Thornton Tomasetti
Building Solutions

ONE VANDERBILT
NEW YORK, NY

STRUCTURAL PEER REVIEW REPORT
FOUNDATION PACKAGE

February 9, 2016

Prepared For

Hines – New York
499 Park Avenue, 12th Floor
New York. NY 10022

Prepared By

Thornton Tomasetti Inc.
51 Madison Avenue
New York, NY 10010-1603
Phone: 917.661.7800
Fax: 917.661.7801

TABLE OF CONTENTS

Thornton Tomasetti

A. EXECUTIVE SUMMARY

The following report contains a summary of Thornton Tomasetti's (TT) peer review of the foundation documents for the One Vanderbilt project located at 1 Vanderbilt Avenue, New York, NY. The peer review has been performed in accordance with the NYC 2014 Building Code Requirements. This peer review is based on design documents issuance No. 3 dated December 7, 2015.

This peer review report has evaluated the foundation elements based on foundation loads from the analysis of tower above provided by the Severud Associates, the Engineer of Record (EOR). This peer review report does not extend to elements outside the foundation design or documents as noted in Section D. A superstructure peer review will be completed as the superstructure design is competed. ds

1. *Confirm that the design loads conform to this code.*

   Thornton Tomasetti has reviewed the design loads for conformance with the NYC Building code loading requirements. The design dead, superimposed dead and live loads appear to be in conformance with the NYC Building Code.

   We have reviewed wind and seismic base shear based on 2014 NYC Building and based on the building geometry from an Architectural Revit model issued on December 9, 2015. Any discrepancies have been discussed and resolved with the EOR. A building of this height and massing requires a wind tunnel test to validate the wind loads on the building structure. A wind tunnel has been performed, and wind loads have been estimated from this wind tunnel using preliminary building stiffness properties. As a normal part of the design process, final building properties will be determined as the Tower design above is finalized, and a final wind tunnel report with final wind loads recommendations will be produced. We will peer review these final wind load recommendations with the superstructure peer review.

2. *Confirm that other structural design criteria and design assumptions conform to this code and are in accordance with general accepted engineering practice.*

   The structural design criteria and design assumptions appear to be in accordance with general engineering practice.

   As noted above the foundation loads are based upon a wind tunnel test combined with preliminary building properties which will be finalized upon completion of the tower design. We will peer review these final wind load recommendations with the superstructure peer review and amend this report as needed with any additional observations.

3. *Review geotechnical and other engineering investigations that are related to the foundation and structural design and confirm that the design properly incorporates the results and recommendations of the investigations.*

We have reviewed the geotechnical report produced by Langan Engineering, dated October 16, 2015, including supplemental information provided to us during the peer review process. The foundation documents appear consistent with these recommendations.

4. *Confirm that the structure has a complete load path.*

The foundation documents appear to have a complete load path for the design loads indicated. The load path of the tower above will be confirmed with the superstructure peer review.

5. *Perform Independent calculations for a representative fraction of systems, members and details to check their adequacy. The number of representative systems, members, and details verified shall be sufficient to form a basis for the review's conclusions.*

We have performed independent calculations for the design loads indicated, including footings, the mat design and bearing pressures, foundation walls and rock anchors. Any discrepancies have been discussed with the EOR and resolved accordingly.

6. *Verify that performance-specified structural components (such as certain precast concrete elements) have been appropriately specified and coordinated with the primary building structure.*

This item is not applicable to the foundation design documents. No performance-specified structural components are included as part of the foundation package.

7. *Confirm that the structural integrity provisions of the code are being followed.*

The foundation elements as indicated on the foundation documents do not contain elements subject to the integrity provisions of the code. The peer review of the tower above will address these items.

8. Review the structural and architectural plans for the building. Confirm that the structural plans are in general conformance with the architectural plans regarding *loads and other conditions that may affect the structural design.*

We have reviewed the foundation documents for the Tower size and massing obtained from BIM model issued on December 9, 2015. In addition, we have reviewed the architectural drawings of foundation issued on October 16, 2015 which is in general conformance with structural drawings regarding loads. The foundation design loads appear to be adequate for the imposed tower Loads from above.

As the tower design above the foundations is finalized, a peer review will be performed to confirm final loading, including final wind loads as recommended by the wind tunnel consultant. We will amend this report as needed with any additional observations.

9. *Confirm that major mechanical items are accommodated in the structural plans.*

The foundation elements as indicated on the foundation documents do not contain major mechanical items. We have performed representative column load takedowns with general assumptions for mechanical loads as indicated on the structural documents. The peer review of the tower above will address this item.

10. *Attest to the general completeness of the structural plans and specifications.*

The foundation documents peer reviewed for this report appear generally complete.

B. INTRODUCTION AND STRUCTURAL DESCRIPTION

1.0 INTRODUCTION

Thornton Tomasetti (TT) was retained by SL Green Realty Corporation to conduct a structural peer review for the One Vanderbilt Avenue project located in New York, NY.

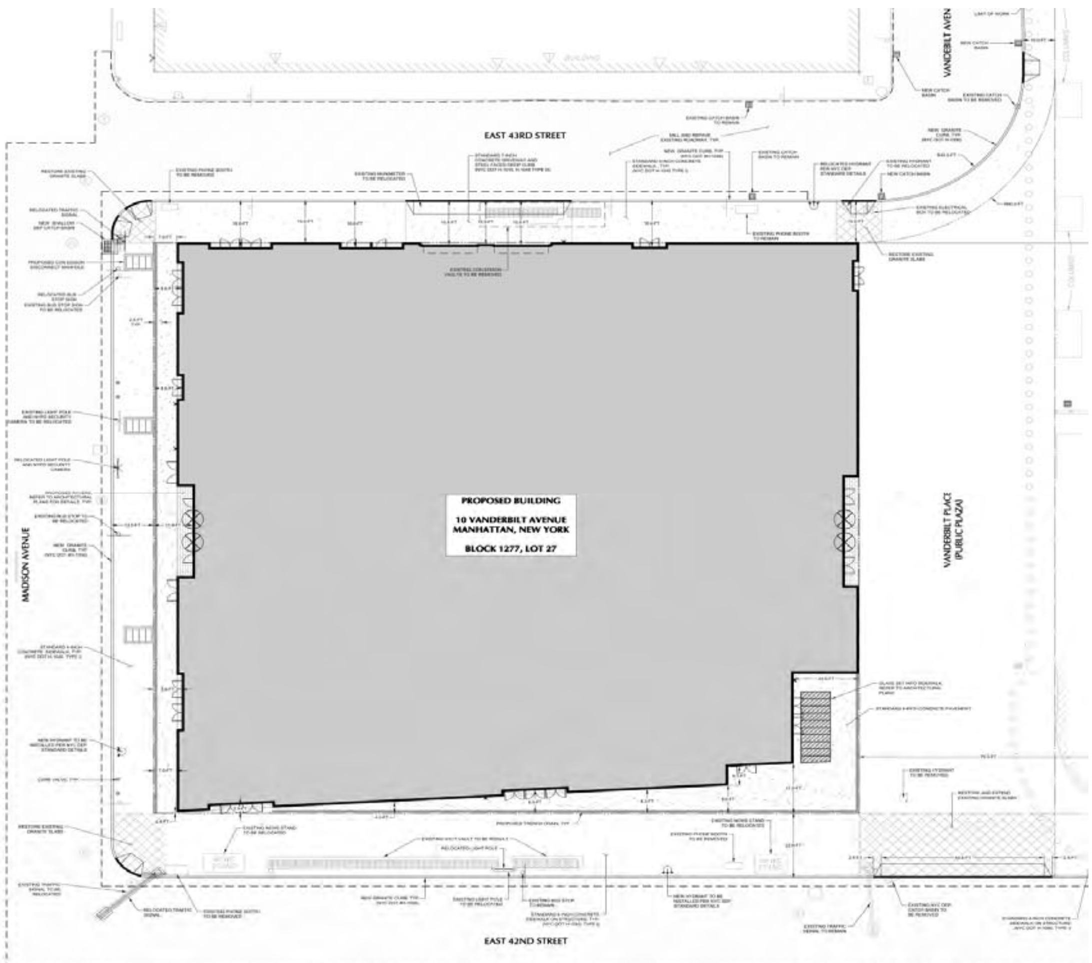


Figure 1. Site Map

The building is a 58-story high-rise office tower with a height of approximately 1,400 feet above grade, with 4 below-grade levels. Levels 1, 2, and 3 contain lobby and amenity spaces. Mechanical areas are located on Levels 4, 5, 12, 13, 36, 50, and 58.

The lot size is approximately 216 feet wide x 201 feet deep, with a tower that tapers to approximately 120 feet wide by 120 feet deep at the top occupiable floor.

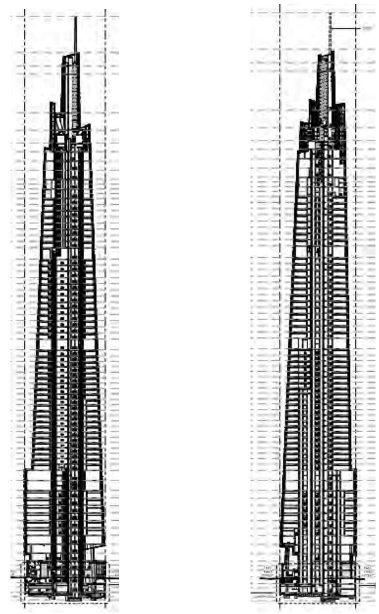


Figure 2. Building Sections

TT's role is to perform a peer review of the foundation system, which includes the overall building behavior. TT's review is based on the Foundation Permit Set Issuance 3 Architectural and Structural drawings dated December 7, 2015 prepared by Kohn Pederson Fox Associates (KPF) and Severud Associates Consulting Engineers respectively. TT also studied the structural design for compliance to the recommendations in the Geotechnical report by Langan dated November 20, 2014 and the Wind-Induced Structural Responses report by RWDI dated June 23, 2014.

In general for peer reviews, the reviewers provide different, complimentary services to advance the design of a building project. In this peer review report, the comments, suggestions and observations on the structural design performed to date are intended to assist the designers by providing another perspective.

TT's scope of work is as follows:

- Confirm that the design loads conform to the 2014 New York City Building Code.
- Confirm that other structural design criteria and design assumptions conform to the 2014 New York City Building Code and are in accordance with generally accepted engineering practice.
- Review geotechnical and other engineering investigations that are related to the foundation and structural design and confirm that the design properly incorporates the results and recommendations of the investigations.
- Review wind tunnel reports and confirm that the design properly incorporates the results and recommendations of the investigation.

- Confirm that the structure has a complete load path.
- Independently assess the structural responses and stability of the building under actions of lateral and gravity loads.
- Perform independent calculations for a representative fraction of systems, members, and details to check their adequacy. The number of representative systems, members, and details verified shall be sufficient to form a basis for TT's conclusions.
- Confirm that the structural integrity provisions of the 2014 New York City Building Code are being followed.
- Attest to the general completeness of the structural plans.
- Provide a written report that covers all aspects of the review performed, including conclusions reached by the reviewer.

2.0 STRUCTURAL SYSTEM DESCRIPTION

The lateral load resisting system is composed of a reinforced concrete shear wall core with steel truss outriggers. The outriggers are one story deep at the 36th, 50th, and 59th floors, and span between the concrete core roughly at the center of the floor plans and the perimeter steel columns. The upper and lower chords are comprised of built-up box beam members, while the diagonals are standard hot-rolled wide-flange shapes.

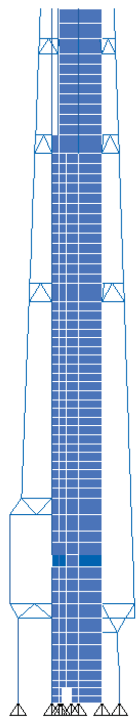


Figure 3. ETABS Image of Lateral System

In addition to the trusses described above acting as outirggers, there is a series of trusses on floors 5, 6, 12, and 13 that allow gravity loads to transfer where the buiding increases or decreases in width. These trusses are primarily gravity system elements, but they do contribute to the lateral system behavior as well.

The typical office floor construction is a 3” metal deck with an additional 2 1/2" of concrete, while mechanical floors and floors directly above the mechanical floors include a 4 ½” thick normal weight concrete topping over 3” metal deck. Steel framing supports the deck and spans between the concrete core and perimeter steel wide-flange columns.

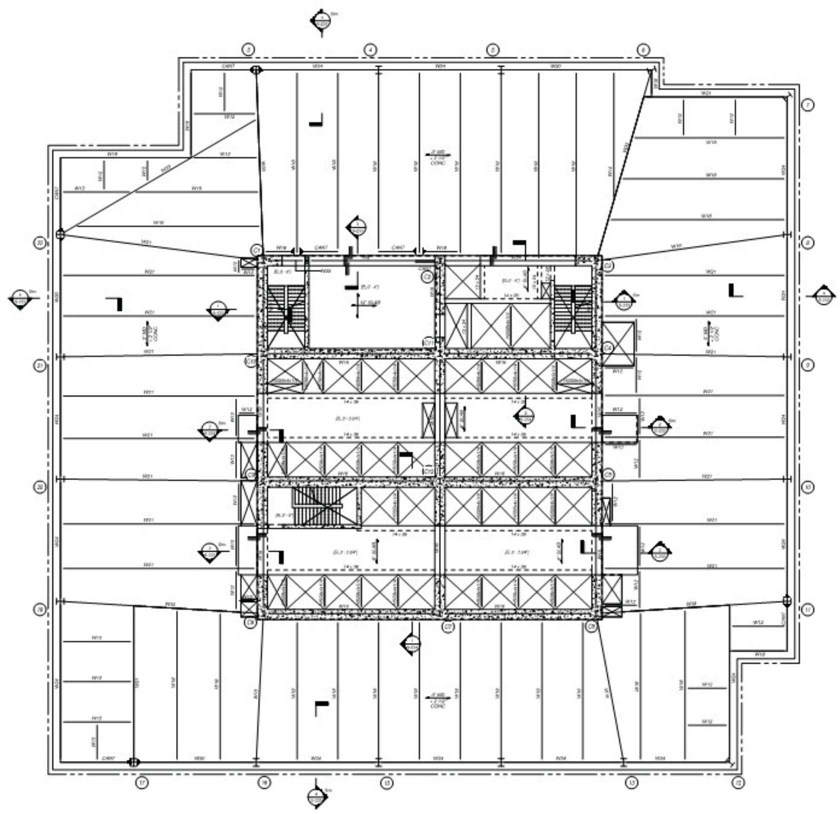


Figure 4. Typical Framing Plan

The foundation system consists of spread footings bearing on rock with an allowable bearing capacity of 60tsf. A 10-foot thick mat is set beneath the core, and individual spread footings support most of the perimeter columns. Foundation walls typically consist of 24” double-reinforced concrete walls.

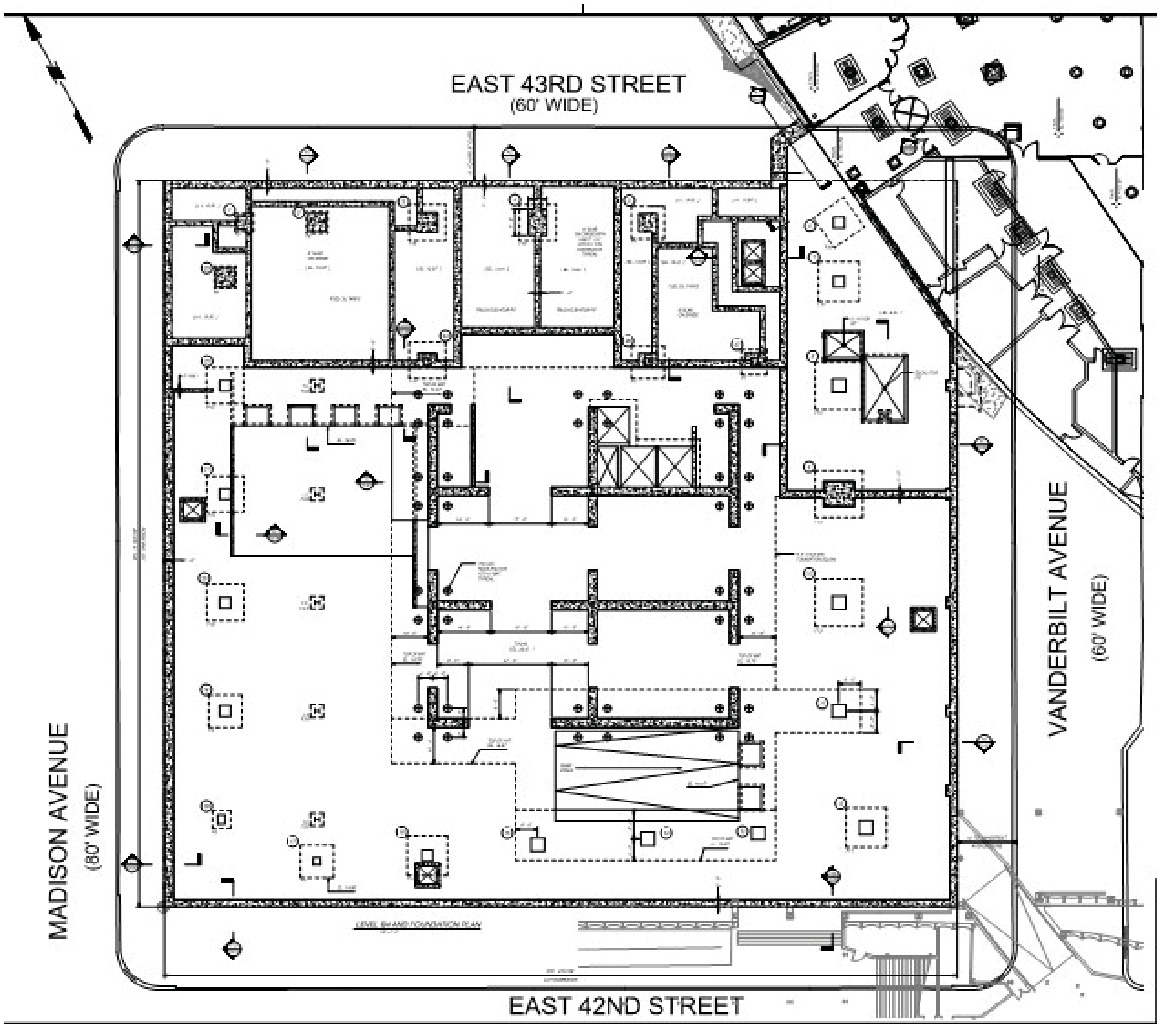


Figure 5. Typical Foundation Section

C. FINDINGS AND COMMENTS

1.0 BUILDING CODES

Based on the General Notes on S-701, and Loading Schedule on S-702, the structural design was conducted according to the following building codes:

- 2014 Edition of the New York City Building Code
- ASCE-7 (2010), Minimum Design Loads for Buildings and other Structures
- ASCE-7 (2005), Minimum Design Loads for Buildings and other Structures
- AISC 360 (2005), Specification for Structural Steel Buildings.
- ACI-318 (2011), Building code requirements for Reinforced Concrete
- AWS D1.1 (2004), Structural Welding Code
- ASTM Standards
- AISC Design Guide 11

The building codes listed on the Peer Review Set drawings are consistent and appropriate for this project.

2.0 MATERIAL PROPERTIES

The material properties noted in the General Notes on S.001.0 for the major structural elements are noted below.

Structural Steel:	ASTM A992 or ASTM A572, Grade 50
HSS Steel:	ASTM A500, Grade B
Footings and Foundation Mat:	10,000 psi
Piers and Buttresses:	10,000 psi
Foundation Walls	10,000 psi
Slabs On Grade	4,000 psi
Shear Walls – Foundation to 13th Floor	14,000 psi
Raised Slabs	4,000 psi
Concrete on Metal Deck	4,000 psi
Bar Reinforcing	ASTM A 615, Grade 60

3.0 STRUCTURAL LOADING

3.1 GRAVITY LOADS

The gravity loading consists of the member self-weight, the superimposed dead load (floor finish, partitions, ceiling & hung mechanical), and live load. The Gravity Design Loads are shown in the Loading Schedule on S-702 of the 100% SD structural drawings. The following tables summarize the types of dead loads and live loads used, as well as TT comments.

Table 1. Dead Loads per S-702

SLAB CONSTRUCTION	LOAD (PSF)	TT COMMENTS
6" NWC SLAB	75	
CONCRETE RISERS*	130	
TYPE 1	55	2 1/2" NWC on 3" DECK (TYP.)
TYPE 2	80	4 1/2" NWC on 3" DECK (TYP.)
TYPE 3	80	4 1/2" NWC on 3" DECK (TYP.)
TYPE 4	80	4 1/2" NWC on 3" DECK (TYP.)
18" NWC SLAB	225	
24" NWC SLAB	300	

Table 2. Live Loads per S-702

AREA	LIVE LOAD (PSF)	TT COMMENTS
Core	100	Treat as Lobby Space
Core - Stairs	100	Per Code
Typical - Mechanical	150	75 Req'd for Equipment Rooms
Elevator Machine Room	75+*	
Core- Freight Elevator Vestibule	100	Treat as a Lobby Space
Core - Mer	100	75 Req'd for Equipment Rooms
Core - Passenger Elevator Lobby	100	Treat as a Lobby Space
Core - Toilet Rooms	100	Same as Floor Load
Terrace	100	Roof for Promenade Purposes
Typical - Office	50	Office Load Eplicitly Addressed in Code
Core - Elevator Machine Room	75+*	Treat as an equipment rooms
Core - Back of House	100	Conservative estimation, Engineering Judgement
Temporary Construction Loading - Staging Area	250	Equivalent to "Heavy Storage Warehouses" - Reasonable
Temporary Construction Loading - Truck Areas	600	Typical Construction Surcharge Load
Typical - Amenity	100	Reasonably Conservative for this Stage - Recheck as design progresses
Typical - Dock Master	100	Not addressed in Code, reasonable assumption
Typical - Messenger Center	100	Not addressed in Code, reasonable assumption
Typical - Office Lobby	100	Office Lobby Load Eplicitly Addressed in Code
Typical - Retail	100	Retail Load Explicitly Addressed in Code
Typical - Subway Entrance	100	Treat as a Lobby Space
Typical - Transit Hall	100	
Core - Circulation	100	Treat as a Lobby Space

Typical - Toilet Rooms	50	Assumed same as floor load
Roof - Glass	40	20 psf requirred for Roofs
Roof - Slab	100	20 psf requirred for Roofs
BMU-1	100	75 Req'd for Equipment Rooms
BMU-2	100	75 Req'd for Equipment Rooms
BMU-3	100	75 Req'd for Equipment Rooms
Top Of Building	40	
Typical - Trading Floor	100	
B1 (Cellar) East	100	
B1 (Cellar) Northwest	100	
B1 (Cellar) West	100	
Shuttle Platform	100	

*+ Sheave Beam Reactions

TT found the Gravity loads to be acceptable and in conformance with the NYC Building Code 2014.

3.2 WIND LOADS

The wind loads for the foundation design are based on the following parameters per ASCE 7-05 and the New York City Building Code:

Design Wind Speed, V	100mph
Occupancy Category	II
Wind Exposure	A
Importance Factor	1.00

These parameters are relevant for the equivalent lateral force procedure, and were relevant at the beginning of the project where the 2008 New York City Building Code governed. Since the update to the 2014 New York City Building Code, TT finds that the following parameters are required to be used for the equivalent lateral force method.

Design Wind Speed, V	98mph
Occupancy Category	III
Wind Exposure	B
Importance Factor	1.15

The wind loads under the 2008 NYC Building Code were verified as conservative with the wind tunnel testing conducted by RWDI. Their findings and recommendations were issued in a report dated 6/23/2014.

