0.000*EarthQuake
U3 = 1.200*Dead + 1.000*Live + 0.000*Wind + 0.000*EarthQuake
U4 = 1.200*Dead + 0.000*Live + 0.800*Wind + 0.000*EarthQuake
U5 = 1.200*Dead + 1.000*Live + 1.600*Wind + 0.000*EarthQuake
U6 = 0.900*Dead + 0.000*Live + 1.600*Wind + 0.000*EarthQuake
U7 = 1.200*Dead + 0.000*Live - 0.800*Wind + 0.000*EarthQuake
U8 = 1.200*Dead + 1.000*Live - 1.600*Wind + 0.000*EarthQuake
U9 = 0.900*Dead + 0.000*Live - 1.600*Wind + 0.000*EarthQuake
U10 = 1.200*Dead + 1.000*Live + 0.000*Wind + 1.000*EarthQuake
U11 = 0.900*Dead + 0.000*Live + 0.000*Wind + 1.000*EarthQuake
U12 = 1.200*Dead + 1.000*Live + 0.000*Wind - 1.000*EarthQuake
U13 = 0.900*Dead + 0.000*Live + 0.000*Wind - 1.000*EarthQuake

Service Loads:

No.	Load Case	Axial Load kip	Mx @ Top k-ft	Mx @ Bot k-ft	My @ Top k-ft	My @ Bot k-ft
1	Dead	13.0	0.0	0.0	0.0	0.0
	Live	33.9	0.0	0.0	0.0	0.0
	Wind	0.0	0.0	0.0	0.0	0.0
	E.Q.	0.0	0.0	0.0	0.0	0.0
2	Dead	13.0	0.0	0.0	0.0	0.0
	Live	-33.9	0.0	0.0	0.0	0.0
	Wind	0.0	0.0	0.0	0.0	0.0
	E.Q.	0.0	0.0	0.0	0.0	0.0

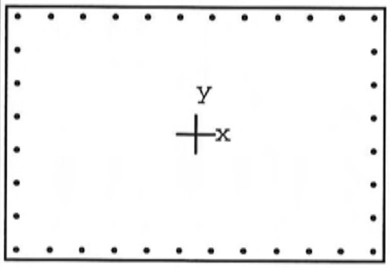
Factored Loads and Moments with Corresponding Capacities: (see user's manual for notation)

NOTE: Each loading combination includes the following cases:
First line - at column top
Second line - at column bottom

No.	Load Combo	Pu kip	Mux k-ft	Muy k-ft	fMnx k-ft	fMny k-ft	fMn/Mu
1	1 U1	18.2	0.0	0.0	7351.9	0.0	999.999
2		18.2	0.0	0.0	7351.9	0.0	999.999
3	1 U2	69.9	0.0	0.0	7496.5	0.0	999.999
4		69.9	0.0	0.0	7496.5	0.0	999.999
5	1 U3	49.5	0.0	0.0	7439.6	0.0	999.999
6		49.5	0.0	0.0	7439.6	0.0	999.999
7	1 U4	15.6	0.0	0.0	7344.6	0.0	999.999
8		15.6	0.0	0.0	7344.6	0.0	999.999
9	1 U5	49.5	0.0	0.0	7439.6	0.0	999.999
10		49.5	0.0	0.0	7439.6	0.0	999.999
11	1 U6	11.7	0.0	0.0	7333.6	0.0	999.999
12		11.7	0.0	0.0	7333.6	0.0	999.999
13	1 U7	15.6	0.0	0.0	7344.6	0.0	999.999
14		15.6	0.0	0.0	7344.6	0.0	999.999
15	1 U8	49.5	0.0	0.0	7439.6	0.0	999.999
16		49.5	0.0	0.0	7439.6	0.0	999.999
17	1 U9	11.7	0.0	0.0	7333.6	0.0	999.999
18		11.7	0.0	0.0	7333.6	0.0	999.999
19	1 U10	49.5	0.0	0.0	7439.6	0.0	999.999
20		49.5	0.0	0.0	7439.6	0.0	999.999
21	1 U11	11.7	0.0	0.0	7333.6	0.0	999.999
22		11.7	0.0	0.0	7333.6	0.0	999.999
23	1 U12	49.5	0.0	0.0	7439.6	0.0	999.999
24		49.5	0.0	0.0	7439.6	0.0	999.999
25	1 U13	11.7	0.0	0.0	7333.6	0.0	999.999
26		11.7	0.0	0.0	7333.6	0.0	999.999
27	2 U1	18.2	0.0	0.0	7351.9	0.0	999.999
28		18.2	0.0	0.0	7351.9	0.0	999.999
29	2 U2	-38.7	0.0	0.0	7192.0	0.0	999.999
30		-38.7	0.0	0.0	7192.0	0.0	999.999
31	2 U3	-18.3	0.0	0.0	7249.4	0.0	999.999
32		-18.3	0.0	0.0	7249.4	0.0	999.999
33	2 U4	15.6	0.0	0.0	7344.6	0.0	999.999
34		15.6	0.0	0.0	7344.6	0.0	999.999
35	2 U5	-18.3	0.0	0.0	7249.4	0.0	999.999
36		-18.3	0.0	0.0	7249.4	0.0	999.999
37	2 U6	11.7	0.0	0.0	7333.6	0.0	999.999
38		11.7	0.0	0.0	7333.6	0.0	999.999
39	2 U7	15.6	0.0	0.0	7344.6	0.0	999.999
40		15.6	0.0	0.0	7344.6	0.0	999.999
41	2 U8	-18.3	0.0	0.0	7249.4	0.0	999.999
42		-18.3	0.0	0.0	7249.4	0.0	999.999

43	2 U9	11.7	0.0	0.0	7333.6	0.0	999.999
44		11.7	0.0	0.0	7333.6	0.0	999.999
45	2 U10	-18.3	0.0	0.0	7249.4	0.0	999.999
46		-18.3	0.0	0.0	7249.4	0.0	999.999
47	2 U11	11.7	0.0	0.0	7333.6	0.0	999.999
48		11.7	0.0	0.0	7333.6	0.0	999.999
49	2 U12	-18.3	0.0	0.0	7249.4	0.0	999.999
50		-18.3	0.0	0.0	7249.4	0.0	999.999
51	2 U13	11.7	0.0	0.0	7333.6	0.0	999.999
52		11.7	0.0	0.0	7333.6	0.0	999.999

*** Program completed as requested! ***



114.313 x 77 in

Code: ACI 318-02

Units: English

Run axis: Biaxial

Run option: Investigation

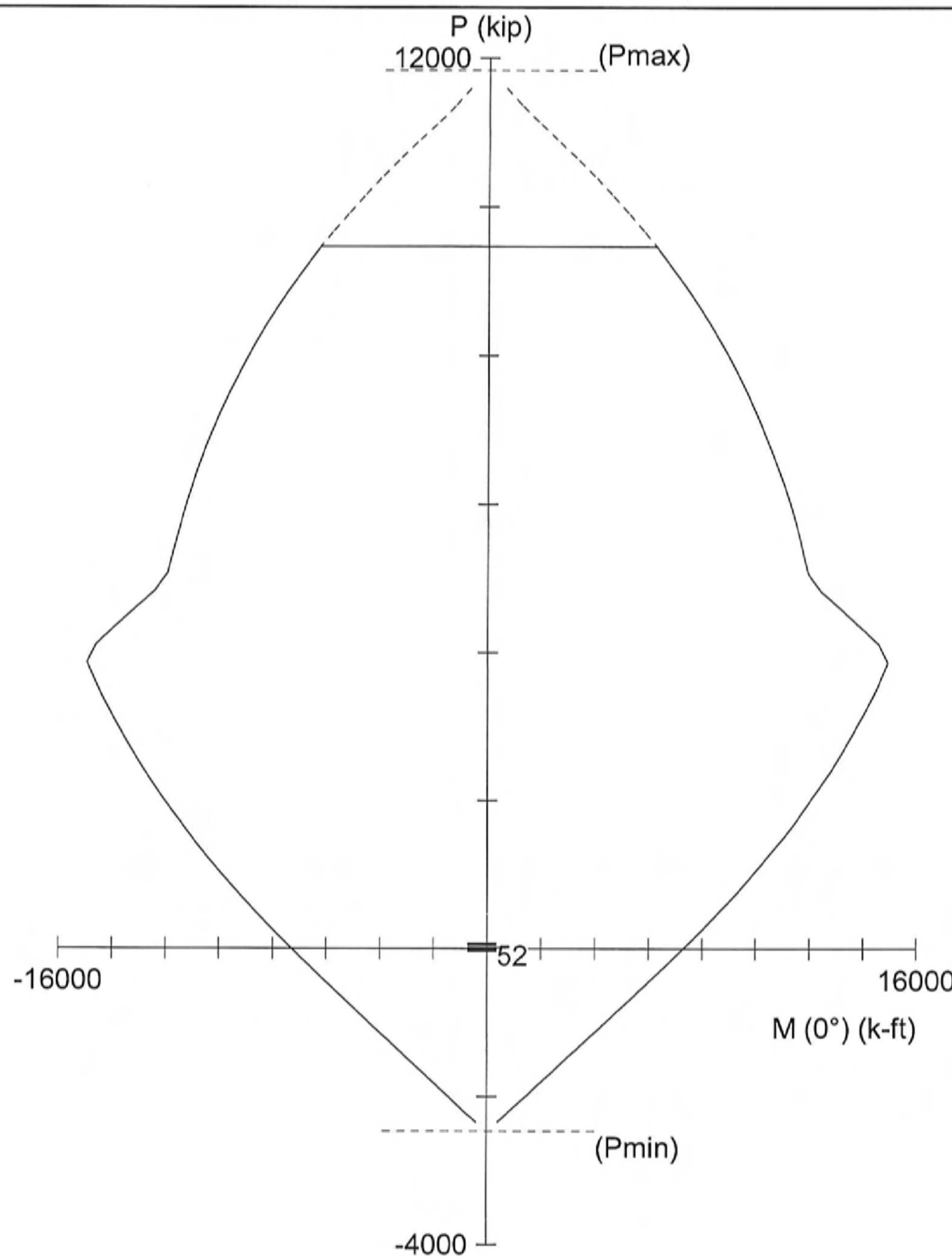
Slenderness: Not considered

Column type: Architectural

Bars: ASTM A615

Date: 10/28/11

Time: 12:59:24



pcaColumn v3.63 - Licensed to: FLSmidth

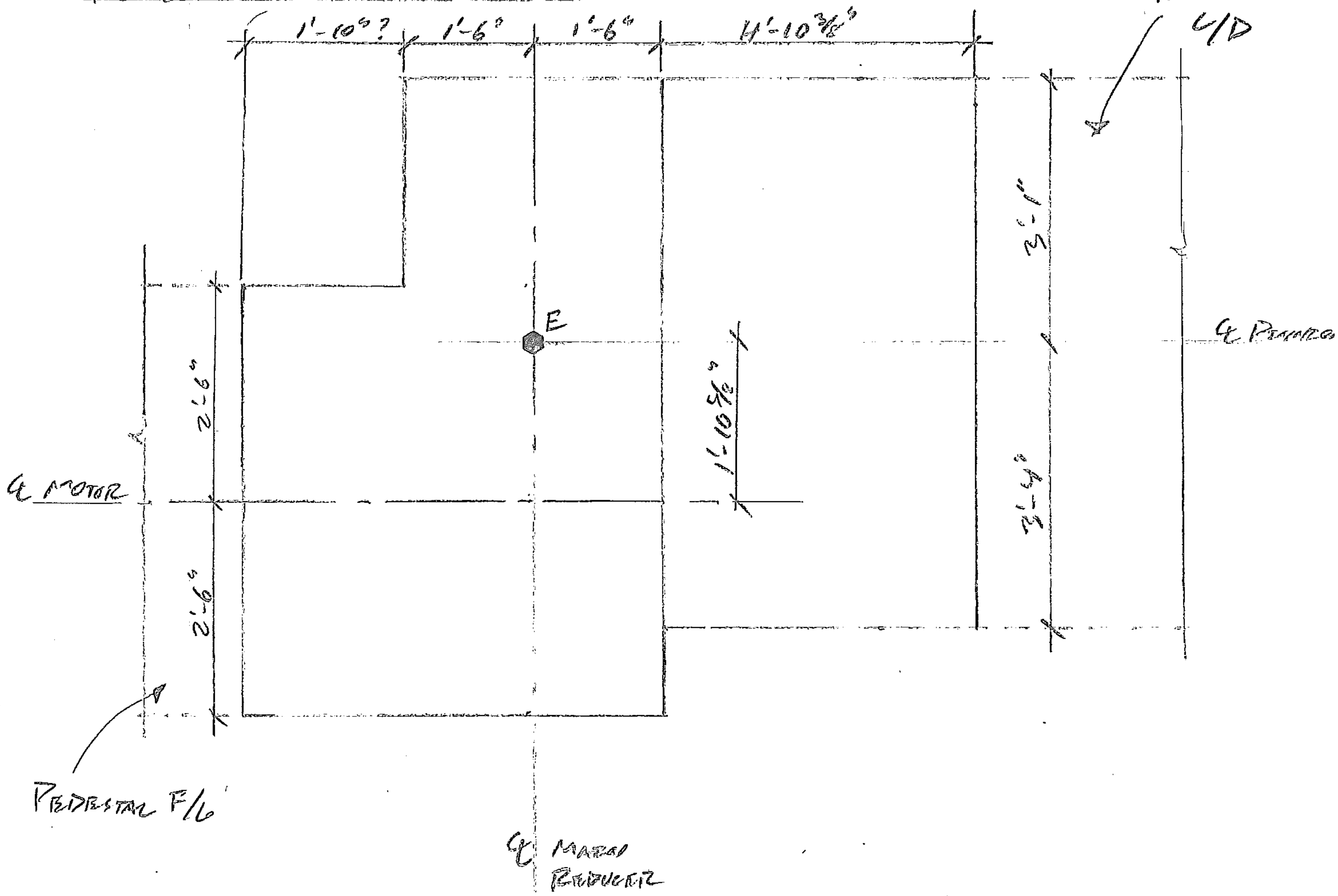
File: C:\Users\esum-us\Desktop\Pedestal Design\Column E.col

Project: CC&V High Grade Ore

Column: A/B		Engineer: ECS	
f'c = 4 ksi	fy = 60 ksi	Ag = 8802.1 in^2	36 #10 bars
Ec = 3605 ksi	Es = 29000 ksi	As = 45.72 in^2	Rho = 0.52%
fc = 3.4 ksi	fc = 3.4 ksi	Xo = 0.00 in	Ix = 4.34897e+006 in^4
ı = 0.003 in/in		Yo = 0.00 in	Iy = 9.58509e+006 in^4
Beta1 = 0.85		Clear spacing = 8.55 in	Clear cover = 2.50 in
Confinement: Tied	phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.65		

