DEPT OF BLDGS121191441 Job Number

ES375891435 Scan Code

DESIMONE

25 May 2017
SOLOW9W57
Solow Realty & Development, LLC
9 West 57th St, 45th Floor
New York, NY 10019

DeSimone Project # 17214.00

7 WEST 57TH STREET PEER REVIEW

Attn: Mr. Anthony Calicchio
Re: Foundation Structural Peer Review Statement

The structural peer review and report is complete for phase I (Foundation) of the two phased submissions.

Structural Peer Reviewer Name: **Stephen V. DeSimone**

Structural Peer Reviewer Address: **140 Broadway, 25th Fl., New York, NY 10005**

Department Application Number for Structural Work: **NB # 121191441**

Structural Peer Review Statement

We have completed the structural peer review of the foundation design for 7 West 57th Street in accordance with the 2014 New York City Building Code Section 1617 and have found that the current design is in compliance with The Code and reference standards. A detailed report showing our findings is attached.

Please do not hesitate to contact us with any questions or comments.

**DESIMONE CONSULTING ENGINEERS**

STATE OF NEW YORK
STEPHEN V. DeSIMONE
074933
LICENSED PROFESSIONAL ENGINEER

Stephen V. DeSimone, PE, LEED AP
President/Chief Executive

DESIMONE


**7 WEST 57TH STREET**
NEW YORK, NY
STRUCTURAL PEER REVIEW REPORT
FOUNDATION REVIEW

Prepared for:
SOLOW9W57
Solow Realty & Development, LLC

Prepared by:
DeSimone Consulting Engineers

May 25th, 2017

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## I. INTRODUCTION

DeSimone Consulting Engineers was retained by Solow Realty & Development Company, LLC to perform a structural peer review of the 7 West 57th Street project. Hill West Architects are the architect of record and WSP-Parsons Brinckerhoff are the engineer of record for the project. The review is triggered by 2014 New York City Building Code (BC) 1617.2 (2) as the aspect ratio of the building is approximately 8.3 to 1, which exceeds the 7 to 1 threshold. This structural peer review is performed in compliance with BC 1617 and summarizes DeSimone's findings on the foundation system. Per NYCBC Section BC 1617, the following specific items that must checked:

Foundation Review

- Develop an analytical model to confirm overall performance of the structure.
- Review the design loads per BC 1617.5.1 (1).
- Review the design criteria per BC 1617.5.1 (2).
- Review for appropriateness the interpretation of the geotechnical investigation and their recommendations per BC 1617.5.1 (3).
- Review the structural frame and load supporting parts of the foundations per BC 1617.5.1 (4) and review the structural load path for completeness per BC 1617.5.1 (5).
- Perform independent calculations on a representative number of foundation elements (footings, etc.) to verify calculation methodology per BC 1617.5.1 (6).
- General review of the architectural and structural plans and that the structural plans are in general conformance with the architectural plans for loading and other conditions that may affect the structural design per BC 1617.5.1 (9).
- Confirm that major mechanical items are accommodated on the structural plans per BC 1617.5.1 (10).

The following items will be reviewed in a subsequent submission:

SUPERSTRUCTURE REVIEW

- Review the structural frame and load supporting parts of floors, roofs and walls per BC 1617.5.1 (4).
- Perform independent calculations on a representative number of elements (shear walls, columns, beams, slabs, etc.) to verify calculation methodology per BC 1617.5.1 (6).
- Verify that performance-specified structural components have been appropriately specified and coordinated with the primary building structure BC 1617.5.1 (7).
- Review for compliance with the structural integrity provisions of BC 1616, per BC 1617.5.1 (8).
- Attest to the general completeness of the structural plans and specifications BC 1617.5.1 (11).

The building is a new 19-story residential tower with two cellars, a roof, and two bulkhead levels. The structure is located on the north side of West 57th Street between 5th Avenue and 6th Avenues. The site is currently occupied by a four-story brick masonry building with one cellar which will be

demolished for the new building. The building footprint at the ground floor and at the two cellars is 31'-5" by 100'-4" (E-W by N-S) and the tower footprint is setback to 31'-5" by 57'-8" (E-W by N-S) at the main roof. The tower main roof height is 236'-0" with an additional 25'-4" of bulkhead structure. Typical Residential floor to floor heights of 11'-4" from levels 5 to 19. Levels 2 (retail), 3 (mechanical), and 4 (residential) have floor-to-floor heights of 12'-0".

## II. EXECUTIVE SUMMARY AND FINDINGS

DeSimone Consulting Engineers has completed the peer review of the overall building and foundation designs for the 7 West 57th Street project in compliance with 2014 New York City Building Code (BC) 16.17. The review is based on structural and architectural drawings, and geotechnical reports that were provided to us by the Architect of Record of the project, Hill West Architects. The entire list of items reviewed is itemized in the "Design Criteria" section of the report and findings are summarized within the pages of this report and in the "Review Comments" section.

The review shows that the current design generally complies with the New York City Building Code and reference standards and standard of care. Several minor comments are presented within the report that should be addressed in future design documents.

As the peer reviewer, DeSimone presents findings on the proposed structural design prepared by the Engineer of Record. The Engineer of Record shall retain sole responsibility for the structural design of the entire building.

## III. DESIGN CRITERIA

### A. REFERENCE DESIGN DOCUMENTS

The following documents and reports were reviewed:

- "90% Construction Documents" (32 pages) dated April 19th, 2017 and prepared by WSP-Parsons Brinckerhoff (Structural Drawings).
- "90% Construction Documents" (67 pages) dated April 19th, 2017 and prepared by Hill West Architects (Architectural Drawings).
- "Geotechnical Engineering Study" dated February 27th, 2016 and prepared by Langan Engineering, Environmental, Surveying and Landscape Architecture, D.P.C. (Geotechnical Report).
- "ASCE 7 Wind Load Analysis" dated March 3rd, 2017 and prepared by IBA A Vidaris Inc. Company for the Component & Cladding Design Wind Pressures.

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## B. DESIGN CODES

The following design codes have been referenced on FO-001 as the basis of their design:

- New York City Building Code (BC) 2014, including all Supplements
- ACI 318-2011, "Building Code Requirements for Structural Concrete"

| DeSimone Comments | BC Section | Status |
|---|---|---|
| ***The design codes used are appropriate and are in general conformance to industry standards.*** | ***1617.5.1 (2)*** | ✓ |

## C. DESIGN LOADS

The following design loads have been referenced on FO-001 as the basis of their design:

1) GRAVITY LOADS

| OCCUPANCY | FLOORS | Superimposed Dead Load (PARTITIONS/ FILL &/OR FINISHES) | Superimposed Dead Load (CEIL. & MECH.) | Live Load |
|---|---|---|---|---|
| **ROOF** | MEP BULKHEAD | 40 | 5 | 30 |
| **MECHANICAL ROOF** | MID ROOF | 55 | 5 | 150 |
| **ACCESSIBLE ROOF/ TERRACES** | MAIN ROOF | 35 | 5 | 60 |
| **LOBBIES/STAIRS/ CORRIDORS** | ALL FLOORS | 30 | 5 | 100 |
| **Mechanical ROOMS** | 3RD FLOOR | 20 | 5 | 150 |
| **RETAIL** | CELLAR THRU 2ND FLOOR | 25 | 5 | 100 |
| **RESIDENTIAL** | 4TH FLOOR THRU 19TH FLOOR | 12 | 5 | 40 |

**All loads in table above are in pounds per square foot**

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2) SEISMIC LOADS

| Design Criteria | Value |
|---|---|
| **Risk Category:** | II |
| **Seismic Importance Factor:** | $I_E$ = 1.00 |
| **Site Class:** | B |
| **Mapped Spectral Acceleration Parameters:** | $S_S$ = 0.281g<br>$S_1$ = 0.073g |
| **Design Spectral Acceleration Parameters:** | $S_{DS}$ = 0.187g<br>$S_{D1}$ = 0.049g |
| **Seismic Design Category:** | B |
| **Seismic Force Resisting System:** | Ordinary Reinforced Concrete Shear walls (Bearing Wall System) |
| **Response Modification Factor:** | R = 4 |
| **Seismic Response Coefficient:** | $C_S$ = 0.01 E/W & N/S |
| **Design Base Shear:** | 160 kips E/W & N/S |
| **Analysis Procedure Used:** | Equivalent Lateral Force Analysis |

**Per Geotech Report since the building foundations will bear directly on Bedrock, liquefaction need not be considered in design of foundation**

3) WIND LOADS

| Design Criteria | Value |
|---|---|
| **Risk Category:** | II |
| **Building Type:** | Enclosed |
| **Basic Wind Speed:** | 98 mph |
| **Wind Exposure Category:** | B |
| **Importance Factor:** | $I_W$ = 1.00 |
| **MWFRS Design Wind Loads:** | N-S DIRECTION:<br>• OVERTURNING MOMENT = 33,600 K-FT<br>• BASE SHEAR = 200 K<br>E-W DIRECTIN:<br>• OVERTURNING MOMENT =71,300 K-FT<br>• BASE SHEAR = 460 K |
| **Component and Cladding Design Wind Pressure:** | -30psf to -50psf<br>+30psf to +30psf |

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| DeSimone Comments | BC Section | Status |
|---|---|---|
| ***The design loads used are appropriate and are in general conformance to industry standards.*** | **1617.5.1 (1)** | ✓ |
| ***The current structural drawings are in general conformance with the architectural drawings for loads.*** | **1617.5.1 (9)** | ✓ |
| ***The current structural drawings accommodate major mechanical items as shown in MEP drawings.*** | **1617.5.1 (10)** | ✓ |

### D. MATERIALS

1) CONCRETE

| MEMBER | LOCATION | f'c |
|---|---|---|
| **FOUNDATIONS** | Mat Foundation, Footings (on rock), Pressure Slabs | 5,950psi |
| | Basement/Retaining Walls | 8,000psi |
| | Footings (on soil), Slab on Ground | 5,950psi |
| **SHEARWALLS & COLUMNS** | Foundation to MEP Bulk | 8,000psi |
| **SLABS & BEAMS** | Cellar to MEP Bulk | 8,000psi |

2) STEEL

| MEMBER | LOCATION | MATERIAL |
|---|---|---|
| **REINFORCING BARS** | Typical | ASTM A615, GRADE 60 |

## IV. STRUCTURAL SYSTEM

The building is constructed with conventionally reinforced concrete elements for the gravity, lateral and foundation systems. Overviews are provided for the gravity and lateral load-resisting systems as they are the elements that deliver load to the foundations.

