zenith Engineers | Architects
Construction Managers

22320 Foothill Blvd, Suite 600
Hayward, CA 94541
Phone – 415 619 6000
Fax – 415 500 9583
Email – hemal@zenithengineers.com
www.zenithengineers.com

PROJECT: 190417-New Railing System Design

PROJECT #: 190417

CLIENT: Nationwide Industries

PREPARED BY: Hemal Modi, P.E.

REVIEWED BY: Senthil Puliyadi, M.S. M.Eng., P.E.

REV: 0

DATE: 09/22/2022

REGISTERED PROFESSIONAL ENGINEER
HEMAL MODI
C 78688
EXP. 09/30/2023
Hemal Modi
22nd SEP., 2022
CIVIL
STATE OF CALIFORNIA

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Fax – 415 500 9583
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RFX aluminum guard rail system utilizes aluminum extrusions with wire rope (stainless steel cable) and glass infill to construct building guards and rails for decks, balconies, stairs, fences and similar locations. The system is intended for interior and exterior weather exposed applications and is suitable for use in most natural environments. This system may be used for residential, commercial and industrial applications. It is an engineered system designed for the following criteria:

RFX Rail System Stainless Steel Cable:

The design loading conditions are: (Railing is designed for max speed of 160mph)

On Top Rail:

Concentrated load = 200 lbs any direction, any location

Uniform load = 50 plf, any perpendicular to rail

For installations compliant with the IRC only the 200# top rail load is applicable.

On In-fill Panels:

Concentrated load = 50# on one sf.

Distributed load = 25 psf on area of in-fill, including spaces

Wind load will not control and doesn't impact design.

Refer to IBC Section 1607.7.1 for loading.

Minimum Required Wood Type:

Wood Shall be Douglas-Fir or Better

Anchor Material Specifications:

DIN EN ISO 4042 (For Epoxy Anchors)

Stainless Steel (For Lag Screws)

Railing Post Material Specifications:

Post Shall be Aluminum 6063 – T5 and shall conform to Aluminum Design Manual.

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RFX Rail System Glass In-fill Panels:

The design loading conditions are: (Railing is designed for max speed of 110mph)

On Top Rail:

Concentrated load = 200 lbs any direction, any location

Uniform load = 50 plf, any perpendicular to rail

For installations compliant with the IRC only the 200# top rail load is applicable.

On In-fill Panels:

Concentrated load = 50# on one sf.

Distributed load = 25 psf on area of in-fill, including spaces

Wind load will apply in glass in-fill system.

Refer to IBC Section 1607.7.1 for loading.

Minimum Required Wood Type:

Wood Shall be Douglas-Fir or Better

Anchor Material Specifications:

DIN EN ISO 4042 (For Epoxy Anchors)

Stainless Steel (For Lag Screws)

Railing Post Material Specifications:

Railing Post Shall be Aluminum 6063 – T5 and shall conform to Aluminum Design Manual.

The RFX system will meet all applicable requirements of the 2006, 2009, 2012, 2015 and 2018 International Building Codes and International Residential Codes, CBC 2019 and state building codes based on these versions of the IBC, and 2005 and 2010 Aluminum Design Manuals. Wood components and anchorage to wood are designed in accordance with the 2018 National Design Specification for Wood Construction.

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Typical Installations:

Surface mounted with base plates:

Residential Applications:

Rail Height 36” or 42” above finish floor.

Steel Cable: Standard Post spacing 5’ on center maximum all mounting methods (one, or two-story house only) except as noted below.

Glass In-fill Panels: Standard Post spacing 4’ on center maximum all mounting methods (one, or two-story house only) except as noted below.

All top rails

Commercial and Industrial Applications:

Rail Height 42” above finish floor.

Steel Cable: Standard Post spacing 5’ on center maximum with stiffener for all posts.

Glass In-fill Panels: Standard Post spacing 4’ on center maximum with stiffener for all posts.

All top rails

Core pocket /embedded posts:

Residential Applications:

Rail Height 36” or 42” above finish floor.

Steel Cable: Standard Post spacing 5’ on center maximum all mounting methods (one, or two-story house only) except as noted below.

Glass In-fill Panels: Standard Post spacing 4’ on center maximum all mounting methods (one, or two-story house only) except as noted below.

Commercial and Industrial Applications:

Rail Height 42” above finish floor.

Steel Cable: Standard Post spacing 5’ on center maximum with stiffener for all posts.

Glass In-fill Panels: Standard Post spacing 4’ on center maximum with stiffener for all posts.

Note:

1. Post spacing RFX239P is 4’ on center maximum without using stiffener for posts.
2. PFX1000P post may be used for 6’ & 8’ panels with vertical cables and bottom rail support.

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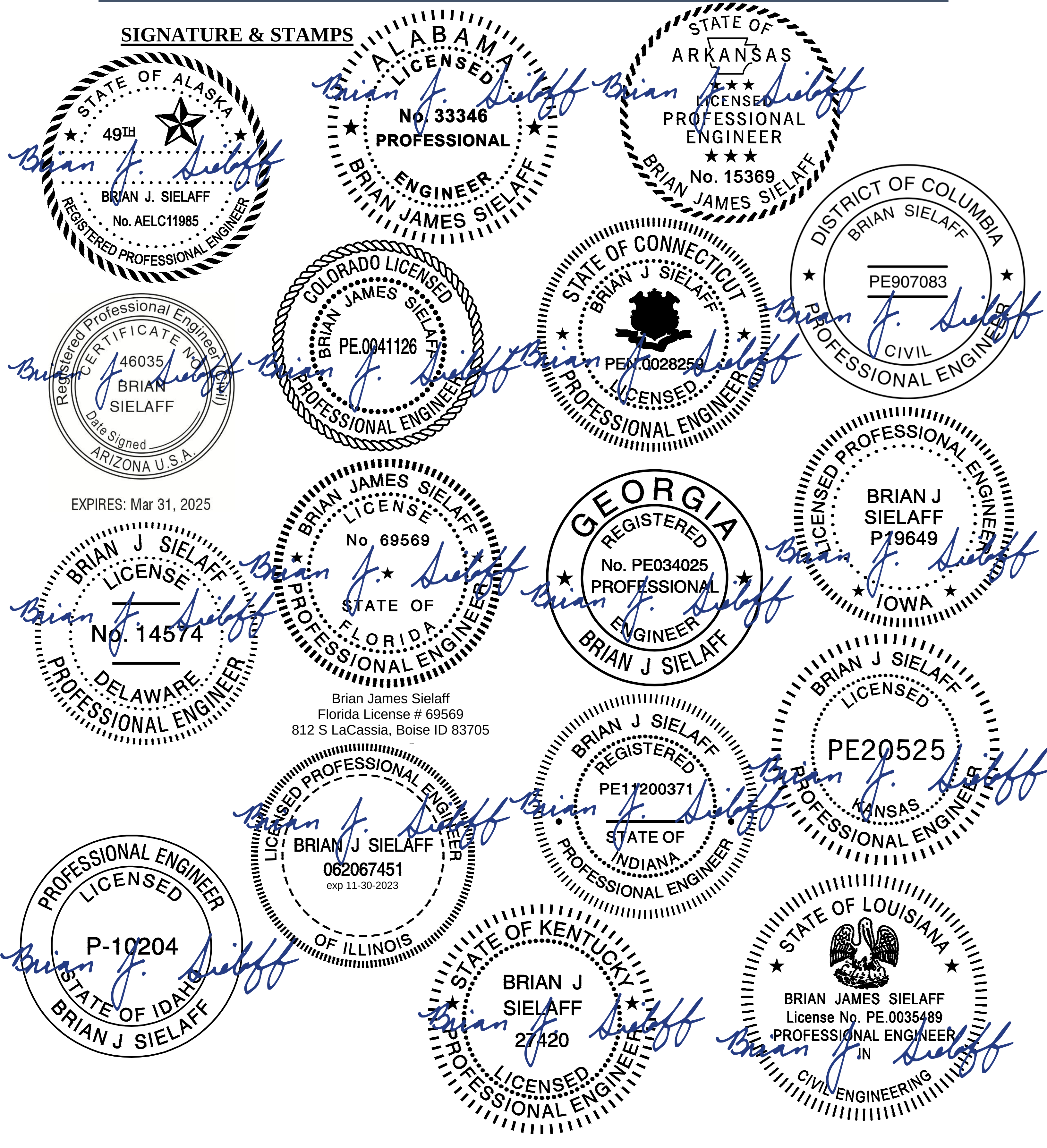
SIGNATURE & STAMPS



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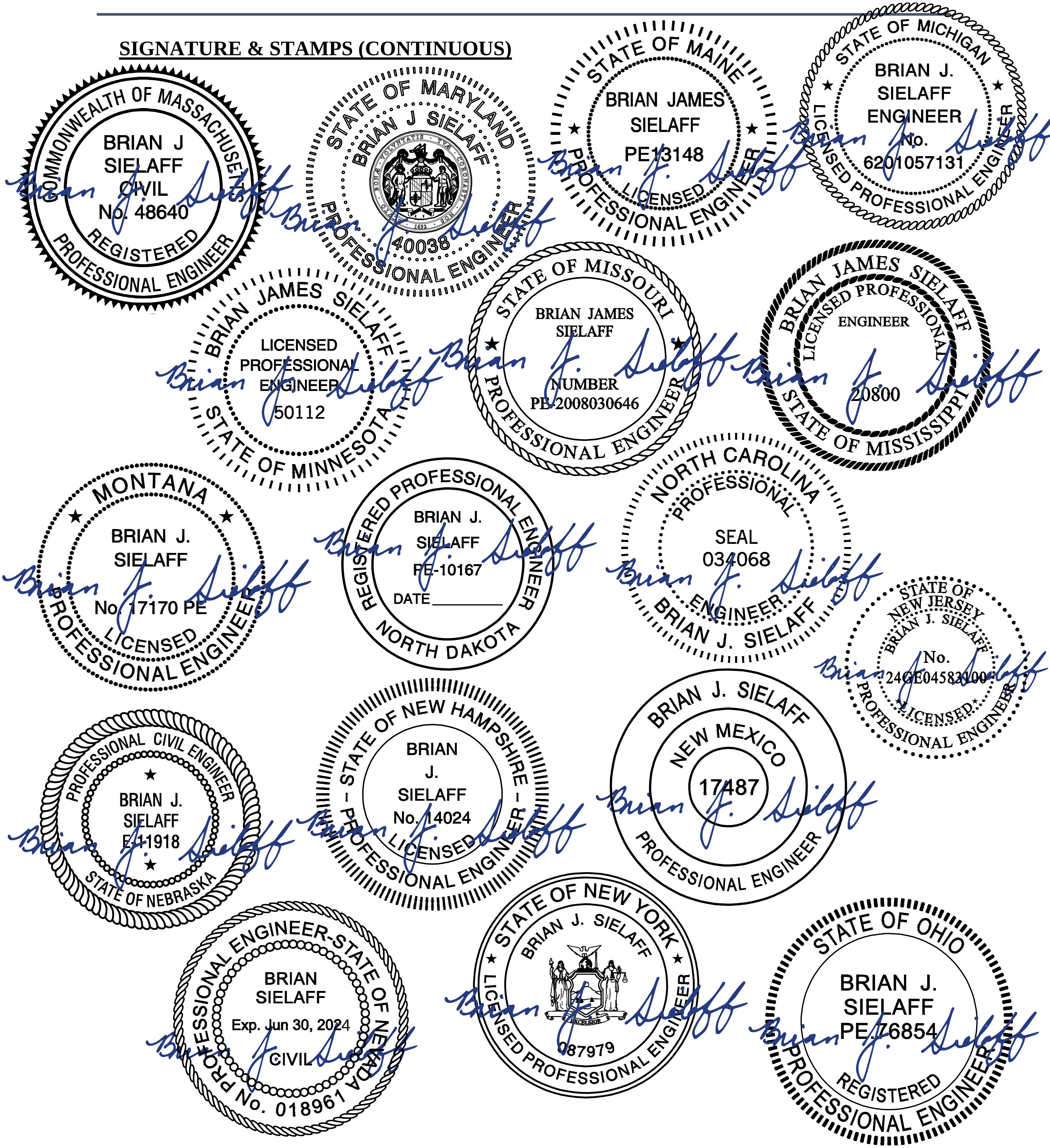
SIGNATURE & STAMPS (CONTINUOUS)



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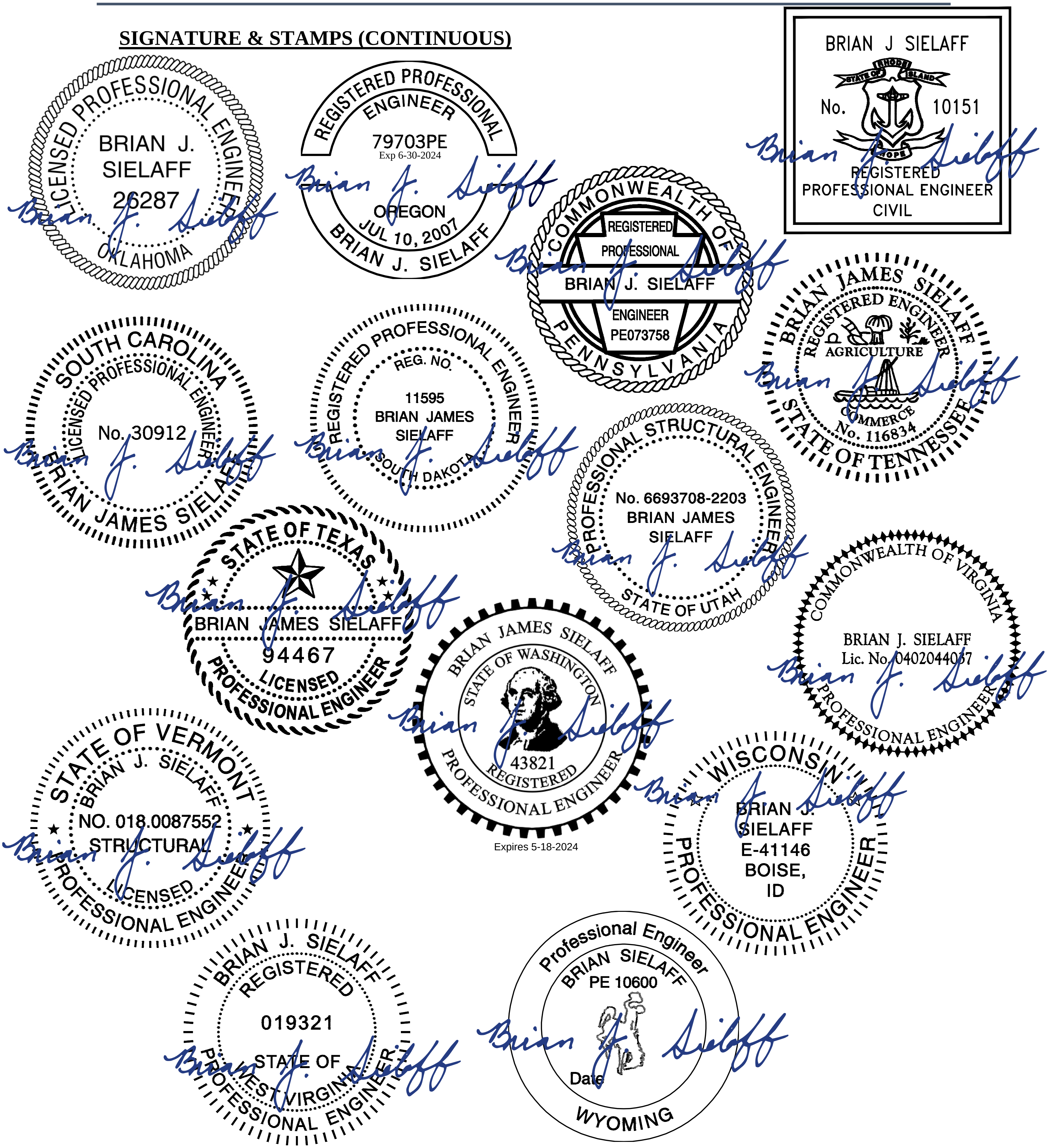

NATIONWIDE INDUSTRIES
50 STATES

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SHEET NO.	SHEET TITLE
COVER	COVER
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S2.0	RFX 200 / RFX300 / RFX400 W/GLASS INFIL – OFFSET FASICA MOUNTED
S3.0	RFX 200 / RFX300 / RFX400 W/GLASS INFIL – FLUSH FASICA MOUNTED
S4.0	RFX 200 / RFX300 / RFX400 W/GLASS INFIL – CORE MOUNTED
S5.0	RFX 200 / RFX300 W/STAINLESS STEEL CABLE INFILL – SURFACE MOUNTED
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S12.0	RFX 100 / RFX250 W/STAINLESS STEEL CABLE INFILL – CORE

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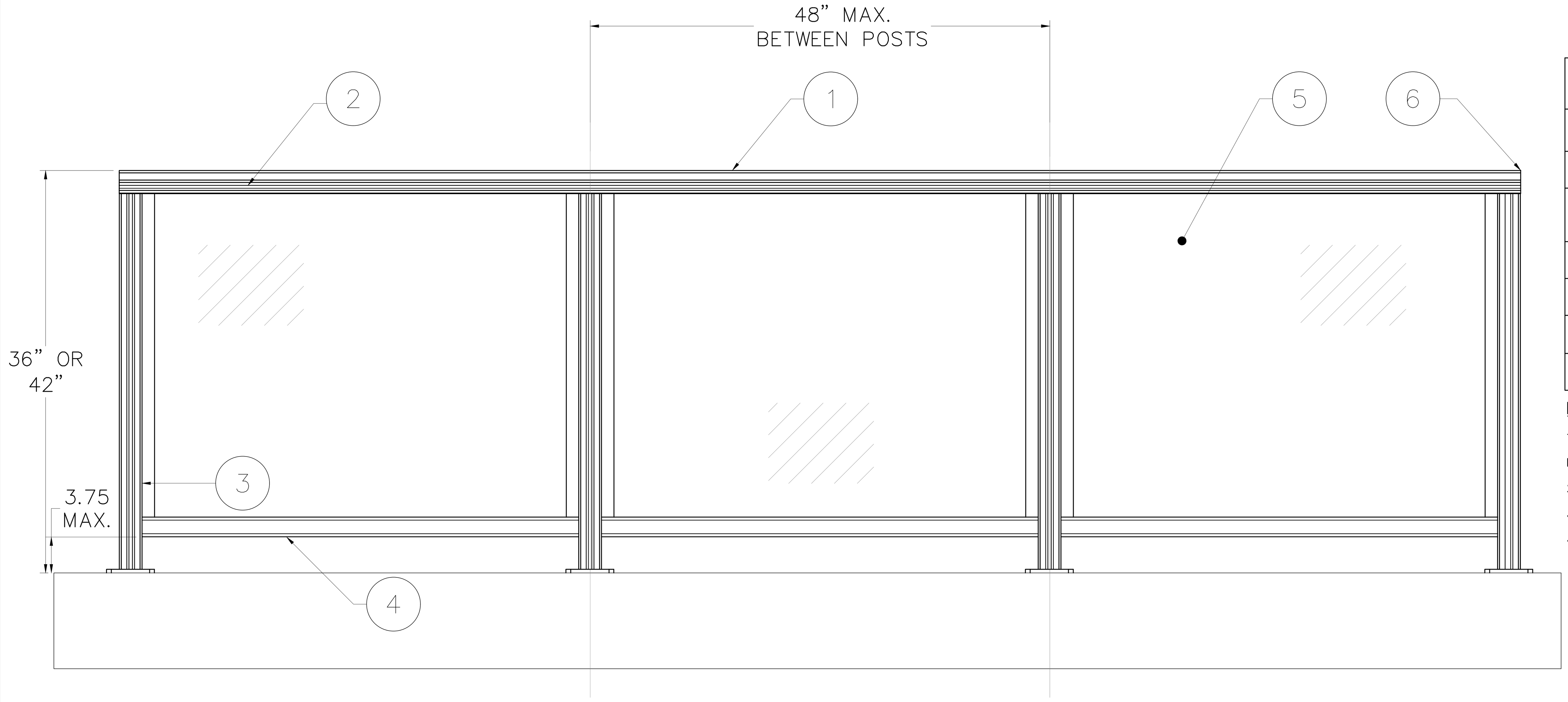
GENERAL NOTES

NATIONWIDE INDUSTRIES - 50 STATES

DATE: 09.22.2022
SCALE: AS SHOWN
DESIGN BY: HM
DRAWN BY: SSK
REVIEWED BY:SP
190417

COVER



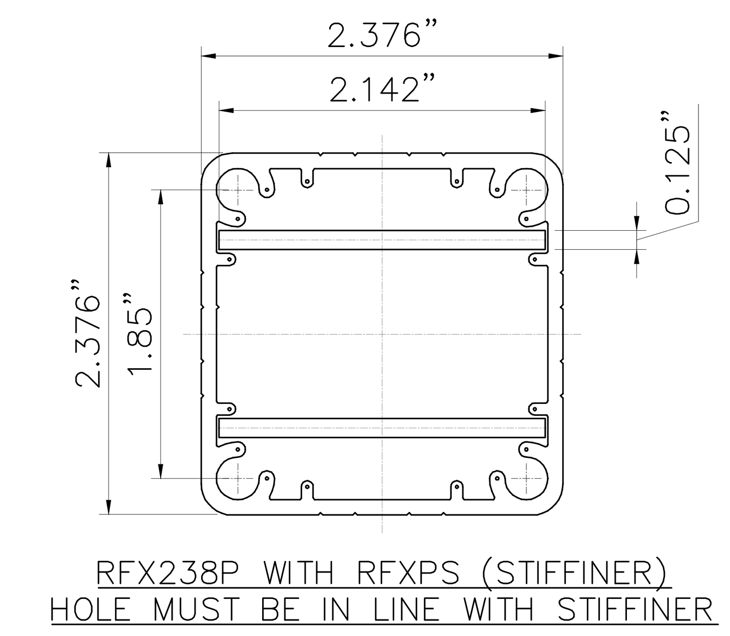
1 RFX 200 / RFX300 ALUMINUM RAIL W/GLASS INFILL SURFACE

Scale: 1" : 1'-0"

RFX200 / RFX300 / RFX400 ALUMINUM RAIL WITH GLASS INFILL SYSTEM	
ITEM	PART NUMBER
1	RFX200/RFX300/RFX400 TOP RAIL
2	INFILL FOR RFX200/RFX300 FOR GLASS AND PICKETS USES RFXUGSK AND RFXLGSK (UPPER AND LOWER GASKETS)
3	2.375"X2.375" SURFACE MOUNTED POST
4	RFXBR–BOTTOM RAIL
5	TEMPERED SAFETY GLASS INFILL 0.25" MIN. THICKNESS
6	RFXEC200/RFXEC300 OR RFXEC200EXP/ RFXEC300EXP END CAP USED WITH SCREWS

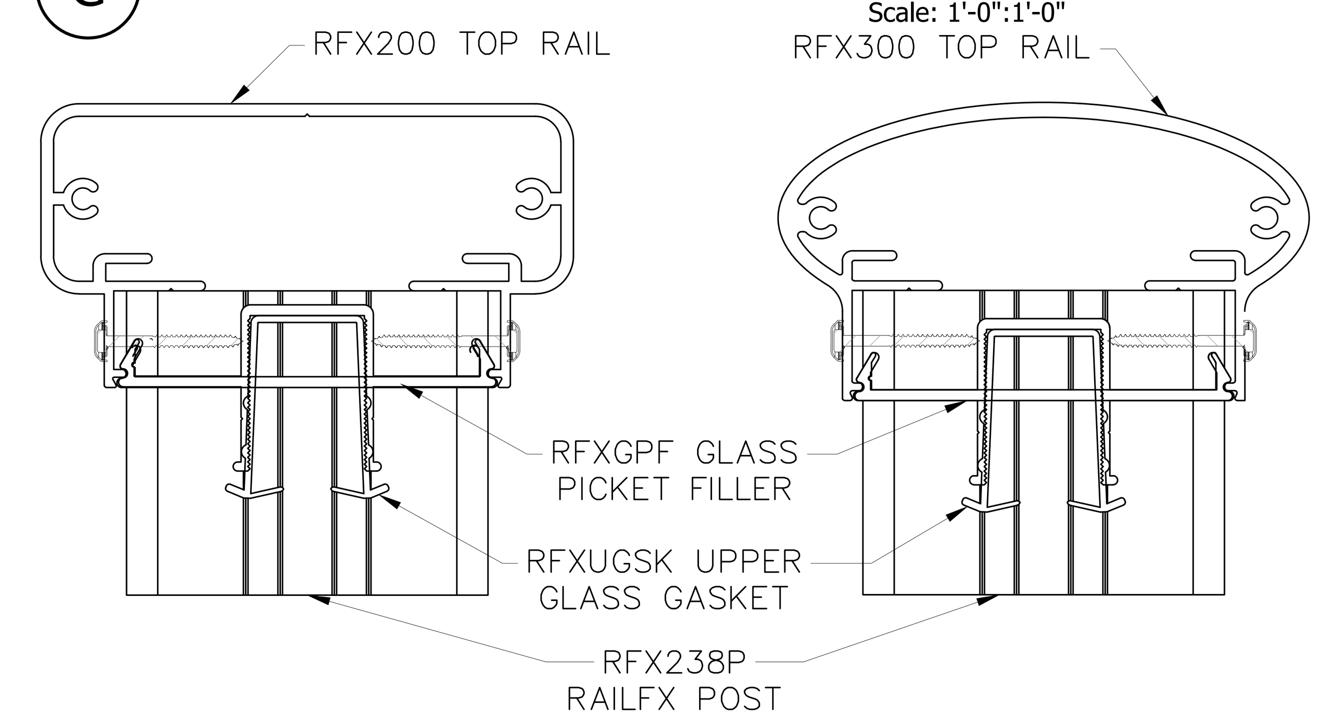
NOTES:

1. DESIGN CAPACITY OF EXISTING STRUCTURE THAT SUPPORTS THE RAILING IS NOT IN ZENITH SCOPE OF WORK.
2. RAILING IS DESIGNED FOR MAX SPEED OF 110MPH.
3. GLASS IN–FILL IS NOT IN ZENITH SCOPE OF WORK.
4. POST SPACING OF 5' O.C REQUIRES RFX238P (POST) WITH RFXPS (STIFFENER).



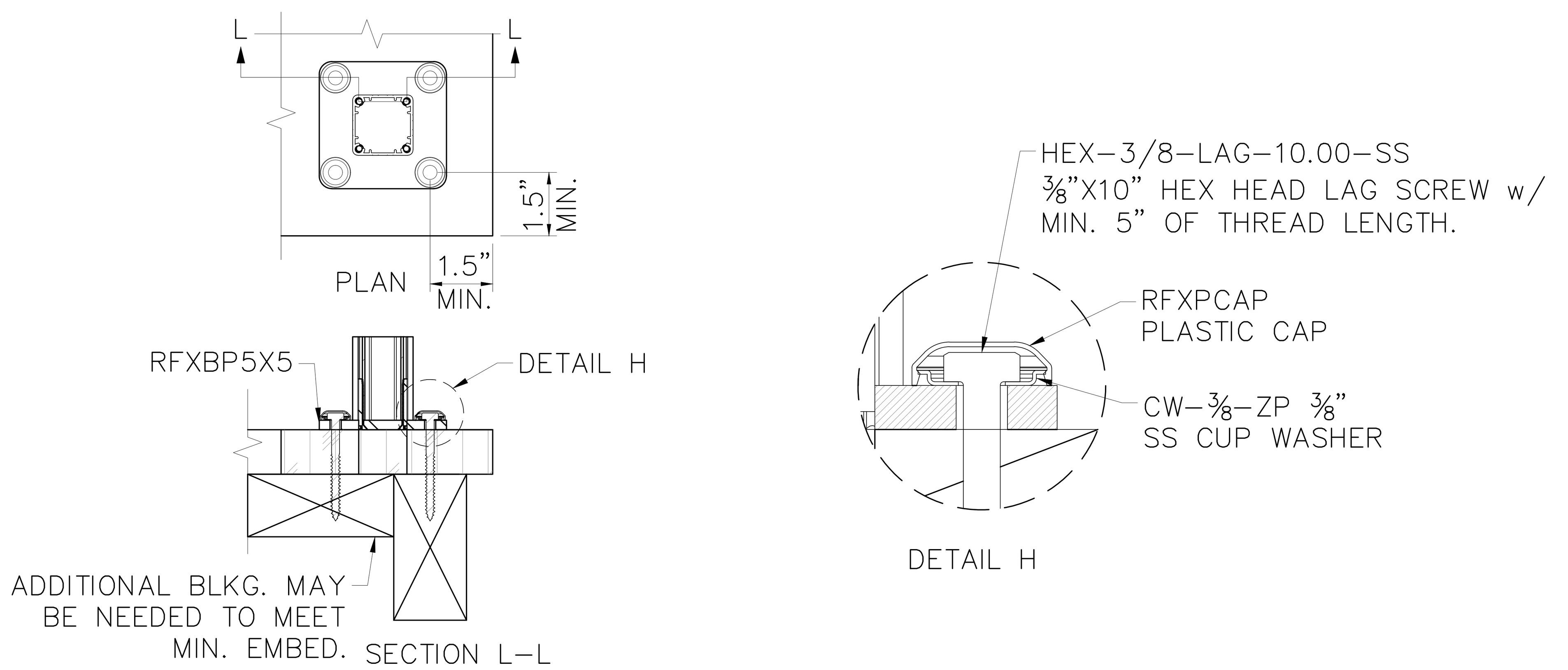
G PE-POST EXTRUSION PROFILE

Scale: 1'-0":1'-0"



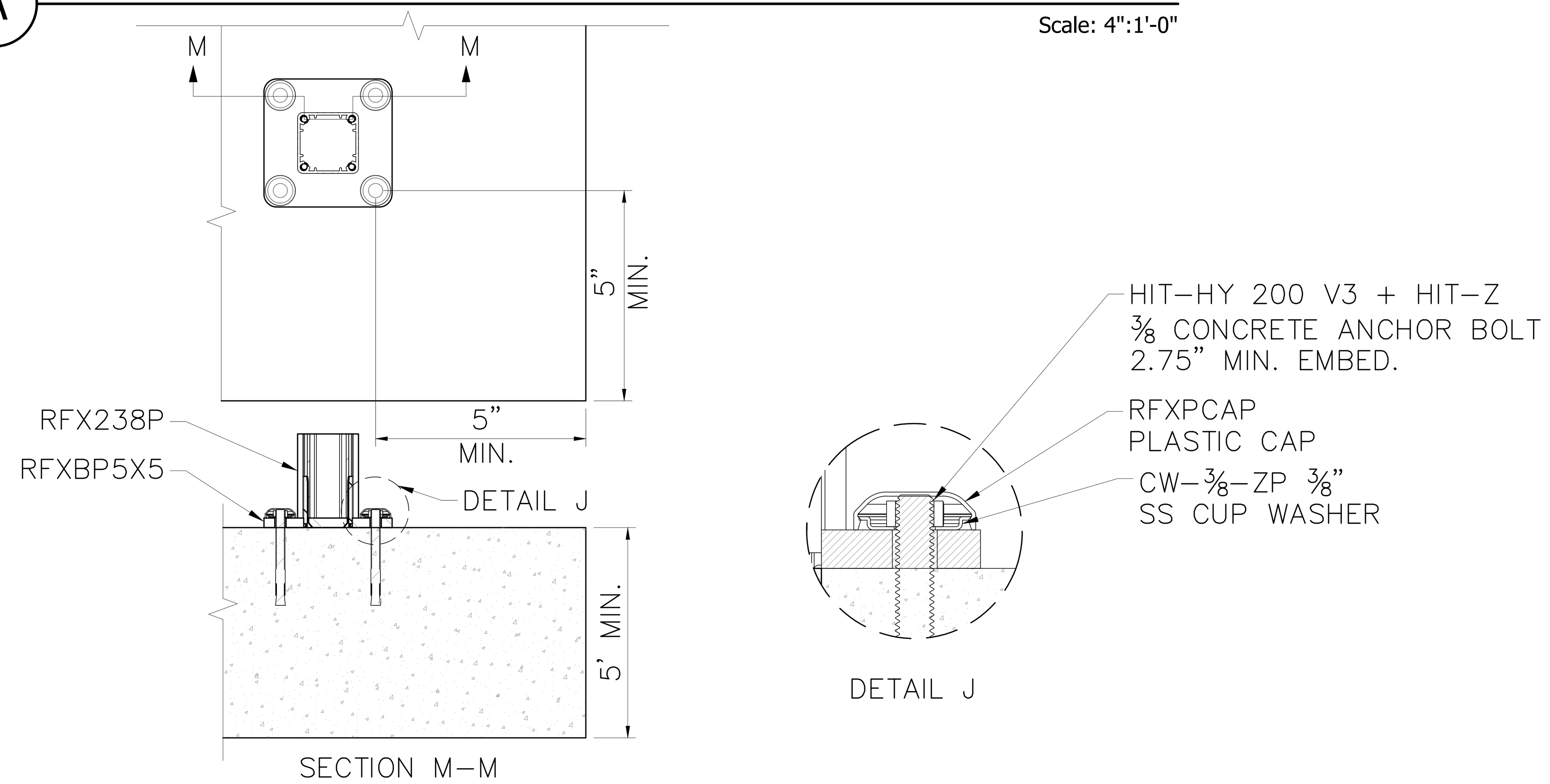
F TOP RAIL PROFILES GLASS INFILL

Scale: 1'-0":1'-0"



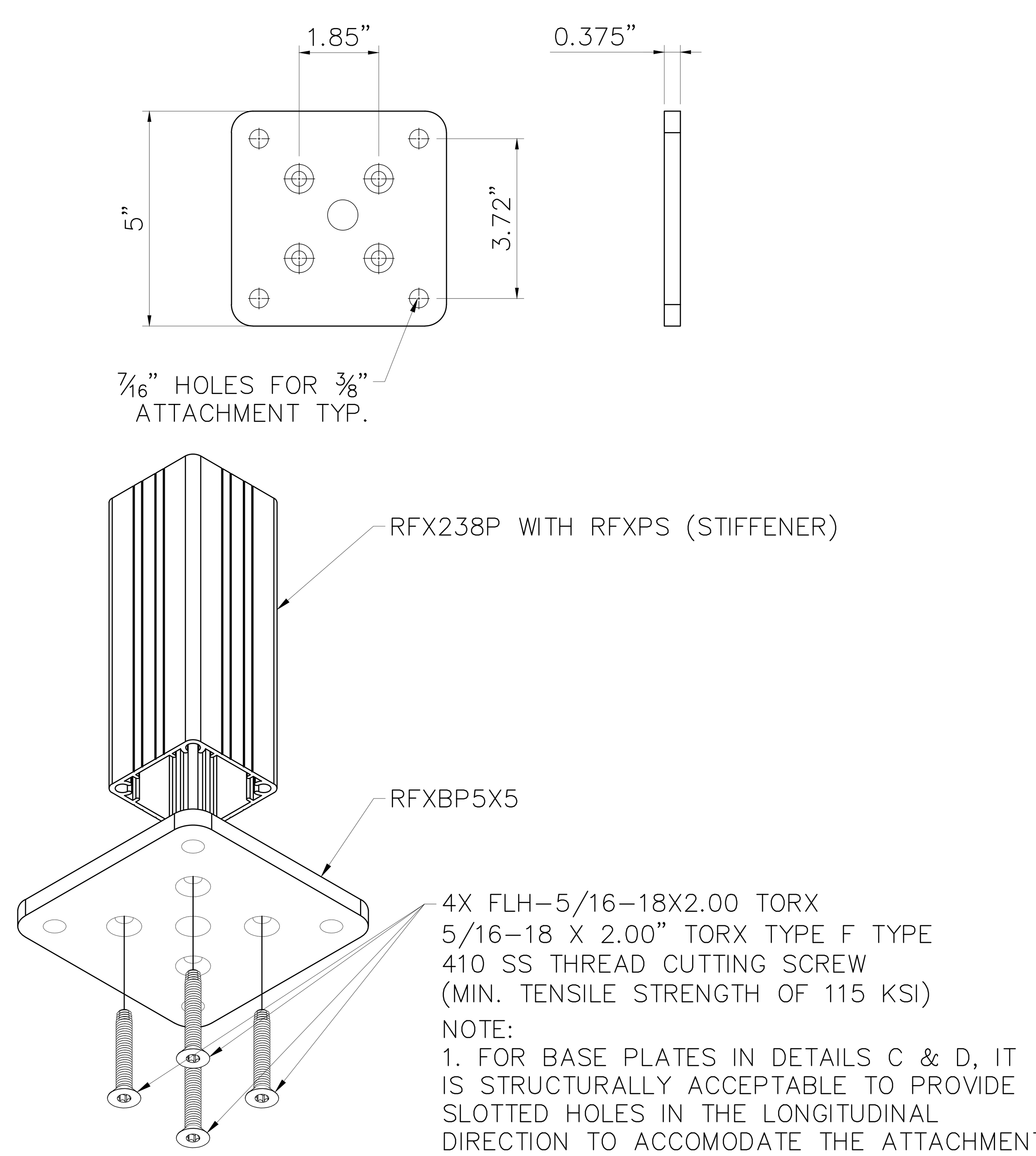
A SURFACE MOUNT POST WITH BASE PLATE IN WOOD

Scale: 4":1'-0"



B SURFACE MOUNT POST WITH BASE PLATE IN CONCRETE

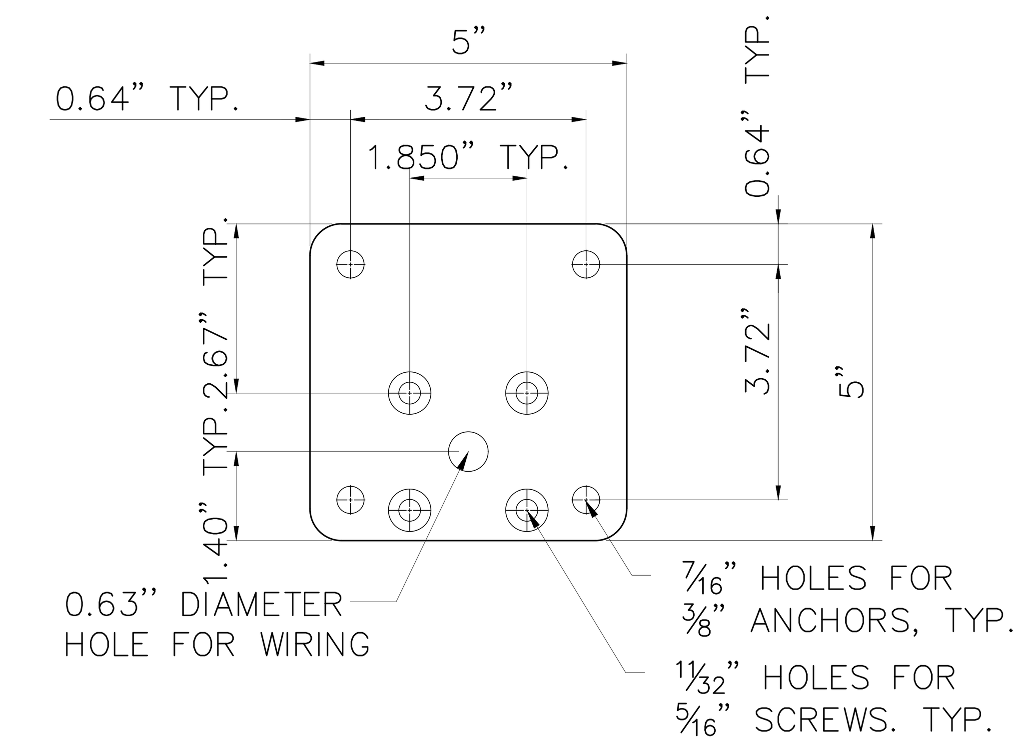
Scale: 4":1'-0"



NOTE:
1. FOR BASE PLATES IN DETAILS C & D, IT IS STRUCTURALLY ACCEPTABLE TO PROVIDE SLOTTED HOLES IN THE LONGITUDINAL DIRECTION TO ACCOMODATE THE ATTACHMENT OF SLOPED BASE PLATE AND VERTICAL POST AT INTERMEDIATE POSTS ONLY AND NOT AT THE END OF THE STAIR RAILS.

C RFXBP5X5 DETAILS

Scale: 5'-0":1'-0"

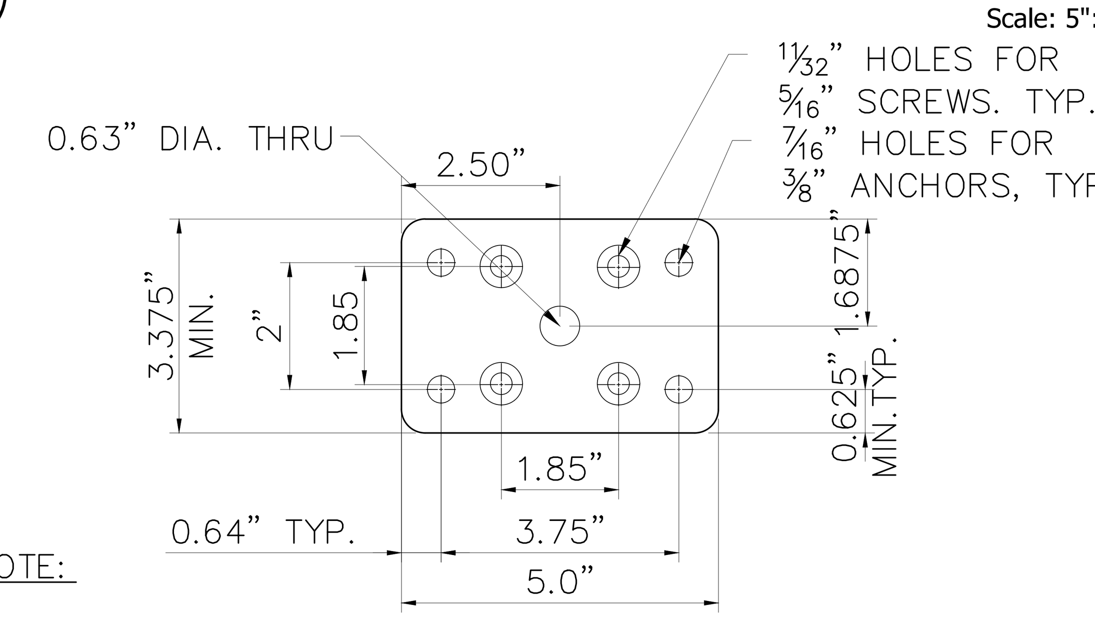


NOTE:

PROVIDE HIT–HY 200 V3 + HIT–Z ⅜"ANCHOR W/ MIN. 3¾" EMBEDMENT IN 6" OR THICKER CONCRETE SLAB WITH AT LEAST 5" ANCHOR TO CONCRETE EDGE DISTANCE.

E ALTERNATE 1/2x5x5 BASE PLATE

Scale: 5":1'-0"



NOTE:

PROVIDE HIT–HY 200 V3 + HIT–Z ⅜"ANCHOR W/ MIN. 3¾" EMBEDMENT IN 6" OR THICKER CONCRETE SLAB WITH AT LEAST 5" ANCHOR TO CONCRETE EDGE DISTANCE.

D ALTERNATE 1/2x3x5 BASE PLATE

Scale: 5":1'-0"

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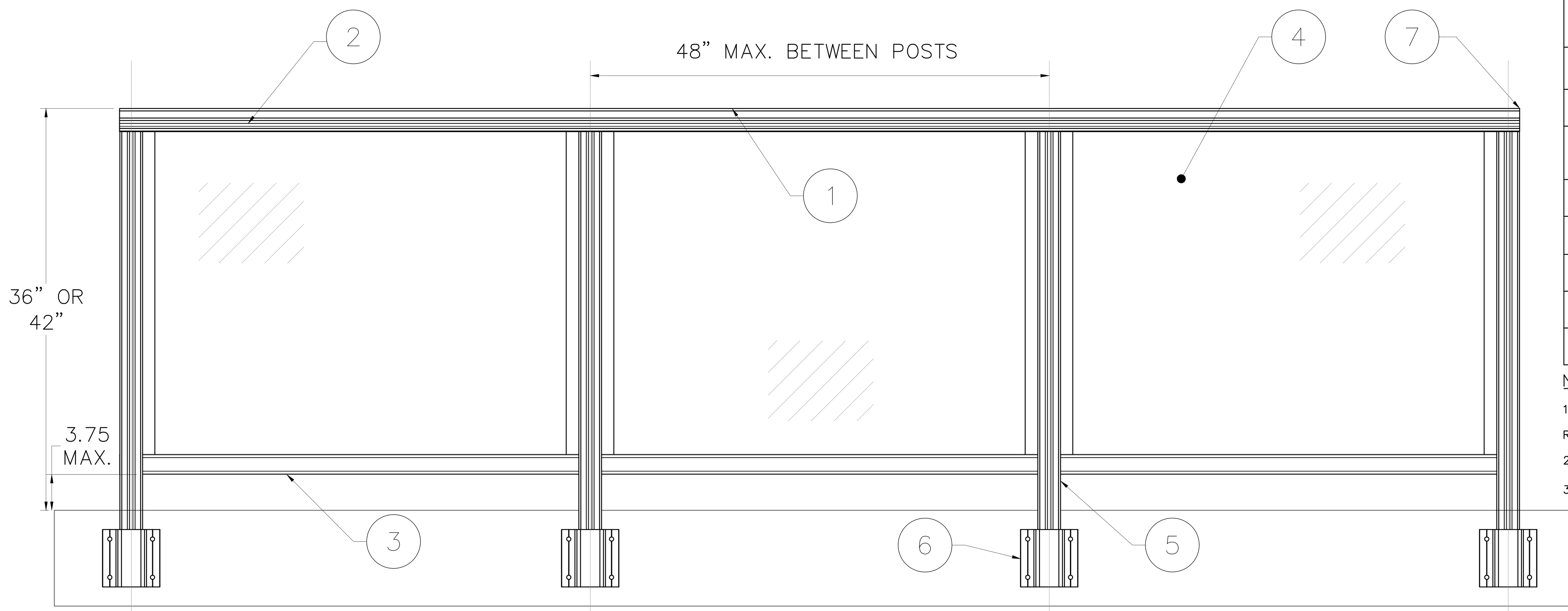
22nd SEP, 2022

RFX 200 / RFX300 / RFX400 W/GLASS INFILL
SURFACE MOUNTED

NATIONWIDE INDUSTRIES - 50 STATES

DATE: 09.22.2022
SCALE: AS SHOWN
DESIGN BY: HM
DRAWN BY: SSK
REVIEWED BY:SP
190417

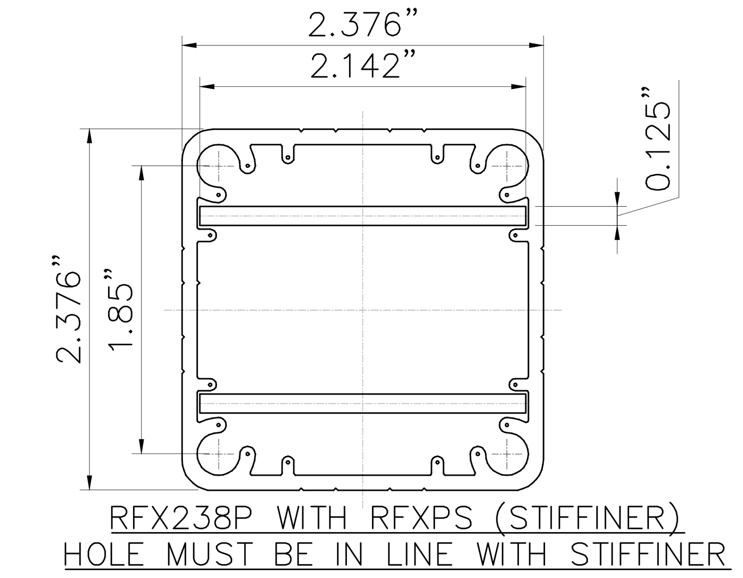
S1.0



RFX200 / RFX300 / RFX400 ALUMINUM RAIL WITH GLASS INFILL SYSTEM	
ITEM	PART NUMBER
1	RFX200/RFX300/RFX400 TOP RAIL
2	INFILL FOR RFX200/RFX300 FOR GLASS AND PICKETS USES RFXUGSK AND RFXLGSK (UPPER AND LOWER GASKETS)
3	RFXBR–BOTTOM RAIL
4	TEMPERED SAFETY GLASS INFILL 0.25" MIN. THICKNESS
5	RFXRCB–RAIL CONNECTING BLOCK
6	RFXFMINT – 1" OFFSET FASCIA MOUNT BRACKET
7	RFXEC200/RFXEC300 OR RFXEC200EXP/ RFXEC300EXP END CAP USED WITH SCREWS

NOTES:

1. DESIGN CAPACITY CHECK OF EXISTING STRUCTURE THAT SUPPORTS THE RAILING IS NOT IN ZENITH SCOPE OF WORK.
2. RAILING IS DESIGNED FOR MAX SPEED OF 110MPH.
3. GLASS IN-FILL & TOP RAIL DESIGN IS NOT IN ZENITH SCOPE OF WORK.

