vista pro

# Design Guide

## Designers & Installers

## Engineers & Architects

8th Edition
Updated April 2020

Manufactured by: Vista Railing Systems Inc.
Tel: 1-800-667-8247 Fax: 604-467-1197

www.vistaprorailings.com

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**IMPORTANT:**
Proper layout, design and installation of a deck railing are critical to the performance and strength of the deck railings. Failure to comply with proper layout, design and installation of a deck railing could result in serious injury or loss of life. This document is intended as a guide for designers, architects, engineers and professional installers. If additional clarification is required, please consult a professional engineer to evaluate your specific circumstances, prior to starting your residential deck railing project.

## 1.0 INTRODUCTION

Permanent guardrail systems are required near or at the open sides of elevated walking/viewing surfaces for the purpose of minimizing the potential of an accidental fall to a lower level.

Aluminum guardrail assemblies are commonly comprised of straight sections of top rail elevated and supported above a floor by uniformly spaced posts. The posts are anchored to the floor system by means of anchor screws or bolts. A bottom channel runs between support posts just above the floor system. The vertical space between the posts, the bottom channel and top rail is infilled with either glass panels or aluminum pickets. Figure 1 below illustrates the main elements of a glass panel and aluminum picket guardrail system.

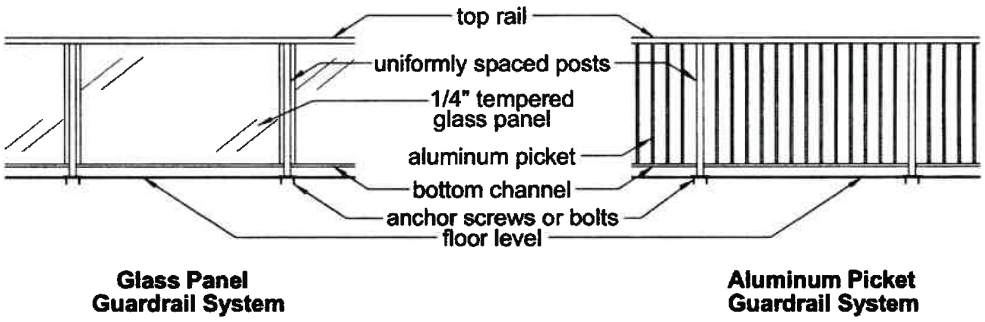



**FIGURE 1: MAIN ELEMENTS OF GUARDRAIL SYSTEMS**

## 2.0 GENERAL DESIGN

This manual has been compiled to provide relevant structural information which will enable designers, installers, architects, and engineers to select safe and code-conforming guardrail designs using
Vista Pro Railing Systems products.

The major considerations for the structural design of guardrails are:

1. Structural design criteria as established by governing building codes, bodies and authorities or by specific and unique established project design requirements,
2. Mechanical properties of material used in the manufacture of guardrail elements,
3. Physical properties of guardrail elements,
4. Load capacities of guardrail elements and component systems,
5. Load distribution characteristics of various guardrail elements and systems, and
6. Proper anchorage of support elements to surrounding supporting structures.

## 2.1 DESIGN CRITERIA

### 2.1.1 Loadings

Structural design loading requirements for guardrails are specified by governing building codes and bodies, local ordinances, project specifications and/or regulatory authorities. Usually a uniformly distributed load and/or a concentrated load applied to the top rail is specified. The loading requirements of the 2018 International Building Code for guardrails are provided in section 1607.8.1 Handrails and guards as shown below:

> **1607.8.1 Handrails and guards.** Handrail and guards shall be designed to resist a linear load of 50 pounds per lineal foot (plf) (0.73 kN/m) in accordance with Section 4.5.1.1 of ASCE 7. Glass handrail assemblies and guards shall comply with Section 2407.
>
> **Exceptions:**
>
> 1. For one- and two-family dwellings, only the single concentrated load required by Section 1607.8.1.1 shall be applied.
> 2. In Group I-3, F,H and S occupancies, for areas that are not accessible to the general public and that have an occupant load no greater than 50, the minimum load shall be 20 pounds per foot (0.29 kN/m).
>
> **1607.8.1.1 Concentrated load.** Handrail and guards shall be designed to resist a concentrated load of 200 pounds (0.89 kN) in accordance with Section 4.5.1.1 of ASCE 7.
>
> **1607.8.1.2 Intermediate Rails.** Intermediate rails (all those except the handrail), balusters and panel fillers shall be designed to resist a concentrated load of 50 pounds (0.22 kN) in accordance with Section 4.5.1.1 of ASCE 7.

### 2.1.2 Factors Of Safety

Factors of safety are generally related to a mode of failure. Ductile failure, such as stable (no buckling) yielding of a metal element, is usually assigned a lower factor of safety than is brittle failure, such as screw fracture or anchor bolt pullout. A higher or lower factor of safety may be appropriate depending upon the type of application and other considerations made by the certifying professional. For instance, a higher factor of safety may be more appropriate for glass infill panels since their failure is of a brittle nature. The guardrail configurations/design tables provided at the end of this manual have been developed using the factors of safety as set out in the 2018 International Building Code, ASCE 7 Standard, and the Aluminum Association Aluminum Design Manual.