### A. GAVITY LOAD-RESISTING SYSTEM OVERVIEW

1) FLOOR SLAB

The floor slabs are constructed as cast-in-place concrete slabs with a typical thickness of 12" except for the mechanical 3rd floor slab being 14" thick. The floor slab compressive strength is specified as 8,000 psi as specified on the general notes (FO-001).

2) COLUMNS

The eight building columns are cast-in-place concrete. Of the eight columns only Column 7 begins at foundation level, with the remaining columns transferring at ground floor on the foundation wall. Per the column schedule shown on S-950, the compressive strength for the columns and walls is specified as 8,000 psi. The column capacity was checked based on the dimensions and reinforcement shown on the column schedule on S-950.00 and DeSimone has performed an independent load takedown to verify the columns can adequately carry the axial load. Columns will be reviewed for punching shear performance in the superstructure peer review phase.

3) SHEAR WALLS

Shear walls are constructed as cast-in-place concrete. See below for description of the system.

4) WALL WALK AT LEVEL 4

Between level 2 and 4, SW5 walks south with a thickened wall element at the 3rd floor that overlaps the walk dimension. This portion will be further reviewed and addressed in the superstructure peer review phase.

5) COLUMN 7 WALK AT GROUND FLOOR

Column 7 between cellar and ground is shown as 18x24 and changes to a 12x42 Column between 2nd and 3rd. This portion will be further reviewed and addressed in the superstructure peer review phase.

## B. LATERAL LOAD-RESISTING SYSTEM OVERVIEW

The lateral system is composed of cast-in-place concrete shear walls with coupling beams to link the walls together. The shear walls vary in thickness from 9" to 18" throught the floor plate. DeSimone created an independent lateral building model in ETABS which showed the first three natural periods of the following;

- mode 1 = 2.183 seconds (Translational in the x-direction with a strong torsional response)
- mode 2 = 1.516 seconds (Primary translational in the North-South direction)
- mode 3 = 0.853 seconds (Primary torsion)

While a building with a strong torsional response is not recommended for an economical design, the building inter-story drifts have been checked based on ASCE 7-10 requirements for buildings with extreme torsional irregularity. Based on these requirements the amplified

inter-story drifts remain less than the $0.020h_{sx}$ (maximum allowable story drift for risk category II, all other structures per ASCE 7-10 Table 12.12-1). The inter-story drift for wind has also been reviewed with a maximum inter-story drift of L/1525 for 10-year recurrence wind loads, which is typically used as industry standard for evaluation of serviceability with a limit of L/400.

| DeSimone Comments | BC Section | Status |
|---|---|---|
| **The structural load path is complete.** | **1617.5.1 (4)** | ✓ |

## C. FOUNDATION SYSTEM

The foundation consists of two below-grade cellar levels. The primary foundation structure at the sub-cellar level is a 24-inch-wide strip footing supporting the concrete shear walls. Additionally, five 3 feet by 3 feet spread footings support Column 7 and the corners of the foundation walls with the remainder of the foundation walls designed to span between the spread footings and strip footings. The remainder of the sub-cellar slab is designed as a 5-inch-thick slab-on-grade.

Per the geotechnical report, the standing water elevation was measured at elevation +32'-6" (NAVD88), with a recommended design water elevation of elevation +38'-0" which is 13'-9.5" above the sub-cellar level top of slab. To resist the hydrostatic head, the sub-cellar slab has been designed with a sub-slab drainage system consisting of a 1 foot gravel layer with PVC drainage pipes connected to interior sumps that allow for the pumping and relief of any hydrostatic pressure. As the use of this system has been confirmed by the engineer of record (WSP-Parsons Brinckerhoff), the use of a slab-on-grade and foundation walls have been designed for unsaturated lateral earth pressures & sidewalk surcharge, as well as vertical and lateral loads from the tower above. The geotechnical report states that "If a sub-slab drainage system is not used or if New York City Authorities do not allow drainage system to discharge into the storm sewer system, the below grade walls and the lower cellar slab should be designed to resist hydrostatic pressure for design water table at El. 38.". Therefore it is imperative this system is approved by the New York City Authorities that have jurisdiction over this issue.

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**Figure 1 SITE LOCATION SHOWING ADJACENT STRUCTURES**

The basement walls vary from 14.5 inches thick to 18 inches thick. Walls to the east, west, and north will be placed against existing foundation walls to remain.

DeSimone used forces from our independent ETABS lateral model and independent gravity takedown to create a SAFE model of the mat foundation. DeSimone reviewed mat bearing pressure, mat uplift with the specified rock anchors and shear and flexural reinforcing demands: our analysis showed that WSP's design meets code requirements and geotechnical specifications for these elements. Additionally, DeSimone reviewed spread footings and foundation wall designs and similarly found they meet code and geotechnical requirements.

| DeSimone Comments | BC Section | Status |
|---|---|---|
| **The current foundation design is appropriate and is in general in general conformance to industry standards.** | **1617.5.1 (4)** | ✓ |
| ***The interpretation of the geotechnical report is appropriate and are in general conformance to industry standards.*** | **1617.5.1 (3)** | ✓ |

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## V. REVIEW COMMENTS

| Comment# | DeSimone Comment | WSP Group Response | Status |
|---|---|---|---|
| **DC-1** | FO-100.01: on the foundation notes indicates a 5" slab-on-grade bearing on 20 TSF with a note that states, "There is no ground water within the excavation according to preliminary "Langan" investigation." | Note 3 on FO-100 to be revised | **CLOSED** |
| **DC-2** | Note that Langan's Geotech report indicates 60 TSF bearing capacity. | Footing schedule and note on FO-001 indicates 60TSF. Note 3 on FO-100 to be revised. | **CLOSED** |
| **DC-3** | Please have EOR confirm 60 TSF bearing capacity was used in design. | Confirmed. 60TSF used. | **CLOSED** |
| **DC-4** | EoR to confirm if sub-slab drainage system is being used to relieve the hydrostatic pressure. | Confirmed. Sub-grade drainage system required. | **CLOSED** |

## VI. ADDITIONAL COMMENTS

At column 3 at foundation level (Dwg. FO-100.01), a 200 Ton tie down anchor is shown with a corresponding 36" x 36" strap beam. (identified as STB1). Based on DeSimone's analysis it does not appear that these elements are required. This does not impact the suitability of the design but may present some opportunity for value engineering.

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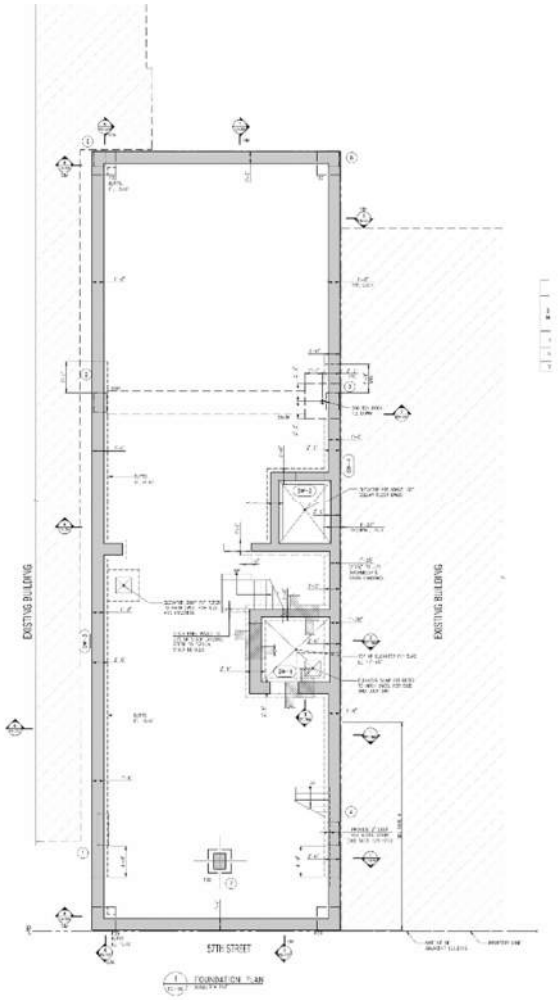
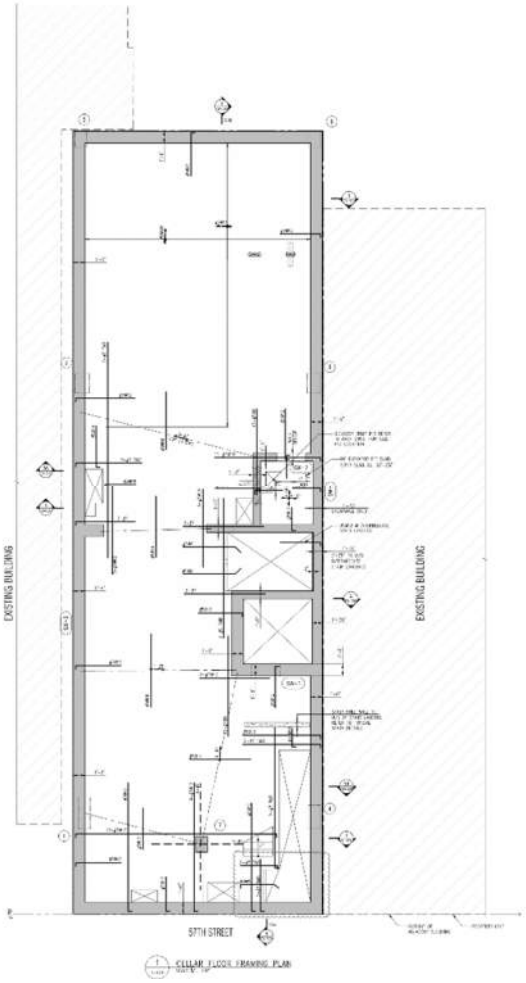
## VII. APPENDIX

