Exhibit A

File No. 210387
Riverwalk SPROZ for Development known as Eighteen87 On Water
1887 N. Water St, Milwaukee, WI
June 18, 2021
Revised 06-28-2021

Rule Enterprises is proposing to rezone 1887 N. Water Street to a new Detailed Planned Development (DPD, File No. 210172) to allow a 5-story, 79-unit multi-family residential building with associated parking. This site is also located within the Riverwalk Site Plan Review Overlay Zone (SPROZ) and as such, requires the construction of a Riverwalk.

<u>Project Summary</u>
(Tax Key -3540913110)

Project Overview:
The proposed project is for the design and construction of 5-story Residential Apartment building with two levels of interior and integrated parking within the building. There are total of 79 units, (7 of which will be walk-up townhouse-style units) with associated tenant amenities to include a management/leasing office, fitness room, community room, business center, storge, and indoor parking. The building height is up to 58 feet from street side elevation. A Riverwalk will also be constructed on the north and west sides of the building as shown in the drawings. Details relating to the Riverwalk, site plan, and building facades within the 50 foot overlay zoneare provided in this exhibit relating to the Riverwalk Site Plan Review Overlay Zone (SPROZ). Currently, the site is occupied by a one-story storage building and surface parking lot, which will be demolished to provide needed area for the new construction.

Building Overview:

- Street Level- First Floor: Main Building Resident Entrance & Lobby, leasing office, mechanicalspaces, indoor parking, trash/recycling, and all first floors of the wo-story Townhomes. Additionally, 3 apartments have access on first floor.
- Second Level: Indoor Parking, Storage spaces, second floors of the two- story Townhomes, six Apartment units, and the Business center.
- Third Level: Residential tenant amenities, a community room with roof terrace access, a fitness room, storage units, and support spaces
- Fourth – Fifth, Residential Unit Levels, Support spaces
- The project also includes a roof terrace area located on third floor allocated use to four units and the community room, all with direct entry access to the terrace area.

Building Materials:

The exterior materials for the proposed building will consist of a combination of the following materials.Material samples will be provided to DCD as requested, and all final material selections will be reviewedand approved by DCD in advance of permit issuance:

- Face brick: utility size
- Precast Stone sills at brick surfaces: size varies.

- Architectural fiber cement panels in various shades and cuts.
- Smooth Surface Interlocking Metal panels with concealed fasteners
- Clear, Low E glazing
- Vinyl operable windows, and patio doors
- Aluminum storefront, for Building Entry, and Townhome Entries
- See sheets A100-A103 for Riverwalk perspectives, A200 for site plan, Elevations on A400 – A401 Building renderings on sheets A502- A504 for building perspectives .
- Metal railings for terrace and exterior ramps and Riverwalk
- Metal garage doors with windows
- Membrane roofing.

○ Riverwalk specifics: North **Riverwalk perspectives on Sheet A100- A103**	○ The River is located to the north side of the site. Grades from the River's edge rise to a plateau as an existing condition. Site's flat area meets Water Street at similar elevation. ○ The sloped area along the River's edge is covered with existing greens, and trees. The project anticipates keeping this natural edge, as is, with minimal disturbance. Clearing of some of these will become critical during demolition and for staging areas needed for the construction of the new elevated ramp, and the building. It is inevitable that not all greens can be saved, however to the extent we can keep them they will be left as natural setting. Through this process perhaps some clearing becomes possible to expose views and glimpse of the water and river. ○ Riverwalk is planned to run along the top of this sloped area closer to the building. The top of the slope where it plateaus, the elevation of Riverwalk along north will be kept at about 18 inches below the elevation of the first-floor plate of the building. This allows for the Townhomes that are located on the northside to receive 3 steps before entering the units from outside. This provides some privacy and separation from public walks and the private units.
Connection at northeast corner:	○ The Riverwalk connection to the east will be made with a series of three ramps and associated landings that connect to the existing Riverwalk at 1905 north Water Street which is the neighboring property. The ramp's first landing will be elevated from the grade at about 10 feet closest to the river, midway close to building the pier support will be 6 feet above grade, then 4 feet above grade diminishes to 2 feet above grade, until it matches grade on the north side. Please see info and detail on sheet A200 ○ This elevated portion of the ramp is structured with steel framing supported by columns and shallow concrete footings as foundation. The column support for a small portion of ramp and its first landing will be over MMSD's deep tunnel sanitary line. All efforts have been made regarding coordination of this construction with MMSD project manager Micki Klappa Sullivan. (attached is the string of communication emails from project Civil Engineer and MMSD PM regarding this specific project. **Exhibit B**