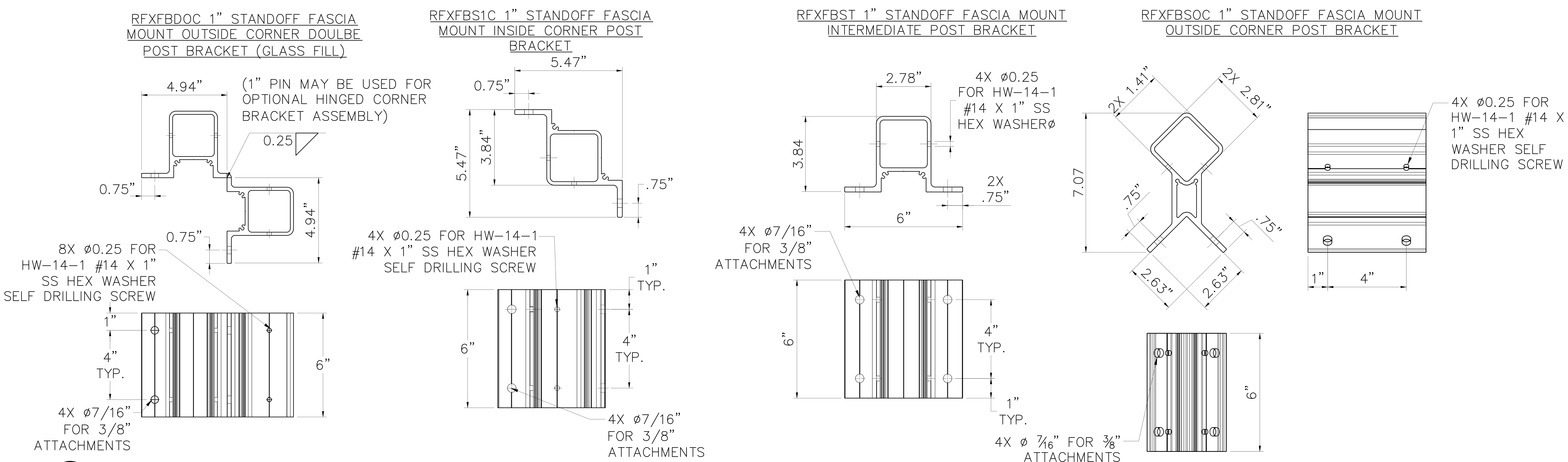


1 RFX 200 / RFX300 / RXF400 ALUMINUM RAIL W/GLASS INFILL OFFSET FASCIA MOUNT

Scale: 1" : 1'-0"

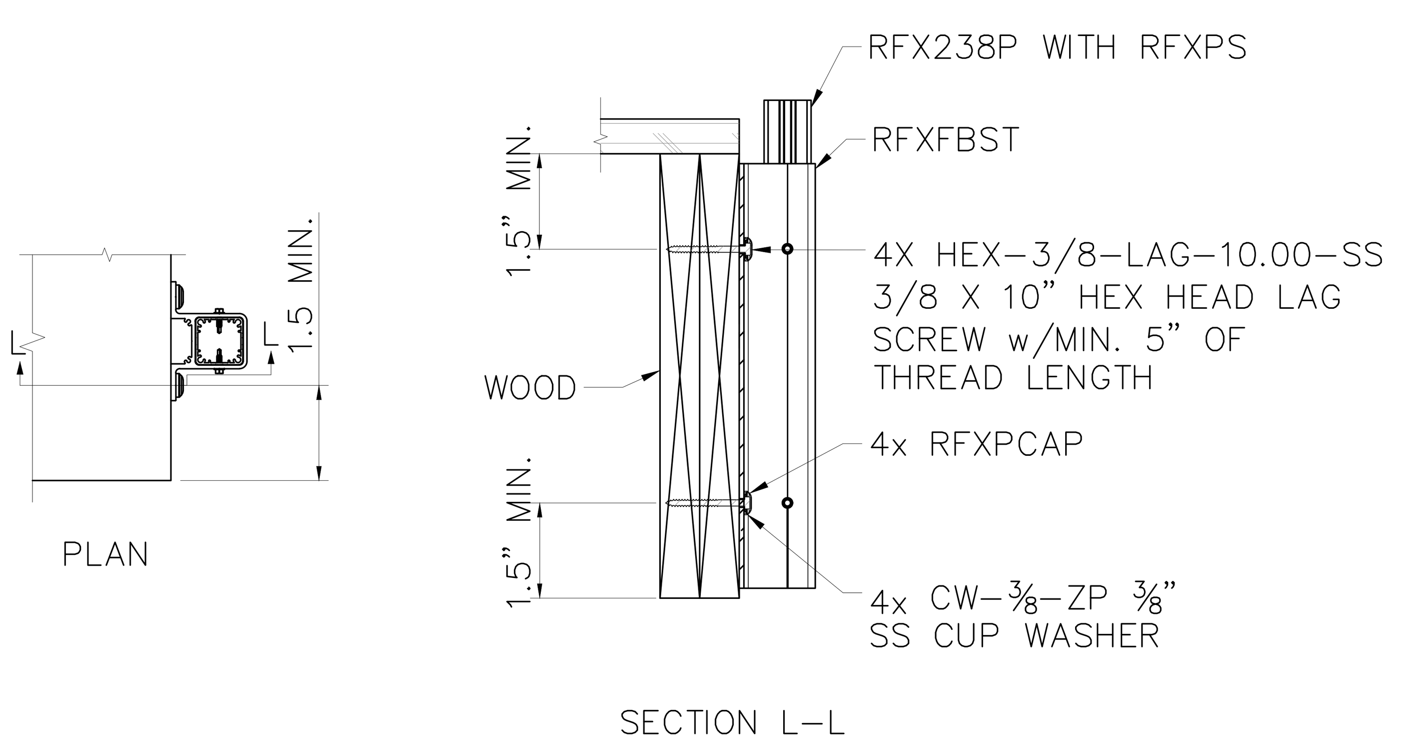
E PE-POST EXTRUSION PROFILE

Scale: 1'-0":1'-0"



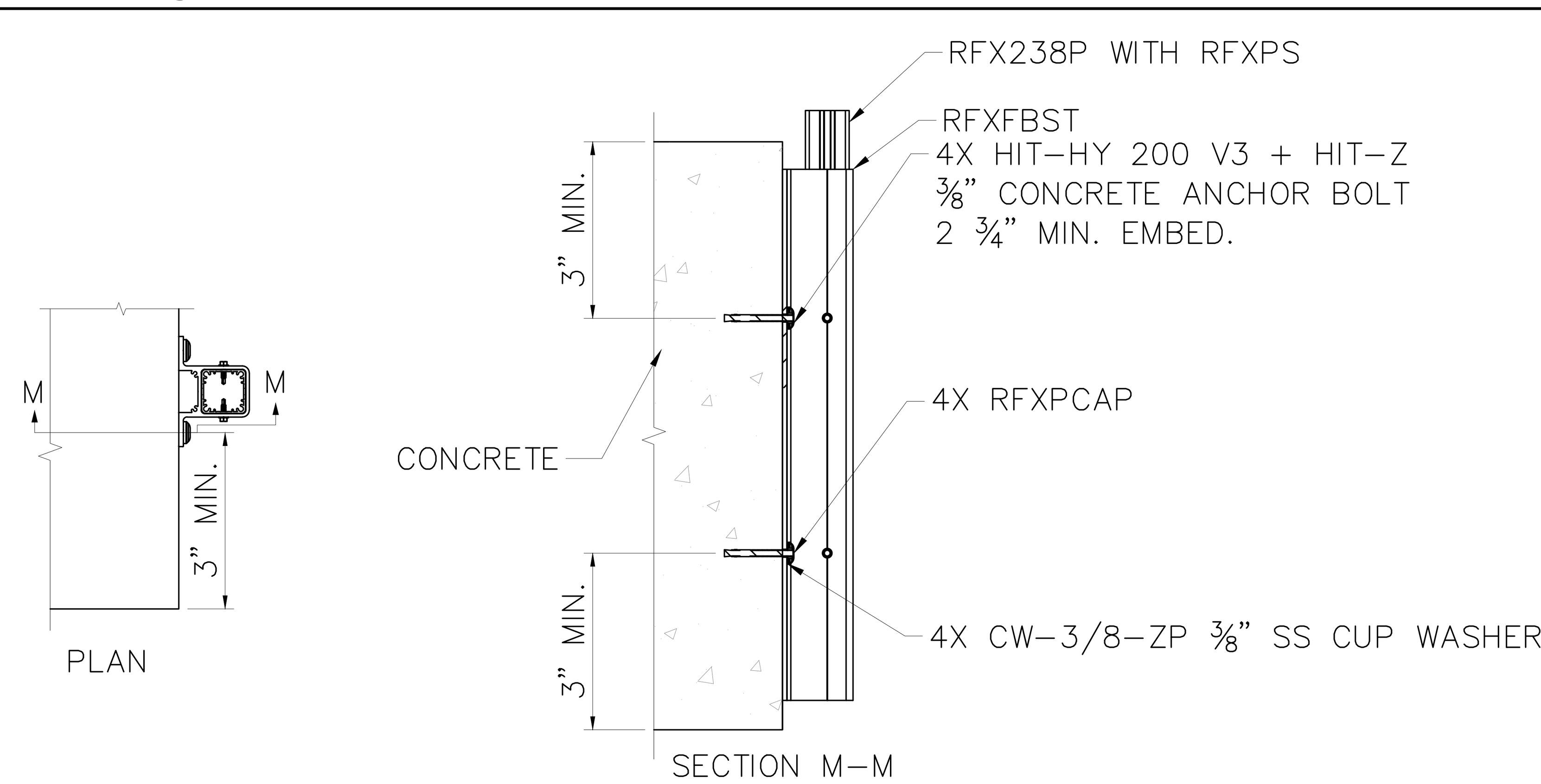
A 1" OFFSET FASCIA MOUNT BRACKET - POST ATTACHMENT OPTIONS AND DETAILS

Scale: 5":1'-0"



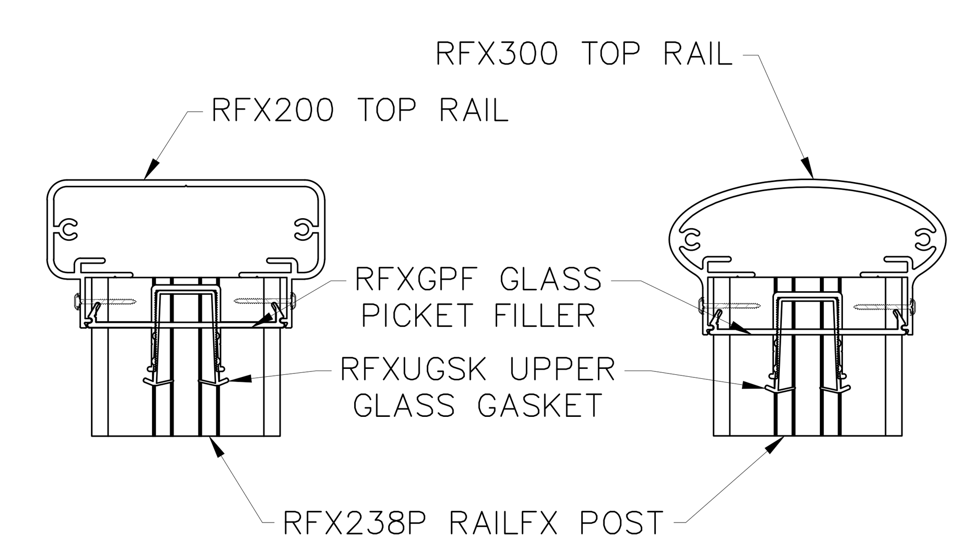
B RFXMINT MOUNTING IN WOOD

Scale: 5":1'-0"



C RFXMINT MOUNTING IN CONCRETE

Scale: 5":1'-0"



D TOP RAIL PROFILES GLASS INFILL

Scale: 5":1'-0"

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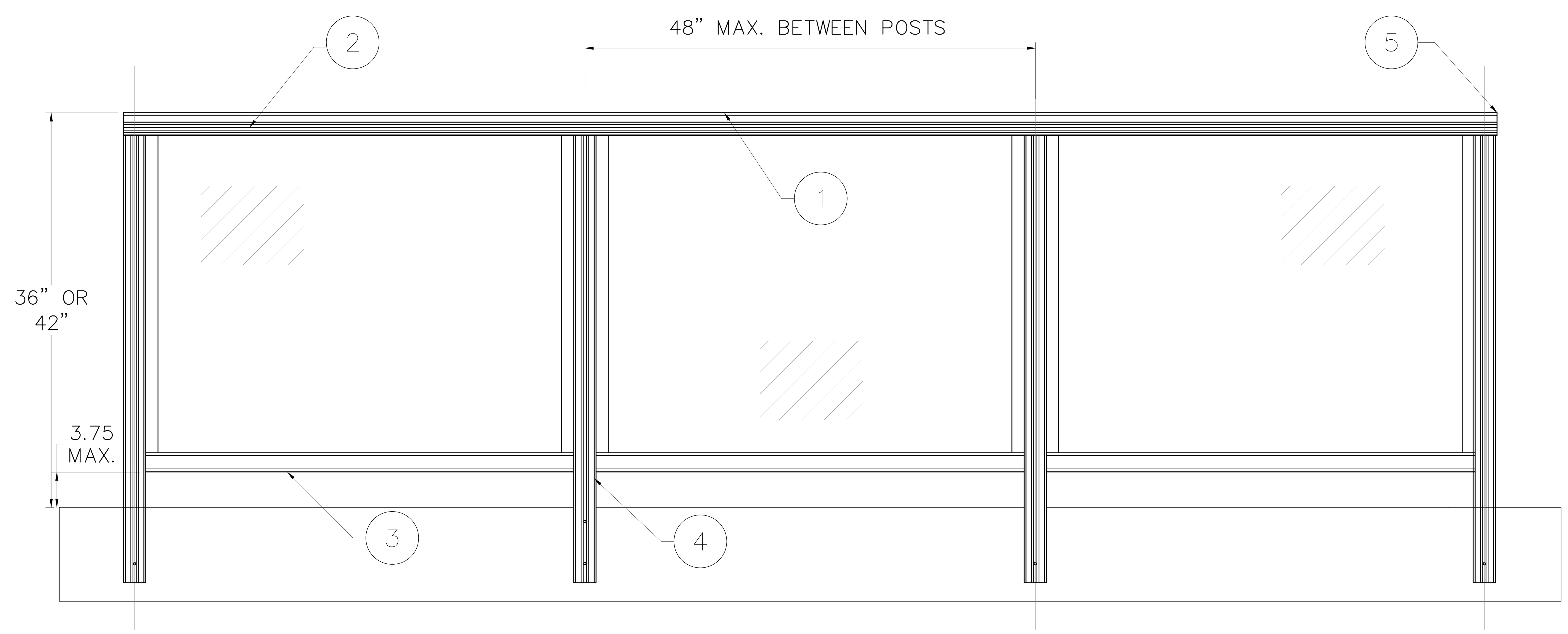
RFX 200 / RFX300 / RFX400 W/GLASS INFILL OFFSET FASCIA MOUNT

NATIONWIDE INDUSTRIES - 50 STATES

DATE: 09.22.2022
SCALE: AS SHOWN
DESIGN BY: HM
DRAWN BY: SSK
REVIEWED BY:SP

190417

S2.0



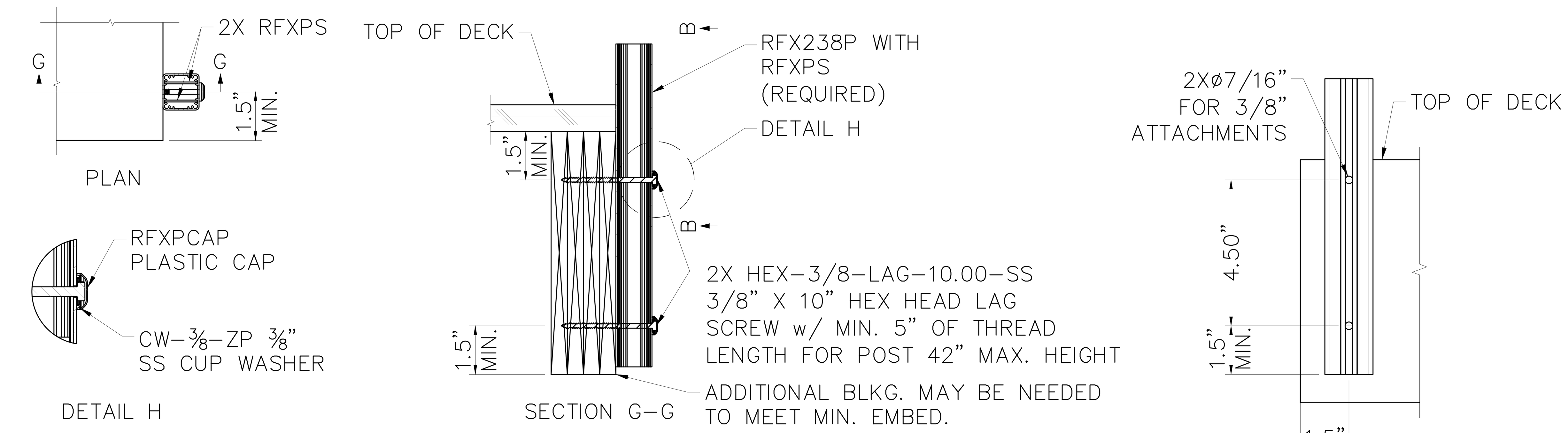
1 RFX 200 / RFX300 ALUMINUM RAIL W/GLASS INFILL FLUSH FASCIA MOUNT

Scale: 1" : 1'-0"

RFX200 / RFX300 / RFX400 ALUMINUM RAIL WITH GLASS INFILL SYSTEM	
ITEM	PART NUMBER
1	RFX200/RFX300/RFX400 TOP RAIL
2	INFILL FOR RFX200/RFX300 FOR GLASS AND PICKETS USES RFXUGSK AND RFXLGSK (UPPER AND LOWER GASKETS)
3	RFXBR-BOTTOM RAIL
4	DIRECT TO FLUSH FASCIA MOUNTED POST
5	RFXEC200/RFXEC300 OR RFXEC200EXP/ RFXEC300EXP END CAP USED WITH SCREWS

NOTES:

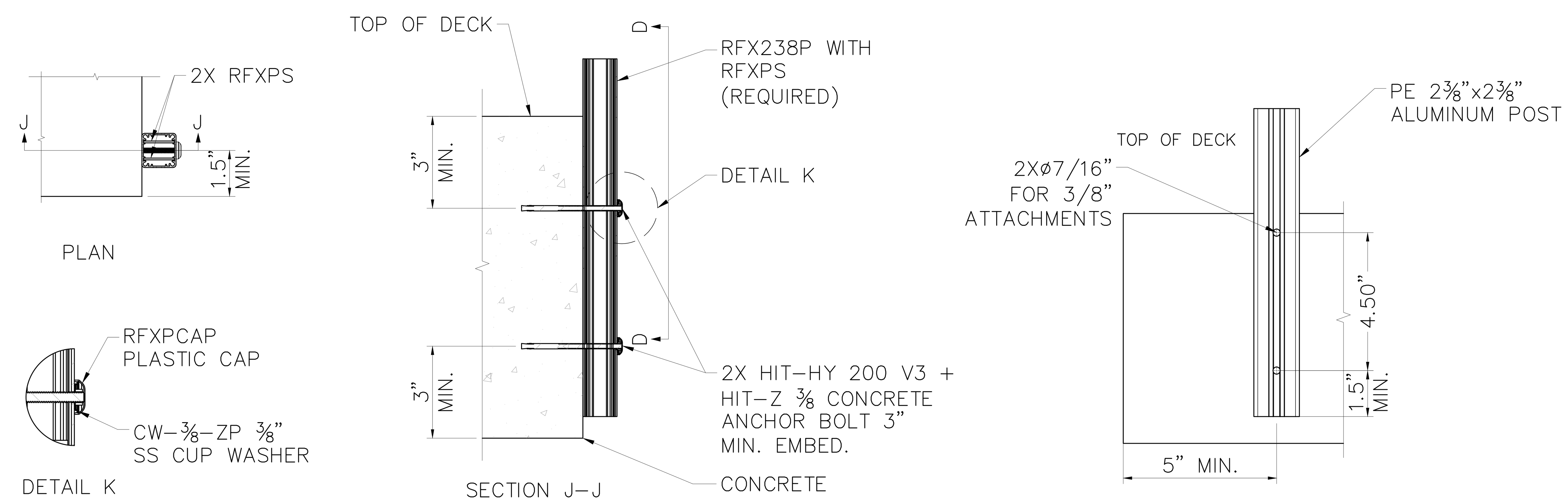
1. DESIGN CAPACITY CHECK OF EXISTING STRUCTURE THAT SUPPORTS THE RAILING IS NOT IN ZENITH SCOPE OF WORK.
2. RAILING IS DESIGNED FOR MAX SPEED OF 110MPH.
3. GLASS IN-FILL & TOP RAIL DESIGN IS NOT IN ZENITH SCOPE OF WORK.
4. FLUSH FASCIA MOUNTED CONNECTION IS NOT RECOMMENDED TO WOODEN MEMBERS



TIMBER FRAME SHOULD BE DOUGLAS-FIR OR BETTER (MIN S.G = 0.5)

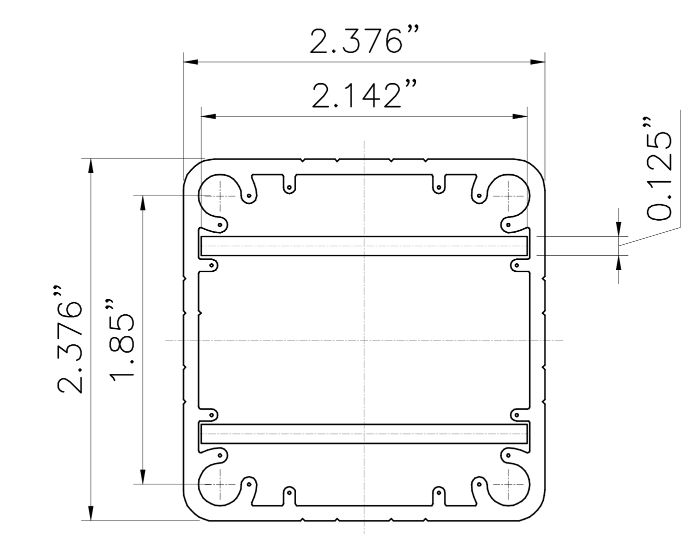
A FLUSH MOUNT FASCIA ATTACHMENT TO WOOD

Scale: 4":1'-0"



B FLUSH MOUNT FASCIA ATTACHMENT TO CONCRETE

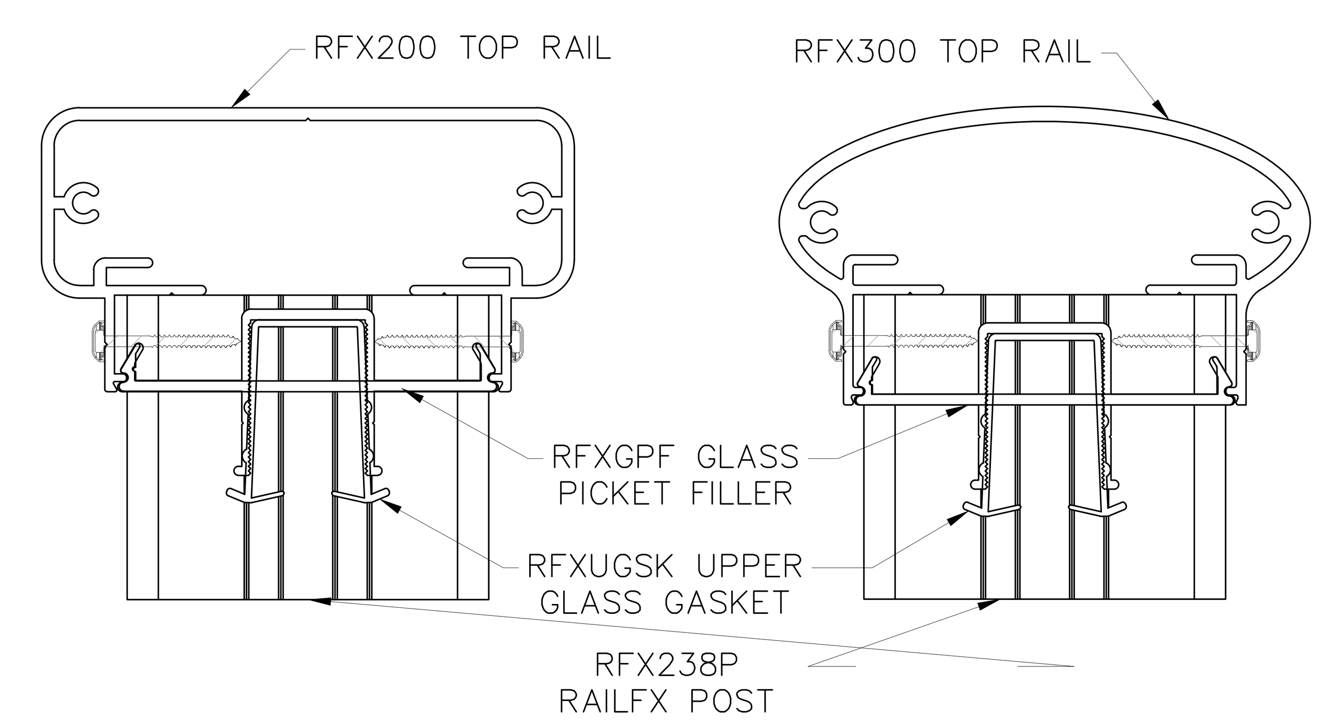
Scale: 4":1'-0"



RFX238P WITH RFXPS (STIFFINER)
HOLE MUST BE IN LINE WITH STIFFINER

D PE-POST EXTRUSION PROFILE

Scale: 1'-0":1'-0"



C TOP RAIL PROFILES GLASS INFILL

Scale: 1'-0":1'-0"

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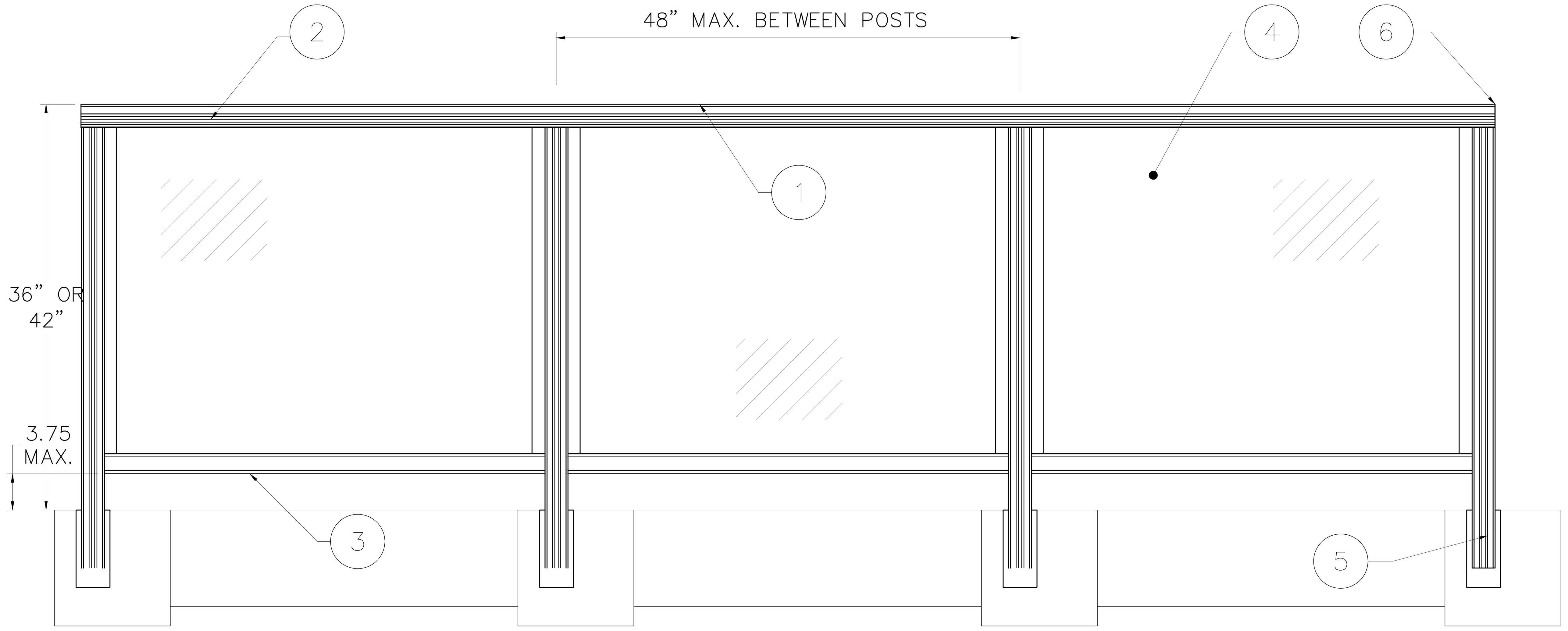
Hemal Modi 22nd SEP, 2022

RFX 200 / RFX300 / RFX400 W/GLASS INFILL FLUSH FASCIA MOUNTED

NATIONWIDE INDUSTRIES - 50 STATES

DATE: 09.22.2022
SCALE: AS SHOWN
DESIGN BY: HM
DRAWN BY: SSK
REVIEWED BY:SP
190417

S3.0



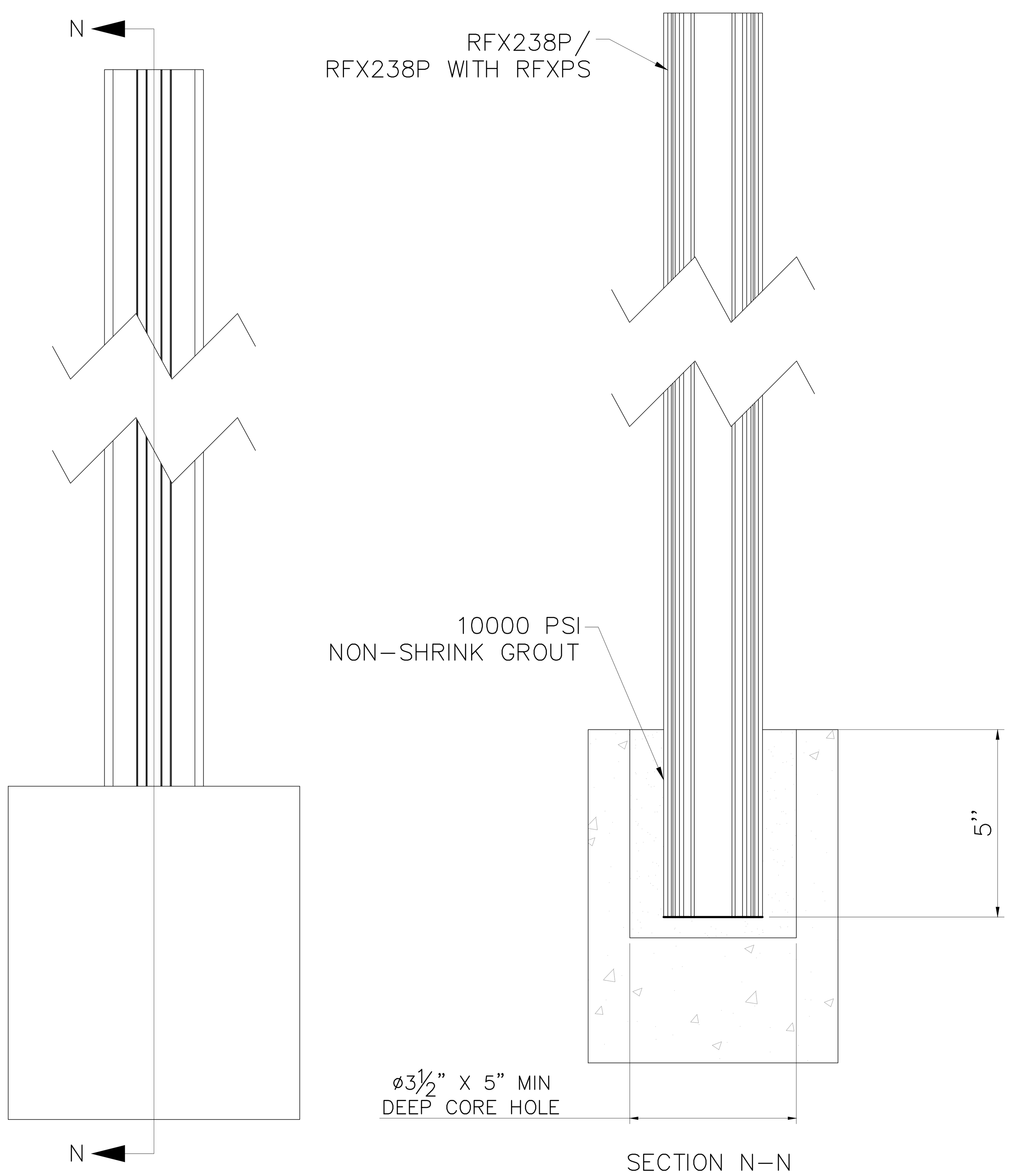
1 RFX 200 / RFX300 ALUMINUM RAIL W/GLASS INFILL POST CORE MOUNT

Scale: 1" : 1'-0"

RFX200 / RFX300 / RFX400 ALUMINUM RAIL WITH GLASS INFILL SYSTEM	
ITEM	PART NUMBER
1	RFX200/RFX300/RFX400 TOP RAIL
2	INFILL FOR RFX200/RFX300 FOR GLASS AND PICKETS USES RFXUGSK AND RFXLGSK (UPPER AND LOWER GASKETS)
3	RFXBR–BOTTOM RAIL
4	TEMPERED SAFETY GLASS INFILL 0.25" MIN. THICKNESS
5	POST WITH CORE MOUNTED IN CONCRETE
6	RFXEC200/RFXEC300 OR RFXEC200EXP/ RFXEC300EXP END CAP USED WITH SCREWS

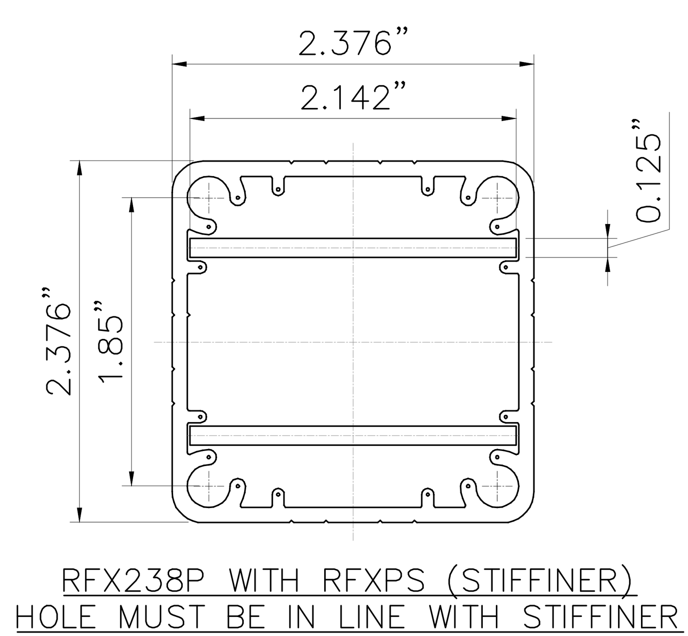
NOTES:

1. DESIGN CAPACITY CHECK OF EXISTING STRUCTURE THAT SUPPORTS THE RAILING IS NOT IN ZENITH SCOPE OF WORK.
2. RAILING IS DESIGNED FOR MAX SPEED OF 110MPH.
3. GLASS IN-FILL & TOP RAIL DESIGN IS NOT IN ZENITH SCOPE OF WORK.



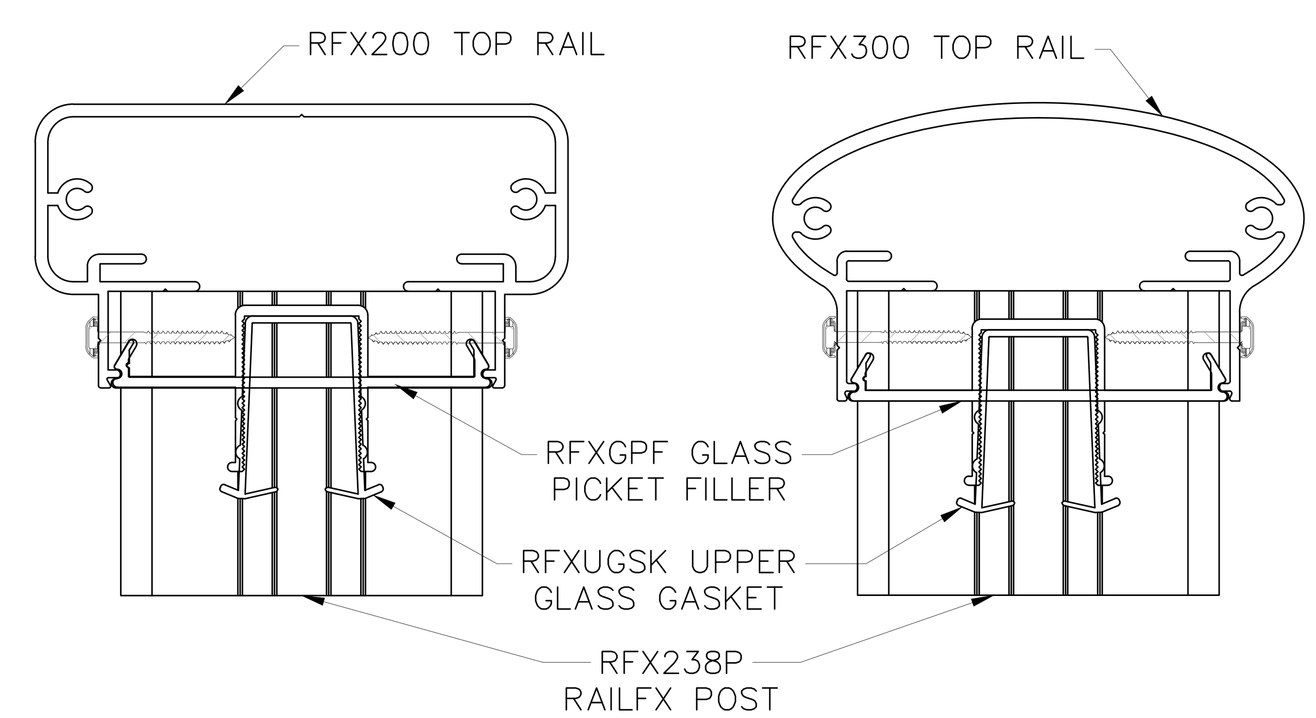
A DETAIL A - POST CORE MOUNTING ATTACHMENT DETAIL

Scale: 6":1'-0"



B PE-POST EXTRUSION PROFILE

Scale: 1'-0":1'-0"



C TOP RAIL PROFILES GLASS INFILL

Scale: 1'-0":1'-0"

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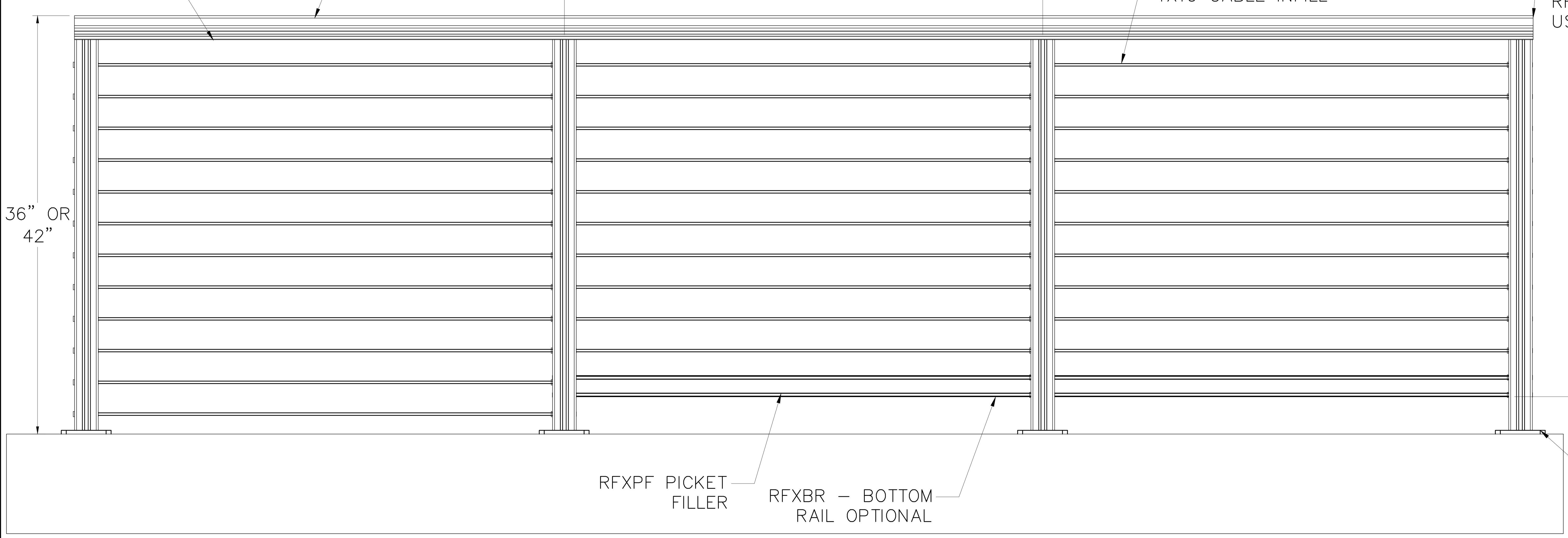
RFX 200 / RFX300 / RFX400 W/GLASS INFILL POST CORE MOUNT

NATIONWIDE INDUSTRIES - 50 STATES

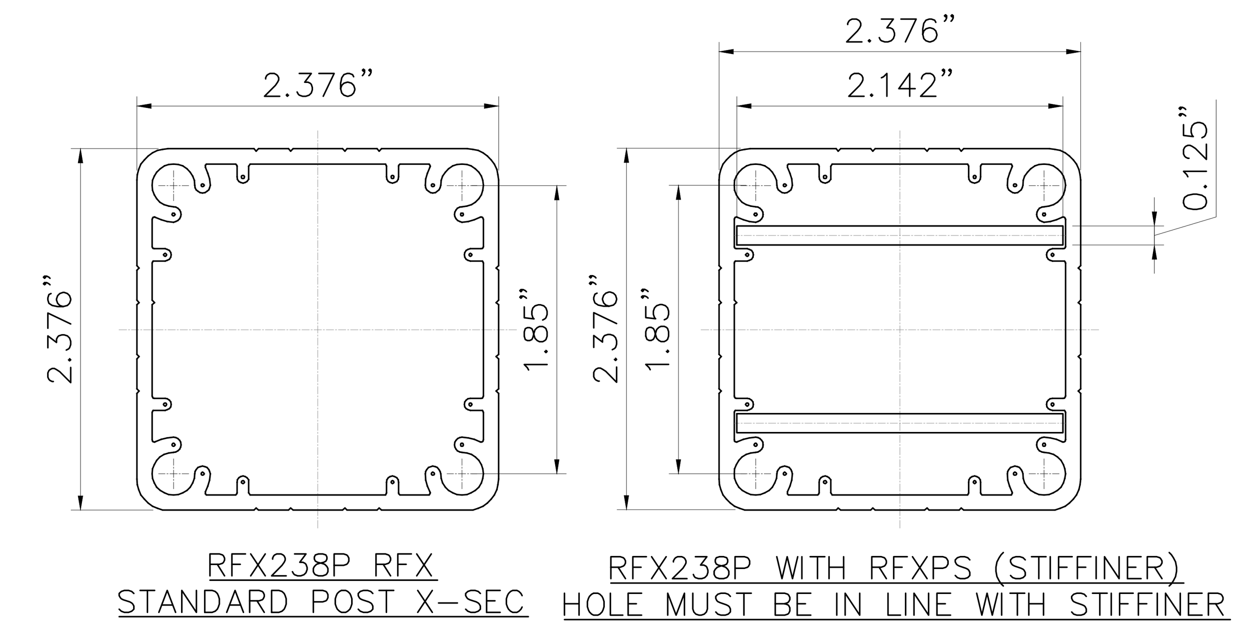
DATE: 09.22.2022
SCALE: AS SHOWN
DESIGN BY: HM
DRAWN BY: SSK
REVIEWED BY:SP
190417

S4.0



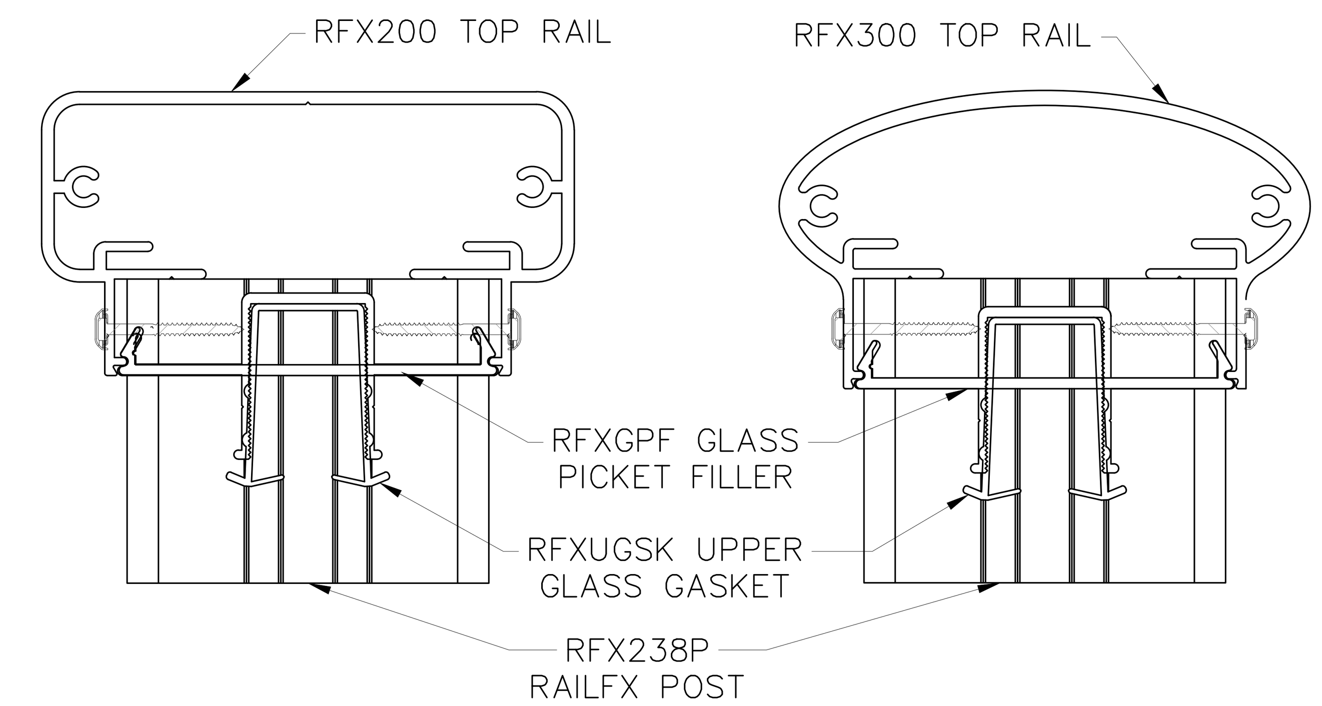
1 RFX 200 / RFX300 ALUMINUM RAIL W/STAINLESS STEEL CABLE INFILL SURFACE MOUNT

Scale: 1-1/2" : 1'-0"



G PE-POST EXTRUSION PROFILE

Scale: 1'-0":1'-0"

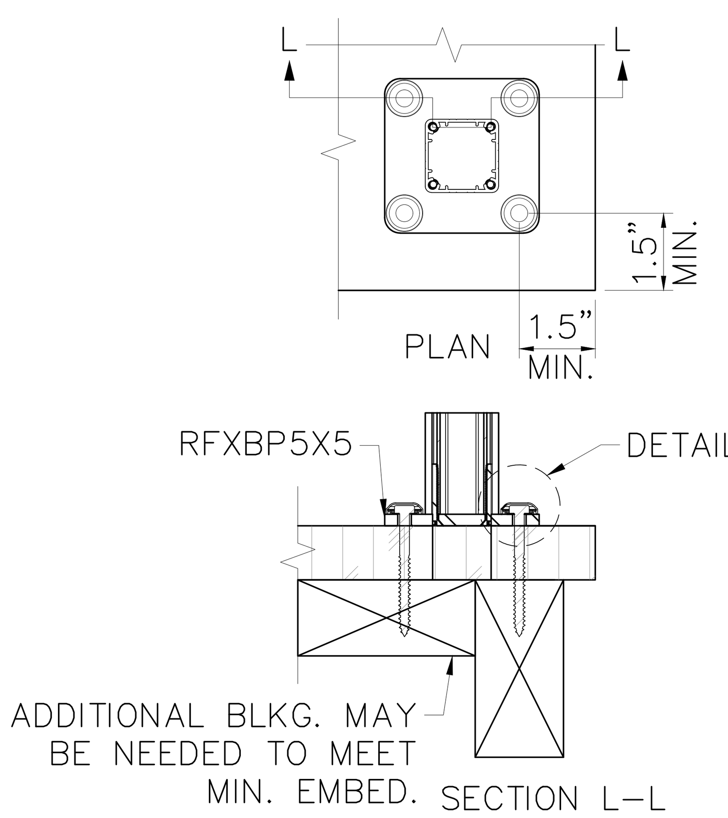


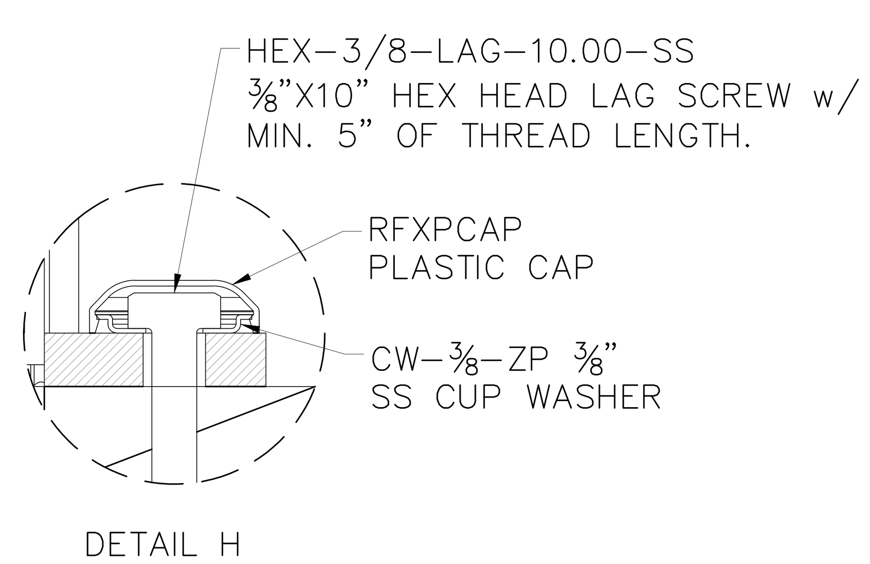
F TOP RAIL PROFILES GLASS INFILL

Scale: 1'-0":1'-0"

NOTES:

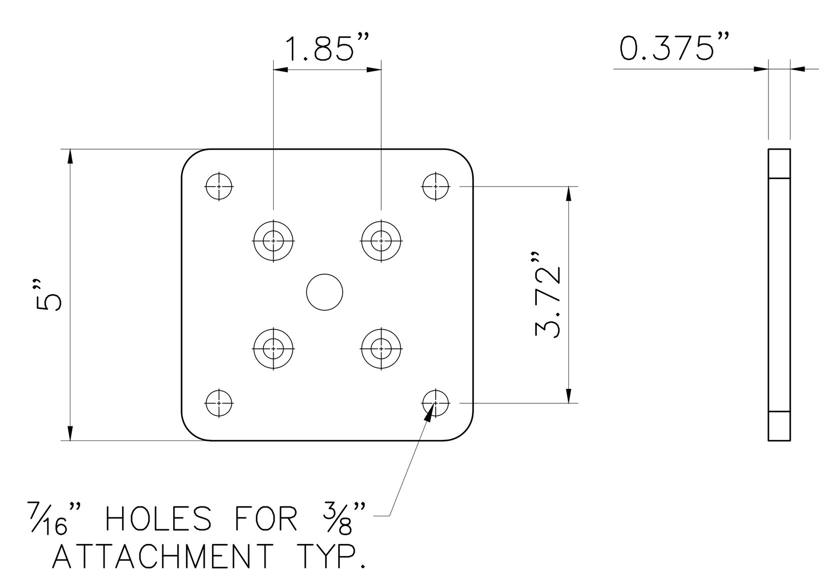
1. DESIGN CAPACITY CHECK OF EXISTING STRUCTURE THAT SUPPORTS THE RAILING IS NOT IN ZENITH SCOPE OF WORK.
2. RAILING IS DESIGNED FOR MAX SPEED OF 110MPH.
3. CABLE IN-FILL & TOP RAIL DESIGN IS NOT IN ZENITH SCOPE OF WORK.
4. POST SPACING OF 5' O.C REQUIRES RFS238P (POST) WITH RFXPS (STIFFENER).