### A. Building Plans




**FOUNDATION AND CELLAR PLAN**

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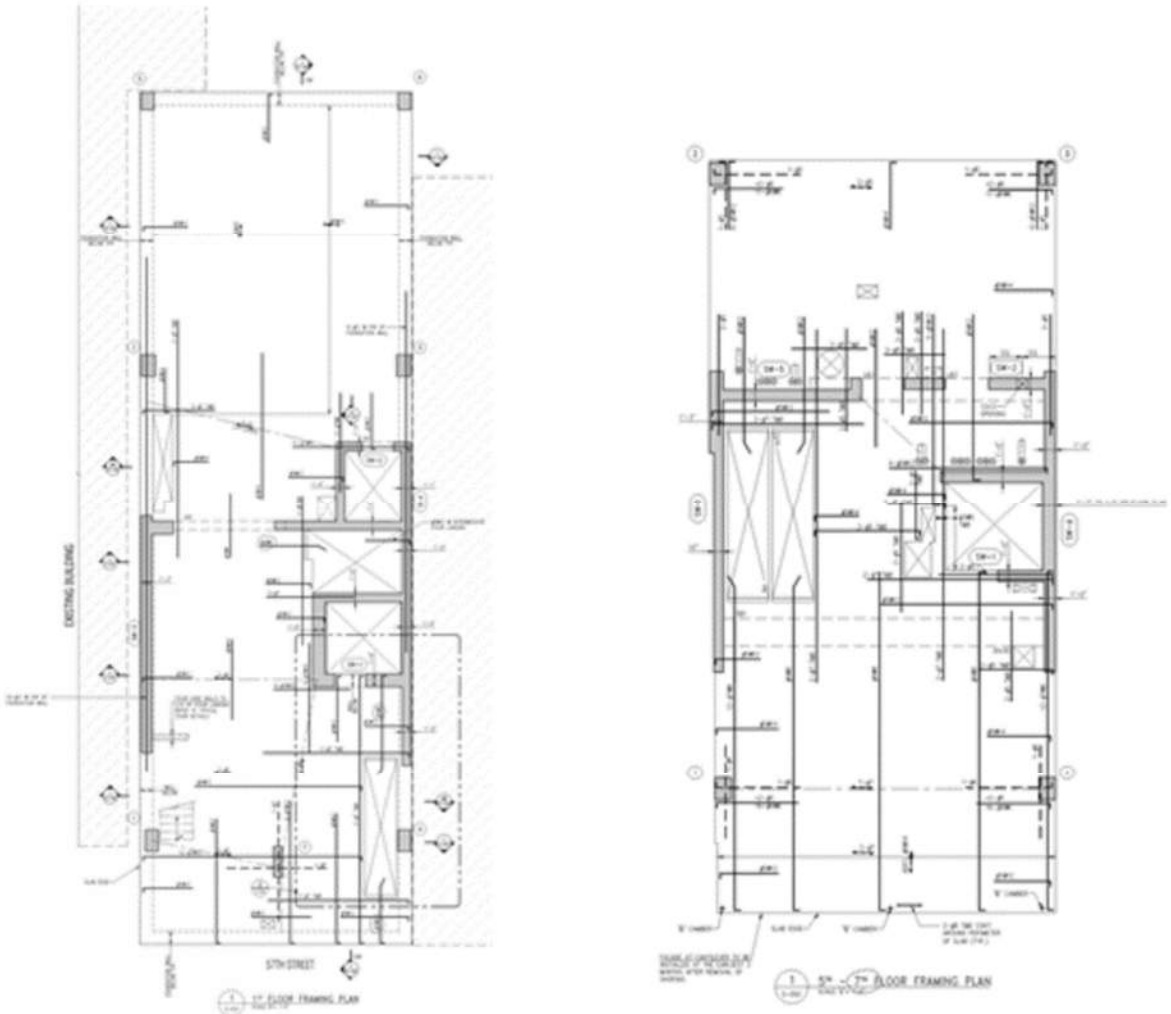


**GROUND FLOOR & TYPICAL LOWER FLOOR PLAN**

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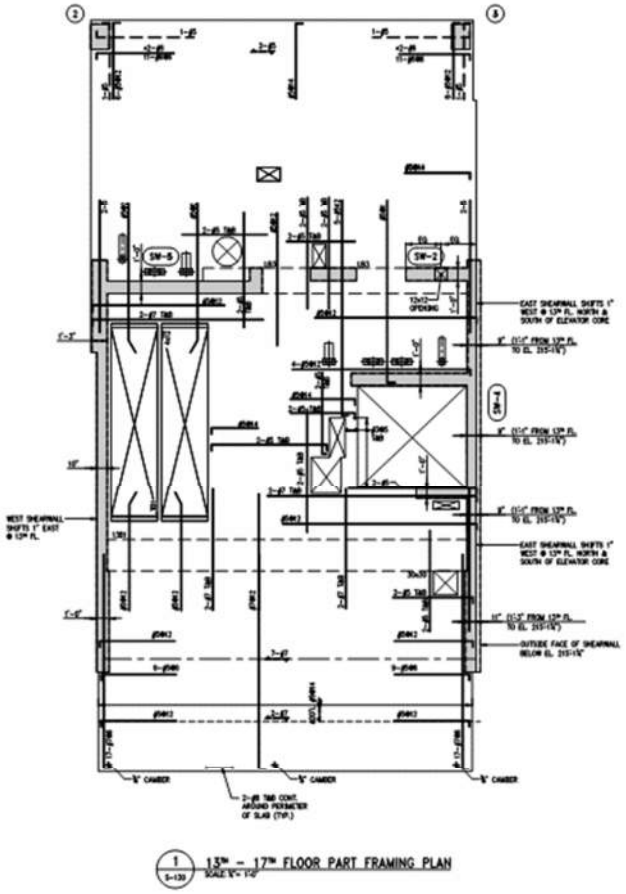
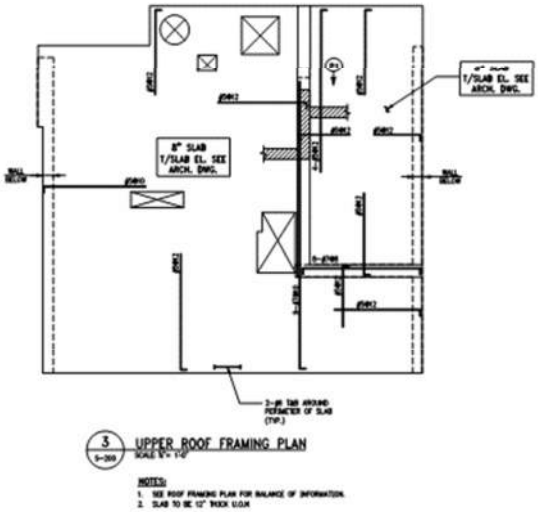