	○ Additional technical report from geotechnical consultant on this project attached for preliminary technical overview of loading and soil conditions which will support this construction without adverse effect to the MMSD's deep tunnel. Please see technical memo as **Exhibit C.** Also See **Exhibit D** for report related to loading overview on MMSD's 30- and 48-inch pipes. ○ **Exhibit E** , also provides with structural calcs based on which the geotechnical consultant has provided this certificate.
North Segment Riverwalk	○ When Riverwalk expands over areas where the grade starts to fall off, north side of the site, the construction of ramps itself will revert to steel framing supported by columns and shallow concrete footings, and ramp surfaces will be of composite decking. See Sheet A200 for extents of the 2 different types of construction proposed for the Riverwalk.
West Segment Riverwalk	○ The Riverwalk connection to the west will be brought to the public pedestrian sidewalk meeting at Water Street. At west side the 18 inches of elevation difference is made up with a gentle continuous slope over 80 feet of length, after the entrance of the last town home on the west side is cleared. This ramping will be done in 2 segments to allow for connection to the west side property at mid landing of this portion of Riverwalk. This allows to connect midway to their proposed Riverwalk segment. ○ Given the suggestion to widen the west side Riverwalk from 9 feet to 12 feet, we like to share our findings with the DRT team. The land is owned by the adjacent property owner as GIS map shows. It also is a vacated R.O.W due to utilities of MMSD in this area. MMSD has an easement over this area, granted from the west side property owner. To get the 3 feet and expand our western Riverwalk, we need **to get an easement from west side property owner.** Then potentially, we need to coordinate with MMSD to make sure we do not interfere with their road by this encouragement. Attempts have been made to connect to the side property owner, however no discussion has taken place yet. This is a process that we will continue to work on and push for, but we will not have resolution by the deadline of this submittal.

	○ This project will integrate a Riverwalk along its two sides, with two connections described above. The project will provide the City with a permanent public access easement for the Riverwalk, while it remains as part of the private property and will follow Riverwalk Design Guidelines to achieve this.
Riverwalk surfaces and railing details:	○ Ramp surfaces when elevated and supported by piers will be finished with resin decking material over steel framing supported by columns and shallow concrete footings foundation. Ramp width will be 9 feet. An application to request deviation from width required for Riverwalk per design standards within this overlay zone is submitted for your consideration. ○ The ramp will have finished pipe rail system on both sides per code and code compliant height of 42 inches. The first initial elevated ramp section will have integrated lighting within the railing system to light the ramp path. ○ Continuation of Riverwalk on the north side at bottom of the ramp will be changed to be of concrete surfaces and will be constructed like slab on grade concrete sidewalk on the plateaued area. ○ Riverwalk along the west side will be also made from composite decking with steel framing supported by columns and shallow concrete footings foundation. ○ All portion of Riverwalk will receive railing continues and of same material except when the walk is along building side at the same protected elevation.
Lighting:	○ Harp lights are integrated as best as possible, and where Riverwalk width is at 9 feet on the west side, the lighting will be provided by cutoff light fixtures mounted from the building façade with proper illumination. ○ The balance of lighting requirements for the ramp will be provided by fixtures installed along the building façade for proper illumination. ○ Additional to installation of harp lights and building light fixtures, prefinished benches and trash receptacles will be provided for public use. These are placed in a manner to not interfere with townhome entrances and provide them with privacy, while accommodating public use.

	Please see sheet L100 for location and numbers. (7 harp lights, 2 trash receptacles, and 2 benches)
Landscaping:	○ Riverwalk along the north edge against the building will also receive landscaping please see landscape plans, and renderings of Riverwalk perspectives on Sheet A100-A103 ○ Additionally, growing vines will be planted in planters located on the third -floor terrace. Growing vines along with associated trellis structures against the building's lower parking floors will provide more visual interest and will cover parking wall.

EXHIBIT B

Falamak Nourzad

From:	Klappa-Sullivan, Micki <MKlappaSullivan@mmsd.com>
Sent:	Wednesday, June 02, 2021 11:00 AM
To:	Terry Meyer, P.E.
Cc:	Christopher Carr, P.E.; Colin Trautschold; Megan Schuetz; Brandon Rule; Heather Wogsland; Falamak Nourzad; Kevin Slottke, P.L.S.
Subject:	RE: [EXT] 1887 Water- Proposed Residential Building
Attachments:	[EXT] 1887 Water- Proposed Residential Building

Micki Klappa-Sullivan, PE, ENV SP

Manager of Engineering Planning | MMSD

P: 414.225.2178
M: 414.416.5389
E: MKlappaSullivan@mmsd.com

From: Terry Meyer, P.E. <tmeyer@thesigmagroup.com>
Sent: Wednesday, June 2, 2021 8:49 AM
To: Klappa-Sullivan, Micki <MKlappaSullivan@mmsd.com>
Cc: Christopher Carr, P.E. <ccarr@thesigmagroup.com>; Colin Trautschold <ctrautschold@thesigmagroup.com>; Megan Schuetz <ms@movin-out.org>; Brandon Rule <BRule@ruleenterprisesllc.com>; Heather Wogsland <heather.wogsland@continuumarchitects.com>; Falamak Nourzad <falamak.nourzad@continuumarchitects.com>; Kevin Slottke, P.L.S. <kslottke@thesigmagroup.com>
Subject: RE: [EXT] 1887 Water- Proposed Residential Building

Micki,
We requested the record drawings from diggers and they never sent it over. Please find the attached diggers request from 3/24/21. Can MMSD provide them?
Thanks,
Terry

From: Klappa-Sullivan, Micki <MKlappaSullivan@mmsd.com>
Sent: Wednesday, June 2, 2021 6:39 AM
To: Christopher Carr, P.E. <ccarr@thesigmagroup.com>
Cc: Falamak Nourzad <falamak.nourzad@continuumarchitects.com>; Heather Wogsland <heather.wogsland@continuumarchitects.com>; Brandon Rule <BRule@ruleenterprisesllc.com>; Megan Schuetz <ms@movin-out.org>; Terry Meyer, P.E. <tmeyer@thesigmagroup.com>; Colin Trautschold <ctrautschold@thesigmagroup.com>
Subject: RE: [EXT] 1887 Water- Proposed Residential Building

Tell the Digger's contact that you need record drawings. They will provide them.