The wind tunnel report provides Effective Static Floor-by-Floor Wind loads for Fx, Fy and Mz. In turn, these loads were used in TT's analysis with the load factors given in 24 load combinations. These loads were applied per the ASCE7-05 load combinations.d

3.3 SEISMIC LOADS

The General Notes indicate that the seismic loads are in compliance with Chapter 16 of the NYC Building Code using the following seismic parameters:

Table 3. Seismic Parameters

Seismic Parameters per 2014 NYC Code		
Parameter	**Value**	**Reference**
Occupancy Category	III	Table 1604.5
Importance Factor, Ie	1.15	Table 11.5.1
Ss	0.281g	1613.5.1
S1	0.073g	1613.5.1
Site Class	B	Per Geotech
Fa	1.0	Table 1613.5.3(1)
Fv	1.0	Table 1613.5.3(2)
Sms	0.281g	Section 1613.5.3
Sm1	0.073g	Section 1612.5.3
Sds	0.187g	Section 1612.5.4
Sd1	0.049g	Section 1612.5.4
Design Category	B	Table 1616..5.6
Seismic Force Resisting System	Ordinary Reinforced Concrete Shear Walls	
Response Mod., R	4.0	Table 12.2-1, ASCE 7-10
Deflection Amp., Cd	4.0	Table 12.2-1, ASCE 7-10
Approx. Fundamental Period, Ta	2.00s	Eq. 12.8-7 ASCE 7-10
Fund. Period, T	3.40s	Not Listed
Seismic Weight, W	Not Provided	
Base Shear, V	Not Provided	Section 11.7.2

TT found that these parameters are consistent with the NYC Building Code and ASCE 7-10. Additionally TT has performed an independent analysis of the seismic loads, and found the Seismic Weight to be approximately 440,000k, and the seismic base shear to be approximately 4,600k.

3.4 LOAD COMBINATIONS

The following load combinations in accordance with the NYCBC 2014 have been used to verify members' strength and service design.

Ultimate (Strength) Design
1.4D
1.2D+1.6L+0.5(Lr or S or R)
1.2D+1.6(Lr or S or R)+(f_1L or 0.8W)
1.2D+1.6W+f_1L+0.5(Lr or S or R)
1.2D+1.0E+f_1L+f_2S
0.9D+1.6W
0.9D+1.0E

The load factor on L in combinations 3,4 and 5 is permitted to equal 0.5 for all occupancies in which Live load is less than or equal to 100 psf.

Allowable Stress (Service) Design
D
D+L
D+L+(Lr or S or R)
D+0.75L+0.75(Lr or S or R)
D+(0.6W or 0.7E)
D+0.75L+0.75(0.6W)+0.75(Lr or S or R)
D+0.75L+0.75(0.7E)+0.75S
0.6D+0.6W
0.6D+0.7E

4.0 GEOTECHNICAL REPORT REVIEW

TT reviewed the Geotechnical Engineering Study for One Vanderbilt Avenue prepared by Langan and dated October 16, 2015.

TT has the following comments:

1. A subgrade modulus of 1000 pci was utilized in analysis model of the core mat foundation. This value is not in the report but was communicated through correspondence (see Appendix, page 1, email item 1).

2. The Langan report specifies that an allowable bearing capacity of 120 ksf should be used for foundation checks but that a higher bearing capacity can be used when footings are embedded into rock. Subsequent correspondence with Langan (see Appendix, page 1, email

item 4) verifies that a 10% increase in bearing capacity for each foot of embedment is acceptable.

3. Langan report specifies that friction between the mat and subgrade should be neglected if a waterproofing membrane and mud slab are installed. Subsequent Langan correspondence (see Appendix, page 1, email item 5) states that minimal sliding resistance due to friction (5000 kips) when a waterproofing membrane and mud slab are installed and that passive side bearing resistance (9400 kips) is achievable for the current foundation scheme. TT calculated wind base shears were typically on the order of 7000 kips which results in a factor of safety against sliding over 2.0. Therefore, TT confirms the tower foundation satisfies a sliding stability check.

4. Langan confirms that surcharge loading diagram as specified in the report has been amended and that loading diagrams as provided by Severud (EOR) for typical basement wall sections are appropriate for design (see Appendix, page 1, email item 2).

5.0 MEMBER DESIGN CHECK

5.1 MAT FOUNDATION

The core wall of One Vanderbilt is supported on a reinforced concrete mat foundation. In a few locations the reinforced concrete mat extends out to support isolated tower columns. The mat varies in thickness between 8'-9.5' typical, with thicker zones that grow up to 13'-6" at mat steps and 24'-2" at elevator pits.

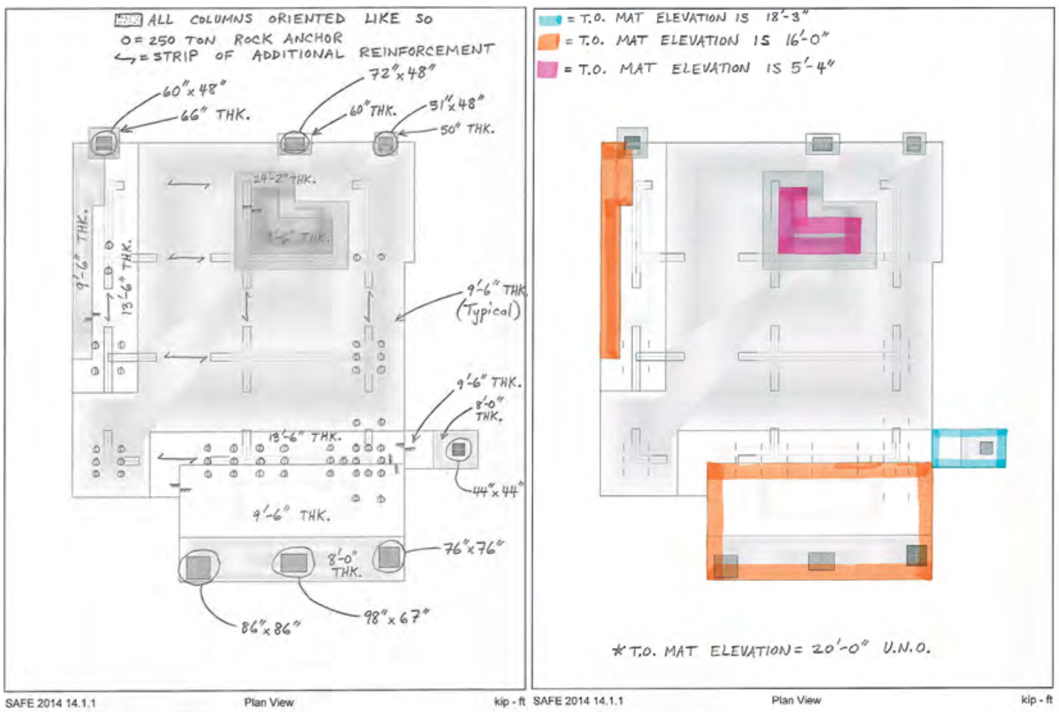
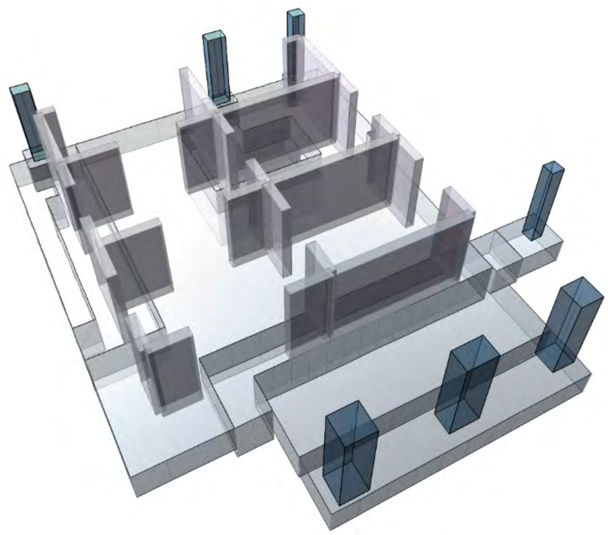


Figure 10. TT Foundation Mat SAFE Model Geometry

Diagrams above show the TT SAFE analysis model that was developed to check Severud (EOR) foundation design with the assumed extents of varied mat thicknesses and assumed top of mat elevations. Tower column and wall loads were applied on a SAFE model that took into account stiff bearing of walls and columns above by applying point loads at the top of double story height walls and columns.



An isometric view of the SAFE model used for analysis with extruded tower columns and walls for loading is shown. Additionally, tower and column loads were provided by Severud (EOR) for foundation design checks in a load diagram issued on 1/8/2016. The tower load diagram included service dead, live, and wind x and wind y loads. TT used these loads to conduct the appropriate service and ultimate foundation design load combination checks.

Figure 11. TT SAFE Model

Figure 12. Severud (EOR) Provided Tower Loads (Service DL, LL, WindX, WindY)

5.1.1 MAT BEARING AND ROCK ANCHOR CAPACITY CHECKS

Using a 1000 pci subgrade modulus for compression of the rock subgrade under the mat and a rock anchor stiffness derived for a 3”Φ high strength steel rock anchor rod, TT checked the design for appropriate service cases per ASCE 7.

TT reviewed the enveloped maximum bearing pressures over the extent of the mat for all the appropriate service load combinations. The maximum bearing pressures underneath the mat were typically around 40 ksf with pressure concentrations up to 90 ksf in one isolated location. These maximum pressures are well below the allowable capacity of 120 ksf (see diagram in psf below).

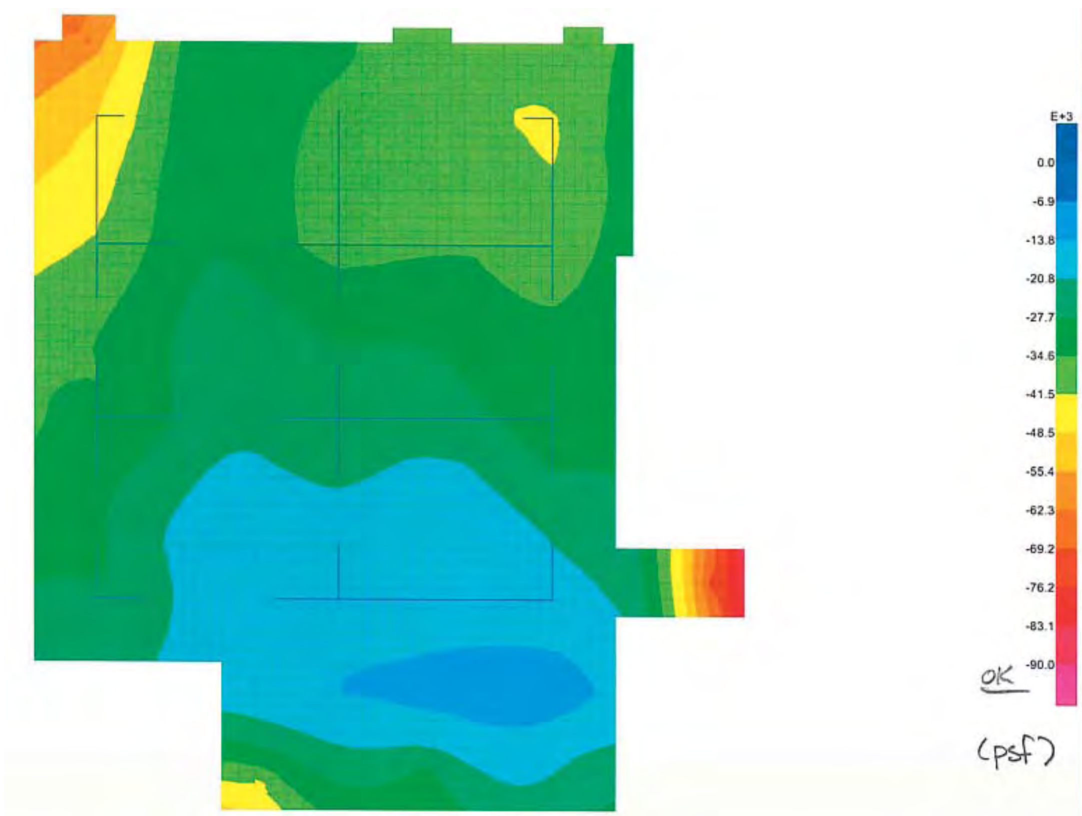


Figure 13. TT SAFE Model Enveloped Bearing Pressures (psf)

5.1.2 MAT SHEAR CHECK

The reinforced concrete mat thickness was verified by checking one-way shear in the mat under a typical line of core wall. Assuming the core wall could reach full axial capacity (see ACI section 14.5.2) and taking into account the amount wall load that goes into direct bearing underneath the core wall, a one-way shear check was conducted. The shear check confirmed that a 9'-6" thick reinforced concrete mat typically is sufficient (see Appendix page 2).

5.1.3 MAT FLEXURE CHECK

The mat flexure was checked by calculating the mat flexural capacity over strip widths defined by primary core wall lines in plan. Additional rebar specified on the Severud (EOR) drawings along these lines is understood to extend to the edges of the mat. Bottom and top moment flexural reinforcement demands and capacities were calculated for each design strip and the results of these checks are included in the following images. Locations where Demand-Capacity Ratios (DCR) exceed 100% for flexural reinforcement (section is over-stressed) are identified in the plans. Some additional notes are included on diagrams to confirm design is acceptable in some conditions (for example continuous shear walls above that stiffen the mat). TT calculations still point out a few locations where the mat is over-stressed (see figures 14-17).

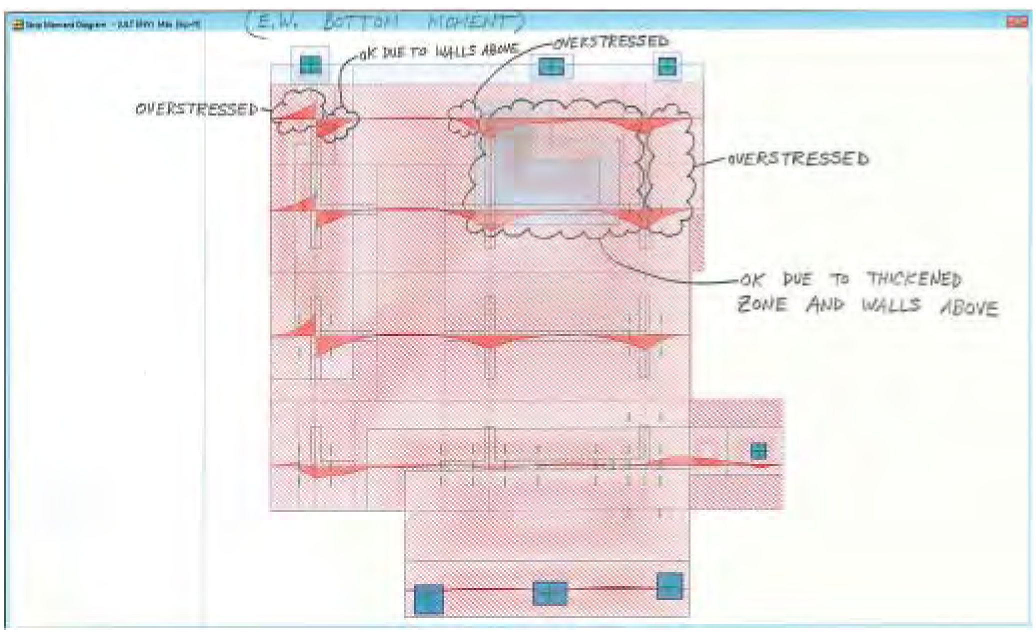


Figure 14. TT SAFE Flexure Check X-direction, Bottom Rebar (4 locations)

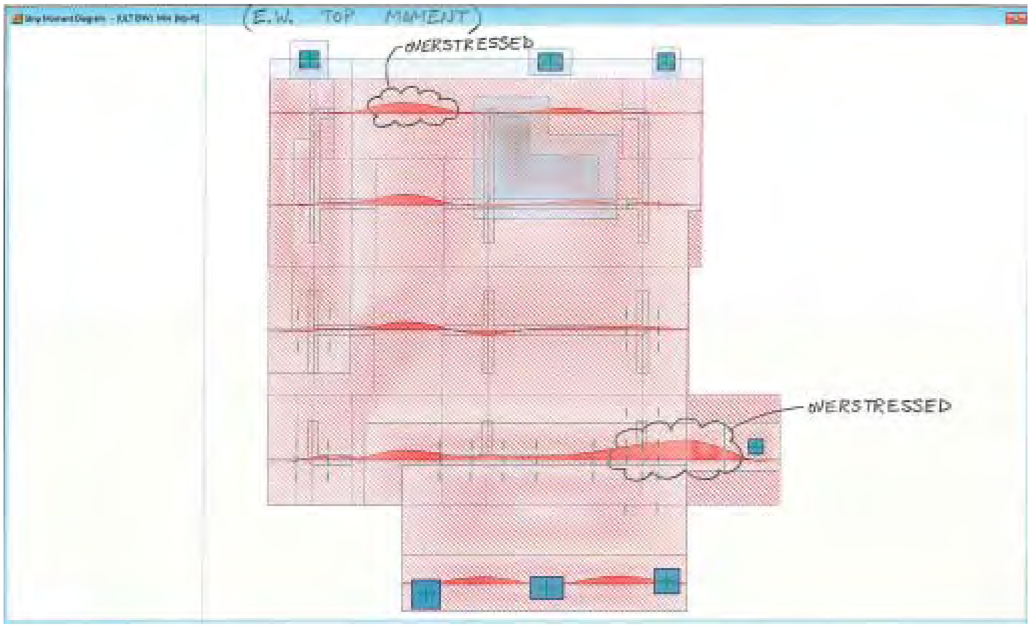


Figure 15. TT SAFE Flexure Check X-direction, Top Rebar (2 locations)

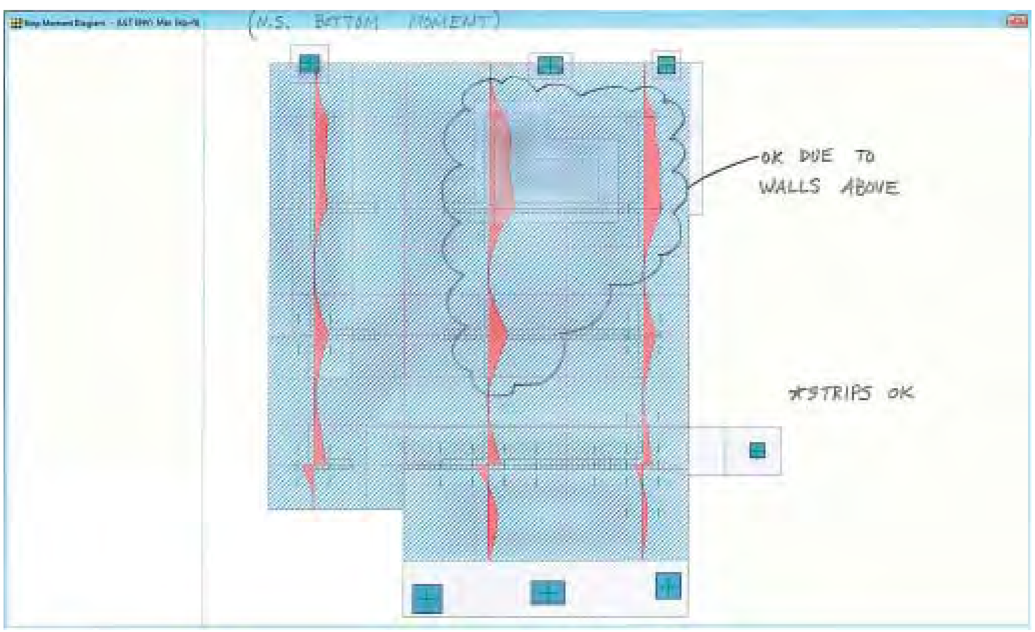


Figure 16. TT SAFE Flexure Check Y-direction, Bottom Rebar (OK)

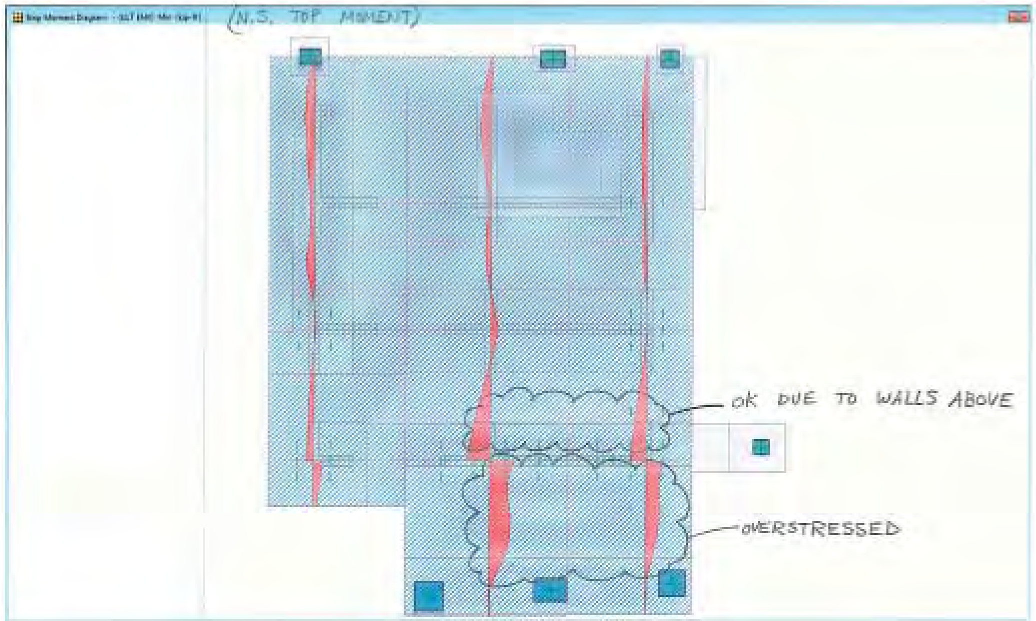


Figure 17. TT SAFE Flexure Check Y-direction, Top Rebar (2 locations)

5.1.4 SETTLEMENT

The geotechnical report estimates a maximum mat settlement of 1/2” to 3/4”.

TT reviewed the short-term settlement of the mat due to dead load and live load, using the mat and pile spring properties described earlier. TT obtained settlements of 1/2” which is in line with Langan predicted values.

5.2 SPREAD FOOTINGS

Tower Column Spread footings were checked as isolated footings with an allowable bearing capacity of 120 ksf. Spread footing designs were found to be generally acceptable. In areas where slightly higher bearing pressures were realized in the calculations, additional bearing capacity can be enhanced based on recommendations from Langan (see Appendix, page 1, email item 4). Spread footing design checks for all isolated tower column footings are included in Appendix (see Appendix, pages 3-22).

5.3 FOUNDATION WALLS

Severud (EOR) provided basement wall criteria sheet for each primary wall system along the basement perimeter (South, West, North, and East). TT reviewed the design of the four primary basement wall sections along each side of the building.

The results of TT design checks are as follows:

1. South Wall general basement wall section design is acceptable (see Appendix, page 23).

2. West Wall design is slightly over-stressed in two locations but once the surcharge is adjusted to revised loading profile, TT confirms the design is acceptable (see Appendix, page 24).

3. North Wall design as provided by Severud (EOR) is acceptable based on adjusted loading diagram approved by Langan (see Appendix, pages 25-26).

4. East Wall general basement wall section design is acceptable (see Appendix, page 27).

5.4 ROCK ANCHORS

Using a 1000 pci subgrade modulus for compression of the rock subgrade under the mat and a rock anchor stiffness derived for a 3”Φ high strength steel rod, TT checked the design for appropriate service cases per ASCE 7. The maximum force in any of the rock anchors was found to be 470 kips which is below the 500 kip allowable capacity (see Appendix, page 28). Subsequent information provided by Langan in correspondence (see Appendix, page 1, email item 3 and pages 29-30) demonstrates that group effects were considered in calculation of rock anchor embedment capacity and that bond length and free length specified is appropriate.