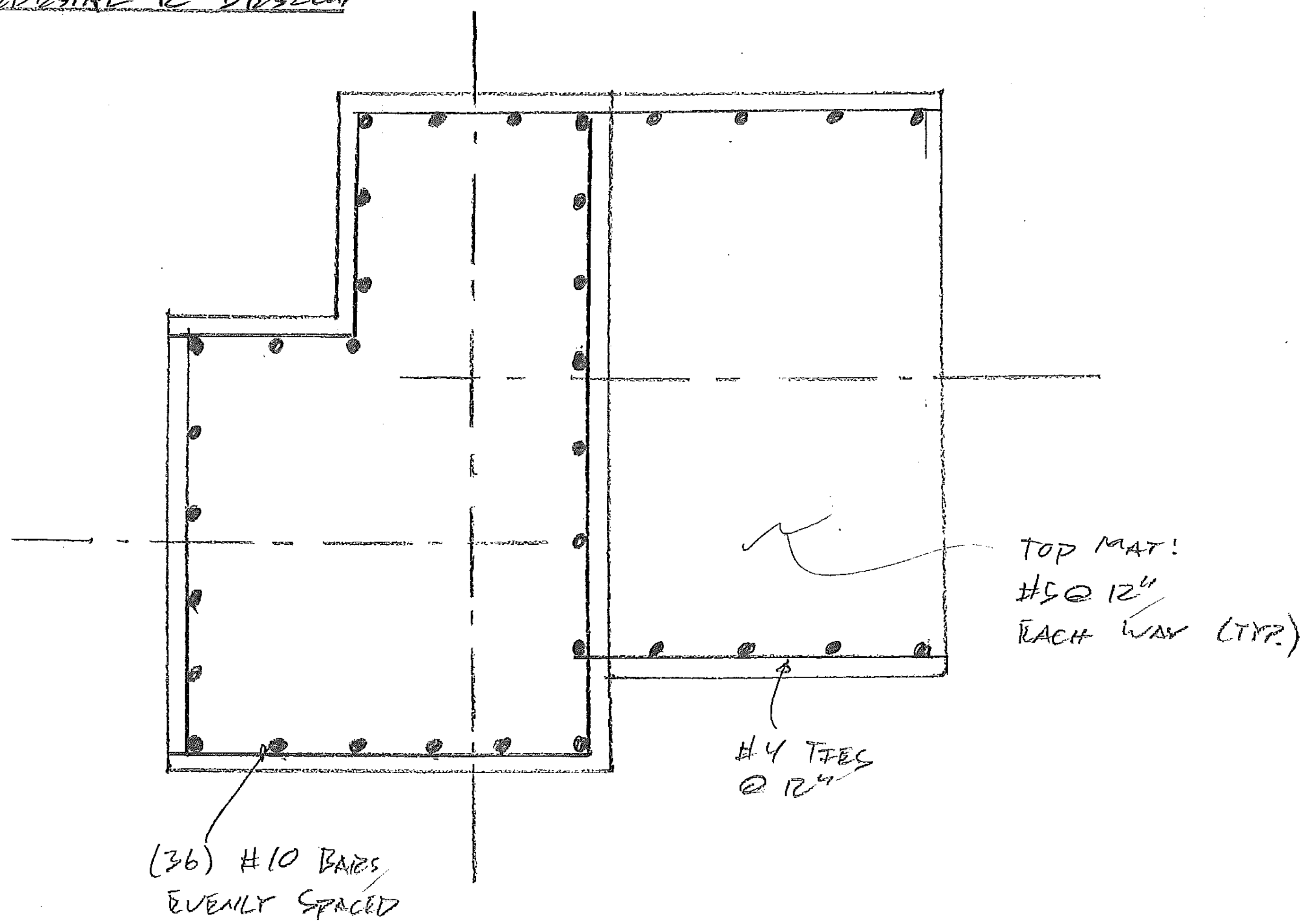
FLSMIDTH	PROJECT CC&V High Grade Ore	PROJ NO. 11021
		CALC NO. C-005
	SUBJECT Ball Mill Foundation	BY ECS DATE 10-28-11
		CHK DATE
		SHEET OF REV

PEDESTAL E DESIGN:



	PROJECT CC & V HIGH GRADE ORE	PROJ NO. 11021
		CALC NO. C-005
	SUBJECT BALL MILL FOUNDATION	BY GCS DATE 10-28-11
		CHK DATE
		SHEET OF REV

PEDESTAL E DESIGN:



Concrete Pedestal Natural Period of Vibration
Pedestal E

Pedestal Dimensions:

$L_x := 9ft + 6.3125in = 114.313\,in$ — Pedestal Length X Direction

$L_y := 6ft + 5in = 77\,in$ — Pedestal Length Y Direction

$H := 18ft + 5.125in = 221.125\,in$ — Pedestal Height

Concrete Properties:

$\gamma_c := 145pcf$ — Concrete Unit Weight

$f_c := 4000psi$ — Concrete Compressive Strength

$E := 57000psi \cdot \sqrt{\frac{f_c}{psi}} = 3.605 \times 10^3 \cdot ksi$ — Concrete Modulus of Elasticity

Loads and Masses:

$m := L_x \cdot L_y \cdot H \cdot \frac{\gamma_c}{g} = 1.633 \times 10^5 \cdot lb$ — Pedestal Mass

$F_x := 0lb$ $\quad F_y := 0lb$ — Applied Mass

$m_x := F_x + 0.23m = 3.756 \times 10^4\,lb$ $\quad m_y := F_y + 0.23m = 3.756 \times 10^4\,lb$ — Equivalent Mass

Dynamic Properties:

$I_x := \frac{L_x^3 \cdot L_y}{12} = 9.585 \times 10^6\,in^4$ $\quad I_y := \frac{L_x \cdot L_y^3}{12} = 4.349 \times 10^6 \cdot in^4$ — Moment of Inertia

$k_x := \frac{(3 \cdot E \cdot I_x)}{H^3} = 1.15 \times 10^5 \cdot \frac{kip}{ft}$ $\quad k_y := \frac{(3 \cdot E \cdot I_y)}{H^3} = 5.22 \times 10^4 \cdot \frac{kip}{ft}$ — Stiffness Factor

$\omega_x := \sqrt{\frac{k_x}{0.23m}} = 313.912 \cdot Hz$ $\quad \omega_y := \sqrt{\frac{k_y}{0.23m}} = 211.449 \cdot Hz$ — Natural Frequency without added Mass

$\omega_{x.} := \sqrt{\frac{k_x}{m_x}} = 313.912 \cdot Hz$ $\quad \omega_{y.} := \sqrt{\frac{k_y}{m_y}} = 211.449 \cdot Hz$ — Natural Frequency with added Mass

```
OOOOOOO    OOOOO    OOOOO    OOOOO    OOOOO   OO
OO    OO  OO   OO  OO   OO  OO   OO  OO   OO  OO
OO    OO  OO   OO  OO   OO  OO   OO  OO   OO  OO
OO    OO  OO       OO   OO  OO       OO   OO  OO
OO    OO  OO       OOOOOOO  OO       OO   OO  OO
OOOOOOO   OO   OO  OO   OO  OO   OO  OO   OO  OO
OO        OO   OO  OO   OO  OO   OO  OO   OO  OO
OO         OOOOO   OO   OO   OOOOO    OOOOO   OOOOO  (TM)
```

===
Computer program for the Strength Design of Reinforced Concrete Sections
===

General Information:
====================
File Name: C:\Users\esum-us\Desktop\Pedestal Design\Column E.col
Project: CC&V High Grade Ore
Column: A/B
Engineer: ECS
Code: ACI 318-02
Units: English

Run Option: Investigation
Slenderness: Not considered
Run Axis: Biaxial
Column Type: Architectural

Material Properties:
====================
f'c = 4 ksi
fy = 60 ksi
Ec = 3605 ksi
Es = 29000 ksi
Ultimate strain = 0.003 in/in
Beta1 = 0.85

Section:
========
Rectangular: Width = 114.313 in
Depth = 77 in

Gross section area, Ag = 8802.1 in^2
Ix = 4.34897e+006 in^4
Iy = 9.58509e+006 in^4
Xo = 0 in
Yo = 0 in

Reinforcement:
==============
Rebar Database: ASTM A615

Size	Diam (in)	Area (in^2)	Size	Diam (in)	Area (in^2)	Size	Diam (in)	Area (in^2)
# 3	0.38	0.11	# 4	0.50	0.20	# 5	0.63	0.31
# 6	0.75	0.44	# 7	0.88	0.60	# 8	1.00	0.79
# 9	1.13	1.00	# 10	1.27	1.27	# 11	1.41	1.56
# 14	1.69	2.25	# 18	2.26	4.00			

Confinement: Tied; #3 ties with #7 bars, #4 with larger bars.
phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.65

Layout: Rectangular
Pattern: Equal Bar Spacing (Cover to transverse reinforcement)
Total steel area, As = 45.72 in^2 at 0.52%
36 #10 Cover = 2 in

Load Combinations:
==================
U1 = 1.400*Dead + 0.000*Live + 0.000*Wind + 0.000*EarthQuake
U2 = 1.200*Dead + 1.600*Live + 0.000*Wind + 0.000*EarthQuake
U3 = 1.200*Dead + 1.000*Live + 0.000*Wind + 0.000*EarthQuake
U4 = 1.200*Dead + 0.000*Live + 0.800*Wind + 0.000*EarthQuake
U5 = 1.200*Dead + 1.000*Live + 1.600*Wind + 0.000*EarthQuake
U6 = 0.900*Dead + 0.000*Live + 1.600*Wind + 0.000*EarthQuake
U7 = 1.200*Dead + 0.000*Live - 0.800*Wind + 0.000*EarthQuake
U8 = 1.200*Dead + 1.000*Live - 1.600*Wind + 0.000*EarthQuake
U9 = 0.900*Dead + 0.000*Live - 1.600*Wind + 0.000*EarthQuake
U10 = 1.200*Dead + 1.000*Live + 0.000*Wind + 1.000*EarthQuake
U11 = 0.900*Dead + 0.000*Live + 0.000*Wind + 1.000*EarthQuake
U12 = 1.200*Dead + 1.000*Live + 0.000*Wind - 1.000*EarthQuake
U13 = 0.900*Dead + 0.000*Live + 0.000*Wind - 1.000*EarthQuake

Service Loads:
==============

No.	Load Case	Axial Load kip	Mx @ Top k-ft	Mx @ Bot k-ft	My @ Top k-ft	My @ Bot k-ft
1	Dead	13.0	0.0	0.0	0.0	0.0
	Live	33.9	0.0	0.0	0.0	0.0
	Wind	0.0	0.0	0.0	0.0	0.0
	E.Q.	0.0	0.0	0.0	0.0	0.0
2	Dead	13.0	0.0	0.0	0.0	0.0
	Live	-33.9	0.0	0.0	0.0	0.0
	Wind	0.0	0.0	0.0	0.0	0.0
	E.Q.	0.0	0.0	0.0	0.0	0.0

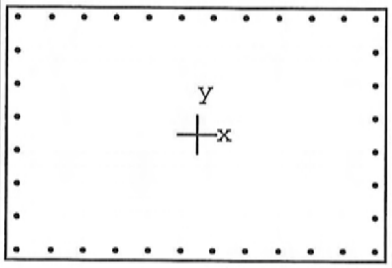
Factored Loads and Moments with Corresponding Capacities: (see user's manual for notation)
==

NOTE: Each loading combination includes the following cases:
First line - at column top
Second line - at column bottom

No.	Load Combo	Pu kip	Mux k-ft	Muy k-ft	fMnx k-ft	fMny k-ft	fMn/Mu
1	1 U1	18.2	0.0	0.0	7351.9	0.0	999.999
2		18.2	0.0	0.0	7351.9	0.0	999.999
3	1 U2	69.9	0.0	0.0	7496.5	0.0	999.999
4		69.9	0.0	0.0	7496.5	0.0	999.999
5	1 U3	49.5	0.0	0.0	7439.6	0.0	999.999
6		49.5	0.0	0.0	7439.6	0.0	999.999
7	1 U4	15.6	0.0	0.0	7344.6	0.0	999.999
8		15.6	0.0	0.0	7344.6	0.0	999.999
9	1 U5	49.5	0.0	0.0	7439.6	0.0	999.999
10		49.5	0.0	0.0	7439.6	0.0	999.999
11	1 U6	11.7	0.0	0.0	7333.6	0.0	999.999
12		11.7	0.0	0.0	7333.6	0.0	999.999
13	1 U7	15.6	0.0	0.0	7344.6	0.0	999.999
14		15.6	0.0	0.0	7344.6	0.0	999.999
15	1 U8	49.5	0.0	0.0	7439.6	0.0	999.999
16		49.5	0.0	0.0	7439.6	0.0	999.999
17	1 U9	11.7	0.0	0.0	7333.6	0.0	999.999
18		11.7	0.0	0.0	7333.6	0.0	999.999
19	1 U10	49.5	0.0	0.0	7439.6	0.0	999.999
20		49.5	0.0	0.0	7439.6	0.0	999.999
21	1 U11	11.7	0.0	0.0	7333.6	0.0	999.999
22		11.7	0.0	0.0	7333.6	0.0	999.999
23	1 U12	49.5	0.0	0.0	7439.6	0.0	999.999
24		49.5	0.0	0.0	7439.6	0.0	999.999
25	1 U13	11.7	0.0	0.0	7333.6	0.0	999.999
26		11.7	0.0	0.0	7333.6	0.0	999.999
27	2 U1	18.2	0.0	0.0	7351.9	0.0	999.999
28		18.2	0.0	0.0	7351.9	0.0	999.999
29	2 U2	-38.7	0.0	0.0	7192.0	0.0	999.999
30		-38.7	0.0	0.0	7192.0	0.0	999.999
31	2 U3	-18.3	0.0	0.0	7249.4	0.0	999.999
32		-18.3	0.0	0.0	7249.4	0.0	999.999
33	2 U4	15.6	0.0	0.0	7344.6	0.0	999.999
34		15.6	0.0	0.0	7344.6	0.0	999.999
35	2 U5	-18.3	0.0	0.0	7249.4	0.0	999.999
36		-18.3	0.0	0.0	7249.4	0.0	999.999
37	2 U6	11.7	0.0	0.0	7333.6	0.0	999.999
38		11.7	0.0	0.0	7333.6	0.0	999.999
39	2 U7	15.6	0.0	0.0	7344.6	0.0	999.999
40		15.6	0.0	0.0	7344.6	0.0	999.999
41	2 U8	-18.3	0.0	0.0	7249.4	0.0	999.999
42		-18.3	0.0	0.0	7249.4	0.0	999.999