1 15TH – 17TH FLOOR PART FRAMING PLAN



3 UPPER ROOF FRAMING PLAN

**TYPICAL UPPER FLOOR & ROOF FLOOR PLAN**

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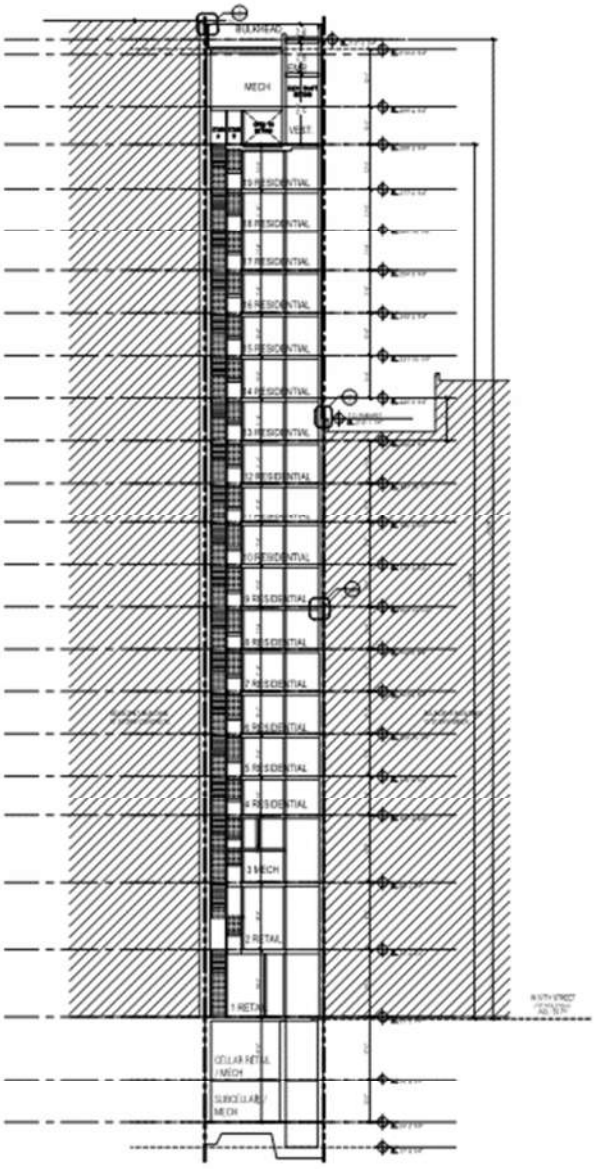
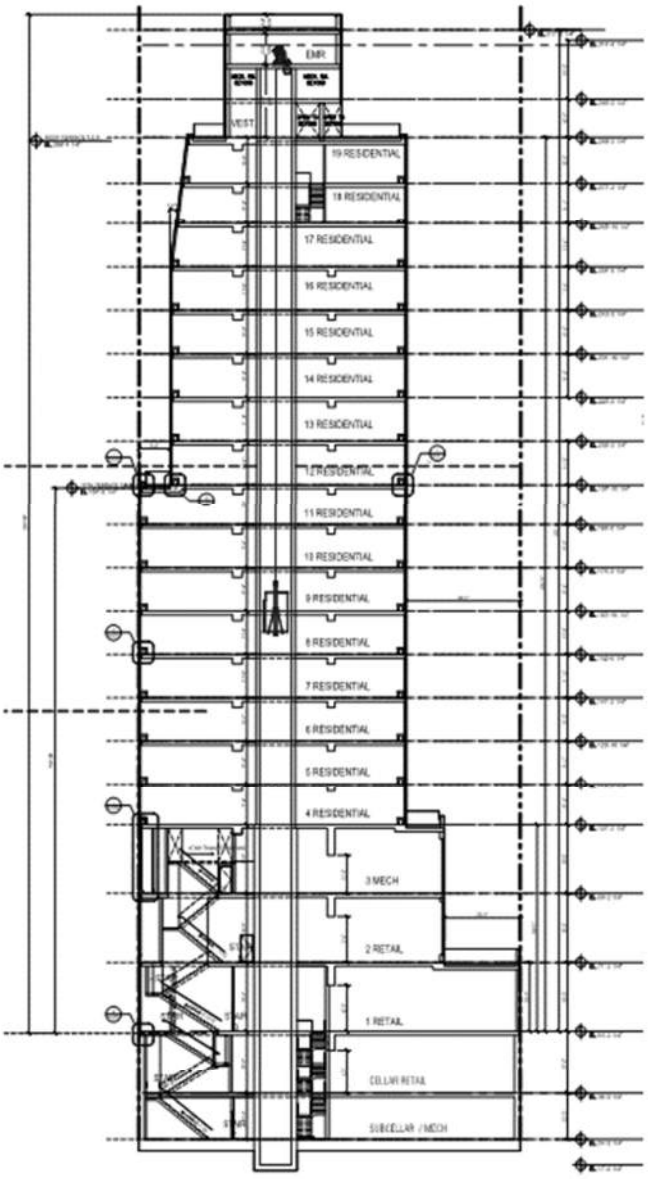
## B. BUILDING SECTION




1 EAST-WEST BUILDING SECTION
SCALE: 3/32"=1'-0"




2 NORTH SOUTH BUILDING SECTION
SCALE: 3/32"=1'-0"

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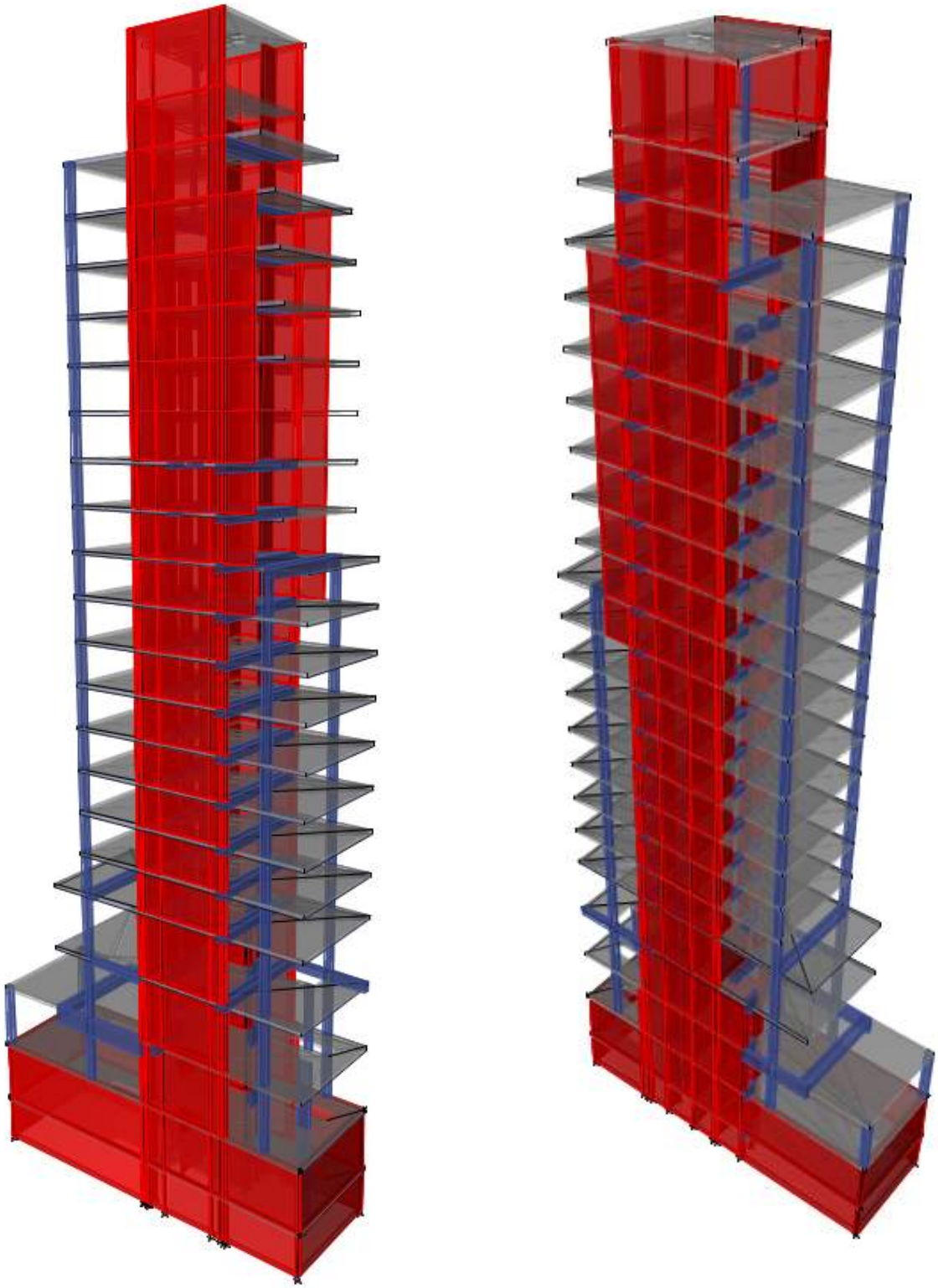
## C. ETABS ISOMETRIC



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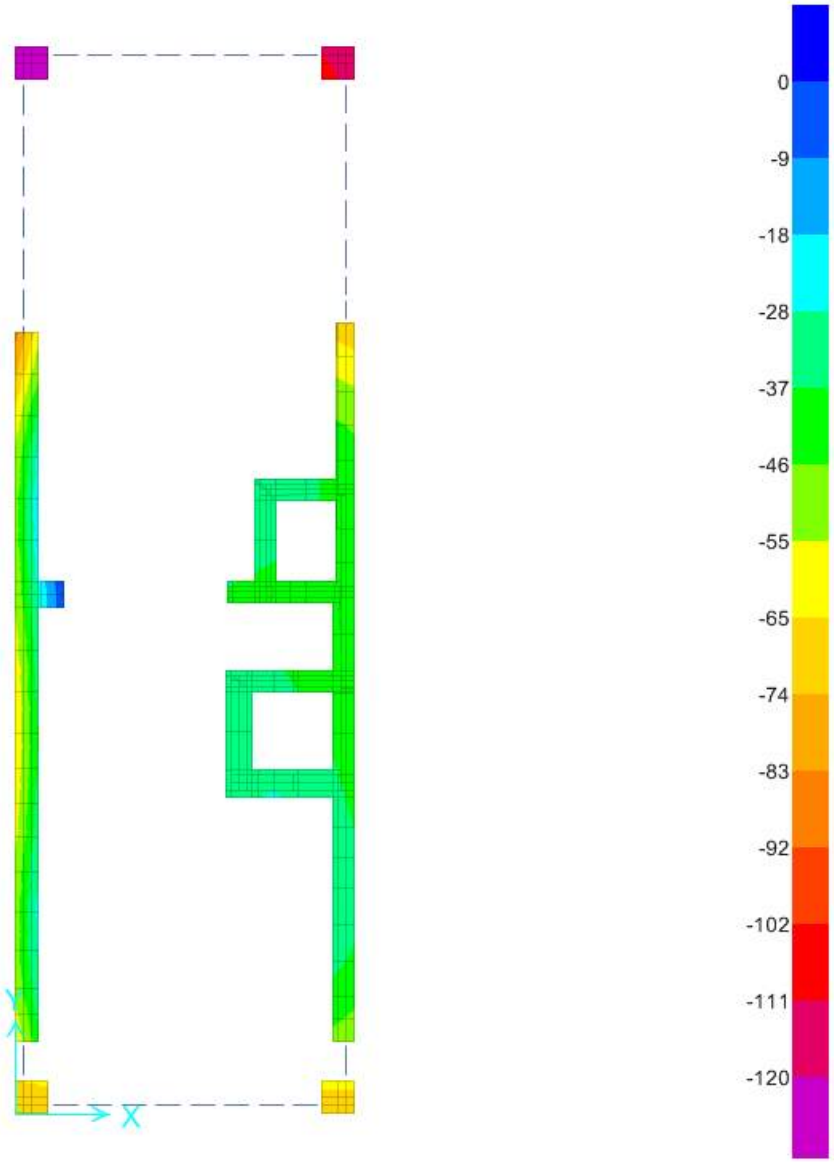
## D. SAFE FOUNDATION MODEL BEARING PRESSURE