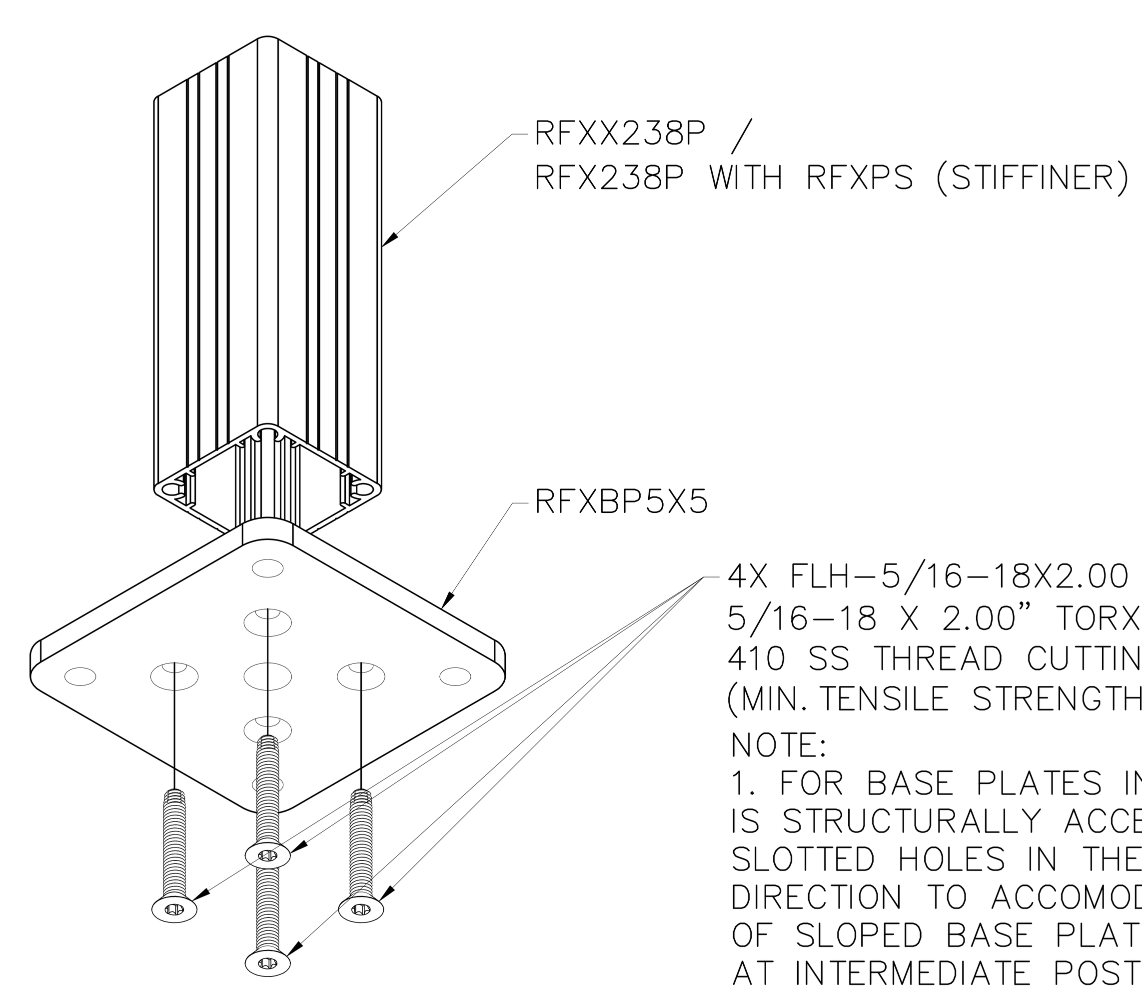




A SURFACE MOUNT POST WITH BASE PLATE IN WOOD

Scale: 4":1'-0"

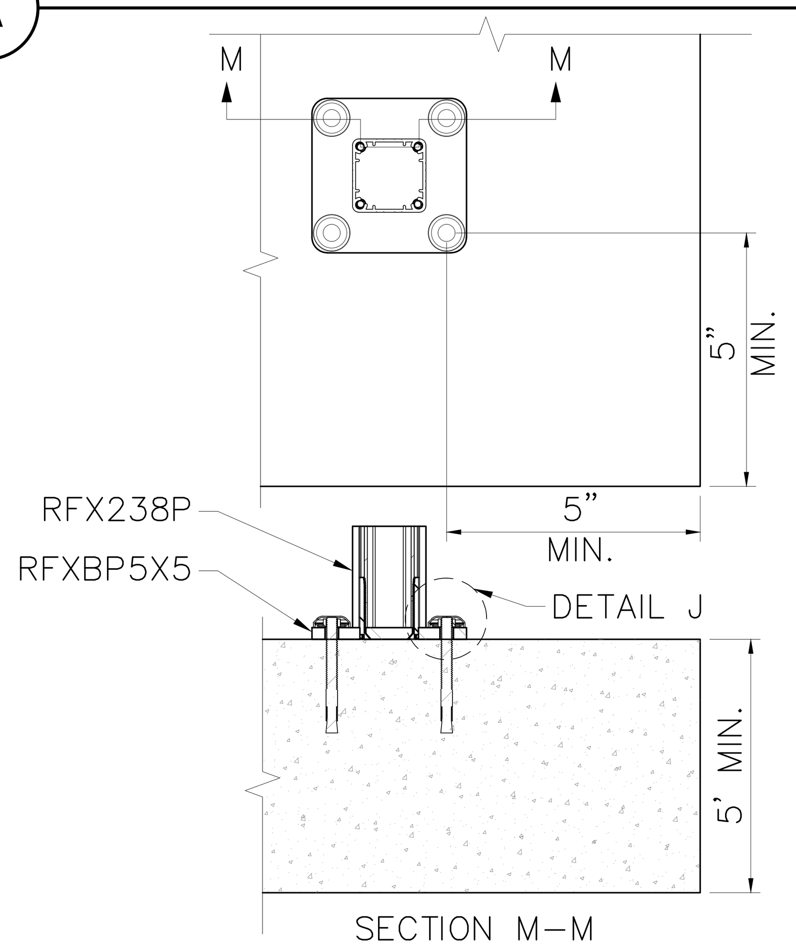


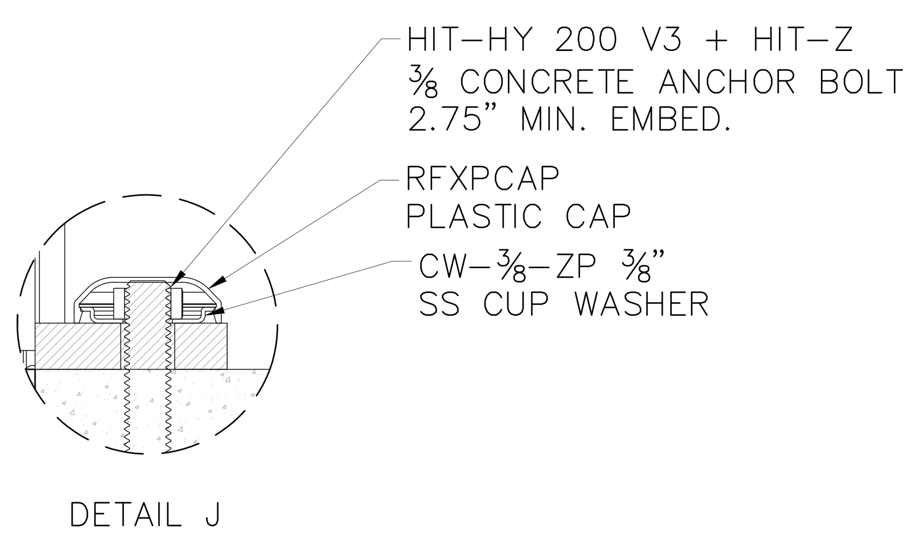


NOTE:
1. FOR BASE PLATES IN DETAILS C & D, IT IS STRUCTURALLY ACCEPTABLE TO PROVIDE SLOTTED HOLES IN THE LONGITUDINAL DIRECTION TO ACCOMODATE THE ATTACHMENT OF SLOPED BASE PLATE AND VERTICAL POST AT INTERMEDIATE POSTS ONLY AND NOT AT THE END OF THE STAIR RAILS.

C RFXBP5X5 DETAILS

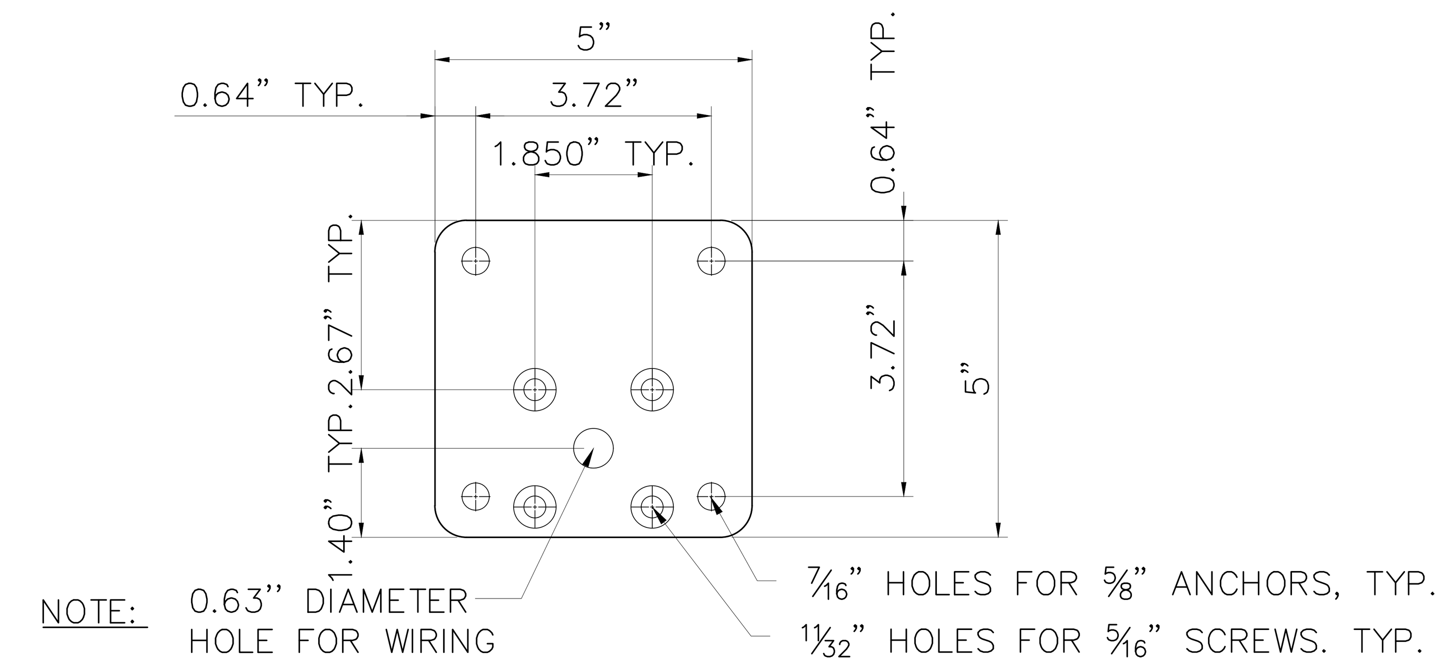
Scale: 1'-0":1'-0"





B SURFACE MOUNT POST WITH BASE PLATE IN CONCRETE

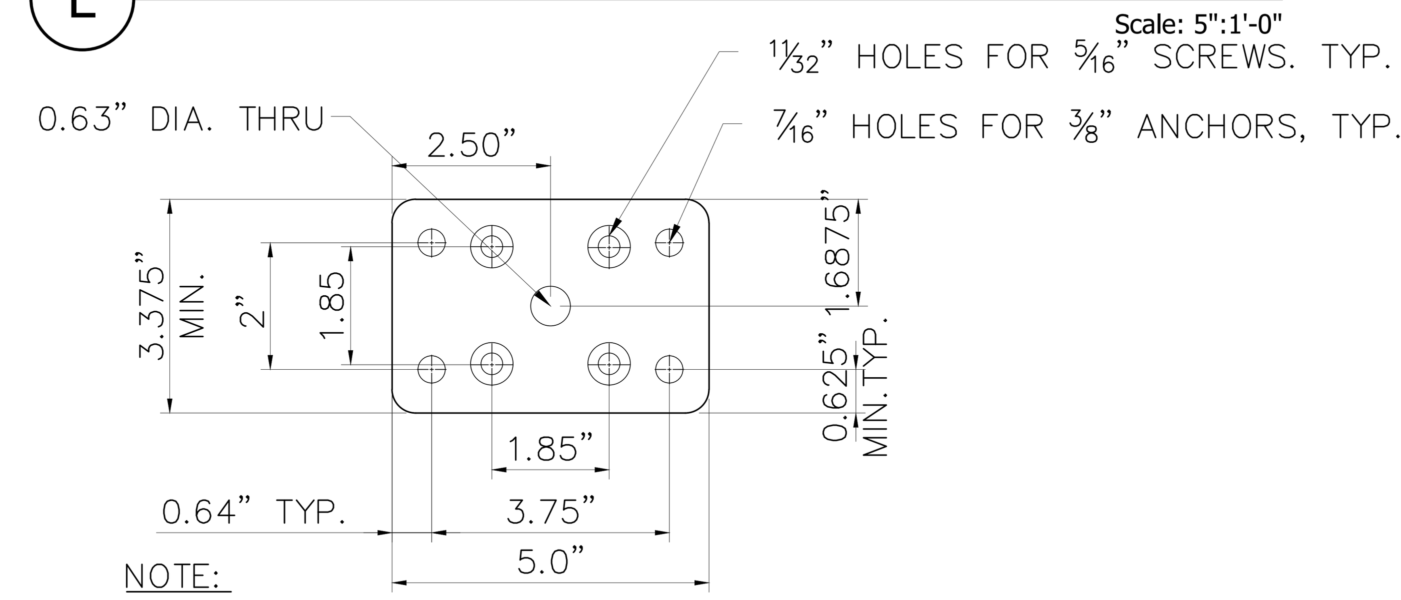
Scale: 4":1'-0"



NOTE: PROVIDE HIT-HY 200 V3 + HIT-Z ⅜"ANCHOR W/ MIN. 3¾" EMBEDMENT IN 6" OR THICKER CONCRETE SLAB WITH AT LEAST 5" ANCHOR TO CONCRETE EDGE DISTANCE.

E ALTERNATE 1/2x5x5 BASE PLATE

Scale: 5":1'-0"



NOTE: PROVIDE HIT-HY 200 V3 + HIT-Z ⅜"ANCHOR W/ MIN. 3¾" EMBEDMENT IN 6" OR THICKER CONCRETE SLAB WITH AT LEAST 5" ANCHOR TO CONCRETE EDGE DISTANCE.

D ALTERNATE 1/2x3x5 BASE PLATE

Scale: 5":1'-0"

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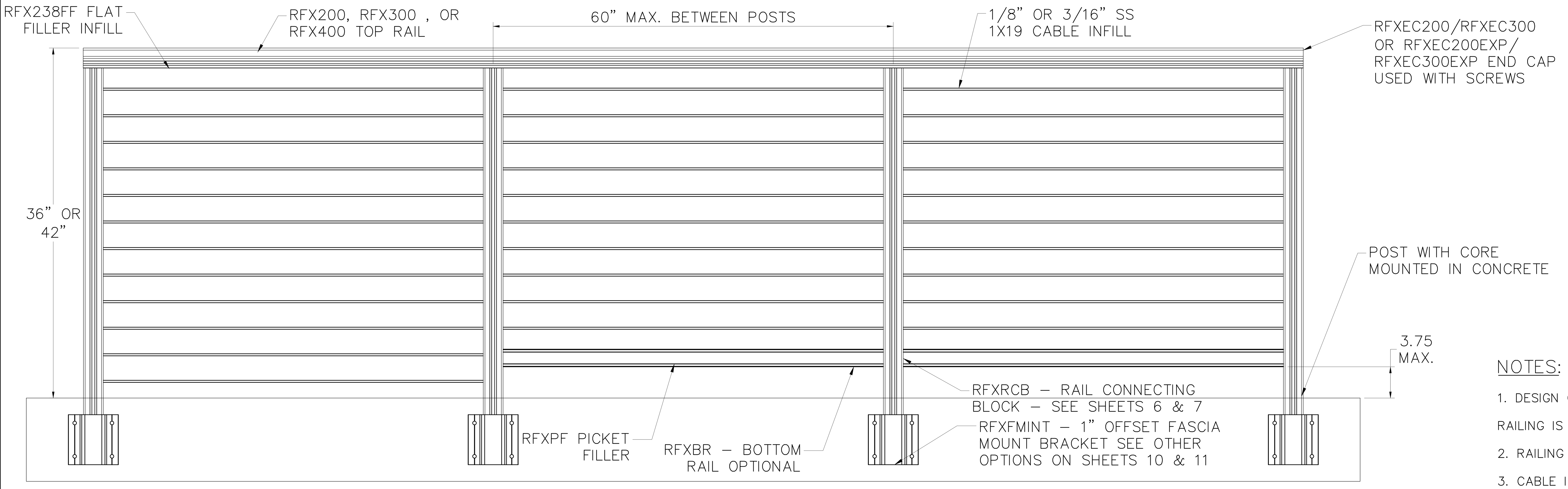
REGISTERED PROFESSIONAL ENGINEER HEMAL MODI C 78688 EXP. 09/30/2023 CIVIL STATE OF CALIFORNIA 22nd SEP, 2022

RFX 200 / RFX300 W/STAINLESS STEEL CABLE INFILL SURFACE MOUNTED

NATIONWIDE INDUSTRIES - 50 STATES

DATE: 09.22.2022
SCALE: AS SHOWN
DESIGN BY: HM
DRAWN BY: SSK
REVIEWED BY:SP
190417
S5.0

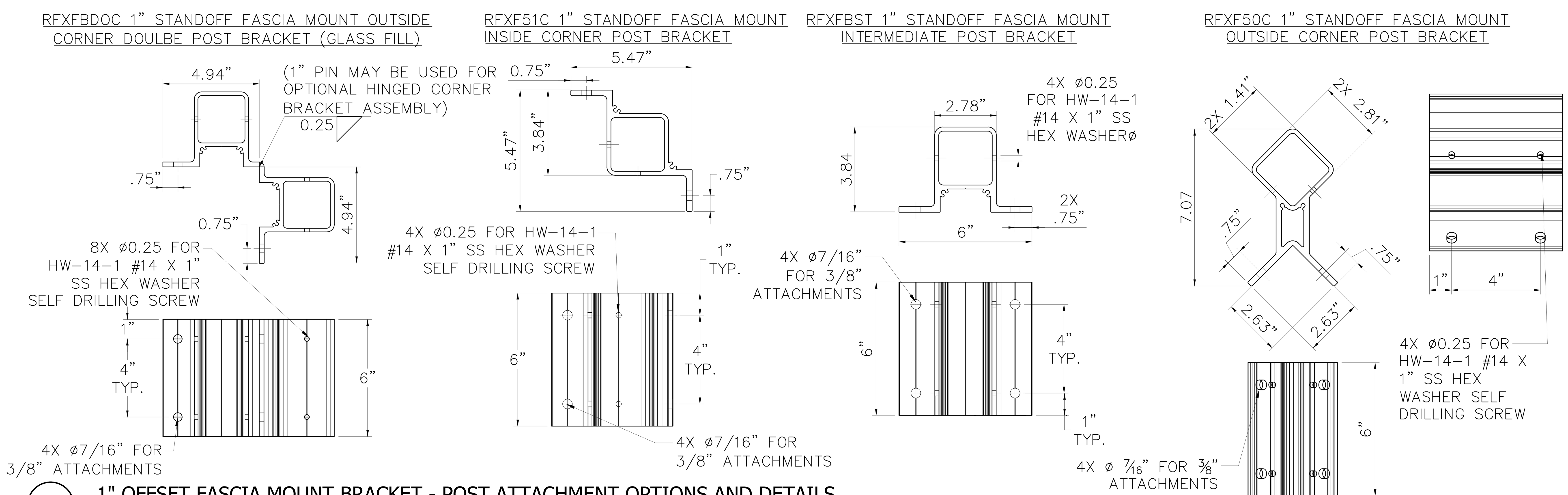


1 RFX 200 / RFX300 ALUMINUM RAIL W/STAINLESS STEEL CABLE INFILL OFFSET FASCIA MOUNT

Scale: 1-1/2" : 1'-0"

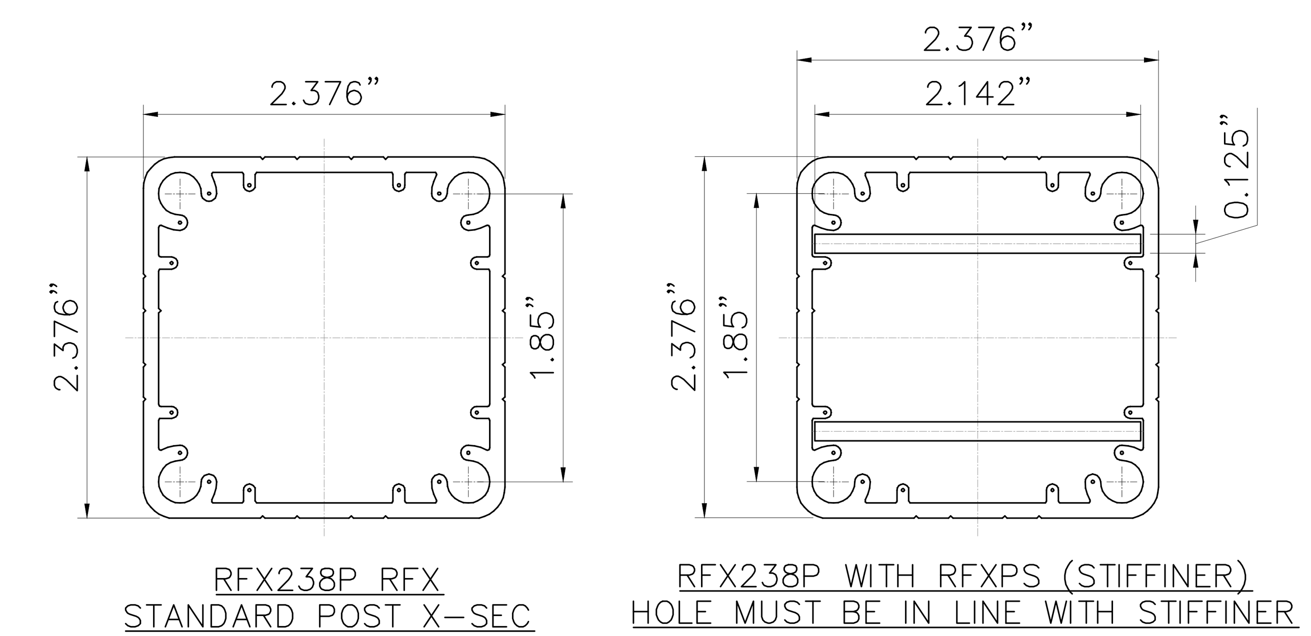
NOTES:

1. DESIGN CAPACITY CHECK OF EXISTING STRUCTURE THAT SUPPORTS THE RAILING IS NOT IN ZENITH SCOPE OF WORK.
2. RAILING IS DESIGNED FOR MAX SPEED OF 110MPH.
3. CABLE IN-FILL & TOP RAIL DESIGN IS NOT IN ZENITH SCOPE OF WORK.
4. POST SPACING OF 5' O.C REQUIRES RFS238P (POST) WITH RFXPS (STIFFENER).



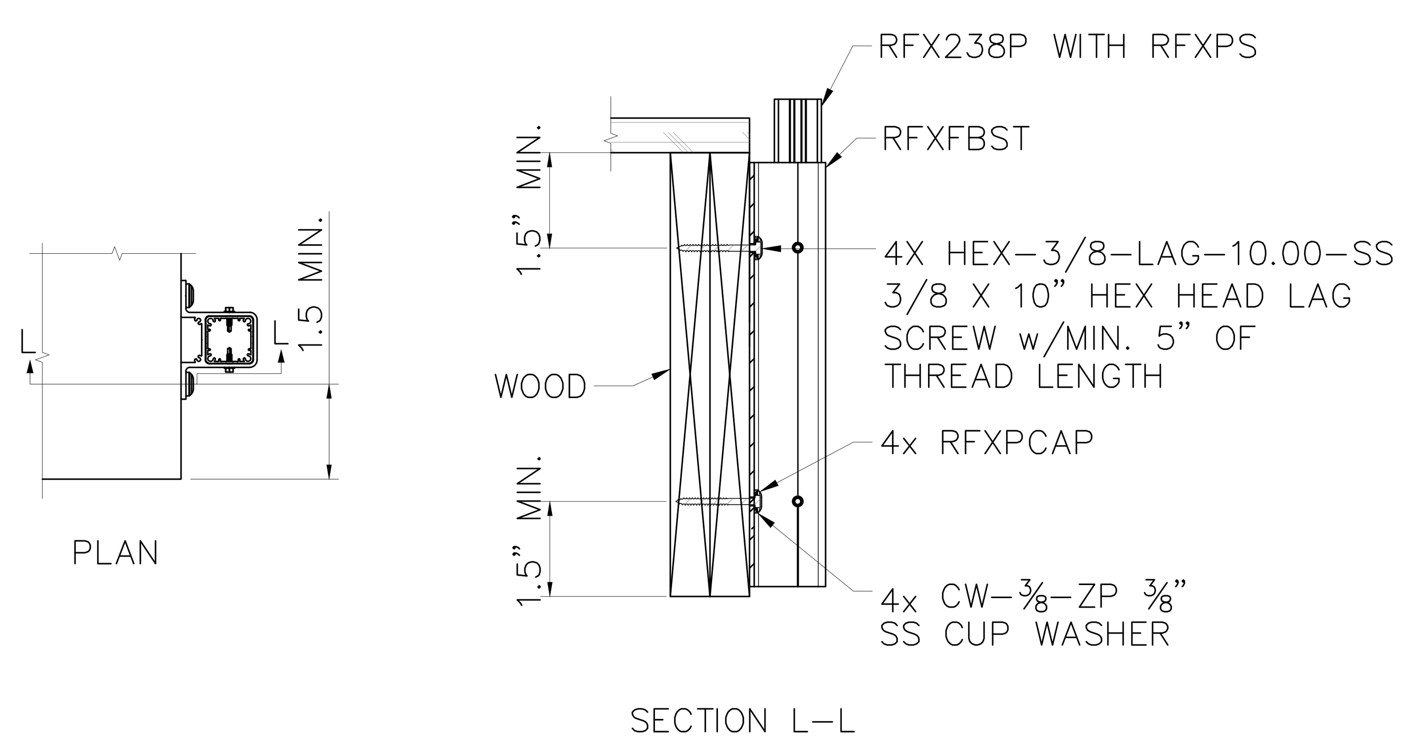
A 1" OFFSET FASCIA MOUNT BRACKET - POST ATTACHMENT OPTIONS AND DETAILS

Scale: 5":1'-0"



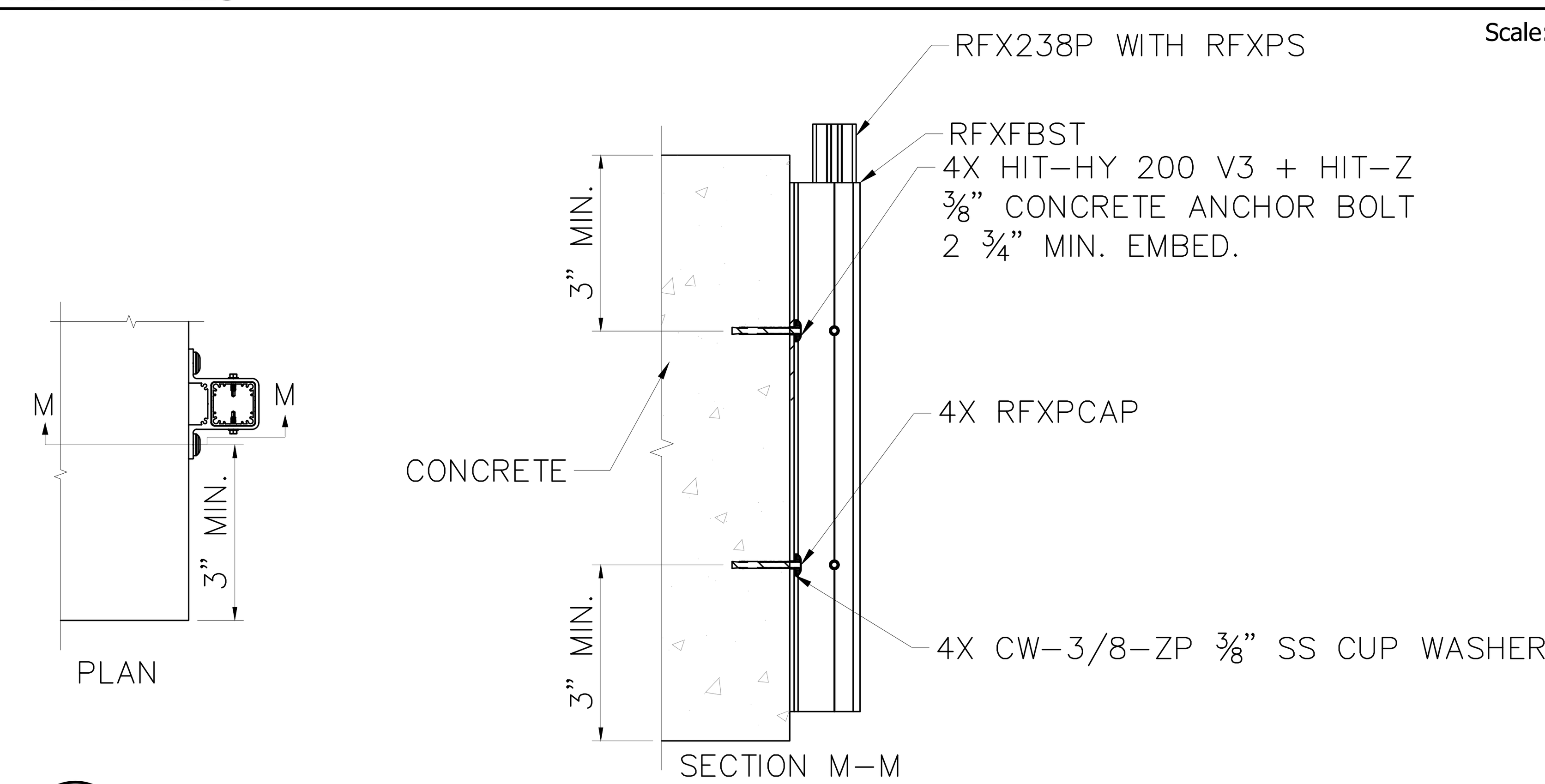
D PE-POST EXTRUSION PROFILE

Scale: 1'-0":1'-0"



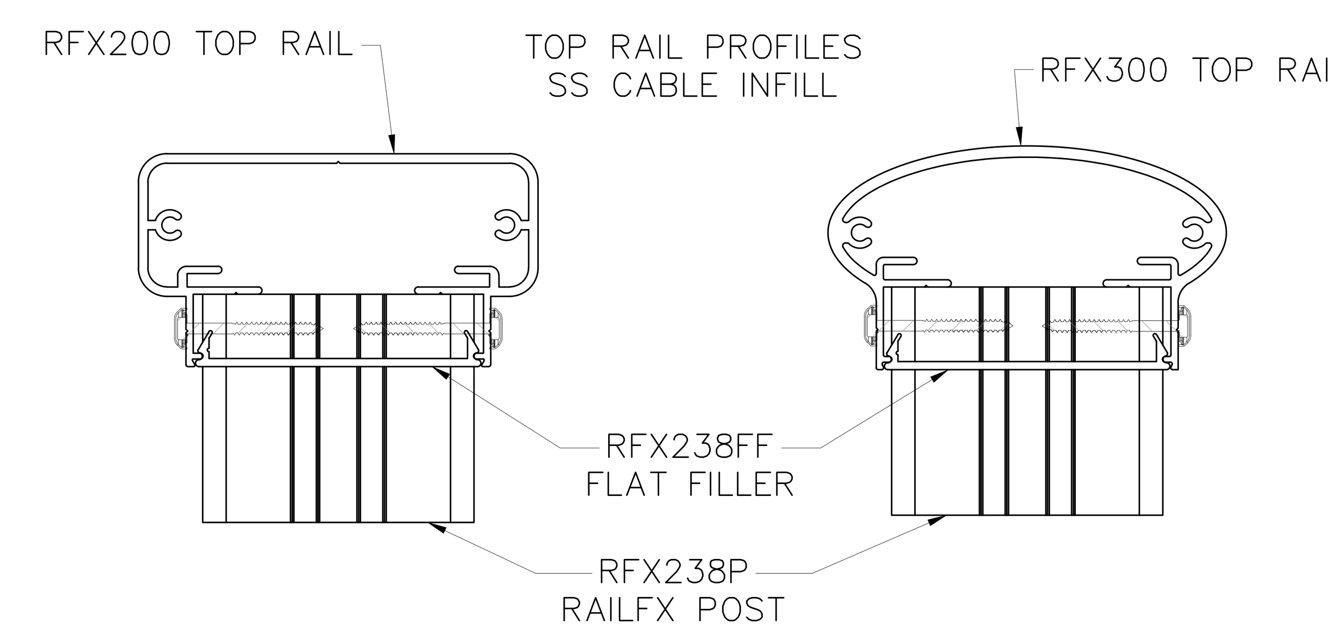
B OFFSET FASCIA MOUNT TO WOOD

Scale: 5":1'-0"



C OFFSET FASCIA MOUNT TO CONCRETE

Scale: 5":1'-0"



E TOP RAIL PROFILES (CONTIUOUS TOP RAIL)

Scale: 1'-0":1'-0"

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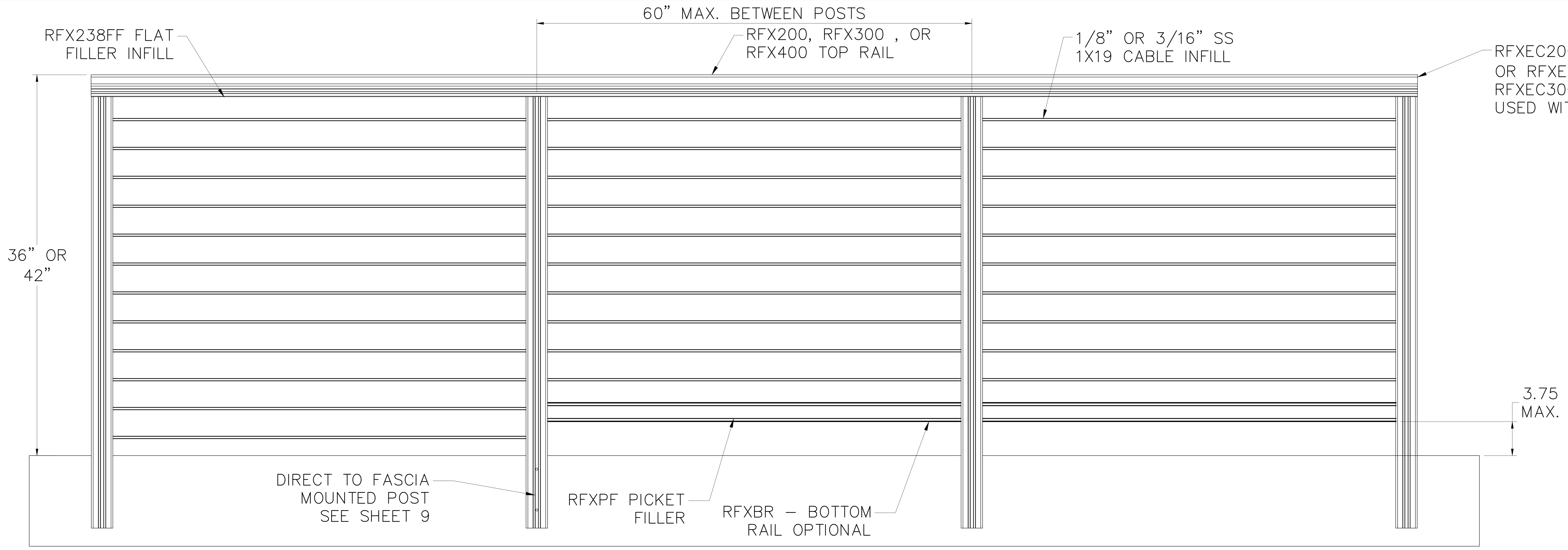
EXP. 09/30/2023
CIVIL
STATE OF CALIFORNIA

RFX 200 / RFX300 W/STAINLESS STEEL CABLE INFILL OFFSET FASCIA MOUNTED

NATIONWIDE INDUSTRIES - 50 STATES

DATE: 09.22.2022
SCALE: AS SHOWN
DESIGN BY: HM
DRAWN BY: SSK
REVIEWED BY:SP
190417

S6.0

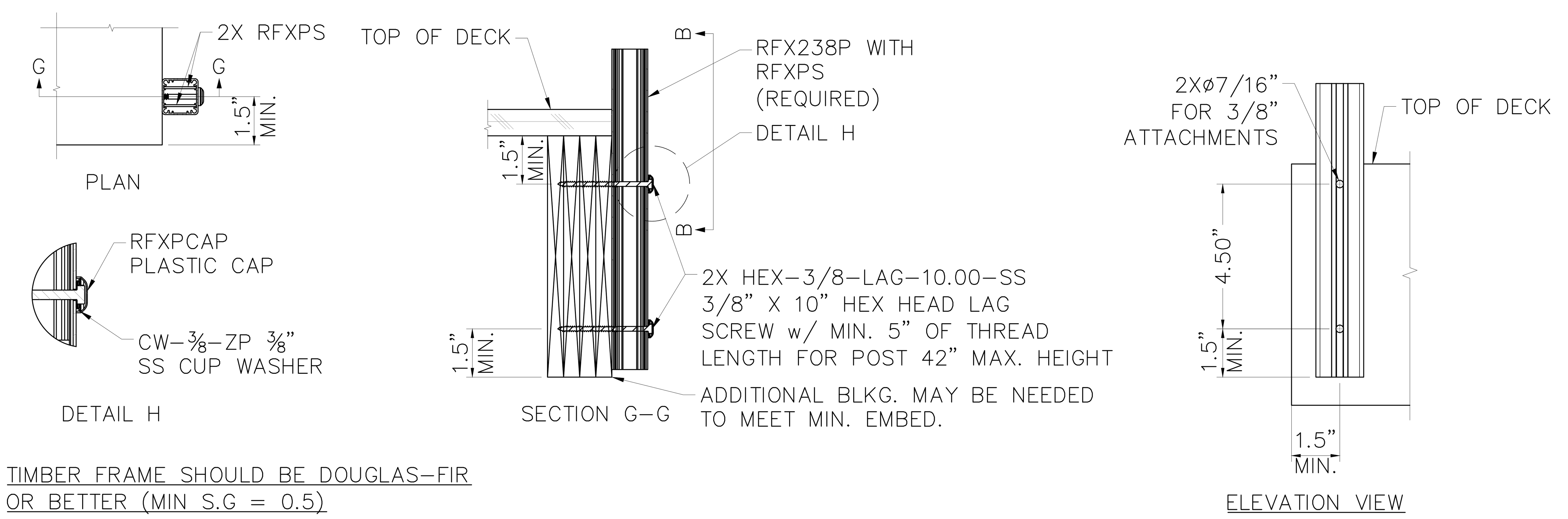


1 RFX 200 / RFX300 ALUMINUM RAIL W/STAINLESS STEEL CABLE INFILL FLUSH FASCIA MOUNT

Scale: 1-1/2" : 1'-0"

NOTES:

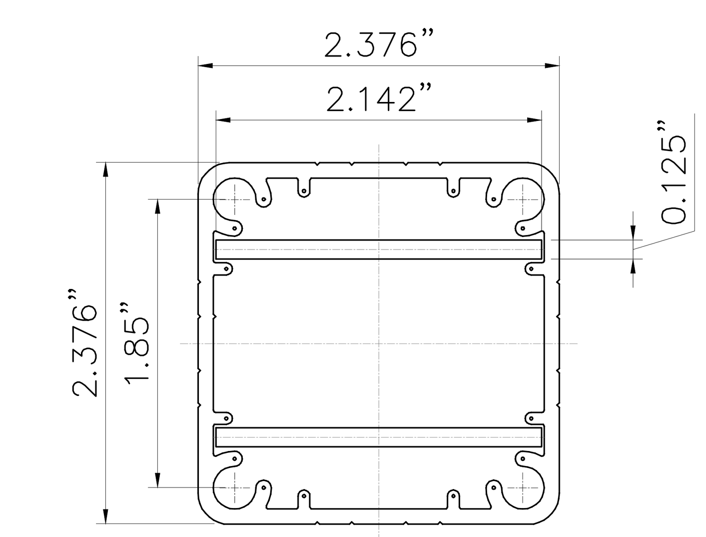
1. DESIGN CAPACITY CHECK OF EXISTING STRUCTURE THAT SUPPORTS THE RAILING IS NOT IN ZENITH SCOPE OF WORK.
2. RAILING IS DESIGNED FOR MAX SPEED OF 110MPH.
3. CABLE IN-FILL & TOP RAIL DESIGN IS NOT IN ZENITH SCOPE OF WORK.
4. FLUSH FASCIA MOUNTED CONNECTION IS NOT RECOMMENDED TO WOODEN MEMBERS



TIMBER FRAME SHOULD BE DOUGLAS-FIR OR BETTER (MIN S.G = 0.5)

A FLUSH MOUNT FASCIA ATTACHMENT TO WOOD

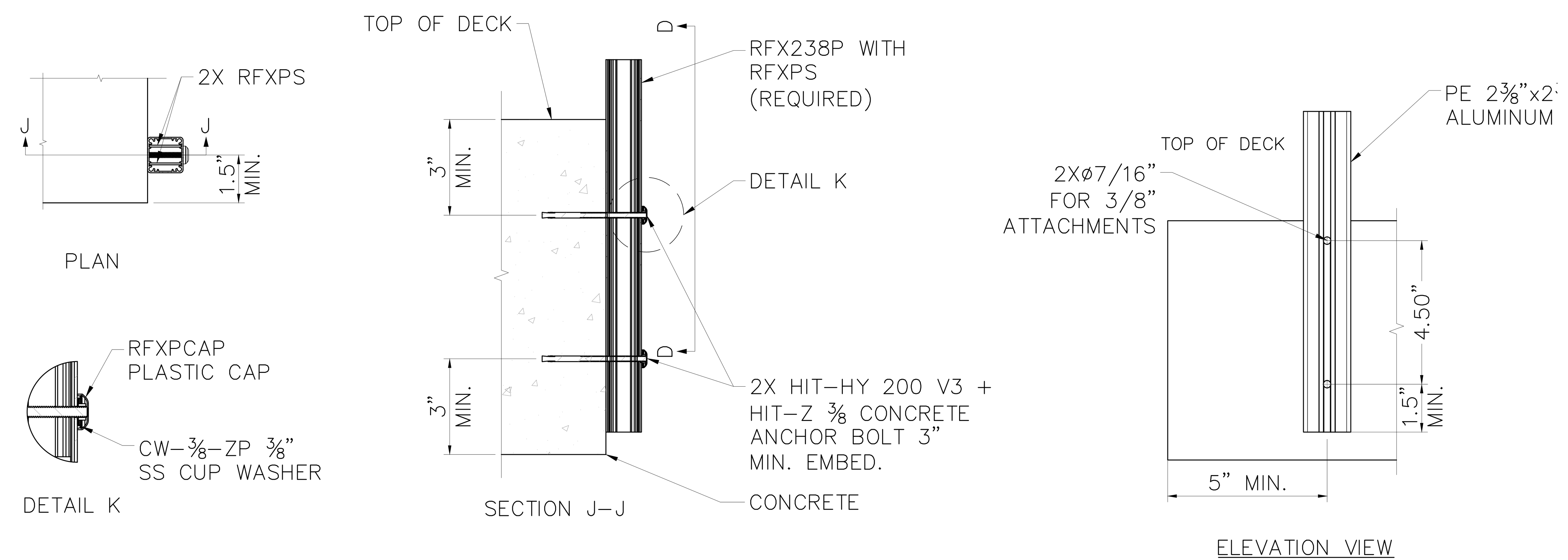
Scale: 4":1'-0"



RFX238P WITH RFXPS (STIFFINER)
HOLE MUST BE IN LINE WITH STIFFINER

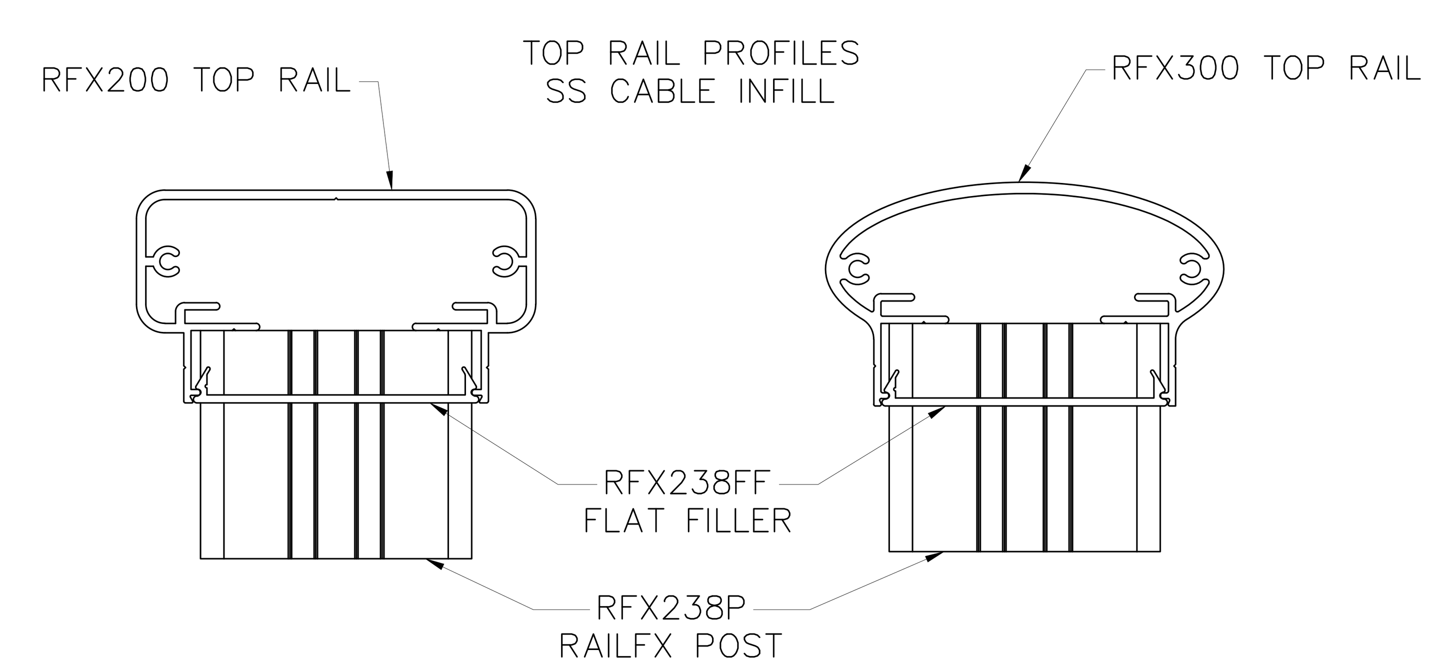
C PE-POST EXTRUSION PROFILE

Scale: 1'-0":1'-0"



B FLUSH MOUNT FASCIA ATTACHMENT TO CONCRETE

Scale: 4":1'-0"



D TOP RAIL PROFILES (CONTIUOUS TOP RAIL)

Scale: 1'-0":1'-0"

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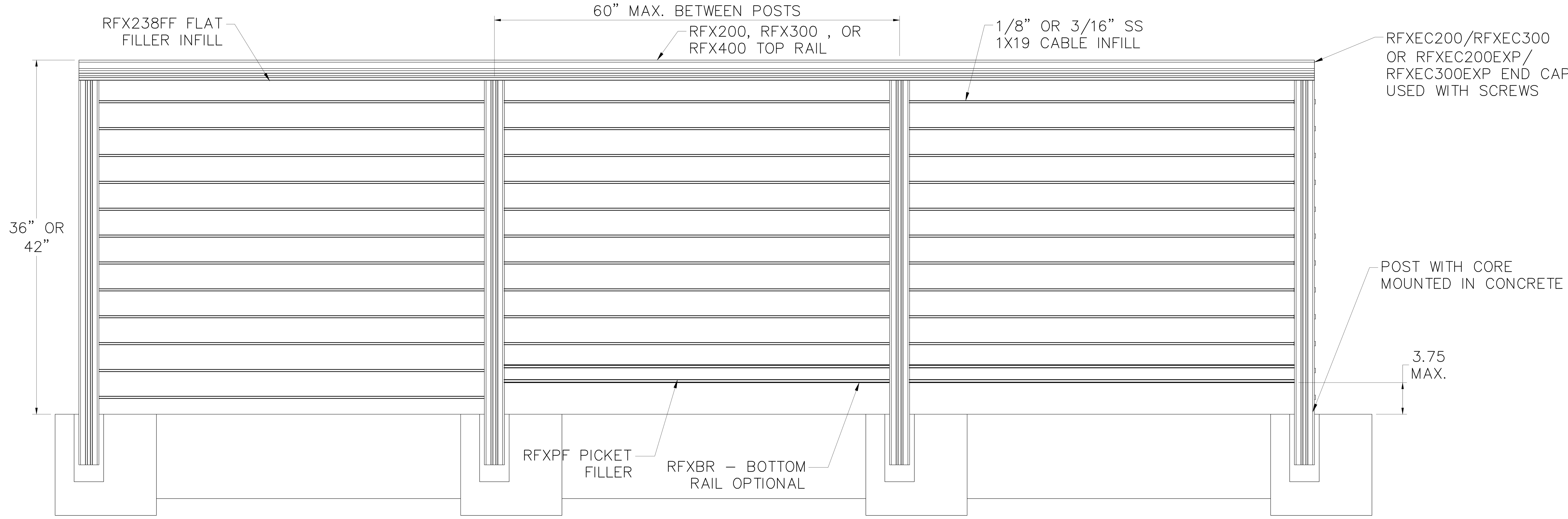
REGISTERED PROFESSIONAL ENGINEER HEMAL MODI C 78688 EXP. 09/30/2023 CIVIL STATE OF CALIFORNIA
22nd SEP, 2022

RFX 200 / RFX300 W/STAINLESS STEEL CABLE INFILL FLUSH FASCIA MOUNTED

NATIONWIDE INDUSTRIES - 50 STATES

DATE: 09.22.2022
SCALE: AS SHOWN
DESIGN BY: HM
DRAWN BY: SSK
REVIEWED BY:SP
190417

S7.0



NOTES:

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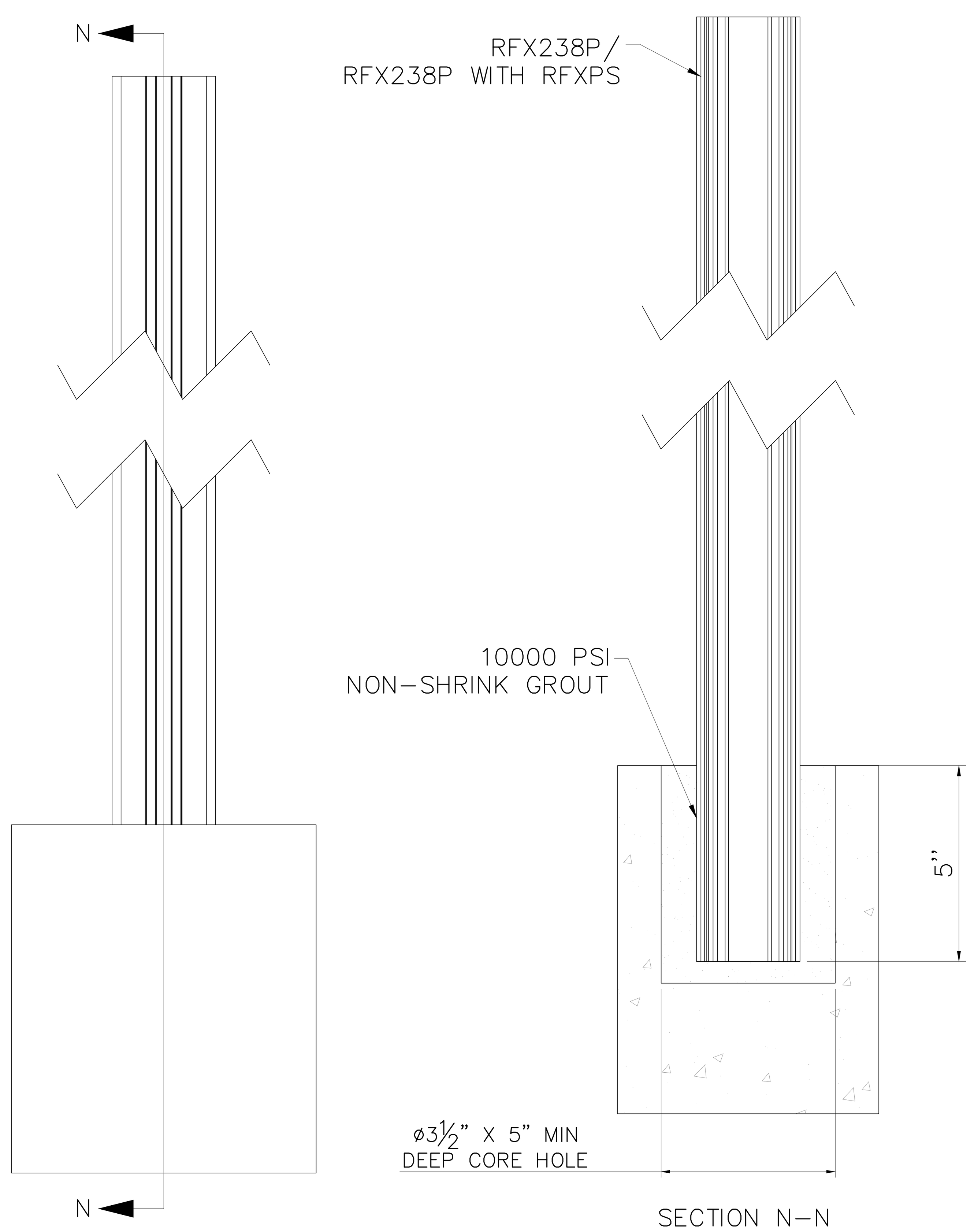
2. RAILING IS DESIGNED FOR MAX SPEED OF 110MPH.
3. CABLE IN–FILL & TOP RAIL DESIGN IS NOT IN ZENITH SCOPE OF WORK.
4. POST SPACING OF 5' O.C REQUIRES RFS238P (POST) WITH RFXPS (STIFFENER).