43	2 U9	11.7	0.0	0.0	7333.6	0.0	999.999
44		11.7	0.0	0.0	7333.6	0.0	999.999
45	2 U10	-18.3	0.0	0.0	7249.4	0.0	999.999
46		-18.3	0.0	0.0	7249.4	0.0	999.999
47	2 U11	11.7	0.0	0.0	7333.6	0.0	999.999
48		11.7	0.0	0.0	7333.6	0.0	999.999
49	2 U12	-18.3	0.0	0.0	7249.4	0.0	999.999
50		-18.3	0.0	0.0	7249.4	0.0	999.999
51	2 U13	11.7	0.0	0.0	7333.6	0.0	999.999
52		11.7	0.0	0.0	7333.6	0.0	999.999

*** Program completed as requested! ***



114.313 x 77 in

Code: ACI 318-02

Units: English

Run axis: Biaxial

Run option: Investigation

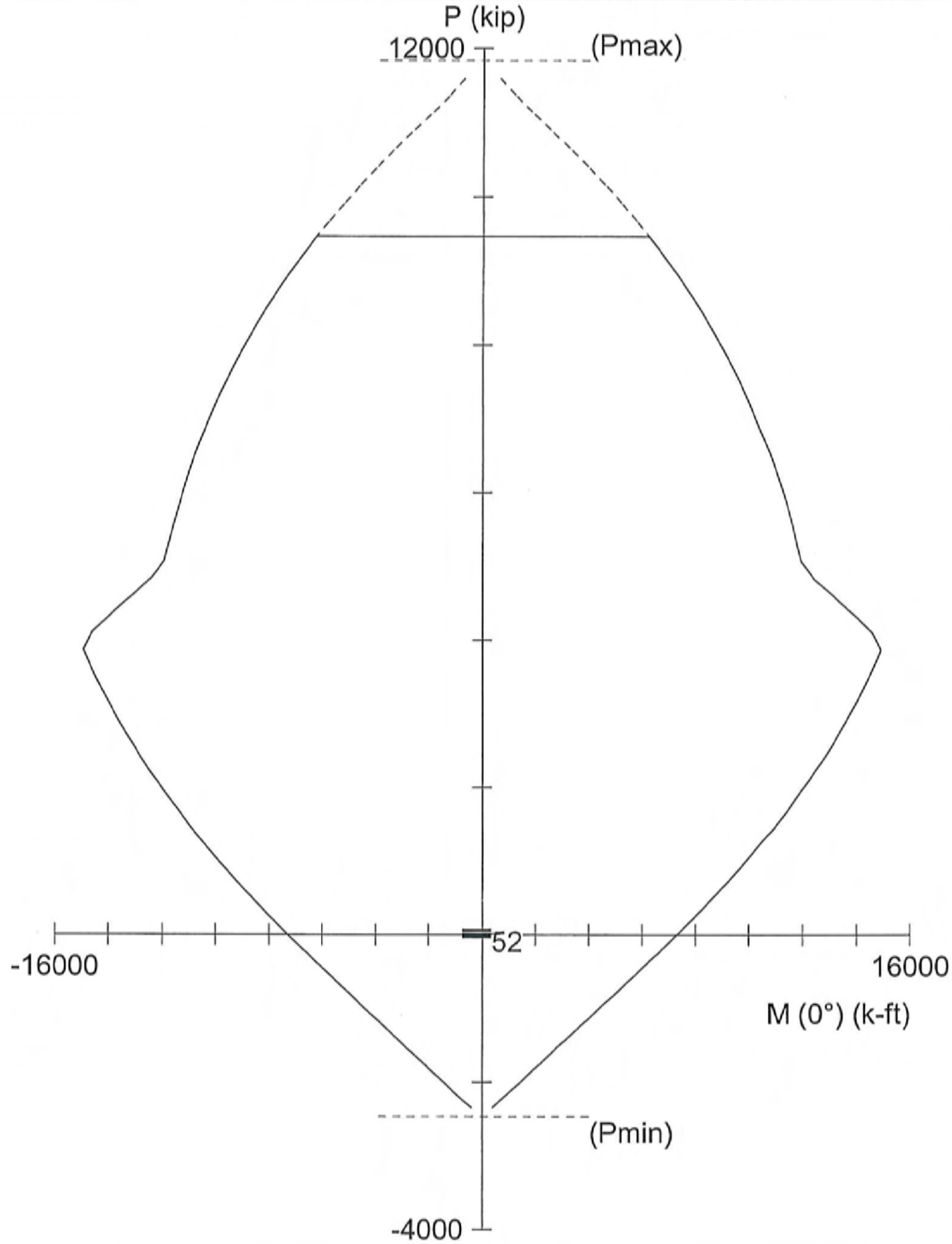
Slenderness: Not considered

Column type: Architectural

Bars: ASTM A615

Date: 10/28/11

Time: 12:59:24



pcaColumn v3.63 - Licensed to: FLSmidth

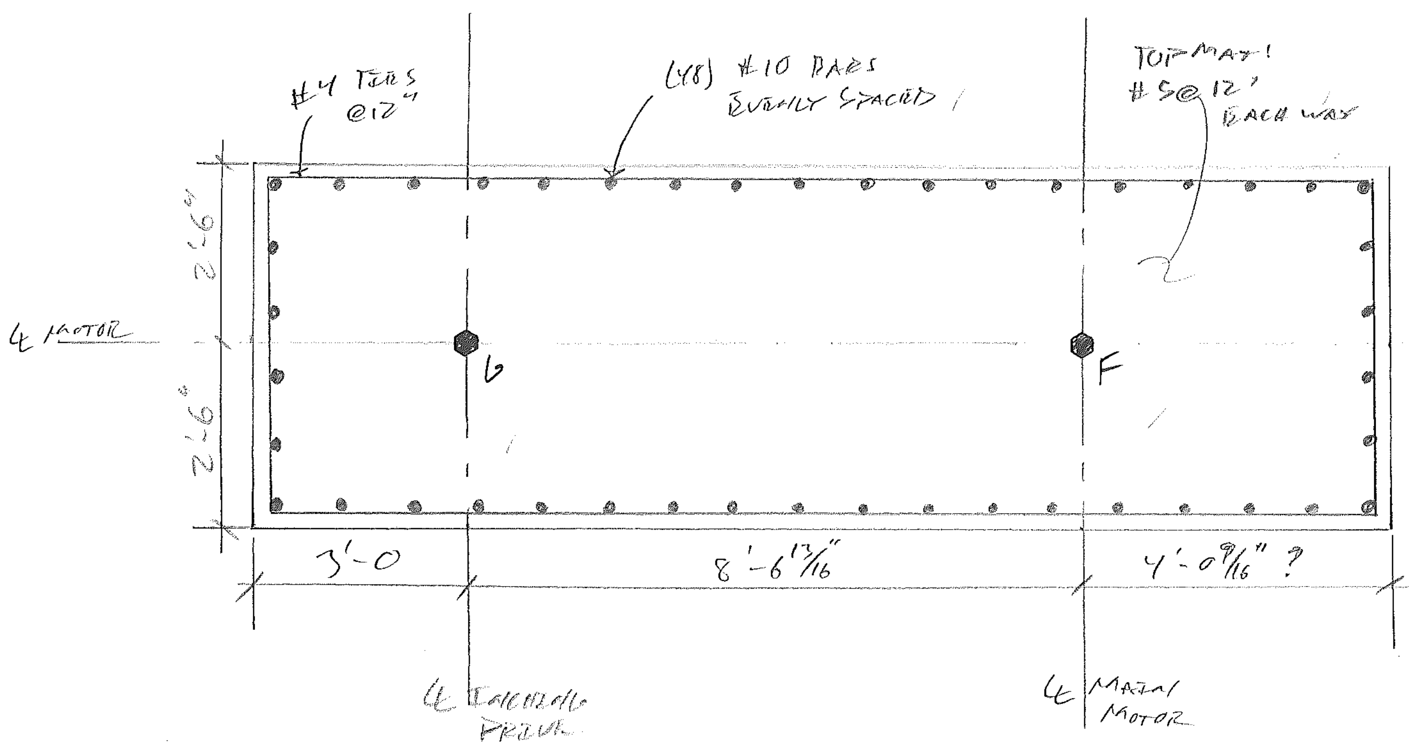
File: C:\Users\esum-us\Desktop\Pedestal Design\Column E.col

Project: CC&V High Grade Ore

Column: A/B		Engineer: ECS	
f'c = 4 ksi	fy = 60 ksi	Ag = 8802.1 in^2	36 #10 bars
Ec = 3605 ksi	Es = 29000 ksi	As = 45.72 in^2	Rho = 0.52%
fc = 3.4 ksi	fc = 3.4 ksi	Xo = 0.00 in	Ix = 4.34897e+006 in^4
= 0.003 in/in		Yo = 0.00 in	Iy = 9.58509e+006 in^4
Beta1 = 0.85		Clear spacing = 8.55 in	Clear cover = 2.50 in
Confinement: Tied	phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.65		

FLSMIDTH	PROJECT: CC&V HIGH GRADE ORE	PROJ NO. 11021
		CALC NO. C-005
	SUBJECT: BALL MILL FOUNDATION	BY ECS DATE 10-31-11
		CHK DATE
		SHEET OF REV

PEDESTAL F/G DESIGN:



Concrete Pedestal Natural Period of Vibration
Pedestal F/G

Pedestal Dimensions:

$L_x := 15ft + 9.375in = 189.375\ in$ — Pedestal Length X Direction

$L_y := 5ft + 0in = 60\ in$ — Pedestal Length Y Direction

$H := 18ft + 11.625in = 227.625\ in$ — Pedestal Height

Concrete Properties:

$\gamma_c := 145pcf$ — Concrete Unit Weight

$f_c := 4000psi$ — Concrete Compressive Strength

$E := 57000psi \cdot \sqrt{\frac{f_c}{psi}} = 3.605 \times 10^3 \cdot ksi$ — Concrete Modulus of Elasticity

Loads and Masses:

$m := L_x \cdot L_y \cdot H \cdot \frac{\gamma_c}{g} = 2.17 \times 10^5 \cdot lb$ — Pedestal Mass

$F_x := 0lb$ $\quad$ $F_y := 0lb$ — Applied Mass

$m_x := F_x + 0.23m = 4.992 \times 10^4\ lb$ $\quad$ $m_y := F_y + 0.23m = 4.992 \times 10^4\ lb$ — Equivalent Mass

Dynamic Properties:

$I_x := \frac{L_x^3 \cdot L_y}{12} = 3.396 \times 10^7\ in^4$ $\quad$ $I_y := \frac{L_x \cdot L_y^3}{12} = 3.409 \times 10^6 \cdot in^4$ — Moment of Inertia

$k_x := \frac{(3 \cdot E \cdot I_x)}{H^3} = 3.737 \times 10^5 \cdot \frac{kip}{ft}$ $\quad$ $k_y := \frac{(3 \cdot E \cdot I_y)}{H^3} = 3.751 \times 10^4 \cdot \frac{kip}{ft}$ — Stiffness Factor

$\omega_x := \sqrt{\frac{k_x}{0.23m}} = 490.764 \cdot Hz$ $\quad$ $\omega_y := \sqrt{\frac{k_y}{0.23m}} = 155.49 \cdot Hz$ — Natural Frequency without added Mass

$\omega_{x.} := \sqrt{\frac{k_x}{m_x}} = 490.764 \cdot Hz$ $\quad$ $\omega_{y.} := \sqrt{\frac{k_y}{m_y}} = 155.49 \cdot Hz$ — Natural Frequency with added Mass

Pedestal F/G Loading

Pedestal Height (ft): 18.75

Load Locations:

Using CL Main Motor & CL Motor as Axis Origin

	X (ft)	Y (ft)
Pedestal Center of Gravity	-3.70	0.00

Location	Coordinates		Eccentricity	
	X (ft)	Y (ft)	e_x (ft)	e_y (ft)
G	-8.50	0.00	-4.80	0.00
F	0.00	0.00	3.70	0.00

Dead Load:

Location	F_x (kip)	F_y (kip)	F_z (kip)	M_x (k*ft)		M_y (k*ft)	
				Top	Bot	Top	Bot
G	0.0	0.0	31.0	0.0	0.0	-148.9	-148.9
F	0.0	0.0	3.0	0.0	0.0	11.1	11.1
Result	**0.0**	**0.0**	**34.0**	**0.0**	**0.0**	**-137.8**	**-137.8**

Live Load:

Location	F_x (kip)	F_y (kip)	F_z (kip)	M_x (k*ft)		M_y (k*ft)	
				Top	Bot	Top	Bot
G	0.0	0.0	33.9	0.0	0.0	-163.0	-163.0
F	0.0	0.0	15.7	0.0	0.0	57.9	57.9
Result	**0.0**	**0.0**	**49.6**	**0.0**	**0.0**	**-105.1**	**-105.1**

```
0000000     00000     00000     00000     00000    00
00     00  00    00  00    00  00    00  00    00  00
00     00  00    00  00    00  00    00  00    00  00
00     00  00        00    00  00        00    00  00
00     00  00        0000000   00        00    00  00
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00         00    00  00    00  00    00  00    00  00
00          00000    00    00   00000     00000    00000   (TM)
```

===
Computer program for the Strength Design of Reinforced Concrete Sections
===

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General Information:
====================
File Name: C:\Users\esum-us\Desktop\Pedestal Design\Column F-G.col
Project: CC&V High Grade Ore
Column: A/B Engineer: ECS
Code: ACI 318-02 Units: English

Run Option: Investigation Slenderness: Not considered
Run Axis: Biaxial Column Type: Architectural

Material Properties:
====================
f'c = 4 ksi fy = 60 ksi
Ec = 3605 ksi Es = 29000 ksi
Ultimate strain = 0.003 in/in
Beta1 = 0.85

Section:
========
Rectangular: Width = 189.375 in Depth = 60 in

Gross section area, Ag = 11362.5 in^2
Ix = 3.40875e+006 in^4 Iy = 3.39577e+007 in^4
Xo = 0 in Yo = 0 in

Reinforcement:
==============
Rebar Database: ASTM A615

Size	Diam (in)	Area (in^2)	Size	Diam (in)	Area (in^2)	Size	Diam (in)	Area (in^2)
# 3	0.38	0.11	# 4	0.50	0.20	# 5	0.63	0.31
# 6	0.75	0.44	# 7	0.88	0.60	# 8	1.00	0.79
# 9	1.13	1.00	# 10	1.27	1.27	# 11	1.41	1.56
# 14	1.69	2.25	# 18	2.26	4.00			

Confinement: Tied; #3 ties with #7 bars, #4 with larger bars.
phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.65

Layout: Rectangular
Pattern: Equal Bar Spacing (Cover to transverse reinforcement)
Total steel area, As = 60.96 in^2 at 0.54%
48 #10 Cover = 2 in