**Bearing Pressures shown are in kips per square foot**

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## E. EXAMPLE SPREAD FOOTING CALCULATION

| Tekla Tedds<br>DeSimone Consulting Engineers | Project<br>7 West 57th Street Peer Review | | | | Job Ref.<br>17214.00 | |
|---|---|---|---|---|---|---|
| | Section<br>F30 FOOTING UNDER COL. 5 (SUPPORTS WALL & COL) | | | | Sheet no./rev.<br>1 | |
| | Calc. by<br>AWK | Date<br>5/24/2017 | Chk'd by<br>RAM | Date | App'd by | Date |

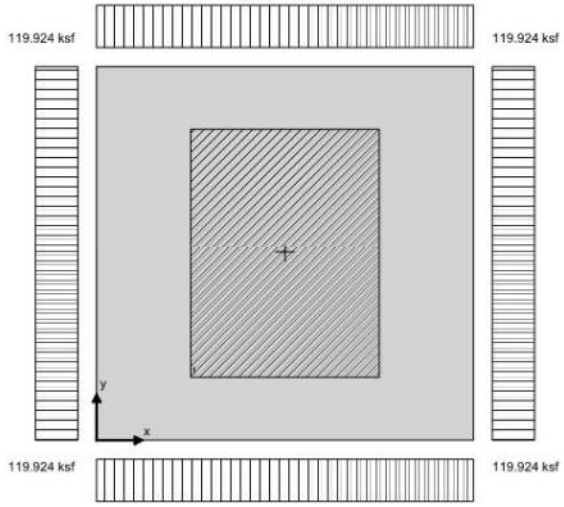
**FOUNDATION ANALYSIS & DESIGN (ACI318)**

**In accordance with ACI318-11 incorporating Errata as of August 8, 2014**

Tedds calculation version 3.0.01

**FOOTING ANALYSIS**

| | |
|---|---|
| Length of foundation | $L_x$ = **3** ft |
| Width of foundation | $L_y$ = **3** ft |
| Foundation area | $A = L_x \times L_y$ = **9** ft$^2$ |
| Depth of foundation | h = **24** in |
| Depth of soil over foundation | $h_{soil}$ = **18** in |
| Density of concrete | $\gamma_{conc}$ = **150.0** lb/ft$^3$ |




**Column no.1 details**

| | |
|---|---|
| Length of column | $l_{x1}$ = **18.00** in |
| Width of column | $l_{y1}$ = **24.00** in |
| position in x-axis | $x_1$ = **18.00** in |
| position in y-axis | $y_1$ = **18.00** in |

**Soil properties**

| | |
|---|---|
| Gross allowable bearing pressure | $q_{allow\_Gross}$ = **120** ksf |
| Density of soil | $\gamma_{soil}$ = **120.0** lb/ft$^3$ |
| Angle of internal friction | $\phi_b$ = **30.0** deg |
| Design base friction angle | $\delta_{bb}$ = **30.0** deg |
| Coefficient of base friction | $\tan(\delta_{bb})$ = **0.577** |
| Self weight | $F_{swt} = h \times \gamma_{conc}$ = **300** psf |
| Soil weight | $F_{soil} = h_{soil} \times \gamma_{soil}$ = **180** psf |

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| Tekla Tedds<br>DeSimone Consulting Engineers | Project<br>7 West 57th Street Peer Review | | | | Job Ref.<br>17214.00 | |
|---|---|---|---|---|---|---|
| | Section<br>F30 FOOTING UNDER COL. 5 (SUPPORTS WALL & COL) | | | | Sheet no./rev.<br>2 | |
| | Calc. by<br>AWK | Date<br>5/24/2017 | Chk'd by<br>RAM | Date | App'd by | Date |

**Column no.1 loads**

Dead load in z — $F_{Dz1}$ = **745.0** kips

Live load in z — $F_{Lz1}$ = **90.0** kips

Wind load in z — $F_{Wz1}$ = **330.0** kips

**Footing analysis for soil and stability**

**Load combinations per ASCE 7-05**

1.0D (0.694)
1.0D + 1.0L (0.777)
1.0D + 1.0W (0.999)
1.0D + 0.75L + 0.75Lr + 0.75W (0.985)
1.0D + 0.75L + 0.75S + 0.75W (0.985)
1.0D + 0.75L + 0.75R + 0.75W (0.985)
0.6D + 1.0W (0.722)

**Combination 9 results: 1.0D + 1.0W**

**Forces on foundation**

Force in z-axis — $F_{dz} = \gamma_D \times A \times (F_{swt} + F_{soil}) + \gamma_D \times F_{Dz1} + \gamma_W \times F_{Wz1}$ = **1079.3** kips

**Moments on foundation**

Moment in x-axis, about x is 0 — $M_{dx} = \gamma_D \times (A \times (F_{swt} + F_{soil}) \times L_x / 2) + \gamma_D \times (F_{Dz1} \times x_1) + \gamma_W \times (F_{Wz1} \times x_1)$ = **1619.0** kip_ft

Moment in y-axis, about y is 0 — $M_{dy} = \gamma_D \times (A \times (F_{swt} + F_{soil}) \times L_y / 2) + \gamma_D \times (F_{Dz1} \times y_1) + \gamma_W \times (F_{Wz1} \times y_1)$ = **1619.0** kip_ft

**Uplift verification**

Vertical force — $F_{dz}$ = **1079.32** kips

***PASS - Foundation is not subject to uplift***

**Bearing resistance**

**Eccentricity of base reaction**

Eccentricity of base reaction in x-axis — $e_{dx} = M_{dx} / F_{dz} - L_x / 2$ = **0** in

Eccentricity of base reaction in y-axis — $e_{dy} = M_{dy} / F_{dz} - L_y / 2$ = **0** in

**Pad base pressures**

$q_1 = F_{dz} \times (1 - 6 \times e_{dx} / L_x - 6 \times e_{dy} / L_y) / (L_x \times L_y)$ = **119.924** ksf

$q_2 = F_{dz} \times (1 - 6 \times e_{dx} / L_x + 6 \times e_{dy} / L_y) / (L_x \times L_y)$ = **119.924** ksf

$q_3 = F_{dz} \times (1 + 6 \times e_{dx} / L_x - 6 \times e_{dy} / L_y) / (L_x \times L_y)$ = **119.924** ksf

$q_4 = F_{dz} \times (1 + 6 \times e_{dx} / L_x + 6 \times e_{dy} / L_y) / (L_x \times L_y)$ = **119.924** ksf

Minimum base pressure — $q_{min} = \min(q_1, q_2, q_3, q_4)$ = **119.924** ksf

Maximum base pressure — $q_{max} = \max(q_1, q_2, q_3, q_4)$ = **119.924** ksf

**Allowable bearing capacity**

Allowable bearing capacity — $q_{allow} = q_{allow\_Gross}$ = **120** ksf

$q_{max} / q_{allow}$ = **0.999**

***PASS - Allowable bearing capacity exceeds design base pressure***

**FOOTING DESIGN (ACI318)**

**In accordance with ACI318-11 incorporating Errata as of August 8, 2014**

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| Tekla Tedds<br>DeSimone Consulting Engineers | Project<br>7 West 57th Street Peer Review | | | | Job Ref.<br>17214.00 | |
|---|---|---|---|---|---|---|
| | Section<br>F30 FOOTING UNDER COL. 5 (SUPPORTS WALL & COL) | | | | Sheet no./rev.<br>3 | |
| | Calc. by<br>AWK | Date<br>5/24/2017 | Chk'd by<br>RAM | Date | App'd by | Date |

**Material details**

| | |
|---|---|
| Compressive strength of concrete | $f'_c$ = **5950** psi |
| Yield strength of reinforcement | $f_y$ = **60000** psi |
| Cover to reinforcement | $c_{nom}$ = **3** in |
| Concrete type | Normal weight |
| Concrete modification factor | $\lambda$ = **1.00** |
| Column type | Concrete |

**Analysis and design of concrete footing**

**Load combinations per ASCE 7-05**

1.4D (0.177)
1.2D + 1.6L + 0.5Lr (0.176)
1.2D + 1.6Lr + 0.8W (0.196)
1.2D + 1.6S + 0.8W (0.196)
1.2D + 1.6R + 0.8W (0.196)
1.2D + 0.5L + 0.5Lr + 1.6W (0.248)
1.2D + 0.5L + 0.5S + 1.6W (0.248)
1.2D + 0.5L + 0.5R + 1.6W (0.248)
0.9D + 1.6W (0.203)