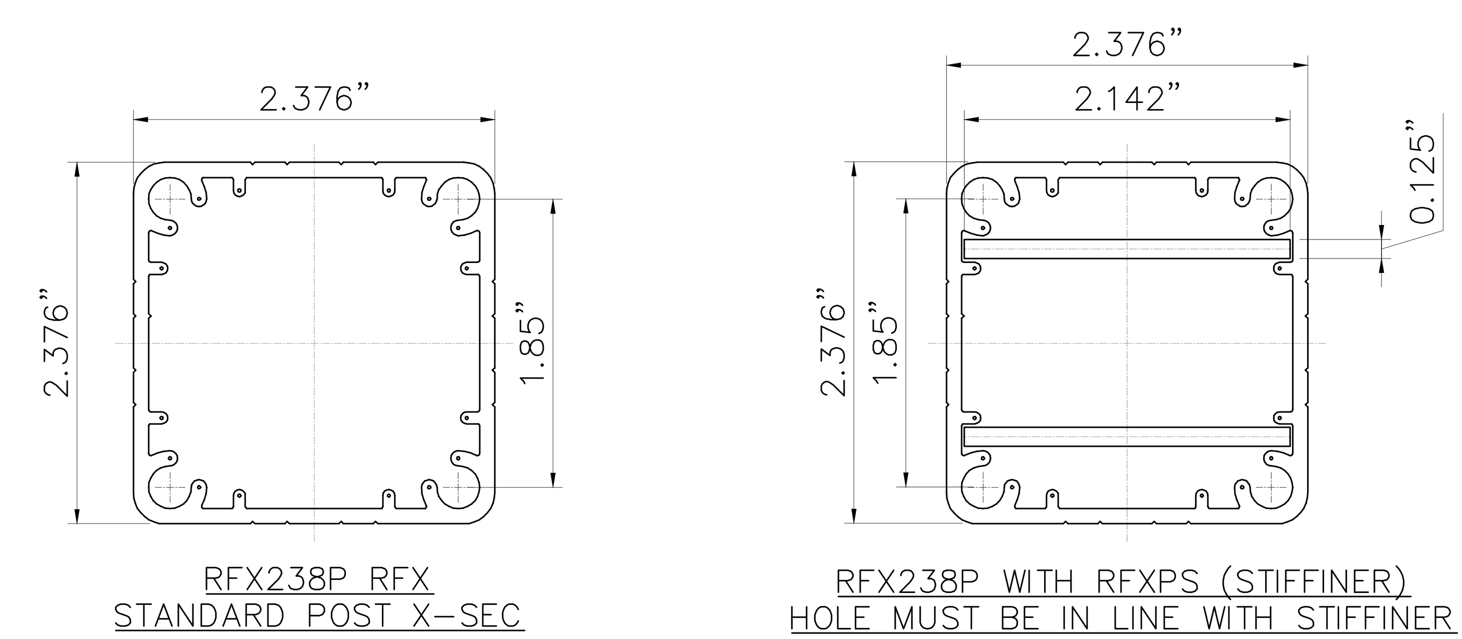
1 RFX 200 / RFX300 ALUMINUM RAIL W/STAINLESS STEEL CABLE INFILL CORE MOUNT

Scale: 1-1/2" : 1'-0"



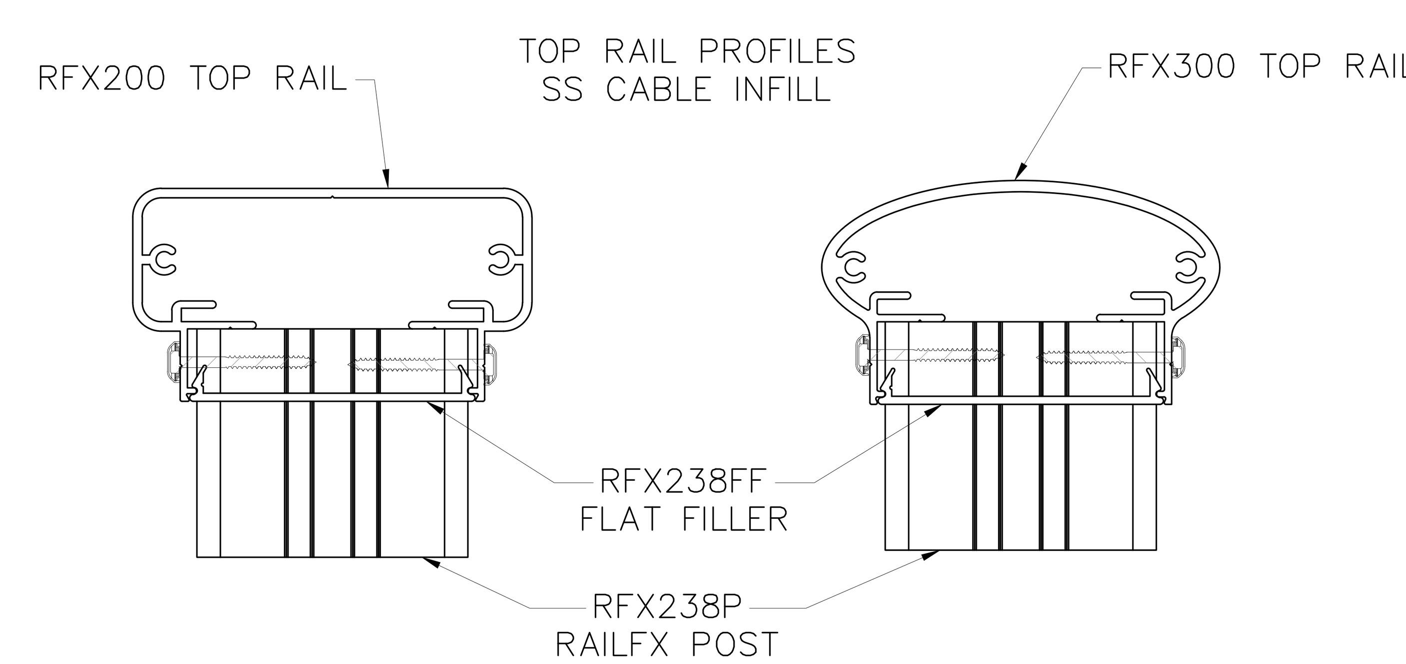
A DETAIL A - POST CORE MOUNTING ATTACHMENT DETAIL

Scale: 5":1'-0"



B PE-POST EXTRUSION PROFILE

Scale: 1'-0":1'-0"



C TOP RAIL PROFILES (CONTIUOUS TOP RAIL)

Scale: 1'-0":1'-0"

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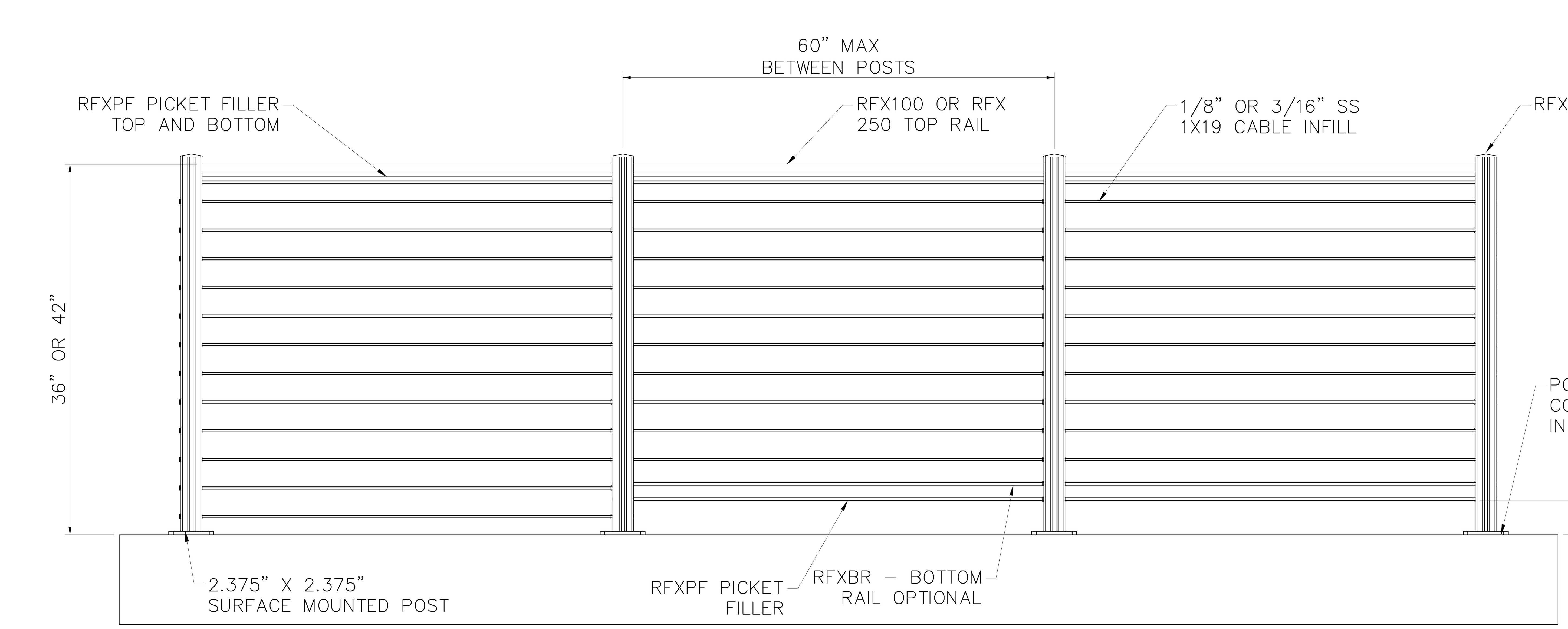
EXP. 09/30/2023
CIVIL
STATE OF CALIFORNIA

RFX 200 / RFX300 W/STAINLESS STEEL CABLE INFILL POST CORE MOUNT

NATIONWIDE INDUSTRIES - 50 STATES

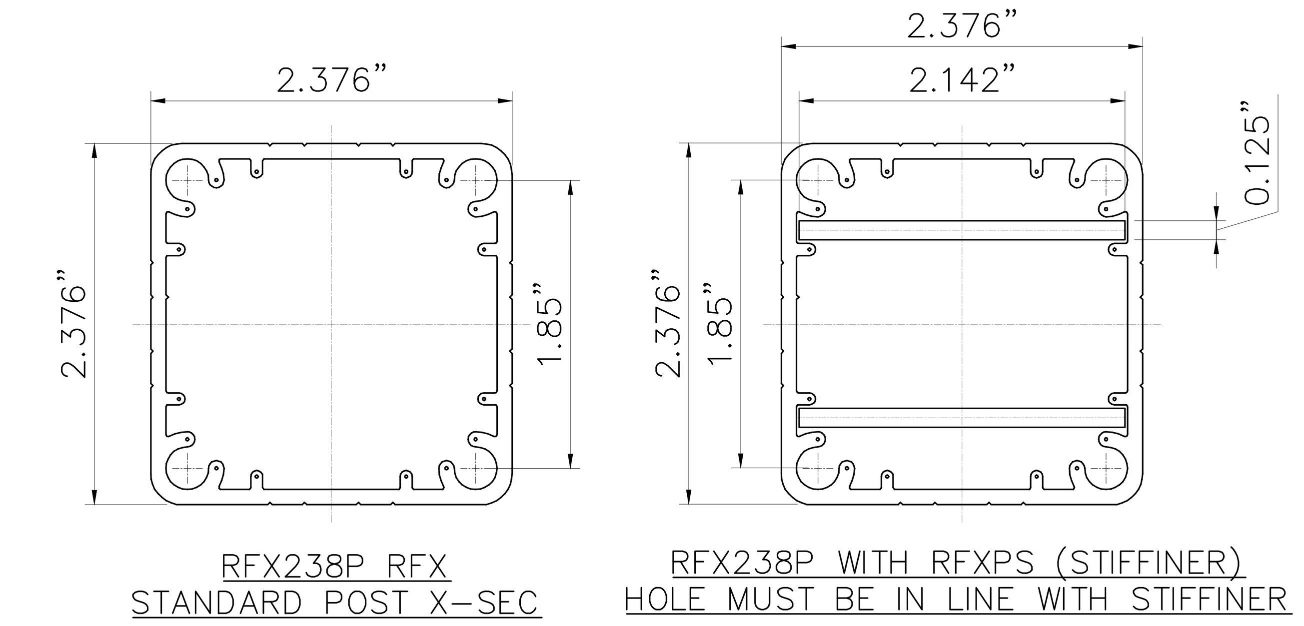
DATE: 09.22.2022
SCALE: AS SHOWN
DESIGN BY: HM
DRAWN BY: SSK
REVIEWED BY:SP
190417

S8.0



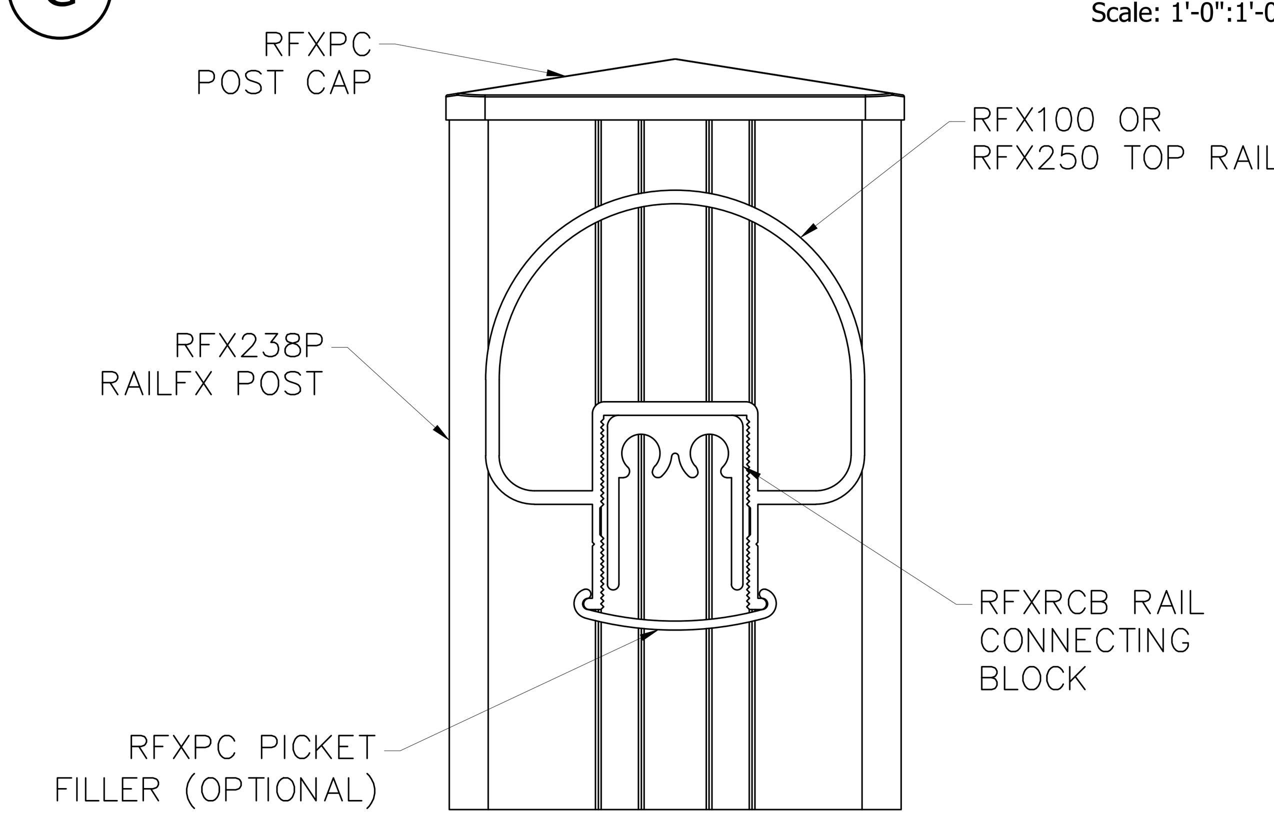
1 RFX 100 / RFX200 ALUMINUM RAIL W/STAINLESS STEEL CABLE INFILL SURFACE MOUNT

Scale: 1-1/2" : 1'-0"



G PE-POST EXTRUSION PROFILE

Scale: 1'-0":1'-0"



F TOP RAIL PROFILE FOR SS CABLE INFILL

Scale: 1'-0":1'-0"

NOTES:

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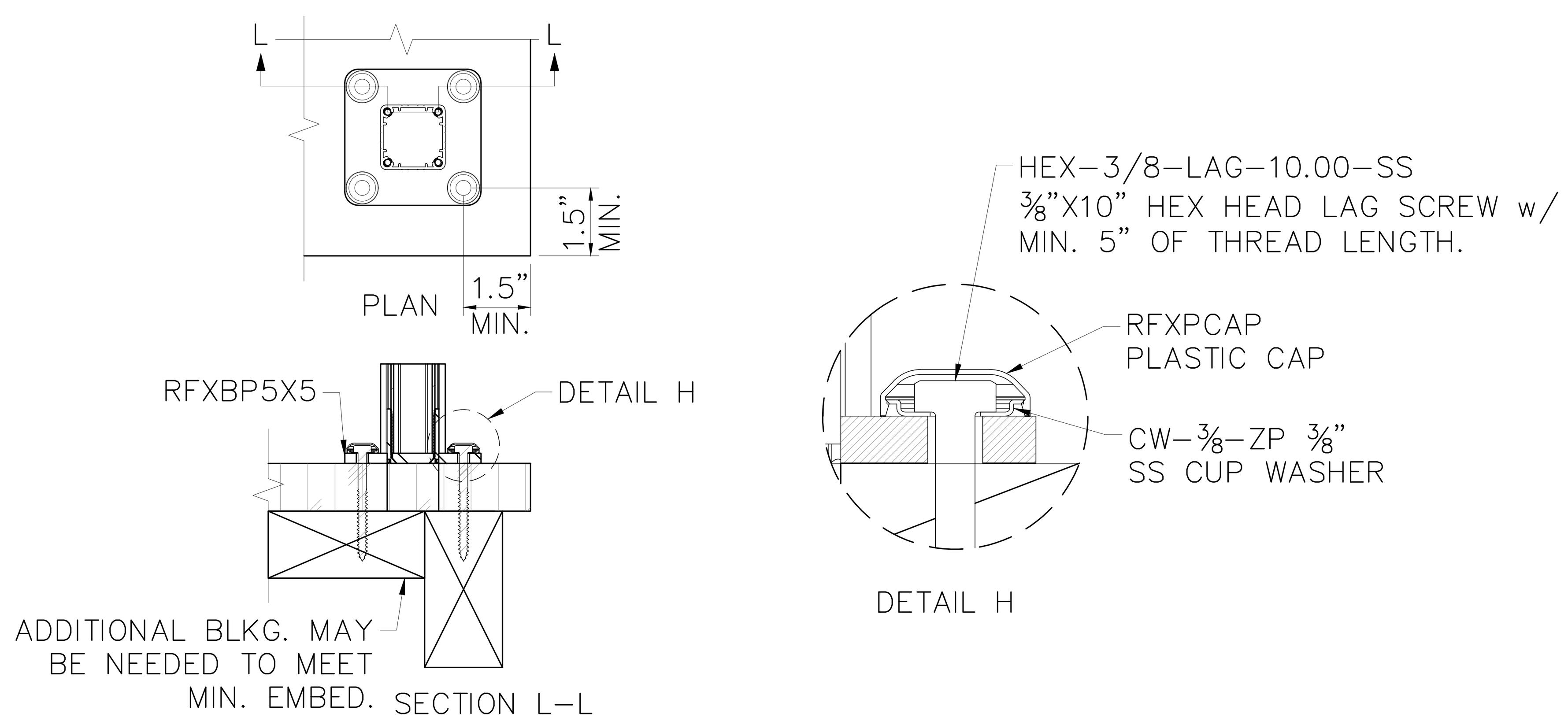
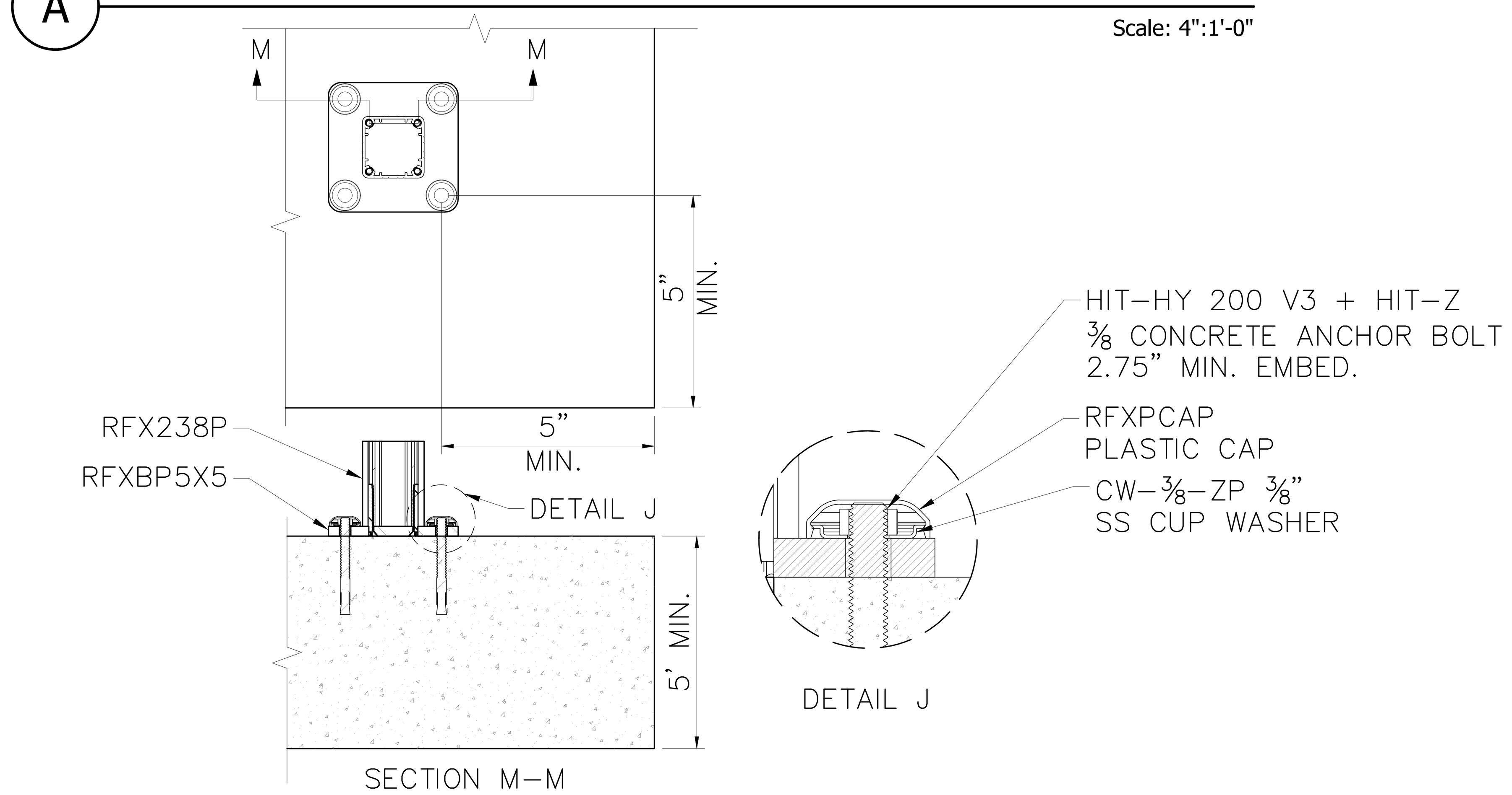
4. POST SPACING OF 5' O.C REQUIRES RFX238P (POST) WITH RFXPS (STIFFENER).



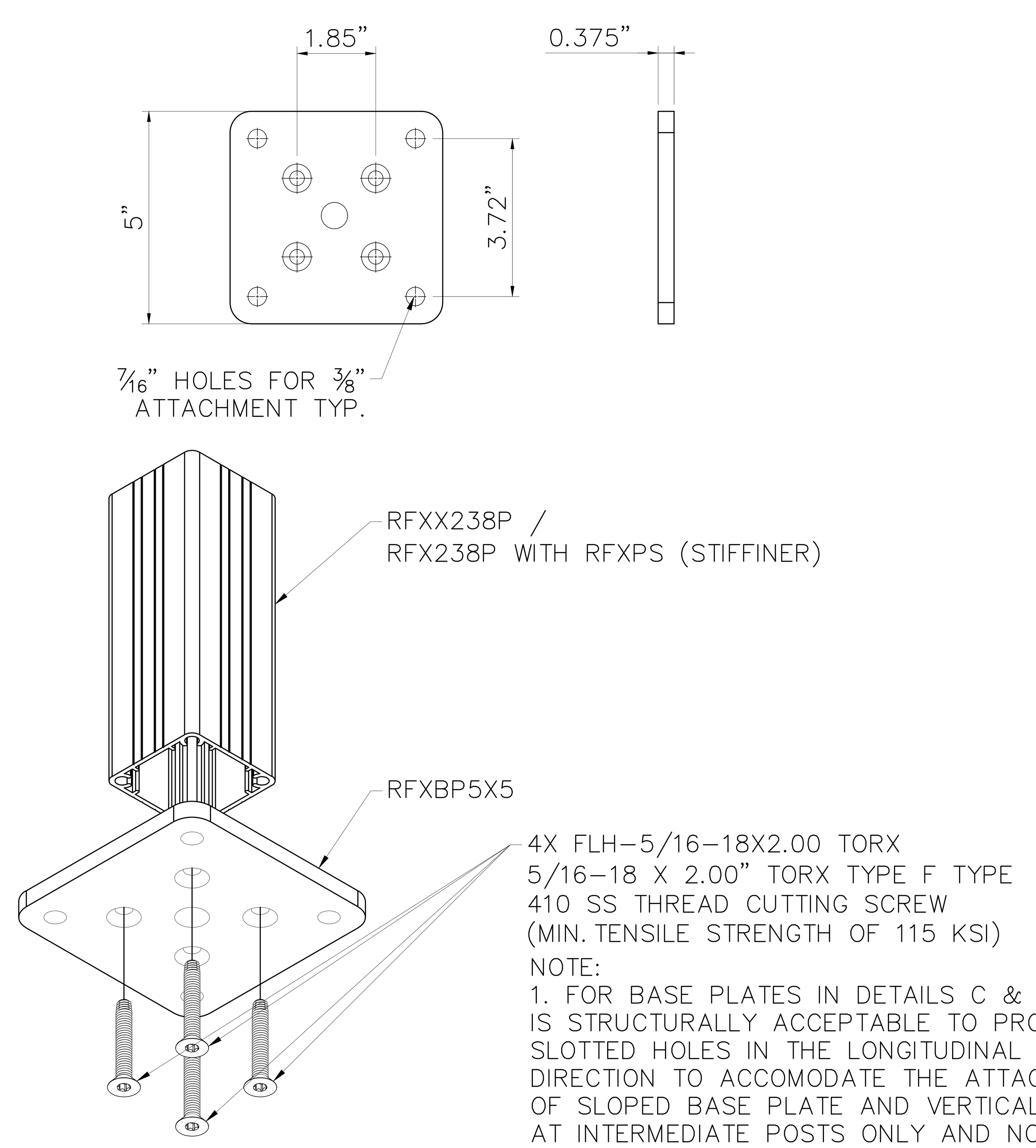
A SURFACE MOUNT POST WITH BASE PLATE IN WOOD

Scale: 4":1'-0"



B SURFACE MOUNT POST WITH BASE PLATE IN CONCRETE

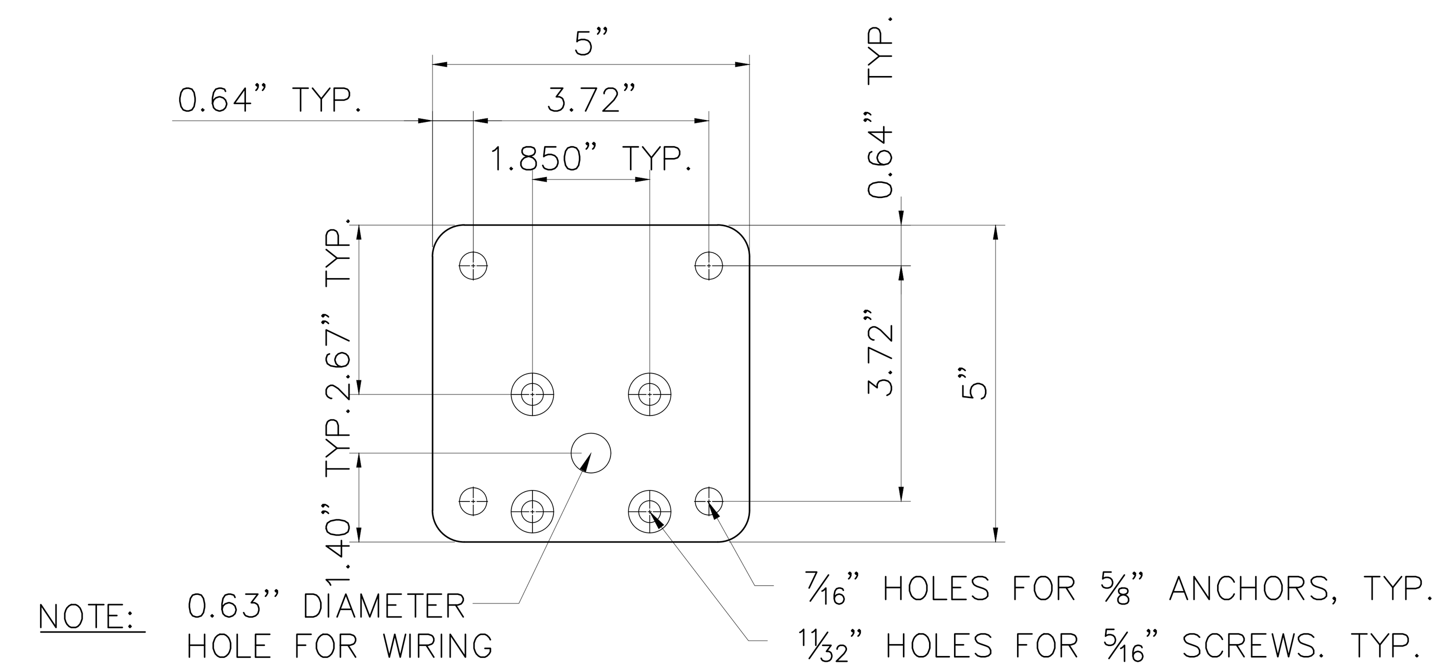
Scale: 4":1'-0"



NOTE:
1. FOR BASE PLATES IN DETAILS C & D, IT IS STRUCTURALLY ACCEPTABLE TO PROVIDE SLOTTED HOLES IN THE LONGITUDINAL DIRECTION TO ACCOMODATE THE ATTACHMENT OF SLOPED BASE PLATE AND VERTICAL POST AT INTERMEDIATE POSTS ONLY AND NOT AT THE END OF THE STAIR RAILS.

C RFXBP5X5 DETAILS

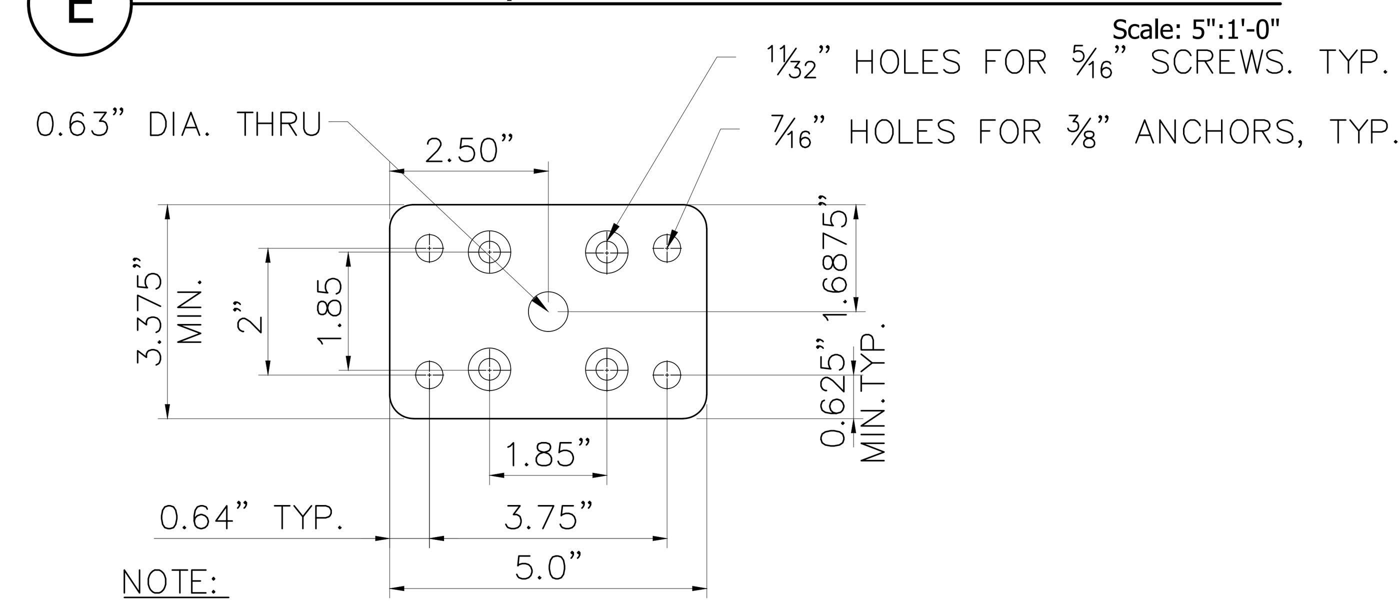
Scale: 1'-0":1'-0"



NOTE: PROVIDE HIT–HY 200 V3 + HIT–Z ⅜"ANCHOR W/ MIN. 3¾" EMBEDMENT IN 6" OR THICKER CONCRETE SLAB WITH AT LEAST 5" ANCHOR TO CONCRETE EDGE DISTANCE.

E ALTERNATE 1/2x5x5 BASE PLATE

Scale: 5":1'-0"



NOTE:

PROVIDE HIT–HY 200 V3 + HIT–Z ⅜"ANCHOR W/ MIN. 3¾" EMBEDMENT IN 6" OR THICKER CONCRETE SLAB WITH AT LEAST 5" ANCHOR TO CONCRETE EDGE DISTANCE.

D ALTERNATE 1/2x3x5 BASE PLATE

Scale: 5":1'-0"

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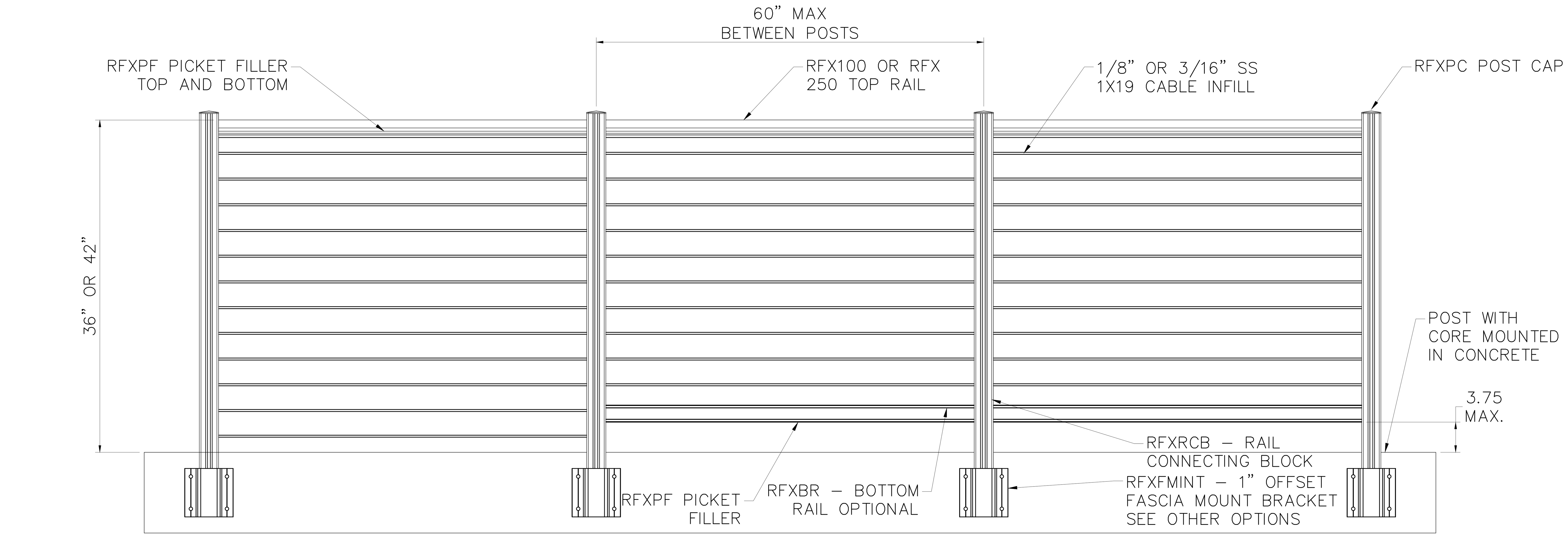
REGISTERED PROFESSIONAL ENGINEER HEMAL MODI C 78688 EXP. 09/30/2023 CIVIL STATE OF CALIFORNIA 22nd SEP 2022

RFX 100 / RFX250 W/STAINLESS STEEL CABLE INFILL SURFACE MOUNTED

NATIONWIDE INDUSTRIES - 50 STATES

DATE: 09.22.2022
SCALE: AS SHOWN
DESIGN BY: HM
DRAWN BY: SSK
REVIEWED BY:SP
190417

S9.0

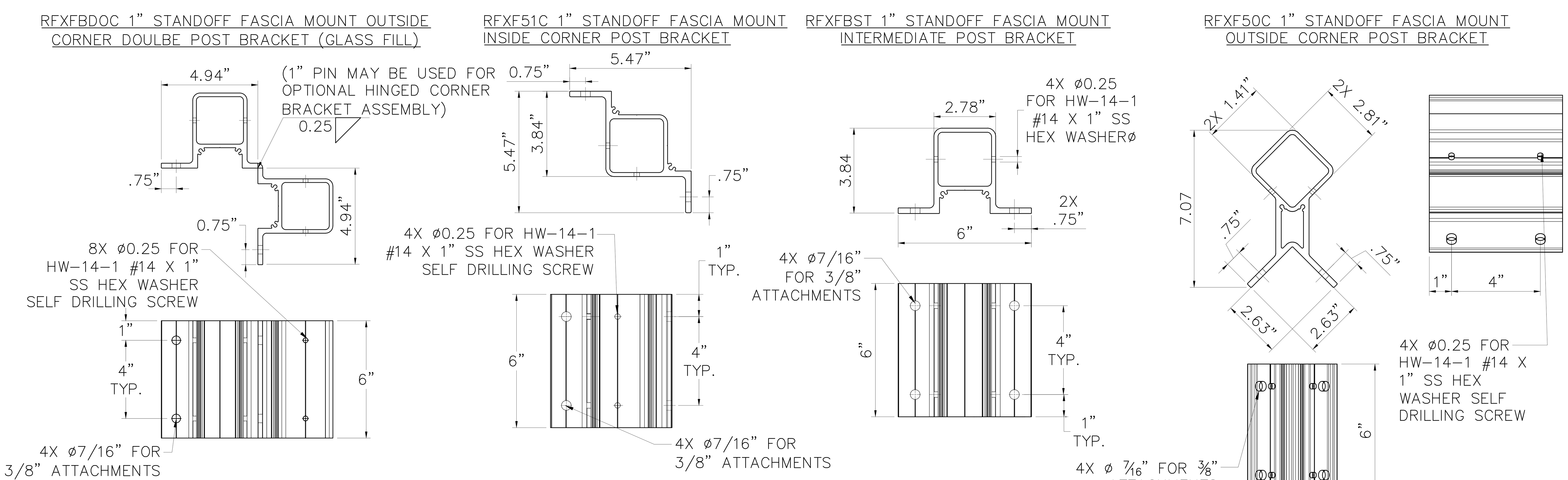


1 RFX 100 / RFX250 ALUMINUM RAIL W/STAINLESS STEEL CABLE INFILL OFFSET FASCIA MOUNT

Scale: 1-1/2" : 1'-0"

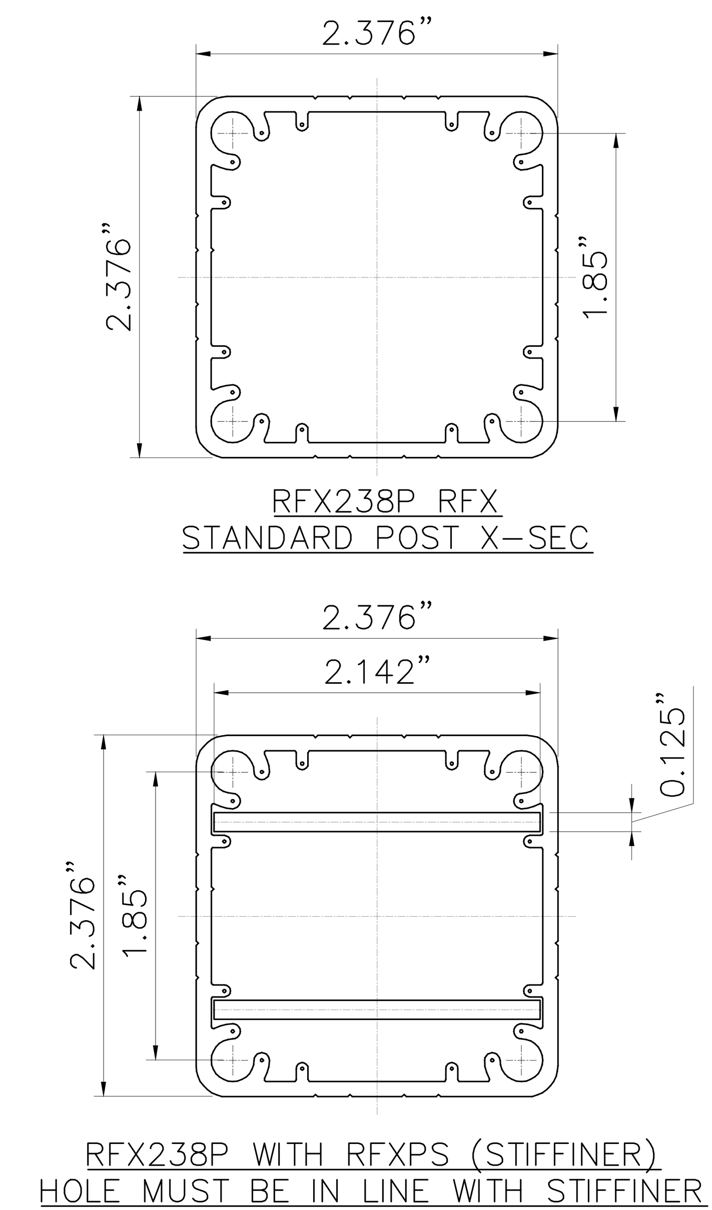
NOTES:

1. DESIGN CAPACITY CHECK OF EXISTING STRUCTURE THAT SUPPORTS THE RAILING IS NOT IN ZENITH SCOPE OF WORK.
2. RAILING IS DESIGNED FOR MAX SPEED OF 110MPH.
3. CABLE IN-FILL & TOP RAIL DESIGN IS NOT IN ZENITH SCOPE OF WORK.
4. POST SPACING OF 5' O.C REQUIRES RFS238P (POST) WITH RFXPS (STIFFENER).



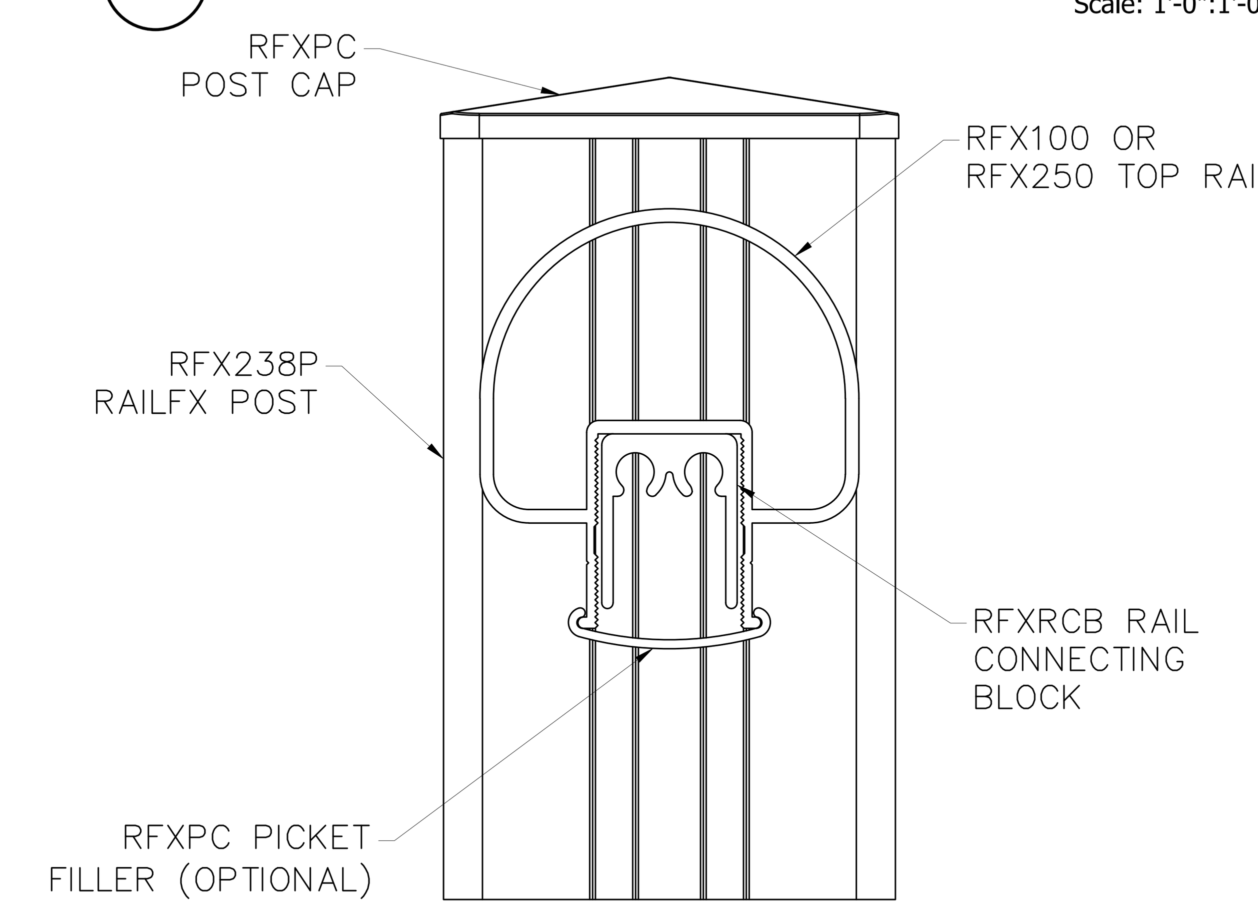
A 1" OFFSET FASCIA MOUNT BRACKET - POST ATTACHMENT OPTIONS AND DETAILS

Scale: 5":1'-0"



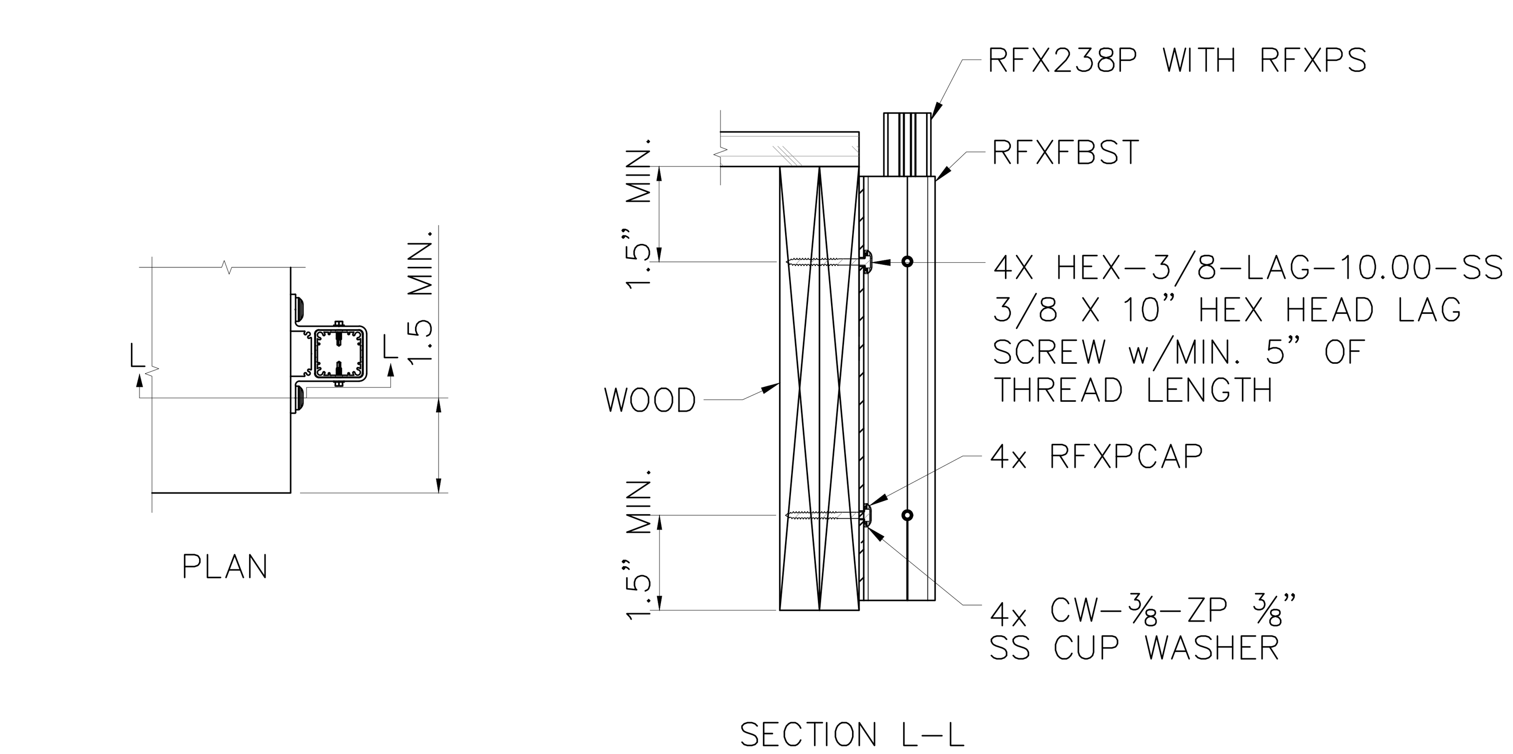
E PE-POST EXTRUSION PROFILE

Scale: 1'-0":1'-0"