Load Combinations:
=================
```
U1  =  1.400*Dead + 0.000*Live + 0.000*Wind + 0.000*EarthQuake
U2  =  1.200*Dead + 1.600*Live + 0.000*Wind + 0.000*EarthQuake
U3  =  1.200*Dead + 1.000*Live + 0.000*Wind + 0.000*EarthQuake
U4  =  1.200*Dead + 0.000*Live + 0.800*Wind + 0.000*EarthQuake
U5  =  1.200*Dead + 1.000*Live + 1.600*Wind + 0.000*EarthQuake
U6  =  0.900*Dead + 0.000*Live + 1.600*Wind + 0.000*EarthQuake
U7  =  1.200*Dead + 0.000*Live - 0.800*Wind + 0.000*EarthQuake
U8  =  1.200*Dead + 1.000*Live - 1.600*Wind + 0.000*EarthQuake
U9  =  0.900*Dead + 0.000*Live - 1.600*Wind + 0.000*EarthQuake
U10 =  1.200*Dead + 1.000*Live + 0.000*Wind + 1.000*EarthQuake
U11 =  0.900*Dead + 0.000*Live + 0.000*Wind + 1.000*EarthQuake
U12 =  1.200*Dead + 1.000*Live + 0.000*Wind - 1.000*EarthQuake
U13 =  0.900*Dead + 0.000*Live + 0.000*Wind - 1.000*EarthQuake
```

Service Loads:
==============

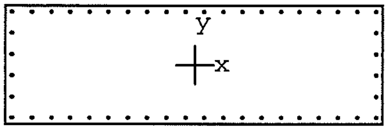
No.	Load Case	Axial Load kip	Mx @ Top k-ft	Mx @ Bot k-ft	My @ Top k-ft	My @ Bot k-ft
1	Dead	34.0	0.0	0.0	-137.8	-137.8
	Live	49.6	0.0	0.0	-105.1	-105.1
	Wind	0.0	0.0	0.0	0.0	0.0
	E.Q.	0.0	0.0	0.0	0.0	0.0

Factored Loads and Moments with Corresponding Capacities: (see user's manual for notation)
===

NOTE: Each loading combination includes the following cases:
First line - at column top
Second line - at column bottom

No.	Load Combo	Pu kip	Mux k-ft	Muy k-ft	fMnx k-ft	fMny k-ft	fMn/Mu
1	1 U1	47.6	0.0	-192.9	0.0	-23589.0	122.273
2		47.6	0.0	192.9	-0.0	23589.0	122.273
3	1 U2	120.2	0.0	-333.5	0.0	-24014.9	72.004
4		120.2	0.0	333.5	-0.0	24014.9	72.004
5	1 U3	90.4	0.0	-270.5	0.0	-23840.4	88.148
6		90.4	0.0	270.5	-0.0	23840.4	88.148
7	1 U4	40.8	0.0	-165.4	0.0	-23548.7	142.409
8		40.8	0.0	165.4	-0.0	23548.7	142.409
9	1 U5	90.4	0.0	-270.5	0.0	-23840.4	88.148
10		90.4	0.0	270.5	-0.0	23840.4	88.148
11	1 U6	30.6	0.0	-124.0	0.0	-23487.0	189.380
12		30.6	0.0	124.0	-0.0	23487.0	189.380
13	1 U7	40.8	0.0	-165.4	0.0	-23548.7	142.409
14		40.8	0.0	165.4	-0.0	23548.7	142.409
15	1 U8	90.4	0.0	-270.5	0.0	-23840.4	88.148
16		90.4	0.0	270.5	-0.0	23840.4	88.148
17	1 U9	30.6	0.0	-124.0	0.0	-23487.0	189.380
18		30.6	0.0	124.0	-0.0	23487.0	189.380
19	1 U10	90.4	0.0	-270.5	0.0	-23840.4	88.148
20		90.4	0.0	270.5	-0.0	23840.4	88.148
21	1 U11	30.6	0.0	-124.0	0.0	-23487.0	189.380
22		30.6	0.0	124.0	-0.0	23487.0	189.380
23	1 U12	90.4	0.0	-270.5	0.0	-23840.4	88.148
24		90.4	0.0	270.5	-0.0	23840.4	88.148
25	1 U13	30.6	0.0	-124.0	0.0	-23487.0	189.380
26		30.6	0.0	124.0	-0.0	23487.0	189.380

*** Program completed as requested! ***



189.375 x 60 in

Code: ACI 318-02

Units: English

Run axis: Biaxial

Run option: Investigation

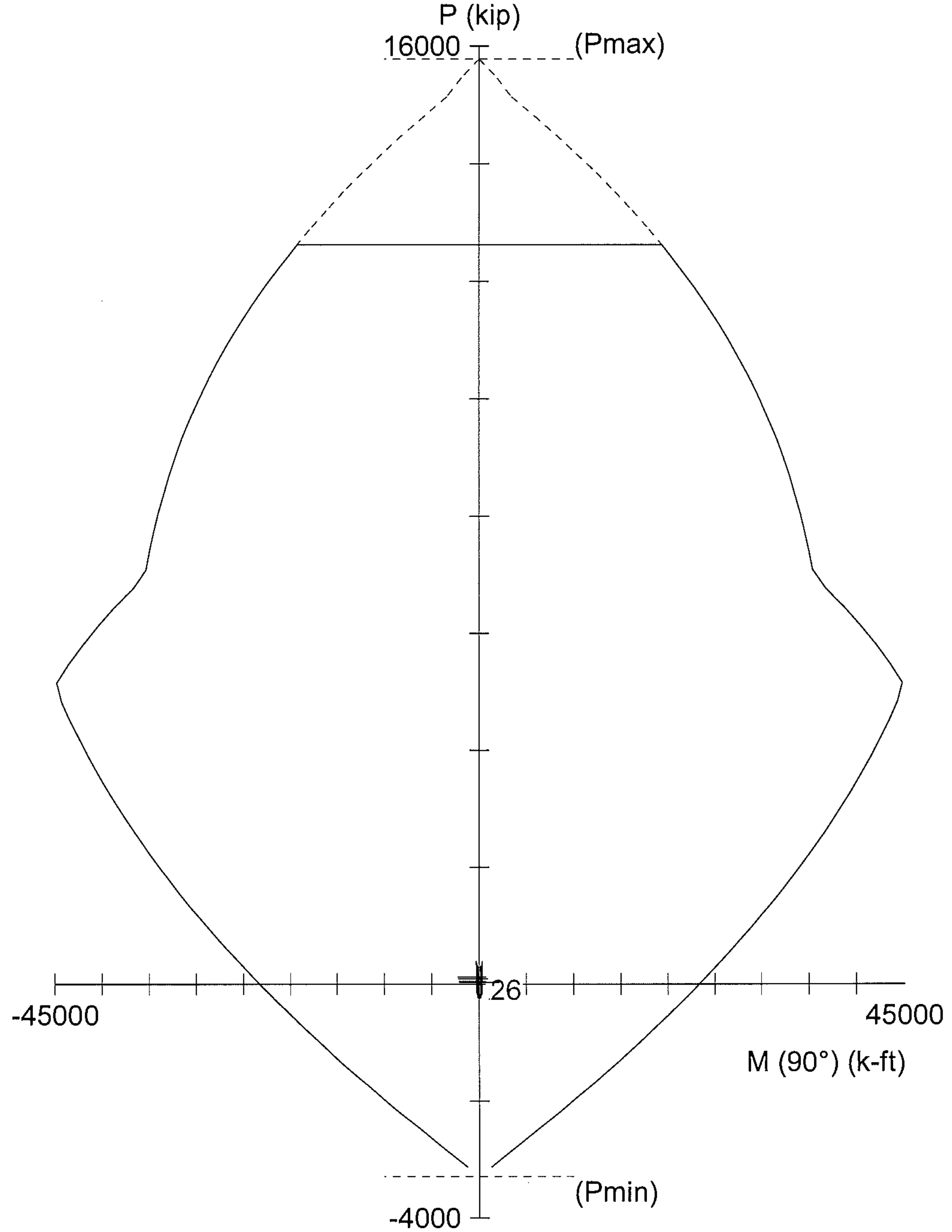
Slenderness: Not considered

Column type: Architectural

Bars: ASTM A615

Date: 10/28/11

Time: 13:39:46



pcaColumn v3.63 - Licensed to: FLSmidth

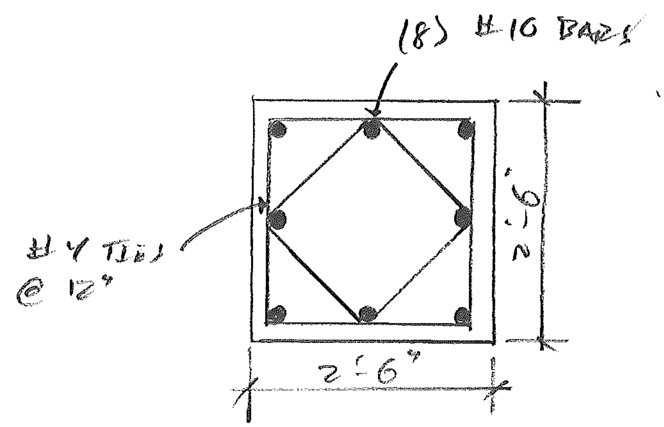
File: C:\Users\esum-us\Desktop\Pedestal Design\Column F-G.col

Project: CC&V High Grade Ore

Column: A/B		Engineer: ECS	
f'c = 4 ksi	fy = 60 ksi	Ag = 11362.5 in^2	48 #10 bars
Ec = 3605 ksi	Es = 29000 ksi	As = 60.96 in^2	Rho = 0.54%
fc = 3.4 ksi	fc = 3.4 ksi	Xo = 0.00 in	Ix = 3.40875e+006 in^4
[illegible] = 0.003 in/in		Yo = 0.00 in	Iy = 3.39577e+007 in^4
Beta1 = 0.85		Clear spacing = 8.37 in	Clear cover = 2.50 in
Confinement: Tied	phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.65		

FLSmidth	PROJECT CC & V High Grade Ore	PROJ NO. 11021
		CALC NO. C-005
	SUBJECT Ball Mill Foundation	BY ECS DATE 10-31-11
		CHK DATE
		SHEET OF REV

PEDESTAL H DESIGN:



Concrete Pedestal Natural Period of Vibration
Pedestal H

Pedestal Dimensions:

$L_x := 2ft + 6in = 30\,in$ — Pedestal Length X Direction

$L_y := 2ft + 6in = 30\,in$ — Pedestal Length Y Direction

$H := 19ft + 10.75in = 238.75\,in$ — Pedestal Height

Concrete Properties:

$\gamma_c := 145pcf$ — Concrete Unit Weight

$f_c := 4000psi$ — Concrete Compressive Strength

$E := 57000psi \cdot \sqrt{\frac{f_c}{psi}} = 3.605 \times 10^3 \cdot ksi$ — Concrete Modulus of Elasticity

Loads and Masses:

$m := L_x \cdot L_y \cdot H \cdot \frac{\gamma_c}{g} = 1.803 \times 10^4 \cdot lb$ — Pedestal Mass

$F_x := 0lb$ $\quad F_y := 0lb$ — Applied Mass

$m_x := F_x + 0.23m = 4.147 \times 10^3\,lb$ $\quad m_y := F_y + 0.23m = 4.147 \times 10^3\,lb$ — Equivalent Mass

Dynamic Properties:

$I_x := \frac{L_x^3 \cdot L_y}{12} = 6.75 \times 10^4\,in^4$ $\quad I_y := \frac{L_x \cdot L_y^3}{12} = 6.75 \times 10^4 \cdot in^4$ — Moment of Inertia

$k_x := \frac{(3 \cdot E \cdot I_x)}{H^3} = 643.696 \cdot \frac{kip}{ft}$ $\quad k_y := \frac{(3 \cdot E \cdot I_y)}{H^3} = 643.696 \cdot \frac{kip}{ft}$ — Stiffness Factor

$\omega_x := \sqrt{\frac{k_x}{0.23m}} = 70.668 \cdot Hz$ $\quad \omega_y := \sqrt{\frac{k_y}{0.23m}} = 70.668 \cdot Hz$ — Natural Frequency without added Mass