**Combination 11 results: 1.2D + 0.5L + 0.5Lr + 1.6W**

**Forces on foundation**

Ultimate force in z-axis

$F_{uz} = \gamma_D \times A \times (F_{swt} + F_{soil}) + \gamma_D \times F_{Dz1} + \gamma_L \times F_{Lz1} + \gamma_W \times F_{Wz1}$ = **1472.2** kips

**Moments on foundation**

Ultimate moment in x-axis, about x is 0

$M_{ux} = \gamma_D \times (A \times (F_{swt} + F_{soil}) \times L_x / 2) + \gamma_D \times (F_{Dz1} \times x_1) + \gamma_L \times (F_{Lz1} \times x_1) + \gamma_W \times (F_{Wz1} \times x_1)$ = **2208.3** kip_ft

Ultimate moment in y-axis, about y is 0

$M_{uy} = \gamma_D \times (A \times (F_{swt} + F_{soil}) \times L_y / 2) + \gamma_D \times (F_{Dz1} \times y_1) + \gamma_L \times (F_{Lz1} \times y_1) + \gamma_W \times (F_{Wz1} \times y_1)$ = **2208.3** kip_ft

**Eccentricity of base reaction**

Eccentricity of base reaction in x-axis

$e_{ux} = M_{ux} / F_{uz} - L_x / 2$ = **0** in

Eccentricity of base reaction in y-axis

$e_{uy} = M_{uy} / F_{uz} - L_y / 2$ = **0** in

**Pad base pressures**

$q_{u1} = F_{uz} \times (1 - 6 \times e_{ux} / L_x - 6 \times e_{uy} / L_y) / (L_x \times L_y)$ = **163.576** ksf

$q_{u2} = F_{uz} \times (1 - 6 \times e_{ux} / L_x + 6 \times e_{uy} / L_y) / (L_x \times L_y)$ = **163.576** ksf

$q_{u3} = F_{uz} \times (1 + 6 \times e_{ux} / L_x - 6 \times e_{uy} / L_y) / (L_x \times L_y)$ = **163.576** ksf

$q_{u4} = F_{uz} \times (1 + 6 \times e_{ux} / L_x + 6 \times e_{uy} / L_y) / (L_x \times L_y)$ = **163.576** ksf

Minimum ultimate base pressure

$q_{umin} = \min(q_{u1}, q_{u2}, q_{u3}, q_{u4})$ = **163.576** ksf

Maximum ultimate base pressure

$q_{umax} = \max(q_{u1}, q_{u2}, q_{u3}, q_{u4})$ = **163.576** ksf

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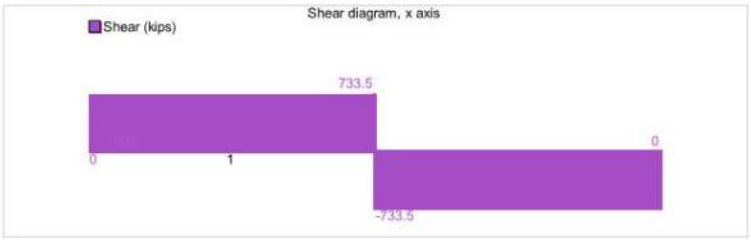


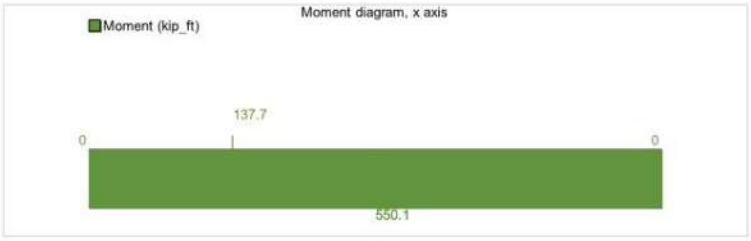


**Moment design, x direction, positive moment**

| | |
|---|---|
| Ultimate bending moment | $M_{u.x.max}$ = **137.652** kip_ft |
| Tension reinforcement provided | 9 No.5 bottom bars (3.6 in c/c) |
| Area of tension reinforcement provided | $A_{sx.bot.prov}$ = **2.79** in$^2$ |
| Minimum area of reinforcement (10.5.4) | $A_{s.min} = 0.0018 \times L_y \times h$ = **1.555** in$^2$ |
| | ***PASS - Area of reinforcement provided exceeds minimum*** |
| Maximum spacing of reinforcement (10.5.4) | $s_{max} = \min(3 \times h, 18\text{ in})$ = **18** in |
| | ***PASS - Maximum permissible reinforcement spacing exceeds actual spacing*** |
| Depth to tension reinforcement | $d = h - c_{nom} - \phi_{x.bot} / 2$ = **20.687** in |
| Depth of compression block | $a = A_{sx.bot.prov} \times f_y / (0.85 \times f'_c \times L_y)$ = **0.919** in |
| Neutral axis factor | $\beta_1$ = **0.75** |
| Depth to neutral axis | $c = a / \beta_1$ = **1.222** in |
| Strain in tensile reinforcement (10.3.5) | $\varepsilon_t = 0.003 \times d / c - 0.003$ = **0.04779** |
| | ***PASS - Tensile strain exceeds minimum required, 0.004*** |
| Nominal moment capacity | $M_n = A_{sx.bot.prov} \times f_y \times (d - a / 2)$ = **282.178** kip_ft |
| Flexural strength reduction factor | $\phi_f = \min(\max(0.65 + (\varepsilon_t - 0.002) \times (250 / 3), 0.65), 0.9)$ = **0.900** |
| Design moment capacity | $\phi M_n = \phi_f \times M_n$ = **253.96** kip_ft |
| | $M_{u.x.max} / \phi M_n$ = **0.542** |
| | ***PASS - Design moment capacity exceeds ultimate moment load*** |

**One-way shear design, x direction**

***One-way shear design does not apply. Shear failure plane fall outside extents of foundation.***

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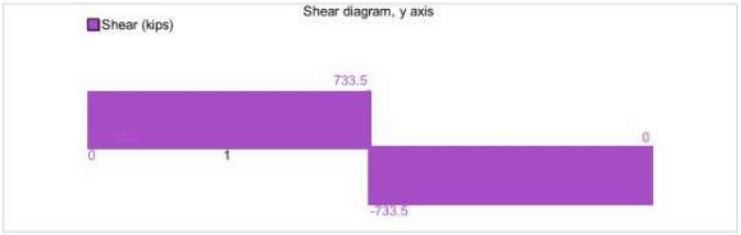


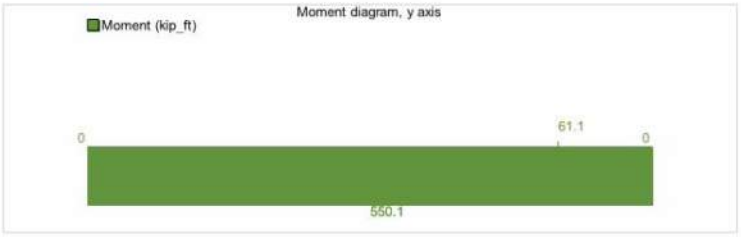


**Moment design, y direction, positive moment**

| | |
|---|---|
| Ultimate bending moment | $M_{u.y.max}$ = **61.125** kip_ft |
| Tension reinforcement provided | 9 No.5 bottom bars (3.6 in c/c) |
| Area of tension reinforcement provided | $A_{sy.bot.prov}$ = **2.79** in$^2$ |
| Minimum area of reinforcement (10.5.4) | $A_{s.min}$ = 0.0018 × $L_x$ × h = **1.555** in$^2$ |
| | ***PASS - Area of reinforcement provided exceeds minimum*** |
| Maximum spacing of reinforcement (10.5.4) | $s_{max}$ = min(3 × h, 18 in) = **18** in |
| | ***PASS - Maximum permissible reinforcement spacing exceeds actual spacing*** |
| Depth to tension reinforcement | d = h - $c_{nom}$ - $\phi_{x.bot}$ - $\phi_{y.bot}$ / 2 = **20.062** in |
| Depth of compression block | a = $A_{sy.bot.prov}$ × $f_y$ / (0.85 × f'$_c$ × $L_x$) = **0.919** in |
| Neutral axis factor | $\beta_1$ = **0.75** |
| Depth to neutral axis | c = a / $\beta_1$ = **1.222** in |
| Strain in tensile reinforcement (10.3.5) | $\varepsilon_t$ = 0.003 × d / c - 0.003 = **0.04626** |
| | ***PASS - Tensile strain exceeds minimum required, 0.004*** |
| Nominal moment capacity | $M_n$ = $A_{sy.bot.prov}$ × $f_y$ × (d - a / 2) = **273.459** kip_ft |
| Flexural strength reduction factor | $\phi_f$ = min(max(0.65 + ($\varepsilon_t$ - 0.002) × (250 / 3), 0.65), 0.9) = **0.900** |
| Design moment capacity | $\phi M_n$ = $\phi_f$ × $M_n$ = **246.113** kip_ft |
| | $M_{u.y.max}$ / $\phi M_n$ = **0.248** |
| | ***PASS - Design moment capacity exceeds ultimate moment load*** |