Micki Klappa-Sullivan, PE, ENV SP

Manager of Engineering Planning | MMSD

P: 414.225.2178
M: 414.416.5389
E: MKlappaSullivan@mmsd.com

From: Christopher Carr, P.E. <ccarr@thesigmagroup.com>
Sent: Tuesday, June 1, 2021 2:58 PM
To: Klappa-Sullivan, Micki <MKlappaSullivan@mmsd.com>
Cc: Falamak Nourzad <falamak.nourzad@continuumarchitects.com>; Heather Wogsland <heather.wogsland@continuumarchitects.com>; Brandon Rule <BRule@ruleenterprisesllc.com>; Megan Schuetz <ms@movin-out.org>; Terry Meyer, P.E. <tmeyer@thesigmagroup.com>; Colin Trautschold <ctrautschold@thesigmagroup.com>
Subject: RE: [EXT] 1887 Water- Proposed Residential Building

Thanks Micki, We will resubmit plans with a little more detail.

We got the attached from Diggers. Any chance we can get as builts of the structures on the parcel? I don't think we can get those through Diggers. Want to make sure we understand sizes and supports of the existing infrastructure.

Thanks again,

Chris

Christopher Carr, PE
The Sigma Group
ccarr@thesigmagroup.com
414-643-4163

From: Klappa-Sullivan, Micki <MKlappaSullivan@mmsd.com>
Sent: Tuesday, June 1, 2021 7:21 AM
To: Christopher Carr, P.E. <ccarr@thesigmagroup.com>
Cc: Falamak Nourzad <falamak.nourzad@continuumarchitects.com>; Heather Wogsland <heather.wogsland@continuumarchitects.com>; Brandon Rule <BRule@ruleenterprisesllc.com>; Megan Schuetz <ms@movin-out.org>; Terry Meyer, P.E. <tmeyer@thesigmagroup.com>; Colin Trautschold <ctrautschold@thesigmagroup.com>
Subject: RE: [EXT] 1887 Water- Proposed Residential Building

Chris,
Please contact Digger's Hotline to request record drawings of our facilities, they are happy to provide them.
MMSD requires a buildover letter for work within our easements. You can always make these requests to our real estate department at ContactRealEstate@mmsd.com as they are responsible for our easements.
In regards to the approval for building over our facilities, generally speaking, we would need plans showing all work near and over our pipes and any structural elements near our facilities and any loading changes that would result due to structural loads. If you want to send me a preliminary plan, I would be happy to look it over and provide some initial comments.

Micki Klappa-Sullivan, PE, ENV SP

Manager of Engineering Planning | MMSD

P: 414.225.2178

M: 414.416.5389
E: MKlappaSullivan@mmsd.com

From: Christopher Carr, P.E. <ccarr@thesigmagroup.com>
Sent: Wednesday, May 26, 2021 9:04 AM
To: Klappa-Sullivan, Micki <MKlappaSullivan@mmsd.com>
Cc: Falamak Nourzad <falamak.nourzad@continuumarchitects.com>; Heather Wogsland <heather.wogsland@continuumarchitects.com>; Brandon Rule <BRule@ruleenterprisesllc.com>; Megan Schuetz <ms@movin-out.org>; Terry Meyer, P.E. <tmeyer@thesigmagroup.com>; Colin Trautschold <ctrautschold@thesigmagroup.com>
Subject: [EXT] 1887 Water- Proposed Residential Building

Good Morning Micki,

We are working with Rule Enterprises and partners on a proposed residential development at 1887 Water Street. We are removing the existing building and constructing a new multi-story residential development. In general the development is staying off the existing slope and trees; we are currently planning to have a Riverwalk along the edge. The majority of the Riverwalk is off the existing easement and sewers although on the east there is an area of the Riverwalk that will need to go over part of the MMSD sewers. In this location we are looking at using an elevated structure with supports. We are not planning to impact any of the existing manholes.

Micki- We would request the following:

1. More detailed as builts of the sewer in the area. We have the Diggers maps but as builts with depths and sizes would help.
2. Meeting to discuss any concerns or issues from the District on the proposed project.

Please review the initial items and let us know when you are available to meet.