$\omega_{x.} := \sqrt{\frac{k_x}{m_x}} = 70.668 \cdot Hz$ $\quad \omega_{y.} := \sqrt{\frac{k_y}{m_y}} = 70.668 \cdot Hz$ — Natural Frequency with added Mass

```
0000000    00000    00000    00000    00000   00
00     00 00    00 00    00 00    00 00    00 00
00     00 00    00 00    00 00    00 00    00 00
00     00 00       00    00 00       00    00 00
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00         00000   00    00  00000    00000   00000  (TM)
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===
Computer program for the Strength Design of Reinforced Concrete Sections
===

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General Information:
====================
File Name: C:\Users\esum-us\Desktop\Pedestal Design\Column H.col
Project: CC&V High Grade Ore
Column: A/B Engineer: ECS
Code: ACI 318-02 Units: English

Run Option: Investigation Slenderness: Not considered
Run Axis: Biaxial Column Type: Structural

Material Properties:
====================
f'c = 4 ksi fy = 60 ksi
Ec = 3605 ksi Es = 29000 ksi
Ultimate strain = 0.003 in/in
Beta1 = 0.85

Section:
========
Rectangular: Width = 30 in Depth = 30 in

Gross section area, Ag = 900 in^2
Ix = 67500 in^4 Iy = 67500 in^4
Xo = 0 in Yo = 0 in

Reinforcement:
==============
Rebar Database: ASTM A615

Size	Diam (in)	Area (in^2)	Size	Diam (in)	Area (in^2)	Size	Diam (in)	Area (in^2)
# 3	0.38	0.11	# 4	0.50	0.20	# 5	0.63	0.31
# 6	0.75	0.44	# 7	0.88	0.60	# 8	1.00	0.79
# 9	1.13	1.00	# 10	1.27	1.27	# 11	1.41	1.56
# 14	1.69	2.25	# 18	2.26	4.00			

Confinement: Tied; #3 ties with #7 bars, #4 with larger bars.
phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.65

Layout: Rectangular
Pattern: Equal Bar Spacing (Cover to transverse reinforcement)
Total steel area, As = 10.16 in^2 at 1.13%
8 #10 Cover = 2 in

Load Combinations:
=================
U1 = 1.400*Dead + 0.000*Live + 0.000*Wind + 0.000*EarthQuake
U2 = 1.200*Dead + 1.600*Live + 0.000*Wind + 0.000*EarthQuake
U3 = 1.200*Dead + 1.000*Live + 0.000*Wind + 0.000*EarthQuake
U4 = 1.200*Dead + 0.000*Live + 0.800*Wind + 0.000*EarthQuake
U5 = 1.200*Dead + 1.000*Live + 1.600*Wind + 0.000*EarthQuake
U6 = 0.900*Dead + 0.000*Live + 1.600*Wind + 0.000*EarthQuake
U7 = 1.200*Dead + 0.000*Live - 0.800*Wind + 0.000*EarthQuake
U8 = 1.200*Dead + 1.000*Live - 1.600*Wind + 0.000*EarthQuake
U9 = 0.900*Dead + 0.000*Live - 1.600*Wind + 0.000*EarthQuake
U10 = 1.200*Dead + 1.000*Live + 0.000*Wind + 1.000*EarthQuake
U11 = 0.900*Dead + 0.000*Live + 0.000*Wind + 1.000*EarthQuake
U12 = 1.200*Dead + 1.000*Live + 0.000*Wind - 1.000*EarthQuake
U13 = 0.900*Dead + 0.000*Live + 0.000*Wind - 1.000*EarthQuake

Service Loads:

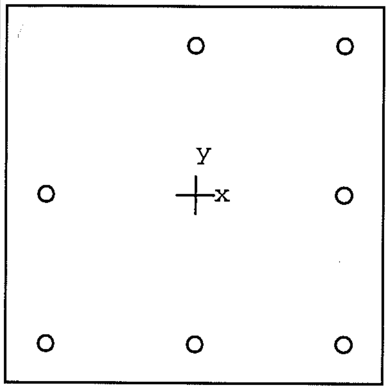
No.	Load Case	Axial Load kip	Mx @ Top k-ft	Mx @ Bot k-ft	My @ Top k-ft	My @ Bot k-ft
1	Dead	8.8	0.0	0.0	0.0	0.0
	Live	0.0	0.0	0.0	0.0	0.0
	Wind	0.0	0.0	0.0	0.0	0.0
	E.Q.	0.0	0.0	0.0	0.0	0.0

Factored Loads and Moments with Corresponding Capacities: (see user's manual for notation)

NOTE: Each loading combination includes the following cases:
First line - at column top
Second line - at column bottom

No.	Load Combo	Pu kip	Mux k-ft	Muy k-ft	fMnx k-ft	fMny k-ft	fMn/Mu
1	1 U1	12.3	0.0	0.0	592.1	0.0	999.999
2		12.3	0.0	0.0	592.1	0.0	999.999
3	1 U2	10.6	0.0	0.0	590.4	0.0	999.999
4		10.6	0.0	0.0	590.4	0.0	999.999
5	1 U3	10.6	0.0	0.0	590.4	0.0	999.999
6		10.6	0.0	0.0	590.4	0.0	999.999
7	1 U4	10.6	0.0	0.0	590.4	0.0	999.999
8		10.6	0.0	0.0	590.4	0.0	999.999
9	1 U5	10.6	0.0	0.0	590.4	0.0	999.999
10		10.6	0.0	0.0	590.4	0.0	999.999
11	1 U6	7.9	0.0	0.0	587.8	0.0	999.999
12		7.9	0.0	0.0	587.8	0.0	999.999
13	1 U7	10.6	0.0	0.0	590.4	0.0	999.999
14		10.6	0.0	0.0	590.4	0.0	999.999
15	1 U8	10.6	0.0	0.0	590.4	0.0	999.999
16		10.6	0.0	0.0	590.4	0.0	999.999
17	1 U9	7.9	0.0	0.0	587.8	0.0	999.999
18		7.9	0.0	0.0	587.8	0.0	999.999
19	1 U10	10.6	0.0	0.0	590.4	0.0	999.999
20		10.6	0.0	0.0	590.4	0.0	999.999
21	1 U11	7.9	0.0	0.0	587.8	0.0	999.999
22		7.9	0.0	0.0	587.8	0.0	999.999
23	1 U12	10.6	0.0	0.0	590.4	0.0	999.999
24		10.6	0.0	0.0	590.4	0.0	999.999
25	1 U13	7.9	0.0	0.0	587.8	0.0	999.999
26		7.9	0.0	0.0	587.8	0.0	999.999

*** Program completed as requested! ***



30 x 30 in

Code: ACI 318-02

Units: English

Run axis: Biaxial

Run option: Investigation

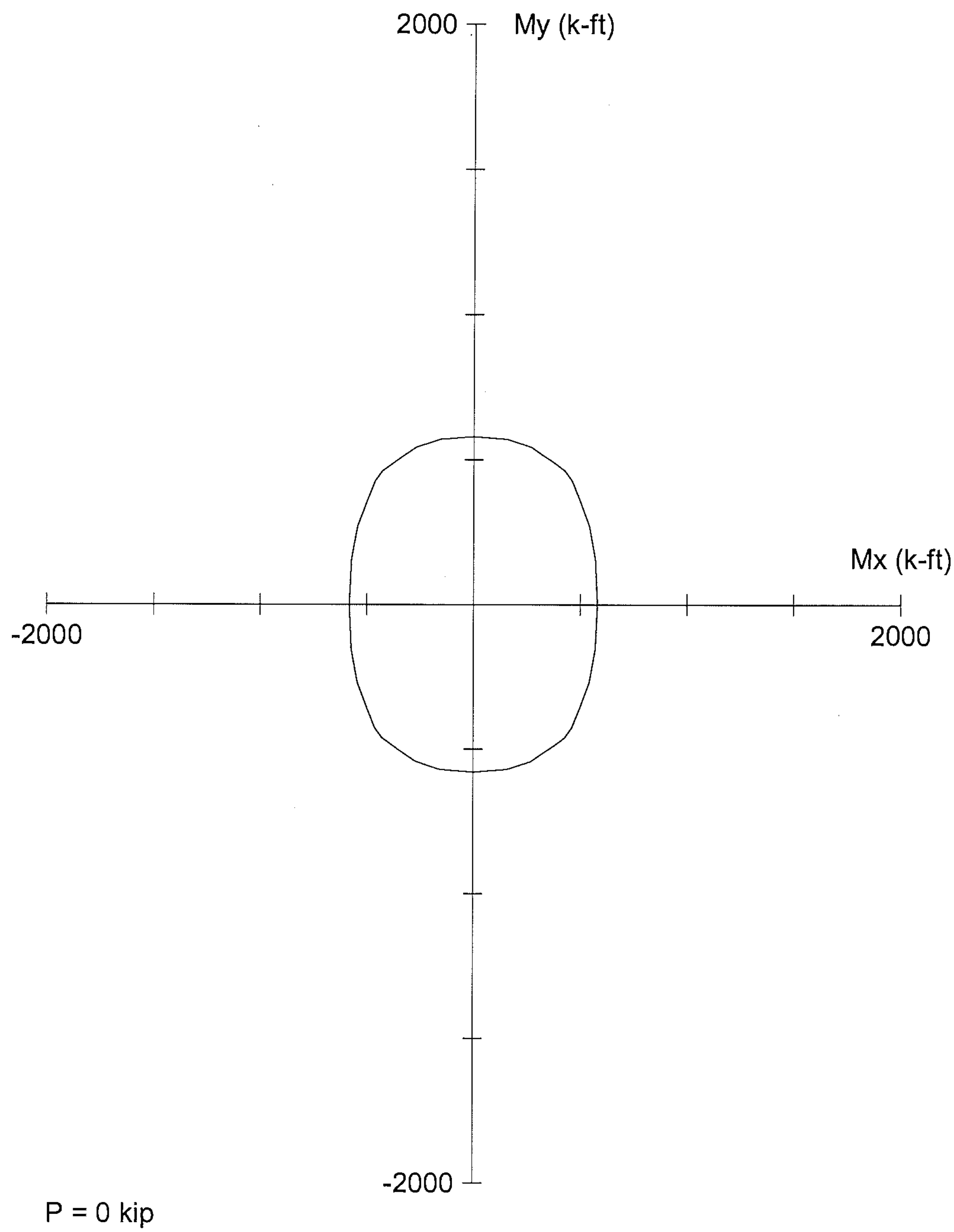
Slenderness: Not considered

Column type: Structural

Bars: ASTM A615

Date: 10/31/11

Time: 08:42:58



pcaColumn v3.63 - Licensed to: FLSmidth

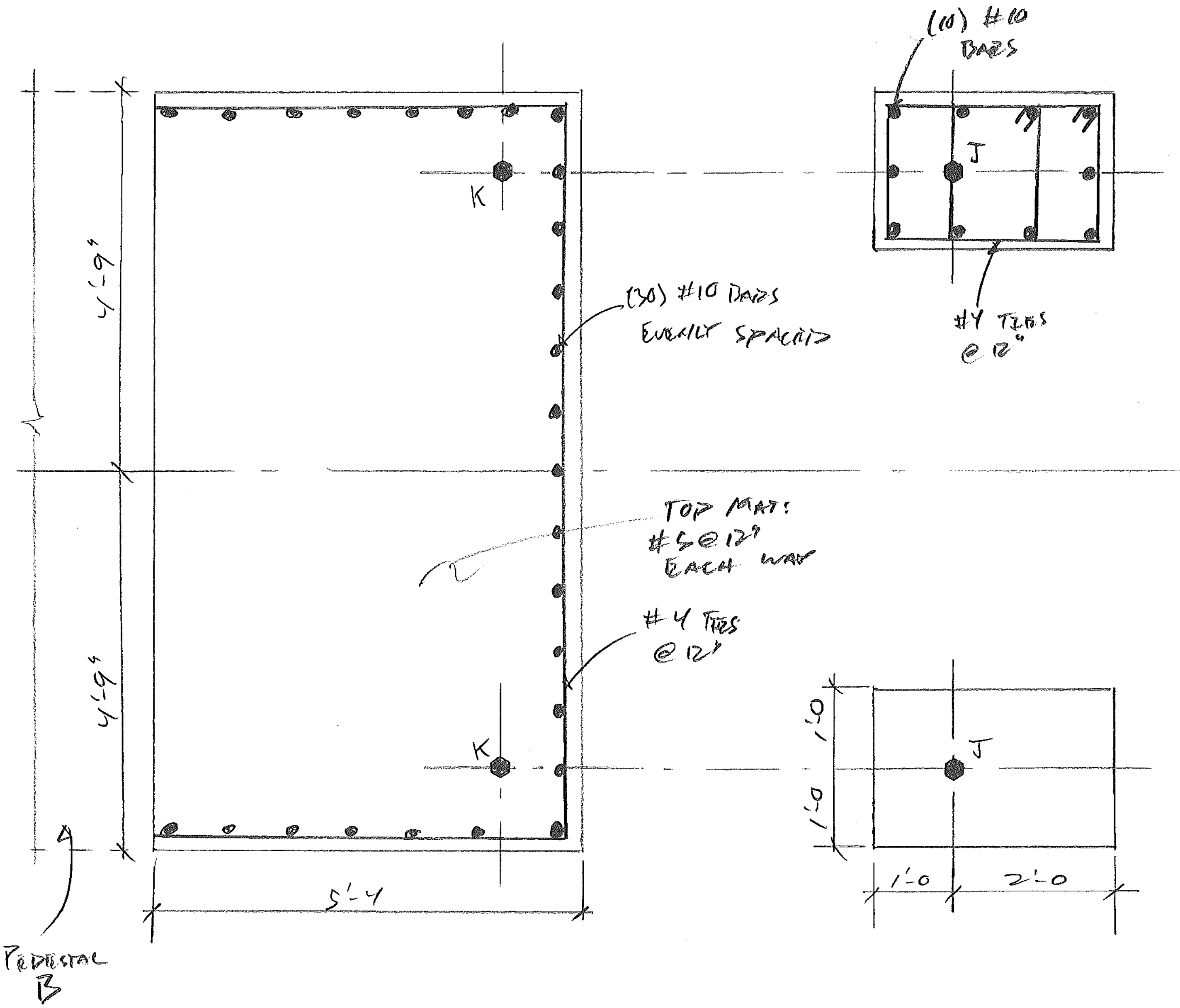
File: C:\Users\esum-us\Desktop\Pedestal Design\Column H.col

Project: CC&V High Grade Ore

Column: A/B		Engineer: ECS	
f'c = 4 ksi	fy = 60 ksi	Ag = 900 in^2	8 #10 bars
Ec = 3605 ksi	Es = 29000 ksi	As = 10.16 in^2	Rho = 1.13%
fc = 3.4 ksi	fc = 3.4 ksi	Xo = 0.00 in	Ix = 67500 in^4
= 0.003 in/in		Yo = 0.00 in	Iy = 67500 in^4
Beta1 = 0.85		Clear spacing = 10.59 in	Clear cover = 2.50 in
Confinement: Tied	phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.65		

FLSMIDTH	PROJECT CC&V High Grade Ore	PROJ NO. 11021
		CALC NO. C-005
	SUBJECT Ball Mill Foundation	BY ECS DATE 10-31-11
		CHK DATE
		SHEET OF REV

Pedestal J/K Design:



Concrete Pedestal Natural Period of Vibration
Pedestal J

Pedestal Dimensions:

$L_x := 3ft + 0in = 36\,in$ — Pedestal Length X Direction

$L_y := 2ft + 0in = 24\,in$ — Pedestal Length Y Direction

$H := 13ft + 9.75in = 165.75\,in$ — Pedestal Height

Concrete Properties:

$\gamma_c := 145pcf$ — Concrete Unit Weight

$f_c := 4000psi$ — Concrete Compressive Strength

$E := 57000psi \cdot \sqrt{\frac{f_c}{psi}} = 3.605 \times 10^3 \cdot ksi$ — Concrete Modulus of Elasticity

Loads and Masses:

$m := L_x \cdot L_y \cdot H \cdot \frac{\gamma_c}{g} = 1.202 \times 10^4 \cdot lb$ — Pedestal Mass

$F_x := 0lb$ $\quad F_y := 0lb$ — Applied Mass

$m_x := F_x + 0.23m = 2.764 \times 10^3\,lb$ $\quad m_y := F_y + 0.23m = 2.764 \times 10^3\,lb$ — Equivalent Mass

Dynamic Properties:

$I_x := \frac{L_x^3 \cdot L_y}{12} = 9.331 \times 10^4\,in^4$ $\quad I_y := \frac{L_x \cdot L_y^3}{12} = 4.147 \times 10^4 \cdot in^4$ — Moment of Inertia

$k_x := \frac{(3 \cdot E \cdot I_x)}{H^3} = 2.659 \times 10^3 \cdot \frac{kip}{ft}$ $\quad k_y := \frac{(3 \cdot E \cdot I_y)}{H^3} = 1.182 \times 10^3 \cdot \frac{kip}{ft}$ — Stiffness Factor

$\omega_x := \sqrt{\frac{k_x}{0.23m}} = 175.948 \cdot Hz$ $\quad \omega_y := \sqrt{\frac{k_y}{0.23m}} = 117.299 \cdot Hz$ — Natural Frequency without added Mass

$\omega_{x.} := \sqrt{\frac{k_x}{m_x}} = 175.948 \cdot Hz$ $\quad \omega_{y.} := \sqrt{\frac{k_y}{m_y}} = 117.299 \cdot Hz$ — Natural Frequency with added Mass