Additionally, TT provided a group check of anchor rod embedment into the foundation mat. The embedment check confirmed that the anchor rod embedment shown in the mat was generally acceptable (see Appendix, page 31).

5.5 SHEAR WALLS

For review of the shear wall design, TT used the Shear Wall Design module in ETABS and extracted the required reinforcement area for each pier. These values were compared to the provided reinforcement shown in the shear wall schedules on drawings S.221.0~236.0. Overall, the horizontal reinforcement in the shear walls was found to be acceptable with some exceptions noted below. For some regions along the height, TT found that the vertical reinforcement was not sufficient.

5.6 COLUMNS

While reviewing the rebar provided in the columns based on the schedules in the drawings, TT found that a majority of the columns do not have a minimum area of longitudinal reinforcement as per ACI318 Section 10.9.1. The ACI code states "area of longitudinal reinforcement, Ast, for non-composite compression members shall not be less than 0.01Ag or more than 0.08Ag." The ACI318 code commentary, in the ACI Committee 105 report minimum reinforcement ratios of 0.01 and 0.005 were recommended for spiral and tied columns, respectively.

TT checked the axial capacity of the columns for the longitudinal reinforcement shown in the schedules and found all column reinforcement was sufficient for the axial forces. Please note this design check was done without considering moments in the columns.

In reality, the columns may take some lateral forces as load is distributed from the walls, through the slabs, and into the columns. However, the EOR's approach is that the structure will behave in accordance to the fact that the loads will remain or redistribute to the shear walls.

A few typical column designs were spot-checked for both axial load and moment and the current design was found to be acceptable.

D. DOCUMENTS RECEIVED

TT used as a basis of this review the Architectural drawings, Structural drawings, and reports listed below. In addition, a drawing list of the structural foundation permit drawings is included in the appendix.

Table 4. List of Documents Received

	Document Name	By	Date	Received
1	Geotechnical Evaluation	Langan	11/20/2014	05/05/2015
2	Wind Tunnel Testing	RWDI	06/23/2014	01/15/2015
3	Structural Foundation Permit Drawings – Issuance 3	Severud	12/07/2015	12/09/2015
4	Architectural Foundation Permit Drawings – Issuance 3	KPF	12/07/2015	12/09/2015
5	Structural 100% SD Drawings	Severud	08/14/2015	08/14/2015
6	Architectural 100% SD Drawings	KPF	08/14/2015	08/14/2015

APPENDIX 1

Viise, John

From:	Arthur Alzamora <aalzamora@Langan.com>
Sent:	Friday, February 05, 2016 3:51 PM
To:	Farimani, Reza; O'Reilly, Daniel
Cc:	Viise, John; Daniel Surrett; Heinze, Douglas; Ghate, Sai; Seth Martin; Gutmann, Jim; DePaola, Ed; Squarzini, Michael
Subject:	RE: TT Foundation review comments
Attachments:	Tie-down Anchor Calcs - Cone Pull-out Failure Mode.pdf
Importance:	High

Hello Reza and Daniel,

It was nice to speak with you yesterday. We have provided responses below to your comments on the Langan related items.

1. Langan takes no exception to the use of a subgrade modulus of 1,000 pci. We provided this value to Severud during foundation design.
2. Langan and Severud agreed on a lateral pressure from surcharge loading as an inverted triangular distribution starting at 300 psf at the surface and decreasing to 0 psf at 15 feet below grade. The surcharge loading extents at grade are assumed to be limited and therefore dissipates with depth.
3. Langan analyzed the tie-down anchors geotechnical capacity based on an individual anchor capacity and a global cone pull-out failure mode, which accounts for the tensile strength of the rock and the weight of the cone. See attached excerpt from our analysis. We also note that the project specifications are written so that the contractor's engineer must submit shop drawings and calculations for their anchor design.
4. The 2014 NYC Building Code allows a 10 percent increase in the allowable bearing capacity of rock for each foot of embedment. This is summarized in our geotechnical engineering study. Based on the footing embedment in Class 1a rock is sufficient to justify an 8 percent increase in the allowable bearing capacity of the rock.
5. Langan assessed the mat's lateral resistance based on the passive resistance (embedment in the rock) in the rock mass and minimal frictional resistance. We estimate the passive resistance of the rock mass is about 9,400 kips. We note that a frictional coefficient of 0.02 (less than 10 percent of typical values for rock-concrete interfaces) below the mat would provide an additional sliding resistance of about 5,000 kips. The combination of passive resistance along the sides of the mat plus minimal friction below the mat would provide adequate lateral resistance at the base of the mat.

Please let us know if you have any other comments or questions. Have a great weekend!

Arthur J. Alzamora, Jr., PE, LEED AP
Senior Associate/VP
Direct: 212.479.5442
Mobile: 917.912.4832
File Sharing Link

LANGAN
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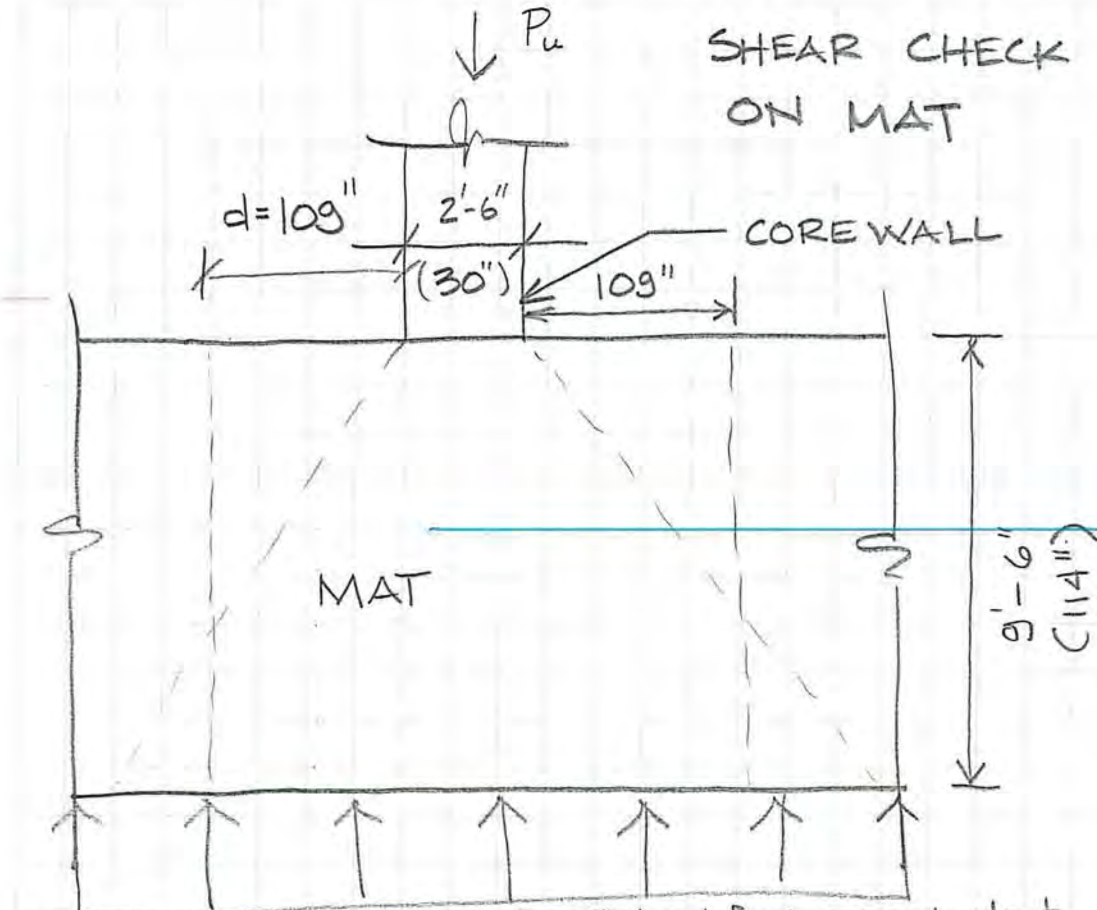
PROJECT ONE VANDERBILT	PROJECT NO.	DATE 2/5/16	
	BY JRV	SHEET	of
SUBJECT FOUNDATION PEER REVIEW	CHECKED BY	DRAWING NO.	

SHEAR CHECK ON MAT



Serv. pressure → P (≈1.3) load factor equivalent

ASSUME $P_u = \phi P_n$ (shear wall) $= 0.55\phi f'_c A_w$

$= 0.55(0.65)(10ksi)(30")(12") = 1287$ K/'

$35ksf(1.3)\left(\frac{109(2)+30}{12}\right)(1) = 940K/'$

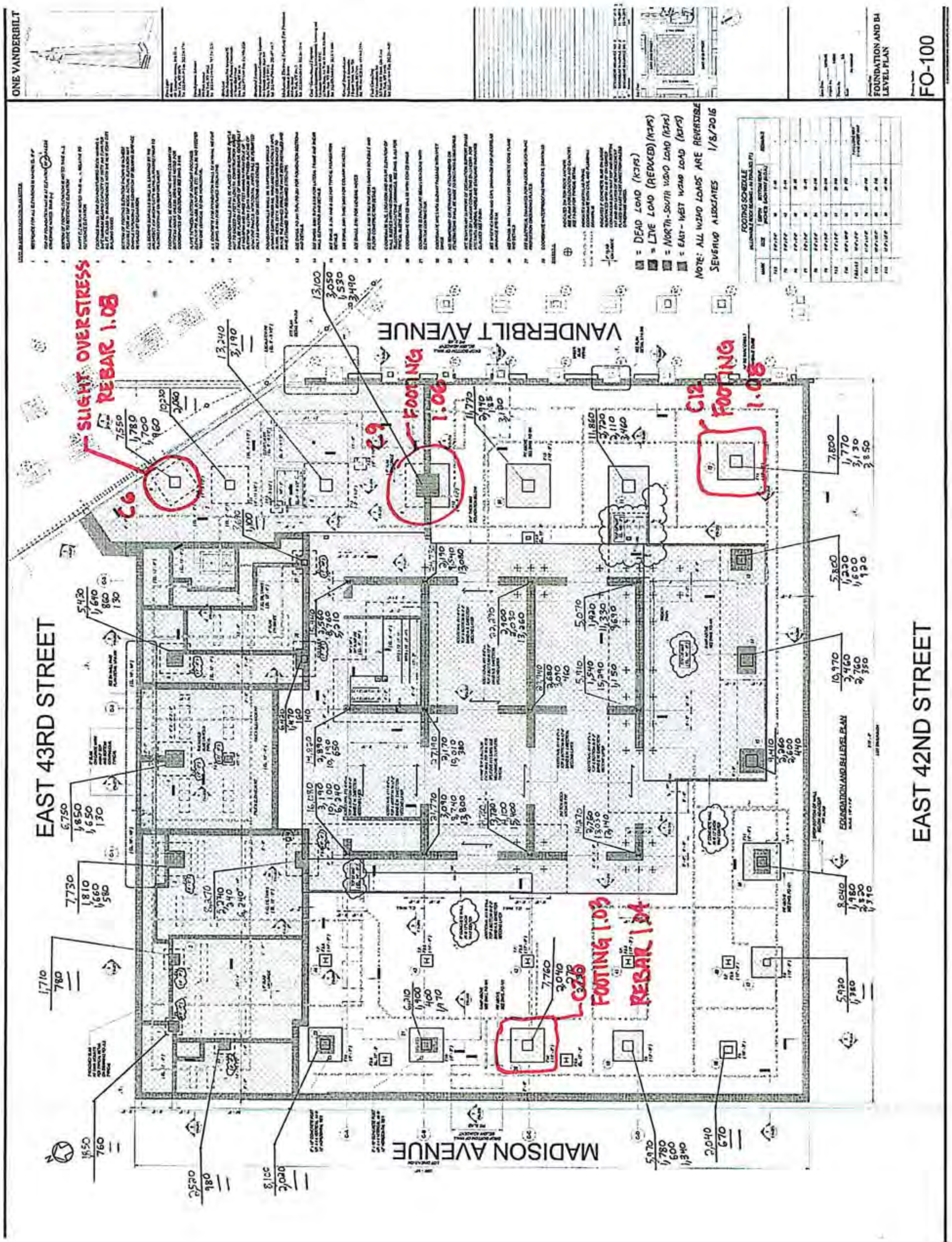
$1287 - 940 = \frac{347 K/'}{2}$ ← ONE WAY SHEAR

$\phi V_c = 0.75(2)\frac{\sqrt{10000}}{1000}(109")(12") = 196^K > \frac{347}{2} = 173^K$

O.K.

THIS CHECK ASSUMES WALL DEVELOPED TO FULL CAPACITY W/O STIRRUPS OR COMPRESSION STEEL. NO DETAILS FOR WALL PROVIDED.

APPENDIX 3

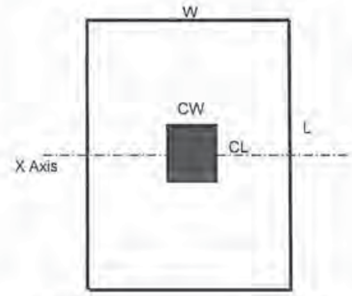

ONE VANDERBILT
FOUNDATION AND B4 LEVEL PLAN
FO-100
EAST 43RD STREET
EAST 42ND STREET
MADISON AVENUE
VANDERBILT AVENUE
SLIGHT OVERSTRESS REBAR 1.08
C6
C9
FOOTING 1.06
C12
FOOTING 1.08
C26
FOOTING 1.03
REBAR 1.04
= DEAD LOAD (KIPS)
= LIVE LOAD (REDUCED) (KIPS)
= NORTH-SOUTH WIND LOAD (KIPS)
= EAST-WEST WIND LOAD (KIPS)
NOTE: ALL WIND LOADS ARE REVERSIBLE
SEVERUD ASSOCIATES 1/8/2016

Footing Size and Thickness Calculation based on Shear Considerations and true soil pressure... Enter Yellow Values

C1

P live load	760 K	LL Factor	1.6	
P dead load	1850 K	DL Factor	1.2	
Mll about X axis	K-ft	WL Factor	1.6	
Mdl about X axis	K-ft	Shear Fact	0.75	
Mwl about X axis	K-ft (Moment caused by Wind load)			
CW=Width of Col	38 Inches			
CL=Depth of Col	38 Inches			
q allowable	120 Ksf (compare to E24)			
W = Footing Width used	5 Ft	(X direction)		
L = Footing Length used	5 Ft	(Y direction)		
f'c	10000 Psi			
fy	60 Ksi			
Est. Ftg thickness	42 Inches	(d shown below)		
Include Ftg weight	y (Y or N)			

Bar	Ld	Area
3	9.00	0.11
4	12.00	0.2
5	15.00	0.31
6	18.00	0.44
7	26.25	0.6
8	30.00	0.79
9	33.84	1
10	38.10	1.27
11	42.30	1.57



Short Rebars run along the Width and carry the short moment.

Long Rebars run along the length and carry the long moment.

Ftg Weight=	12.69	K (included in qs)
Pa=	2610.00	K without ftg weight
Pu=	3436.00	K without ftg weight
Mu X axis=	0	K-ft
Actual max soil pressure qs =	**104.91**	**Ksf OK**
Actual min soil pressure qs =	104.91	Ksf includes ftg weight
Ultimate max soil pressure qu =	138.05	Ksf without ftg weight
Ultimate min soil pressure qu =	138.05	Ksf without ftg weight
d =	38	inches (assume thickness-4 inches)

Footing Two Way Shear Calculation (Uses avg. ult. soil pressure)

Pu=	3436	K (same as previously calculated)
Average qu=	138.049	Ksf
Vu=	-2101.30	K
Vn=	-2801.73	K
bo=	304	(Inches: perimeter around column, d/2 away)
β	1	
Vc=	4620.80	K **OK**

Footing One Way Shear Calc - Long Direction-(Uses true ult. soil pressure profile)

b=	60	Inches (same as footing width)		
cs-e=	-2.25	Ft: (Distance: from crit. section to edge of footing)	-27.00	Inches
quc=	138.05	Ksf: qu at critical section (d from face of column)	0.958674	Ksi
Vu Component 1:	-1553.051			
Vu Component 2:	0			
Vu=	-1553.05	K		
Vn=	-2070.74	K		
Vc=	456.00	K **OK**		

Short Moment Calculations

Face of Col to Edge of Footing:	0.92 Ft	11.00 Inches	
Footing Mu Short=	**290.00 K-Ft**	Uses Average ultimate soil pressure	**3479.99 K-in**
Required for moment As=	1.70 Sq-Inches		
Minimum As=	4.54 Sq-Inches		
Use=	**4.54 Sq-Inches**		
As in Mid Band=	**4.54 Sq-Inches**		
Short Rebar used	9	Ld Reqd **33.84** Ld Available 8.00	
Number of Rebars	8	Average Spacing 7.7143 inches	Maximum Spacing is 18"
Total As provided=	8.000 Sq-Inches	This can be used to reduce Ld by the ratio of (As prov/As Reqd)	
Min. # of Rebars Req'd in Mid Band:	5		

As prov/As reqd 1.764
Reduced Ld 19.19

Long Moment Calculations

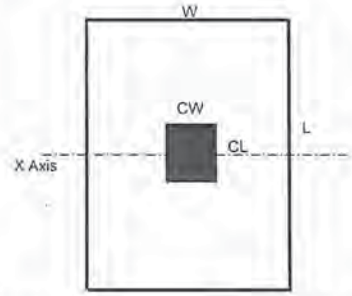
Face of Column to edge of footing	0.92 Ft	11.00 Inches	
qu at face of col:	138.05 Ksf	(ultimate soil pressure at face of column)	0.958674 Ksi
Moment Force Component 1:	632.72 K	(based on rectangular area)	
Moment Force Component 2:	0.00 K	(based on triangular area)	
Moment Arm 1:	0.46 Ft		
Moment Arm 2:	0.61 Ft		
Footing Mu Long=	**290.00 K-Ft**	Uses true ultimate soil pressure profile	**3479.99 K-in**
Required As=	1.70 Sq-Inches		
Minimum As=	4.54 Sq-Inches		
Use=	**4.54 Sq-Inches**		
Long Rebar used	9	Ld Reqd **33.84** Ld Available 8.00	
Number of Rebars	8	Average Spacing 7.7143 inches	Maximum Spacing is 18"
Total As provided=	8.000 Sq-Inches	This can be used to reduce Ld by the ratio of (As prov/As Reqd)	

As prov/As reqd 1.764
Reduced Ld 19.19

Footing Size and Thickness Calculation based on Shear Considerations and true soil pressure... Enter Yellow Values

C2

P live load	780	K	LL Factor	1.6		Bar	Ld	Area
P dead load	1710	K	DL Factor	1.2		3	9.00	0.11
Mll about X axis		K-ft	WL Factor	1.6		4	12.00	0.2
Mdl about X axis		K-ft	Shear Fact	0.75		5	15.00	0.31
Mwl about X axis		K-ft (Moment caused by Wind load)				6	18.00	0.44
CW=Width of Col.	40	Inches				7	26.25	0.6
CL=Depth of Col.	40	Inches				8	30.00	0.79
q allowable	120	Ksf (compare to E24)				9	33.84	1
W = Footing Width used	6	Ft	(X direction)			10	38.10	1.27
L = Footing Length used	6	Ft	(Y direction)			11	42.30	1.57
f'c	10000	Psi						
fy	60	Ksi						
Est. Ftg thickness	48	Inches	(d shown below)					
Include Ftg weight	y	(Y or N)						



Short Rebars run along the Width and carry the short moment.

Long Rebars run along the length and carry the long moment.

Ftg Weight=	20.88	K (included in qs)
Pa=	2490.00	K without ftg weight
Pu=	3300.00	K without ftg weight
Mu X axis=	0	K-ft
Actual max soil pressure qs =	**69.75**	**Ksf** **OK**
Actual min soil pressure qs =	69.75	Ksf includes ftg weight
Ultimate max soil pressure qu =	92.36	Ksf without ftg weight
Ultimate min soil pressure qu =	92.36	Ksf without ftg weight
d =	44	inches (assume thickness-4 inches)

Footing Two Way Shear Calculation (Uses avg. ult. soil pressure)

Pu=	3300	K (same as previously calculated)
Average qu=	92.363	Ksf
Vu=	-1225.77	K
Vn=	-1634.36	K
bo=	336	(Inches: perimeter around column, d/2 away)
β	1	
Vc=	5913.60	K **OK**

Footing One Way Shear Calc - Long Direction-(Uses true ult. soil pressure profile)

b=	72	Inches (same as footing width)	
cs-e=	-2.33	Ft: (Distance: from crit. section to edge of footing)	-28.00 Inches
quc=	92.36	Ksf: qu at critical section (d from face of column)	0.641407 Ksi
Vu Component 1:	-1293.077		
Vu Component 2:	0		
Vu=	-1293.08	K	
Vn=	-1724.10	K.	
Vc=	633.60	K **OK**	

Short Moment Calculations

Face of Col to Edge of Footing:	1.33	Ft	16.00 Inches	
Footing Mu Short=	**492.60**	**K-Ft**	Uses Average ultimate soil pressure	**5911.21 K-in**
Required for moment As=	2.49	Sq-Inches		
Minimum As=	6.22	Sq-Inches		
Use=	**6.22**	**Sq-Inches**		
As in Mid Band=	**6.22**	**Sq-Inches**		
Short Rebar used	9		Ld Reqd **33.84** Ld Available 13.00	
Number of Rebars	10		Average Spacing 7.3333 inches	Maximum Spacing is 18"
Total As provided=	10.000	Sq-Inches	This can be used to reduce Ld by the ratio of (As prov/As Reqd)	
Min. # of Rebars Req'd in Mid Band:	7			

As prov/As reqd 1.608
Reduced Ld 21.05

Long Moment Calculations

Face of Column to edge of footing	1.33	Ft	16.00 Inches	
qu at face of col:	92.36	Ksf	(ultimate soil pressure at face of column)	0.641407 Ksi
Moment Force Component 1:	738.90	K	(based on rectangular area)	
Moment Force Component 2:	0.00	K	(based on triangular area)	
Moment Arm 1:	0.67	Ft		
Moment Arm 2:	0.89	Ft		
Footing Mu Long=	**492.60**	**K-Ft**	Uses true ultimate soil pressure profile	**5911.21 K-in**
Required As=	2.49	Sq-Inches		
Minimum As=	6.22	Sq-Inches		
Use=	**6.22**	**Sq-Inches**		
Long Rebar used	9		Ld Reqd **33.84** Ld Available 13.00	
Number of Rebars	10		Average Spacing 7.3333 inches	Maximum Spacing is 18"
Total As provided=	10.000	Sq-Inches	This can be used to reduce Ld by the ratio of (As prov/As Reqd)	

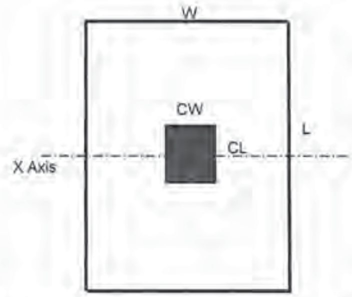
As prov/As reqd 1.608
Reduced Ld 21.05

5

Footing Size and Thickness Calculation based on Shear Considerations and true soil pressure... Enter Yellow Values

C3

P live load	4050	K	LL Factor	1.6		Bar	Ld	Area
P dead load	7730	K	DL Factor	1.2		3	9.00	0.11
Mll about X axis		K-ft	WL Factor	1.6		4	12.00	0.2
Mdl about X axis		K-ft	Shear Fact	0.75		5	15.00	0.31
Mwl about X axis		K-ft (Moment caused by Wind load)				6	18.00	0.44
CW=Width of Col.	60	Inches				7	26.25	0.6
CL=Depth of Col.	72	Inches				8	30.00	0.79
q allowable	120	Ksf (compare to E24)				9	33.84	1
W = Footing Width used	10	Ft	(X direction)			10	38.10	1.27
L = Footing Length used	10	Ft	(Y direction)			11	42.30	1.57
f'c	10000	Psi						
fy	60	Ksi						
Est. Ftg thickness	66	Inches (d shown below)						
Include Ftg weight	y	(Y or N)						



Short Rebars run along the Width and carry the short moment.