Thank you,

Chris

Christopher Carr, PE
Civil Engineering Group Leader
The Sigma Group, Inc.
414.643.4163
414.517.6724
1300 W. Canal Street, Milwaukee, WI 53233
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EXHIBIT C

To: **Brandon Rule, Rule Enterprises**

Megan Schuetz, Movin' Out

Falamak Nourzad, NCARB, AIA, ASID, LEED AP **Continuum Architects**

From: **Paul Koszarek, P.E., C.S.T.– Terracon**

Date: **June 18, 2021**

RE: **1887 N. Water Street, Milwaukee, WI**

Elevated River Walk Foundation over MMSD 84" Diameter Pipe

Terracon Project Number 58215085

Terracon was asked to review and comment on the plan to support an elevated river walk using spread footings. It is our understanding that the planned design bearing pressure is 2,000 psf and the planned bottom of footing elevation is 21 feet (MCD). The top of the MMSD 84 inch diameter pipe is reported to be at elevation -29 feet (MCD). Based on this, essentially no additional load will be placed on the buried MMSD pipe due to the shallow spread footing foundation from the elevated river walk.

Regards,

Paul J. Koszarek, P.E., C.S.T.

Senior Associate/Geotechnical Department Manager

EXHIBIT D

To: **Brandon Rule, Rule Enterprises**

Megan Schuetz, Movin' Out

Falamak Nourzad, NCARB, AIA, ASID, LEED AP Continuum Architects

From: **Paul Koszarek, P.E., C.S.T.– Terracon**

Date: **June 24, 2021**

RE: **1887 N. Water Street, Milwaukee, WI**

Elevated River Walk Foundation near MMSD 30" and 48" Diameter Pipes

Terracon Project Number 58215085

Terracon was asked to review and comment on the plan to support an elevated river walk using spread footings. It is our understanding that the planned design bearing pressure is 2,000 psf and the planned bottom of footing elevation is 11 feet (MCD). The nearest MMSD pipe is 30 inches in diameter and the top of of the pipe is reported to be at elevation 0 feet (MCD). The center of the pipe is located approximately 5 feet from the nearest planned riverwalk column pad. Based on this, approximately 44 psf of additional load will be placed on the buried MMSD pipe due to the shallow spread footing foundation from the elevated river walk. There is a 48 inch pipe that is farther away and is not within the zone of influence of the new planned foundations.

Regards,

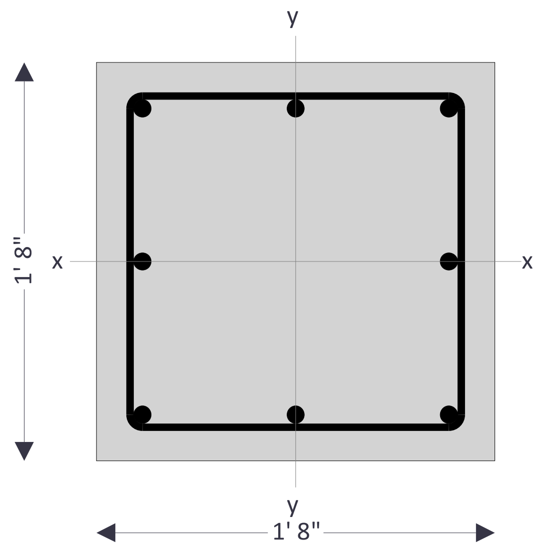
Paul J. Koszarek, P.E., C.S.T.

Senior Associate/Geotechnical Department Manager

RC RECTANGULAR COLUMN DESIGN (ACI318-11)

EXHIBIT E

Tedds calculation version 2.2.02



Applied loads

Ultimate axial force acting on column P_{u_act} = **18** kips

Geometry of column

Depth of column (larger dimension of column) h = **20.0** in

Width of column (smaller dimension of column) b = **20.0** in

Clear cover to reinforcement (both sides) c_c = **1.5** in

Unsupported height of column about x axis l_{ux} = **6.0** ft

Effective height factor about x axis k_x = **1.00**

Column state about the x axis Unbraced

Unsupported height of column about y axis l_{uy} = **6.0** ft

Effective height factor about y axis k_y = **1.00**

Column state about the y axis Unbraced

Check on overall column dimensions

Column dimensions are OK - h < 4b

Reinforcement of column

Numbers of bars of longitudinal steel N = **8**

Longitudinal steel bar diameter number D_{bar_num} = **7**

Diameter of longitudinal bar D_{long} = **0.875** in

Stirrup bar diameter number D_{stir_num} = **3**

Diameter of stirrup bar D_{stir} = **0.375** in

Specified yield strength of reinforcement f_y = **60000** psi

Specified compressive strength of concrete f'_c = **3000** psi

Modulus of elasticity of bar reinforcement $E_s = \mathbf{29 \times 10^6}$ psi

Modulus of elasticity of concrete $E_c = 57000 \times f'_c{}^{1/2} \times (1\text{psi})^{1/2}$ = **3122019** psi

Yield strain $\varepsilon_y = f_y / E_s$ = **0.00207**

Ultimate design strain — ε_c = **0.003** in/in

Check for minimum area of steel - 10.9.1

Gross area of column — $A_g = h \times b$ = **400.000** in^2

Area of steel — $A_{st} = N \times (\pi \times D_{long}^2) / 4$ = **4.811** in^2

Minimum area of steel required — $A_{st\_min} = 0.01 \times A_g$ = **4.000** in^2