```
OOOOOOO    OOOOO    OOOOO    OOOOO    OOOOO   OO
OO    OO  OO   OO  OO   OO  OO   OO  OO   OO  OO
OO    OO  OO   OO  OO   OO  OO   OO  OO   OO  OO
OO    OO  OO       OO   OO  OO       OO   OO  OO
OO    OO  OO       OOOOOOO  OO       OO   OO  OO
OOOOOOO   OO   OO  OO   OO  OO   OO  OO   OO  OO
OO        OO   OO  OO   OO  OO   OO  OO   OO  OO
OO         OOOOO   OO   OO   OOOOO    OOOOO   OOOOO   (TM)
```

==
Computer program for the Strength Design of Reinforced Concrete Sections
==

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General Information:

File Name: C:\Users\esum-us\Desktop\Pedestal Design\Column J.col
Project: CC&V High Grade Ore
Column: A/B
Engineer: ECS
Code: ACI 318-02
Units: English

Run Option: Investigation
Slenderness: Not considered
Run Axis: Biaxial
Column Type: Structural

Material Properties:

f'c = 4 ksi
fy = 60 ksi
Ec = 3605 ksi
Es = 29000 ksi
Ultimate strain = 0.003 in/in
Beta1 = 0.85

Section:

Rectangular: Width = 36 in
Depth = 24 in

Gross section area, Ag = 864 in^2
Ix = 41472 in^4
Iy = 93312 in^4
Xo = 0 in
Yo = 0 in

Reinforcement:

Rebar Database: ASTM A615

Size	Diam (in)	Area (in^2)	Size	Diam (in)	Area (in^2)	Size	Diam (in)	Area (in^2)
# 3	0.38	0.11	# 4	0.50	0.20	# 5	0.63	0.31
# 6	0.75	0.44	# 7	0.88	0.60	# 8	1.00	0.79
# 9	1.13	1.00	# 10	1.27	1.27	# 11	1.41	1.56
# 14	1.69	2.25	# 18	2.26	4.00			

Confinement: Tied; #3 ties with #7 bars, #4 with larger bars.
phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.65

Layout: Rectangular
Pattern: Equal Bar Spacing (Cover to transverse reinforcement)
Total steel area, As = 15.24 in^2 at 1.76%
12 #10 Cover = 2 in

Load Combinations:

U1 = 1.400*Dead + 0.000*Live + 0.000*Wind + 0.000*EarthQuake
U2 = 1.200*Dead + 1.600*Live + 0.000*Wind + 0.000*EarthQuake
U3 = 1.200*Dead + 1.000*Live + 0.000*Wind + 0.000*EarthQuake
U4 = 1.200*Dead + 0.000*Live + 0.800*Wind + 0.000*EarthQuake
U5 = 1.200*Dead + 1.000*Live + 1.600*Wind + 0.000*EarthQuake
U6 = 0.900*Dead + 0.000*Live + 1.600*Wind + 0.000*EarthQuake
U7 = 1.200*Dead + 0.000*Live - 0.800*Wind + 0.000*EarthQuake
U8 = 1.200*Dead + 1.000*Live - 1.600*Wind + 0.000*EarthQuake
U9 = 0.900*Dead + 0.000*Live - 1.600*Wind + 0.000*EarthQuake
U10 = 1.200*Dead + 1.000*Live + 0.000*Wind + 1.000*EarthQuake
U11 = 0.900*Dead + 0.000*Live + 0.000*Wind + 1.000*EarthQuake
U12 = 1.200*Dead + 1.000*Live + 0.000*Wind - 1.000*EarthQuake
U13 = 0.900*Dead + 0.000*Live + 0.000*Wind - 1.000*EarthQuake

Service Loads:
==============

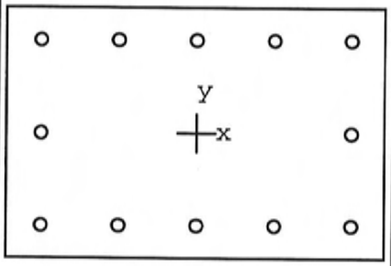
No.	Load Case	Axial Load kip	Mx @ Top k-ft	Mx @ Bot k-ft	My @ Top k-ft	My @ Bot k-ft
1	Dead	147.0	0.0	0.0	73.5	73.5
	Live	143.0	0.0	0.0	71.5	71.5
	Wind	0.0	0.0	0.0	0.0	0.0
	E.Q.	0.0	0.0	0.0	0.0	0.0

Factored Loads and Moments with Corresponding Capacities: (see user's manual for notation)
==

NOTE: Each loading combination includes the following cases:
First line - at column top
Second line - at column bottom

No.	Load Combo	Pu kip	Mux k-ft	Muy k-ft	fMnx k-ft	fMny k-ft	fMn/Mu
1	1 U1	205.8	0.0	102.9	-0.0	1188.1	11.546
2		205.8	0.0	-102.9	0.0	-1188.1	11.546
3	1 U2	405.2	0.0	202.6	-0.0	1339.6	6.612
4		405.2	0.0	-202.6	0.0	-1339.6	6.612
5	1 U3	319.4	0.0	159.7	-0.0	1282.1	8.028
6		319.4	0.0	-159.7	0.0	-1282.1	8.028
7	1 U4	176.4	0.0	88.2	-0.0	1162.8	13.184
8		176.4	0.0	-88.2	0.0	-1162.8	13.184
9	1 U5	319.4	0.0	159.7	-0.0	1282.1	8.028
10		319.4	0.0	-159.7	0.0	-1282.1	8.028
11	1 U6	132.3	0.0	66.2	-0.0	1124.4	16.997
12		132.3	0.0	-66.2	0.0	-1124.4	16.997
13	1 U7	176.4	0.0	88.2	-0.0	1162.8	13.184
14		176.4	0.0	-88.2	0.0	-1162.8	13.184
15	1 U8	319.4	0.0	159.7	-0.0	1282.1	8.028
16		319.4	0.0	-159.7	0.0	-1282.1	8.028
17	1 U9	132.3	0.0	66.2	-0.0	1124.4	16.997
18		132.3	0.0	-66.2	0.0	-1124.4	16.997
19	1 U10	319.4	0.0	159.7	-0.0	1282.1	8.028
20		319.4	0.0	-159.7	0.0	-1282.1	8.028
21	1 U11	132.3	0.0	66.2	-0.0	1124.4	16.997
22		132.3	0.0	-66.2	0.0	-1124.4	16.997
23	1 U12	319.4	0.0	159.7	-0.0	1282.1	8.028
24		319.4	0.0	-159.7	0.0	-1282.1	8.028
25	1 U13	132.3	0.0	66.2	-0.0	1124.4	16.997
26		132.3	0.0	-66.2	0.0	-1124.4	16.997

*** Program completed as requested! ***



36 x 24 in

Code: ACI 318-02

Units: English

Run axis: Biaxial

Run option: Investigation

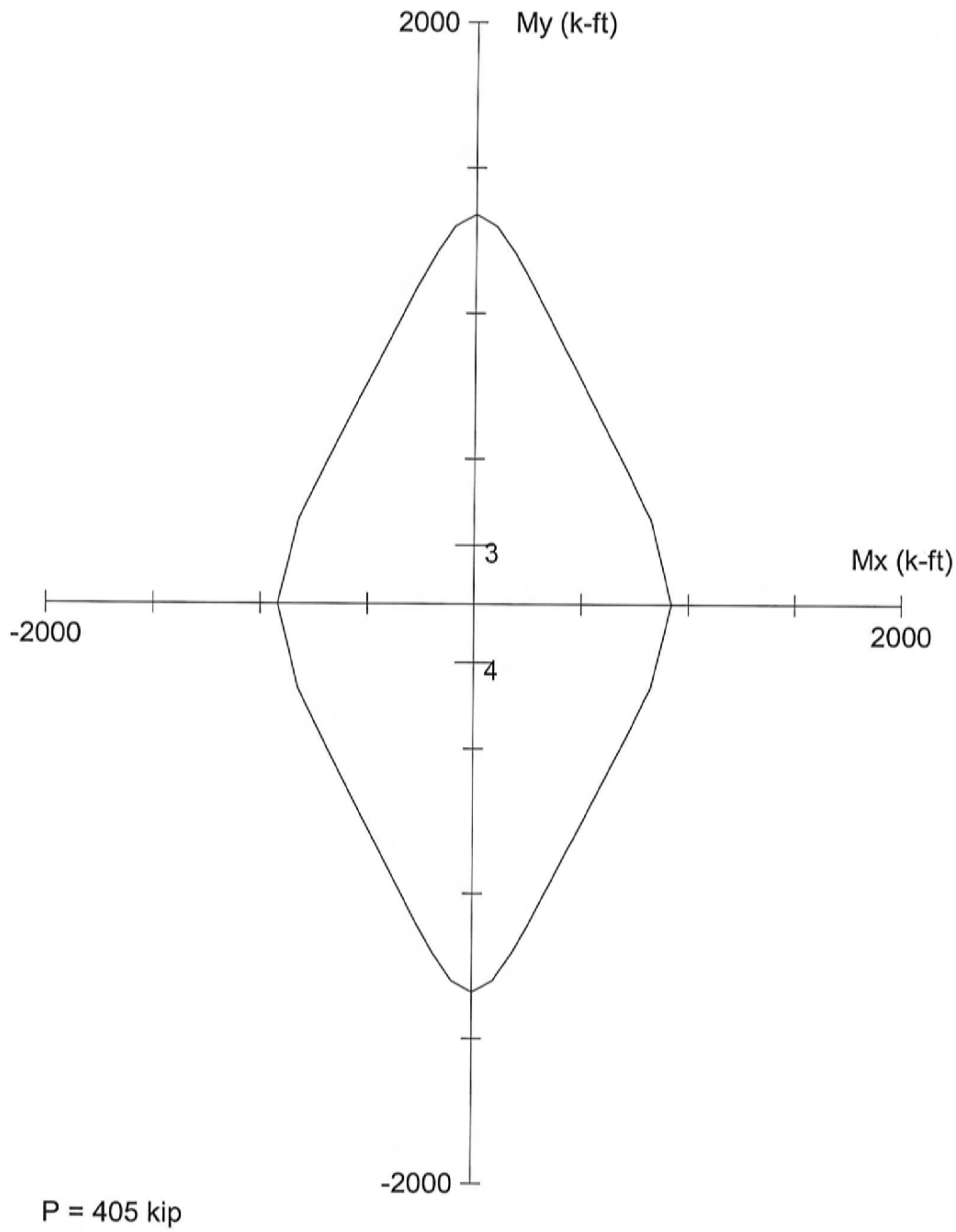
Slenderness: Not considered

Column type: Structural

Bars: ASTM A615

Date: 10/31/11

Time: 10:06:48



pcaColumn v3.63 - Licensed to: FLSmidth

File: C:\Users\esum-us\Desktop\Pedestal Design\Column J.col

Project: CC&V High Grade Ore

Column: A/B

Engineer: ECS

f'c = 4 ksi	fy = 60 ksi	Ag = 864 in^2	12 #10 bars
Ec = 3605 ksi	Es = 29000 ksi	As = 15.24 in^2	Rho = 1.76%
fc = 3.4 ksi	fc = 3.4 ksi	Xo = 0.00 in	Ix = 41472 in^4
[illegible] = 0.003 in/in		Yo = 0.00 in	Iy = 93312 in^4
Beta1 = 0.85		Clear spacing = 6.16 in	Clear cover = 2.50 in
Confinement: Tied	phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.65		

FLSMIDTH			
	PROJECT CC&V	PROJ NO. 11021	
	HIGH GRADE ORE	CALC NO. C-004	
	SCOPE BALL MILL	BY ECS	DATE 16-Jul-12
	ANCHOR BOLT DESIGN	CHK	DATE
		SHEET OF	REV

Anchor Bolt Design - Pedestal

per ACI 318-08 Appendix D, Wind Loads and Anchor Bol Design for Petrochemical Facilities (ASCE Anchor Bolt Task Committee)

Assumptions: *Cast-in-place Anchor Bolts, Cracked Concrete*
Intermediate to High Seismic, No eccentric loading

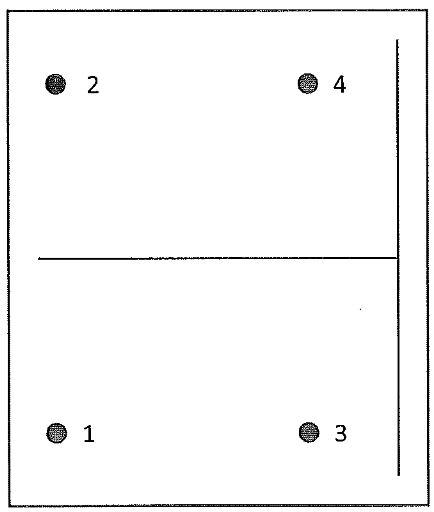
Loads:

N =	34.700	kip	Factored Tensile Load
V_x =	165.440	kip	Factored Shear Load - X Dir.
M_y =	0.000	kip*ft	Factored Moment - About Y Axis
V_y =	0.000	kip	Factored Shear Load - Y Dir.
M_x =	0.000	kip*ft	Factored Moment - about X Axis

Anchor Geometry:

(Origin at Column Centerline)

Bolt #	X (in)	Y (in)
1	-19	-48
2	-19	48
3	-5	-48
4	-5	48
5		
6		
7		
8		
9		
10		
11		
12		
Max Spacing	14	96
Outside Spacing	14	96



Anchor Loads: *(check bolts that resist shear)*

Update Loads

Bolt #	Shear X Dir.	Shear Y Dir.	Tension X Dir.
1	☑ 41.4	☑ 0.0	8.7
2	☑ 41.4	☑ 0.0	8.7
3	☑ 41.4	☑ 0.0	8.7
4	☑ 41.4	☑ 0.0	8.7
5	☐ 0.0	☐ 0.0	0.0
6	☐ 0.0	☐ 0.0	0.0
7	☐ 0.0	☐ 0.0	0.0
8	☐ 0.0	☐ 0.0	0.0
9	☐ 0.0	☐ 0.0	0.0
10	☐ 0.0	☐ 0.0	0.0
11	☐ 0.0	☐ 0.0	0.0
12	☐ 0.0	☐ 0.0	0.0
Sum	**165.4**	**0.00**	**34.70**

Bolt Properties:

$D =$	2	in	Anchor Bolt Diameter
	F1554 36		Anchor Bolt Material
$h_{ef} =$	42	in	Embedment Depth
$h'_{ef} =$	32.00	in	Effective Embedment Depth (D.5.2.3)
$l_e =$	16	in	Load bearing length of anchor for shear (D.6.2.2)
$n_t =$	4		Number of Bolts in Tension
$n_{vx} =$	4		Number of Bolts in Shear X Dir.
$n_{vy} =$	4		Number of Bolts in Shear Y Dir.
$A_{se} =$	2.498	in^2	Effective Tension Bolt Area
$A_{se,v} =$	2.498	in^2	Effective Shear Bolt Area
$A_{brg} =$	5.316	in^2	Bolt Bearing Area
$f_{ya} =$	36	ksi	Anchor Yield Strength
$f_{uta} =$	58	ksi	Ultimate Tensile Anchor Strength

Concrete Properties:

Grout Pad ☑ Tensile Reinforcement ☑ Shear Reinforcement ☑

$f'_c =$	4000	psi	
$H =$	120	in	Pedestal Height
$B =$	54	in	Pedestal Width
$L =$	114	in	Pedestal Length
$c_{at,1} =$	8	in	Tension Edge Distance 1
$c_{at,2} =$	32	in	Tension Edge Distance 2
$c_{at,3} =$	9	in	Tension Edge Distance 3
$c_{at,4} =$	9	in	Tension Edge Distance 4
$c_{av,1} =$	22	in	Shear Edge Distance 1
$c_{av,2} =$	105	in	Shear Edge Distance 2
$c_{a,min} =$	8	in	Minimum Clear Cover
$A_{nc}' =$	6156.0	in^2	Projected Tension Concrete Failure Area (D.5.2.1)
$A_{nco}' =$	9216.0	in^2	Projected Concrete Failure Area of a Single Bolt (D-6)
$A_{vc,x} =$	3762.0	in^2	Projected Shear Concrete Failure Area X Dir. (RD.6.2.1b)
$A_{vc,y} =$	4260.0	in^3	Projected Shear Concrete Failure Area Y Dir. (RD.6.2.1b)
$A_{vco,x} =$	2178.0	in^2	Maximum Projected Area for a Single Anchor X Dir. (D-23)
$A_{vco,y} =$	49612.5	in^3	Maximum Projected Area for a Single Anchor Y Dir. (D-23)

Pedestal Reinforcement:

fy =	60	ksi	Reinforcement Yield Strength
Reinforcement =	# 10		Pedestal Reinforcement Size
N =	48		Total Number of Longitudinal Bars
s =	8	in	Horizontal Clear Distance Between Bolts and Reinforcement
c =	2	in	Concrete Cover (Top of Pedestal to Top of Reinforcement)
ρ =	0.99%		Pedestal Reinforcement Ratio
$A_{s,bar\ Req'd}$ =	0.26	in^2	Required Reinforcement per Tension Bolt (D.3.3.3)
$A_{s,bar}$ =	15.24	in^2	Provided Reinforcement per Tension Bolt
L_d =	60.2	in	Reinforcement Development Length (ACI 318 - 12.2.3)
Reduction Ratio =	0.02		Development Length Reduction Ratio (ACI 318 - 12.2.5)
L_{dev} =	1	in	Reduced Development Length
$h_{ef,\ Req'd}$ =	12	in	Minimum Required Anchor Bolt Embedment

Use (48) # 10 Bars, 12 in. Minimum Anchor Embedment Depth

Factors/ Coefficients:

Tension Factors:

$\psi_{ed,N}$ =	0.750	Factor for insufficient side cover (D-10,D-11)