**One-way shear design, y direction**

***One-way shear design does not apply. Shear failure plane fall outside extents of foundation.***

**Two-way shear design at column 1**

***Two-way shear design does not apply. Shear perimeter falls outside extents of foundation.***

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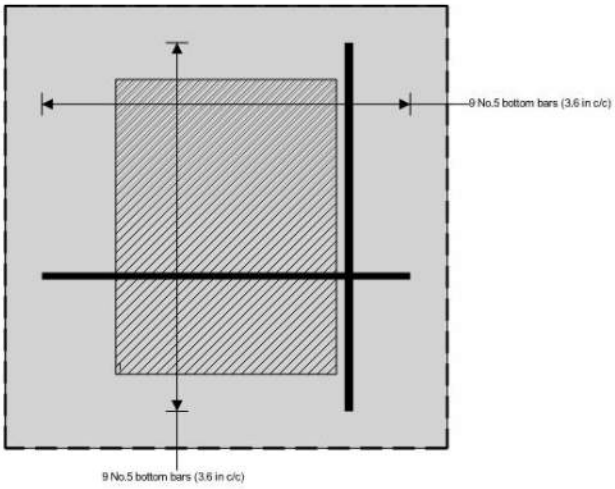

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## F. TYPICAL WALL (PERIMETER AND INTERIOR SHEAR WALLS) STRIP FOOTING CALCULATION

| Tekla Tedds – DeSimone Consulting Engineers | Project: 7 West 57th Street Peer Review | | | | Job Ref.: 17214.00 | |
|---|---|---|---|---|---|---|
| | Section: Typical Wall Strip Footing Design | | | | Sheet no./rev.: 1 | |
| | Calc. by: AWK | Date: 5/24/2017 | Chk'd by: RAM | Date: | App'd by: | Date: |

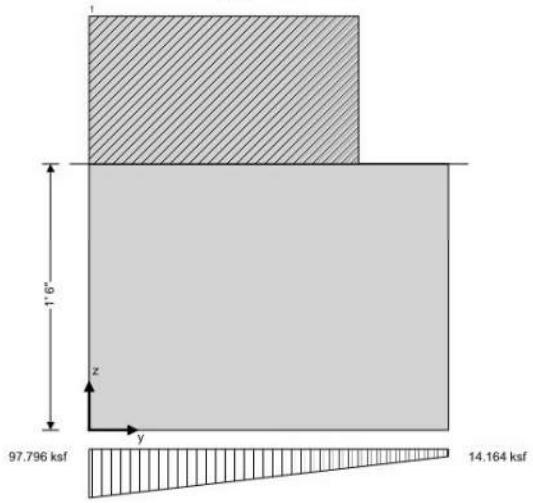
**FOUNDATION ANALYSIS & DESIGN (ACI318)**

**In accordance with ACI318-11 incorporating Errata as of August 8, 2014**

Tedds calculation version 3.0.01

**FOOTING ANALYSIS**

| | |
|---|---|
| Length of foundation | $L_x$ = **1** ft |
| Width of foundation | $L_y$ = **2** ft |
| Foundation area | $A = L_x \times L_y$ = **2** ft$^2$ |
| Depth of foundation | h = **18** in |
| Depth of soil over foundation | $h_{soil}$ = **0** in |
| Density of concrete | $\gamma_{conc}$ = **150.0** lb/ft$^3$ |




**Wall no.1 details**

| | |
|---|---|
| Width of wall | $l_{y1}$ = **18** in |
| position in y-axis | $y_1$ = **9** in |

**Soil properties**

| | |
|---|---|
| Gross allowable bearing pressure | $q_{allow\_Gross}$ = **120** ksf |
| Density of soil | $\gamma_{soil}$ = **120.0** lb/ft$^3$ |
| Angle of internal friction | $\phi_b$ = **30.0** deg |
| Design base friction angle | $\delta_{bb}$ = **30.0** deg |
| Coefficient of base friction | $\tan(\delta_{bb})$ = **0.577** |
| Self weight | $F_{swt} = h \times \gamma_{conc}$ = **225** psf |

**Wall no.1 loads per linear foot**

| | |
|---|---|
| Dead load in z | $F_{Dz1}$ = **80.3** kips |
| Live load in z | $F_{Lz1}$ = **5.5** kips |

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Wind load in z — $F_{Wz1}$ = **31.2** kips

**Footing analysis for soil and stability**

**Load combinations per ASCE 7-05**

1.0D (0.587)
1.0D + 1.0L (0.627)
1.0D + 1.0W (0.815)
1.0D + 0.75L + 0.75Lr + 0.75W (0.788)
1.0D + 0.75L + 0.75S + 0.75W (0.788)
1.0D + 0.75L + 0.75R + 0.75W (0.788)
0.6D + 1.0W (0.580)

**Combination 9 results: 1.0D + 1.0W**

**Forces on foundation per linear foot**

Force in z-axis — $F_{dz} = \gamma_D \times A \times F_{swt} + \gamma_D \times F_{Dz1} + \gamma_W \times F_{Wz1}$ = **112.0** kips

**Moments on foundation per linear foot**

Moment in y-axis, about y is 0 — $M_{dy} = \gamma_D \times A \times F_{swt} \times L_y / 2 + \gamma_D \times (F_{Dz1} \times y_1) + \gamma_W \times (F_{Wz1} \times y_1)$ = **84.1** kip_ft

**Uplift verification**

Vertical force — $F_{dz}$ = **111.96** kips

***PASS - Foundation is not subject to uplift***

**Stability against sliding**

Resistance due to base friction — $F_{RFriction} = \max(F_{dz}, 0\ kN) \times \tan(\delta_{bb})$ = **64.64** kips

**Bearing resistance**

**Eccentricity of base reaction**

Eccentricity of base reaction in y-axis — $e_{dy} = M_{dy} / F_{dz} - L_y / 2$ = **-2.988** in

**Strip base pressures**

$q_1 = F_{dz} \times (1 - 6 \times e_{dy} / L_y) / (L_y \times 1\ ft)$ = **97.796** ksf
$q_2 = F_{dz} \times (1 + 6 \times e_{dy} / L_y) / (L_y \times 1\ ft)$ = **14.164** ksf

Minimum base pressure — $q_{min} = \min(q_1, q_2)$ = **14.164** ksf
Maximum base pressure — $q_{max} = \max(q_1, q_2)$ = **97.796** ksf

**Allowable bearing capacity**

Allowable bearing capacity — $q_{allow} = q_{allow\_Gross}$ = **120** ksf
$q_{max} / q_{allow}$ = **0.815**

***PASS - Allowable bearing capacity exceeds design base pressure***

**FOOTING DESIGN (ACI318)**

**In accordance with ACI318-11 incorporating Errata as of August 8, 2014**

**Material details**

Compressive strength of concrete — $f'_c$ = **5950** psi
Yield strength of reinforcement — $f_y$ = **60000** psi
Cover to reinforcement — $c_{nom}$ = **3** in
Concrete type — Normal weight
Concrete modification factor — $\lambda$ = **1.00**
Wall type — Concrete

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| | Section<br>Typical Wall Strip Footing Design | | | | Sheet no./rev.<br>3 | |
| | Calc. by<br>AWK | Date<br>5/24/2017 | Chk'd by<br>RAM | Date | App'd by | Date |

**Analysis and design of concrete footing**

**Load combinations per ASCE 7-05**

1.4D (0.098)
1.2D + 1.6L + 0.5Lr (0.091)
1.2D + 1.6Lr + 0.8W (0.106)
1.2D + 1.6S + 0.8W (0.106)
1.2D + 1.6R + 0.8W (0.106)
1.2D + 0.5L + 0.5Lr + 1.6W (0.130)
1.2D + 0.5L + 0.5S + 1.6W (0.130)
1.2D + 0.5L + 0.5R + 1.6W (0.130)
0.9D + 1.6W (0.106)

**Combination 11 results: 1.2D + 0.5L + 0.5Lr + 1.6W**

**Forces on foundation per linear foot**

Ultimate force in z-axis

$F_{uz} = \gamma_D \times A \times F_{swt} + \gamma_D \times F_{Dz1} + \gamma_L \times F_{Lz1} + \gamma_W \times F_{Wz1} =$ **149.6** kips

**Moments on foundation per linear foot**

Ultimate moment in y-axis, about y is 0

$M_{uy} = \gamma_D \times A \times F_{swt} \times L_y / 2 + \gamma_D \times (F_{Dz1} \times y_1) + \gamma_L \times (F_{Lz1} \times y_1) + \gamma_W \times (F_{Wz1} \times y_1) =$ **112.3** kip_ft

**Eccentricity of base reaction**

Eccentricity of base reaction in y axis

$e_{uy} = M_{uy} / F_{uz} - L_y / 2 =$ **-2.989** in

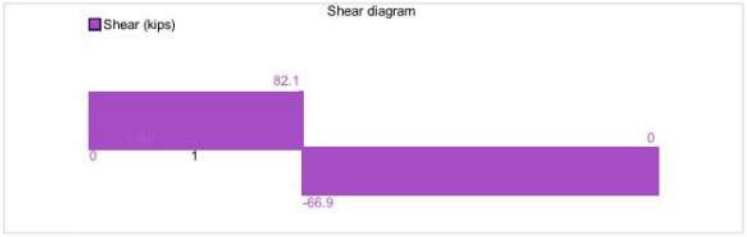
**Strip base pressures**

$q_{u1} = F_{uz} \times (1 - 6 \times e_{uy} / L_y) / (L_y \times 1\text{ ft}) =$ **130.667** ksf

$q_{u2} = F_{uz} \times (1 + 6 \times e_{uy} / L_y) / (L_y \times 1\text{ ft}) =$ **18.898** ksf

Minimum ultimate base pressure $q_{umin} = \min(q_{u1}, q_{u2}) =$ **18.898** ksf

Maximum ultimate base pressure $q_{umax} = \max(q_{u1}, q_{u2}) =$ **130.667** ksf