A_{st}> A_{st_min}, PASS- Minimum steel check

Check for maximum area of steel - 10.9.1

Permissible maximum area of steel — $A_{st\_max} = 0.08 \times A_g$ = **32.000** in^2

A_{st}< A_{st_max}, PASS - Maximum steel check

Slenderness check about x axis

Radius of gyration — $r_x = 0.3 \times h$ = **6** in

Actual slenderness ratio — $s_{rx\_act} = k_x \times l_{ux} / r_x$ = **12**

Slenderness ratio is less than 22, slenderness effects may be neglected

Slenderness check about y axis

Radius of gyration — $r_y = 0.3 \times b$ = **6** in

Actual slenderness ratio — $s_{ry\_act} = k_y \times l_{uy} / r_y$ = **12**

Slenderness ratio is less than 22, slenderness effects may be neglected

Axial load capacity of axially loaded column

Strength reduction factor — $\phi = 0.65$

Area of steel on compression face — $A'_s = A_{st} / 2$ = **2.405** in^2

Area of steel on tension face — $A_s = A_{st} / 2$ = **2.405** in^2

Net axial load capacity of column — $P_n = 0.8 \times (0.85 \times f'_c \times (A_g - A_{st}) + f_y \times A_{st})$ = **1037.094** kips

Ultimate axial load capacity of column — $P_u = \phi \times P_n$ = **674.111** kips

PASS : Column is safe in axial loading

Design of column ties - 7.10.5

Spacing of lateral ties — s_{v_ties} = **9.000** in

16 times longitudinal bar diameter — $s_{v1} = 16 \times D_{long}$ = **14.000** in

48 times tie bar diameter — $s_{v2} = 48 \times D_{stir}$ = **18.000** in

Least column dimension — $s_{v3} = \min(h,b)$ = **20.000** in

Required tie spacing — $s = \min(s_{v1},s_{v2},s_{v3})$ = **14.000** in

s_{v_ties} < s PASS

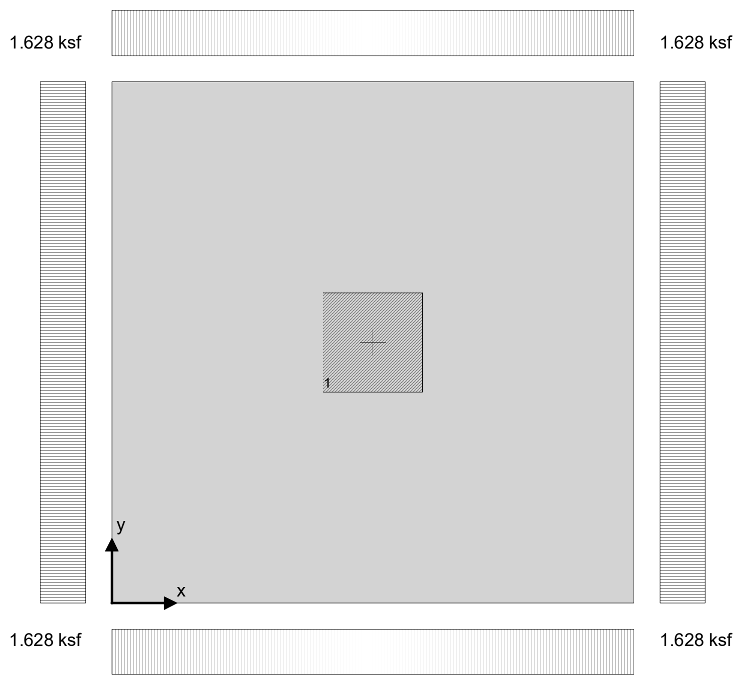
RIVERWALK FOOTING

Foundation analysis & design (ACI318) in accordance with ACI318-11 incorporating Errata as of August 8, 2014

Tedds calculation version 3.2.09

FOOTING ANALYSIS

Length of foundation	L_x = **3.5** ft
Width of foundation	L_y = **3.5** ft
Foundation area	A = $L_x \times L_y$ = **12.25** ft^2
Depth of foundation	h = **12** in
Depth of soil over foundation	h_{soil} = **0** in
Density of concrete	γ_{conc} = **150.0** lb/ft^3



Column no.1 details

Length of column	l_{x1} = **8.00** in
Width of column	l_{y1} = **8.00** in
position in x-axis	x_1 = **21.00** in
position in y-axis	y_1 = **21.00** in

Soil properties

Gross allowable bearing pressure	q_{allow_Gross} = **2** ksf
Density of soil	γ_{soil} = **120.0** lb/ft^3
Angle of internal friction	ϕ_b = **30.0** deg
Design base friction angle	δ_{bb} = **30.0** deg
Coefficient of base friction	$\tan(\delta_{bb})$ = **0.577**

Foundation loads

Self weight $F_{swt} = h * \gamma_{conc} =$ **150** psf

Column no.1 loads

Dead load in z $F_{Dz1} =$ **6.1** kips

Live load in z $F_{Lz1} =$ **12.0** kips

Footing analysis for soil and stability

Load combinations per ASCE 7-10

1.0D (0.324)