Long Rebars run along the length and carry the long moment.

Ftg Weight=	79.75	K (included in qs)
Pa=	11780.00	K without ftg weight
Pu=	15756.00	K without ftg weight
Mu X axis=	0	K-ft
Actual max soil pressure qs =	**118.60**	**Ksf** **OK**
Actual min soil pressure qs =	118.60	Ksf includes ftg weight
Ultimate max soil pressure qu =	158.52	Ksf without ftg weight
Ultimate min soil pressure qu =	158.52	Ksf without ftg weight
d =	62	Inches (assume thickness-4 inches)

Footing Two Way Shear Calculation (Uses avg. ult. soil pressure)

Pu=	15756	K (same as previously calculated)
Average qu=	158.517	Ksf
Vu=	-2240.08	K
Vn=	-2986.78	K
bo=	512	(Inches: perimeter around column, d/2 away)
β	1.2	
Vc=	12697.60	K **OK**

Footing One Way Shear Calc - Long Direction-(Uses true ult. soil pressure profile)

b=	120	Inches (same as footing width)		
cs-e=	-3.17	Ft: (Distance: from crit. section to edge of footing)	-38.00	Inches
quc=	158.52	Ksf: qu at critical section (d from face of column)	1.100813	Ksi
Vu Component 1:	-5019.705			
Vu Component 2:	0			
Vu=	-5019.71	K		
Vn=	-6692.94	K		
Vc=	1488.00	K **OK**		

Short Moment Calculations

Face of Col to Edge of Footing:	2.50	Ft	30.00 Inches			
Footing Mu Short=	**4953.66**	**K-Ft**	Uses Average ultimate soil pressure	**59443.88 K-in**		
Required for moment As=	17.91	Sq-Inches				
Minimum As=	14.26	Sq-Inches				
Use=	**17.91**	**Sq-Inches**				
As in Mid Band=	**17.91**	**Sq-Inches**				
Short Rebar used	10		Ld Reqd	**38.1**	Ld Available	27.00
Number of Rebars	24		Average Spacing	4.9565 inches	Maximum Spacing is 18"	
Total As provided=	30.480	Sq-Inches	This can be used to reduce Ld by the ratio of (As prov/As Reqd)			
Min. # of Rebars Req'd in Mid Band:	15					
			As prov/As reqd	1.702		
			Reduced Ld	22.38		

Long Moment Calculations

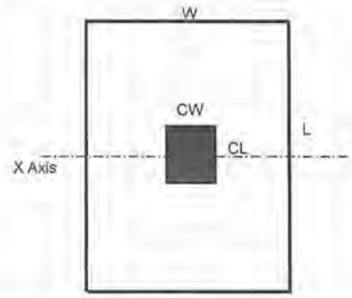
Face of Column to edge of footing	2.00	Ft	24.00 Inches			
qu at face of col:	158.52	Ksf (ultimate soil pressure at face of column)		1.100813 Ksi		
Moment Force Component 1:	3170.34	K (based on rectangular area)				
Moment Force Component 2:	0.00	K (based on triangular area)				
Moment Arm 1:	1.00	Ft				
Moment Arm 2:	1.33	Ft				
Footing Mu Long=	**3170.34**	**K-Ft**	Uses true ultimate soil pressure profile	**38044.08 K-in**		
Required As=	11.43	Sq-Inches				
Minimum As=	14.26	Sq-Inches				
Use=	**14.26**	**Sq-Inches**				
Long Rebar used	10		Ld Reqd	**38.1**	Ld Available	21.00
Number of Rebars	24		Average Spacing	4.9565 inches	Maximum Spacing is 18"	
Total As provided=	30.480	Sq-Inches	This can be used to reduce Ld by the ratio of (As prov/As Reqd)			
			As prov/As reqd	2.138		
			Reduced Ld	17.82		

Footing Size and Thickness Calculation based on Shear Considerations and true soil pressure... Enter Yellow Values

C4

P live load	3630	K	LL Factor	1.6			
P dead load	6750	K	DL Factor	1.2			
Mll about X axis		K-ft	WL Factor	1.6			
Mdl about X axis		K-ft	Shear Fact	0.75			
Mwl about X axis		K-ft (Moment caused by Wind load)					
CW=Width of Col.	60	Inches					
CL=Depth of Col.	66	Inches					
q allowable	120	Ksf (compare to E24)					
W = Footing Width used	10	Ft	(X direction)				
L = Footing Length used	10	Ft	(Y direction)				
f'c	10000	Psi					
fy	60	Ksi					
Est. Ftg thickness	66	Inches (d shown below)					
Include Ftg weight	y	(Y or N)					

Bar	Ld	Area
3	9.00	0.11
4	12.00	0.2
5	15.00	0.31
6	18.00	0.44
7	26.25	0.6
8	30.00	0.79
9	33.84	1
10	38.10	1.27
11	42.30	1.57



Short Rebars run along the Width and carry the short moment.

Long Rebars run along the length and carry the long moment.

Ftg Weight=	79.75	K (included in qs)
Pa=	10380.00	K without ftg weight
Pu=	13908.00	K without ftg weight
Mu X axis=	0	K-ft
Actual max soil pressure qs =	**104.60**	**Ksf** **OK**
Actual min soil pressure qs =	104.60	Ksf includes ftg weight
Ultimate max soil pressure qu =	140.04	Ksf without ftg weight
Ultimate min soil pressure qu =	140.04	Ksf without ftg weight
d =	62	inches (assume thickness-4 inches)

Footing Two Way Shear Calculation (Uses avg. ult. soil pressure)

Pu=	13908	K (same as previously calculated)
Average qu=	140.037	Ksf
Vu=	-1278.23	K
Vn=	-1704.31	K
bo=	500	(Inches: perimeter around column, d/2 away)
β	1.1	
Vc=	12400.00	K **OK**

Footing One Way Shear Calc - Long Direction-(Uses true ult. soil pressure profile)

b=	120	Inches (same as footing width)	
cs-e=	-2.92	Ft: (Distance: from crit. section to edge of footing)	-35.00 Inches
quc=	140.04	Ksf: qu at critical section (d from face of column)	0.972479 Ksi
Vu Component 1:	-4084.413		
Vu Component 2:	0		
Vu=	-4084.41	K	
Vn=	-5445.88	K	
Vc=	1488.00	K **OK**	

Short Moment Calculations

Face of Col to Edge of Footing:	2.50 Ft	30.00 Inches	
Footing Mu Short=	**4376.16 K-Ft**	Uses Average ultimate soil pressure	**52513.88 K-In**
Required for moment As=	15.80 Sq-Inches		
Minimum As=	14.26 Sq-Inches		
Use=	**15.80 Sq-Inches**		
As in Mid Band=	**15.80 Sq-Inches**		
Short Rebar used	10	Ld Reqd 38.1	Ld Available 27.00
Number of Rebars	24	Average Spacing 4.9565 inches	Maximum Spacing is 18"
Total As provided=	30.480 Sq-Inches	This can be used to reduce Ld by the ratio of (As prov/As Reqd)	
Min. # of Rebars Req'd in Mid Band:	13		
		As prov/As reqd	1.929
		Reduced Ld	19.75

Long Moment Calculations

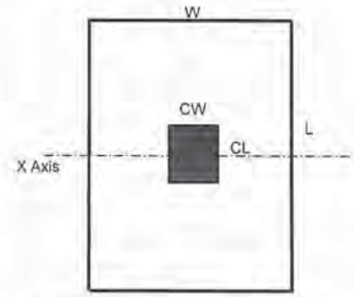
Face of Column to edge of footing	2.25 Ft	27.00 Inches	
qu at face of col:	140.04 Ksf	(ultimate soil pressure at face of column)	0.972479 Ksi
Moment Force Component 1:	3150.83 K	(based on rectangular area)	
Moment Force Component 2:	0.00 K	(based on triangular area)	
Moment Arm 1:	1.13 Ft		
Moment Arm 2:	1.50 Ft		
Footing Mu Long=	**3544.69 K-Ft**	Uses true ultimate soil pressure profile	**42536.24 K-In**
Required As=	12.78 Sq-Inches		
Minimum As=	14.26 Sq-Inches		
Use=	**14.26 Sq-Inches**		
Long Rebar used	10	Ld Reqd 38.1	Ld Available 24.00
Number of Rebars	24	Average Spacing 4.9565 inches	Maximum Spacing is 18"
Total As provided=	30.480 Sq-Inches	This can be used to reduce Ld by the ratio of (As prov/As Reqd)	
		As prov/As reqd	2.138
		Reduced Ld	17.82

Footing Size and Thickness Calculation based on Shear Considerations and true soil pressure... Enter Yellow Values

C5

P live load	2630	K	LL Factor	1.6		
P dead load	5430	K	DL Factor	1.2		
Mll about X axis		K-ft	WL Factor	1.6		
Mdl about X axis		K-ft	Shear Fact	0.75		
Mwl about X axis		K-ft (Moment caused by Wind load)				
CW=Width of Col.	58	Inches				
CL=Depth of Col.	58	Inches				
q allowable	120	Ksf (compare to E24)				
W = Footing Width used	9	Ft	(X direction)			
L = Footing Length used	9	Ft	(Y direction)			
f'c	10000	Psi				
fy	60	Ksi				
Est. Ftg thickness	60	Inches	(d shown below)			
Include Ftg weight	y	(Y or N)				

Bar	Ld	Area
3	9.00	0.11
4	12.00	0.2
5	15.00	0.31
6	18.00	0.44
7	26.25	0.6
8	30.00	0.79
9	33.84	1
10	38.10	1.27
11	42.30	1.57



Short Rebars run along the Width and carry the short moment.

Long Rebars run along the length and carry the long moment.

Ftg Weight=	58.73	K (included in qs)
Pa=	8060.00	K without ftg weight
Pu=	10724.00	K without ftg weight
Mu X axis=	0	K-ft
Actual max soil pressure qs =	**100.23**	**Ksf OK**
Actual min soil pressure qs =	100.23	Ksf includes ftg weight
Ultimate max soil pressure qu =	133.27	Ksf without ftg weight
Ultimate min soil pressure qu =	133.27	Ksf without ftg weight
d =	56	inches (assume thickness-4 inches)

Footing Two Way Shear Calculation (Uses avg. ult. soil pressure)

Pu=	10724	K (same as previously calculated)
Average qu=	133.265	Ksf
Vu=	-1303.17	K
Vn=	-1737.56	K
bo=	456	(Inches: perimeter around column, d/2 away)
β	1	
Vc=	10214.40	K **OK**

Footing One Way Shear Calc - Long Direction-(Uses true ult. soil pressure profile)

b=	108	Inches (same as footing width)		
cs-e=	-2.58	Ft: (Distance: from crit. section to edge of footing)	-31.00	Inches
quc=	133.27	Ksf: qu at critical section (d from face of column)	0.925452	Ksi
Vu Component 1:	-3098.413			
Vu Component 2:	0			
Vu=	-3098.41	K		
Vn=	-4131.22	K		
Vc=	1209.60	K **OK**		

Short Moment Calculations

Face of Col to Edge of Footing:	2.08	Ft	25.00 Inches	
Footing Mu Short=	**2602.83**	**K-Ft**	Uses Average ultimate soil pressure	**31234.00 K-in**
Required for moment As=	10.39	Sq-Inches		
Minimum As=	11.66	Sq-Inches		
Use=	**11.66**	**Sq-Inches**		
As in Mid Band=	**11.66**	**Sq-Inches**		
Short Rebar used	10		Ld Reqd **38.1**	Ld Available 22.00
Number of Rebars	20		Average Spacing 5.3684 inches	Maximum Spacing is 18"
Total As provided=	25.400	Sq-Inches	This can be used to reduce Ld by the ratio of (As prov/As Reqd)	
Min. # of Rebars Req'd in Mid Band:	10			

As prov/As reqd 2.178
Reduced Ld 17.5

Long Moment Calculations

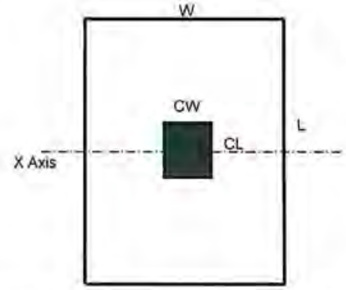
Face of Column to edge of footing	2.08	Ft	25.00 Inches	
qu at face of col:	133.27	Ksf	(ultimate soil pressure at face of column)	0.925452 Ksi
Moment Force Component 1:	2498.72	K	(based on rectangular area)	
Moment Force Component 2:	0.00	K	(based on triangular area)	
Moment Arm 1:	1.04	Ft		
Moment Arm 2:	1.39	Ft		
Footing Mu Long=	**2602.83**	**K-Ft**	Uses true ultimate soil pressure profile	**31234.00 K-in**
Required As=	10.39	Sq-Inches		
Minimum As=	11.66	Sq-Inches		
Use=	**11.66**	**Sq-Inches**		
Long Rebar used	10		Ld Reqd **38.1**	Ld Available 22.00
Number of Rebars	20		Average Spacing 5.3684 inches	Maximum Spacing is 18"
Total As provided=	25.400	Sq-Inches	This can be used to reduce Ld by the ratio of (As prov/As Reqd)	

As prov/As reqd 2.178
Reduced Ld 17.5

Footing Size and Thickness Calculation based on Shear Considerations and true soil pressure... Enter Yellow Values

C6

P live load	4440 K	LL Factor	1.6	Bar	Ld	Area
P dead load	7550 K	DL Factor	1.2	3	9.00	0.11
Mll about X axis	K-ft	WL Factor	1.6	4	12.00	0.2
Mdl about X axis	K-ft	Shear Fac	0.75	5	15.00	0.31
Mwl about X axis	K-ft (Moment caused by Wind load)			6	18.00	0.44
CW=Width of Col.	40 Inches			7	26.25	0.6
CL=Depth of Col.	40 Inches			8	30.00	0.79
q allowable	120 Ksf (compare to E24)			9	33.84	1
W = Footing Width used	10 Ft	(X direction)		10	38.10	1.27
L = Footing Length used	10 Ft	(Y direction)		11	42.30	1.57
f'c	10000 Psi					
fy	60 Ksi					
Est. Ftg thickness	66 Inches (d shown below)					
Include Ftg weight	y (Y or N)					



Short Rebars run along the Width and carry the short moment.

Long Rebars run along the length and carry the long moment.

Ftg Weight=	79.75	K (included in qs)
Pa=	11990.00	K without ftg weight
Pu=	16164.00	K without ftg weight
Mu X axis=	0	K-ft
Actual max soil pressure qs =	**120.70**	**Ksf RESIZE**
Actual min soil pressure qs =	120.70	Ksf includes ftg weight
Ultimate max soil pressure qu =	162.60	Ksf without ftg weight
Ultimate min soil pressure qu =	162.60	Ksf without ftg weight
d =	62	inches (assume thickness-4 inches)

Footing Two Way Shear Calculation (Uses avg. ult. soil pressure)

Pu=	16164	K (same as previously calculated)
Average qu=	162.597	Ksf
Vu=	4416.37	K
Vn=	5888.49	K
bo=	408	(Inches: perimeter around column, d/2 away)
β	1	
Vc=	10118.40	K **OK**

Footing One Way Shear Calc - Long Direction-(Uses true ult. soil pressure profile)

b=	120	Inches (same as footing width)	
cs-e=	-1.83	Ft: (Distance: from crit. section to edge of footing)	-22.00 Inches
quc=	162.60	Ksf: qu at critical section (d from face of column)	1.129146 Ksi
Vu Component 1:	-2980.945		
Vu Component 2:	0		
Vu=	-2980.95	K	
Vn=	-3974.59	K	
Vc=	1488.00	K **OK**	

Short Moment Calculations

Face of Col to Edge of Footing:	3.33 Ft	40.00 Inches	
Footing Mu Short=	**9033.17 K-Ft**	Uses Average ultimate soil pressure	**108398.00 K-in**
Required for moment As=	32.89 Sq-Inches		
Minimum As=	14.26 Sq-Inches		
Use=	**32.89 Sq-Inches**		
As in Mid Band=	**32.89 Sq-Inches**		
Short Rebar used	10	Ld Reqd **38.1**	Ld Available 37.00
Number of Rebars	24	Average Spacing 4.9565 inches	Maximum Spacing is 18"
Total As provided=	**30.480** Sq-Inches	This can be used to reduce Ld by the ratio of (As prov/As Reqd)	
Min. # of Rebars Req'd in Mid Band:	26		

As prov/As reqd 0.927
Reduced Ld 41.11

Long Moment Calculations

Face of Column to edge of footing	3.33 Ft	40.00 Inches	
qu at face of col:	162.60 Ksf	(ultimate soil pressure at face of column)	1.1291458 Ksi
Moment Force Component 1:	5419.90 K	(based on rectangular area)	
Moment Force Component 2:	0.00 K	(based on triangular area)	
Moment Arm 1:	1.67 Ft		
Moment Arm 2:	2.22 Ft		
Footing Mu Long=	**9033.17 K-Ft**	Uses true ultimate soil pressure profile	**108398.00 K-in**
Required As=	32.89 Sq-Inches		
Minimum As=	14.26 Sq-Inches		
Use=	**32.89 Sq-Inches**		
Long Rebar used	10	Ld Reqd **38.1**	Ld Available 37.00
Number of Rebars	24	Average Spacing 4.9565 inches	Maximum Spacing is 18"
Total As provided=	**30.480** Sq-Inches	This can be used to reduce Ld by the ratio of (As prov/As Reqd)	

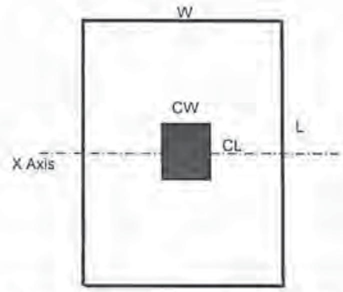
As prov/As reqd 0.927
Reduced Ld 41.11

Footing Size and Thickness Calculation based on Shear Considerations and true soil pressure... Enter Yellow Values

C7

P live load	2060	K	LL Factor	1.6			
P dead load	10230	K	DL Factor	1.2			
Mll about X axis		K-ft	WL Factor	1.6			
Mdl about X axis		K-ft	Shear Fac	0.75			
Mwl about X axis		K-ft (Moment caused by Wind load)					
CW=Width of Col	46	Inches					
CL=Depth of Col	46	Inches					
q allowable	120	Ksf (compare to E24)					
W = Footing Width used	11	Ft	(X direction)				
L = Footing Length used	11	Ft	(Y direction)				
f'c	10000	Psi					
fy	60	Ksi					
Est. Ftg thickness	76	Inches (d shown below)					
Include Ftg weight	y	(Y or N)					

Bar	Ld	Area
3	9.00	0.11
4	12.00	0.2
5	15.00	0.31
6	18.00	0.44
7	26.25	0.6
8	30.00	0.79
9	33.84	1
10	38.10	1.27
11	42.30	1.57



Short Rebars run along the Width and carry the short moment.

Long Rebars run along the length and carry the long moment.

Ftg Weight=	111.12	K (included in qs)
Pa=	12290.00	K without ftg weight
Pu=	15572.00	K without ftg weight
Mu X axis=	0	K-ft
Actual max soil pressure qs =	**102.49**	**Ksf** OK
Actual min soil pressure qs =	102.49	Ksf includes ftg weight
Ultimate max soil pressure qu =	129.80	Ksf without ftg weight
Ultimate min soil pressure qu =	129.80	Ksf without ftg weight
d =	72	inches (assume thickness-4 inches)

Footing Two Way Shear Calculation (Uses avg. ult. soil pressure)

Pu=	15572	K (same as previously calculated)
Average qu=	129.796	Ksf
Vu=	3021.43	K
Vn=	4028.57	K
bo=	472	(Inches: perimeter around column, d/2 away)
β	1	
Vc=	13593.60	K OK

Footing One Way Shear Calc - Long Direction-(Uses true ult. soil pressure profile)

b=	132	Inches (same as footing width)		
cs-e=	-2.42	Ft: (Distance: from crit. section to edge of footing)	-29.00	Inches
quc=	129.80	Ksf: qu at critical section (d from face of column)	0.901363	Ksi
Vu Component 1:	-3450.416			
Vu Component 2:	0			
Vu=	-3450.42	K		
Vn=	-4600.55	K		
Vc=	1900.80	K OK		

Short Moment Calculations

Face of Col to Edge of Footing:	3.58	Ft	43.00 Inches	
Footing Mu Short=	**9166.41**	**K-Ft**	Uses Average ultimate soil pressure	**109996.88 K-In**
Required for moment As=	28.60	Sq-Inches		
Minimum As=	18.06	Sq-Inches		
Use=	**28.60**	**Sq-Inches**		
As in Mid Band=	**28.60**	**Sq-Inches**		
Short Rebar used	10		Ld Reqd 38.1 Ld Available 40.00	
Number of Rebars	30		Average Spacing 4.3448 inches	Maximum Spacing is 18"
Total As provided=	38.100	Sq-Inches	This can be used to reduce Ld by the ratio of (As prov/As Reqd)	
Min. # of Rebars Req'd in Mid Band:	23			

As prov/As reqd 1.332
Reduced Ld 28.6

Long Moment Calculations

Face of Column to edge of footing	3.58	Ft	43.00 Inches	
qu at face of col:	129.80	Ksf	(ultimate soil pressure at face of column)	0.9013626 Ksi
Moment Force Component 1:	5116.13	K	(based on rectangular area)	
Moment Force Component 2:	0.00	K	(based on triangular area)	
Moment Arm 1:	1.79	Ft		
Moment Arm 2:	2.39	Ft		
Footing Mu Long=	**9166.41**	**K-Ft**	Uses true ultimate soil pressure profile	**109996.88 K-In**
Required As=	28.60	Sq-Inches		
Minimum As=	18.06	Sq-Inches		
Use=	**28.60**	**Sq-Inches**		
Long Rebar used	10		Ld Reqd 38.1 Ld Available 40.00	
Number of Rebars	30		Average Spacing 4.3448 inches	Maximum Spacing is 18"
Total As provided=	38.100	Sq-Inches	This can be used to reduce Ld by the ratio of (As prov/As Reqd)	

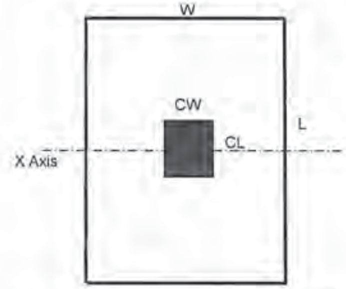
As prov/As reqd 1.332
Reduced Ld 28.6

Footing Size and Thickness Calculation based on Shear Considerations and true soil pressure... Enter Yellow Values

C8

P live load	3190	K	LL Factor	1.6			
P dead load	13240	K	DL Factor	1.2			
Mll about X axis		K-ft	WL Factor	1.6			
Mdl about X axis		K-ft	Shear Fac	0.75			
Mwl about X axis		K-ft (Moment caused by Wind load)					
CW=Width of Col.	52	Inches					
CL=Depth of Col.	52	Inches					
q allowable	120	Ksf (compare to E24)					
W = Footing Width used	13	Ft	(X direction)				
L = Footing Length used	13	Ft	(Y direction)				
f'c	10000	Psi					
fy	60	Ksi					
Est. Ftg thickness	96	Inches (d shown below)					
Include Ftg weight	y	(Y or N)					

Bar	Ld	Area
3	9.00	0.11
4	12.00	0.2
5	15.00	0.31
6	18.00	0.44
7	26.25	0.6
8	30.00	0.79
9	33.84	1
10	38.10	1.27
11	42.30	1.57



Short Rebars run along the Width and carry the short moment.