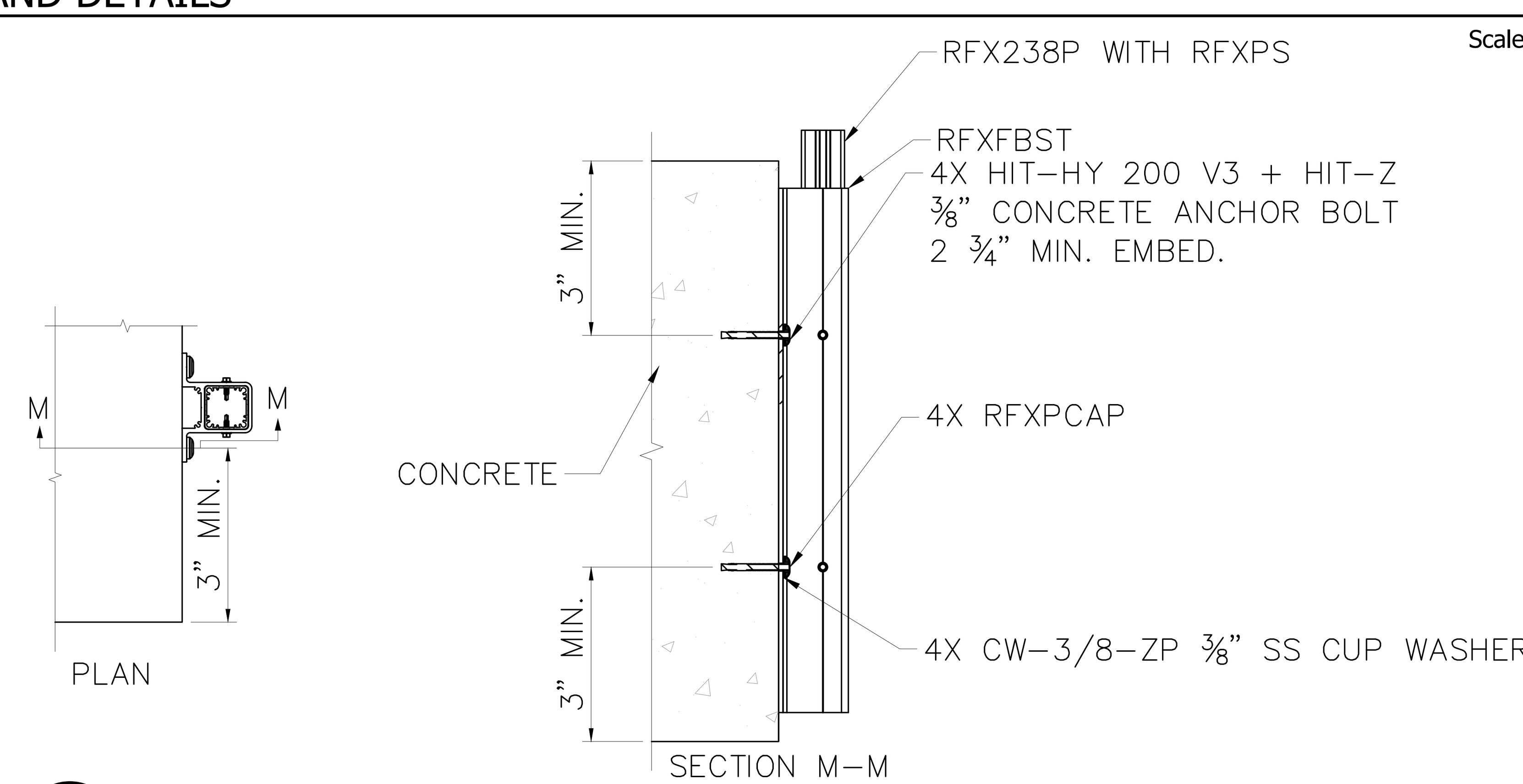
D TOP RAIL PROFILE FOR SS CABLE INFILL

Scale: 1'-0":1'-0"



B OFFSET FASCIA MOUNT TO WOOD

Scale: 5":1'-0"



C OFFSET FASCIA MOUNT TO CONCRETE

Scale: 5":1'-0"

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C 78688
EXP. 09/30/2023
CIVIL
STATE OF CALIFORNIA

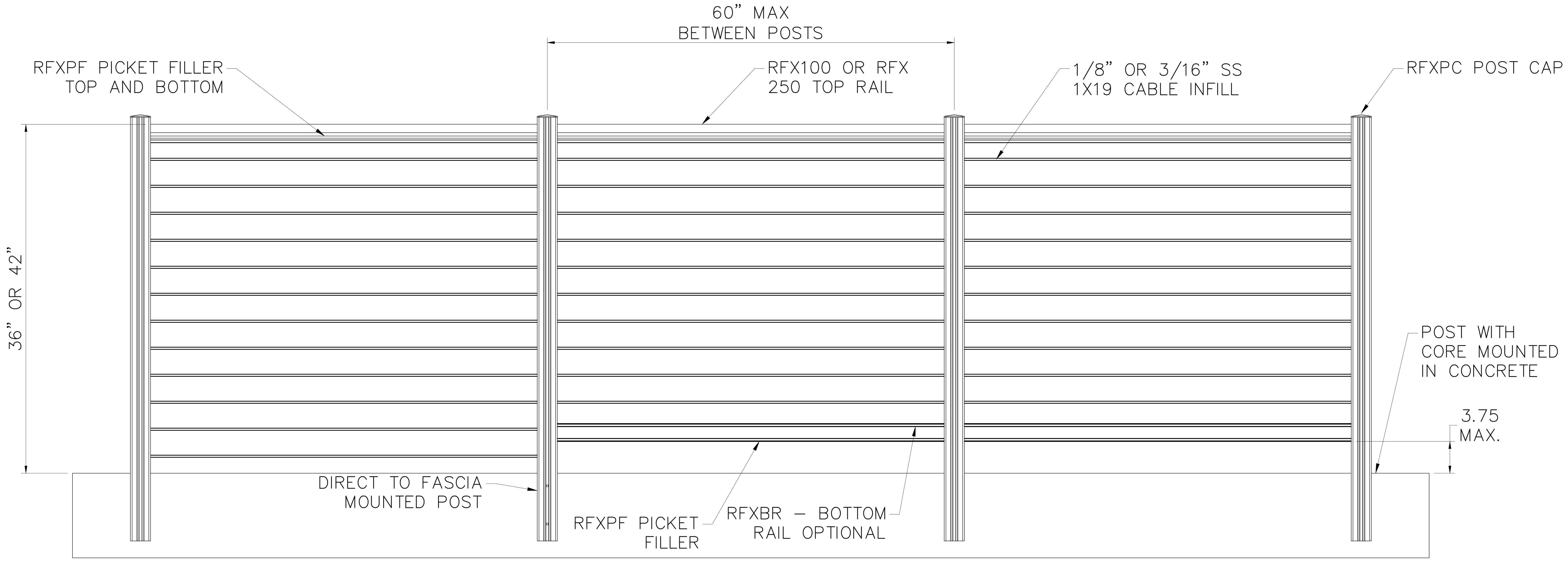
RFX 100 / RFX250 W/STAINLESS STEEL CABLE INFILL OFFSET FASCIA MOUNT

NATIONWIDE INDUSTRIES - 50 STATES

DATE: 09.22.2022
SCALE: AS SHOWN
DESIGN BY: HM
DRAWN BY: SSK
REVIEWED BY:SP
190417

S10.0

PAGE 12 of 14



NOTES:

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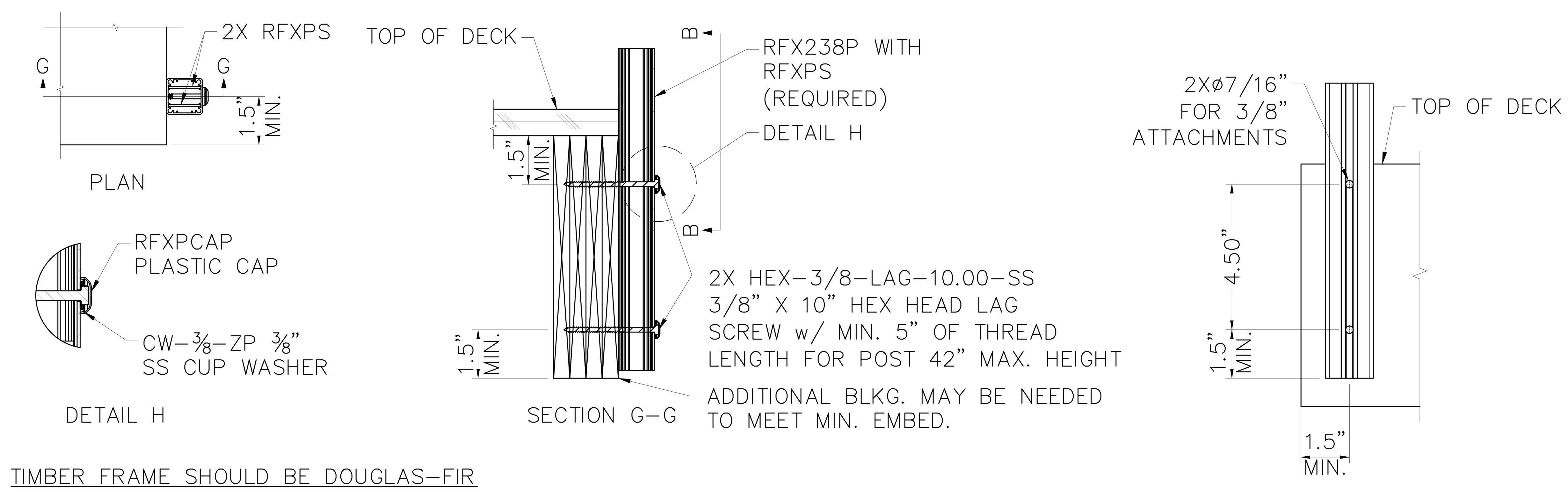
2. RAILING IS DESIGNED FOR MAX SPEED OF 110MPH.
3. CABLE IN-FILL & TOP RAIL DESIGN IS NOT IN ZENITH SCOPE OF WORK.
4. FLUSH FASCIA MOUNTED CONNECTION IS NOT RECOMMENDED TO WOODEN MEMBERS

1 RFX 100 / RFX250 ALUMINUM RAIL W/STAINLESS STEEL CABLE INFILL FLUSH FASCIA MOUNT

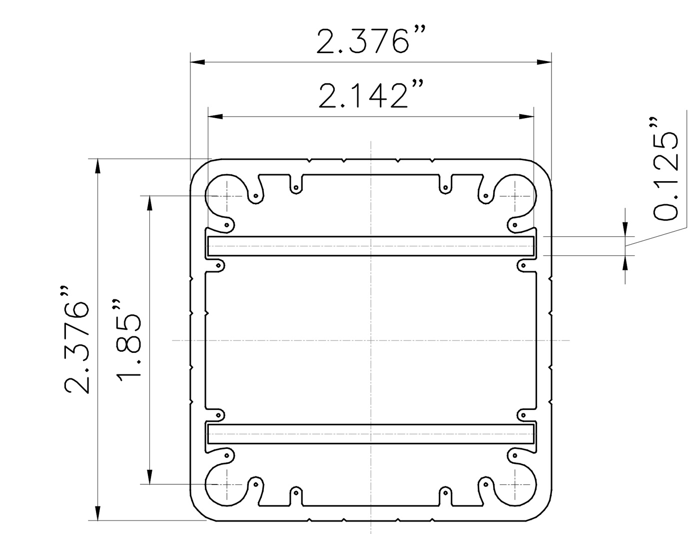
Scale: 1-1/2" : 1'-0"



TIMBER FRAME SHOULD BE DOUGLAS-FIR OR BETTER (MIN S.G = 0.5)

A FLUSH MOUNT FASCIA ATTACHMENT TO WOOD

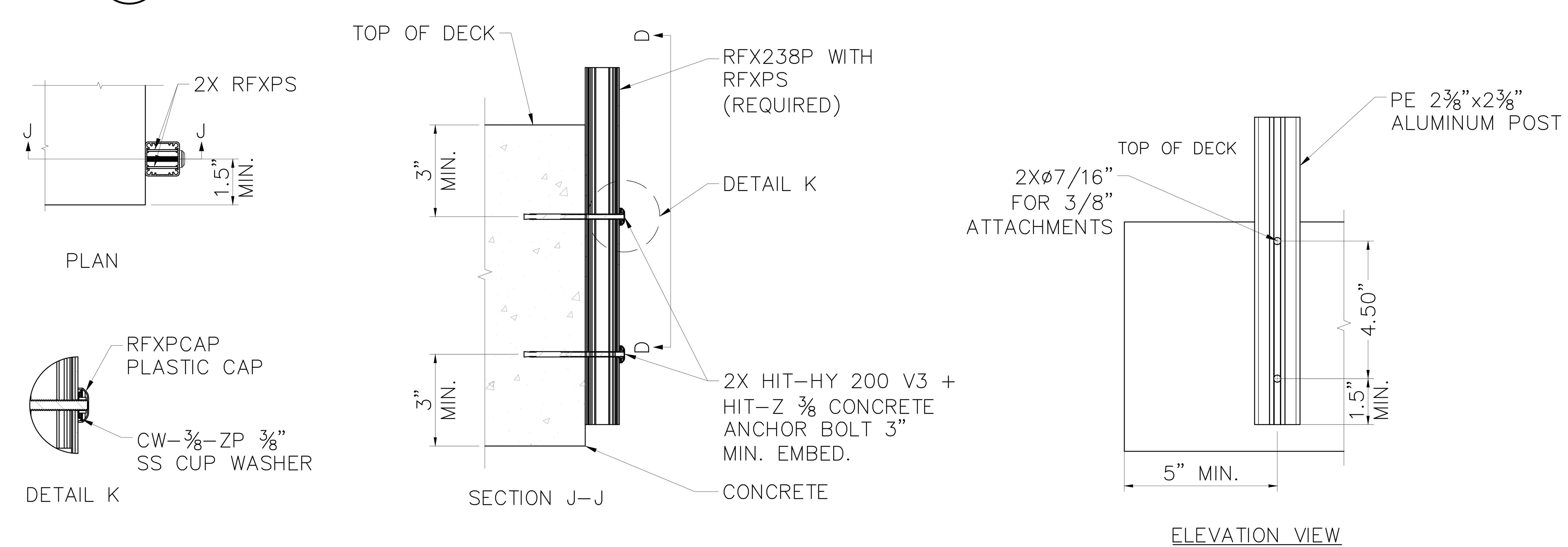
Scale: 4":1'-0"



RFX238P WITH RFXPS (STIFFINER)
HOLE MUST BE IN LINE WITH STIFFINER

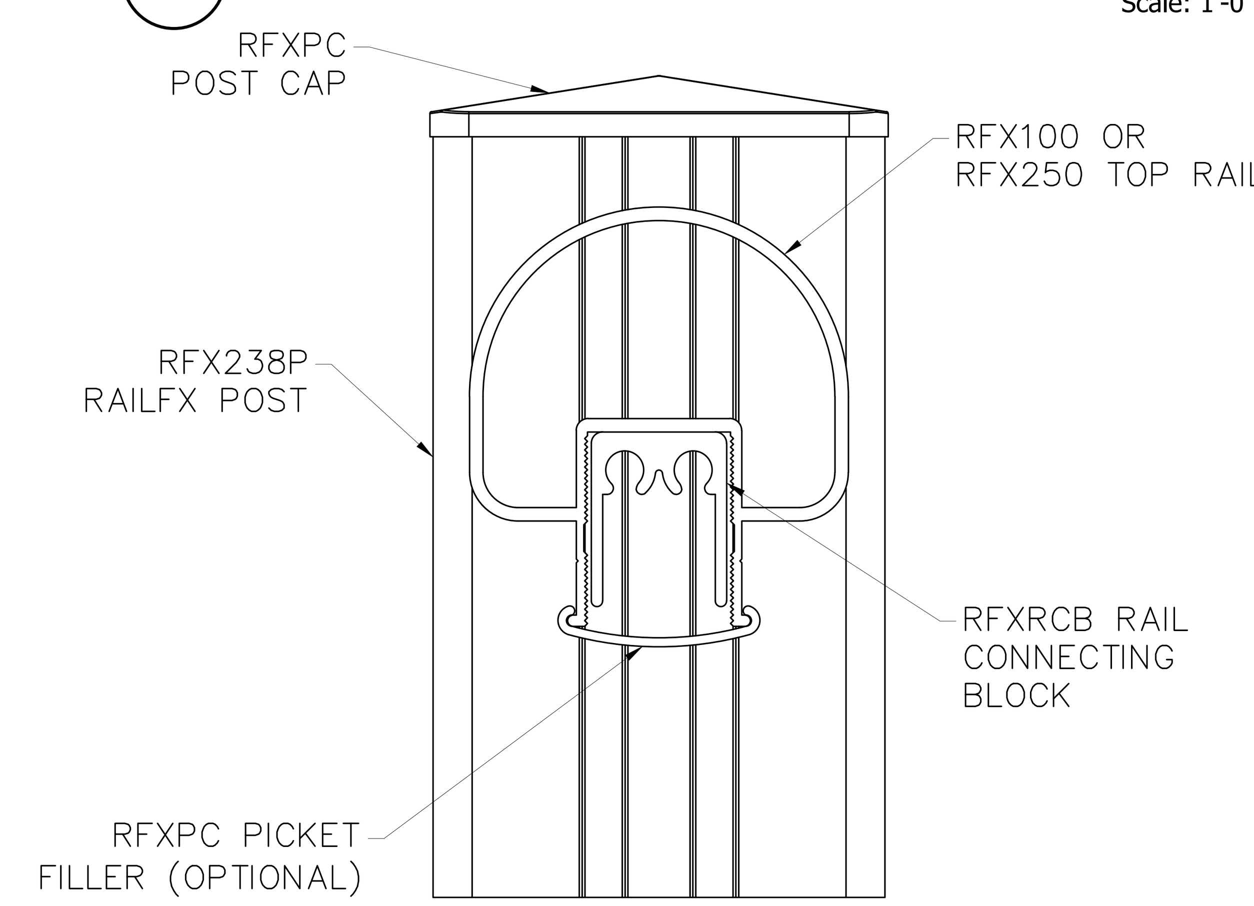
C PE-POST EXTRUSION PROFILE

Scale: 1'-0":1'-0"



B FLUSH MOUNT FASCIA ATTACHMENT TO CONCRETE

Scale: 4":1'-0"



D TOP RAIL PROFILE FOR SS CABLE INFILL

Scale: 1'-0":1'-0"

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Suite 600 Hayward, CA 94541
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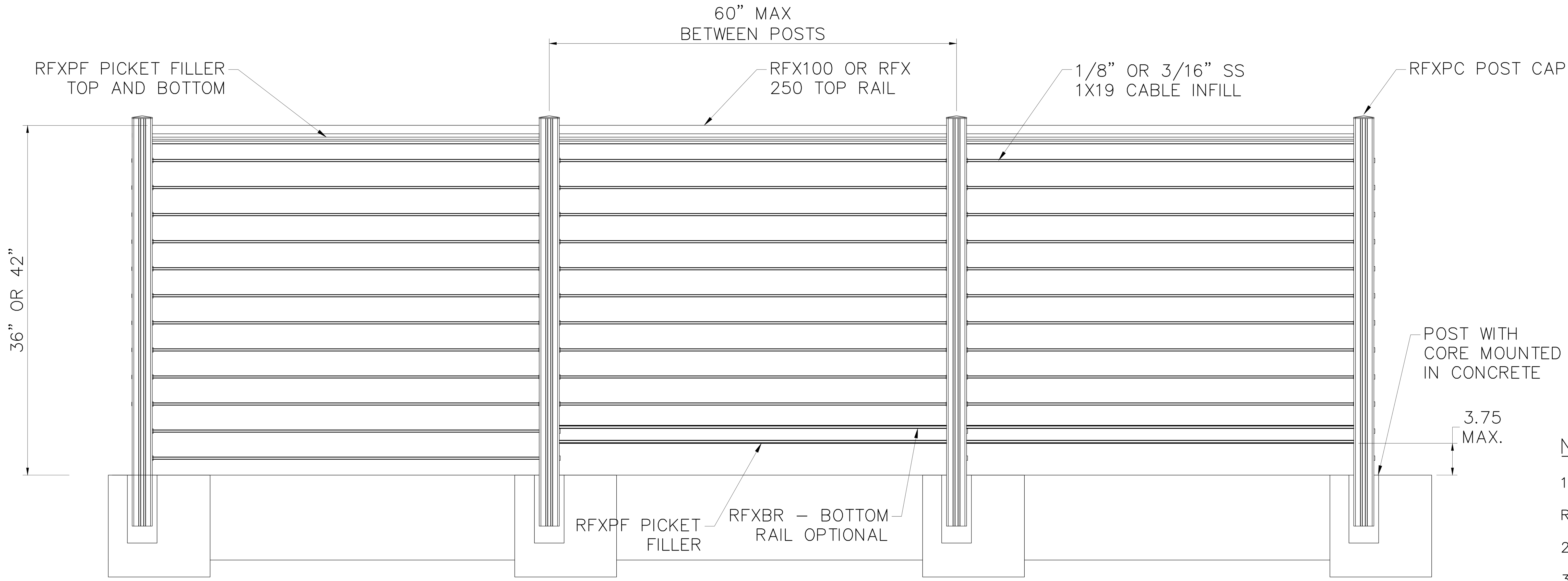
REGISTERED PROFESSIONAL ENGINEER HEMAL MODI C 78688 EXP. 09/30/2023 CIVIL STATE OF CALIFORNIA 22nd SEP. 2022

RFX 100 / RFX250 W/STAINLESS STEEL CABLE INFILL FLUSH FASCIA MOUNT

NATIONWIDE INDUSTRIES - 50 STATES

DATE: 09.22.2022
SCALE: AS SHOWN
DESIGN BY: HM
DRAWN BY: SSK
REVIEWED BY:SP
190417

S11.0

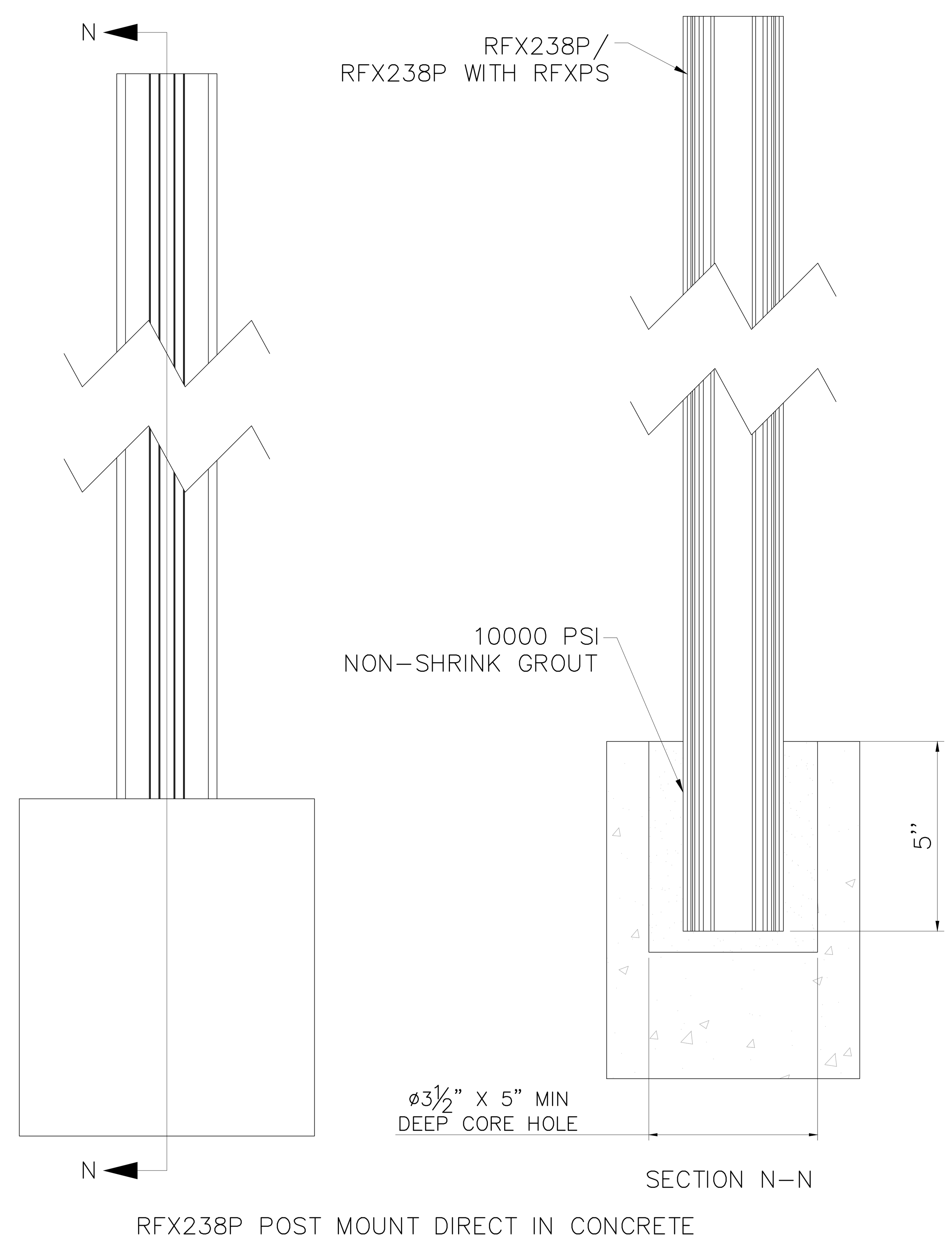


1 RFX 100 / RFX250 ALUMINUM RAIL W/STAINLESS STEEL CABLE INFILL CORE MOUNT

Scale: 1-1/2" : 1'-0"

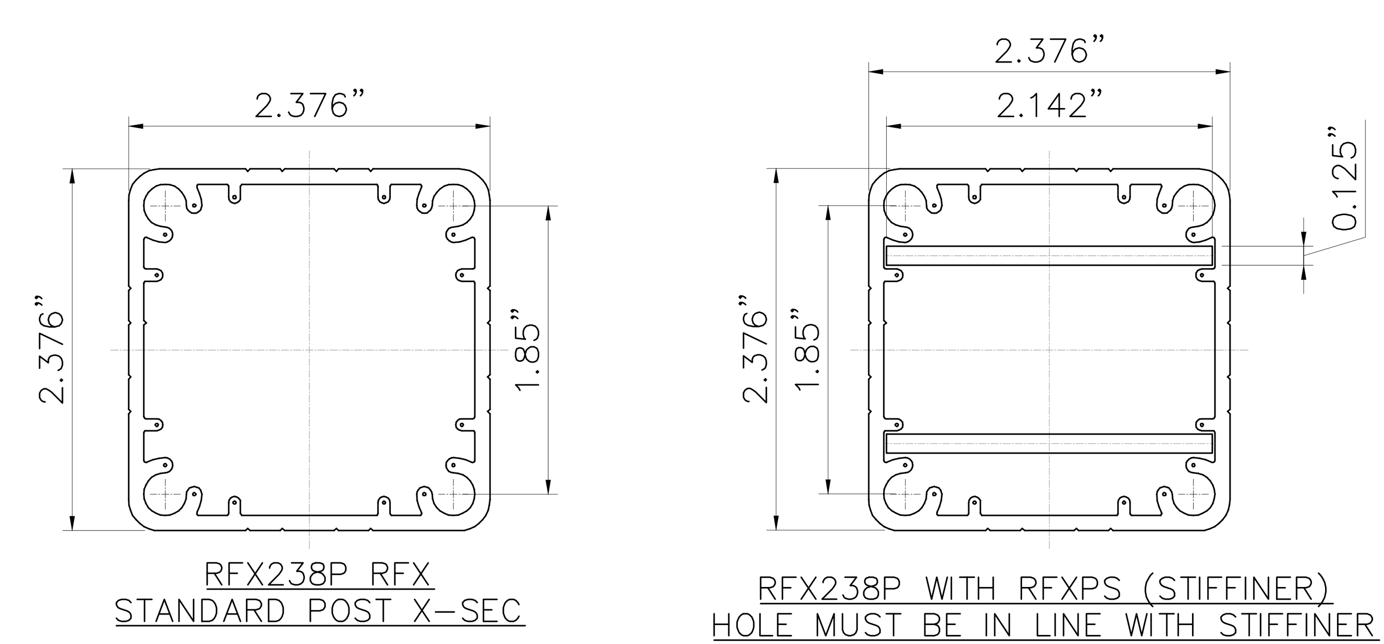
NOTES:

1. DESIGN CAPACITY CHECK OF EXISTING STRUCTURE THAT SUPPORTS THE RAILING IS NOT IN ZENITH SCOPE OF WORK.
2. RAILING IS DESIGNED FOR MAX SPEED OF 110MPH.
3. CABLE IN-FILL & TOP RAIL DESIGN IS NOT IN ZENITH SCOPE OF WORK.
4. POST SPACING OF 5' O.C REQUIRES RFS238P (POST) WITH RFXPS (STIFFENER).



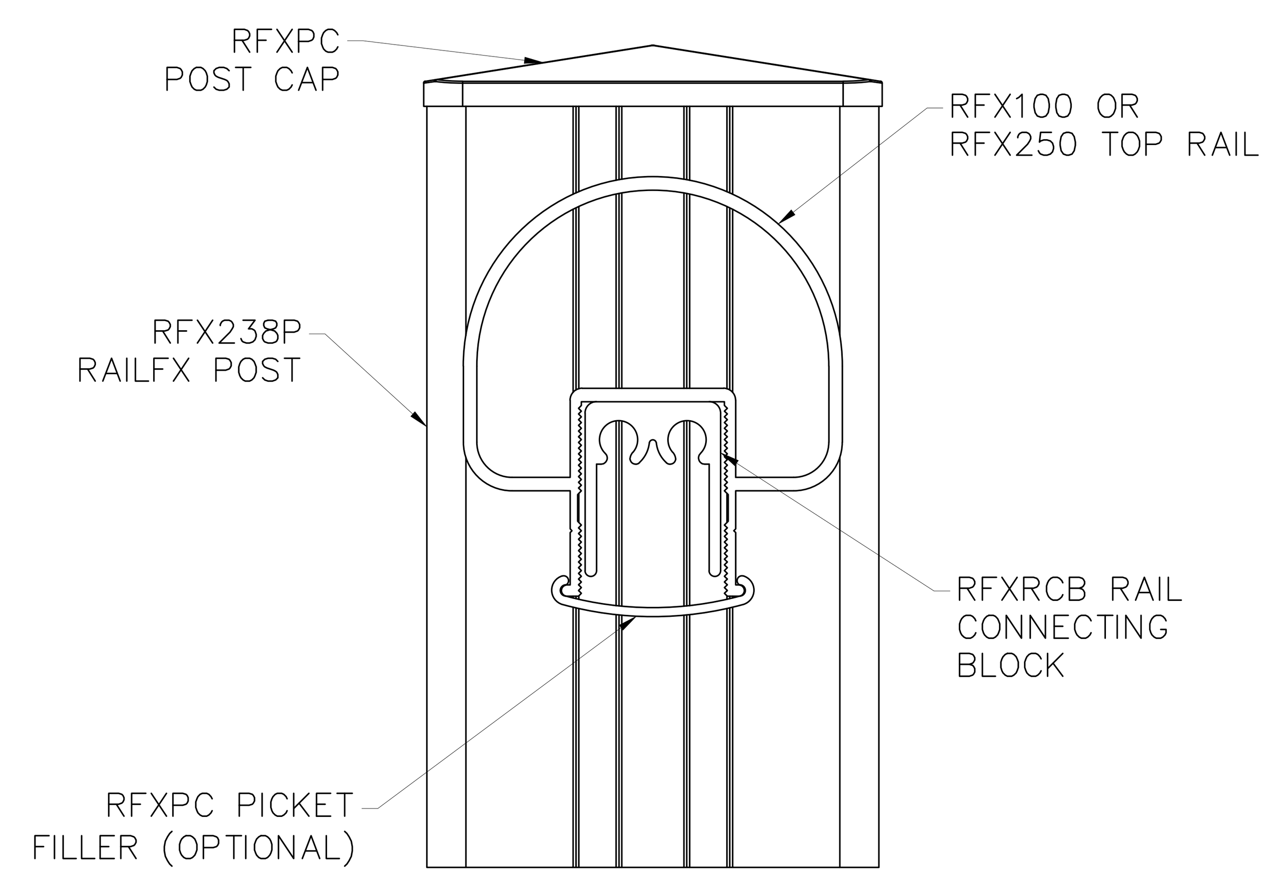
A DETAIL A - POST CORE MOUNTING ATTACHMENT DETAIL

Scale: 5":1'-0"



D PE-POST EXTRUSION PROFILE

Scale: 1'-0":1'-0"



C TOP RAIL PROFILE FOR SS CABLE INFILL

Scale: 1'-0":1'-0"

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REGISTERED PROFESSIONAL ENGINEER
HEMAL MODI
C 78688
EXP. 09/30/2023
CIVIL
STATE OF CALIFORNIA

RFX 100 / RFX250 W/STAINLESS STEEL CABLE INFILL
POST CORE MOUNT

NATIONWIDE INDUSTRIES - 50 STATES

DATE: 09.22.2022
SCALE: AS SHOWN
DESIGN BY: HM
DRAWN BY: SSK
REVIEWED BY:SP
190417

S12.0

190417 - RailFX Railing Design - Nationwide Industries
Design for all 50 states.

1. SCOPE OF WORK:

Zenith scope of work includes design of the post and its anchorage.
Member design checked based on ASCE 7-16 Section 4.5.1 & IBC 2021 Section 1607.9

2. DESIGN CHECK OF POST (WITHOUT STIFFENER) RFX238P RFX Standard Post

For one- and two-family dwellings, and for factory, industrial, and storage occupancies in areas that are not accessible to the public and that serve an occupant load not greater than 50:

Consider 200 pounds concentrated load for top rail or 20 pound per foot of uniform load for top rail.

$L_{outterlength\_RFX238P} := 2.376\ in$

$H_{post\_length} := 42\ in = 3.5\ ft$ $L_{panel\_length} := 48\ in = 4\ ft$ Consider 42"x4' Panel

$P_{post\_load\_1} := \max\left(200\ lbf, 20\ plf \cdot L_{panel\_length}\right) = 200\ lbf$ Consider 200 pounds concentrated load or 20 pound per foot of uniform load.

$M_{post\_flexure\_1} := \max\left(200\ lbf \cdot H_{post\_length}, 20\ plf \cdot L_{panel\_length} \cdot H_{post\_length}\right) = 8.4\ kip \cdot in$

$I_{post} := 0.9341\ in^4$ from AutoCAD

$y_c := 1.1877\ in$ from AutoCAD

$J := 0.9335\ in^4$ from AutoCAD

$S_{post} := \frac{I_{post}}{y_c} = 0.786\ in^3$

$L_b := H_{post\_length} = 42\ in$ $S_c := S_{post} = 0.786\ in^3$ $I_y := I_{post} = 0.93\ in^4$

$C_b := 1.0$ So, $S := \frac{2 \cdot L_b \cdot S_c}{C_b \cdot \sqrt{I_y \cdot J}} = 70.75$ while $S_1 := 95$

When $S < S_1$ (Aluminum Design Manual Table 2-20 for 6063-T5)

$\sigma_{bending\_aluminumallowable} := \left(17.5 - 0.917 \cdot \sqrt{S}\right) \cdot 1\ ksi = 9.79\ ksi$

$\sigma_{bendingpost\_1} := \frac{M_{post\_flexure\_1}}{S_c} = 10.68\ ksi$

$DCR_{post\_1} := \frac{\sigma_{bendingpost\_1}}{\sigma_{bending\_aluminumallowable}} = 1.09$ Acceptable.

Even though it is 9% overstressed it is okay by engineering judgment because this is conservative approach and load will be shared by other post due to frame action.

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Table A.3.4
MECHANICAL PROPERTIES FOR WROUGHT ALUMINUM PRODUCTS (Continued)

ALLOY	TEMPER	PRODUCT	THICKNESS in.	F_{tu} ksi	F_{ty} ksi	F_{cy} ksi	F_{su} ksi	E ksi
6005	-T5	Extrusions	up thru 1.000	38	35	35	24	10,100
6005A	-T61	Extrusions	up thru 1.000	38	35	35	24	10,100
6061	-T6, T651	Sheet & Plate	0.010 to 4.000	42	35	35	27	10,100
	-T6, T6510, T6511	Extrusions	All	38	35	35	24	10,100
	-T6, T651	Rod & Bar	up thru 8.000	42	35	35	25	10,100
	-T6	Drawn Tube	0.025 to 0.500	42	35	35	27	10,100
	-T6	Pipe	All	38	35	35	24	10,100
6063	-T5	Extrusions	up thru 0.500	22	16	16	13	10,100
	-T5	Extrusions	0.501 to 1.000	21	15	15	12	10,100
	-T52	Extrusions	up thru 1.000	22	16	16	13	10,100
	-T6	Extrusions & Pipe	All	30	25	25	19	10,100

Table 2-20
ALLOWABLE STRESSES FOR BUILDING-TYPE STRUCTURES (UNWELDED)

6063 – T5 **Extrusions (Up thru 0.500 in. thick)**
6063 – T52 **Extrusions (Up thru 1.000 in. thick)**

$F_{ty} = 16$ k/in^2 $E = 10{,}100$ k/in^2
$F_{cy} = 16$ k/in^2 $k_t = 1$
$F_{tu} = 22$ k/in^2

Allowable Stresses F/Ω (k/in^2)	**Section**	**F/Ω**
Axial Tension		
axial tension stress on net effective area	D.2b	11.3
axial tension stress on gross area	D.2a	9.7

		Tension	**Compression**
Flexure			
elements in uniform stress	F.8.1.1	9.7	see B.5.4.1 thru B.5.4.5 and E.4.2
elements in flexure	F.8.1.2, F.4.1	12.6	12.6 see also F.4.2
round tubes	F.6.1	11.3	11.3 see also F.6.2
rods	F.7	12.6	12.6

Bearing		
bolts or rivets on holes	J.3.7a, J.4.7	22.6
bolts on slots, pins on holes, flat surfaces	J.3.7b, J.7	15.0

		Slenderness S	**F/Ω for $S \le S_1$**	**S_1**	**F/Ω for $S_1 < S < S_2$**	**S_2**	**F/Ω for $S \ge S_2$**
Axial Compression							
all shapes member buckling	E.3	kL/r			$8.9 - 0.037\ S$	99	$51{,}352\ /S^2$
Flexural Compression							
open shapes lateral-torsional buckling	F.2.1	$L_b/(r_{ye}C_b^{1/2})$			$10.5 - 0.036\ S$	119	$86{,}996\ /S^2$
closed shapes lateral-torsional buckling	F.3.1	$2L_bS_c/(C_b(I_yJ)^{1/2})$			$10.5 - 0.070\ S^{1/2}$	3823	$23{,}599\ /S$
rectangular bars lateral-torsional buckling	F.4.2	$(d/t)(L_b/(C_bd))^{1/2}$			$17.2 - 0.256\ S$	45	$11{,}420\ /S^2$
round tubes local buckling	F.6.2	R_b/t	$17.5 - 0.917\ S^{1/2}$	95	$11.6 - 0.320\ S^{1/2}$	275	$3{,}776\ /[S(1+S^{1/2}/35)^2]$
Elements—Uniform Compression							
flat elements supported on one edge in columns whose buckling axis is not an axis of symmetry	B.5.4.1	b/t	9.7	8.2	$11.8 - 0.260\ S$	19	$2{,}417\ /S^2$
flat elements supported on one edge in all other columns and all beams	B.5.4.1	b/t	9.7	8.2	$11.8 - 0.260\ S$	15.9	$122\ /S$
flat elements supported on both edges	B.5.4.2	b/t	9.7	25.6	$11.8 - 0.083\ S$	50	$382\ /S$
flat elements supported on both edges and with an intermediate stiffener	B.5.4.4	λ_s	9.7	18.8	$10.5 - 0.044\ S$	99	$60{,}414\ /S^2$
curved elements supported on both edges	B.5.4.5	R_b/t	9.7	36.7	$11.6 - 0.320\ S^{1/2}$	275	$3{,}776\ /[S(1+S^{1/2}/35)^2]$
flat elements—alternate method	B.5.4.6	λ_{eq}	9.7	41.0	$11.8 - 0.052\ S$	80	$611\ /S$
Elements—Flexural Compression							
flat elements supported on both edges	B.5.5.1	b/t	12.6	62.9	$17.2 - 0.072\ S$	119	$1{,}017\ /S$
flat elements supported on tension edge, compression edge free	B.5.5.2	b/t	12.6	11.7	$17.2 - 0.389\ S$	29	$4{,}932\ /S^2$
flat elements supported on both edges and with a longitudinal stiffener	B.5.5.3	b/t	12.6	141.1	$17.2 - 0.032\ S$	266	$2{,}280\ /S$
flat elements—alternate method	B.5.5.4	λ_{eq}	12.6	40.9	$17.2 - 0.111\ S$	77	$661\ /S$
Elements—Shear							
flat elements supported on both edges	G.2	b/t	5.8	43.6	$7.2 - 0.031\ S$	96	$38{,}665\ /S^2$

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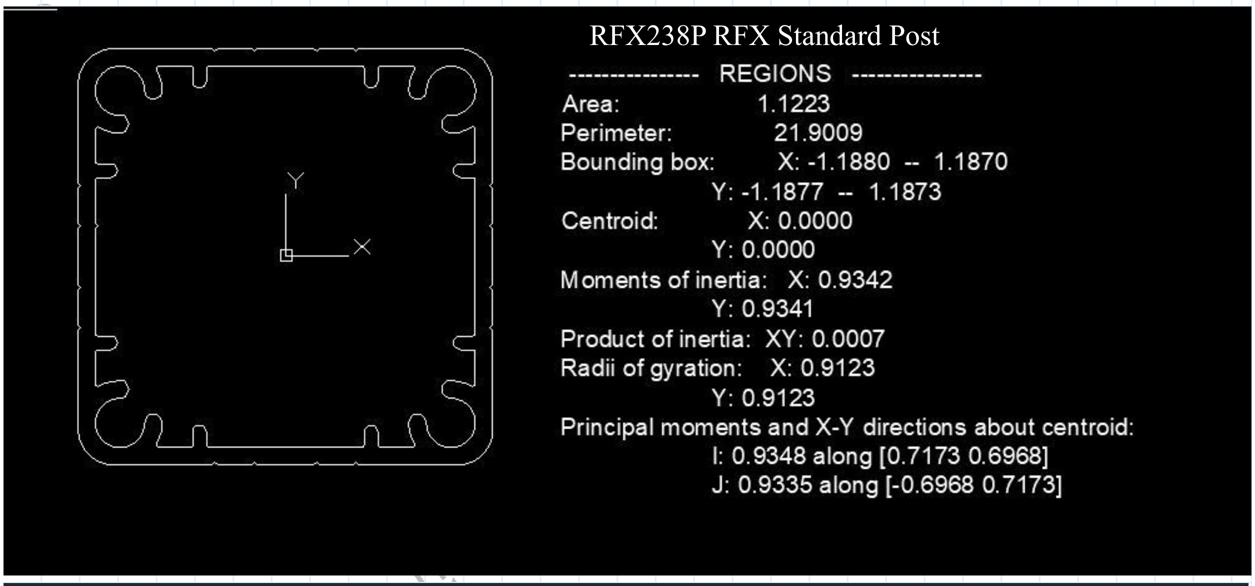

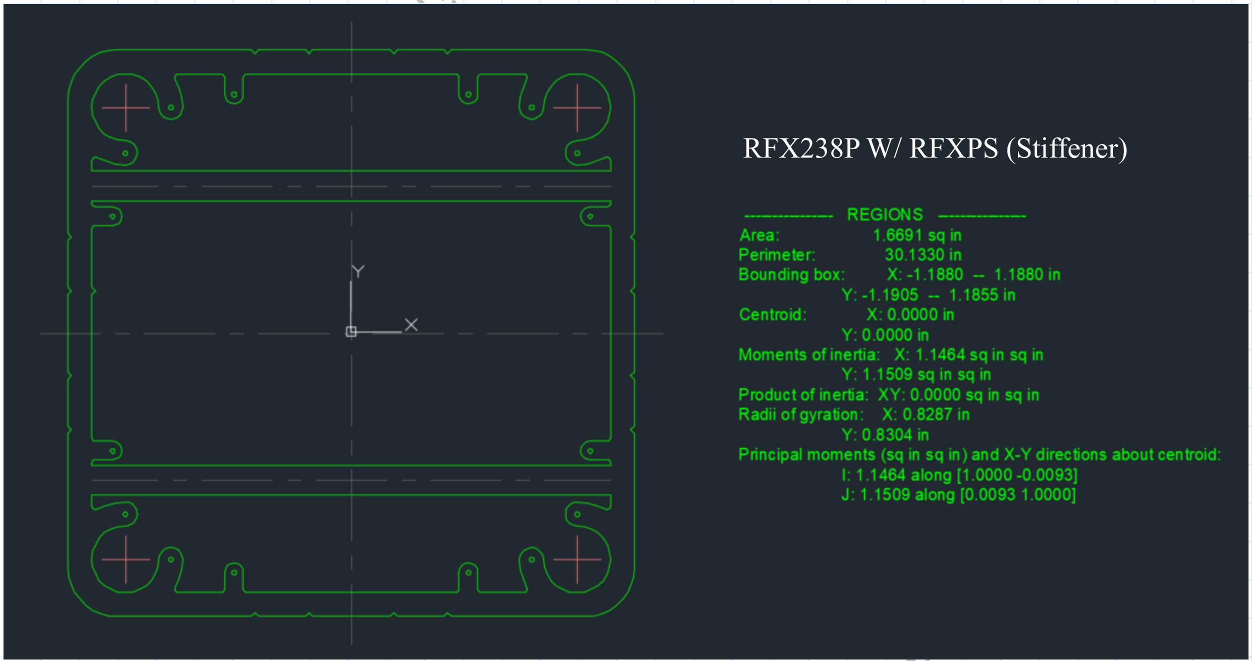

3. DESIGN CHECK OF POST (WITH STIFFENER)

RFX238P W/ RFXPS (Stiffener)

For commercial use or occupancies that are accessible to the public and area that serve an occupant load greater than 50:

Consider 200 pounds concentrated load for top rail or 50 pound per foot of uniform load for top rail.

$H_{post\_length} := 42\ in = 3.5\ ft$ $\qquad L_{panel\_length} := 60\ in = 5\ ft$ $\qquad$ Consider 42"x5' Panel

$P_{post\_load\_2} := \max(200\ lbf, 50\ plf \cdot L_{panel\_length}) = 250\ lbf$ Consider 200 pounds concentrated load or 50 pound per foot of uniform load.

$M_{post\_flexure\_2} := \max(200\ lbf \cdot H_{post\_length}, 50\ plf \cdot L_{panel\_length} \cdot H_{post\_length}) = 10.5\ kip \cdot in$

$I_{post} := 1.1464\ in^4$ from AutoCAD

$y_c := 0.8304\ in$ from AutoCAD

$J := 1.1509\ in^4$ from AutoCAD

$S_{post} := \frac{I_{post}}{y_c} = 1.381\ in^3$

$L_b := H_{post\_length} = 42\ in$ $S_c := S_{post} = 1.381\ in^3$ $I_y := I_{post} = 1.15\ in^4$

$C_b := 1.0$ So, $S := \frac{2 \cdot L_b \cdot S_c}{C_b \cdot \sqrt{I_y \cdot J}} = 100.96$ while $S_1 := 95$

When $S_1 < S$ (Aluminum Design Manual Table 2-20 for 6063-T5)

$\sigma_{bending\_aluminumallowable} := (10.5 - 0.07 \cdot \sqrt{S}) \cdot 1\ ksi = 9.8\ ksi$

$\sigma_{bendingpost\_2} := \frac{M_{post\_flexure\_2}}{S_c} = 7.61\ ksi$

$DCR_{post\_2} := \frac{\sigma_{bendingpost\_2}}{\sigma_{bending\_aluminumallowable}} = 0.78$ Acceptable.

NOTE:

All RFX238P Post connections are checked for 250 lb live load and similar design is applicable to PFX1000P post (3"x3" Tube Post) with PFX1000PB post base, under IRC residential one or two family dwellings limitations.

For glass panels with 4' max panel length, the ASD wind load doesn't govern unless it exceeds 35.5 psf

P = 35.5 psf * [(42"/2)/12] * 4 ft = 248.5 lb

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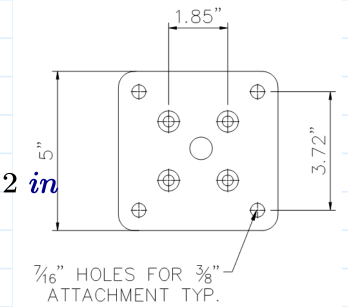
4. CONNECTION OF RFX238P POST TO RFXBP5X5 PLATE



Mounted on top of Slab / Stair

$d_{screw\_dia} := \frac{5}{16}\ in$ $\quad spacing_{screw} := 1.85\ in$ $\quad screw_{length} := 2\ in$

$A_{root\_area} := 0.685 \cdot \left(\frac{\pi}{4} \cdot d_{screw\_dia}^{\ 2}\right) = 0.0525\ in^2$

$\Omega_{screw} := 2$ $\quad \Omega_{ADM} := 3$ Strength reduction factors

$F_{u\_SS304\_316} := 75\ ksi$ $\quad F_{y\_SS304\_316} := 30\ ksi$ $\quad F_{t\_SS304\_316} := 30\ ksi$ $\quad F_{v\_SS304\_316} := 15\ ksi$

$F_{u\_SS410} := 115\ ksi$ $\quad F_{y\_SS410} := 85\ ksi$

Consider 410 hardened stainless steel screws
Unhardened 410 has values similar to 304/316

$F_{t\_SS410} := min\left(F_{y\_SS410}, 0.75\ F_{u\_SS410}\right) = 85\ ksi$

$F_{v\_SS410} := min\left(\frac{0.6\ F_{u\_SS410}}{3}, 0.6\ F_{t\_SS410}\right) = 23\ ksi$

$P_{live\_load} := \max\left(P_{post\_load\_1}, P_{post\_load\_2}\right) = 250\ lbf$

$M_{overturning\_design} := \max\left(M_{post\_flexure\_1}, M_{post\_flexure\_2}\right) = 10.5\ kip \cdot in$

$Tension_{per\_screw} := \frac{M_{overturning\_design}}{2 \cdot spacing_{screw}} = 2.838\ kip$

$Shear_{per\_screw} := \frac{P_{live\_load}}{4} = 0.063\ kip$

$R_{allowable\_shear} := \frac{F_{v\_SS410} \cdot A_{root\_area}}{\Omega_{screw}} = 0.6\ kip$

$R_{n\_tension} := F_{u\_SS410} \cdot A_{root\_area} = 6.04\ kip$ Based on ultimate tensile capacity

For screw into screw slot in posts per ADM J5.5.1.2:

$R_{n\_withdrawal} := 0.29 \cdot d_{screw\_dia} \cdot \left(screw_{length} - 0.5\ in\right) \cdot F_{t\_SS410} = 11.55\ kip$

$R_{allowable\_tension} := min\left(\frac{R_{n\_tension}}{\Omega_{screw}}, \frac{R_{n\_withdrawal}}{\Omega_{ADM}}\right) = 3.02\ kip$

$DCR_{T\_screw} := \frac{Tension_{per\_screw}}{R_{allowable\_tension}} = 0.94$ $\quad DCR_{V\_screw} := \frac{Shear_{per\_screw}}{R_{allowable\_shear}} = 0.1$

$DCR_{screw} := DCR_{T\_screw}^{\ \frac{5}{3}} + DCR_{V\_screw}^{\ \frac{5}{3}} = 0.92$ Ok to use 5/16 screws

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5. CONCRETE ANCHOR CONNECTION FOR RFX238P POST

CASE 1: Mounted on top of concrete slab / concrete stair

Base Plate Anchorage design for Concrete Connection

$V_{reaction} := P_{live\_load} = 250\ lbf$

$M_{overturning\_design} = 10.5\ kip \cdot in$

See attached HILTI calcs for anchorage design assuming minimum concrete thickness of 6 inches. It is okay to use HIT-HY 200 + HIT-Z 3/8 anchors with minimum embedment depth of 2.75 in and minimum edge distance of 5".

CASE 2: Flush Fascia Mounted in concrete

$l_{anchrage\_leverarm} := 4.5\ in$

CASE 2a - For load perpendicular to the fascia

$T_{tension\_pure} := P_{live\_load} = 250\ lbf$

$M_{overturning\_design} = 10500\ lbf \cdot in$

CASE 2b - For load vertically down

$V_{shear\_pure} := P_{live\_load} = 250\ lbf$

Case 2a governs

Flush fascia mounted will govern the anchorage design as it has single rows of bolts, same design is applicable for offset fascia mounted.

See attached HILTI calcs for anchorage design assuming minimum concrete thickness of 6 inches. It is okay to use HIT-HY 200 + HIT-Z 3/8 anchors with minimum embedment depth of 2.75 in and minimum edge distance of 5".

Note: Same design is applicable for offset fascia mounted connection to concrete.

CASE 3: Core mounted in concrete

$S_1 := 2500\ psi$ $\quad P := P_{live\_load} = 250\ lbf$ $\quad h := H_{post\_length} = 3.5\ ft$

$b := \sqrt{2}\ L_{outterlength\_RFX238P} = 3.36\ in$ $\quad$ per 2018 IBC section 1807.3

$A := \frac{2.34 \cdot P}{S_1 \cdot b} = 0.07\ in$ $\quad d := 0.5 \cdot A \cdot \left(1 + \sqrt{\left(1 + \frac{4.36 \cdot h}{A}\right)}\right) = 1.82\ in$

So provide min. 3" embedment.