1.0D + 1.0L (0.814)

Combination 2 results: 1.0D + 1.0L

Forces on foundation

Force in z-axis $F_{dz} = \gamma_D * A * F_{swt} + \gamma_D * F_{Dz1} + \gamma_L * F_{Lz1} =$ **19.9** kips

Moments on foundation

Moment in x-axis, about x is 0 $M_{dx} = \gamma_D * A * F_{swt} * L_x / 2 + \gamma_D * (F_{Dz1} * x_1) + \gamma_L * (F_{Lz1} * x_1) =$ **34.9** kip_ft

Moment in y-axis, about y is 0 $M_{dy} = \gamma_D * A * F_{swt} * L_y / 2 + \gamma_D * (F_{Dz1} * y_1) + \gamma_L * (F_{Lz1} * y_1) =$ **34.9** kip_ft

Uplift verification

Vertical force $F_{dz} =$ **19.938** 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

$q_1 = F_{dz} * (1 - 6 * e_{dx} / L_x - 6 * e_{dy} / L_y) / (L_x * L_y) =$ **1.628** ksf

$q_2 = F_{dz} * (1 - 6 * e_{dx} / L_x + 6 * e_{dy} / L_y) / (L_x * L_y) =$ **1.628** ksf

$q_3 = F_{dz} * (1 + 6 * e_{dx} / L_x - 6 * e_{dy} / L_y) / (L_x * L_y) =$ **1.628** ksf

$q_4 = F_{dz} * (1 + 6 * e_{dx} / L_x + 6 * e_{dy} / L_y) / (L_x * L_y) =$ **1.628** ksf

Minimum base pressure $q_{min} = \min(q_1,q_2,q_3,q_4) =$ **1.628** ksf

Maximum base pressure $q_{max} = \max(q_1,q_2,q_3,q_4) =$ **1.628** ksf

Allowable bearing capacity

Allowable bearing capacity $q_{allow} = q_{allow\_Gross} =$ **2** ksf

$q_{max} / q_{allow} =$ **0.814**

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 $f'_c =$ **3000** 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 7-10

1.4D (0.080)

1.2D + 1.6L + 0.5Lr (0.249)

Combination 2 results: 1.2D + 1.6L + 0.5Lr

Forces on foundation

Ultimate force in z-axis $F_{uz} = \gamma_D * A * F_{swt} + \gamma_D * F_{Dz1} + \gamma_L * F_{Lz1} = \mathbf{28.7}$ kips

Moments on foundation

Ultimate moment in x-axis, about x is 0 $M_{ux} = \gamma_D * A * F_{swt} * L_x / 2 + \gamma_D * (F_{Dz1} * x_1) + \gamma_L * (F_{Lz1} * x_1) = \mathbf{50.3}$ kip_ft

Ultimate moment in y-axis, about y is 0 $M_{uy} = \gamma_D * A * F_{swt} * L_y / 2 + \gamma_D * (F_{Dz1} * y_1) + \gamma_L * (F_{Lz1} * y_1) = \mathbf{50.3}$ kip_ft

Eccentricity of base reaction

Eccentricity of base reaction in x-axis $e_{ux} = M_{ux} / F_{uz} - L_x / 2 = \mathbf{0}$ in

Eccentricity of base reaction in y-axis $e_{uy} = M_{uy} / F_{uz} - L_y / 2 = \mathbf{0}$ in

Pad base pressures

$q_{u1} = F_{uz} * (1 - 6 * e_{ux} / L_x - 6 * e_{uy} / L_y) / (L_x * L_y) = \mathbf{2.345}$ ksf

$q_{u2} = F_{uz} * (1 - 6 * e_{ux} / L_x + 6 * e_{uy} / L_y) / (L_x * L_y) = \mathbf{2.345}$ ksf

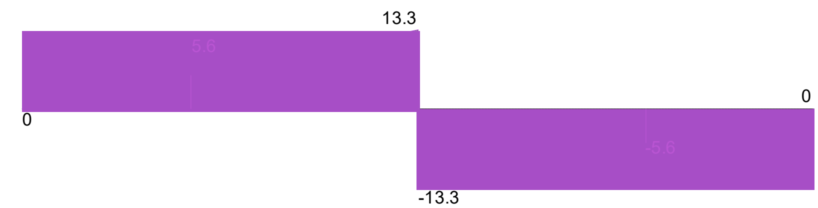
$q_{u3} = F_{uz} * (1 + 6 * e_{ux} / L_x - 6 * e_{uy} / L_y) / (L_x * L_y) = \mathbf{2.345}$ ksf

$q_{u4} = F_{uz} * (1 + 6 * e_{ux} / L_x + 6 * e_{uy} / L_y) / (L_x * L_y) = \mathbf{2.345}$ ksf