$\psi_{c,N}$ =	1	Factor for uncracked concrete (D.5.2.6)

Shear Factors:

$\psi_{ed,Vx}$ =	1.000	Factor for insufficient side cover (D-27,D-28)
$\psi_{ed,Vy}$ =	0.742	Factor for insufficient side cover (D-27,D-28)
$\psi_{c,V}$ =	1	Factor for uncracked concrete (D.6.&.&)

Reduction Factors: (D.4.4)

ϕ_{sn} =	0.75	Steel Reduction Factor for Tension
ϕ_{sv} =	0.65	Steel Reduction Factor for Shear
ϕ_{cp} =	0.70	Tensile Pullout and Shear Pryout Reduction Factor
ϕ_{cn} =	0.75	Concrete Reduction Factor for Tension
ϕ_{cv} =	0.75	Concrete Reduction Factor for Shear

Results:

Note: Pedestal reinforcement is designed to prevent all failure modes with a check mark

Tension Results:

	ϕN_{sa} =	434.7	kip	Nominal Strength of Anchor (Group) in Tension (D-3)
	N_b =	326.4	kip	Basic Concrete Breakout Strength of a Single Anchor (D-7, D-8)
☑	ϕN_{cb} =	NA	kip	Concrete Breakout Strength in Tension (Group) (D-5)
	N_p =	170.1	kip	Pullout strength for single headed stud
☐	ϕN_{Pn} =	476.3	kip	The Nominal pullout Strength in Tension (Group) (D-14)
	N_{sb} =	99.159	kip	Side-face blowout strength of a single bolt (D-17)
☐	ϕN_{sbg} =	244.798	kip	Side-face blowout strength of a bolt group (D-18)

ϕN_n =	**244.8**	**kip**	**0.14**	**DESIGN OK**

Shear Results:

☐	$\phi V_{sa,x}$ =	180.8	kip	Nominal Steel Shear Strength X Dir. (D-20)
☐	$\phi V_{sa,y}$ =	180.8	kip	Nominal Steel Shear Strength Y Dir. (D-20)
	$V_{b,x}$ =	97.9	kip	Basic Concrete Breakout Strength, X Dir. (D-24)
	$V_{b,y}$ =	1021.0	kip	Basic Concrete Breakout Strength, Y Dir. (D-24)
☑	$\phi V_{cbg,x}$ =	NA	kip	Concrete breakout Strength (Group), X Dir. (D-22)
☑	$\phi V_{cbg,y}$ =	NA	kip	Concrete breakout Strength (Group), Y Dir. (D-22)
☐	$\phi V_{cpg,x}$ =	228.9	kip	Nominal Pryout Strength for a group of anchors X Dir. (D-31)
☐	$\phi V_{cpg,y}$ =	228.9	kip	Nominal Pryout Strength for a group of anchors Y Dir. (D-31)

ϕV_{nx} =	**180.8**	**kip**	**0.91**	**DESIGN OK**
ϕV_{ny} =	**180.8**	**kip**	**0.00**	**DESIGN OK**

interaction Ratio:

Ratio =	**1.06**	**DESIGN OK**

September, 20, 2012 Project 74201125G

Timm Comer
Cripple Creek & Victor Gold Mining Co.
P.O. Box 191
Victor, CO 80860

Re: Mill Platform Machine Vibration Effects

Dear Mr. Comer:

Machine vibrations associated with the ball mill and rod mill at the proposed plant site will impart stresses to the underlying soil strata. Concern has arisen that these stresses could (1) densify granular foundation fills, (2) produce strains on the geomembrane liner located beneath the foundations, and (3) contribute to instability in nearby slopes. This letter addresses these concerns through analysis and literature review and presents our opinion.

Subgrade Response to Machine Vibrations

The settlement of granular soils from repeated vertical loading on foundations from machine vibrations have been investigated by several laboratory studies (Raymond and Komos, Brumund and Leonards). The studies show that settlement is a function of machine vibration amplitude and number of load cycles. Brumund and Leonards (1972) showed that settlement is a function of energy transmitted to the soil from the machine vibrations. Each of the aforementioned studies were conducted in laboratory settings with scale foundations and idealized sand. Techniques of extrapolation of settlement of prototype foundation from the laboratory model tests are not currently available.

Methods for predicting settlement in dry sands due to cyclic shear stress have been published by Silver and Seed (1971) and state that the controlling parameters for settlement include (1) relative density, (2) maximum shear strain induced, and (3) number of shear cycles imparted on the soil. This method utilizes a dynamic analysis of the cyclic motions (typically ground accelerations from the design earthquake) to construct a profile of average shear strain due to cyclic loading with depth. Once the shear strain profile has been constructed, laboratory simple shear tests on representative soil specimens are conducted to evaluate the vertical strain resulting from cyclic strain at corresponding vertical stresses. The total settlement is calculated as the sum vertical strains times the corresponding layer thicknesses. This method involves extensive laboratory testing and can be implemented only with materials that can be tested with traditional laboratory equipment therefore is not suitable for our application.

For our evaluation, the computer software QUAKE/W by Geo-Slope (2008) was used to conduct finite element analyses of the cyclic foundation vibrations with an equivalent-linear elastic model. The equivalent-linear elastic model modifies the soil stiffness in response to computed strains. This model accurately estimates elastic strains from the dynamic stress imparted by the foundation vibrations but cannot predict permanent plastic deformations (i.e. settlement due to densification). The results are the elastic response due to the dynamic foundation load. Non-linear models capture large strains and permanent displacements, but the parameters that describe such models are not as well established as those of the equivalent-linear elastic model. A substantial field and laboratory testing program to obtain model parameters is required for non-linear models.

To simplify the analysis, only structural fill was evaluated for dynamic response. The other materials beneath the mill platform include bedrock, drain cover fill and low volume solution collection fill and are not of concern due to either thickness or density. The structural fill is of concern due to depth of the fill, over 100 feet of fill in some areas, and because it makes up the majority of the foundation soils. The structural fill consisting of minus 24" well graded gravel placed beneath the liner system and the select structural fill consisting of minus 3" well graded gravel placed between the liner system and the low volume solution collection fill were model as homogeneous soil. The dynamic properties were conservatively selected for a sandy gravel with medium density. This is a conservative assumption because the structural fill and select structural fill have larger grain size and higher density compared to the modeled fill. Larger grain size and increased density generally result in higher shear moduli and stiffer dynamic properties in cohesionless fills as indicated by studies conducted by Seed and Idriss (1984).

The structural fill is approximately 75 feet thick beneath the center of the mill foundation so a block of material 100 feet thick was conservatively modeled. A thicker layer is considered conservative as there is more compressible material to contribute to the elastic strains. The structural fill was modeled with a unit weight of 130 pounds per cubic foot (pcf), and a Possion's Ratio of 0.35. The shear modulus was defined as a function of vertical effective stress based on correlations by Seed and Idris (1970). The shear modulus is shown graphically in Figure 1. Equivalent-linear elastic modeling estimates strain softening by a shear modulus reduction function which relates shear modulus to cyclic shear strain. For this analysis the shear modulus reduction function was estimated from the confining stress and plastic limit of the soil based on methods developed by Ishibashi and Zhang (1993) and is shown graphically in Figure 2. The damping ratio is also described as a function of cyclic shear strain and can be estimated similarly to the shear modulus reduction function using the confining stress and plastic limit of the soil by the methods developed by Ishibashi and Zhang (1993). These functions compare well with the dynamic functions suggested by the research of Seed et. al. (1984) for rock fill material. The damping ratio function is shown graphically in Figure 3.

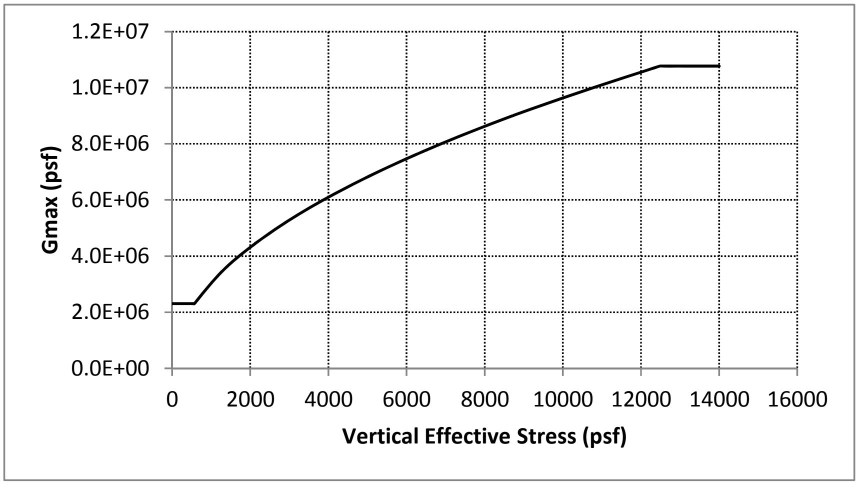


Figure 1: Shear Modulus Function

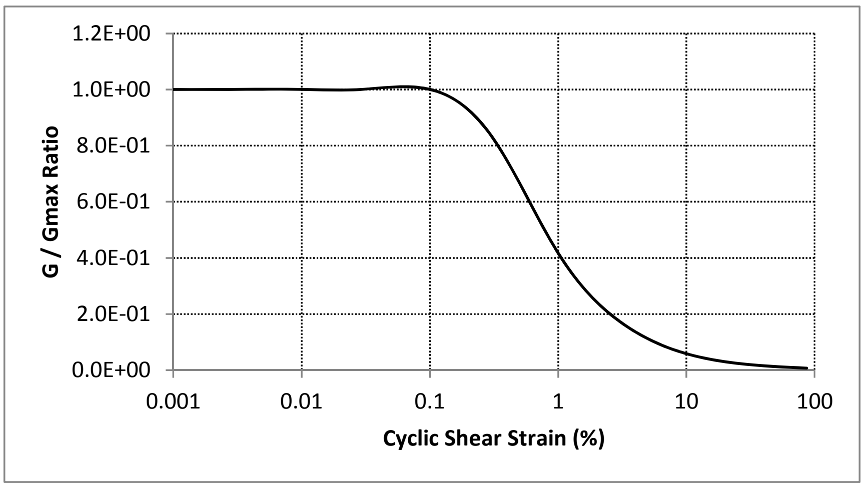


Figure 2: Shear Modulus Reduction Function

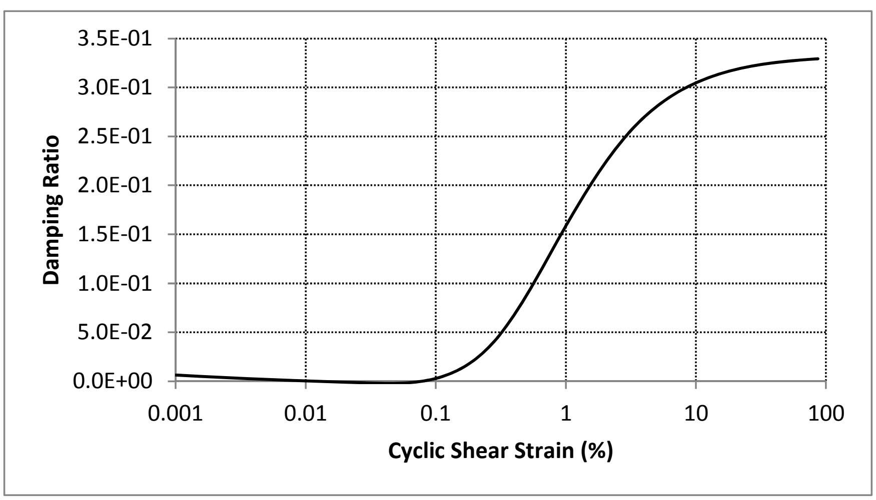


Figure 3: Damping Ratio Function