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Address:	22320 Foothill Blvd, Suite 600, Hayward, CA 94541	Specifier:	
Phone I Fax:	415 619 6000 | 415 500 9583	E-Mail:	irina@zenithengineers.com
Design:	Concrete Mounted - BP3x5	Date:	9/5/2022
Fastening point:	RFXBP3x5 post base for RFC238P		

Specifier's comments: Install per manufacturer's recommendations

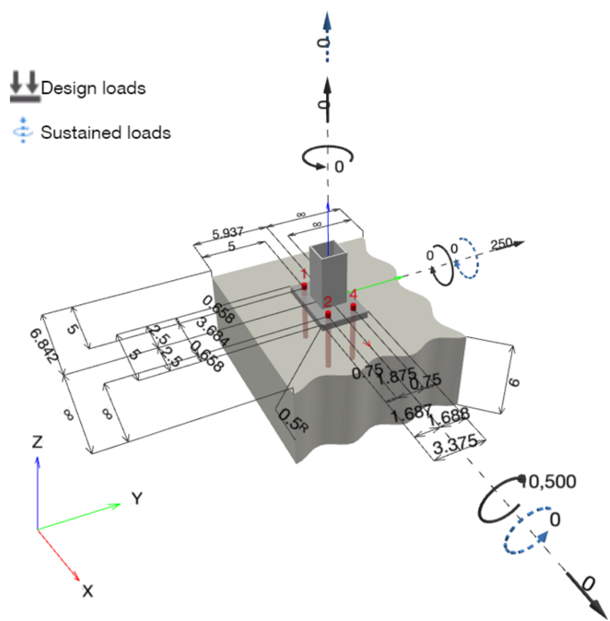
1 Input data

Anchor type and diameter:	**HIT-HY 200 V3 + HIT-Z-R 3/8**
Item number:	2018452 HIT-Z-R 3/8" x 5 1/8" (element) / 2334276 HIT-HY 200-R V3 (adhesive)
Effective embedment depth:	$h_{ef,act}$ = 3.750 in. ($h_{ef,limit}$ = - in.)
Material:	A4
Evaluation Service Report:	ESR-4868
Issued I Valid:	11/1/2021 | 11/1/2022
Proof:	Design Method ACI 318-19 / Chem
Stand-off installation:	e_b = 0.000 in. (no stand-off); t = 0.500 in.
Anchor plate[R] :	l_x x l_y x t = 5.000 in. x 3.375 in. x 0.500 in.;
Profile:	Square HSS (AISC), ; (L x W x T) = 1.850 in. x 1.850 in. x 0.100 in.
Base material:	cracked concrete, 2500, f_c' = 2,500 psi; h = 6.000 in., Temp. short/long: 32/32 °F
Installation:	**hammer drilled hole, Installation condition: Dry**
Reinforcement:	tension: not present, shear: not present; no supplemental splitting reinforcement present
	edge reinforcement: none or < No. 4 bar

Zenith Notes:
1. Depth of concrete shall not be less than 6".
2. Edge distance of concrete from center of anchor bolt shall not be less than 5" on all sides.
3. Minimum compressive strength of concrete shall not be less than 2,500psi.

[R] - The anchor calculation is based on a rigid anchor plate assumption.

Geometry [in.] & Loading [lb, in.lb]



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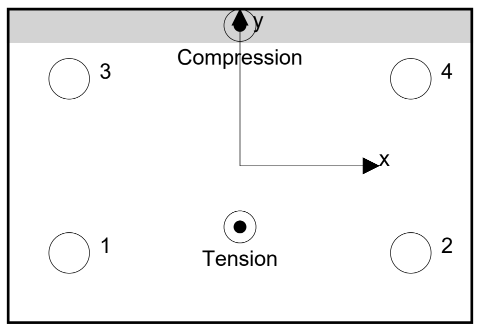
Design:	Concrete Mounted - BP3x5	Date:	9/5/2022
Fastening point:	RFXBP3x5 post base for RFC238P		

1.1 Load combination and design results

Case	Description	Forces [lb] / Moments [in.lb]	Seismic	Max. Util. Anchor [%]
1	Outward	$N = 0; V_x = 0; V_y = -250;$ $M_x = 10{,}500; M_y = 0; M_z = 0;$ $N_{sus} = 0; M_{x,sus} = 0; M_{y,sus} = 0;$	no	99
2	Inward	$N = 0; V_x = 0; V_y = 250;$ $M_x = -10{,}500; M_y = 0; M_z = 0;$ $N_{sus} = 0; M_{x,sus} = 0; M_{y,sus} = 0;$	no	99

2 Load case/Resulting anchor forces

Controlling load case: 2 Inward



Anchor reactions [lb]

Tension force: (+Tension, -Compression)

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	2,058	63	0	63
2	2,058	63	0	63
3	362	63	0	63
4	362	63	0	63

max. concrete compressive strain:	0.14 [‰]
max. concrete compressive stress:	2,762 [psi]
resulting tension force in (x/y)=(0.000/-0.657):	4,840 [lb]
resulting compression force in (x/y)=(0.000/1.512):	4,840 [lb]

Anchor forces are calculated based on the assumption of a rigid anchor plate.

3 Tension load

	Load N_{ua} [lb]	Capacity ϕ N_n [lb]	Utilization $\beta_N = N_{ua}/\phi$ N_n	Status
Steel Strength*	2,058	4,749	44	OK
Pullout Strength*	2,058	5,169	40	OK
Sustained Tension Load Bond Strength*	N/A	N/A	N/A	N/A
Concrete Breakout Failure**	4,840	4,908	99	OK

* highest loaded anchor **anchor group (anchors in tension)

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Phone I Fax:	415 619 6000 | 415 500 9583	E-Mail:	irina@zenithengineers.com
Design:	Concrete Mounted - BP3x5	Date:	9/5/2022
Fastening point:	RFXBP3x5 post base for RFC238P		

3.1 Steel Strength

N_{sa} = ESR value refer to ICC-ES ESR-4868

$\phi\ N_{sa} \geq N_{ua}$ ACI 318-19 Table 17.5.2

Variables

$A_{se,N}$ [in.^{2}]	f_{uta} [psi]
0.08	94,200

Calculations

N_{sa} [lb]
7,306

Results

N_{sa} [lb]	ϕ_{steel}	$\phi\ N_{sa}$ [lb]	N_{ua} [lb]
7,306	0.650	4,749	2,058

3.2 Pullout Strength

$N_{pn} = N_p\ \lambda_a$ refer to ICC-ES ESR-4868

$\phi\ N_{pn} \geq N_{ua}$ ACI 318-19 Table 17.5.2

Variables

λ_a	N_p [lb]
1.000	7,952

Calculations

N_{pn} [lb]
7,952

Results

N_{pn} [lb]	$\phi_{concrete}$	$\phi\ N_{pn}$ [lb]	N_{ua} [lb]
7,952	0.650	5,169	2,058

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Design:	Concrete Mounted - BP3x5	Date:	9/5/2022
Fastening point:	RFXBP3x5 post base for RFC238P		

3.3 Concrete Breakout Failure

$N_{cbg} = \left(\frac{A_{Nc}}{A_{Nc0}}\right) \psi_{ec,N} \psi_{ed,N} \psi_{c,N} \psi_{cp,N} N_b$ ACI 318-19 Eq. (17.6.2.1b)

$\phi N_{cbg} \geq N_{ua}$ ACI 318-19 Table 17.5.2

A_{Nc} see ACI 318-19, Section 17.6.2.1, Fig. R 17.6.2.1(b)

$A_{Nc0} = 9 h_{ef}^2$ ACI 318-19 Eq. (17.6.2.1.4)

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2 e_N'}{3 h_{ef}}}\right) \leq 1.0$ ACI 318-19 Eq. (17.6.2.3.1)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5h_{ef}}\right) \leq 1.0$ ACI 318-19 Eq. (17.6.2.4.1b)

$\psi_{cp,N} = \text{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}}\right) \leq 1.0$ ACI 318-19 Eq. (17.6.2.6.1b)

$N_b = k_c \lambda_a \sqrt{f_c'} h_{ef}^{1.5}$ ACI 318-19 Eq. (17.6.2.2.1)

Variables

h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]	$\psi_{c,N}$
3.750	0.000	0.657	5.000	1.000

c_{ac} [in.]	k_c	λ_a	f_c' [psi]
11.250	17	1.000	2,500

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
178.86	126.56	1.000	0.895	0.967	1.000	6,173

Results

N_{cbg} [lb]	$\phi_{concrete}$	ϕN_{cbg} [lb]	N_{ua} [lb]
7,550	0.650	4,908	4,840

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4 Shear load

	Load V_{ua} [lb]	Capacity ϕ V_n [lb]	Utilization $\beta_V = V_{ua}/\phi\ V_n$	Status
Steel Strength*	63	2,630	3	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength (Concrete Breakout Strength controls)**	250	11,806	3	OK
Concrete edge failure in direction x-**	250	4,359	6	OK

* highest loaded anchor **anchor group (relevant anchors)

4.1 Steel Strength

V_{sa} = ESR value refer to ICC-ES ESR-4868

$\phi\ V_{steel} \geq V_{ua}$ ACI 318-19 Table 17.5.2

Variables

$A_{se,V}$ [in.^{2}]	f_{uta} [psi]
0.08	94,200

Calculations

V_{sa} [lb]
4,384

Results

V_{sa} [lb]	ϕ_{steel}	$\phi\ V_{sa}$ [lb]	V_{ua} [lb]
4,384	0.600	2,630	63

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4.2 Pryout Strength (Concrete Breakout Strength controls)

$V_{cpg} = k_{cp} \left[\left(\frac{A_{Nc}}{A_{Nc0}} \right) \psi_{ec,N}\ \psi_{ed,N}\ \psi_{c,N}\ \psi_{cp,N}\ N_b \right]$ ACI 318-19 Eq. (17.7.3.1b)

$\phi\ V_{cpg} \geq V_{ua}$ ACI 318-19 Table 17.5.2

A_{Nc} see ACI 318-19, Section 17.6.2.1, Fig. R 17.6.2.1(b)

$A_{Nc0} = 9\ h_{ef}^2$ ACI 318-19 Eq. (17.6.2.1.4)

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2\ e_N'}{3\ h_{ef}}} \right) \leq 1.0$ ACI 318-19 Eq. (17.6.2.3.1)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5 h_{ef}} \right) \leq 1.0$ ACI 318-19 Eq. (17.6.2.4.1b)

$\psi_{cp,N} = \text{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5 h_{ef}}{c_{ac}} \right) \leq 1.0$ ACI 318-19 Eq. (17.6.2.6.1b)

$N_b = k_c\ \lambda_a\ \sqrt{f_c'}\ h_{ef}^{1.5}$ ACI 318-19 Eq. (17.6.2.2.1)

Variables

k_{cp}	h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]
2	3.750	0.000	0.000	5.000

$\psi_{c,N}$	c_{ac} [in.]	k_c	λ_a	f_c' [psi]
1.000	11.250	17	1.000	2,500

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
178.86	126.56	1.000	1.000	0.967	1.000	6,173

Results

V_{cpg} [lb]	$\phi_{concrete}$	$\phi\ V_{cpg}$ [lb]	V_{ua} [lb]
16,865	0.700	11,806	250

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4.3 Concrete edge failure in direction x-

$V_{cbg} = \left(\frac{A_{Vc}}{A_{Vc0}}\right) \psi_{ec,V}\ \psi_{ed,V}\ \psi_{c,V}\ \psi_{h,V}\ \psi_{parallel,V}\ V_b$ ACI 318-19 Eq. (17.7.2.1b)

$\phi\ V_{cbg} \geq V_{ua}$ ACI 318-19 Table 17.5.2

A_{Vc} see ACI 318-19, Section 17.7.2.1, Fig. R 17.7.2.1(b)

$A_{Vc0} = 4.5\ c_{a1}^2$ ACI 318-19 Eq. (17.7.2.1.3)

$\psi_{ec,V} = \left(\frac{1}{1 + \frac{e_V'}{1.5c_{a1}}}\right) \leq 1.0$ ACI 318-19 Eq. (17.7.2.3.1)

$\psi_{ed,V} = 0.7 + 0.3\left(\frac{c_{a2}}{1.5c_{a1}}\right) \leq 1.0$ ACI 318-19 Eq. (17.7.2.4.1b)

$\psi_{h,V} = \sqrt{\frac{1.5c_{a1}}{h_a}} \geq 1.0$ ACI 318-19 Eq. (17.7.2.6.1)

$V_b = \left(7\left(\frac{l_e}{d_a}\right)^{0.2} \sqrt{d_a}\right) \lambda_a \sqrt{f_c'}\ c_{a1}^{1.5}$ ACI 318-19 Eq. (17.7.2.2.1a)

Variables

c_{a1} [in.]	c_{a2} [in.]	e_{cV} [in.]	$\psi_{c,V}$	h_a [in.]
5.000	5.000	0.000	1.000	6.000

l_e [in.]	λ_a	d_a [in.]	f_c' [psi]	$\psi_{parallel,V}$
3.000	1.000	0.375	2,500	2.000

Calculations

A_{Vc} [in.^{2}]	A_{Vc0} [in.^{2}]	$\psi_{ec,V}$	$\psi_{ed,V}$	$\psi_{h,V}$	V_b [lb]
86.25	112.50	1.000	1.000	1.118	3,632

Results

V_{cbg} [lb]	$\phi_{concrete}$	$\phi\ V_{cbg}$ [lb]	V_{ua} [lb]
6,227	0.700	4,359	250

5 Combined tension and shear loads, per ACI 318-19 section 17.8

β_N	β_V	ζ	Utilization $\beta_{N,V}$ [%]	Status
0.986	0.057	1.000	87	OK

$\beta_{NV} = (\beta_N + \beta_V) / 1.2 <= 1$

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6 Warnings

- The anchor design methods in PROFIS Engineering require rigid anchor plates per current regulations (AS 5216:2021, ETAG 001/Annex C, EOTA TR029 etc.). This means load re-distribution on the anchors due to elastic deformations of the anchor plate are not considered - the anchor plate is assumed to be sufficiently stiff, in order not to be deformed when subjected to the design loading. PROFIS Engineering calculates the minimum required anchor plate thickness with CBFEM to limit the stress of the anchor plate based on the assumptions explained above. The proof if the rigid anchor plate assumption is valid is not carried out by PROFIS Engineering. Input data and results must be checked for agreement with the existing conditions and for plausibility!
- User is responsible for evaluating the hole bearing capacity in case of shear forces.
- Condition A applies where the potential concrete failure surfaces are crossed by supplementary reinforcement proportioned to tie the potential concrete failure prism into the structural member. Condition B applies where such supplementary reinforcement is not provided, or where pullout or pryout strength governs.
- Design Strengths of adhesive anchor systems are influenced by the cleaning method. Refer to the INSTRUCTIONS FOR USE given in the Evaluation Service Report for cleaning and installation instructions.
- For additional information about ACI 318 strength design provisions, please go to https://submittals.us.hilti.com/PROFISAnchorDesignGuide/
- Installation of Hilti adhesive anchor systems shall be performed by personnel trained to install Hilti adhesive anchors. Reference ACI 318-19, Section 26.7.

Fastening meets the design criteria!

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7 Anchor plate and concrete bearing stress check

	Load	Capacity	Utilization [%]	Status
Concentric Compression	N/A	N/A	N/A	N/A
Concrete bearing	2,762 [psi]	2,762 [psi]	100	OK
Tension Interface	1,174.84 [in.lb/in.]	2,025.00 [in.lb/in.]	59	OK
Uniaxial Moment (Strong Axis)	556.37 [in.lb/in.]	2,025.00 [in.lb/in.]	28	OK
Uniaxial Moment (Weak Axis)	1,416.20 [in.lb/in.]	2,025.00 [in.lb/in.]	70	OK

7.1 Concrete bearing check (per AISC DG1, section 3.1.1)

$A_1 = B \cdot N$

$A_2 = L \cdot W$

$f_{pu(max)} = \phi \left(0.85f'_c \sqrt{\frac{A_2}{A_1}}\right), \sqrt{\frac{A_2}{A_1}} \leq 2$

$f_{pu} = f_{pu(max)}$

Variables

B [in.]	N [in.]	L [in.]	W [in.]
3.375	5.000	13.684	9.237

f_c' [psi]	ϕ	P_u [lb]	M_u [in.lb]
2,500	0.650	0	0

Calculations

A_1 [in.^{2}]	A_2 [in.^{2}]
16.88	126.40

Results

f_{pu} [psi]	$f_{pu(max)}$ [psi]
2,762	2,762

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7.2 Plate bending (Strong Axis), Compression (per AISC DG1, sections 3.3 and AISC's Engineering Journal, Volume 51, No. 4)

$A_1 = B \cdot N$

$A_2 = L \cdot W$

$f_{pu(max)} = \phi \left(0.85 f'_c \sqrt{\frac{A_2}{A_1}}\right), \sqrt{\frac{A_2}{A_1}} \leq 2$

$m = \frac{N - 0.95d}{2}$

$n = \frac{B - 0.95 b_f}{2}$

$M_{pl1} = C_r \cdot \frac{x}{b_{eff}}$

$\phi M_n = \phi \cdot F_y \cdot \frac{t_p^2}{4}$

$M_{pl1} \leq \phi M_n$

Variables

B [in.]	N [in.]	L [in.]	W [in.]	d [in.]	b_f [in.]
3.375	5.000	13.684	9.237	1.850	1.850

F_y [psi]	ϕ	t_p [in.]	P_u [lb]	M_u [in.lb]
36,000	0.900	0.500	0	10,500

Calculations

A_1 [in.^{2}]	A_2 [in.^{2}]	$f_{pu(max)}$ [psi]	m [in.]	n [in.]
16.88	126.40	2,762	1.621	0.809

f_{pu} [psi]	C_r [lb]	x [in.]	b_{eff} [in.]	M_{pl1} [in.lb/in.]
2,762	4,840	0.575	5.000	556.37

Results

M_n [in.lb/in.]	ϕ	ϕM_n [in.lb/in.]	M_{pl1} [in.lb/in.]
2,250.00	0.900	2,025.00	556.37

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7.3 Plate bending (Weak Axis), Compression (per AISC DG1, sections 3.3 and AISC's Engineering Journal, Volume 51, No. 4)

$A_1 = B \cdot N$

$A_2 = L \cdot W$

$f_{pu(max)} = \phi \left(0.85 f'_c \sqrt{\frac{A_2}{A_1}}\right), \sqrt{\frac{A_2}{A_1}} \leq 2$

$m = \frac{N - 0.95d}{2}$

$n = \frac{B - 0.95b_f}{2}$

$M_{pl2} = C_r \cdot \frac{x}{b_{eff}}$

$\phi M_n = \phi \cdot F_y \cdot \frac{t_p^2}{4}$

$M_{pl2} \leq \phi M_n$

Variables

B [in.]	N [in.]	L [in.]	W [in.]	d [in.]	b_f [in.]
3.375	5.000	13.684	9.237	1.850	1.850

F_y [psi]	ϕ	t_p [in.]	P_u [lb]	M_u [in.lb]
36,000	0.900	0.500	0	10,500

Calculations

A_1 [in.^{2}]	A_2 [in.^{2}]	$f_{pu(max)}$ [psi]	m [in.]	n [in.]
16.88	126.40	2,762	1.621	0.809

f_{pu} [psi]	C_r [lb]	x [in.]	b_{eff} [in.]	M_{pl2} [in.lb/in.]
2,762	1,569	1.621	1.796	1,416.20

Results

M_n [in.lb/in.]	ϕ	ϕM_n [in.lb/in.]	M_{pl2} [in.lb/in.]
2,250.00	0.900	2,025.00	1,416.20

7.4 Plate bending, tension (per AISC DG1, sections 3.2, 3.3)

$$m = \frac{N-0.95d}{2}$$

$$n = \frac{B-0.95b_f}{2}$$

$$M_{pl} = \frac{T_u \cdot x}{b_{eff}}$$

$$\phi M_n = \phi \cdot F_y \cdot \frac{t_p^2}{4}$$

$$M_{pl} \leq \phi M_n$$

Variables

B [in.]	N [in.]	d [in.]	b_f [in.]	F_y [psi]
3.375	5.000	1.850	1.850	36,000

ϕ	t_p [in.]	P_u [lb]	M_u [in.lb]
0.900	0.500	0	10,500

Calculations

m [in.]	n [in.]
1.621	0.809

T_u [lb]	x [in.]	b_{eff} [in.]
2,058	0.963	1.687

Results

M_n [in.lb/in.]	ϕ	ϕM_n [in.lb/in.]	M_{pl} [in.lb/in.]
2,250.00	0.900	2,025.00	1,174.84

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8 Installation data

Profile: Square HSS (AISC), ; (L x W x T) = 1.850 in. x 1.850 in. x 0.100 in.

Hole diameter in the fixture (pre-setting) : d_f = 0.438 in.

Hole diameter in the fixture (through fastening) : d_f = 0.500 in.

Plate thickness (input): 0.500 in.

Drilling method: Hammer drilled

Cleaning: Compressed air cleaning of the drilled hole according to instructions for use is required

Anchor type and diameter: HIT-HY 200 V3 + HIT-Z-R 3/8

Item number: 2018452 HIT-Z-R 3/8" x 5 1/8" (element) / 2334276 HIT-HY 200-R V3 (adhesive)

Maximum installation torque: 354 in.lb

Hole diameter in the base material: 0.438 in.

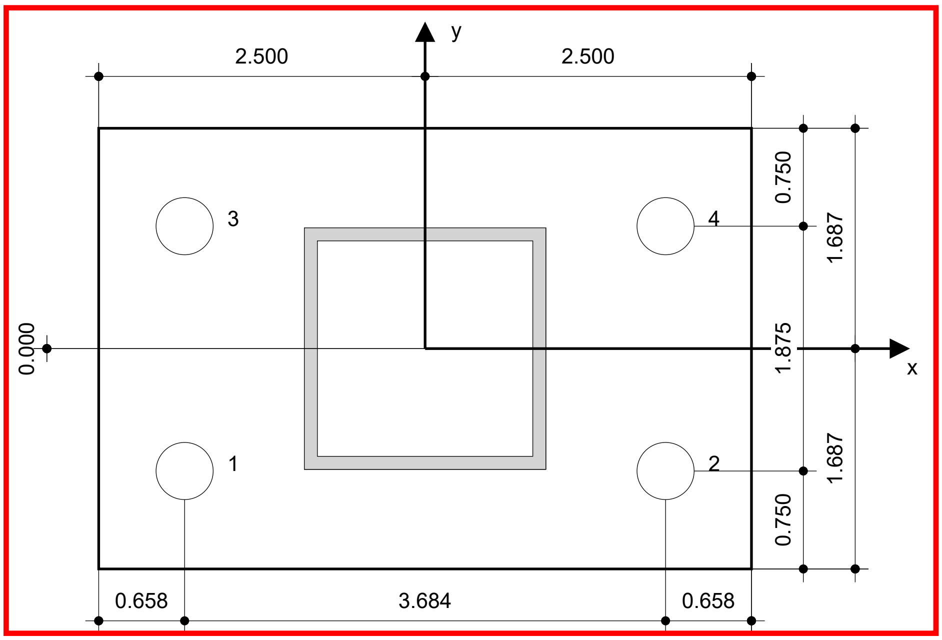
Hole depth in the base material: 3.750 in.

Minimum thickness of the base material: 6.000 in.

3/8 Hilti HIT-Z Stainless steel non-cleaning bonded expansion anchor with Hilti HIT-HY 200 V3 Safe Set System

8.1 Recommended accessories

Drilling	Cleaning	Setting
• Suitable Rotary Hammer • Properly sized drill bit	• -	• Dispenser including cassette and mixer • Torque wrench



Coordinates Anchor in.

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	-1.842	-0.938	5.000	-	5.000	-
2	1.842	-0.938	8.684	-	5.000	-
3	-1.842	0.938	5.000	-	6.875	-
4	1.842	0.938	8.684	-	6.875	-

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9 Remarks; Your Cooperation Duties

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Design:	Concrete Mounted - BP5x5 edge	Date:	9/5/2022
Fastening point:	RFXBP5x5 edge post base for RFC238P		

Specifier's comments: Install per manufacturer's recommendations

1 Anchor Design

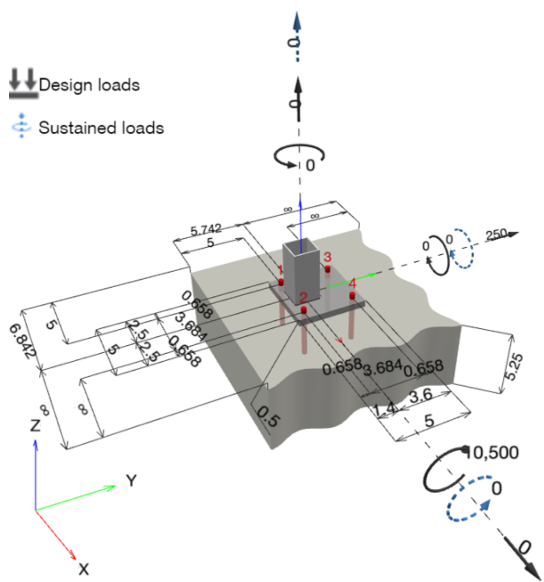
1.1 Input data

Anchor type and diameter:	**HIT-HY 200 V3 + HIT-Z-R 3/8**
Item number:	2018451 HIT-Z-R 3/8" x 4 3/8" (element) / 2334276 HIT-HY 200-R V3 (adhesive)
Effective embedment depth:	$h_{ef,act}$ = 3.000 in. ($h_{ef,limit}$ = - in.)
Material:	A4
Evaluation Service Report:	ESR-4868
Issued I Valid:	11/1/2021 | 11/1/2022
Proof:	Design Method ACI 318-19 / Chem
Stand-off installation:	e_b = 0.000 in. (no stand-off); t = 0.500 in.
Anchor plate[CBFEM] :	l_x x l_y x t = 5.000 in. x 5.000 in. x 0.500 in.;
Profile:	Square HSS (AISC), ; (L x W x T) = 1.850 in. x 1.850 in. x 0.100 in.
Base material:	cracked concrete, 2500, f_c' = 2,500 psi; h = 5.250 in., Temp. short/long: 32/32 °F
Installation:	**hammer drilled hole, Installation condition: Dry**
Reinforcement:	tension: not present, shear: not present; no supplemental splitting reinforcement present
	edge reinforcement: none or < No. 4 bar

Zenith Notes:
1. Depth of concrete shall not be less than 5.25".
2. Edge distance of concrete from center of anchor bolt shall not be less than 5" on all sides.
3. Minimum compressive strength of concrete shall not be less than 2,500psi.

CBFEM - The anchor calculation is based on a component-based Finite Element Method (CBFEM)

Geometry [in.] & Loading [lb, in.lb]



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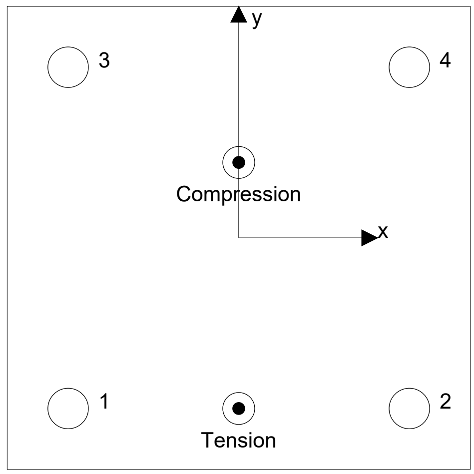
Design:	Concrete Mounted - BP5x5 edge	Date:	9/5/2022
Fastening point:	RFXBP5x5 edge post base for RFC238P		

1.1.1 Load combination and design results

Case	Description	Forces [lb] / Moments [in.lb]	Seismic	Max. Util. Anchor [%]
1	Outward	$N = 0; V_x = 0; V_y = -250;$ $M_x = 10{,}500; M_y = 0; M_z = 0;$ $N_{sus} = 0; M_{x,sus} = 0; M_{y,sus} = 0;$	no	66
2	Inward	$N = 0; V_x = 0; V_y = 250;$ $M_x = -10{,}500; M_y = 0; M_z = 0;$ $N_{sus} = 0; M_{x,sus} = 0; M_{y,sus} = 0;$	no	100

1.2 Load case/Resulting anchor forces

Controlling load case: 2 Inward



Anchor reactions [lb]

Tension force: (+Tension, -Compression)

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	2,021	59	10	58
2	2,021	59	-10	58
3	-0	67	-1	67
4	-0	67	1	67

resulting tension force in (x/y)=(-0.000/-1.842): 4,042 [lb]
resulting compression force in (x/y)=(0.000/0.814): 4,100 [lb]

Anchor forces are calculated based on a component-based Finite Element Method (CBFEM)

1.3 Tension load

	Load N_{ua} [lb]	Capacity ϕ N_n [lb]	Utilization $\beta_N = N_{ua}/\phi$ N_n	Status
Steel Strength*	2,021	4,749	43	OK
Pullout Strength*	2,021	5,169	40	OK
Sustained Tension Load Bond Strength*	N/A	N/A	N/A	N/A
Concrete Breakout Failure**	4,042	4,046	100	OK

* highest loaded anchor **anchor group (anchors in tension)

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Design:	Concrete Mounted - BP5x5 edge	Date:	9/5/2022
Fastening point:	RFXBP5x5 edge post base for RFC238P		

1.3.1 Steel Strength

N_{sa} = ESR value refer to ICC-ES ESR-4868

$\phi\ N_{sa} \geq N_{ua}$ ACI 318-19 Table 17.5.2

Variables

$A_{se,N}$ [in.^{2}]	f_{uta} [psi]
0.08	94,200

Calculations

N_{sa} [lb]
7,306

Results

N_{sa} [lb]	ϕ_{steel}	$\phi\ N_{sa}$ [lb]	N_{ua} [lb]
7,306	0.650	4,749	2,021

1.3.2 Pullout Strength

$N_{pn} = N_p\ \lambda_a$ refer to ICC-ES ESR-4868

$\phi\ N_{pn} \geq N_{ua}$ ACI 318-19 Table 17.5.2

Variables

λ_a	N_p [lb]
1.000	7,952

Calculations

N_{pn} [lb]
7,952

Results

N_{pn} [lb]	$\phi_{concrete}$	$\phi\ N_{pn}$ [lb]	N_{ua} [lb]
7,952	0.650	5,169	2,021

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1.3.3 Concrete Breakout Failure

$N_{cbg} = \left(\frac{A_{Nc}}{A_{Nc0}}\right) \psi_{ec,N}\ \psi_{ed,N}\ \psi_{c,N}\ \psi_{cp,N}\ N_b$ — ACI 318-19 Eq. (17.6.2.1b)

$\phi\ N_{cbg} \geq N_{ua}$ — ACI 318-19 Table 17.5.2

A_{Nc} see ACI 318-19, Section 17.6.2.1, Fig. R 17.6.2.1(b)

$A_{Nc0} = 9\ h_{ef}^2$ — ACI 318-19 Eq. (17.6.2.1.4)

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2\ e_N'}{3\ h_{ef}}}\right) \leq 1.0$ — ACI 318-19 Eq. (17.6.2.3.1)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5h_{ef}}\right) \leq 1.0$ — ACI 318-19 Eq. (17.6.2.4.1b)

$\psi_{cp,N} = MAX\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}}\right) \leq 1.0$ — ACI 318-19 Eq. (17.6.2.6.1b)

$N_b = k_c\ \lambda_a\ \sqrt{f_c'}\ h_{ef}^{1.5}$ — ACI 318-19 Eq. (17.6.2.2.1)

Variables

h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]	$\psi_{c,N}$
3.000	0.000	0.000	5.000	1.000

c_{ac} [in.]	k_c	λ_a	f_c' [psi]
8.100	17	1.000	2,500

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
114.16	81.00	1.000	1.000	1.000	1.000	4,417

Results

N_{cbg} [lb]	$\phi_{concrete}$	$\phi\ N_{cbg}$ [lb]	N_{ua} [lb]
6,224	0.650	4,046	4,042

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1.4 Shear load

	Load V_{ua} [lb]	Capacity $\phi\ V_n$ [lb]	Utilization $\beta_V = V_{ua}/\phi\ V_n$	Status
Steel Strength*	67	2,630	3	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength (Concrete Breakout Strength controls)**	250	12,280	3	OK
Concrete edge failure in direction x-**	250	2,048	13	OK

* highest loaded anchor **anchor group (relevant anchors)

1.4.1 Steel Strength

V_{sa} = ESR value	refer to ICC-ES ESR-4868
$\phi\ V_{steel} \geq V_{ua}$	ACI 318-19 Table 17.5.2

Variables

$A_{se,V}$ [in.^{2}]	f_{uta} [psi]
0.08	94,200

Calculations

V_{sa} [lb]
4,384

Results

V_{sa} [lb]	ϕ_{steel}	$\phi\ V_{sa}$ [lb]	V_{ua} [lb]
4,384	0.600	2,630	67

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1.4.2 Pryout Strength (Concrete Breakout Strength controls)

$V_{cpg} = k_{cp} \left[\left(\frac{A_{Nc}}{A_{Nc0}}\right) \psi_{ec,N}\ \psi_{ed,N}\ \psi_{c,N}\ \psi_{cp,N}\ N_b\right]$ ACI 318-19 Eq. (17.7.3.1b)

$\phi\ V_{cpg} \geq V_{ua}$ ACI 318-19 Table 17.5.2

A_{Nc} see ACI 318-19, Section 17.6.2.1, Fig. R 17.6.2.1(b)

$A_{Nc0} = 9\ h_{ef}^2$ ACI 318-19 Eq. (17.6.2.1.4)

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2\ e_N'}{3\ h_{ef}}}\right) \leq 1.0$ ACI 318-19 Eq. (17.6.2.3.1)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5h_{ef}}\right) \leq 1.0$ ACI 318-19 Eq. (17.6.2.4.1b)

$\psi_{cp,N} = MAX\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}}\right) \leq 1.0$ ACI 318-19 Eq. (17.6.2.6.1b)

$N_b = k_c\ \lambda_a\ \sqrt{f_c'}\ h_{ef}^{1.5}$ ACI 318-19 Eq. (17.6.2.2.1)

Variables

k_{cp}	h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]
2	3.000	0.000	0.000	5.000

$\psi_{c,N}$	c_{ac} [in.]	k_c	λ_a	f_c' [psi]
1.000	8.100	17	1.000	2,500

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
160.88	81.00	1.000	1.000	1.000	1.000	4,417

Results

V_{cpg} [lb]	$\phi_{concrete}$	$\phi\ V_{cpg}$ [lb]	V_{ua} [lb]
17,544	0.700	12,280	250

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1.4.3 Concrete edge failure in direction x-

$V_{cbg} = \left(\frac{A_{Vc}}{A_{Vc0}}\right) \psi_{ec,V}\ \psi_{ed,V}\ \psi_{c,V}\ \psi_{h,V}\ \psi_{parallel,V}\ V_b$ ACI 318-19 Eq. (17.7.2.1b)

$\phi\ V_{cbg} \geq V_{ua}$ ACI 318-19 Table 17.5.2

A_{Vc} see ACI 318-19, Section 17.7.2.1, Fig. R 17.7.2.1(b)

$A_{Vc0} = 4.5\ c_{a1}^2$ ACI 318-19 Eq. (17.7.2.1.3)

$\psi_{ec,V} = \left(\frac{1}{1 + \frac{e_V'}{1.5c_{a1}}}\right) \leq 1.0$ ACI 318-19 Eq. (17.7.2.3.1)

$\psi_{ed,V} = 0.7 + 0.3\left(\frac{c_{a2}}{1.5c_{a1}}\right) \leq 1.0$ ACI 318-19 Eq. (17.7.2.4.1b)

$\psi_{h,V} = \sqrt{\frac{1.5c_{a1}}{h_a}} \geq 1.0$ ACI 318-19 Eq. (17.7.2.6.1)

$V_b = \left(7\left(\frac{l_e}{d_a}\right)^{0.2} \sqrt{d_a}\right) \lambda_a \sqrt{f_c'}\ c_{a1}^{1.5}$ ACI 318-19 Eq. (17.7.2.2.1a)

Variables

c_{a1} [in.]	c_{a2} [in.]	e_{cV} [in.]	$\psi_{c,V}$	h_a [in.]
5.000	5.000	0.065	1.000	5.250

l_e [in.]	λ_a	d_a [in.]	f_c' [psi]	$\psi_{parallel,V}$
3.000	1.000	0.375	2,500	1.000

Calculations

A_{Vc} [in.^{2}]	A_{Vc0} [in.^{2}]	$\psi_{ec,V}$	$\psi_{ed,V}$	$\psi_{h,V}$	V_b [lb]
84.97	112.50	0.991	0.900	1.195	3,632

Results

V_{cbg} [lb]	$\phi_{concrete}$	$\phi\ V_{cbg}$ [lb]	V_{ua} [lb]
2,925	0.700	2,048	250

1.5 Combined tension and shear loads, per ACI 318-19 section 17.8

β_N	β_V	ζ	Utilization $\beta_{N,V}$ [%]	Status
0.999	0.122	1.000	94	OK

$\beta_{NV} = (\beta_N + \beta_V) / 1.2 <= 1$

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1.6 Warnings

- The anchor design methods in PROFIS Engineering require rigid anchor plates as per current regulations (ETAG 001/Annex C, EOTA TR029, etc.). This means load re-distribution on the anchors due to elastic deformations of the anchor plate are not considered - the anchor plate is assumed to be sufficiently stiff, in order not to be deformed when subjected to the design loading. PROFIS Engineering calculates the minimum required anchor plate thickness with CBFEM to limit the stress of the anchor plate based on the assumptions explained above. The proof if the rigid base plate assumption is valid is not carried out by PROFIS Engineering. Input data and results must be checked for agreement with the existing conditions and for plausibility!
- Condition A applies where the potential concrete failure surfaces are crossed by supplementary reinforcement proportioned to tie the potential concrete failure prism into the structural member. Condition B applies where such supplementary reinforcement is not provided, or where pullout or pryout strength governs.
- Design Strengths of adhesive anchor systems are influenced by the cleaning method. Refer to the INSTRUCTIONS FOR USE given in the Evaluation Service Report for cleaning and installation instructions.
- For additional information about ACI 318 strength design provisions, please go to https://submittals.us.hilti.com/PROFISAnchorDesignGuide/
- Attention! In case of compressive anchor forces a buckling check as well as the proof of the local load transfer into and within the base material (incl. punching) has to be done separately.
- Installation of Hilti adhesive anchor systems shall be performed by personnel trained to install Hilti adhesive anchors. Reference ACI 318-19, Section 26.7.
- The anchor design methods in PROFIS Engineering require rigid anchor plates, as per current regulations (AS 5216:2021, ETAG 001/Annex C, EOTA TR029 etc.). This means that the anchor plate should be sufficiently rigid to prevent load re-distribution to the anchors due to elastic/plastic displacements. The user accepts that the anchor plate is considered close to rigid by engineering judgment."

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1.7 Installation data

Profile: Square HSS (AISC), ; (L x W x T) = 1.850 in. x 1.850 in. x 0.100 in.

Hole diameter in the fixture (pre-setting) : d_f = 0.438 in.

Hole diameter in the fixture (through fastening) : d_f = 0.500 in.

Plate thickness (input): 0.500 in.

Drilling method: Hammer drilled

Cleaning: Compressed air cleaning of the drilled hole according to instructions for use is required

Anchor type and diameter: HIT-HY 200 V3 + HIT-Z-R 3/8

Item number: 2018451 HIT-Z-R 3/8" x 4 3/8" (element) / 2334276 HIT-HY 200-R V3 (adhesive)

Maximum installation torque: 354 in.lb

Hole diameter in the base material: 0.438 in.

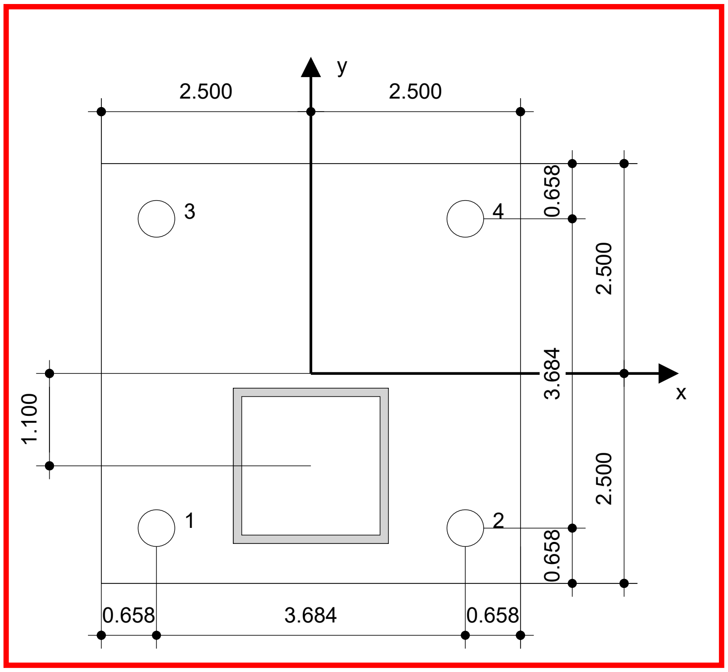
Hole depth in the base material: 3.000 in.

Minimum thickness of the base material: 5.250 in.

3/8 Hilti HIT-Z Stainless steel non-cleaning bonded expansion anchor with Hilti HIT-HY 200 V3 Safe Set System

1.7.1 Recommended accessories

Drilling	Cleaning	Setting
• Suitable Rotary Hammer • Properly sized drill bit	• -	• Dispenser including cassette and mixer • Torque wrench



Coordinates Anchor [in.]

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	-1.842	-1.842	5.000	-	5.000	-
2	1.842	-1.842	8.684	-	5.000	-
3	-1.842	1.842	5.000	-	8.684	-
4	1.842	1.842	8.684	-	8.684	-

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2 Anchor plate design

2.1 Input data

Anchor plate:	Shape: Rectangular l_x x l_y x t = 5.000 in x 5.000 in x 0.500 in Calculation: CBFEM Material: ASTM A36; F_y = 36,000 psi; ε_{lim} = 5.00%
Anchor type and size:	HIT-HY 200 V3 + HIT-Z-R 3/8, h_{ef} = 3.000 in
Anchor stiffness:	The anchor is modeled considering stiffness values determined from load displacement curves tested in an independent laboratory. Please note that no simple replacement of the anchor is possible as the anchor stiffness has a major impact on the load distribution results.
Design method:	AISC and LRFD-based design using component-based FEM
Stand-off installation:	e_b = 0.000 in (No stand-off); t = 0.500 in
Profile:	Custom; (L x W x T x FT) = 1.850 in x 1.850 in x 0.100 in x - Material: ASTM A500 Gr.B Rect; F_y = 46,000 psi; ε_{lim} = 5.00% Eccentricity x: 0.000 in Eccentricity y: -1.100 in
Base material:	Cracked concrete; 2500; $f_{c,cyl}$ = 2,500 psi; h = 5.250 in
Welds (profile to anchor plate):	Type of redistribution: Plastic Material: E70xx
Mesh size:	Number of elements on edge: 8 Min. size of element: 0.394 in Max. size of element: 1.969 in

2.2 Summary

	Description	Profile		Anchor plate			Concrete [%]
		σ_{Ed} [psi]	ε_{Pl} [%]	σ_{Ed} [psi]	ε_{Pl} [%]	Hole bearing [%]	
1	Outward	33,708	0.00	23,642	0.00	1	18
2	Inward	38,605	0.00	19,478	0.00	1	9

2.3 Anchor plate classification

Results below are displayed for the decisive load combinations: Outward

Anchor tension forces	Equivalent rigid anchor plate (CBFEM)	Component-based Finite Element Method (CBFEM) anchor plate design
Anchor 1	-1 lb	0 lb
Anchor 2	-1 lb	0 lb
Anchor 3	1,451 lb	1,328 lb
Anchor 4	1,451 lb	1,328 lb

User accepted to consider the selected anchor plate as rigid by his/her engineering judgement. This means the anchor design guidelines can be applied.

2.4 Profile/Stiffeners/Plate

Profile and stiffeners are verified at the level of the steel to concrete connection. The connection design does not replace the steel design for critical cross sections, which should be performed outside of PROFIS Engineering.

2.4.1 Equivalent stress and plastic strain

Part	Load combination	Material	f_y [psi]	ε_{lim} [%]	σ_{Ed} [psi]	ε_{Pl} [%]	Status
Plate	Outward	ASTM A36	36,000	5.00	23,642	0.00	OK

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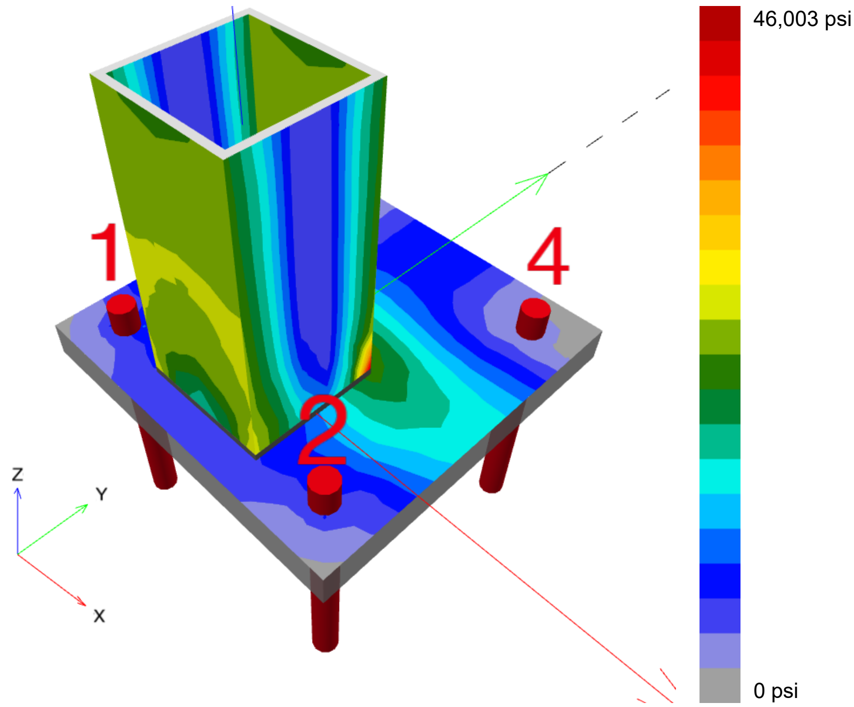
Part	Load combination	Material	f_y [psi]	ε_{lim} [%]	σ_{Ed} [psi]	ε_{Pl} [%]	Status
Profile	Outward	ASTM A500 Gr.B Rect	46,000	5.00	33,708	0.00	OK
Profile	Outward	ASTM A500 Gr.B Rect	46,000	5.00	33,698	0.00	OK
Profile	Outward	ASTM A500 Gr.B Rect	46,000	5.00	25,505	0.00	OK
Profile	Outward	ASTM A500 Gr.B Rect	46,000	5.00	39,035	0.00	OK

2.4.1.1 Equivalent stress

Results below are displayed for the decisive load combination: 1 - Outward



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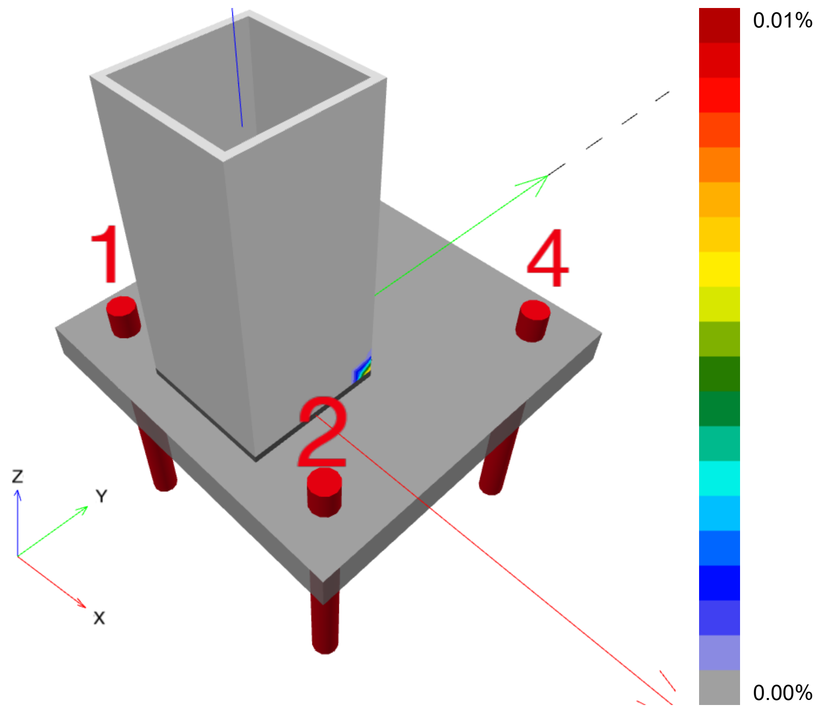
2.4.1.2 Plastic strain

Results below are displayed for the decisive load combination: 1 - Outward



2.4.2 Plate hole bearing resistance, AISC 360-16 Section J3

Decisive load combination: 1 - Outward

Equations

$R_n = \min(1.2\, l_c\, t\, F_u\, ,\, 2.4\, d\, t\, F_u)$ (AISC 360-16 J3-6a, c)

$\Phi R_n = 0.75\, R_n$

$V \leq \Phi R_n$

Variables

	l_c [in]	t [in]	F_u [psi]	d [in]	R_n [lb]
Anchor 1	3.247	0.500	58,000	0.375	26,100
Anchor 2	3.247	0.500	58,000	0.375	26,100
Anchor 3	0.440	0.500	58,000	0.375	15,316
Anchor 4	0.440	0.500	58,000	0.375	15,316

Results

	V [lb]	ΦR_n [lb]	Utilization [%]	Status
Anchor 1	56	19,575	1	OK
Anchor 2	56	19,575	1	OK
Anchor 3	69	11,487	1	OK

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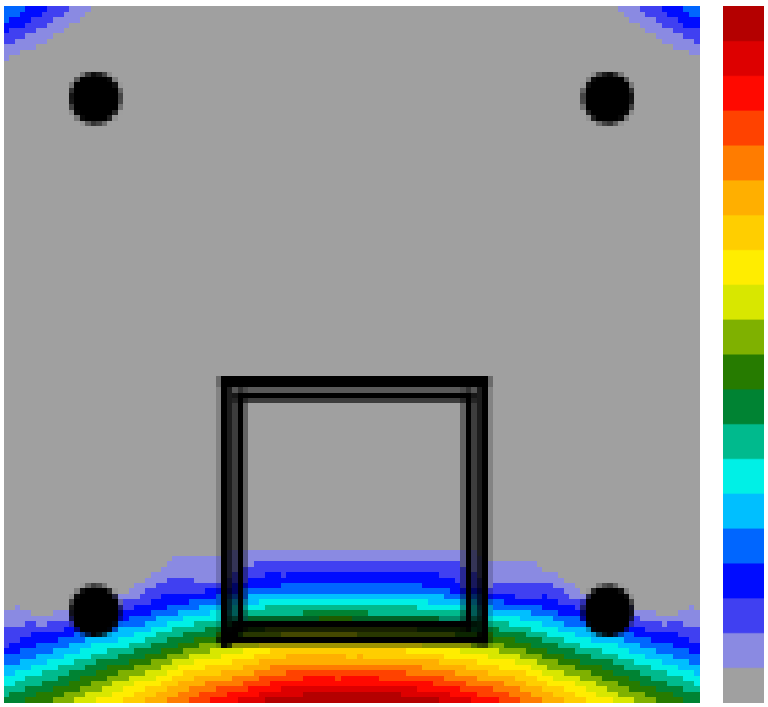
	V [lb]	ΦR_n [lb]	Utilization [%]	Status
Anchor 4	69	11,487	1	OK

2.5 Concrete

Decisive load combination: 1 - Outward

2.5.1 Compression in concrete under the anchor plate



2.5.2 Concrete block compressive strength resistance check, AISC 360-16 Section J8

Equations

$F_p = \Phi f_{p,max}$

$f_{p,max} = 0.85 f_c' \sqrt{(\frac{A_2}{A_1})} \leq 1.7 f_c; \sqrt{(\frac{A_2}{A_1})} \leq 2$

$\sigma = \frac{N}{A_1}$

$\text{Utilization} = \frac{\sigma}{F_p}$

Variables

N [lb]	f_c' [psi]	Φ	A_1 [in²]	A_2 [in²]
2,735	2,500	0.65	5.61	118.97

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Results

Load combination	F_p [psi]	σ [psi]	Utilization [%]	Status
Outward	2,762	488	18	OK

2.6 Symbol explanation

A_1	Loaded area of concrete
A_2	Supporting area
d	Nominal diameter of the bolt
ε_{lim}	Limit plastic strain
ε_{Pl}	Plastic strain from CBFEM results
f_c	Concrete compressive strength
f_c'	Concrete compressive strength
F_u	Specified minimum tensile strength of the connected material
F_p	Concrete block design bearing strength
$f_{p,max}$	Concrete block design bearing strength maximum
f_y	Yield strength
l_c	Clear distance, in the direction of the force, between the edge of the hole and the edge of the adjacent hole or edge of the material
N	Resulting compression force
σ	Average stress in concrete
σ_{Ed}	Equivalent stress
Φ	Resistance factor
ΦR_n	Factored resistance
t	Thickness of the anchor plate
V	Resultant of shear forces Vy, Vz in bolt.