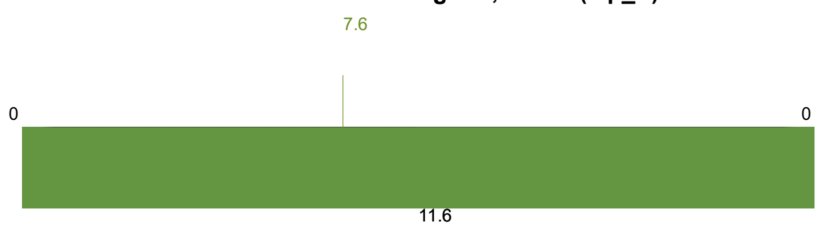
Minimum ultimate base pressure $q_{umin} = \min(q_{u1},q_{u2},q_{u3},q_{u4}) = \mathbf{2.345}$ ksf

Maximum ultimate base pressure $q_{umax} = \max(q_{u1},q_{u2},q_{u3},q_{u4}) = \mathbf{2.345}$ ksf

Shear diagram, x axis (kips)



Moment diagram, x axis (kip_ft)



Moment design, x direction, positive moment

Ultimate bending moment $M_{u.x.max} = \mathbf{7.607}$ kip_ft

Tension reinforcement provided 4 No.5 bottom bars (11.7 in c/c)

Area of tension reinforcement provided $A_{sx.bot.prov} = \mathbf{1.24}$ in^2

Minimum area of reinforcement (10.5.4) $A_{s.min} = 0.0018 * L_y * h = \mathbf{0.907}$ 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 $d = h - c_{nom} - \phi_{x.bot} / 2$ = **8.688** in

Depth of compression block $a = A_{sx.bot.prov} * f_y / (0.85 * f'_c * L_y)$ = **0.695** in

Neutral axis factor β_1 = **0.85**

Depth to neutral axis $c = a / \beta_1$ = **0.817** in

Strain in tensile reinforcement (10.3.5) $\varepsilon_t = 0.003 * d / c - 0.003$ = **0.02889**

PASS - Tensile strain exceeds minimum required, 0.004

Nominal moment capacity $M_n = A_{sx.bot.prov} * f_y * (d - a / 2)$ = **51.709** 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 $\phi M_n = \phi_f * M_n$ = **46.538** kip_ft

$M_{u.x.max} / \phi M_n$ = **0.163**

PASS - Design moment capacity exceeds ultimate moment load

One-way shear design, x direction

Ultimate shear force $V_{u.x}$ = **5.646** kips

Depth to reinforcement $d_v = h - c_{nom} - \phi_{x.bot} / 2$ = **8.688** in

Shear strength reduction factor ϕ_v = **0.75**

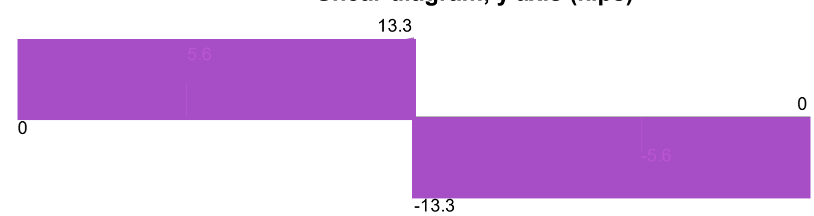
Nominal shear capacity (Eq. 11-3) $V_n = 2 * \lambda * \sqrt{(f'_c * 1 \text{ psi})} * L_y * d_v$ = **39.97** kips

Design shear capacity $\phi V_n = \phi_v * V_n$ = **29.978** kips

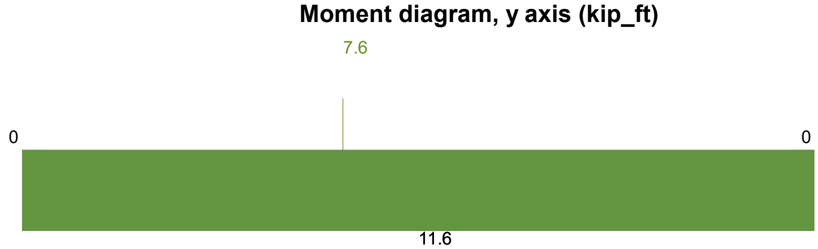
$V_{u.x} / \phi V_n$ = **0.188**

PASS - Design shear capacity exceeds ultimate shear load

Shear diagram, y axis (kips)



Moment diagram, y axis (kip_ft)



Moment design, y direction, positive moment

Ultimate bending moment $M_{u.y.max}$ = **7.607** kip_ft

Tension reinforcement provided 4 No.5 bottom bars (11.7 in c/c)

Area of tension reinforcement provided $A_{sy.bot.prov}$ = **1.24** in^2

Minimum area of reinforcement (10.5.4) $A_{s.min} = 0.0018 * L_x * h$ = **0.907** 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 $d = h - c_{nom} - \phi_{x.bot} - \phi_{y.bot} / 2$ = **8.062** in

Depth of compression block $a = A_{sy.bot.prov} * f_y / (0.85 * f'_c * L_x)$ = **0.695** in

Neutral axis factor β_1 = **0.85**

Depth to neutral axis $c = a / \beta_1$ = **0.817** in

Strain in tensile reinforcement (10.3.5) $\varepsilon_t = 0.003 * d / c - 0.003$ = **0.02660**

PASS - Tensile strain exceeds minimum required, 0.004

Nominal moment capacity $M_n = A_{sy.bot.prov} * f_y * (d - a / 2)$ = **47.834** 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 $\phi M_n = \phi_f * M_n$ = **43.051** kip_ft