Long Rebars run along the length and carry the long moment.

Ftg Weight=	196.04	K (included in qs)
Pa=	16430.00	K without ftg weight
Pu=	20992.00	K without ftg weight
Mu X axis=	0	K-ft
Actual max soil pressure qs =	**98.38**	**Ksf** OK
Actual min soil pressure qs =	98.38	Ksf includes ftg weight
Ultimate max soil pressure qu =	125.61	Ksf without ftg weight
Ultimate min soil pressure qu =	125.61	Ksf without ftg weight
d =	92	inches (assume thickness-4 inches)

Footing Two Way Shear Calculation (Uses avg. ult. soil pressure)

Pu=	20992	K (same as previously calculated)
Average qu=	125.605	Ksf
Vu=	2904.88	K
Vn=	3873.17	K
bo=	576	(Inches: perimeter around column, d/2 away)
β	1	
Vc=	21196.80	K OK

Footing One Way Shear Calc - Long Direction-(Uses true ult. soil pressure profile)

b=	156	Inches (same as footing width)		
cs-e=	-3.33	Ft: (Distance: from crit. section to edge of footing)	-40.00	Inches
quc=	125.61	Ksf: qu at critical section (d from face of column)	0.872257	Ksi
Vu Component 1:	-5442.884			
Vu Component 2:	0			
Vu=	-5442.88	K		
Vn=	-7257.18	K		
Vc=	2870.40	K OK		

Short Moment Calculations

Face of Col to Edge of Footing:	4.33	Ft	52.00 Inches	
Footing Mu Short=	**15330.79**	**K-Ft**	Uses Average ultimate soil pressure	**183969.48 K-in**
Required for moment As=	37.37	Sq-Inches		
Minimum As=	26.96	Sq-Inches		
Use=	**37.37**	**Sq-Inches**		
As in Mid Band=	**37.37**	**Sq-Inches**		
Short Rebar used	10		Ld Reqd 38.1 Ld Available 49.00	
Number of Rebars	38		Average Spacing 4.0541 inches	Maximum Spacing is 18"
Total As provided=	48.260	Sq-Inches	This can be used to reduce Ld by the ratio of (As prov/As Reqd)	
Min. # of Rebars Req'd in Mid Band:	30			

As prov/As reqd 1.291
Reduced Ld 29.51

Long Moment Calculations

Face of Column to edge of footing	4.33	Ft	52.00 Inches	
qu at face of col:	125.61	Ksf	(ultimate soil pressure at face of column)	0.8722571 Ksi
Moment Force Component 1:	7075.75	K	(based on rectangular area)	
Moment Force Component 2:	0.00	K	(based on triangular area)	
Moment Arm 1:	2.17	Ft		
Moment Arm 2:	2.89	Ft		
Footing Mu Long=	**15330.79**	**K-Ft**	Uses true ultimate soil pressure profile	**183969.48 K-in**
Required As=	37.37	Sq-Inches		
Minimum As=	26.96	Sq-Inches		
Use=	**37.37**	**Sq-Inches**		
Long Rebar used	10		Ld Reqd 38.1 Ld Available 49.00	
Number of Rebars	38		Average Spacing 4.0541 inches	Maximum Spacing is 18"
Total As provided=	48.260	Sq-Inches	This can be used to reduce Ld by the ratio of (As prov/As Reqd)	

As prov/As reqd 1.291
Reduced Ld 29.51

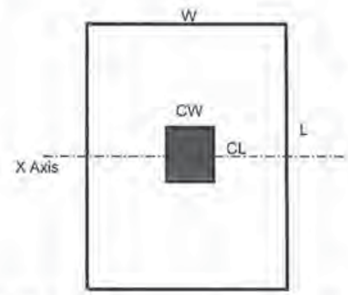
11

Footing Size and Thickness Calculation based on Shear Considerations and true soil pressure... Enter Yellow Values

C9

P live load	8070	K	LL Factor	1.6	
P dead load	13100	K	DL Factor	1.2	
Mll about X axis		K-ft	WL Factor	1.6	
Mdl about X axis		K-ft	Shear Fac	0.75	
Mwl about X axis		K-ft (Moment caused by Wind load)			
CW=Width of Col.	84	Inches			
CL=Depth of Col.	84	Inches			
q allowable	120	Ksf (compare to E24)			
W = Footing Width used	13	Ft	(X direction)		
L = Footing Length used	13	Ft	(Y direction)		
f'c	10000	Psi			
fy	60	Ksi			
Est. Ftg thickness	96	Inches (d shown below)			
Include Ftg weight	y	(Y or N)			

Bar	Ld	Area
3	9.00	0.11
4	12.00	0.2
5	15.00	0.31
6	18.00	0.44
7	26.25	0.6
8	30.00	0.79
9	33.84	1
10	38.10	1.27
11	42.30	1.57



Short Rebars run along the Width and carry the short moment.

Long Rebars run along the length and carry the long moment.

Ftg Weight=	196.04	K (included in qs)
Pa=	21170.00	K without ftg weight
Pu=	28632.00	K without ftg weight
Mu X axis=	0	K-ft
Actual max soil pressure qs =	126.43	Ksf RESIZE
Actual min soil pressure qs =	126.43	Ksf includes ftg weight
Ultimate max soil pressure qu =	170.81	Ksf without ftg weight
Ultimate min soil pressure qu =	170.81	Ksf without ftg weight
d =	92	inches (assume thickness-4 inches)

Footing Two Way Shear Calculation (Uses avg. ult. soil pressure)

Pu=	28632	K (same as previously calculated)
Average qu=	170.812	Ksf
Vu=	-8111.58	K
Vn=	-10815.45	K
bo=	704	(Inches: perimeter around column, d/2 away)
β	1	
Vc=	25907.20	K **OK**

Footing One Way Shear Calc - Long Direction-(Uses true ult. soil pressure profile)

b=	156	Inches (same as footing width)	
cs-e=	-4.67	Ft: (Distance: from crit. section to edge of footing)	-56.00 Inches
quc=	170.81	Ksf: qu at critical section (d from face of column)	1.186195 Ksi
Vu Component 1:	-10362.6		
Vu Component 2:	0		
Vu=	-10362.60	K	
Vn=	-13816.80	K	
Vc=	2870.40	K **OK**	

Short Moment Calculations

Face of Col to Edge of Footing:	3.00	Ft	36.00 Inches	
Footing Mu Short=	**9992.51**	**K-Ft**	Uses Average ultimate soil pressure	**119910.11 K-in**
Required for moment As=	24.28	Sq-Inches		
Minimum As=	26.96	Sq-Inches		
Use=	**26.96**	**Sq-Inches**		
As in Mid Band=	**26.96**	**Sq-Inches**		
Short Rebar used	10		Ld Reqd **38.1** Ld Available 33.00	
Number of Rebars	38		Average Spacing 4.0541 inches	Maximum Spacing is 18"
Total As provided=	48.260	Sq-Inches	This can be used to reduce Ld by the ratio of (As prov/As Reqd)	
Min. # of Rebars Req'd in Mid Band:	22			

As prov/As reqd 1.79
Reduced Ld 21.28

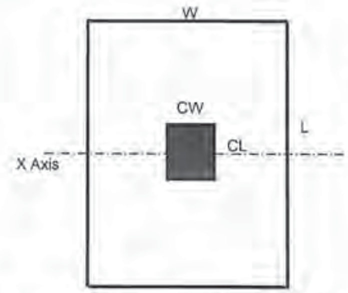
Long Moment Calculations

Face of Column to edge of footing	3.00	Ft	36.00 Inches	
qu at face of col:	170.81	Ksf	(ultimate soil pressure at face of column)	1.1861953 Ksi
Moment Force Component 1:	6661.67	K	(based on rectangular area)	
Moment Force Component 2:	0.00	K	(based on triangular area)	
Moment Arm 1:	1.50	Ft		
Moment Arm 2:	2.00	Ft		
Footing Mu Long=	**9992.51**	**K-Ft**	Uses true ultimate soil pressure profile	**119910.11 K-in**
Required As=	24.28	Sq-Inches		
Minimum As=	26.96	Sq-Inches		
Use=	**26.96**	**Sq-Inches**		
Long Rebar used	10		Ld Reqd **38.1** Ld Available 33.00	
Number of Rebars	38		Average Spacing 4.0541 inches	Maximum Spacing is 18"
Total As provided=	48.260	Sq-Inches	This can be used to reduce Ld by the ratio of (As prov/As Reqd)	

As prov/As reqd 1.79
Reduced Ld 21.28

Footing Size and Thickness Calculation based on Shear Considerations and true soil pressure... Enter Yellow Values
C10

P live load	6245	K	LL Factor	1.6		Bar	Ld	Area
P dead load	11770	K	DL Factor	1.2		3	9.00	0.11
Mll about X axis		K-ft	WL Factor	1.6		4	12.00	0.2
Mdl about X axis		K-ft	Shear Fac	0.75		5	15.00	0.31
Mwl about X axis		K-ft (Moment caused by Wind load)				6	18.00	0.44
CW=Width of Col.	52	Inches				7	26.25	0.6
CL=Depth of Col.	52	Inches				8	30.00	0.79
q allowable	120	Ksf (compare to E24)				9	33.84	1
W = Footing Width used	13	Ft	(X direction)			10	38.10	1.27
L = Footing Length used	13	Ft	(Y direction)			11	42.30	1.57
f'c	10000	Psi						
fy	60	Ksi						
Est. Ftg thickness	96	Inches (d shown below)						
Include Ftg weight	y	(Y or N)						



Short Rebars run along the Width and carry the short moment.

Long Rebars run along the length and carry the long moment.

Ftg Weight=	196.04	K (included in qs)
Pa=	18015.00	K without ftg weight
Pu=	24116.00	K without ftg weight
Mu X axis=	0	K-ft
Actual max soil pressure qs =	**107.76**	**Ksf OK**
Actual min soil pressure qs =	107.76	Ksf includes ftg weight
Ultimate max soil pressure qu =	144.09	Ksf without ftg weight
Ultimate min soil pressure qu =	144.09	Ksf without ftg weight
d =	92	inches (assume thickness-4 inches)

Footing Two Way Shear Calculation (Uses avg. ult. soil pressure)

Pu=	24116	K (same as previously calculated)
Average qu=	144.090	Ksf
Vu=	3367.01	K
Vn=	4489.34	K
bo=	576	(Inches: perimeter around column, d/2 away)
β	1	
Vc=	21196.80	K **OK**

Footing One Way Shear Calc - Long Direction-(Uses true ult. soil pressure profile)

b=	156	Inches (same as footing width)		
cs-e=	-3.33	Ft: (Distance: from crit. section to edge of footing)	-40.00	Inches
quc=	144.09	Ksf: qu at critical section (d from face of column)	1.000627	Ksi
Vu Component 1:	-6243.91			
Vu Component 2:	0			
Vu=	-6243.91	K		
Vn=	-8325.21	K		
Vc=	2870.40	K **OK**		

Short Moment Calculations

Face of Col to Edge of Footing:	4.33	Ft	52.00 Inches	
Footing Mu Short=	**17587.01**	**K-Ft**	Uses Average ultimate soil pressure	**211044.15 K-in**
Required for moment As=	42.93	Sq-Inches		
Minimum As=	26.96	Sq-Inches		
Use=	**42.93**	**Sq-Inches**		
As in Mid Band=	**42.93**	**Sq-Inches**		
Short Rebar used	10		Ld Reqd 38.1 Ld Available 49.00	
Number of Rebars	38		Average Spacing 4.0541 inches	Maximum Spacing is 18"
Total As provided=	48.260	Sq-Inches	This can be used to reduce Ld by the ratio of (As prov/As Reqd)	
Min. # of Rebars Req'd in Mid Band:	34			

As prov/As reqd 1.124
Reduced Ld 33.9

Long Moment Calculations

Face of Column to edge of footing	4.33	Ft	52.00 Inches	
qu at face of col:	144.09	Ksf	(ultimate soil pressure at face of column)	1.0006266 Ksi
Moment Force Component 1:	8117.08	K	(based on rectangular area)	
Moment Force Component 2:	0.00	K	(based on triangular area)	
Moment Arm 1:	2.17	Ft		
Moment Arm 2:	2.89	Ft		
Footing Mu Long=	**17587.01**	**K-Ft**	Uses true ultimate soil pressure profile	**211044.15 K-in**
Required As=	42.93	Sq-Inches		
Minimum As=	26.96	Sq-Inches		
Use=	**42.93**	**Sq-Inches**		
Long Rebar used	10		Ld Reqd 38.1 Ld Available 49.00	
Number of Rebars	38		Average Spacing 4.0541 inches	Maximum Spacing is 18"
Total As provided=	48.260	Sq-Inches	This can be used to reduce Ld by the ratio of (As prov/As Reqd)	

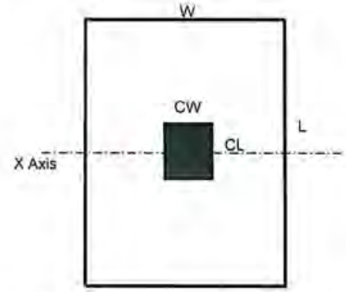
As prov/As reqd 1.124
Reduced Ld 33.9

13

Footing Size and Thickness Calculation based on Shear Considerations and true soil pressure... Enter Yellow Values
C12

P live load	7750	K	LL Factor	1.6	
P dead load	7800	K	DL Factor	1.2	
Mll about X axis		K-ft	WL Factor	1.6	
Mdl about X axis		K-ft	Shear Fac	0.75	
Mwl about X axis		K-ft (Moment caused by Wind load)			
CW=Width of Col.	50	Inches			
CL=Depth of Col.	50	Inches			
q allowable	120	Ksf (compare to E24)			
W = Footing Width used	11	Ft	(X direction)		
L = Footing Length used	11	Ft	(Y direction)		
f'c	10000	Psi			
fy	60	Ksi			
Est. Ftg thickness	76	Inches	(d shown below)		
Include Ftg weight	y	(Y or N)			

Bar	Ld	Area
3	9.00	0.11
4	12.00	0.2
5	15.00	0.31
6	18.00	0.44
7	26.25	0.6
8	30.00	0.79
9	33.84	1
10	38.10	1.27
11	42.30	1.57



Short Rebars run along the Width and carry the short moment.

Long Rebars run along the length and carry the long moment.

Ftg Weight=	111.12	K (included in qs)
Pa=	15550.00	K without ftg weight
Pu=	21760.00	K without ftg weight
Mu X axis=	0	K-ft
Actual max soil pressure qs =	129.43	Ksf RESIZE
Actual min soil pressure qs =	129.43	Ksf includes ftg weight
Ultimate max soil pressure qu =	180.94	Ksf without ftg weight
Ultimate min soil pressure qu =	180.94	Ksf without ftg weight
d =	72	inches (assume thickness-4 inches)

Footing Two Way Shear Calculation (Uses avg. ult. soil pressure)

Pu=	21760	K (same as previously calculated)
Average qu=	180.937	Ksf
Vu=	3058.18	K
Vn=	4077.57	K
bo=	488	(Inches: perimeter around column, d/2 away)
β	1	
Vc=	14054.40	K OK

Footing One Way Shear Calc - Long Direction-(Uses true ult. soil pressure profile)

b=	132	Inches (same as footing width)	
cs-e=	-2.58	Ft: (Distance: from crit. section to edge of footing)	-31.00 Inches
quc=	180.94	Ksf: qu at critical section (d from face of column)	1.256505 Ksi
Vu Component 1:	-5141.618		
Vu Component 2:	0		
Vu=	-5141.62	K	
Vn=	-6855.49	K	
Vc=	1900.80	K	OK

Short Moment Calculations

Face of Col to Edge of Footing:	3.42	Ft	41.00 Inches	
Footing Mu Short=	**11617.02**	**K-Ft**	Uses Average ultimate soil pressure	**139404.20 K-in**
Required for moment As=	36.35	Sq-Inches		
Minimum As=	18.06	Sq-Inches		
Use=	**36.35**	**Sq-Inches**		
As in Mid Band=	**36.35**	**Sq-Inches**		
Short Rebar used	10		Ld Reqd 38.1	Ld Available 38.00
Number of Rebars	30		Average Spacing 4.3448 inches	Maximum Spacing is 18"
Total As provided=	38.100	Sq-Inches	This can be used to reduce Ld by the ratio of (As prov/As Reqd)	
Min. # of Rebars Req'd in Mid Band:	29			

As prov/As reqd 1.048
Reduced Ld 36.35

Long Moment Calculations

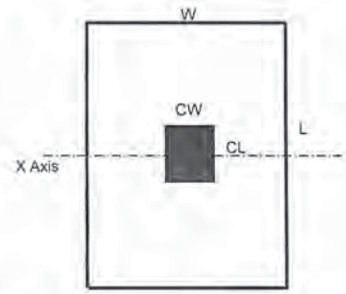
Face of Column to edge of footing	3.42	Ft	41.00 Inches	
qu at face of col:	180.94	Ksf	(ultimate soil pressure at face of column)	1.2565049 Ksi
Moment Force Component 1:	6800.20	K	(based on rectangular area)	
Moment Force Component 2:	0.00	K	(based on triangular area)	
Moment Arm 1:	1.71	Ft		
Moment Arm 2:	2.28	Ft		
Footing Mu Long=	**11617.02**	**K-Ft**	Uses true ultimate soil pressure profile	**139404.20 K-in**
Required As=	36.35	Sq-Inches		
Minimum As=	18.06	Sq-Inches		
Use=	**36.35**	**Sq-Inches**		
Long Rebar used	10		Ld Reqd 38.1	Ld Available 38.00
Number of Rebars	30		Average Spacing 4.3448 inches	Maximum Spacing is 18"
Total As provided=	38.100	Sq-Inches	This can be used to reduce Ld by the ratio of (As prov/As Reqd)	

As prov/As reqd 1.048
Reduced Ld 36.35

Footing Size and Thickness Calculation based on Shear Considerations and true soil pressure... Enter Yellow Values

C16

P live load	6190	K	LL Factor	1.6	Bar	Ld	Area
P dead load	8040	K	DL Factor	1.2	3	9.00	0.11
Mll about X axis		K-ft	WL Factor	1.6	4	12.00	0.2
Mdl about X axis		K-ft	Shear Fac	0.75	5	15.00	0.31
Mwl about X axis		K-ft (Moment caused by Wind load)			6	18.00	0.44
CW=Width of Col.	44	Inches			7	26.25	0.6
CL=Depth of Col.	44	Inches			8	30.00	0.79
q allowable	120	Ksf (compare to E24)			9	33.84	1
W = Footing Width used	11	Ft	(X direction)		10	38.10	1.27
L = Footing Length used	11	Ft	(Y direction)		11	42.30	1.57
f'c	10000	Psi					
fy	60	Ksi					
Est. Ftg thickness	76	Inches (d shown below)					
Include Ftg weight	y	(Y or N)					



Short Rebars run along the Width and carry the short moment.

Long Rebars run along the length and carry the long moment.

Ftg Weight=	111.12	K (included in qs)
Pa=	14230.00	K without ftg weight
Pu=	19552.00	K without ftg weight
Mu X axis=	0	K-ft
Actual max soil pressure qs =	**118.52**	**Ksf** **OK**
Actual min soil pressure qs =	118.52	Ksf includes ftg weight
Ultimate max soil pressure qu =	162.69	Ksf without ftg weight
Ultimate min soil pressure qu =	162.69	Ksf without ftg weight
d =	72	inches (assume thickness-4 inches)

Footing Two Way Shear Calculation (Uses avg. ult. soil pressure)

Pu=	19552	K (same as previously calculated)
Average qu=	162.689	Ksf
Vu=	4349.64	K
Vn=	5799.52	K
bo=	464	(Inches; perimeter around column, d/2 away)
β	1	
Vc=	13363.20	K **OK**

Footing One Way Shear Calc - Long Direction-(Uses true ult. soil pressure profile)

b=	132	Inches (same as footing width)	
cs-e=	-2.33	Ft: (Distance: from crit. section to edge of footing)	-28.00 Inches
quc=	162.69	Ksf: qu at critical section (d from face of column)	1.129783 Ksi
Vu Component 1:	-4175.679		
Vu Component 2:	0		
Vu=	-4175.68	K	
Vn=	-5567.57	K	
Vc=	1900.80	K **OK**	

Short Moment Calculations

Face of Col to Edge of Footing:	3.67	Ft	44.00 Inches
Footing Mu Short=	**12029.93**	**K-Ft**	Uses Average ultimate soil pressure **144359.17 K-in**
Required for moment As=	37.66	Sq-Inches	
Minimum As=	18.06	Sq-Inches	
Use=	**37.66**	**Sq-Inches**	
As in Mid Band=	**37.66**	**Sq-Inches**	
Short Rebar used	10		Ld Reqd 38.1 Ld Available 41.00
Number of Rebars	30		Average Spacing 4.3448 inches Maximum Spacing is 18"
Total As provided=	38.100	Sq-Inches	This can be used to reduce Ld by the ratio of (As prov/As Reqd)
Min. # of Rebars Req'd in Mid Band:	30		

As prov/As reqd 1.012
Reduced Ld 37.66

Long Moment Calculations

Face of Column to edge of footing	3.67	Ft	44.00 Inches
qu at face of col:	162.69	Ksf	(ultimate soil pressure at face of column) 1.1297832 Ksi
Moment Force Component 1:	6561.78	K	(based on rectangular area)
Moment Force Component 2:	0.00	K	(based on triangular area)
Moment Arm 1:	1.83	Ft	
Moment Arm 2:	2.44	Ft	
Footing Mu Long=	**12029.93**	**K-Ft**	Uses true ultimate soil pressure profile **144359.17 K-in**
Required As=	37.66	Sq-Inches	
Minimum As=	18.06	Sq-Inches	
Use=	**37.66**	**Sq-Inches**	
Long Rebar used	10		Ld Reqd 38.1 Ld Available 41.00
Number of Rebars	30		Average Spacing 4.3448 inches Maximum Spacing is 18"
Total As provided=	38.100	Sq-Inches	This can be used to reduce Ld by the ratio of (As prov/As Reqd)

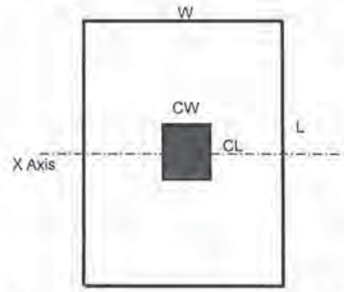
As prov/As reqd 1.012
Reduced Ld 37.66

15

Footing Size and Thickness Calculation based on Shear Considerations and true soil pressure... Enter Yellow Values

C17

P live load	1380	K	LL Factor	1.6	Bar	Ld	Area
P dead load	5920	K	DL Factor	1.2	3	9.00	0.11
Mll about X axis		K-ft	WL Factor	1.6	4	12.00	0.2
Mdl about X axis		K-ft	Shear Fac	0.75	5	15.00	0.31
Mwl about X axis		K-ft (Moment caused by Wind load)			6	18.00	0.44
CW=Width of Col.	34	Inches			7	26.25	0.6
CL=Depth of Col.	34	Inches			8	30.00	0.79
q allowable	120	Ksf (compare to E24)			9	33.84	1
W = Footing Width used	9	Ft	(X direction)		10	38.10	1.27
L = Footing Length used	9	Ft	(Y direction)		11	42.30	1.57
f'c	10000	Psi					
fy	60	Ksi					
Est. Ftg thickness	60	Inches (d shown below)					
Include Ftg weight	y	(Y or N)					



Short Rebars run along the Width and carry the short moment.

Long Rebars run along the length and carry the long moment.