The machine foundation vibrations were applied to a beam modeled in QUAKE/W. The beam was given material properties to simulate a 3 foot thick concrete mat foundation. Initial stress conditions were calculated with a static stress boundary condition applied to the foundation equal to one half of the maximum allowable bearing capacity given in the geotechnical report, i.e. 3,500 pounds per square foot (psf). The material was modeled as a dry fill without pore water pressures. Generation of pore water pressure is not expected to occur due to the granular nature of the fill and because water infiltration is limited by the geomembrane liner. To simulate the machine vibrations a boundary condition was defined along the foundation as a stress function with time. A sinusoidal function was used to model the vertical oscillation of the stresses. The assumption was made that stresses induced from dynamic loads would not exceed the maximum allowable bearing capacity given in the geotechnical report, i.e. 7,000 psf. The sine waves representing the vibrations had a maximum stress of 7,000 psf, a minimum stress equal to the initial foundation load of 3,500 psf. The wave lengths of the sine functions were equal to the operating angular velocity (rotations per minute, rpm) of the ball and rod mills which were 15.58 rpm and 14.12 rpm, respectively. The sine waves representing the machine vibrations are shown in Figure 4. The vibrations were applied to the foundation independent from one another.

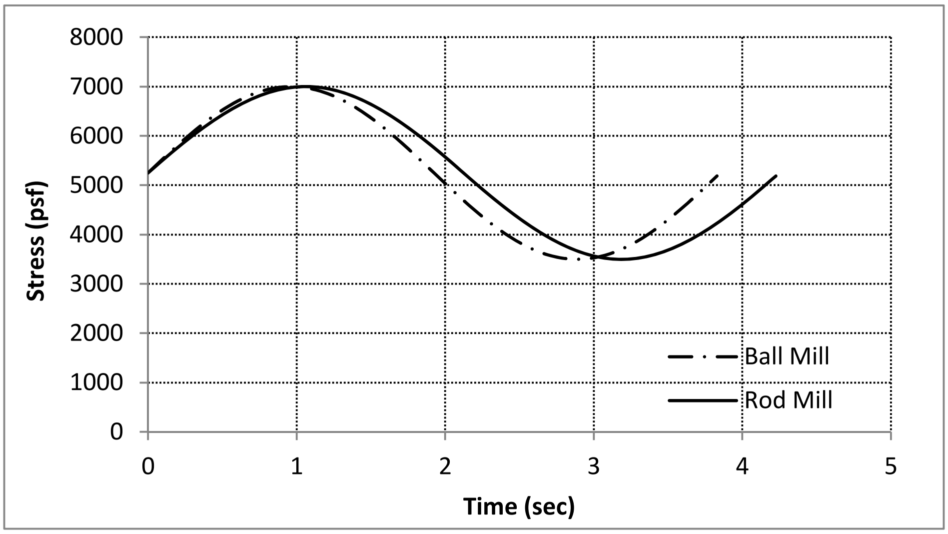


Figure 4: Machine Vibrations

The model was subjected to the foundation vibrations for 1 year and the soil response was recorded. The vertical displacements immediately beneath the mill foundation are plotted in Figure 5 for a period of 60 seconds. The results show that under the stress levels imparted by the foundation vibrations, the structural fill deflects linearly according to the relationships defined by the shear modulus used in the linear-equivalent elastic model. After an initial peak strain, a deflection pattern is established and is consistent with time. This indicates no significant degradation of shear strength in the structural fill which could lead to larger displacements over time.

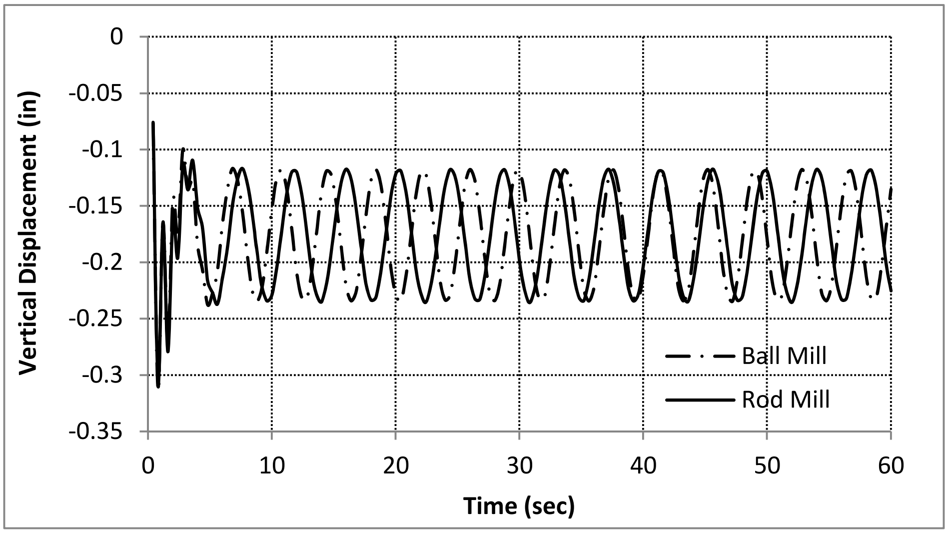


Figure 5: Soil Response to Dynamic Loading

The maximum vertical deflection for the ball and rod mill vibrations was estimated as 0.24 inches by the model. The magnitude of the maximum deflection is the same for both machine vibrations because the magnitude of the stresses were the same (7,000 psf). Only the frequency is different between the two loads. This deflection represents elastic deflection and not permanent settlement from static foundation loads which have already been addressed in the soils and foundation recommendation report.

Densification of the compacted structural fill from the foundation vibrations is not expected to occur as the structural fill is comprised of minus 24" waste rock and minus 3" waste rock that was systematically compacted using a method developed by the U.S. Army Corp of Engineers (EM1110-2-2301). Based on review of this method specification, it is reasonable to assume the material is adequately compacted to approximately 80% relative density. Deformations of the subgrade material resulting from the dynamic loading of the foundations are estimated to be minor (less than 1/4th of an inch).

Geomembrane Liner Response to Machine Vibration

Effects on the liner from the machine vibrations can be assessed by examining the vertical stresses and horizontal and vertical strains at the level of the geomembrane liner. The geomembrane liner is approximately 15 feet below the foundation bottom. A point 15 feet below the applied dynamic stress was examined within the equivalent-linear elastic model to estimate the stress and strain levels resulting from the machine vibrations. Figures 6, 7 and 8 show vertical stress, vertical strain and horizontal strain, respectively, occurring at the level of the geomembrane.

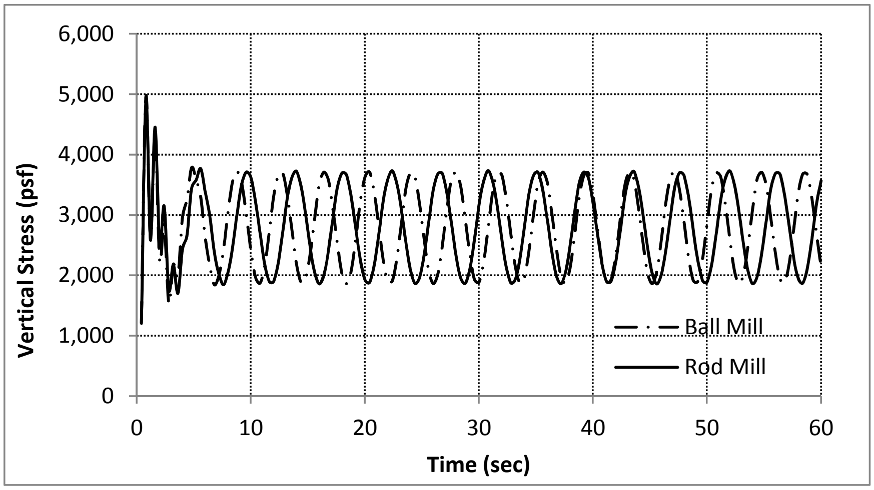


Figure 6: Verical Stress on geomembrane liner

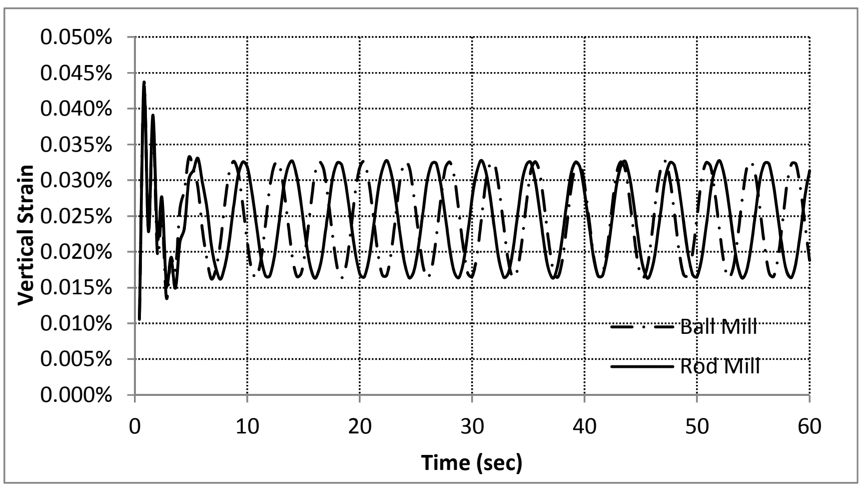


Figure 7: Vertical Strain on geomembrane liner

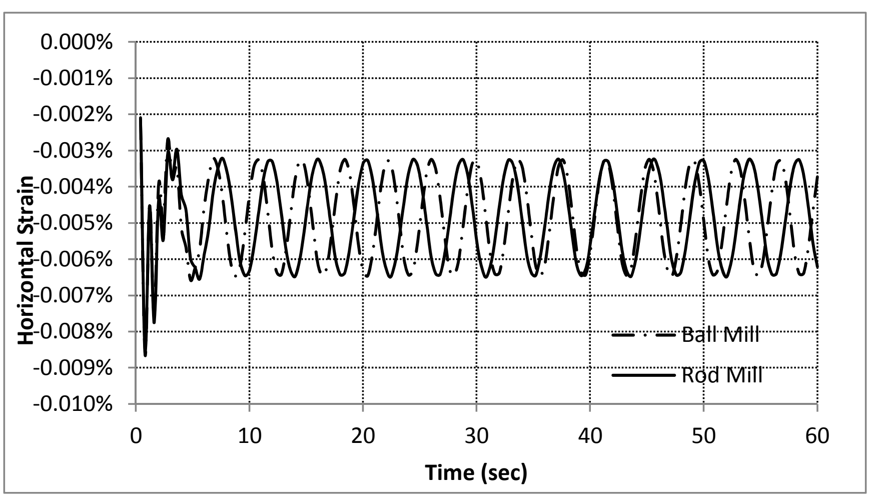


Figure 8: Horizontal Strain on geomembrane liner

The compatibility of a liner to the material in contact with it is commonly investigated in the laboratory with a puncture resistance test. The puncture resistance test places a 12" diameter sample of the liner between material representative of the overliner and underliner soils used in the field and subjects the system to normal stresses greater than or equal to the maximum normal stress expected from the overburden. A puncture resistance test was conducted on a sample of 80 mil high density polyethylene (HDPE) liner with an overliner material having a similar gradation to the material in contact with the liner under the mill platform foundations. Additionally, 10 to 12 rocks were hand placed directly on the liner to simulate worst-case conditions. A vertical stress of 122,400 psf was applied to the test specimen for 28 hours. Visual inspection and vacuum testing of the liner at the end of the test indicated that the liner did not have any defects (Golder, 2005).

The maximum repeated vertical stress on the liner resulting from the model was 3,300 psf, which is about 3% of the load applied during the puncture tests indicating that stress induced puncture will not occur. The liner used for the puncture resistance test was an 80 mil HDPE liner while the liner proposed for the design is an 80 mil linear low density polyethylene (LLDPE) liner. LLDPE liners have a lower elastic modulus and a larger allowable maximum strain making LLDPE liner more ductile compared to HDPE liners. The higher ductility of the LLDPE liner proposed will further enhance the compatibility with the soil in contact with the liner by deforming around the particles reducing the susceptibility of puncture.

The maximum repeated vertical and horizontal strains occurring on the liner was estimated from the model to be approximately 0.033% and -0.0065%, respectively. Negative strain values indicate elongation while positive strain values indicate compression. At strains this small, it can be assumed that the material would not be sliding along the liner causing wearing to occur, but rather be straining with the liner. This can be assumed because the stiffness (modulus) of the soil under the confining pressure associated with 15 feet of overburden combined with the additional vertical stress from the foundation is much greater than the stiffness (modulus) of the LLDPE geomembrane liner. The softer geomembrane liner would deform with the straining soil and the movement of soil particles relative to the liner would be zero.

Slope Stability Response to Machine Vibration

Slope stability in regards to the machine vibrations from the dynamic loads was evaluated qualitatively. The machine vibrations, while large, are typically smaller than the design earthquake of 0.14 times the force of gravity (g). Pseudostatic slope stability analyses were conducted as part of the design of the mill platform and resulted in acceptable factors of safety of 1.0 or greater. The acceleration imparted on the foundation soil from the machine vibrations was evaluated from the vertical displacements beneath the foundation estimated from the model (Figure 5). The vertical acceleration of the soil directly beneath the machine foundations was calculated as 0.003g. The pseudostatic evaluation subjects the slopes to a horizontal acceleration of 0.14g, several orders of magnitude greater than the ground acceleration produced from the mill vibrations, indicating that the machine vibrations will not affect slope stability.

The propagation of surface waves along the mill platform could cause shallow surface failures, or sloughing, to occur in the top 2 feet on the slopes surround the mill platform. Sloughing occurs because the dynamic forces from the machine vibration could be larger than the low confining stresses at shallow depths. Slope maintenance of the cosmetic sloughing failures may be required from time to time during operation of the mill. Deep failure surfaces are not expect to be an issue as the confining stresses increase with depth and therefore would require greater mobilization forces than expected from the machine vibrations.

AMEC appreciates the opportunity to provide continued engineering and construction support to Cripple Creek & Victor Gold Mining Company. If you have any questions or comments, please contact the undersigned at (303) 630-0784.

Sincerely,

AMEC Environment and Infrastructure

David M. Weidinger, PE.
Geotechnical Project Engineer

Jay. N. Janney-Moore, P.E.
Senior Project Engineer

JNM:dmw

References

Brumund, W. F., and Leonards, G. A., (1972). “Subsidence of Sand Due to Surface Vibration,” *Journal of the Soil Mechanics and Foundations,* ASCE, Vol. 98, No. SM1, pp. 27-42.

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