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| | Section<br>Typical Wall Strip Footing Design | | | | Sheet no./rev.<br>4 | |
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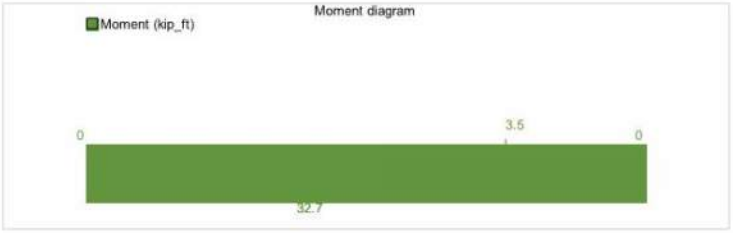
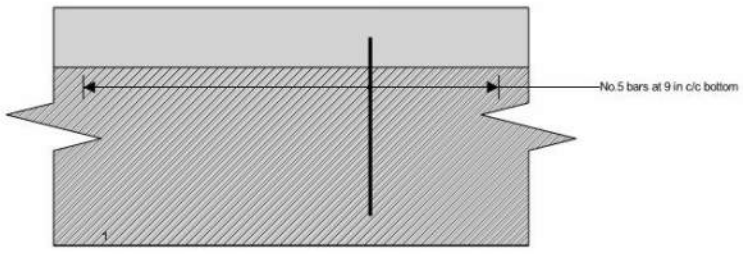



**Moment design, y direction, positive moment**

| | |
|---|---|
| Ultimate bending moment | $M_{u.y.max}$ = **3.493** kip_ft |
| Tension reinforcement provided | No.5 bars at 9.0 in c/c bottom |
| Area of tension reinforcement provided | $A_{sy.bot.prov}$ = **0.413** in$^2$ |
| Minimum area of reinforcement (10.5.4) | $A_{s.min}$ = 0.0018 × $L_x$ × h = **0.389** in$^2$ |
| | ***PASS - Area of reinforcement provided exceeds minimum*** |
| Maximum spacing of reinforcement (10.5.4) | $s_{max}$ = min(3 × h, 18 in) = **18** in |
| | ***PASS - Maximum permissible reinforcement spacing exceeds actual spacing*** |
| Depth to tension reinforcement | d = h - $c_{nom}$ - $\phi_{y.bot}$ / 2 = **14.688** in |
| Depth of compression block | a = $A_{sy.bot.prov}$ × $f_y$ / (0.85 × f'$_c$ × $L_x$) = **0.409** in |
| Neutral axis factor | $\beta_1$ = **0.75** |
| Depth to neutral axis | c = a / $\beta_1$ = **0.543** in |
| Strain in tensile reinforcement (10.3.5) | $\varepsilon_t$ = 0.003 × d / c - 0.003 = **0.07814** |
| | ***PASS - Tensile strain exceeds minimum required, 0.004*** |
| Nominal moment capacity | $M_n$ = $A_{sy.bot.prov}$ × $f_y$ × (d - a / 2) = **29.932** kip_ft |
| Flexural strength reduction factor | $\phi_f$ = min(max(0.65 + ($\varepsilon_t$ - 0.002) × (250 / 3), 0.65), 0.9) = **0.900** |
| Design moment capacity | $\phi M_n$ = $\phi_f$ × $M_n$ = **26.939** kip_ft |
| | $M_{u.y.max}$ / $\phi M_n$ = **0.130** |
| | ***PASS - Design moment capacity exceeds ultimate moment load*** |

**One-way shear design, y direction**

***One-way shear design does not apply. Shear failure plane fall outside extents of foundation.***



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## G. TYPICAL FOUNDATION WALL CACLCULATION (ASSUMING SUB-SLAB DRAINAGE SYSTEM IS APPROVED PER DESIGN SHOWN ON STRUCTURAL DRAWINGS)

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* **MEMBER NAME : 7 West 57th Street Typical Foundation Wall**

**1. General Information**

(1) Design Code : ACI318-11

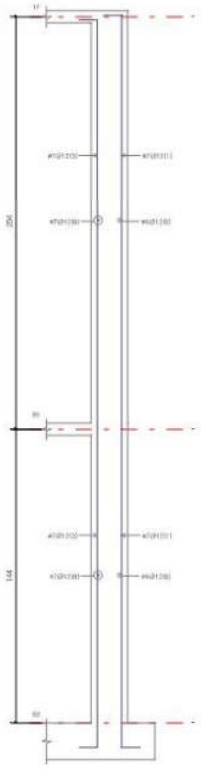
(2) Unit System : lbf, in

**2. Material**

(1) $f'_c$ : 8,000psi

(2) $F_y$ : 60,000psi

(3) $F_{yh}$ : 60,000psi



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**3. Section**

(1) Basewall Type : 1 Way

(2) Cover : 2.000in

(3) Width of Basewall : 1.00ft

(4) Story Information

* Story(B1) : H=17.00ft, THK.=18.00in

* Story(B2) : H=12.00ft, THK.=18.00in

**4. Boundary Condition**

(1) Top : Pin (Factor = 0.000)

(2) Bottom : Pin (Factor = 0.000)

**5. Soil Load**

(1) User defined soil load is applied.

**6. Soil Pressure**

(1) Soil pressure by Level

* $F_1$ = 0.300 kip/ft^2 ( GL+0.000ft )

* $F_2$ = 1.269 kip/ft^2 ( GL-17.00ft )

* $F_3$ = 0.400 kip/ft^2 ( GL-17.00ft )

* $F_4$ = 0.400 kip/ft^2 ( GL-29.00ft )

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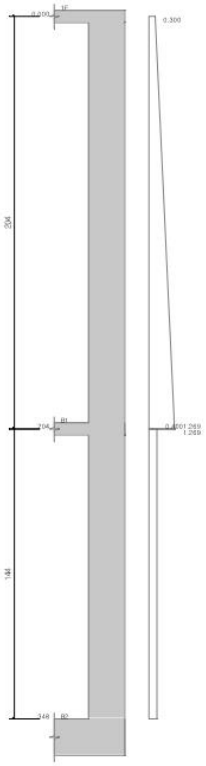

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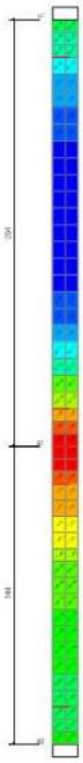
**7. Check Moment Capacity [ Direction Y ]**



DESIMONE

MIDAS Information Technology Co., Ltd

(1) Story : B1

| - | Top | Center | Bottom | Remark |
|---|---|---|---|---|
| Rebar1 | #7@12.00 | #7@12.00 | #7@12.00 | |
| Rebar2 | - | - | - | |
| Layer(s) | - | - | - | |
| Mu(kip.in/ft) | 24.40 | 221 | -244 | |
| ωσΠΗΙMn(kip.in/ft) | 510 | 510 | 510 | |
| Ratio | OK(0.0478) | OK(0.433) | OK(0.479) | |
| Rebar Length(in) | 0.000 | 0.000 | 0.000 | |
| $s_{bar}$ / $s_{max}$ | OK(1.000) | OK(1.000) | OK(1.000) | $s_{max}$ = 12.00in |

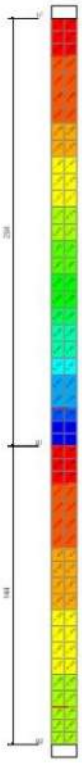
(2) Story : B2

| - | Top | Center | Bottom | Remark |
|---|---|---|---|---|
| Rebar1 | #7@12.00 | #7@12.00 | #7@12.00 | |
| Rebar2 | - | - | - | |
| Layer(s) | - | - | - | |
| Mu(kip.in/ft) | -245 | 7.733 | 3.773 | |
| ωσΠΗΙMn(kip.in/ft) | 510 | 510 | 510 | |
| Ratio | OK(0.480) | OK(0.0152) | OK(0.00740) | |
| Rebar Length(in) | 0.000 | 0.000 | 0.000 | |
| $s_{bar}$ / $s_{max}$ | OK(1.000) | OK(1.000) | OK(1.000) | $s_{max}$ = 12.00in |

DESIMONE

MIDAS Information Technology Co., Ltd

**8. Check Shear Capacity [ Direction Y ]**



DESIMONE

MIDAS Information Technology Co., Ltd

(1) Story : B1

| - | Top | Center | Bottom | Remark |
|---|---|---|---|---|
| Vu(kip/ft) | -4.179 | - | 9.485 | |
| $Vu_{critical}$(kip/ft) | -3.597 | - | 7.258 | |
| ωσΠHIVc(kip/ft) | 27.86 | - | 27.86 | |
| ωσΠHIVs(kip/ft) | 14.92 | - | 14.92 | |
| ωσΠHIVn(kip/ft) | 42.77 | - | 42.77 | |
| Ratio | OK(0.0812) | - | OK(0.22176) | |
| Rebar | #4@10.00 | - | #4@10.00 | |
| Reinf. Length(in) | - | - | - | |

(2) Story : B2

| - | Top | Center | Bottom | Remark |
|---|---|---|---|---|
| Vu(kip/ft) | -4.763 | - | 0.647 | |
| $Vu_{critical}$(kip/ft) | -3.471 | - | -0.00166 | |
| ωσΠHIVc(kip/ft) | 27.86 | - | 27.86 | |
| ωσΠHIVs(kip/ft) | 14.92 | - | 14.92 | |
| ωσΠHIVn(kip/ft) | 42.77 | - | 42.77 | |
| Ratio | OK(0.0812) | - | OK(0.0000388) | |
| Rebar | #4@10.00 | - | #4@10.00 | |
| Reinf. Length(in) | - | - | - | |