2.7 Warnings

- By using the CBFEM calculation functionality of PROFIS Engineering you may act outside the applicable design codes and your specified anchor plate may not behave rigid. Please, validate the results with a professional designer and/or structural engineer to ensure suitability and adequacy for your specific jurisdiction and project requirements.
- The anchor is modeled considering stiffness values determined from load displacement curves tested in an independent laboratory. Please note that no simple replacement of the anchor is possible as the anchor stiffness has a major impact on the load distribution results.

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Design:	Concrete Mounted - BP5x5 edge	Date:	9/5/2022
Fastening point:	RFXBP5x5 edge post base for RFC238P		

3 Summary of results

Design of the anchor plate, anchors, welds and other elements are based on CBFEM (component based finite element method) and AISC.

	Load combination	Max. utilization	Status
Anchors	Inward	100%	OK
Anchor plate	Outward	66%	OK
Concrete	Outward	18%	OK
Profile	Outward	74%	OK

Fastening meets the design criteria!

4 Remarks; Your Cooperation Duties

- Any and all information and data contained in the Software concern solely the use of Hilti products and are based on the principles, formulas and security regulations in accordance with Hilti's technical directions and operating, mounting and assembly instructions, etc., that must be strictly complied with by the user. All figures contained therein are average figures, and therefore use-specific tests are to be conducted prior to using the relevant Hilti product. The results of the calculations carried out by means of the Software are based essentially on the data you put in. Therefore, you bear the sole responsibility for the absence of errors, the completeness and the relevance of the data to be put in by you. Moreover, you bear sole responsibility for having the results of the calculation checked and cleared by an expert, particularly with regard to compliance with applicable norms and permits, prior to using them for your specific facility. The Software serves only as an aid to interpret norms and permits without any guarantee as to the absence of errors, the correctness and the relevance of the results or suitability for a specific application.
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Specifier's comments: Install per manufacturer's recommendations

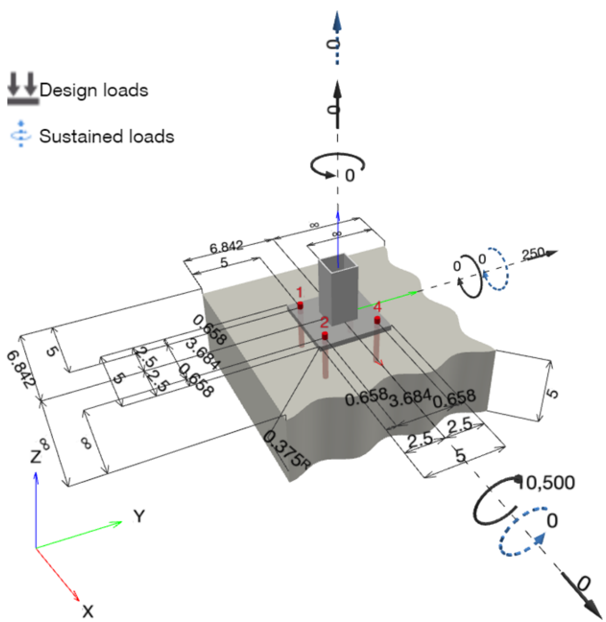
1 Input data

Anchor type and diameter:	**HIT-HY 200 V3 + HIT-Z-R 3/8**
Item number:	2018451 HIT-Z-R 3/8" x 4 3/8" (element) / 2334276 HIT-HY 200-R V3 (adhesive)
Effective embedment depth:	$h_{ef,act}$ = 2.750 in. ($h_{ef,limit}$ = - in.)
Material:	A4
Evaluation Service Report:	ESR-4868
Issued I Valid:	11/1/2021 | 11/1/2022
Proof:	Design Method ACI 318-19 / Chem
Stand-off installation:	e_b = 0.000 in. (no stand-off); t = 0.375 in.
Anchor plate[R] :	l_x x l_y x t = 5.000 in. x 5.000 in. x 0.375 in.;
Profile:	Square HSS (AISC), ; (L x W x T) = 1.850 in. x 1.850 in. x 0.100 in.
Base material:	cracked concrete, 2500, f_c' = 2,500 psi; h = 5.000 in., Temp. short/long: 32/32 °F
Installation:	**hammer drilled hole, Installation condition: Dry**
Reinforcement:	tension: not present, shear: not present; no supplemental splitting reinforcement present
	edge reinforcement: none or < No. 4 bar

Zenith Notes:
1. Depth of concrete shall not be less than 5".
2. Edge distance of concrete from center of anchor bolt shall not be less than 5" on all sides.
3. Minimum compressive strength of concrete shall not be less than 2,500psi.

[R] - The anchor calculation is based on a rigid anchor plate assumption.

Geometry [in.] & Loading [lb, in.lb]



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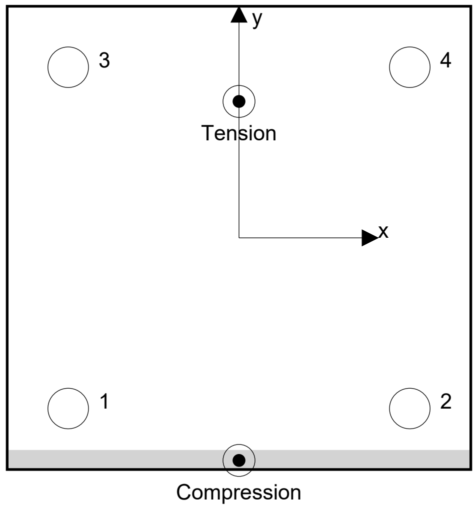
1.1 Load combination and design results

Case	Description	Forces [lb] / Moments [in.lb]	Seismic	Max. Util. Anchor [%]
1	Outward	$N = 0; V_x = 0; V_y = -250;$ $M_x = 10{,}500; M_y = 0; M_z = 0;$ $N_{sus} = 0; M_{x,sus} = 0; M_{y,sus} = 0;$	no	70
2	Inward	$N = 0; V_x = 0; V_y = 250;$ $M_x = -10{,}500; M_y = 0; M_z = 0;$ $N_{sus} = 0; M_{x,sus} = 0; M_{y,sus} = 0;$	no	70

2 Load case/Resulting anchor forces

Controlling load case: 2 Inward



Anchor reactions [lb]

Tension force: (+Tension, -Compression)

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	136	63	0	-63
2	136	63	0	-63
3	1,219	63	0	-63
4	1,219	63	0	-63

max. concrete compressive strain: 0.03 [‰]
max. concrete compressive stress: 2,762 [psi]
resulting tension force in (x/y)=(0.000/1.473): 2,710 [lb]
resulting compression force in (x/y)=(0.000/-2.402): 2,710 [lb]

Anchor forces are calculated based on the assumption of a rigid anchor plate.

3 Tension load

	Load N_{ua} [lb]	Capacity ϕ N_n [lb]	Utilization $\beta_N = N_{ua}/\phi$ N_n	Status
Steel Strength*	1,219	4,749	26	OK
Pullout Strength*	1,219	5,169	24	OK
Sustained Tension Load Bond Strength*	N/A	N/A	N/A	N/A
Concrete Breakout Failure**	2,710	3,885	70	OK

* highest loaded anchor **anchor group (anchors in tension)

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3.1 Steel Strength

N_{sa} = ESR value refer to ICC-ES ESR-4868
$\phi\ N_{sa} \geq N_{ua}$ ACI 318-19 Table 17.5.2

Variables

$A_{se,N}$ [in.^{2}]	f_{uta} [psi]
0.08	94,200

Calculations

N_{sa} [lb]
7,306

Results

N_{sa} [lb]	ϕ_{steel}	$\phi\ N_{sa}$ [lb]	N_{ua} [lb]
7,306	0.650	4,749	1,219

3.2 Pullout Strength

$N_{pn} = N_p\ \lambda_a$ refer to ICC-ES ESR-4868
$\phi\ N_{pn} \geq N_{ua}$ ACI 318-19 Table 17.5.2

Variables

λ_a	N_p [lb]
1.000	7,952

Calculations

N_{pn} [lb]
7,952

Results

N_{pn} [lb]	$\phi_{concrete}$	$\phi\ N_{pn}$ [lb]	N_{ua} [lb]
7,952	0.650	5,169	1,219

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3.3 Concrete Breakout Failure

$N_{cbg} = \left(\frac{A_{Nc}}{A_{Nc0}}\right) \psi_{ec,N}\ \psi_{ed,N}\ \psi_{c,N}\ \psi_{cp,N}\ N_b$ ACI 318-19 Eq. (17.6.2.1b)

$\phi\ N_{cbg} \geq N_{ua}$ ACI 318-19 Table 17.5.2

A_{Nc} see ACI 318-19, Section 17.6.2.1, Fig. R 17.6.2.1(b)

$A_{Nc0} = 9\ h_{ef}^2$ ACI 318-19 Eq. (17.6.2.1.4)

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2\ e_N'}{3\ h_{ef}}}\right) \leq 1.0$ ACI 318-19 Eq. (17.6.2.3.1)

$\psi_{ed,N} = 0.7 + 0.3\left(\frac{c_{a,min}}{1.5h_{ef}}\right) \leq 1.0$ ACI 318-19 Eq. (17.6.2.4.1b)

$\psi_{cp,N} = \text{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}}\right) \leq 1.0$ ACI 318-19 Eq. (17.6.2.6.1b)

$N_b = k_c\ \lambda_a\ \sqrt{f_c'}\ h_{ef}^{1.5}$ ACI 318-19 Eq. (17.6.2.2.1)

Variables

h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]	$\psi_{c,N}$
2.750	0.000	1.473	5.000	1.000

c_{ac} [in.]	k_c	λ_a	f_c' [psi]
7.050	17	1.000	2,500

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
142.42	68.06	1.000	0.737	1.000	1.000	3,876

Results

N_{cbg} [lb]	$\phi_{concrete}$	$\phi\ N_{cbg}$ [lb]	N_{ua} [lb]
5,977	0.650	3,885	2,710

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4 Shear load

	Load V_{ua} [lb]	Capacity ϕ V_n [lb]	Utilization $\beta_V = V_{ua}/\phi\ V_n$	Status
Steel Strength*	63	2,630	3	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength (Concrete Breakout Strength controls)**	250	11,356	3	OK
Concrete edge failure in direction y-**	250	1,981	13	OK

* highest loaded anchor   **anchor group (relevant anchors)

4.1 Steel Strength

V_{sa} = ESR value refer to ICC-ES ESR-4868

$\phi\ V_{steel} \geq V_{ua}$ ACI 318-19 Table 17.5.2

Variables

$A_{se,V}$ [in.^{2}]	f_{uta} [psi]
0.08	94,200

Calculations

V_{sa} [lb]
4,384

Results

V_{sa} [lb]	ϕ_{steel}	$\phi\ V_{sa}$ [lb]	V_{ua} [lb]
4,384	0.600	2,630	63

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4.2 Pryout Strength (Concrete Breakout Strength controls)

$V_{cpg} = k_{cp} \left[\left(\frac{A_{Nc}}{A_{Nc0}} \right) \psi_{ec,N}\ \psi_{ed,N}\ \psi_{c,N}\ \psi_{cp,N}\ N_b \right]$ ACI 318-19 Eq. (17.7.3.1b)

$\phi\ V_{cpg} \geq V_{ua}$ ACI 318-19 Table 17.5.2

A_{Nc} see ACI 318-19, Section 17.6.2.1, Fig. R 17.6.2.1(b)

$A_{Nc0} = 9\ h_{ef}^2$ ACI 318-19 Eq. (17.6.2.1.4)

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2\ e'_N}{3\ h_{ef}}} \right) \leq 1.0$ ACI 318-19 Eq. (17.6.2.3.1)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5h_{ef}} \right) \leq 1.0$ ACI 318-19 Eq. (17.6.2.4.1b)

$\psi_{cp,N} = \mathrm{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}} \right) \leq 1.0$ ACI 318-19 Eq. (17.6.2.6.1b)

$N_b = k_c\ \lambda_a\ \sqrt{f'_c}\ h_{ef}^{1.5}$ ACI 318-19 Eq. (17.6.2.2.1)

Variables

k_{cp}	h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]
2	2.750	0.000	0.000	5.000

$\psi_{c,N}$	c_{ac} [in.]	k_c	λ_a	f'_c [psi]
1.000	7.050	17	1.000	2,500

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
142.42	68.06	1.000	1.000	1.000	1.000	3,876

Results

V_{cpg} [lb]	$\phi_{concrete}$	$\phi\ V_{cpg}$ [lb]	V_{ua} [lb]
16,222	0.700	11,356	250

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4.3 Concrete edge failure in direction y-

$V_{cbg} = \left(\frac{A_{Vc}}{A_{Vc0}}\right) \psi_{ec,V}\ \psi_{ed,V}\ \psi_{c,V}\ \psi_{h,V}\ \psi_{parallel,V}\ V_b$ ACI 318-19 Eq. (17.7.2.1b)

$\phi\ V_{cbg} \geq V_{ua}$ ACI 318-19 Table 17.5.2

A_{Vc} see ACI 318-19, Section 17.7.2.1, Fig. R 17.7.2.1(b)

$A_{Vc0} = 4.5\ c_{a1}^2$ ACI 318-19 Eq. (17.7.2.1.3)

$\psi_{ec,V} = \left(\frac{1}{1 + \frac{e_V'}{1.5c_{a1}}}\right) \leq 1.0$ ACI 318-19 Eq. (17.7.2.3.1)

$\psi_{ed,V} = 0.7 + 0.3\left(\frac{c_{a2}}{1.5c_{a1}}\right) \leq 1.0$ ACI 318-19 Eq. (17.7.2.4.1b)

$\psi_{h,V} = \sqrt{\frac{1.5c_{a1}}{h_a}} \geq 1.0$ ACI 318-19 Eq. (17.7.2.6.1)

$V_b = \left(7\left(\frac{l_e}{d_a}\right)^{0.2} \sqrt{d_a}\right) \lambda_a \sqrt{f_c'}\ c_{a1}^{1.5}$ ACI 318-19 Eq. (17.7.2.2.1a)

Variables

c_{a1} [in.]	c_{a2} [in.]	e_{cV} [in.]	$\psi_{c,V}$	h_a [in.]
5.000	5.000	0.000	1.000	5.000

l_e [in.]	λ_a	d_a [in.]	f_c' [psi]	$\psi_{parallel,V}$
2.750	1.000	0.375	2,500	1.000

Calculations

A_{Vc} [in.^{2}]	A_{Vc0} [in.^{2}]	$\psi_{ec,V}$	$\psi_{ed,V}$	$\psi_{h,V}$	V_b [lb]
80.92	112.50	1.000	0.900	1.225	3,569

Results

V_{cbg} [lb]	$\phi_{concrete}$	$\phi\ V_{cbg}$ [lb]	V_{ua} [lb]
2,830	0.700	1,981	250

5 Combined tension and shear loads, per ACI 318-19 section 17.8

β_N	β_V	ζ	Utilization $\beta_{N,V}$ [%]	Status
0.698	0.126	5/3	59	OK

$\beta_{NV} = \beta_N^{\zeta} + \beta_V^{\zeta} <= 1$

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6 Warnings

- The anchor design methods in PROFIS Engineering require rigid anchor plates per current regulations (AS 5216:2021, ETAG 001/Annex C, EOTA TR029 etc.). This means load re-distribution on the anchors due to elastic deformations of the anchor plate are not considered - the anchor plate is assumed to be sufficiently stiff, in order not to be deformed when subjected to the design loading. PROFIS Engineering calculates the minimum required anchor plate thickness with CBFEM to limit the stress of the anchor plate based on the assumptions explained above. The proof if the rigid anchor plate assumption is valid is not carried out by PROFIS Engineering. Input data and results must be checked for agreement with the existing conditions and for plausibility!
- User is responsible for evaluating the hole bearing capacity in case of shear forces.
- Condition A applies where the potential concrete failure surfaces are crossed by supplementary reinforcement proportioned to tie the potential concrete failure prism into the structural member. Condition B applies where such supplementary reinforcement is not provided, or where pullout or pryout strength governs.
- Design Strengths of adhesive anchor systems are influenced by the cleaning method. Refer to the INSTRUCTIONS FOR USE given in the Evaluation Service Report for cleaning and installation instructions.
- For additional information about ACI 318 strength design provisions, please go to https://submittals.us.hilti.com/PROFISAnchorDesignGuide/
- Installation of Hilti adhesive anchor systems shall be performed by personnel trained to install Hilti adhesive anchors. Reference ACI 318-19, Section 26.7.

Fastening meets the design criteria!

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7 Anchor plate and concrete bearing stress check

	Load	Capacity	Utilization [%]	Status
Concentric Compression	N/A	N/A	N/A	N/A
Concrete bearing	2,762 [psi]	2,762 [psi]	100	OK
Tension Interface	724.35 [in.lb/in.]	1,139.06 [in.lb/in.]	64	OK
Uniaxial Moment (Strong Axis)	303.45 [in.lb/in.]	1,139.06 [in.lb/in.]	27	OK
Uniaxial Moment (Weak Axis)	828.55 [in.lb/in.]	1,139.06 [in.lb/in.]	73	OK

7.1 Concrete bearing check (per AISC DG1, section 3.1.1)

$A_1 = B \cdot N$

$A_2 = L \cdot W$

$f_{pu(max)} = \phi \left(0.85 f'_c \sqrt{\frac{A_2}{A_1}}\right), \sqrt{\frac{A_2}{A_1}} \leq 2$

$f_{pu} = f_{pu(max)}$

Variables

B [in.]	N [in.]	L [in.]	W [in.]
5.000	5.000	13.684	13.684

f_c' [psi]	ϕ	P_u [lb]	M_u [in.lb]
2,500	0.650	0	0

Calculations

A_1 [in.^{2}]	A_2 [in.^{2}]
25.00	187.25

Results

f_{pu} [psi]	$f_{pu(max)}$ [psi]
2,762	2,762

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7.2 Plate bending (Strong Axis), Compression (per AISC DG1, sections 3.3 and AISC's Engineering Journal, Volume 51, No. 4)

$$A_1 = B \cdot N$$
$$A_2 = L \cdot W$$
$$f_{pu(max)} = \phi \left(0.85 f'_c \sqrt{\frac{A_2}{A_1}}\right),\ \sqrt{\frac{A_2}{A_1}} \leq 2$$
$$m = \frac{N - 0.95d}{2}$$
$$n = \frac{B - 0.95b_f}{2}$$
$$M_{pl1} = C_r \cdot \frac{x}{b_{eff}}$$
$$\phi M_n = \phi \cdot F_y \cdot \frac{t_p^2}{4}$$
$$M_{pl1} \leq \phi M_n$$

Variables

B [in.]	N [in.]	L [in.]	W [in.]	d [in.]	b_f [in.]
5.000	5.000	13.684	13.684	1.850	1.850

F_y [psi]	ϕ	t_p [in.]	P_u [lb]	M_u [in.lb]
36,000	0.900	0.375	0	10,500

Calculations

A_1 [in.^{2}]	A_2 [in.^{2}]	$f_{pu(max)}$ [psi]	m [in.]	n [in.]
25.00	187.25	2,762	1.621	1.621

f_{pu} [psi]	C_r [lb]	x [in.]	b_{eff} [in.]	M_{pl1} [in.lb/in.]
2,762	2,710	0.560	5.000	303.45

Results

M_n [in.lb/in.]	ϕ	ϕM_n [in.lb/in.]	M_{pl1} [in.lb/in.]
1,265.62	0.900	1,139.06	303.45

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7.3 Plate bending (Weak Axis), Compression (per AISC DG1, sections 3.3 and AISC's Engineering Journal, Volume 51, No. 4)

$A_1 = B \cdot N$

$A_2 = L \cdot W$

$f_{pu(max)} = \phi \left(0.85 f'_c \sqrt{\frac{A_2}{A_1}}\right), \sqrt{\frac{A_2}{A_1}} \leq 2$

$m = \frac{N - 0.95d}{2}$

$n = \frac{B - 0.95b_f}{2}$

$M_{pl2} = C_r \cdot \frac{x}{b_{eff}}$

$\phi M_n = \phi \cdot F_y \cdot \frac{t_p^2}{4}$

$M_{pl2} \leq \phi M_n$

Variables

B [in.]	N [in.]	L [in.]	W [in.]	d [in.]	b_f [in.]
5.000	5.000	13.684	13.684	1.850	1.850

F_y [psi]	ϕ	t_p [in.]	P_u [lb]	M_u [in.lb]
36,000	0.900	0.375	0	10,500

Calculations

A_1 [in.^{2}]	A_2 [in.^{2}]	$f_{pu(max)}$ [psi]	m [in.]	n [in.]
25.00	187.25	2,762	1.621	1.621

f_{pu} [psi]	C_r [lb]	x [in.]	b_{eff} [in.]	M_{pl2} [in.lb/in.]
2,762	879	1.621	1.719	828.55

Results

M_n [in.lb/in.]	ϕ	ϕM_n [in.lb/in.]	M_{pl2} [in.lb/in.]
1,265.62	0.900	1,139.06	828.55

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Design:	Concrete Mounted - BP5x5 center	Date:	9/5/2022
Fastening point:	RFXBP5x5 post base centered for RFC238P		

7.4 Plate bending, tension (per AISC DG1, sections 3.2, 3.3)

$$m = \frac{N-0.95d}{2}$$

$$n = \frac{B-0.95b_f}{2}$$

$$M_{pl} = \frac{T_u \cdot x}{b_{eff}}$$

$$\phi M_n = \phi \cdot F_y \cdot \frac{t_p^2}{4}$$

$$M_{pl} \leq \phi M_n$$

Variables

B [in.]	N [in.]	d [in.]	b_f [in.]	F_y [psi]
5.000	5.000	1.850	1.850	36,000

ϕ	t_p [in.]	P_u [lb]	M_u [in.lb]
0.900	0.375	0	10,500

Calculations

m [in.]	n [in.]
1.621	1.621

T_u [lb]	x [in.]	b_{eff} [in.]
1,219	0.963	1.621

Results

M_n [in.lb/in.]	ϕ	ϕM_n [in.lb/in.]	M_{pl} [in.lb/in.]
1,265.62	0.900	1,139.06	724.35

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Fastening point:	RFXBP5x5 post base centered for RFC238P		

8 Installation data

Profile: Square HSS (AISC), ; (L x W x T) = 1.850 in. x 1.850 in. x 0.100 in.

Hole diameter in the fixture (pre-setting) : d_f = 0.438 in.

Hole diameter in the fixture (through fastening) : d_f = 0.500 in.

Plate thickness (input): 0.375 in.

Drilling method: Hammer drilled

Cleaning: Compressed air cleaning of the drilled hole according to instructions for use is required

Anchor type and diameter: HIT-HY 200 V3 + HIT-Z-R 3/8

Item number: 2018451 HIT-Z-R 3/8" x 4 3/8" (element) / 2334276 HIT-HY 200-R V3 (adhesive)

Maximum installation torque: 354 in.lb

Hole diameter in the base material: 0.438 in.

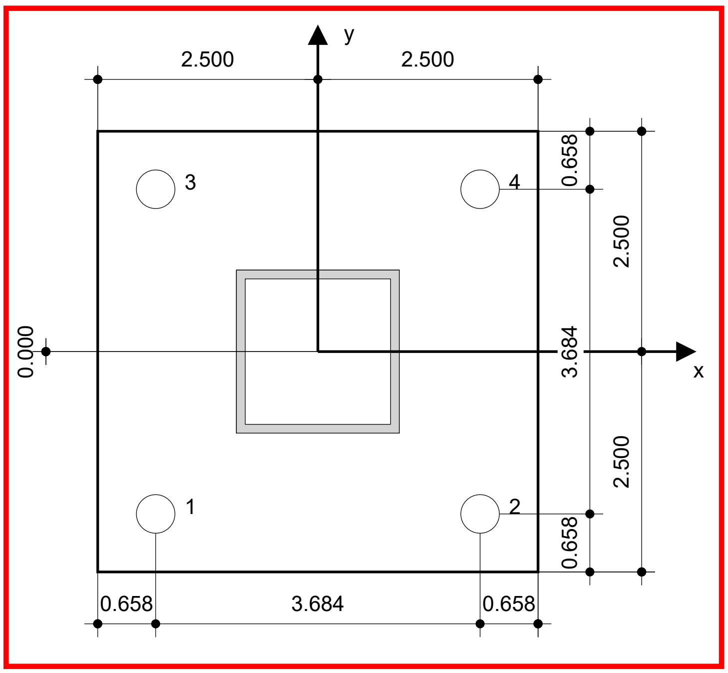
Hole depth in the base material: 2.750 in.

Minimum thickness of the base material: 5.000 in.

3/8 Hilti HIT-Z Stainless steel non-cleaning bonded expansion anchor with Hilti HIT-HY 200 V3 Safe Set System

8.1 Recommended accessories

Drilling	Cleaning	Setting
• Suitable Rotary Hammer • Properly sized drill bit	• -	• Dispenser including cassette and mixer • Torque wrench



Coordinates Anchor in.

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	-1.842	-1.842	5.000	-	5.000	-
2	1.842	-1.842	8.684	-	5.000	-
3	-1.842	1.842	5.000	-	8.684	-
4	1.842	1.842	8.684	-	8.684	-

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Fastening point:	RFXBP5x5 post base centered for RFC238P		

9 Remarks; Your Cooperation Duties

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Design:	Concrete Offset Fascia Mounted	Date:	9/5/2022
Fastening point:	Offset Fascia Mount for RFC238P		

Specifier's comments: Install per manufacturer's recommendations

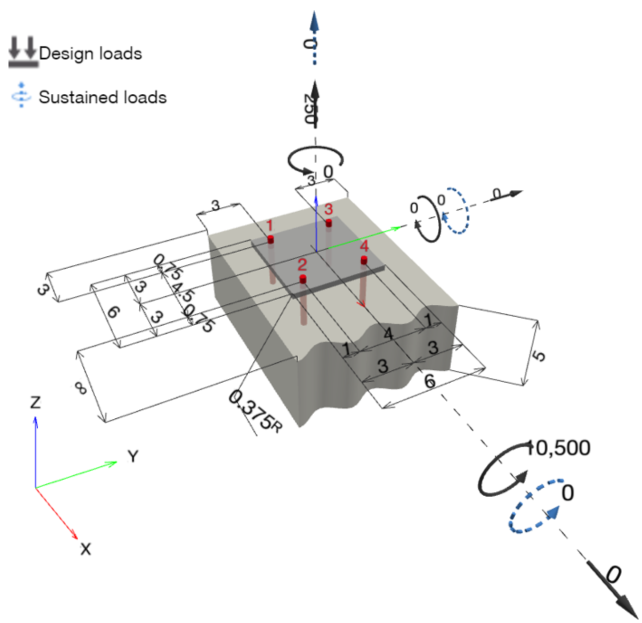
1 Input data

Anchor type and diameter:	**HIT-HY 200 V3 + HIT-Z-R 3/8**
Item number:	2018451 HIT-Z-R 3/8" x 4 3/8" (element) / 2334276 HIT-HY 200-R V3 (adhesive)
Effective embedment depth:	$h_{ef,act}$ = 2.750 in. ($h_{ef,limit}$ = - in.)
Material:	A4
Evaluation Service Report:	ESR-4868
Issued I Valid:	11/1/2021 | 11/1/2022
Proof:	Design Method ACI 318-19 / Chem
Stand-off installation:	e_b = 0.000 in. (no stand-off); t = 0.375 in.
Anchor plate[R] :	l_x x l_y x t = 6.000 in. x 6.000 in. x 0.375 in.; (Recommended plate thickness: not calculated)
Profile:	no profile
Base material:	cracked concrete, 2500, f_c' = 2,500 psi; h = 5.000 in., Temp. short/long: 32/32 °F
Installation:	**hammer drilled hole, Installation condition: Dry**
Reinforcement:	tension: not present, shear: not present; no supplemental splitting reinforcement present
	edge reinforcement: none or < No. 4 bar

Zenith Notes:
1. Depth of concrete shall not be less than 5".
2. Edge distance of concrete from center of anchor bolt shall not be less than 3" on all sides.
3. Minimum compressive strength of concrete shall not be less than 2,500psi.

[R] - The anchor calculation is based on a rigid anchor plate assumption.

Geometry [in.] & Loading [lb, in.lb]



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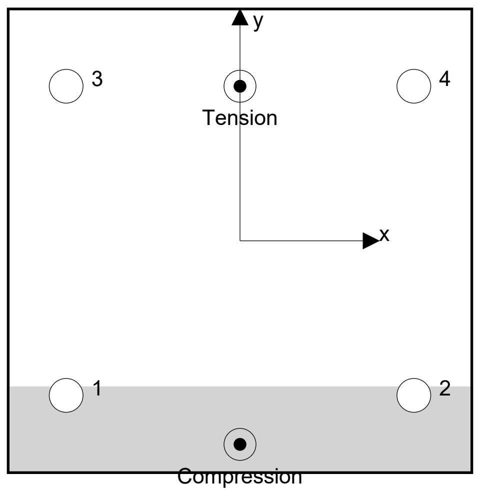
Design:	Concrete Offset Fascia Mounted	Date:	9/5/2022
Fastening point:	Offset Fascia Mount for RFC238P		

1.1 Load combination and design results

Case	Description	Forces [lb] / Moments [in.lb]	Seismic	Max. Util. Anchor [%]
1	Outward	$N = 250; V_x = 0; V_y = 0;$ $M_x = 10{,}500; M_y = 0; M_z = 0;$ $N_{sus} = 0; M_{x,sus} = 0; M_{y,sus} = 0;$	no	86
2	Inward	$N = -250; V_x = 0; V_y = 0;$ $M_x = -10{,}500; M_y = 0; M_z = 0;$ $N_{sus} = 0; M_{x,sus} = 0; M_{y,sus} = 0;$	no	77
3	Downward	$N = 0; V_x = 0; V_y = -250;$ $M_x = 0; M_y = 0; M_z = 0;$ $N_{sus} = 0; M_{x,sus} = 0; M_{y,sus} = 0;$	no	18

2 Load case/Resulting anchor forces

Controlling load case: 1 Outward



Anchor reactions [lb]

Tension force: (+Tension, -Compression)

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	0	0	0	0
2	0	0	0	0
3	1,204	0	0	0
4	1,204	0	0	0

max. concrete compressive strain: 0.15 [‰]
max. concrete compressive stress: 655 [psi]
resulting tension force in (x/y)=(0.000/2.000): 2,408 [lb]
resulting compression force in (x/y)=(0.000/-2.634): 2,158 [lb]

Anchor forces are calculated based on the assumption of a rigid anchor plate.

3 Tension load

	Load N_{ua} [lb]	Capacity ϕ N_n [lb]	Utilization $\beta_N = N_{ua}/\phi$ N_n	Status
Steel Strength*	1,204	4,749	26	OK
Pullout Strength*	1,204	5,169	24	OK
Sustained Tension Load Bond Strength*	N/A	N/A	N/A	N/A
Concrete Breakout Failure**	2,408	2,815	86	OK

* highest loaded anchor **anchor group (anchors in tension)

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Design:	Concrete Offset Fascia Mounted	Date:	9/5/2022
Fastening point:	Offset Fascia Mount for RFC238P		

3.1 Steel Strength

N_{sa} = ESR value refer to ICC-ES ESR-4868

$\phi\ N_{sa} \geq N_{ua}$ ACI 318-19 Table 17.5.2

Variables

$A_{se,N}$ [in.^{2}]	f_{uta} [psi]
0.08	94,200

Calculations

N_{sa} [lb]
7,306

Results

N_{sa} [lb]	ϕ_{steel}	$\phi\ N_{sa}$ [lb]	N_{ua} [lb]
7,306	0.650	4,749	1,204

3.2 Pullout Strength

$N_{pn} = N_p\ \lambda_a$ refer to ICC-ES ESR-4868

$\phi\ N_{pn} \geq N_{ua}$ ACI 318-19 Table 17.5.2

Variables

λ_a	N_p [lb]
1.000	7,952

Calculations

N_{pn} [lb]
7,952

Results

N_{pn} [lb]	$\phi_{concrete}$	$\phi\ N_{pn}$ [lb]	N_{ua} [lb]
7,952	0.650	5,169	1,204

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Fastening point:	Offset Fascia Mount for RFC238P		

3.3 Concrete Breakout Failure

$N_{cbg} = \left(\frac{A_{Nc}}{A_{Nc0}}\right) \psi_{ec,N}\ \psi_{ed,N}\ \psi_{c,N}\ \psi_{cp,N}\ N_b$ — ACI 318-19 Eq. (17.6.2.1b)

$\phi\ N_{cbg} \geq N_{ua}$ — ACI 318-19 Table 17.5.2

A_{Nc} see ACI 318-19, Section 17.6.2.1, Fig. R 17.6.2.1(b)

$A_{Nc0} = 9\ h_{ef}^2$ — ACI 318-19 Eq. (17.6.2.1.4)

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2\ e'_N}{3\ h_{ef}}}\right) \leq 1.0$ — ACI 318-19 Eq. (17.6.2.3.1)

$\psi_{ed,N} = 0.7 + 0.3 \left(\frac{c_{a,min}}{1.5h_{ef}}\right) \leq 1.0$ — ACI 318-19 Eq. (17.6.2.4.1b)

$\psi_{cp,N} = \text{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}}\right) \leq 1.0$ — ACI 318-19 Eq. (17.6.2.6.1b)

$N_b = k_c\ \lambda_a\ \sqrt{f'_c}\ h_{ef}^{1.5}$ — ACI 318-19 Eq. (17.6.2.2.1)

Variables

h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]	$\psi_{c,N}$
2.750	0.000	0.000	3.000	1.000

c_{ac} [in.]	k_c	λ_a	f'_c [psi]
7.050	17	1.000	2,500

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
82.83	68.06	1.000	1.000	0.918	1.000	3,876

Results

N_{cbg} [lb]	$\phi_{concrete}$	$\phi\ N_{cbg}$ [lb]	N_{ua} [lb]
4,331	0.650	2,815	2,408

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Design:	Concrete Offset Fascia Mounted	Date:	9/5/2022
Fastening point:	Offset Fascia Mount for RFC238P		

4 Shear load

	Load V_{ua} [lb]	Capacity ϕ V_n [lb]	Utilization $\beta_V = V_{ua}/\phi$ V_n	Status
Steel Strength*	N/A	N/A	N/A	N/A
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength (Bond Strength controls)*	N/A	N/A	N/A	N/A
Concrete edge failure in direction **	N/A	N/A	N/A	N/A

* highest loaded anchor   **anchor group (relevant anchors)

5 Warnings

- The anchor design methods in PROFIS Engineering require rigid anchor plates per current regulations (AS 5216:2021, ETAG 001/Annex C, EOTA TR029 etc.). This means load re-distribution on the anchors due to elastic deformations of the anchor plate are not considered - the anchor plate is assumed to be sufficiently stiff, in order not to be deformed when subjected to the design loading. PROFIS Engineering calculates the minimum required anchor plate thickness with CBFEM to limit the stress of the anchor plate based on the assumptions explained above. The proof if the rigid anchor plate assumption is valid is not carried out by PROFIS Engineering. Input data and results must be checked for agreement with the existing conditions and for plausibility!
- Condition A applies where the potential concrete failure surfaces are crossed by supplementary reinforcement proportioned to tie the potential concrete failure prism into the structural member. Condition B applies where such supplementary reinforcement is not provided, or where pullout or pryout strength governs.
- Design Strengths of adhesive anchor systems are influenced by the cleaning method. Refer to the INSTRUCTIONS FOR USE given in the Evaluation Service Report for cleaning and installation instructions.
- For additional information about ACI 318 strength design provisions, please go to https://submittals.us.hilti.com/PROFISAnchorDesignGuide/
- Installation of Hilti adhesive anchor systems shall be performed by personnel trained to install Hilti adhesive anchors. Reference ACI 318-19, Section 26.7.

Fastening meets the design criteria!

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Design:	Concrete Offset Fascia Mounted	Date:	9/5/2022
Fastening point:	Offset Fascia Mount for RFC238P		

6 Installation data

Profile: no profile

Hole diameter in the fixture (pre-setting) : d_f = 0.438 in.

Hole diameter in the fixture (through fastening) : d_f = 0.500 in.

Plate thickness (input): 0.375 in.

Recommended plate thickness: not calculated

Drilling method: Hammer drilled

Cleaning: Compressed air cleaning of the drilled hole according to instructions for use is required

Anchor type and diameter: HIT-HY 200 V3 + HIT-Z-R 3/8

Item number: 2018451 HIT-Z-R 3/8" x 4 3/8" (element) / 2334276 HIT-HY 200-R V3 (adhesive)

Maximum installation torque: 354 in.lb

Hole diameter in the base material: 0.438 in.

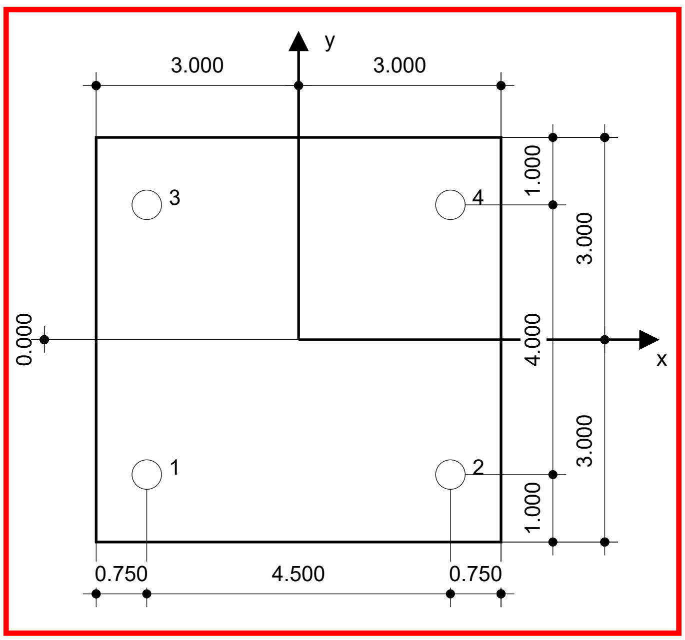
Hole depth in the base material: 2.750 in.

Minimum thickness of the base material: 5.000 in.

3/8 Hilti HIT-Z Stainless steel non-cleaning bonded expansion anchor with Hilti HIT-HY 200 V3 Safe Set System

6.1 Recommended accessories

Drilling	Cleaning	Setting
• Suitable Rotary Hammer • Properly sized drill bit	• -	• Dispenser including cassette and mixer • Torque wrench



Coordinates Anchor [in.]

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	-2.250	-2.000	3.000	-	3.000	7.000
2	2.250	-2.000	7.500	-	3.000	7.000
3	-2.250	2.000	3.000	-	7.000	3.000
4	2.250	2.000	7.500	-	7.000	3.000

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Design:	Concrete Offset Fascia Mounted	Date:	9/5/2022
Fastening point:	Offset Fascia Mount for RFC238P		

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Design:	Concrete Flush Fascia Mounted	Date:	9/5/2022
Fastening point:	Flush Fascia Mount for RFC238P		

Specifier's comments: Install per manufacturer's recommendations

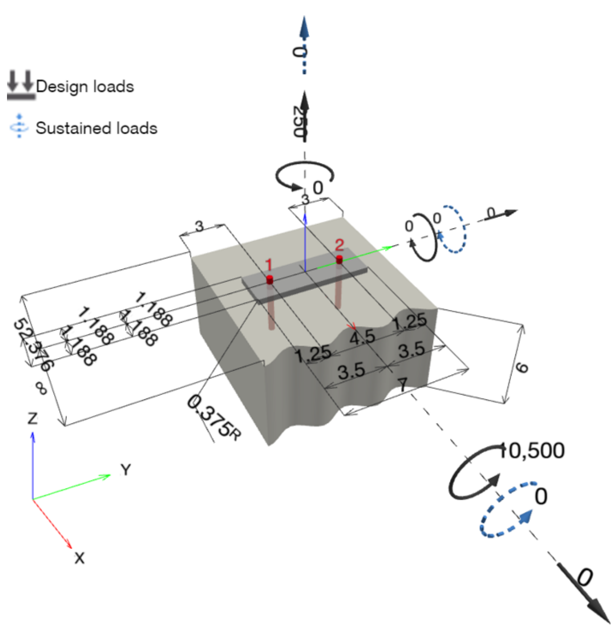
1 Input data

Anchor type and diameter:	**HIT-HY 200 V3 + HIT-Z-R 3/8**
Item number:	2018451 HIT-Z-R 3/8" x 4 3/8" (element) / 2334276 HIT-HY 200-R V3 (adhesive)
Effective embedment depth:	$h_{ef,act}$ = 3.000 in. ($h_{ef,limit}$ = - in.)
Material:	A4
Evaluation Service Report:	ESR-4868
Issued I Valid:	11/1/2021 | 11/1/2022
Proof:	Design Method ACI 318-19 / Chem
Stand-off installation:	e_b = 0.000 in. (no stand-off); t = 0.375 in.
Anchor plate[R] :	l_x x l_y x t = 2.376 in. x 7.000 in. x 0.375 in.; (Recommended plate thickness: not calculated)
Profile:	no profile
Base material:	cracked concrete, 2500, f_c' = 2,500 psi; h = 6.000 in., Temp. short/long: 32/32 °F
Installation:	**hammer drilled hole, Installation condition: Dry**
Reinforcement:	tension: not present, shear: not present; no supplemental splitting reinforcement present edge reinforcement: none or < No. 4 bar

Zenith Notes:
1. Depth of concrete shall not be less than 6".
2. Edge distance of concrete from center of anchor bolt shall not be less than 3" on all sides.
3. Minimum compressive strength of concrete shall not be less than 2,500psi.

[R] - The anchor calculation is based on a rigid anchor plate assumption.

Geometry [in.] & Loading [lb, in.lb]



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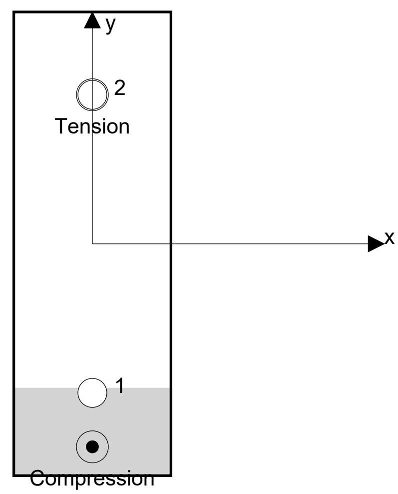
Design:	Concrete Flush Fascia Mounted	Date:	9/5/2022
Fastening point:	Flush Fascia Mount for RFC238P		

1.1 Load combination and design results

Case	Description	Forces [lb] / Moments [in.lb]	Seismic	Max. Util. Anchor [%]
1	Outward	$N = 250; V_x = 0; V_y = 0;$ $M_x = 10,500; M_y = 0; M_z = 0;$ $N_{sus} = 0; M_{x,sus} = 0; M_{y,sus} = 0;$	no	99
2	Inward	$N = -250; V_x = 0; V_y = 0;$ $M_x = -10,500; M_y = 0; M_z = 0;$ $N_{sus} = 0; M_{x,sus} = 0; M_{y,sus} = 0;$	no	86
3	Downward	$N = 0; V_x = 0; V_y = -250;$ $M_x = 0; M_y = 0; M_z = 0;$ $N_{sus} = 0; M_{x,sus} = 0; M_{y,sus} = 0;$	no	22

2 Load case/Resulting anchor forces

Controlling load case: 1 Outward



Anchor reactions [lb]

Tension force: (+Tension, -Compression)

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	0	0	0	0
2	2,120	0	0	0

max. concrete compressive strain:	0.28 [‰]
max. concrete compressive stress:	1,205 [psi]
resulting tension force in (x/y)=(0.000/2.250):	2,120 [lb]
resulting compression force in (x/y)=(0.000/-3.065):	1,870 [lb]

Anchor forces are calculated based on the assumption of a rigid anchor plate.

3 Tension load

	Load N_{ua} [lb]	Capacity ϕ N_n [lb]	Utilization $\beta_N = N_{ua}/\phi$ N_n	Status
Steel Strength*	2,120	4,749	45	OK
Pullout Strength*	2,120	5,169	42	OK
Sustained Tension Load Bond Strength*	N/A	N/A	N/A	N/A
Concrete Breakout Failure**	2,120	2,153	99	OK

* highest loaded anchor **anchor group (anchors in tension)

Hilti PROFIS Engineering 3.0.79

www.hilti.com

Company:	Zenith Engineers	Page:	3
Address:	22320 Foothill Blvd, Suite 600, Hayward, CA 94541	Specifier:	
Phone I Fax:	415 619 6000 | 415 500 9583	E-Mail:	irina@zenithengineers.com
Design:	Concrete Flush Fascia Mounted	Date:	9/5/2022
Fastening point:	Flush Fascia Mount for RFC238P		

3.1 Steel Strength

N_{sa} = ESR value refer to ICC-ES ESR-4868

$\phi\ N_{sa} \geq N_{ua}$ ACI 318-19 Table 17.5.2

Variables

$A_{se,N}$ [in.^{2}]	f_{uta} [psi]
0.08	94,200

Calculations

N_{sa} [lb]
7,306

Results

N_{sa} [lb]	ϕ_{steel}	$\phi\ N_{sa}$ [lb]	N_{ua} [lb]
7,306	0.650	4,749	2,120

3.2 Pullout Strength

$N_{pn} = N_p\ \lambda_a$ refer to ICC-ES ESR-4868

$\phi\ N_{pn} \geq N_{ua}$ ACI 318-19 Table 17.5.2

Variables

λ_a	N_p [lb]
1.000	7,952

Calculations

N_{pn} [lb]
7,952

Results

N_{pn} [lb]	$\phi_{concrete}$	$\phi\ N_{pn}$ [lb]	N_{ua} [lb]
7,952	0.650	5,169	2,120

Hilti PROFIS Engineering 3.0.79

www.hilti.com

Company:	Zenith Engineers	Page:	4
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Phone I Fax:	415 619 6000 | 415 500 9583	E-Mail:	irina@zenithengineers.com
Design:	Concrete Flush Fascia Mounted	Date:	9/5/2022
Fastening point:	Flush Fascia Mount for RFC238P		

3.3 Concrete Breakout Failure

$N_{cbg} = \left(\frac{A_{Nc}}{A_{Nc0}}\right) \psi_{ec,N}\ \psi_{ed,N}\ \psi_{c,N}\ \psi_{cp,N}\ N_b$ — ACI 318-19 Eq. (17.6.2.1b)

$\phi\ N_{cbg} \geq N_{ua}$ — ACI 318-19 Table 17.5.2

A_{Nc} see ACI 318-19, Section 17.6.2.1, Fig. R 17.6.2.1(b)

$A_{Nc0} = 9\ h_{ef}^2$ — ACI 318-19 Eq. (17.6.2.1.4)

$\psi_{ec,N} = \left(\frac{1}{1 + \frac{2\ e'_N}{3\ h_{ef}}}\right) \leq 1.0$ — ACI 318-19 Eq. (17.6.2.3.1)

$\psi_{ed,N} = 0.7 + 0.3\left(\frac{c_{a,min}}{1.5h_{ef}}\right) \leq 1.0$ — ACI 318-19 Eq. (17.6.2.4.1b)

$\psi_{cp,N} = \text{MAX}\left(\frac{c_{a,min}}{c_{ac}}, \frac{1.5h_{ef}}{c_{ac}}\right) \leq 1.0$ — ACI 318-19 Eq. (17.6.2.6.1b)

$N_b = k_c\ \lambda_a\ \sqrt{f'_c}\ h_{ef}^{1.5}$ — ACI 318-19 Eq. (17.6.2.2.1)

Variables

h_{ef} [in.]	$e_{c1,N}$ [in.]	$e_{c2,N}$ [in.]	$c_{a,min}$ [in.]	$\psi_{c,N}$
3.000	0.000	0.000	3.000	1.000

c_{ac} [in.]	k_c	λ_a	f'_c [psi]
6.600	17	1.000	2,500

Calculations

A_{Nc} [in.^{2}]	A_{Nc0} [in.^{2}]	$\psi_{ec1,N}$	$\psi_{ec2,N}$	$\psi_{ed,N}$	$\psi_{cp,N}$	N_b [lb]
67.50	81.00	1.000	1.000	0.900	1.000	4,417

Results

N_{cbg} [lb]	$\phi_{concrete}$	$\phi\ N_{cbg}$ [lb]	N_{ua} [lb]
3,313	0.650	2,153	2,120

Hilti PROFIS Engineering 3.0.79

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Company:	Zenith Engineers	Page:	5
Address:	22320 Foothill Blvd, Suite 600, Hayward, CA 94541	Specifier:	
Phone I Fax:	415 619 6000 | 415 500 9583	E-Mail:	irina@zenithengineers.com
Design:	Concrete Flush Fascia Mounted	Date:	9/5/2022
Fastening point:	Flush Fascia Mount for RFC238P		

4 Shear load

	Load V_{ua} [lb]	Capacity ϕ V_n [lb]	Utilization $\beta_V = V_{ua}/\phi$ V_n	Status
Steel Strength*	N/A	N/A	N/A	N/A
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength (Bond Strength controls)*	N/A	N/A	N/A	N/A
Concrete edge failure in direction **	N/A	N/A	N/A	N/A

* highest loaded anchor **anchor group (relevant anchors)

5 Warnings

- The anchor design methods in PROFIS Engineering require rigid anchor plates per current regulations (AS 5216:2021, ETAG 001/Annex C, EOTA TR029 etc.). This means load re-distribution on the anchors due to elastic deformations of the anchor plate are not considered - the anchor plate is assumed to be sufficiently stiff, in order not to be deformed when subjected to the design loading. PROFIS Engineering calculates the minimum required anchor plate thickness with CBFEM to limit the stress of the anchor plate based on the assumptions explained above. The proof if the rigid anchor plate assumption is valid is not carried out by PROFIS Engineering. Input data and results must be checked for agreement with the existing conditions and for plausibility!
- Condition A applies where the potential concrete failure surfaces are crossed by supplementary reinforcement proportioned to tie the potential concrete failure prism into the structural member. Condition B applies where such supplementary reinforcement is not provided, or where pullout or pryout strength governs.
- Design Strengths of adhesive anchor systems are influenced by the cleaning method. Refer to the INSTRUCTIONS FOR USE given in the Evaluation Service Report for cleaning and installation instructions.
- For additional information about ACI 318 strength design provisions, please go to https://submittals.us.hilti.com/PROFISAnchorDesignGuide/
- Installation of Hilti adhesive anchor systems shall be performed by personnel trained to install Hilti adhesive anchors. Reference ACI 318-19, Section 26.7.

Fastening meets the design criteria!

Hilti PROFIS Engineering 3.0.79

www.hilti.com

Company:	Zenith Engineers	Page:	6
Address:	22320 Foothill Blvd, Suite 600, Hayward, CA 94541	Specifier:	
Phone I Fax:	415 619 6000 | 415 500 9583	E-Mail:	irina@zenithengineers.com
Design:	Concrete Flush Fascia Mounted	Date:	9/5/2022
Fastening point:	Flush Fascia Mount for RFC238P		

6 Installation data

Profile: no profile

Hole diameter in the fixture (pre-setting) : d_f = 0.438 in.

Hole diameter in the fixture (through fastening) : d_f = 0.500 in.

Plate thickness (input): 0.375 in.