Ftg Weight=	58.73	K (included in qs)
Pa=	7300.00	K without ftg weight
Pu=	9312.00	K without ftg weight
Mu X axis=	0	K-ft
Actual max soil pressure qs =	**90.85**	**Ksf OK**
Actual min soil pressure qs =	90.85	Ksf includes ftg weight
Ultimate max soil pressure qu =	115.83	Ksf without ftg weight
Ultimate min soil pressure qu =	115.83	Ksf without ftg weight
d =	56	inches (assume thickness-4 inches)

Footing Two Way Shear Calculation (Uses avg. ult. soil pressure)

Pu=	9312	K (same as previously calculated)
Average qu=	115.833	Ksf
Vu=	2796.40	K
Vn=	3728.53	K
bo=	360	(Inches: perimeter around column, d/2 away)
β	1	
Vc=	8064.00	K **OK**

Footing One Way Shear Calc - Long Direction-(Uses true ult. soil pressure profile)

b=	108	Inches (same as footing width)	
cs-e=	-1.58	Ft: (Distance: from crit. section to edge of footing)	-19.00 Inches
quc=	115.83	Ksf: qu at critical section (d from face of column)	0.804396 Ksi
Vu Component 1:	-1650.62		
Vu Component 2:	0		
Vu=	-1650.62	K	
Vn=	-2200.83	K	
Vc=	1209.60	K **OK**	

Short Moment Calculations

Face of Col to Edge of Footing:	3.08	Ft	37.00 Inches	
Footing Mu Short=	**4955.48**	**K-Ft**	Uses Average ultimate soil pressure	**59465.75 K-in**
Required for moment As=	19.90	Sq-Inches		
Minimum As=	11.66	Sq-Inches		
Use=	**19.90**	**Sq-Inches**		
As in Mid Band=	**19.90**	**Sq-Inches**		
Short Rebar used	10		Ld Reqd **38.1** Ld Available 34.00	
Number of Rebars	20		Average Spacing 5.3684 inches	Maximum Spacing is 18"
Total As provided=	25.400	Sq-Inches	This can be used to reduce Ld by the ratio of (As prov/As Reqd)	
Min. # of Rebars Req'd in Mid Band:	16			

As prov/As reqd 1.277
Reduced Ld 29.84

Long Moment Calculations

Face of Column to edge of footing	3.08	Ft	37.00 Inches	
qu at face of col:	115.83	Ksf	(ultimate soil pressure at face of column)	0.8043956 Ksi
Moment Force Component 1:	3214.36	K	(based on rectangular area)	
Moment Force Component 2:	0.00	K	(based on triangular area)	
Moment Arm 1:	1.54	Ft		
Moment Arm 2:	2.06	Ft		
Footing Mu Long=	**4955.48**	**K-Ft**	Uses true ultimate soil pressure profile	**59465.75 K-in**
Required As=	19.90	Sq-Inches		
Minimum As=	11.66	Sq-Inches		
Use=	**19.90**	**Sq-Inches**		
Long Rebar used	10		Ld Reqd **38.1** Ld Available 34.00	
Number of Rebars	20		Average Spacing 5.3684 inches	Maximum Spacing is 18"
Total As provided=	25.400	Sq-Inches	This can be used to reduce Ld by the ratio of (As prov/As Reqd)	

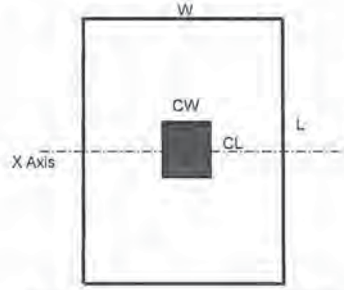
As prov/As reqd 1.277
Reduced Ld 29.84

Footing Size and Thickness Calculation based on Shear Considerations and true soil pressure... Enter Yellow Values

C18

P live load	670	K	LL Factor	1.6	
P dead load	2040	K	DL Factor	1.2	
Mll about X axis		K-ft	WL Factor	1.6	
Mdl about X axis		K-ft	Shear Fac	0.75	
Mwl about X axis		K-ft (Moment caused by Wind load)			
CW=Width of Col.	26	Inches			
CL=Depth of Col.	30	Inches			
q allowable	120	Ksf (compare to E24)			
W = Footing Width used	5	Ft	(X direction)		
L = Footing Length used	5	Ft	(Y direction)		
f'c	10000	Psi			
fy	60	Ksi			
Est. Ftg thickness	42	Inches (d shown below)			
Include Ftg weight	y	(Y or N)			

Bar	Ld	Area
3	9.00	0.11
4	12.00	0.2
5	15.00	0.31
6	18.00	0.44
7	26.25	0.6
8	30.00	0.79
9	33.84	1
10	38.10	1.27
11	42.30	1.57



Short Rebars run along the Width and carry the short moment.

Long Rebars run along the length and carry the long moment.

Ftg Weight=	12.69	K (included in qs)
Pa=	2710.00	K without ftg weight
Pu=	3520.00	K without ftg weight
Mu X axis=	0	K-ft
Actual max soil pressure qs =	**108.91**	**Ksf** OK
Actual min soil pressure qs =	108.91	Ksf includes ftg weight
Ultimate max soil pressure qu =	141.41	Ksf without ftg weight
Ultimate min soil pressure qu =	141.41	Ksf without ftg weight
d =	38	inches (assume thickness-4 inches)

Footing Two Way Shear Calculation (Uses avg. ult. soil pressure)

Pu=	3520	K (same as previously calculated)
Average qu=	141.409	Ksf
Vu=	-753.69	K
Vn=	-1004.93	K
bo=	264	(Inches: perimeter around column, d/2 away)
β	1.15384615	
Vc=	4012.80	K **OK**

Footing One Way Shear Calc - Long Direction-(Uses true ult. soil pressure profile)

b=	60	Inches (same as footing width)		
cs-e=	-1.92	Ft: (Distance: from crit. section to edge of footing)	-23.00	Inches
quc=	141.41	Ksf: qu at critical section (d from face of column)	0.982007	Ksi
Vu Component 1:	-1355.17			
Vu Component 2:	0			
Vu=	-1355.17	K		
Vn=	-1806.89	K		
Vc=	456.00	K **OK**		

Short Moment Calculations

Face of Col to Edge of Footing:	1.42	Ft	17.00 Inches	
Footing Mu Short=	**709.50**	**K-Ft**	Uses Average ultimate soil pressure	**8514.00 K-in**
Required for moment As=	4.18	Sq-Inches		
Minimum As=	4.54	Sq-Inches		
Use=	**4.54**	**Sq-Inches**		
As in Mid Band=	**4.54**	**Sq-Inches**		
Short Rebar used	9		Ld Reqd **33.84** Ld Available 14.00	
Number of Rebars	8		Average Spacing 7.7143 inches	Maximum Spacing is 18"
Total As provided=	8.000	Sq-Inches	This can be used to reduce Ld by the ratio of (As prov/As Reqd)	
Min. # of Rebars Req'd in Mid Band:	5			
			As prov/As reqd	1.764
			Reduced Ld	19.19

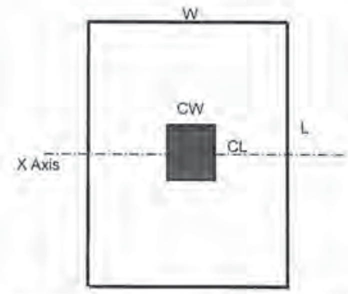
Long Moment Calculations

Face of Column to edge of footing	1.25	Ft	15.00 Inches	
qu at face of col:	141.41	Ksf	(ultimate soil pressure at face of column)	0.9820069 Ksi
Moment Force Component 1:	883.81	K	(based on rectangular area)	
Moment Force Component 2:	0.00	K	(based on triangular area)	
Moment Arm 1:	0.63	Ft		
Moment Arm 2:	0.83	Ft		
Footing Mu Long=	**552.38**	**K-Ft**	Uses true ultimate soil pressure profile	**6628.55 K-in**
Required As=	3.25	Sq-Inches		
Minimum As=	4.54	Sq-Inches		
Use=	**4.54**	**Sq-Inches**		
Long Rebar used	9		Ld Reqd **33.84** Ld Available 12.00	
Number of Rebars	8		Average Spacing 7.7143 inches	Maximum Spacing is 18"
Total As provided=	8.000	Sq-Inches	This can be used to reduce Ld by the ratio of (As prov/As Reqd)	
			As prov/As reqd	1.764
			Reduced Ld	19.19

Footing Size and Thickness Calculation based on Shear Considerations and true soil pressure... Enter Yellow Values

C19

P live load	3720 K	LL Factor	1.6		Bar	Ld	Area
P dead load	5970 K	DL Factor	1.2		3	9.00	0.11
Mll about X axis	K-ft	WL Factor	1.6		4	12.00	0.2
Mdl about X axis	K-ft	Shear Fac	0.75		5	15.00	0.31
Mwl about X axis	K-ft (Moment caused by Wind load)				6	18.00	0.44
CW=Width of Col.	44 Inches				7	26.25	0.6
CL=Depth of Col.	44 Inches				8	30.00	0.79
q allowable	120 Ksf (compare to E24)				9	33.84	1
W = Footing Width used	9 Ft	(X direction)			10	38.10	1.27
L = Footing Length used	9 Ft	(Y direction)			11	42.30	1.57
f'c	10000 Psi						
fy	60 Ksi						
Est. Ftg thickness	60 Inches (d shown below)						
Include Ftg weight	y (Y or N)						



Short Rebars run along the Width and carry the short moment.

Long Rebars run along the length and carry the long moment.

Ftg Weight=	58.73 K (included in qs)
Pa=	9690.00 K without ftg weight
Pu=	13116.00 K without ftg weight
Mu X axis=	0 K-ft
Actual max soil pressure qs =	**120.35 Ksf** **RESIZE**
Actual min soil pressure qs =	120.35 Ksf includes ftg weight
Ultimate max soil pressure qu =	162.80 Ksf without ftg weight
Ultimate min soil pressure qu =	162.80 Ksf without ftg weight
d =	56 inches (assume thickness-4 inches)

Footing Two Way Shear Calculation (Uses avg. ult. soil pressure)

Pu=	13116 K (same as previously calculated)
Average qu=	162.796 Ksf
Vu=	1810.73 K
Vn=	2414.30 K
bo=	400 (Inches: perimeter around column, d/2 away)
β	1
Vc=	8960.00 K **OK**

Footing One Way Shear Calc - Long Direction-(Uses true ult. soil pressure profile)

b=	108 Inches (same as footing width)
cs-e=	-2.00 Ft: (Distance: from cnt. section to edge of footing) -24.00 Inches
quc=	162.80 Ksf: qu at critical section (d from face of column) 1.130527 Ksi
Vu Component 1:	-2930.327
Vu Component 2:	0
Vu=	-2930.33 K
Vn=	-3907.10 K
Vc=	1209.60 K **OK**

Short Moment Calculations

Face of Col to Edge of Footing:	2.67 Ft	32.00 Inches
Footing Mu Short=	**5209.47 K-Ft**	Uses Average ultimate soil pressure **62513.64 K-in**
Required for moment As=	20.93 Sq-Inches	
Minimum As=	11.66 Sq-Inches	
Use=	**20.93 Sq-Inches**	
As in Mid Band=	**20.93 Sq-Inches**	
Short Rebar used	10	Ld Reqd **38.1** Ld Available 29.00
Number of Rebars	20	Average Spacing 5.3684 Inches Maximum Spacing is 18"
Total As provided=	25.400 Sq-Inches	This can be used to reduce Ld by the ratio of (As prov/As Reqd)
Min. # of Rebars Req'd in Mid Band:	17	

As prov/As reqd 1.214
Reduced Ld 31.39

Long Moment Calculations

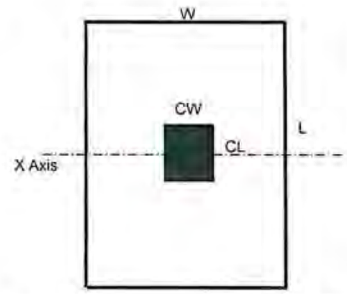
Face of Column to edge of footing	2.67 Ft	32.00 Inches
qu at face of col:	162.80 Ksf	(ultimate soil pressure at face of column) 1.1305273 Ksi
Moment Force Component 1:	3907.10 K	(based on rectangular area)
Moment Force Component 2:	0.00 K	(based on triangular area)
Moment Arm 1:	1.33 Ft	
Moment Arm 2:	1.78 Ft	
Footing Mu Long=	**5209.47 K-Ft**	Uses true ultimate soil pressure profile **62513.64 K-in**
Required As=	20.93 Sq-Inches	
Minimum As=	11.66 Sq-Inches	
Use=	**20.93 Sq-Inches**	
Long Rebar used	10	Ld Reqd **38.1** Ld Available 29.00
Number of Rebars	20	Average Spacing 5.3684 Inches Maximum Spacing is 18"
Total As provided=	25.400 Sq-Inches	This can be used to reduce Ld by the ratio of (As prov/As Reqd)

As prov/As reqd 1.214
Reduced Ld 31.39

Footing Size and Thickness Calculation based on Shear Considerations and true soil pressure... Enter Yellow Values
C20

P live load	4440	K	LL Factor	1.6	
P dead load	7760	K	DL Factor	1.2	
Mll about X axis		K-ft	WL Factor	1.6	
Mdl about X axis		K-ft	Shear Fac	0.75	
Mwl about X axis		K-ft	(Moment caused by Wind load)		
CW=Width of Col.	42	Inches			
CL=Depth of Col.	42	Inches			
q allowable	120	Ksf	(compare to E24)		
W = Footing Width used	10	Ft	(X direction)		
L = Footing Length used	10	Ft	(Y direction)		
f'c	10000	Psi			
fy	60	Ksi			
Est. Ftg thickness	66	Inches	(d shown below)		
Include Ftg weight	y	(Y or N)			

Bar	Ld	Area
3	9.00	0.11
4	12.00	0.2
5	15.00	0.31
6	18.00	0.44
7	26.25	0.6
8	30.00	0.79
9	33.84	1
10	38.10	1.27
11	42.30	1.57



Short Rebars run along the Width and carry the short moment.

Long Rebars run along the length and carry the long moment.

Ftg Weight=	79.75	K (included in qs)
Pa=	12200.00	K without ftg weight
Pu=	16416.00	K without ftg weight
Mu X axis=	0	K-ft
Actual max soil pressure qs =	122.80	Ksf RESIZE
Actual min soil pressure qs =	122.80	Ksf includes ftg weight
Ultimate max soil pressure qu =	165.12	Ksf without ftg weight
Ultimate min soil pressure qu =	165.12	Ksf without ftg weight
d =	62	inches (assume thickness-4 inches)

Footing Two Way Shear Calculation (Uses avg. ult. soil pressure)

Pu=	16416	K (same as previously calculated)
Average qu=	165.117	Ksf
Vu=	4013.88	K
Vn=	5351.84	K
bo=	416	(Inches: perimeter around column, d/2 away)
β	1	
Vc=	10316.80	K **OK**

Footing One Way Shear Calc - Long Direction-(Uses true ult. soil pressure profile)

b=	120	Inches (same as footing width)	
cs-e=	-1.92	Ft: (Distance: from crit. section to edge of footing)	-23.00 Inches
quc=	165.12	Ksf: qu at critical section (d from face of column)	1.146646 Ksi
Vu Component 1:	-3164.743		
Vu Component 2:	0		
Vu=	-3164.74	K	
Vn=	-4219.66	K	
Vc=	1488.00	K **OK**	

Short Moment Calculations

Face of Col to Edge of Footing:	3.25	Ft	39.00 Inches	
Footing Mu Short=	**8720.24**	**K-Ft**	Uses Average ultimate soil pressure	**104642.90 K-in**
Required for moment As=	31.73	Sq-Inches		
Minimum As=	14.26	Sq-Inches		
Use=	**31.73**	**Sq-Inches**		
As in Mid Band=	**31.73**	**Sq-Inches**		
Short Rebar used	10		Ld Reqd **38.1**	Ld Available 36.00
Number of Rebars	24		Average Spacing 4.9565 inches	Maximum Spacing is 18"
Total As provided=	**30.480**	Sq-Inches	This can be used to reduce Ld by the ratio of (As prov/As Reqd)	
Min. # of Rebars Req'd in Mid Band:	25			

As prov/As reqd 0.961
Reduced Ld 39.67

Long Moment Calculations

Face of Column to edge of footing	3.25	Ft	39.00 Inches	
qu at face of col:	165.12	Ksf	(ultimate soil pressure at face of column)	1.1466458 Ksi
Moment Force Component 1:	5366.30	K	(based on rectangular area)	
Moment Force Component 2:	0.00	K	(based on triangular area)	
Moment Arm 1:	1.63	Ft		
Moment Arm 2:	2.17	Ft		
Footing Mu Long=	**8720.24**	**K-Ft**	Uses true ultimate soil pressure profile	**104642.90 K-in**
Required As=	31.73	Sq-Inches		
Minimum As=	14.26	Sq-Inches		
Use=	**31.73**	**Sq-Inches**		
Long Rebar used	10		Ld Reqd **38.1**	Ld Available 36.00
Number of Rebars	24		Average Spacing 4.9565 inches	Maximum Spacing is 18"
Total As provided=	**30.480**	Sq-Inches	This can be used to reduce Ld by the ratio of (As prov/As Reqd)	

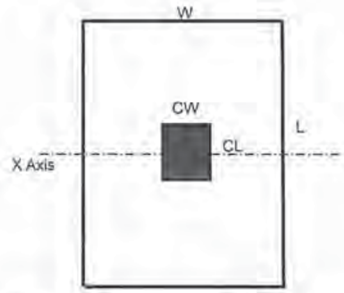
As prov/As reqd 0.961
Reduced Ld 39.67

Footing Size and Thickness Calculation based on Shear Considerations and true soil pressure... Enter Yellow Values

C21

P live load	4270	K	LL Factor	1.6			
P dead load	6210	K	DL Factor	1.2			
Mll about X axis		K-ft	WL Factor	1.6			
Mdl about X axis		K-ft	Shear Fac	0.75			
Mwl about X axis		K-ft (Moment caused by Wind load)					
CW=Width of Col.	38	Inches					
CL=Depth of Col.	38	Inches					
q allowable	120	Ksf (compare to E24)					
W = Footing Width used	10	Ft	(X direction)				
L = Footing Length used	10	Ft	(Y direction)				
f'c	10000	Psi					
fy	60	Ksi					
Est. Ftg thickness	66	Inches (d shown below)					
Include Ftg weight	y	(Y or N)					

Bar	Ld	Area
3	9.00	0.11
4	12.00	0.2
5	15.00	0.31
6	18.00	0.44
7	26.25	0.6
8	30.00	0.79
9	33.84	1
10	38.10	1.27
11	42.30	1.57



Short Rebars run along the Width and carry the short moment.

Long Rebars run along the length and carry the long moment.

Ftg Weight=	79.75	K (included in qs)
Pa=	10480.00	K without ftg weight
Pu=	14284.00	K without ftg weight
Mu X axis=	0	K-ft
Actual max soil pressure qs =	**105.60**	**Ksf OK**
Actual min soil pressure qs =	105.60	Ksf includes ftg weight
Ultimate max soil pressure qu =	143.80	Ksf without ftg weight
Ultimate min soil pressure qu =	143.80	Ksf without ftg weight
d =	62	inches (assume thickness-4 inches)

Footing Two Way Shear Calculation (Uses avg. ult. soil pressure)

Pu=	14284	K (same as previously calculated)
Average qu=	143.797	Ksf
Vu=	4298.10	K
Vn=	5730.80	K
bo=	400	(Inches: perimeter around column, d/2 away)
β	1	
Vc=	9920.00	K **OK**

Footing One Way Shear Calc - Long Direction-(Uses true ult. soil pressure profile)

b=	120	Inches (same as footing width)	
cs-e=	-1.75	Ft: (Distance: from crit. section to edge of footing)	-21.00 Inches
quc=	143.80	Ksf: qu at critical section (d from face of column)	0.99859 Ksi
Vu Component 1:	-2516.448		
Vu Component 2:	0		
Vu=	-2516.45	K	
Vn=	-3355.26	K	
Vc=	1488.00	K **OK**	

Short Moment Calculations

Face of Col to Edge of Footing:	3.42	Ft	41.00 Inches
Footing Mu Short=	**8393.15**	**K-Ft**	Uses Average ultimate soil pressure **100717.82 K-in**
Required for moment As=	30.52	Sq-Inches	
Minimum As=	14.26	Sq-Inches	
Use=	**30.52**	**Sq-Inches**	
As in Mid Band=	**30.52**	**Sq-Inches**	
Short Rebar used	10		Ld Reqd **38.1** Ld Available 38.00
Number of Rebars	24		Average Spacing 4.9565 inches Maximum Spacing is 18"
Total As provided=	**30.480**	Sq-Inches	This can be used to reduce Ld by the ratio of (As prov/As Reqd)
Min. # of Rebars Req'd in Mid Band:	25		

As prov/As reqd 0.999
Reduced Ld 38.16

Long Moment Calculations

Face of Column to edge of footing	3.42	Ft	41.00 Inches
qu at face of col:	143.80	Ksf	(ultimate soil pressure at face of column) 0.9985903 Ksi
Moment Force Component 1:	4913.06	K	(based on rectangular area)
Moment Force Component 2:	0.00	K	(based on triangular area)
Moment Arm 1:	1.71	Ft	
Moment Arm 2:	2.28	Ft	
Footing Mu Long=	**8393.15**	**K-Ft**	Uses true ultimate soil pressure profile **100717.82 K-in**
Required As=	30.52	Sq-Inches	
Minimum As=	14.26	Sq-Inches	
Use=	**30.52**	**Sq-Inches**	
Long Rebar used	10		Ld Reqd **38.1** Ld Available 38.00
Number of Rebars	24		Average Spacing 4.9565 inches Maximum Spacing is 18"
Total As provided=	**30.480**	Sq-Inches	This can be used to reduce Ld by the ratio of (As prov/As Reqd)

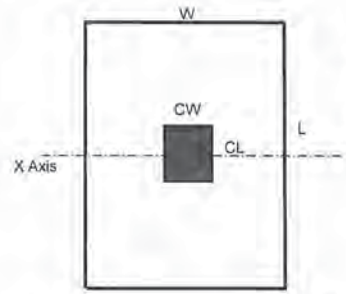
As prov/As reqd 0.999
Reduced Ld 38.16

20

Footing Size and Thickness Calculation based on Shear Considerations and true soil pressure... Enter Yellow Values
C22

P live load	2020	K	LL Factor	1.6			
P dead load	8100	K	DL Factor	1.2			
Mll about X axis		K-ft	WL Factor	1.6			
Mdl about X axis		K-ft	Shear Fac	0.75			
Mwl about X axis		K-ft (Moment caused by Wind load)					
CW=Width of Col.	42	Inches					
CL=Depth of Col.	42	Inches					
q allowable	120	Ksf (compare to E24)					
W = Footing Width used	10	Ft	(X direction)				
L = Footing Length used	10	Ft	(Y direction)				
f'c	10000	Psi					
fy	60	Ksi					
Est. Ftg thickness	66	Inches	(d shown below)				
Include Ftg weight	y	(Y or N)					

Bar	Ld	Area
3	9.00	0.11
4	12.00	0.2
5	15.00	0.31
6	18.00	0.44
7	26.25	0.6
8	30.00	0.79
9	33.84	1
10	38.10	1.27
11	42.30	1.57



Short Rebars run along the Width and carry the short moment.

Long Rebars run along the length and carry the long moment.