$M_{u.y.max} / \phi M_n$ = **0.177**

PASS - Design moment capacity exceeds ultimate moment load

One-way shear design, y direction

Ultimate shear force $V_{u.y}$ = **5.646** kips

Depth to reinforcement $d_v = h - c_{nom} - \phi_{x.bot} - \phi_{y.bot} / 2$ = **8.062** in

Shear strength reduction factor ϕ_v = **0.75**

Nominal shear capacity (Eq. 11-3) $V_n = 2 * \lambda * \sqrt{(f'_c * 1 \text{ psi})} * L_x * d_v$ = **37.095** kips

Design shear capacity $\phi V_n = \phi_v * V_n$ = **27.821** kips

$V_{u.y} / \phi V_n$ = **0.203**

PASS - Design shear capacity exceeds ultimate shear load

Two-way shear design at column 1

Depth to reinforcement d_{v2} = **8.375** in

Shear perimeter length (11.11.1.2) l_{xp} = **16.375** in

Shear perimeter width (11.11.1.2) l_{yp} = **16.375** in

Shear perimeter (11.11.1.2) $b_o = 2 * (l_{x1} + d_{v2}) + 2 * (l_{y1} + d_{v2})$ = **65.500** in

Shear area $A_p = l_{x,perim} * l_{y,perim}$ = **268.141** in^2

Surcharge loaded area $A_{sur} = A_p - l_{x1} * l_{y1}$ = **204.141** in^2

Ultimate bearing pressure at center of shear area $q_{up.avg}$ = **2.345** ksf

Ultimate shear load $F_{up} = \gamma_D * F_{Dz1} + \gamma_L * F_{Lz1} + \gamma_D * A_p * F_{swt} - q_{up.avg} * A_p$ = **22.489** kips

Ultimate shear stress from vertical load $v_{ug} = \max(F_{up} / (b_o * d_{v2}), 0 \text{ psi})$ = **40.996** psi

Column geometry factor (11.11.2.1) $\beta = l_{y1} / l_{x1}$ = **1.00**

Column location factor (11.11.2.1) α_s =**40**

Concrete shear strength (11.11.2.1) $v_{cpa} = (2 + 4 / \beta) * \lambda * \sqrt{(f'_c * 1 \text{ psi})}$ = **328.634** psi

$v_{cpb} = (\alpha_s * d_{v2} / b_o + 2) * \lambda * \sqrt{(f'_c * 1 \text{ psi})}$ = **389.677** psi

$v_{cpc} = 4 * \lambda * \sqrt{(f'_c * 1 \text{ psi})}$ = **219.089** psi

$v_{cp} = \min(v_{cpa}, v_{cpb}, v_{cpc})$ = **219.089** psi

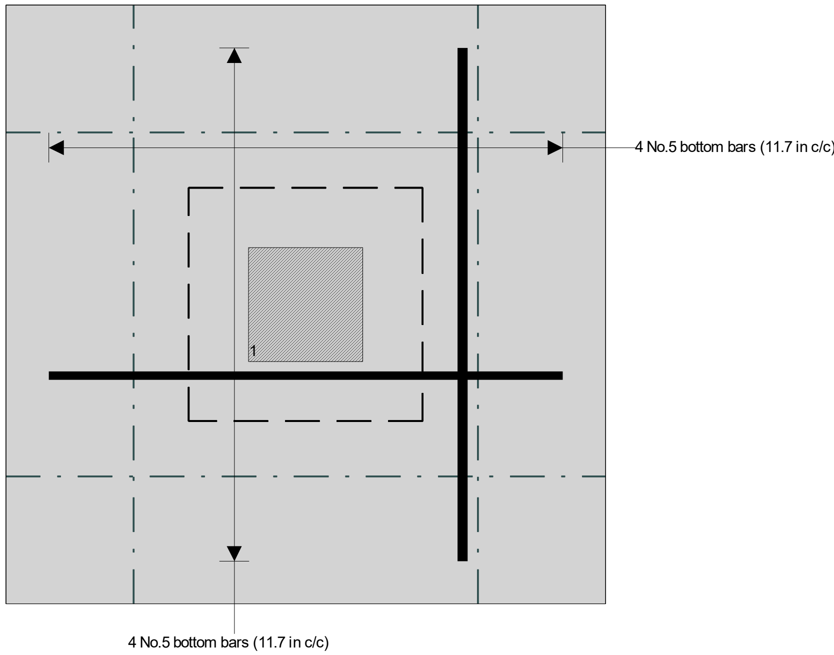
Shear strength reduction factor ϕ_v = **0.75**

Nominal shear stress capacity (Eq. 11-2) $v_n = v_{cp}$ = **219.089** psi

Design shear stress capacity (Eq. 11-1) $\phi v_n = \phi_v * v_n$ = **164.317** psi

$v_{ug} / \phi v_n$ = **0.249**

PASS - Design shear stress capacity exceeds ultimate shear stress load



4 No.5 bottom bars (11.7 in c/c)
1
4 No.5 bottom bars (11.7 in c/c)