Recommended plate thickness: not calculated

Drilling method: Hammer drilled

Cleaning: Compressed air cleaning of the drilled hole according to instructions for use is required

Anchor type and diameter: HIT-HY 200 V3 + HIT-Z-R 3/8

Item number: 2018451 HIT-Z-R 3/8" x 4 3/8" (element) / 2334276 HIT-HY 200-R V3 (adhesive)

Maximum installation torque: 354 in.lb

Hole diameter in the base material: 0.438 in.

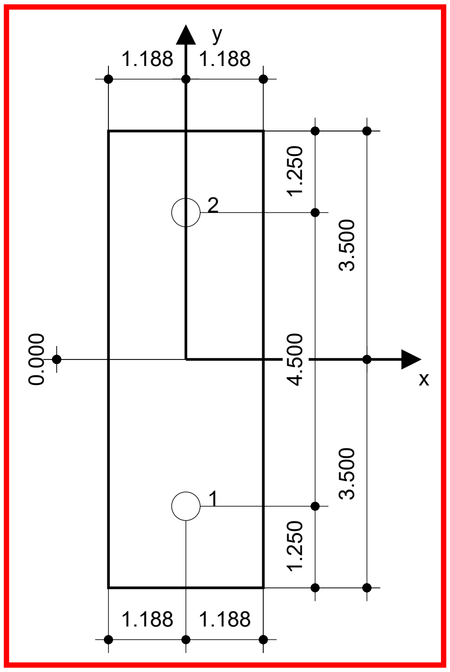
Hole depth in the base material: 3.000 in.

Minimum thickness of the base material: 5.250 in.

3/8 Hilti HIT-Z Stainless steel non-cleaning bonded expansion anchor with Hilti HIT-HY 200 V3 Safe Set System

6.1 Recommended accessories

Drilling	Cleaning	Setting
• Suitable Rotary Hammer • Properly sized drill bit	• -	• Dispenser including cassette and mixer • Torque wrench



Coordinates Anchor [in.]

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	0.000	-2.250	5.000	-	3.000	7.500
2	0.000	2.250	5.000	-	7.500	3.000

Company:	Zenith Engineers	Page:	7
Address:	22320 Foothill Blvd, Suite 600, Hayward, CA 94541	Specifier:	
Phone I Fax:	415 619 6000 | 415 500 9583	E-Mail:	irina@zenithengineers.com
Design:	Concrete Flush Fascia Mounted	Date:	9/5/2022
Fastening point:	Flush Fascia Mount for RFC238P		

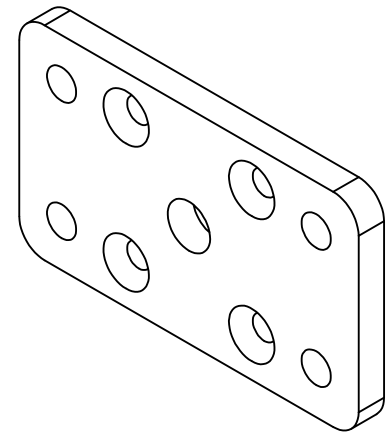
7 Remarks; Your Cooperation Duties

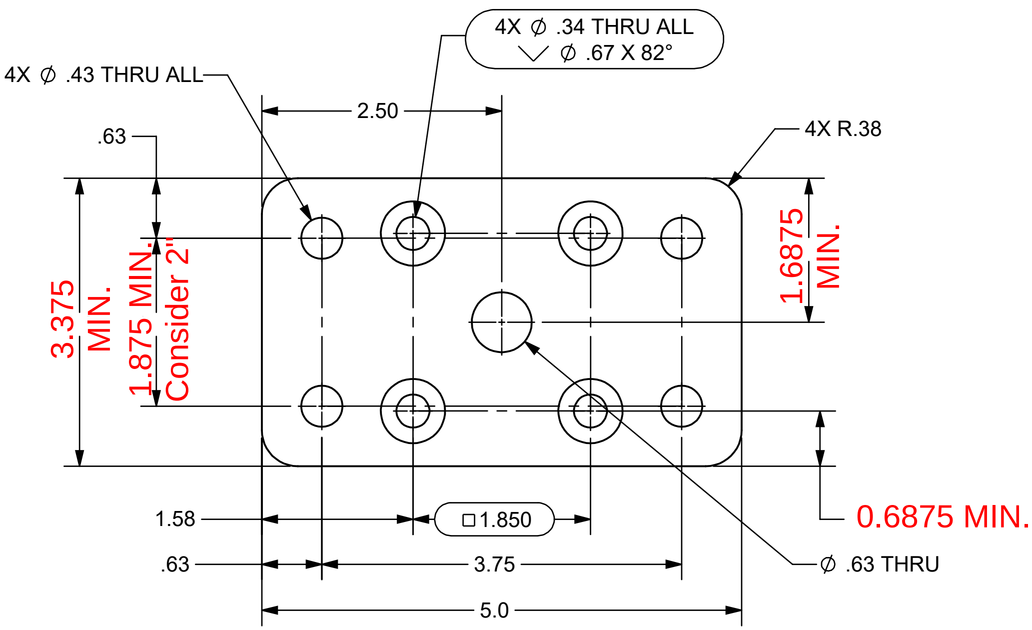
- Any and all information and data contained in the Software concern solely the use of Hilti products and are based on the principles, formulas and security regulations in accordance with Hilti's technical directions and operating, mounting and assembly instructions, etc., that must be strictly complied with by the user. All figures contained therein are average figures, and therefore use-specific tests are to be conducted prior to using the relevant Hilti product. The results of the calculations carried out by means of the Software are based essentially on the data you put in. Therefore, you bear the sole responsibility for the absence of errors, the completeness and the relevance of the data to be put in by you. Moreover, you bear sole responsibility for having the results of the calculation checked and cleared by an expert, particularly with regard to compliance with applicable norms and permits, prior to using them for your specific facility. The Software serves only as an aid to interpret norms and permits without any guarantee as to the absence of errors, the correctness and the relevance of the results or suitability for a specific application.
- You must take all necessary and reasonable steps to prevent or limit damage caused by the Software. In particular, you must arrange for the regular backup of programs and data and, if applicable, carry out the updates of the Software offered by Hilti on a regular basis. If you do not use the AutoUpdate function of the Software, you must ensure that you are using the current and thus up-to-date version of the Software in each case by carrying out manual updates via the Hilti Website. Hilti will not be liable for consequences, such as the recovery of lost or damaged data or programs, arising from a culpable breach of duty by you.

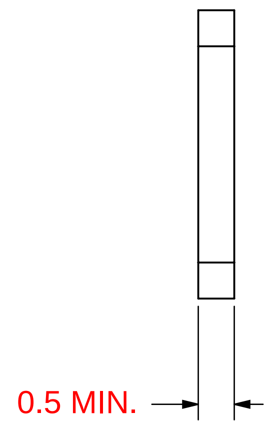
PART NUMBER	FINISH	SPECS	L	a	b	G	THK
RFXBP3X5-MI	MILL	RAW					
RFXBP3X5-BL	BLACK	AAMA 2604 / INTERPON D2000	25.13	0.11	-0.08	35.7	
RFXBP3X5-BZ	BRONZE	AAMA 2604 / INTERPON D2000	32.77	0.73	2.55	40.2	
RFXBP3X5-WH	WHITE	AAMA 2604 / INTERPON D2000	92.45	-0.83	1.6	6.9	
RFXBP3X5-SI	SILVER	AAMA 2604 / INTERPON D2000	87.3	-0.69	1.6	6.9	
RFXBP3X5-AN	ANODIZED	215R 1 CLASS 1 CLEAR	87.3	-0.69	1.6	6.9	

REVISIONS

ECR/DCR	REV.	DESCRIPTION	DATE	APPD
21-021	A	INITIAL RELEASE	4-16-21	MRC
21-091	B	CLARIFIED DIMENSIONAL INFORMATION, ADDED CENTER HOLE, MODIFED GENRAL NOTES, 3.0 WAS 3.00, 5.0 WAS 5.00	11-16-21	CMM







Provide 3/8" anchors with Min. 3.75" embedment in Min. 6" concrete slab. Min. 5" edge distance for anchors is required.

NOTES:

1. *PART TO HAVE A NON-ABRASIVE FINISH.*
2. *PART TO HAVE MIN. DRAFT ANGLE AS TOOLING REQUIRES.*
3. *ANY AND ALL CHANGES TO MATERIAL OR FINISH MUST BE APPROVED BY NWI.*
4. *ALL DIAMETERS TO BE CONCENTRIC WITHIN .005 UNLESS OTHERWISE SPECIFIED.*
5. *ALL CORNERS TO BE .015 MAX R OR CHAMFER OR OTHERWISE NOTED.*
6. *ALL DIMENSIONS ARE FINISHED PART DIMENSIONS.*
7. *POWDERCOAT FINISH TO BE INTERPON 600 OR NWI APPROVED EQUIVALENT.*
8. *REMOVE ALL BURRS, BREAK CORNERS, AND SHARP EDGES.*
9. *NO FLASH ALLOWED.*
10. *PART VOLUME: 5.02 CU. IN.*
11. *(XXXXXXX) DENOTES CRITICAL TO FUNCTION*

***PART NUMBER**: RFXBP3X5-XX*

DIMENSIONS ARE IN INCHES
TOLERANCES:
FRACTIONAL ±1/16"
ANGULAR: MACH ±1° BEND ±1°
ONE PLACE DECIMAL ±0.03
TWO PLACE DECIMAL ±0.01
THREE PLACE DECIMAL ±0.005

MATERIAL: *6061-T6*

FINISH: *VARIOUS*

DO NOT SCALE DRAWING

	NAME	DATE
DRAWN	*MRC*	*04/16/21*
CHECKED	.	.
ENG APPR.		
MFG APPR.		
Q.A.		

COMMENTS:

RailFX CABLE + SPECIALTY

RFX 3X5 SURFACE MOUNT BASE PLATE

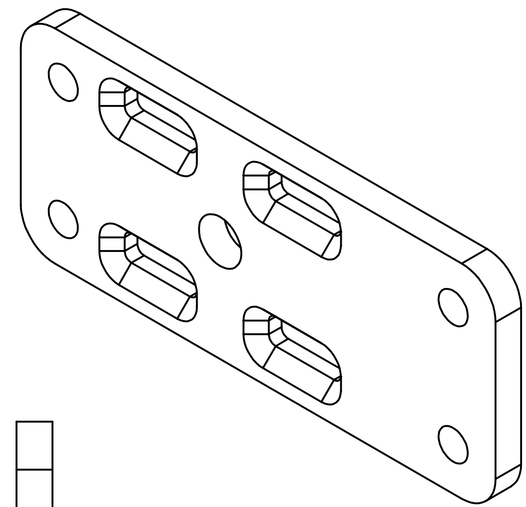
SIZE: A | DWG. NO.: **RFXBP3X5-XX** | REV.: B

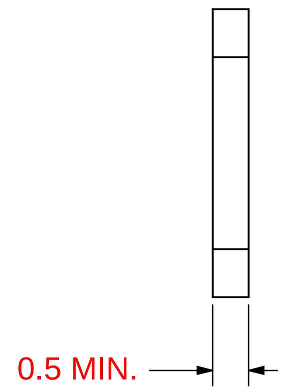
SCALE: 1:2 | WEIGHT: | SHEET 1 OF 1

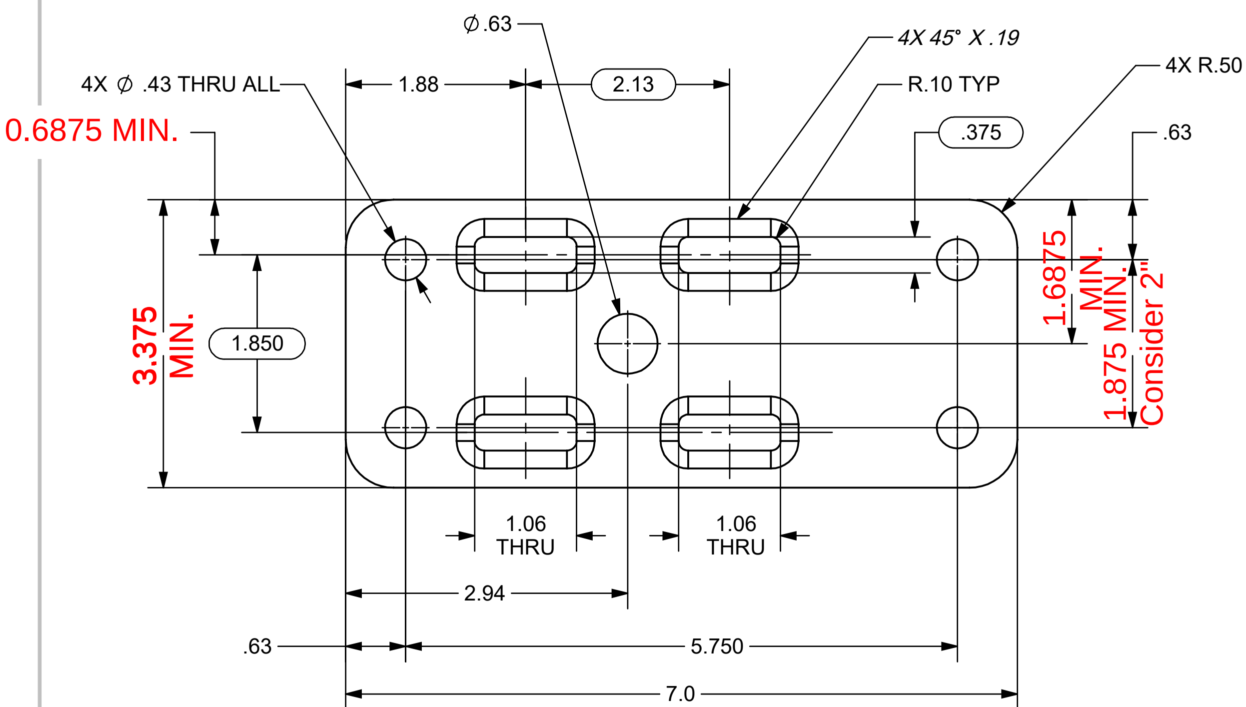
PART NUMBER	FINISH	SPECS	L	a	b	G	THK
RFXBP3X74H-BL	BLACK	AAMA 2604 / INTERPON D2000	25.13	0.11	-0.08	35.7	
RFXBP3X74H-BZ	BRONZE	AAMA 2604 / INTERPON D2000	32.77	0.73	2.55	40.2	
RFXBP3X74H-SI	SILVER	AAMA 2604 / INTERPON D2000	87.3	-0.69	1.6	6.9	
RFXBP3X74H-WH	WHITE	AAMA 2604 / INTERPON D2000	92.45	-0.83	1.6	6.9	

REVISIONS

ECR/DCR	REV.	DESCRIPTION	DATE	APPD
21-021	A	INITIAL RELEASE	4-16-21	MRC
21-021	B	UPDATED SLOT RADIUS TO .100	5-05-21	MRC
21-091	C	CLARIFIED DIMENSIONAL INFORMATION, ADDED CENTER DRAIN HOLE, MODIFIED GENERAL NOTES, 3.0 WAS 3.00, 7.0 WAS 7.00	11-16-21	CMM







Provide 3/8" anchors with Min. 3.75" embedment in Min. 6" concrete slab. Min. 5" edge distance for anchors is required.

NOTES:
1. IT IS STRUCTURALLY ACCEPTABLE TO PROVIDE SLOTTED HOLES IN THE LONGITUDINAL DIRECTION TO ACCOMODATE THE ATTACHMENT OF SLOPED BASE PLATE AND VERTICAL POST AT INTERMEDIATE POSTS ONLY AND NOT AT THE END OF THE STAIR RAILS.

NOTES:

1. *PART TO HAVE A NON-ABRASIVE FINISH.*
2. *PART TO HAVE MIN. DRAFT ANGLE AS TOOLING REQUIRES.*
3. *ANY AND ALL CHANGES TO MATERIAL OR FINISH MUST BE APPROVED BY NWI.*
4. *ALL DIAMETERS TO BE CONCENTRIC WITHIN .005 UNLESS OTHERWISE SPECIFIED.*
5. *ALL CORNERS TO BE .015 MAX R OR CHAMFER OR OTHERWISE NOTED.*
6. *ALL DIMENSIONS ARE FINISHED PART DIMENSIONS.*
7. *POWDERCOAT FINISH TO BE INTERPON 600 OR NWI APPROVED EQUIVALENT.*
8. *REMOVE ALL BURRS, BREAK CORNERS, AND SHARP EDGES.*
9. *NO FLASH ALLOWED.*
10. *PART VOLUME: 6.66 CU. IN.*
11. *(XXXXXXX) DENOTES CRITICAL TO FUNCTION*

***PART NUMBER**: RFXBP3X74H-XX*

DIMENSIONS ARE IN INCHES
TOLERANCES:
FRACTIONAL ±1/16"
ANGULAR: MACH ±1° BEND ±1°
ONE PLACE DECIMAL ±0.03
TWO PLACE DECIMAL ±0.01
THREE PLACE DECIMAL ±0.005

MATERIAL: 6061-T6 AL
FINISH: VARIOUS
DO NOT SCALE DRAWING

	NAME	DATE
DRAWN	MRC	04/16/21
CHECKED	.	.
ENG APPR.		
MFG APPR.		
Q.A.		

COMMENTS:

RailFX CABLE • SPECIALTY

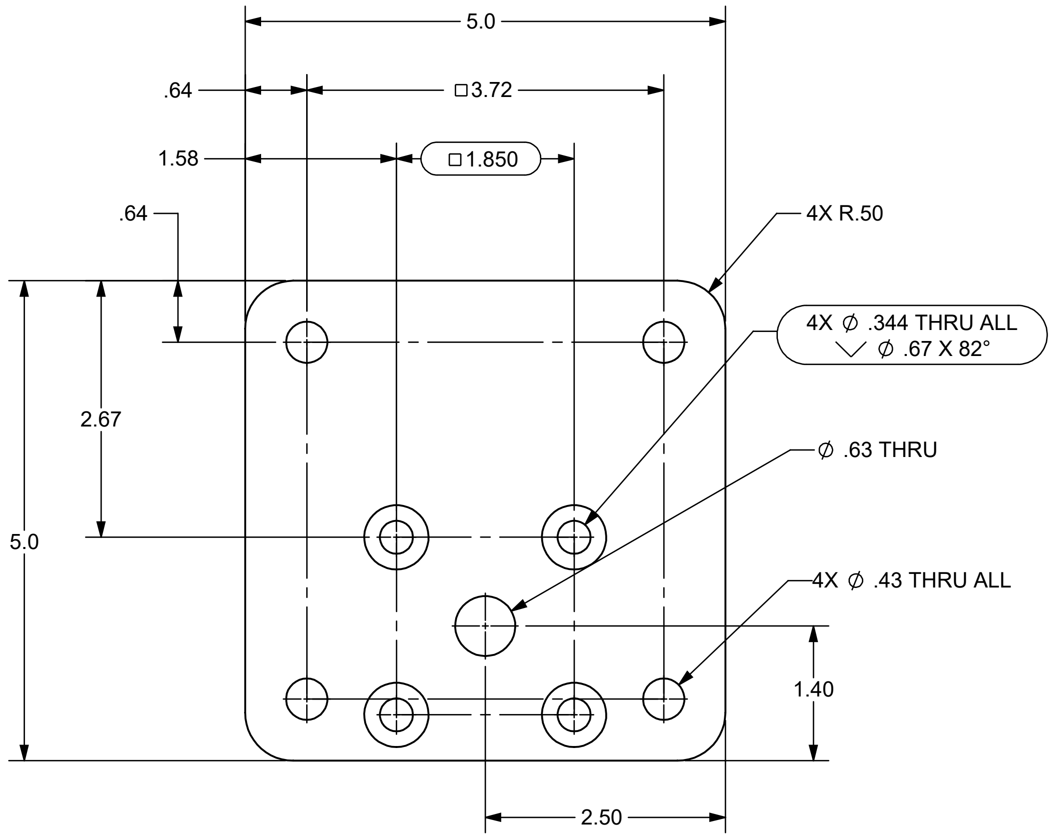
RFX 3X7 SURFACE MOUNT BASE PLATE

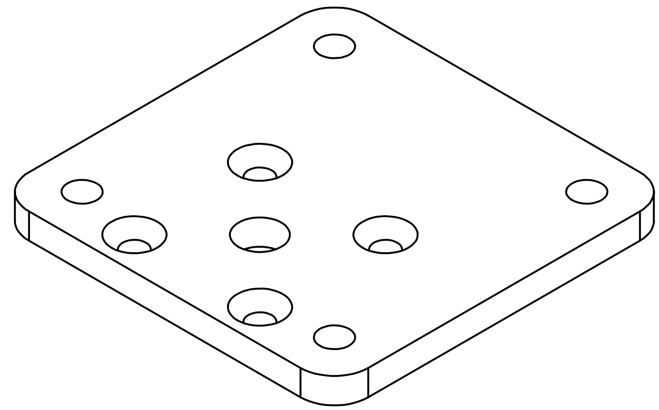
SIZE A | DWG. NO. RFXBP3X74H-XX | REV. C

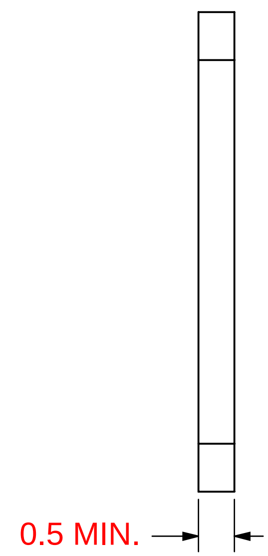
SCALE:1:2 | WEIGHT: | SHEET 1 OF 1

PART NUMBER	FINISH	SPECS	L	a	b	G
RFXBP5X5OS-MI	MILL	RAW				
RFXBP5X5OS-BL	BLACK	PAINTED	25.13	0.11	-0.08	35.7
RFXBP5X5OS-BZ	BRONZE	PAINTED	32.77	0.73	2.55	40.2
RFXBP5X5OS-WH	WHITE	PAINTED	92.45	-0.83	2.13	51.9
RFXBP5X5OS-SI	SILVER	PAINTED	87.3	-0.69	1.6	6.9
RFXBP5X5OS-AN	ANODIZED	ANODIZED	87.3	-0.69	1.6	6.9

REVISIONS				
ECR/DCR	REV.	DESCRIPTION	DATE	APPD
21-031	A	INITIAL RELEASE	10-18-21	CMM
21-091	B	CLARIFIED DIMENSIONAL INFORMATION, ADDED DRAIN HOLE, MODIFIED GENERAL NOTES, 3.72 WAS 3.717, 1.850 WAS 1.85. 5.0 WAS 5.00	11-16-21	CMM







Provide 3/8" anchors with Min. 3" embedment in Min. 5.25" concrete slab. Min. 5" edge distance for anchors is required.

NOTES:

1. *PART TO HAVE A NON-ABRASIVE FINISH.*
2. *PART TO HAVE MIN. DRAFT ANGLE AS TOOLING REQUIRES.*
3. *ANY AND ALL CHANGES TO MATERIAL OR FINISH MUST BE APPROVED BY NWI.*
4. *ALL DIAMETERS TO BE CONCENTRIC WITHIN .005 UNLESS OTHERWISE SPECIFIED.*
5. *ALL CORNERS TO BE .015 MAX R OR CHAMFER OR OTHERWISE NOTED.*
6. *ALL DIMENSIONS ARE FINISHED PART DIMENSIONS.*
7. *POWDERCOAT FINISH TO BE INTERPON 600 OR NWI APPROVED EQUIVALENT.*
8. *REMOVE ALL BURRS, BREAK CORNERS, AND SHARP EDGES.*
9. *NO FLASH ALLOWED.*
10. *PART VOLUME: 8.74 CU. IN.*
11. *(XXXXXXX) DENOTES CRITICAL TO FUNCTION*

DIMENSIONS ARE IN INCHES
TOLERANCES:
FRACTIONAL ±1/16"
ANGULAR: MACH ±1° BEND ±1°
ONE PLACE DECIMAL ±0.03
TWO PLACE DECIMAL ±0.01
THREE PLACE DECIMAL ±0.005

MATERIAL: *6061-T6 ALUMINUM*

FINISH: *VARIOUS*

DO NOT SCALE DRAWING

	NAME	DATE
DRAWN	*MRC*	*5-25-21*
CHECKED		
ENG APPR.		
MFG APPR.		
Q.A.		

COMMENTS:

RailFX CABLE - SPECIALTY

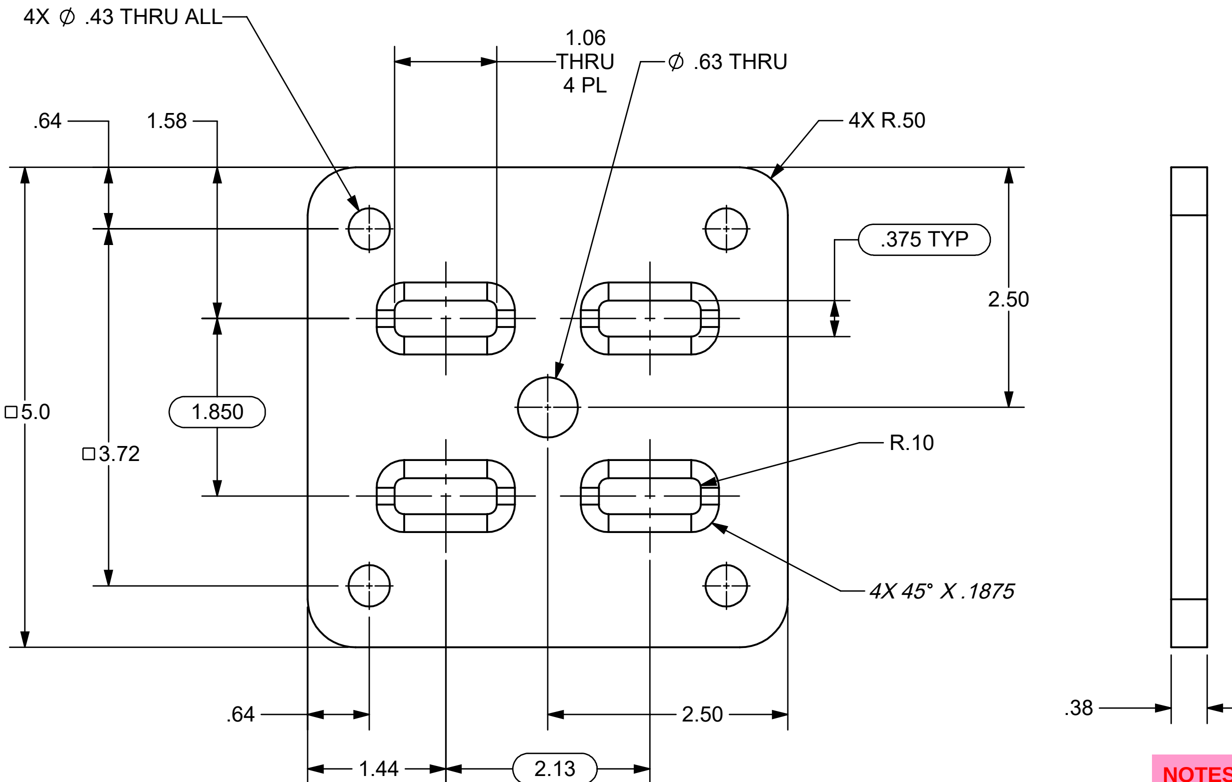
RFX 5X5 OFFSET BASE PLATE

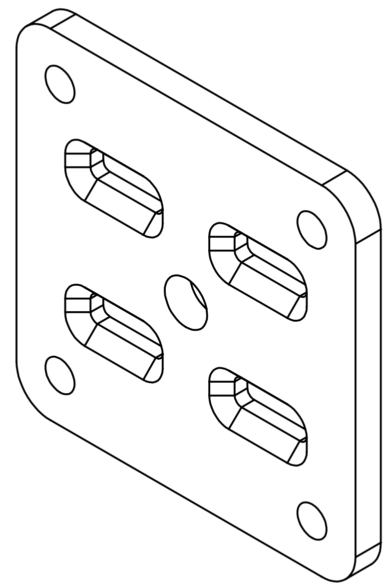
SIZE A | DWG. NO. **RFXBP5X5OS** | REV. B

SCALE: 1:1 | WEIGHT: | SHEET 1 OF 1

PART NUMBER	FINISH	SPECS	L	a	b	G
RFXBP5X5S-MI	MILL	RAW				
RFXBP5X5S-BL	BLACK	AAMA 2604 / INTERPON D2000	25.13	0.11	-0.08	35.7
RFXBP5X5S-BZ	BRONZE	AAMA 2604 / INTERPON D2000	32.77	0.73	2.55	40.2
RFXBP5X5S-WH	WHITE	AAMA 2604 / INTERPON D2000	92.45	-0.83	1.6	6.9
RFXBP5X5S-SI	SILVER	AAMA 2604 / INTERPON D2000	87.3	-0.69	1.6	6.9
RFXBP5X5S-AN	ANODIZED	215R 1 CLASS 1 CLEAR	87.3	-0.69	1.6	6.9

REVISIONS				
ZONE	REV.	DESCRIPTION	DATE	APPD
21-021	A	INITIAL RELEASE	4-16-21	MRC
21-021	B	UPDATED SLOT RADIUS TO .100	5-05-21	MRC
21-091	C	CLARIFIED DIMENSIONAL INFORMATION, ADDED CENTER DRAIN HOLE, MODIFIED GENERAL NOTES, 3.72 WAS 3.717, 5.0 WAS 5.00	11-16-21	CMM





Provide 3/8" anchors with Min. 2.75" embedment in Min. 5" concrete slab. Min. 5" edge distance for anchors is required.

NOTES:
1. IT IS STRUCTURALLY ACCEPTABLE TO PROVIDE SLOTTED HOLES IN THE LONGITUDINAL DIRECTION TO ACCOMODATE THE ATTACHMENT OF SLOPED BASE PLATE AND VERTICAL POST AT INTERMEDIATE POSTS ONLY AND NOT AT THE END OF THE STAIR RAILS.

NOTES:

1. *PART TO HAVE A NON-ABRASIVE FINISH.*
2. *PART TO HAVE MIN. DRAFT ANGLE AS TOOLING REQUIRES.*
3. *ANY AND ALL CHANGES TO MATERIAL OR FINISH MUST BE APPROVED BY NWI.*
4. *ALL DIAMETERS TO BE CONCENTRIC WITHIN .005 UNLESS OTHERWISE SPECIFIED.*
5. *ALL CORNERS TO BE .015 MAX R OR CHAMFER OR OTHERWISE NOTED.*
6. *ALL DIMENSIONS ARE FINISHED PART DIMENSIONS.*
7. *POWDERCOAT FINISH TO BE INTERPON 600 OR NWI APPROVED EQUIVALENT.*
8. *REMOVE ALL BURRS, BREAK CORNERS, AND SHARP EDGES.*
9. *NO FLASH ALLOWED.*
10. *PART VOLUME: 8.16 CU. IN.*
11. *(XXXXXXX) DENOTES CRITICAL TO FUNCTION*

DIMENSIONS ARE IN INCHES
TOLERANCES:
FRACTIONAL ±1/16"
ANGULAR: MACH ±1° BEND ±1°
ONE PLACE DECIMAL ±0.03
TWO PLACE DECIMAL ±0.01
THREE PLACE DECIMAL ±0.005

MATERIAL: 6061-T6
FINISH: VARIOUS
DO NOT SCALE DRAWING

	NAME	DATE
DRAWN	MRC	4/16/21
CHECKED	.	.
ENG APPR.		
MFG APPR.		
Q.A.		

COMMENTS:

RailFX CABLE • SPECIALTY

RFX 5X5 SLOTTED SURFACE MOUNT BASE PLATE

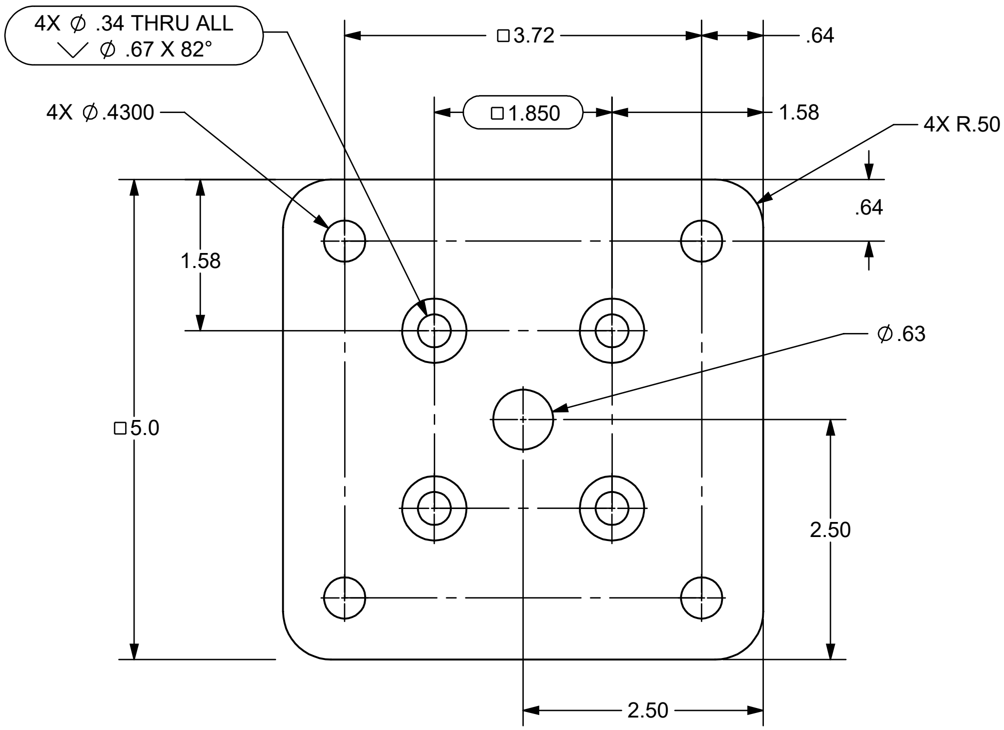
SIZE: A | DWG. NO.: RFXBP5X5S | REV. C

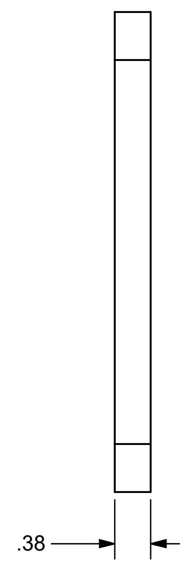
SCALE:1:2 | WEIGHT: | SHEET 1 OF 1

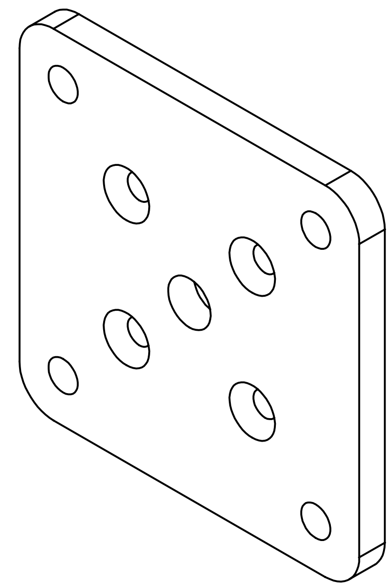
PART NUMBER	XX-FINISH	SPECS	L	a	b	G	THK
RFXBP5X5-MI	MILL	RAW					
RFXBP5X5-BL	BLACK	AAMA 2604 / INTERPON D2000	25.13	0.11	-0.08	35.7	
RFXBP5X5-BZ	BRONZE	AAMA 2604 / INTERPON D2000	32.77	0.73	2.55	40.2	
RFXBP5X5-WH	WHITE	AAMA 2604 / INTERPON D2000	92.45	-0.83	1.6	6.9	
RFXBP5X5-SI	SILVER	AAMA 2604 / INTERPON D2000	87.3	-0.69	1.6	6.9	
RFXBP5X5-AN	ANODIZED	215R 1 CLASS 1 CLEAR	87.3	-0.69	1.6	6.9	

REVISIONS

ECR/DCR	REV.	DESCRIPTION	DATE	APPD
-	1	INITIAL RELEASE	3-11-18	DHL
-	2	ADDED WIRING HOLE	6-26-19	DHL
21-015	3	UPDATED TOLERANCES FOR MANUFACTURING PROCESS	3-31-21	MRC
21-021	A	INITIAL RELEASE	4-16-21	MRC
21-091	B	CLARIFIED DIMENSIONAL INFORMATION, MODIFIED GENERAL NOTES, .38 WAS .375, 3.72 WAS 3.717, 5.0 WAS 5.00	11-16-21	CMM







Provide 3/8" anchors with Min. 2.75" embedment in Min. 5" concrete slab. Min. 5" edge distance for anchors is required.

NOTES:

1. *PART TO HAVE A NON-ABRASIVE FINISH.*
2. *PART TO HAVE MIN. DRAFT ANGLE AS TOOLING REQUIRES.*
3. *ANY AND ALL CHANGES TO MATERIAL OR FINISH MUST BE APPROVED BY NWI.*
4. *ALL DIAMETERS TO BE CONCENTRIC WITHIN .005 UNLESS OTHERWISE SPECIFIED.*
5. *ALL CORNERS TO BE .015 MAX R OR CHAMFER OR OTHERWISE NOTED.*
6. *ALL DIMENSIONS ARE FINISHED PART DIMENSIONS.*
7. *POWDERCOAT FINISH TO BE INTERPON 600 OR NWI APPROVED EQUIVALENT.*
8. *REMOVE ALL BURRS, BREAK CORNERS, AND SHARP EDGES.*
9. *NO FLASH ALLOWED.*
10. *PART VOLUME: 8.74 CU. IN.*
11. *(XXXXXXX) DENOTES CRITICAL TO FUNCTION*

***PART NUMBER**: RFXBP5X5-XX*

DIMENSIONS ARE IN INCHES
TOLERANCES:
FRACTIONAL ±1/16"
ANGULAR: MACH ±1° BEND ±1°
ONE PLACE DECIMAL ±0.03
TWO PLACE DECIMAL ±0.01
THREE PLACE DECIMAL ±0.005

MATERIAL *6061-T6*

FINISH *VARIOUS*

DO NOT SCALE DRAWING

	NAME	DATE
DRAWN	*MRC*	*04/16/21*
CHECKED	.	.
ENG APPR.		
MFG APPR.		
Q.A.		

COMMENTS:

RailFX CABLE • SPECIALTY

RFX 5X5 SURFACE MOUNT BASE PLATE

SIZE **A** DWG. NO. **RFXBP5X5-XX** REV. **B**

SCALE:1:2 WEIGHT: SHEET 1 OF 1

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6. WOOD ANCHOR CONNECTION FOR RFX238P POST

Consider short-term loading in wet enviroment & wood shall be Douglas-Fir or better:

$G := 0.5$ (Specific Gravity of wood member)

$D := \frac{3}{8}$ (Diameter of Lag Screw)

$C_D := 1.6$ $C_m := 0.7$ $C_t := 1.0$ $K_w := 1800$

$W_{3\_8\_screw} := K_w \cdot G^{\frac{3}{2}} \cdot D^{\frac{3}{4}} \frac{lbf}{in} = 304.97 \frac{lbf}{in}$ (3/8" Lag Screw Withdrawal Value)

$W'_{3\_8\_screw} := C_D \cdot C_m \cdot C_t \cdot W_{3\_8\_screw} = 341.56 \frac{lbf}{in}$

$Tension_{capacity} := 4.72\ in \cdot W'_{3\_8\_screw} = 1.6\ kip$ (Withdrawal Capacity for 5 inch thread length)
(Use 3/8" x 10" long lag screw)

$Shear_{capacity} := 150\ lbf$ (Capacity of 3/8" lag screw per NDS Table 12K)

CASE 1: Mounted on top of Wood Member

Base Plate Anchorage design for Wood Connection

$P_{live\_load} = 250\ lbf$

$M_{overturning\_design} = 10.5\ kip \cdot in$

$Min_{anchor\_spacing} := 3.717\ in$ (Minimum spacing between lag screws)

$Tension_{per\_anchor} := \frac{M_{overturning\_design}}{2 \cdot Min_{anchor\_spacing}} = 1.41\ kip$ (Tension per lag screw)

$Shear_{per\_anchor} := \frac{P_{live\_load}}{4} = 62.5\ lbf$ (Shear per lag screw)

$Tension_{capacity} = 1.612\ kip$

$Shear_{capacity} = 150\ lbf$

$DCR_T := \frac{Tension_{per\_anchor}}{Tension_{capacity}} = 0.88$ (Less than 1, therefore Okay in Tension)

$DCR_V := \frac{Shear_{per\_anchor}}{Shear_{capacity}} = 0.42$ (Less than 1, therefore Okay in Shear)

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$$DCR := DCR_T^{\frac{5}{3}} + DCR_V^{\frac{5}{3}} = 1.03$$ Approximate formula for combined check !

$$\alpha := \operatorname{atan}\left(\frac{Tension_{per\_anchor}}{Shear_{per\_anchor}}\right) = 87.466\ deg$$ Harkinsons formula should be used for combined check !

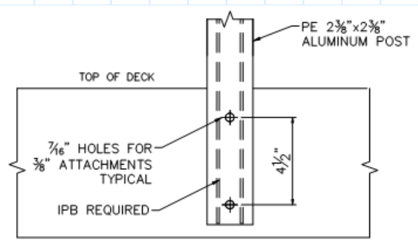
$$P_{resultantload} := \sqrt{Shear_{per\_anchor}^{2} + Tension_{per\_anchor}^{2}} = 1.414\ kip$$

$$Z_{\alpha} := \frac{Tension_{capacity} \cdot Shear_{capacity}}{Tension_{capacity} \cdot \cos(\alpha)^{2} + Shear_{capacity} \cdot \sin(\alpha)^{2}} = 1.582\ kip$$

$$DCR := \frac{P_{resultantload}}{Z_{\alpha}} = 0.894$$

So, 3/8" lag screws with 5" thread length as embedment is required.

CASE 2: Flush Fascia Mounted on Wood Member



$$P_{live\_load} = 250\ lbf$$

CASE 2a - For load perpendicular to the fascia

$$M_{overturning\_design} = 10.5\ kip \cdot in$$

$$L_{lever\_arm\_upper\_lag} := 4.5\ in + 1.5\ in = 6\ in \qquad L_{lever\_arm\_lower\_lag} := 1.5\ in$$

$$Tension_{capacity} = 1.612\ kip$$

$$M_{resist} := L_{lever\_arm\_upper\_lag} \cdot Tension_{capacity} + L_{lever\_arm\_lower\_lag} \cdot \frac{L_{lever\_arm\_lower\_lag}}{L_{lever\_arm\_upper\_lag}} \cdot Tension_{capacity}$$

$$M_{resist} = 10.28\ kip \cdot in$$

$$DCR := \frac{M_{overturning\_design}}{M_{resist}} = 1.02$$ (Acceptable in Tension)

CASE 2b - For load vertically down

$$Shear_{per\_anchor} := \frac{P_{live\_load}}{2} = 125\ lbf$$

$$Shear_{capacity} = 150\ lbf$$

$$DCR := \frac{Shear_{per\_anchor}}{Shear_{capacity}} = 0.83$$ (Less than 1, therefore Okay in Shear)

So, 3/8" lag screws with 5" thread length as embedment is required.

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CASE 3: Offset Fascia Mounted on Wood Member

$P_{live\_load} = 250\ lbf$

CASE 2a - For load perpendicular to the fascia (Consider additional 3" for offset fascia mounted)

$M_{overturning\_design\_offsetfascia} := M_{overturning\_design} + P_{live\_load} \cdot 3\ in = 11.25\ kip \cdot in$

$Tension_{per\_anchor} := \dfrac{M_{overturning\_design\_offsetfascia}}{2 \cdot 4\ in} + \dfrac{P_{live\_load}}{4} = 1.469\ kip$

$Tension_{capacity} = 1.612\ kip$

$DCR := \dfrac{Tension_{per\_anchor}}{Tension_{capacity}} = 0.91$ (Less than 1, therefore Okay in Tension)

CASE 2b - For load vertically down

$Shear_{per\_anchor} := \dfrac{P_{live\_load}}{4} = 62.5\ lbf$ $Shear_{capacity} = 150\ lbf$

$DCR := \dfrac{Shear_{per\_anchor}}{Shear_{capacity}} = 0.42$ (Less than 1, therefore Okay in Shear)

So, 3/8" lag screws with 5" thread length as embedment is required.

7. HINGED OFFSET FASCIA FOR RFX238P POST

$d_{pin\_dia} := \dfrac{1}{4}\ in$

$A_{pin\_area} := \left(\dfrac{\pi}{4} \cdot d_{pin\_dia}^{\ 2}\right) = 0.0491\ in^2$

$\Omega_{pin} := 2$ Strength reduction factor

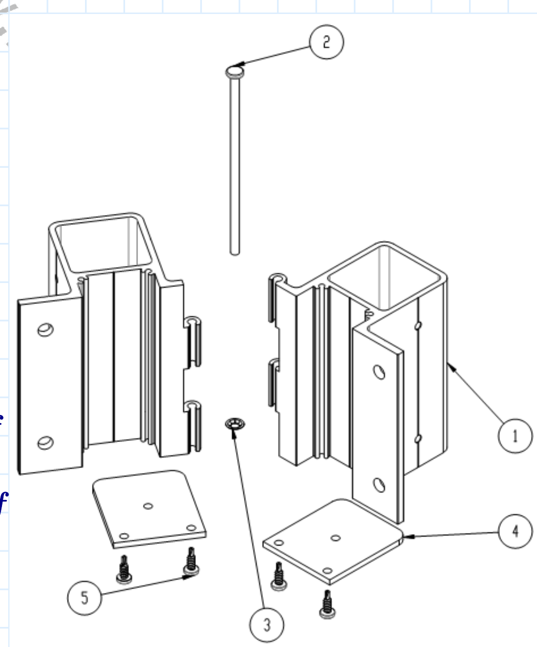
$F_{u\_SS304\_316} := 75\ ksi$ $F_{y\_SS304\_316} := 30\ ksi$

$F_{t\_SS304\_316} := 30\ ksi$ $F_{v\_SS304\_316} := 15\ ksi$

$P_{live\_load} = 250\ lbf$ $P_{pin} := \dfrac{P_{live\_load}}{2} = 125\ lbf$

$Shear_{capacity} := \dfrac{F_{v\_SS304\_316} \cdot A_{pin\_area}}{\Omega_{pin}} = 368.16\ lbf$

$DCR_{pin} := \dfrac{P_{pin}}{Shear_{capacity}} = 0.34$ $<$ **0.5**



1/4" x 6" long stainless steel pin is required to transmit shear to the other side with FOS of 4.

Hinged Rail Splice is extension of rail over the post, less than 12" and considered non structural.

Design Method	Allowable Stress Design (ASD)
Connection Type	Withdrawal loading
Fastener Type	Lag Screw
Loading Scenario	N/A

Main Member Type	Douglas Fir-Larch
Main Member Thickness	11.5 in.
Side Member Type	Steel
Side Member Thickness	12 gage
Washer Thickness	0 in.
Nominal Diameter	3/8 in.
Length	10 in.
Load Duration Factor	C_D = 1.6
Wet Service Factor	C_M = 0.7
End Grain Factor	C_eg = 1.0
Temperature Factor	C_t = 1.0

Adjusted ASD Capacity	**1804 lbs.**

- The Adjusted ASD Capacity only applies to withdrawal of the fastener from the main member. It does <u>not</u> address head pull-through capacity of the fastener in the side member.

While every effort has been made to insure the accuracy of the information presented, and special effort has been made to assure that the information reflects the state-of-the-art, neither the American Wood Council nor its members assume any responsibility for any particular design prepared from this on-line Connection Calculator. Those using this on-line Connection Calculator assume all liability from its use.

The Connection Calculator was designed and created by Cameron Knudson, Michael Dodson and David Pollock at Washington State University. Support for development of the Connection Calculator was provided by [American Wood Council](#).

SHEAR PARALLEL TO GRAIN

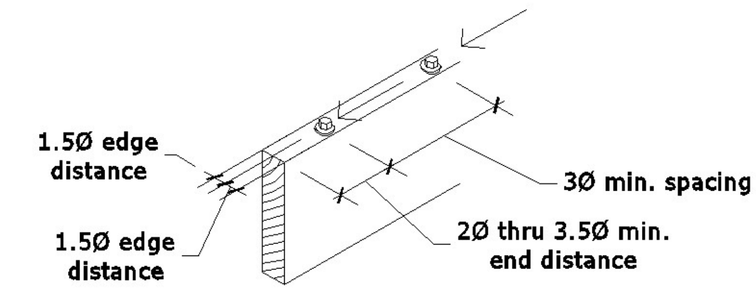


TABLE 12.5.1A / 12.5.1B / 12.5.1C

SHEAR PERPENDICULAR TO GRAIN

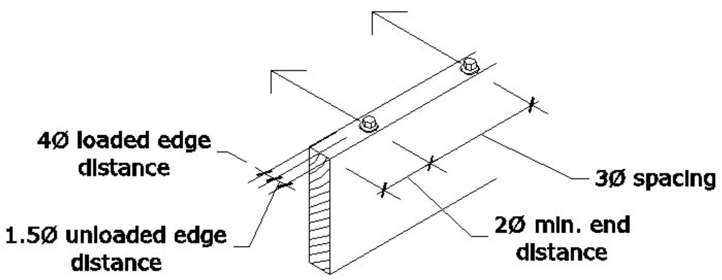


TABLE 12.5.1A / 12.5.1B / 12.5.1C

WITHDRAWAL

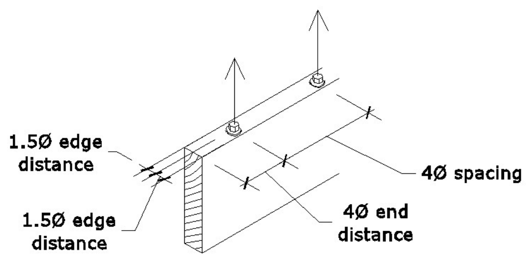


TABLE 12.5.1E (lag screws)

Design Method	Allowable Stress Design (ASD)
Connection Type	Lateral loading
Fastener Type	Lag Screw
Loading Scenario	Single Shear

Main Member Type	Douglas Fir-Larch
Main Member Thickness	2.5 in.
Main Member: Angle of Load to Grain	90
Side Member Type	Steel
Side Member Thickness	1/4 in.
Side Member: Angle of Load to Grain	0
Washer Thickness	0 in.
Nominal Diameter	3/8 in.
Length	2.5 in.
Load Duration Factor	C_D = 1.6
Wet Service Factor	C_M = 0.7
End Grain Factor	C_eg = 1.0
Temperature Factor	C_t = 1.0

Connection Yield Modes

Im	440 lbs.
Is	1291 lbs.
II	241 lbs.
IIIm	251 lbs.
IIIs	241 lbs.
IV	202 lbs.

Adjusted ASD Capacity	**202 lbs.**

- Lag Screw bending yield strength of 45000 psi is assumed.
- The Adjusted ASD Capacity is only applicable for lag screws with adequate end distance, edge distance and spacing per NDS chapter 11.
- ASTM A36 Steel is assumed for steel side members 1/4 in. thick, and ASTM A653 Grade 33 Steel is assumed for steel side members less than 1/4 in. thick.

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Design Method	Allowable Stress Design (ASD)
Connection Type	Lateral loading
Fastener Type	Lag Screw
Loading Scenario	Single Shear

Main Member Type	Douglas Fir-Larch
Main Member Thickness	2.5 in.
Main Member: Angle of Load to Grain	90
Side Member Type	Steel
Side Member Thickness	12 gage
Side Member: Angle of Load to Grain	0
Washer Thickness	0 in.
Nominal Diameter	3/8 in.
Length	2.5 in.
Load Duration Factor	C_D = 1.6
Wet Service Factor	C_M = 0.7
End Grain Factor	C_eg = 1.0
Temperature Factor	C_t = 1.0

Connection Yield Modes

Im	472 lbs.
Is	385 lbs.
II	215 lbs.
IIIm	264 lbs.
IIIs	152 lbs.
IV	200 lbs.

Adjusted ASD Capacity	**152 lbs.**

- Lag Screw bending yield strength of 45000 psi is assumed.
- The Adjusted ASD Capacity is only applicable for lag screws with adequate end distance, edge distance and spacing per NDS chapter 11.
- ASTM A36 Steel is assumed for steel side members 1/4 in. thick, and ASTM A653 Grade 33 Steel is assumed for steel side members less than 1/4 in. thick.

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