Ftg Weight=	79.75	K (included in qs)
Pa=	10120.00	K without ftg weight
Pu=	12952.00	K without ftg weight
Mu X axis=	0	K-ft
Actual max soil pressure qs =	**102.00**	**Ksf** OK
Actual min soil pressure qs =	102.00	Ksf includes ftg weight
Ultimate max soil pressure qu =	130.48	Ksf without ftg weight
Ultimate min soil pressure qu =	130.48	Ksf without ftg weight
d =	62	inches (assume thickness-4 inches)

Footing Two Way Shear Calculation (Uses avg. ult. soil pressure)

Pu=	12952	K (same as previously calculated)
Average qu=	130.477	Ksf
Vu=	3151.73	K
Vn=	4202.30	K
bo=	416	(Inches: perimeter around column, d/2 away)
β	1	
Vc=	10316.80	K **OK**

Footing One Way Shear Calc - Long Direction-(Uses true ult. soil pressure profile)

b=	120	Inches (same as footing width)		
cs-e=	-1.92	Ft: (Distance: from crit. section to edge of footing)	-23.00	Inches
quc=	130.48	Ksf: qu at critical section (d from face of column)	0.90609	Ksi
Vu Component 1:	-2500.809			
Vu Component 2:	0			
Vu=	-2500.81	K		
Vn=	-3334.41	K		
Vc=	1488.00	K **OK**		

Short Moment Calculations

Face of Col to Edge of Footing	3.25	Ft	39.00 Inches	
Footing Mu Short=	**6890.82**	**K-Ft**	Uses Average ultimate soil pressure	**82689.80 K-in**
Required for moment As=	24.99	Sq-Inches		
Minimum As=	14.26	Sq-Inches		
Use=	**24.99**	**Sq-Inches**		
As in Mid Band=	**24.99**	**Sq-Inches**		
Short Rebar used	10		Ld Reqd **38.1**	Ld Available 36.00
Number of Rebars	24		Average Spacing 4.9565 inches	Maximum Spacing is 18"
Total As provided=	30.480	Sq-Inches	This can be used to reduce Ld by the ratio of (As prov/As Reqd)	
Min. # of Rebars Req'd in Mid Band:	20			

As prov/As reqd 1.219
Reduced Ld 31.24

Long Moment Calculations

Face of Column to edge of footing	3.25	Ft	39.00 Inches	
qu at face of col:	130.48	Ksf	(ultimate soil pressure at face of column)	0.9060903 Ksi
Moment Force Component 1:	4240.50	K	(based on rectangular area)	
Moment Force Component 2:	0.00	K	(based on triangular area)	
Moment Arm 1:	1.63	Ft		
Moment Arm 2:	2.17	Ft		
Footing Mu Long=	**6890.82**	**K-Ft**	Uses true ultimate soil pressure profile	**82689.80 K-in**
Required As=	24.99	Sq-Inches		
Minimum As=	14.26	Sq-Inches		
Use=	**24.99**	**Sq-Inches**		
Long Rebar used	10		Ld Reqd **38.1**	Ld Available 36.00
Number of Rebars	24		Average Spacing 4.9565 inches	Maximum Spacing is 18"
Total As provided=	30.480	Sq-Inches	This can be used to reduce Ld by the ratio of (As prov/As Reqd)	

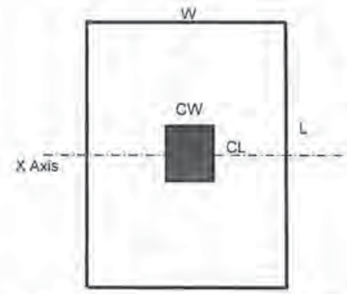
As prov/As reqd 1.219
Reduced Ld 31.24

21

Footing Size and Thickness Calculation based on Shear Considerations and true soil pressure... Enter Yellow Values

C23

						Bar	Ld	Area
P live load	980	K	LL Factor	1.6		3	9.00	0.11
P dead load	2520	K	DL Factor	1.2		4	12.00	0.2
Mll about X axis		K-ft	WL Factor	1.6		5	15.00	0.31
Mdl about X axis		K-ft	Shear Fac	0.75		6	18.00	0.44
Mwl about X axis		K-ft (Moment caused by Wind load)				7	26.25	0.6
CW=Width of Col.	42	Inches				8	30.00	0.79
CL=Depth of Col	42	Inches				9	33.84	1
q allowable	120	Ksf (compare to E24)				10	38.10	1.27
W = Footing Width used	6	Ft	(X direction)			11	42.30	1.57
L = Footing Length used	6	Ft	(Y direction)					
f'c	10000	Psi						
fy	60	Ksi						
Est. Ftg thickness	48	Inches (d shown below)						
Include Ftg weight	y	(Y or N)						



Short Rebars run along the Width and carry the short moment.

Long Rebars run along the length and carry the long moment.

Ftg Weight=	20.88	K (included in qs)
Pa=	3500.00	K without ftg weight
Pu=	4592.00	K without ftg weight
Mu X axis=	0	K-ft
Actual max soil pressure qs =	**97.80**	**Ksf OK**
Actual min soil pressure qs =	97.80	Ksf includes ftg weight
Ultimate max soil pressure qu =	128.25	Ksf without ftg weight
Ultimate min soil pressure qu =	128.25	Ksf without ftg weight
d =	44	inches (assume thickness-4 inches)

Footing Two Way Shear Calculation (Uses avg. ult. soil pressure)

Pu=	4592	K (same as previously calculated)
Average qu=	128.252	Ksf
Vu=	-1995.14	K
Vn=	-2660.19	K
bo=	344	(Inches: perimeter around column, d/2 away)
β	1	
Vc=	6054.40	K **OK**

Footing One Way Shear Calc - Long Direction-(Uses true ult. soil pressure profile)

b=	72	Inches (same as footing width)		
cs-e=	-2.42	Ft: (Distance: from crit. section to edge of footing)	-29.00	Inches
quc=	128.25	Ksf: qu at critical section (d from face of column)	0.890636	Ksi
Vu Component 1:	-1859.648			
Vu Component 2:	0			
Vu=	-1859.65	K		
Vn=	-2479.53	K		
Vc=	633.60	K **OK**		

Short Moment Calculations

Face of Col to Edge of Footing:	1.25	Ft	15.00 Inches	
Footing Mu Short=	**601.18**	**K-Ft**	Uses Average ultimate soil pressure	**7214.15 K-in**
Required for moment As=	3.05	Sq-Inches		
Minimum As=	6.22	Sq-Inches		
Use=	**6.22**	**Sq-Inches**		
As in Mid Band=	**6.22**	**Sq-Inches**		
Short Rebar used	9		Ld Reqd **33.84** Ld Available 12.00	
Number of Rebars	10		Average Spacing 7.3333 inches	Maximum Spacing is 18"
Total As provided=	10.000	Sq-Inches	This can be used to reduce Ld by the ratio of (As prov/As Reqd)	
Min. # of Rebars Req'd in Mid Band:	7			

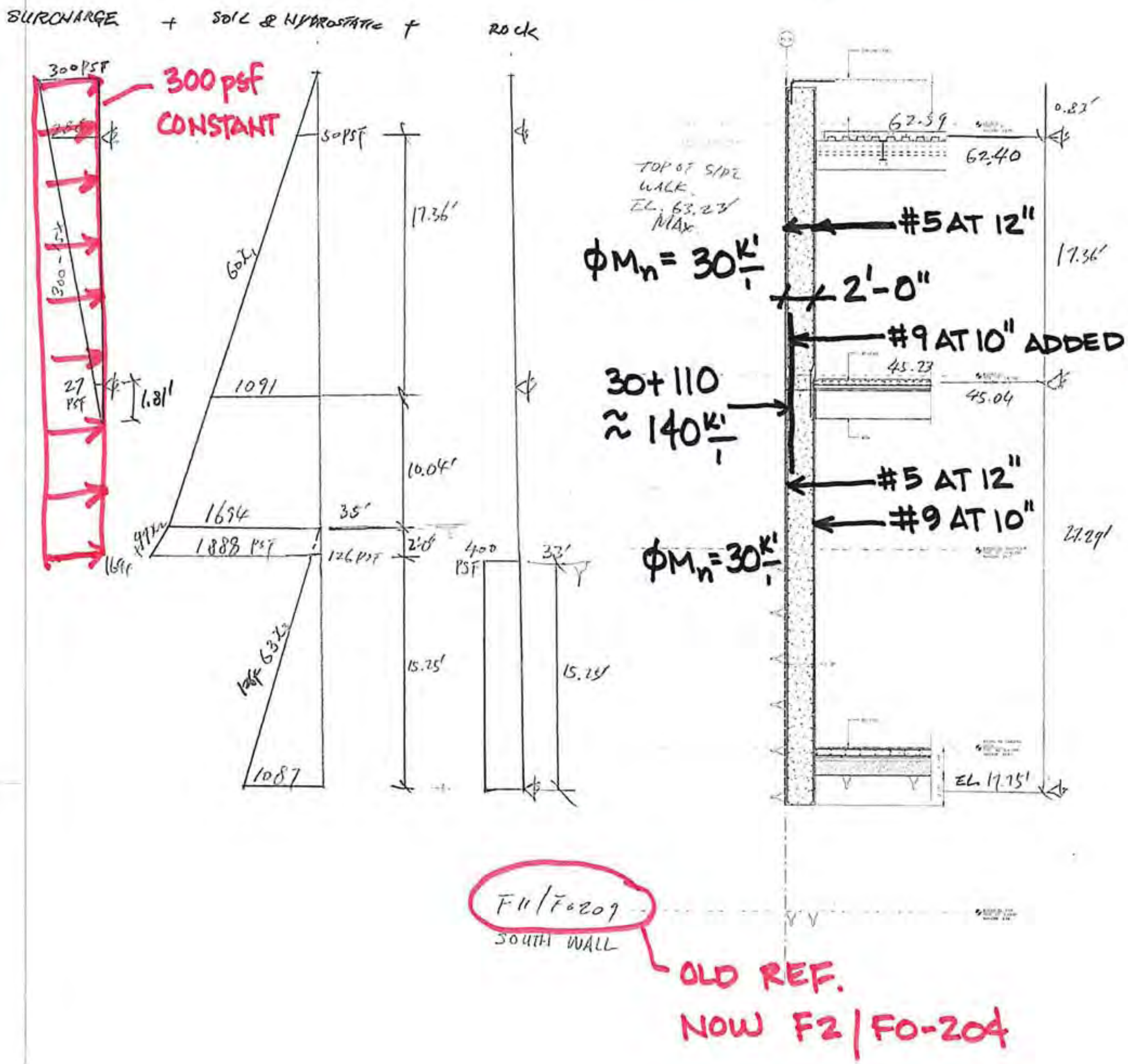
As prov/As reqd 1.608
Reduced Ld 21.05

Long Moment Calculations

Face of Column to edge of footing	1.25	Ft	15.00 Inches	
qu at face of col:	128.25	Ksf	(ultimate soil pressure at face of column)	0.8906358 Ksi
Moment Force Component 1:	961.89	K	(based on rectangular area)	
Moment Force Component 2:	0.00	K	(based on triangular area)	
Moment Arm 1:	0.63	Ft		
Moment Arm 2:	0.83	Ft		
Footing Mu Long=	**601.18**	**K-Ft**	Uses true ultimate soil pressure profile	**7214.15 K-in**
Required As=	3.05	Sq-Inches		
Minimum As=	6.22	Sq-Inches		
Use=	**6.22**	**Sq-Inches**		
Long Rebar used	9		Ld Reqd **33.84** Ld Available 12.00	
Number of Rebars	10		Average Spacing 7.3333 inches	Maximum Spacing is 18"
Total As provided=	10.000	Sq-Inches	This can be used to reduce Ld by the ratio of (As prov/As Reqd)	

As prov/As reqd 1.608
Reduced Ld 21.05

SOUTH WALL



$\phi M_n = 32^{k'}/_1$

$\phi V_n = 40^{k}/_1$

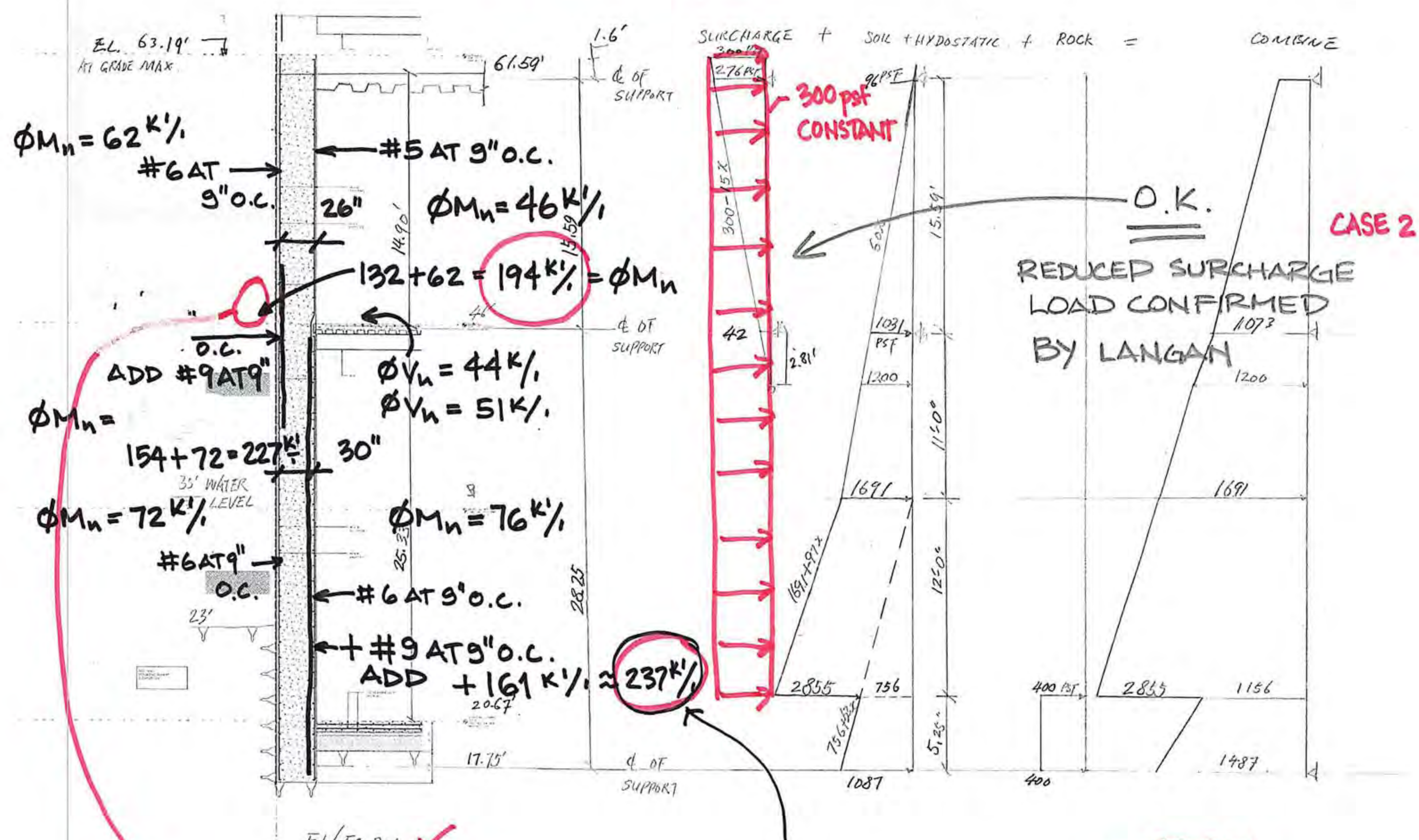
CASE 1

$\phi M_n = 115^{k'}/_1$

$\phi V_n = 40^{k}/_1$

CASE 1 OK.

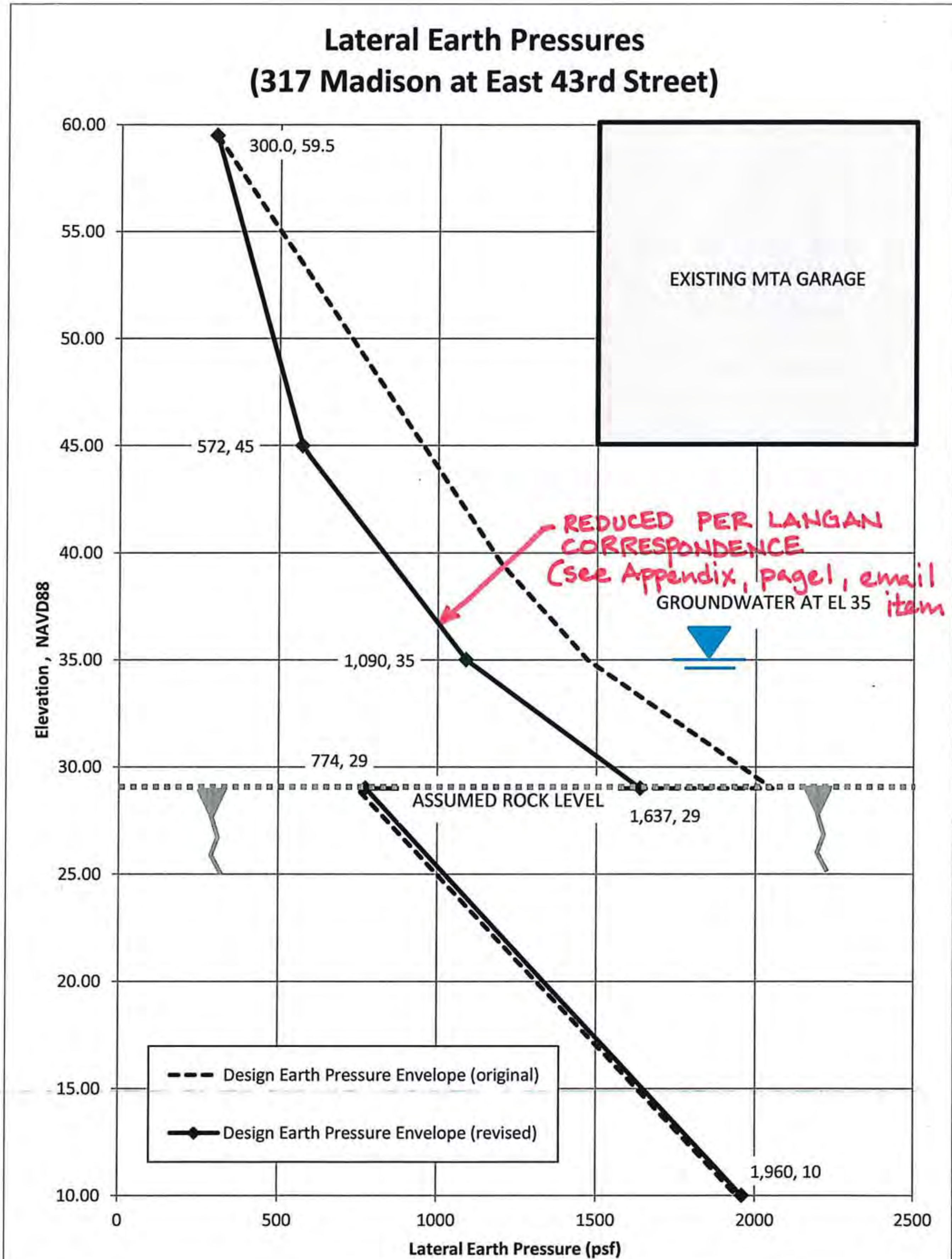
WEST WALL



F1/F0-201 ✓
WEST WALL
CASE 2

OVERSTRESSED $\frac{224}{194} = 1.15$ ← SEE DIAG

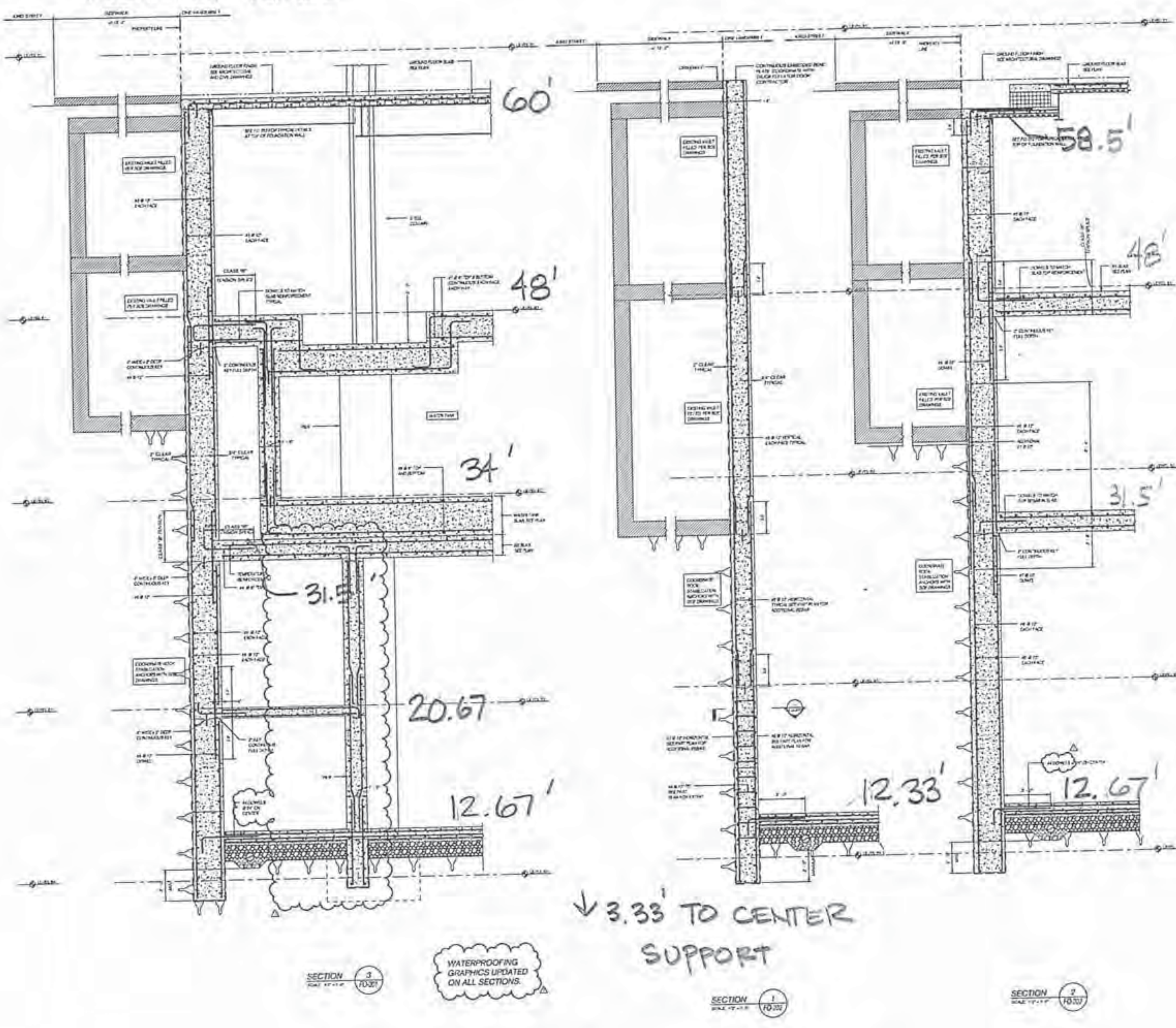
OVERSTRESSED $\frac{254}{237} = 1.07$ ← SEE DIAG.


Lateral Earth Pressures
(317 Madison at East 43rd Street)
60.00
55.00
50.00
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
Elevation , NAVD88
0
500
1000
1500
2000
2500
Lateral Earth Pressure (psf)
300.0, 59.5
572, 45
1,090, 35
774, 29
1,637, 29
1,960, 10
EXISTING MTA GARAGE
GROUNDWATER AT EL 35
ASSUMED ROCK LEVEL
REDUCED PER LANGAN CORRESPONDENCE (see Appendix, page1, email item 2).
Design Earth Pressure Envelope (original)
Design Earth Pressure Envelope (revised)

Thornton Tomasetti

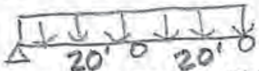
PROJECT: ONE VANDERBILT | PROJECT NO. | DATE: 2/8/16
BY: JRY | SHEET | of
SUBJECT: FOUNDATION PEER REVIEW | CHECKED BY | DRAWING NO.

NORTH WALL



$M_u = 28^{k'}/' < 30^{k'}/'$ O.K.
$V_u = 14.8^{k}/' < 40^{k}/'$ O.K.

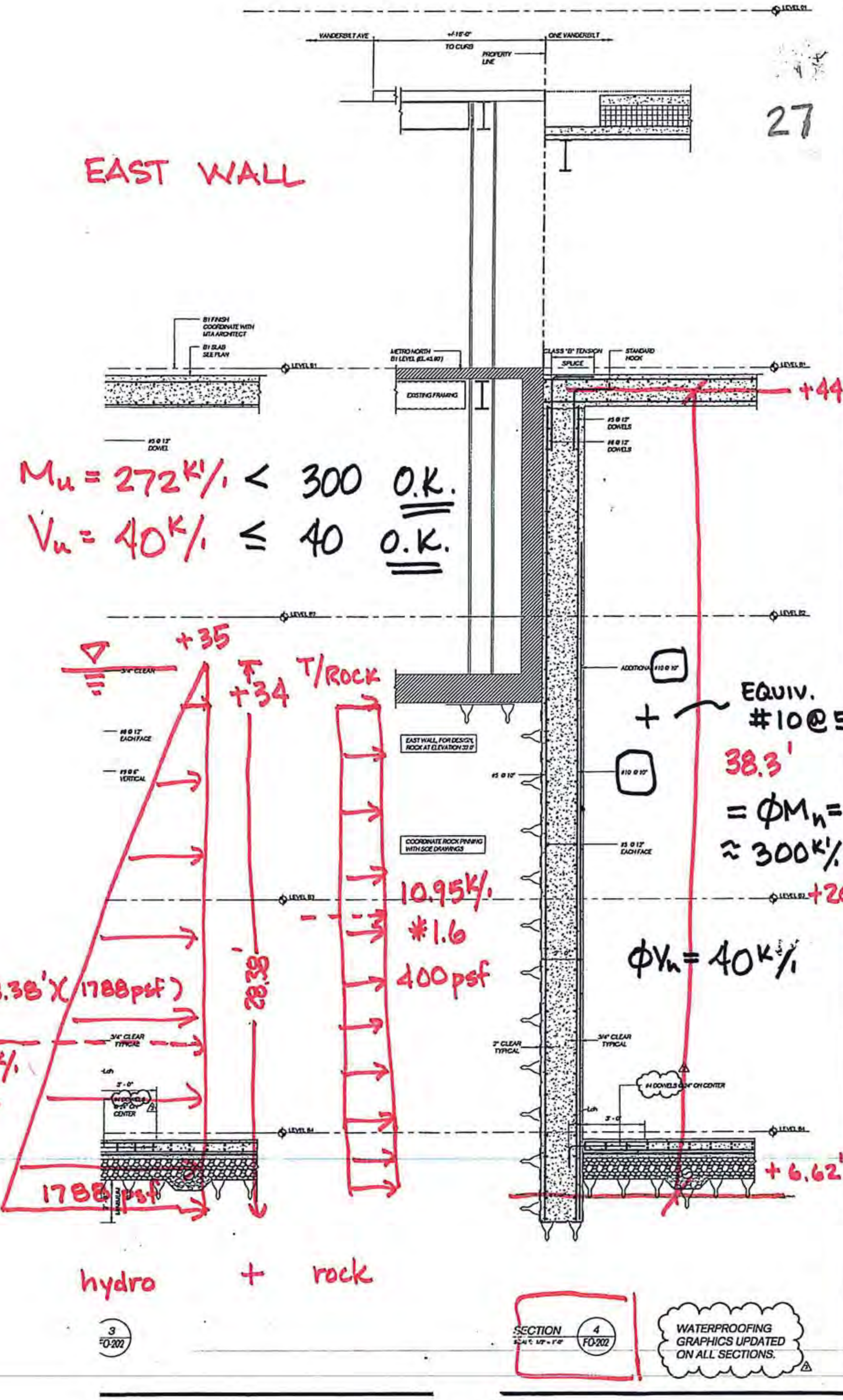
HORIZONTAL SPAN



w/o STIRRUPS #5 AT 12"
$\phi M_n = 21.8^{k'}/'$
$\phi V_c = 28.9^{k}/'$

$M_u^- = 83.8^{k'}/'$
$M_u^+ = 75.8^{k'}/'$
$V_u = 24.7^{k}/'$
$\phi M_n^+ = 99.6^{k'}/'$ O.K
$\phi M_n^- = 94.0^{k'}/'$ O.K
$\phi V_u = 40^k > 24.7$ O.K

w/o shear reinf. $28.9^k \geq w_u(\frac{20}{2}) \Rightarrow w_u \leq 2890$ plf
$\Rightarrow w_s \leq 1806$ plf ≈ 1906 plf ∴ Stirrups B4→B3
total moment o.k. assuming fixity @ walls



Developer
SL Green

Development Advisor

Architect
Kohn Pedersen Fox Associates PC

Structural Engineer

Mechanical, Electrical, Plumbing, Fire Protection

Civil / Geotechnical Engineer
Langan Engineering, Environmental, Surveying and Landscape Architecture, D.P.C.

Vertical Transportation

Code Consulting
Code Consultants, Inc.

DOCUMENT ISSUANCE NO 3
DOCUMENT ISSUANCE NO 1

Key Plan

Drawing Title
FOUNDATIONS SECTIONS 2

Drawing Number
FO-202

Table: Nodal Reactions – (48) 250 TON ROCK ANCHORS (K= 10,250 K/IN)

Nodal Reactions, Part 1 of 2

Node	Point	OutputCase	CaseType	Fx	Fy	Fz	Mx
2	2	2	2	1	1	1	1
154	154	SERV ENV	Combination	-4.461E-006	-3.588E-006	-467.142	0.0000
155	155	SERV ENV	Combination	-3.745E-006	-3.083E-006	-457.967	0.0000
156	156	SERV ENV	Combination	-3.850E-006	-3.458E-006	-447.112	0.0000
157	157	SERV ENV	Combination	-3.804E-006	-3.122E-006	-401.771	0.0000
166	166	SERV ENV	Combination	-8.443E-008	-1.081E-006	-379.617	0.0000
171	171	SERV ENV	Combination	1.084E-007	-9.894E-007	-372.641	0.0000
167	167	SERV ENV	Combination	-1.948E-009	-5.549E-007	-370.179	0.0000
165	165	SERV ENV	Combination	-2.146E-007	-1.427E-006	-369.272	0.0000
170	170	SERV ENV	Combination	1.835E-007	-5.103E-007	-361.899	0.0000
164	164	SERV ENV	Combination	-1.155E-007	-6.912E-007	-358.714	0.0000
146	146	SERV ENV	Combination	-4.877E-006	-8.231E-007	-352.621	0.0000
158	158	SERV ENV	Combination	-4.544E-006	-2.881E-006	-351.334	0.0000
162	162	SERV ENV	Combination	-1.151E-006	-1.782E-006	-342.832	0.0000
159	159	SERV ENV	Combination	-4.515E-006	-3.280E-006	-328.502	0.0000
161	161	SERV ENV	Combination	-4.822E-007	-6.366E-007	-321.310	0.0000
182	182	SERV ENV	Combination	4.581E-007	-1.470E-006	-319.278	0.0000
178	178	SERV ENV	Combination	3.108E-007	-6.762E-007	-308.848	0.0000
144	144	SERV ENV	Combination	-4.199E-006	-6.112E-007	-290.637	0.0000
168	168	SERV ENV	Combination	-3.538E-008	-7.417E-007	-288.536	0.0000
169	169	SERV ENV	Combination	4.098E-007	-6.395E-007	-281.760	0.0000
179	179	SERV ENV	Combination	3.001E-007	-6.620E-007	-278.693	0.0000
163	163	SERV ENV	Combination	-5.328E-007	-8.817E-007	-276.765	0.0000
176	176	SERV ENV	Combination	5.548E-007	-1.423E-006	-261.245	0.0000
173	173	SERV ENV	Combination	5.023E-007	-8.288E-007	-252.716	0.0000
160	160	SERV ENV	Combination	-1.435E-006	-1.281E-006	-246.889	0.0000
183	183	SERV ENV	Combination	2.538E-007	-1.556E-006	-237.410	0.0000
180	180	SERV ENV	Combination	3.203E-007	-7.948E-007	-236.509	0.0000
174	174	SERV ENV	Combination	4.921E-007	-8.419E-007	-235.642	0.0000
175	175	SERV ENV	Combination	5.266E-007	-1.029E-006	-235.285	0.0000
177	177	SERV ENV	Combination	5.918E-007	-1.365E-006	-226.890	0.0000
172	172	SERV ENV	Combination	4.879E-007	-5.942E-007	-216.747	0.0000
153	153	SERV ENV	Combination	4.714E-007	-1.360E-007	-205.414	0.0000
181	181	SERV ENV	Combination	2.952E-007	-9.817E-007	-200.840	0.0000
184	184	SERV ENV	Combination	2.083E-007	-1.490E-006	-182.174	0.0000
151	151	SERV ENV	Combination	4.520E-007	-1.988E-007	-172.407	0.0000
147	147	SERV ENV	Combination	-5.209E-006	-6.802E-007	-170.088	0.0000
185	185	SERV ENV	Combination	2.390E-007	-1.699E-006	-156.825	0.0000
186	186	SERV ENV	Combination	-4.809E-007	-1.776E-006	-146.196	0.0000
149	149	SERV ENV	Combination	5.800E-007	-3.276E-007	-137.520	0.0000
145	145	SERV ENV	Combination	-6.151E-006	-5.886E-007	-107.567	0.0000
143	143	SERV ENV	Combination	-4.533E-006	-8.068E-007	-70.659	0.0000
152	152	SERV ENV	Combination	3.864E-007	-3.880E-008	-70.448	0.0000
187	187	SERV ENV	Combination	-4.459E-007	-1.937E-006	-23.968	0.0000
150	150	SERV ENV	Combination	5.108E-007	-1.093E-007	-22.408	0.0000
142	142	SERV ENV	Combination	-3.738E-006	-6.814E-007	-9.358	0.0000
148	148	SERV ENV	Combination	5.124E-007	-2.002E-007	1.733	0.0000
141	141	SERV ENV	Combination	3.983E-007	-6.016E-007	7.009	0.0000
140	140	SERV ENV	Combination	5.305E-007	-2.412E-007	16.407	0.0000

Table: Nodal Reactions

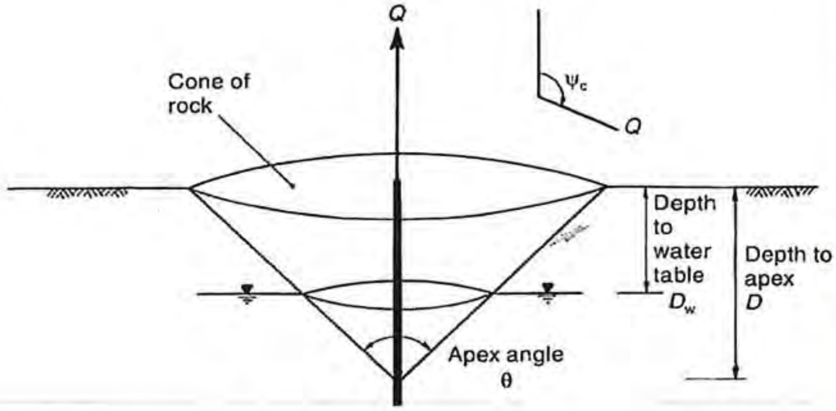
Nodal Reactions, Part 2 of 2

Node	Point	OutputCase	My	Mz
2	2	2	1	1
154	154	SERV ENV	0.0000	0.0000
155	155	SERV ENV	0.0000	0.0000
156	156	SERV ENV	0.0000	0.0000
157	157	SERV ENV	0.0000	0.0000
166	166	SERV ENV	0.0000	0.0000
171	171	SERV ENV	0.0000	0.0000

CAPACITY OF ANCHOR LOADED IN TENSION

Project: 1 Vanderbilt Ave
Project No.: 170140801
Location: 1 Vanderbilt Avenue, New York, NY
Date:
By: S Martin

Anchor No: **NA**
Tension Load: **500** **kips**
OK? **OK**



$$Q = \frac{(f_{(r)} + W_c \cos \Psi_c)}{FS}$$

Where:

Q = Tension Capacity
$f_{(r)}$ = rock strength on the surface of the cone
W_c = weight of rock in the cone
ψ_c = angle between vertical and load direction — 0 degrees; 0 radians
FS = factor of safety = 2

Input:

D = Depth to apex =	22	feet
D_w = Depth to water =	0	feet
Unit Weight of Rock =	160	pcf
Unit Weight of Water =	62.4	pcf
Apex Angle, θ =	70	degrees
Apex Angle, θ =	1.222	radians

Q =	2809	kips

1. Bouyant Weight of the Cone:

W_c =	533581	lbs
W_c =	534	kips

$$W_c = \frac{\pi}{3}\tan^2\left(\frac{\theta}{2}\right)[D^3\gamma_r - (D - D_w)^3\gamma_w]$$

2. Tensile Strength of Fractured Rock:

$\sigma_{u(r)}$ =	6800	psi	unconfined compressive strength of rock
$\sigma_{u(r)}$ =	979200	psf	
m =	5.31		from Hoek and Brown, 1988
s =	0.04		from Hoek and Brown, 1988
FS =	2		*2 for massive rock to 4 for closely fractured rock
σ_t =	-3912	psf	tensile strength of rock
σ_t =	-27	psi	

$$\sigma_t = \frac{\sigma_{u(r)}}{2}\left[m - (m^2 + 4s)^{1/2}\right]\frac{1}{FS}$$

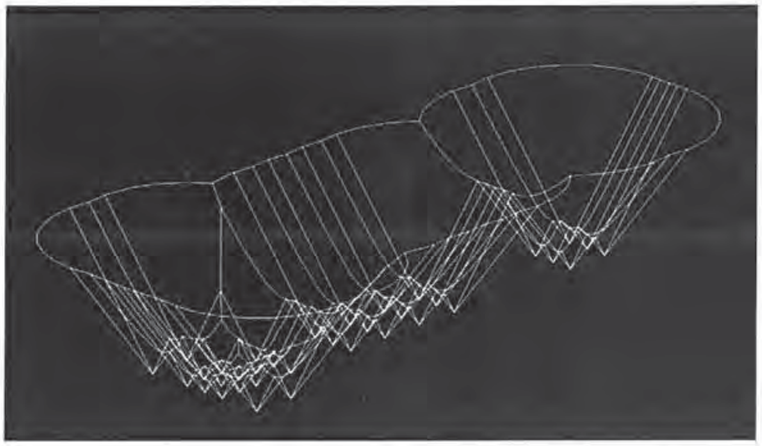
3. Rock Strength on the Surface of the Cone:

absolute value

$f_{(r)}$ =	5085214	lbs
$f_{(r)}$ =	5085	kips

$$f_{(r)} = \frac{\sigma_t \pi D^2 \tan(\theta/2)}{\cos(\theta/2)}$$

LANGAN 21 Penn Plaza 360 West 31st Street, 8th Floor New York, NY 10001-2727 P: +1.212.479.5400 F: +1.212.479.5444 www.langan.com NEW JERSEY PENNSYLVANIA NEW YORK CONNECTICUT FLORIDA VIRGINIA CALIFORNIA ABU DHABI DUBAI ATHENS DOHA ISTANBUL	Project 1 Vanderbilt Ave Manhattan New York	Drawing Title CAPACITY OF ANCHOR LOADED IN TENSION	Project No. 170140801 Date 4/7/2014 Scale n/a Drawn By S Martin	Drawing No. 1 Sheet 1 of 1



Trough Surface Area:	8326	ft^2	1198944	in^2
Cones Volume:	49927	ft^3		
Unit Weight	97.6	pcf		
Total Weight	4872875	lbs		
	4873	kips		
Tensile Strength	-27.170	psi		
	32575277			
	32575	kips		
FS	2			
TOTAL resistance	18724	kips		
TOTAL load	17000	kips		
CHECK	OK			

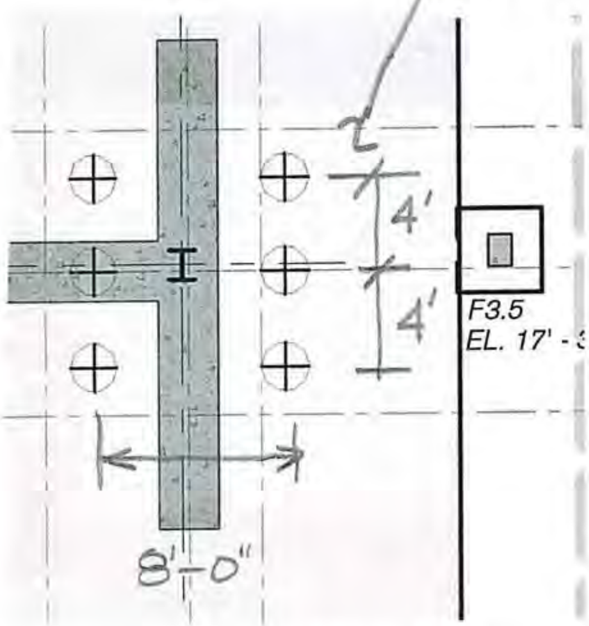
Thornton Tomasetti

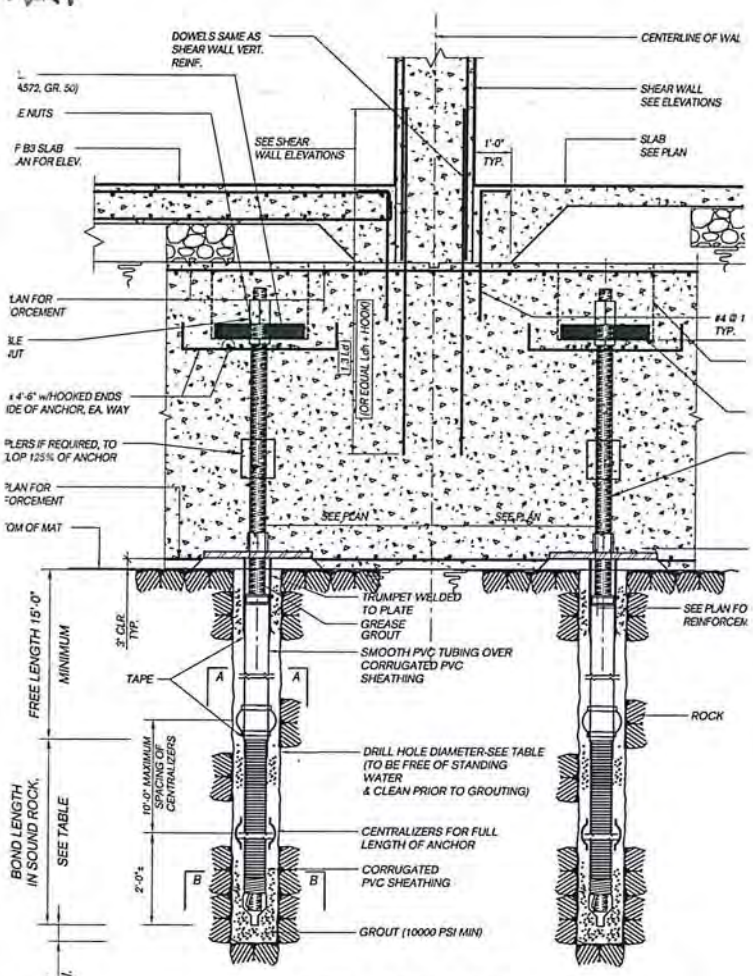
PROJECT	ONE VANDERBILT	PROJECT NO.		DATE	2/5/16
		BY	JRX	SHEET	of
SUBJECT	FOUNDATION PEER REVIEW	CHECKED BY		DRAWING NO.	

Grid
C-C / C-3
Shear Wall

CHECK ROCK ANCHOR PULL-OUT OF CONCRETE MAT

9'-6" MAT





TYPICAL ROCK ANCHOR DETAIL

$$\phi N_{cbg} = \phi \psi_3 \, 16\sqrt{f'_c}\, h_{ef}^{5/3} \frac{A_N}{A_{No}}$$

$\phi = 0.70 \quad f_c = 10000\,psi$

$\psi_3 = 1.0 \quad h_{ef} = 90''$

$$A_{No} = 9(90'')^2 = 72900\,in^2$$

$$\phi N_{cb} = 0.7(1.0)\,16\,\frac{\sqrt{10000}}{1000}\,(90)^{1.67}\,\frac{(135(2)+96)^2}{72900}$$

$$= \frac{3776^K}{6 \text{ ANCHORS}} = \frac{629^K}{470^K} \approx 1.34 \text{ L.F. ASSUMING}$$

ALL ANCHORS STRESSED

MAX CALC. TO MAX ∴ O.K.

APPENDIX 4

DRAWING LIST SERVING AS A BASIS FOR PEER REVIEW

STRUCTURAL DRAWING LIST		
SHEET NUMBER	DRAWING TITLE	FOUNDATION PERMIT 09-01-2015
FO-100.00	FOUNDATION AND B4 LEVEL PLAN	■
FO-101.00	B3 LEVEL PLAN	■
FO-201.00	FOUNDATION SECTIONS 1	■
FO-202.00	FOUNDATION SECTIONS 2	■
FO-203.00	FOUNDATION SECTIONS 3	■
FO-204.00	FOUNDATION SECTIONS 4	■
FO-205.00	FOUNDATION SECTIONS 5	■
FO-206.00	FOUNDATION SECTIONS 6	■
FO-207.00	FOUNDATION SECTIONS 7	■
FO-251.00	FOUNDATION TYPICAL DETAILS 1	■
FO-252.00	FOUNDATION TYPICAL DETAILS 2	■
S-010.00	COLUMN COORDINATE PLAN	■
S-099.00	B2 FLOOR FRAMING PLAN	■
S-100.00	B1 FLOOR FRAMING PLAN	■
S-101.00	GROUND FLOOR FRAMING PLAN	■
S-601.00	COLUMN SCHEDULE 1	■
S-651.00	COLUMN DETAILS 1	■
S-701.00	GENERAL NOTES	■
S-702.00	LOADING SCHEDULE	■
S-703.00	TYPICAL FLOOR CONSTRUCTION DETAILS	■

Attachment A
STRUCTURAL PEER REVIEW STATEMENT

This structural peer review and report is complete for the whole building, or
For phase __1__ of __2__ phased submissions

Structural peer reviewer name: MICHAEL SQUARZINI

Structural peer reviewer address: 51 MADISON AVE. NEW YORK, NY 10010

Project address: ONE VANDERBILT AVE. NEW YORK, NY 10017

Department application number for structural work: 121189828

Structural Peer Reviewer Statement

I (insert name) MICHAEL SQUARZINI ***am a qualified and independent NYS licensed and registered engineer in accordance with BC Section 1617.4, and I have reviewed the structural plans, specifications, and supplemental reports for (Insert address and DOB application # for structural work)*** 1 VANDERBILT AV. NEW YORK, NY APPLICATION # 121189828 ***and found that the structural design shown on the plans and specifications generally conforms to the foundation and structural requirements of Title 28 of the Administrative Code and the NYC Construction Codes. The Structural Peer Review Report is attached.***

New York State Registered Design Professional
(for Structural Peer Review only)

Name (please print) Michael Squarzini

Signature ________ Date 02/10/16

PE/RA Seal (apply seal, then sign and date over seal)

MICHAEL J. SQUARZINI · LICENSED PROFESSIONAL ENGINEER · 080640

cc: Project Owner
Project Registered Design Professional