## 2.2 MATERIALS AND PROPERTIES

### 2.2.1 Mechanical Properties Of Aluminum Alloys And Elements

Mechanical properties of aluminum alloys used in Vista Pro Railing Guardrail Systems are provided in the Aluminum Association Aluminum Design Manual and are listed in Table 1 below. Properties vary with the composition and temper of the material and also, to some degree, with the profile and the direction of stress.

**TABLE 1: MECHANICAL PROPERTIES OF ALUMINUM ALLOYS AND PRODUCTS**

| | | NOT WELDED | | WELDED |
|---|---|---|---|---|
| Alloy & products | Tensile ultimate Ftu | Tensile yield Fty | Compressive yield Fcy | Elastic modulus E |
| 6063-T5 Extrusions up thru 0.500 | 22 ksi (151.7 MPa) | 16 ksi (110.3 MPa) | 16 ksi (110.3 MPa) | 10100 ksi (69640 MPa) |
| 6063-T6 Extrusions & Pipe | 30 ksi (206.9 MPa) | 25 ksi (172.4 MPa) | 25 ksi (172.4 MPa) | 10100 ksi (69640 MPa) |
| 6061-T6 Extrusions | 38 ksi (262.0 MPa) | 35 ksi (241.3 MPa) | 35 ksi (241.3 MPa) | 10100 ksi (69640 MPa) |
| 6005A-T61 Extrusions up thru 1.000 | 38 ksi (262.0 MPa) | 35 ksi (241.3 MPa) | 35 ksi (241.3 MPa) | 10100 ksi (69640 MPa) |

### 2.2.2 Physical Properties Of Guardrail Elements

Physical properties of sections of commonly used elements in Vista Pro Railing Guardrail Systems are given in Table 2. Typical cross-sections of these elements are provided in Figure 2. Additional elements are shown in Vista's Pro Dealer Catalogue.

## TABLE 2: PHYSICAL PROPERTIES OF COMMON ELEMENTS

| ELEMENTS | ALLOY | AREA $in^2$ ($mm^2$) | Ixx $in^4$ ($10^6 mm^4$) | Sxx $in^3$ ($10^3 mm^4$) | Iyy $in^4$ ($10^6 mm^4$) | Syy $10in^3$ ($10^3 mm^4$) |
|---|---|---|---|---|---|---|
| **TOP RAILS** | | | | | | |
| 57.2 mm (2 1/4") round top rail for glass panel infill | 6063-T5 | .727 (469) | .237 (.099) | .228 (3.742) | .412 (.171) | .358 (5.861) |
| 57.2 mm (2 1/4") square top rail for glass panel infill | 6063-T5 | .785 (507) | .298 (.124) | .292 (4.783) | .523 (.218) | .454 (7.440) |
| 57.2 mm (2 1/4") round top rail for picket infill | 6063-T5 | .621 (401) | .238 (.099) | .226 (3.705) | .397 (.165) | .345 (5.654) |
| 57.2 mm (2 1/4") square top rail for picket infill | 6063-T5 | .661 (426) | .298 (.124) | .289 (4.730) | .507 (.211) | .441 (7.221) |
| **TOP RAIL SLEEVES/CORNERS** | | | | | | |
| inside round top rail sleeve/corner | 6063-T5 | .484 (312) | .121 (.050) | .155 (2.540) | .287 (.119) | .275 (4.503) |
| outside round top rail sleeve/corner | 6063-T5 | .541 (349) | .334 (.139) | .281 (4.603) | .395 (.164) | .318 (5.202) |
| outside square top rail sleeve/corner | 6063-T5 | .598 (385) | .407 (.169) | .360 (5.895) | .538 (.224) | .427 (6.995) |
| **BOTTOM RAILS** | | | | | | |
| bottom rail for glass panel system | 6063-T6 | .310 (200) | .051 (.021) | .065 (1.057) | .097 (.040) | .144 (2.357) |
| bottom rail for picket panel system | 6005A-T61 | .208 (134) | .007 (.003) | .015 (.242) | .052 (.022) | .077 (1.254) |
| **POSTS** | | | | | | |
| 63.5 mm (2 1/2") square post | 6005A-T61 | .780 (503) | .772 (.321) | .617 (10.115) | . 772 (.321) | .617 (10.115) |
| 50.8 mm (2") square post | 6005A-T61 | .636 (411) | .393 (.163) | .393 (6.434) | .393 (.163) | .393 (6.434) |
| 38.1 mm (1 1/2") square post | 6005A-T61 | .460 (297) | .156 (.065) | .208 (3.404) | .156 (.065) | .208 (3.404) |
| **MISCELLANEOUS** | | | | | | |
| 1 1/4" (31.8 mm) schedule 40 handrail pipe | 6061-T6 | .667 (430) | .194 (.081) | .234 (3.837) | .194 (.081) | .234 (3.837) |
| pickets | 6063-T5 | .113 (73) | .006 (.003) | .020 (.329) | .006 (.003) | .020 (.329) |
| various plates | 6061-T5 | | | | | |

Legend
I - moment of inertia
S - section modulus

## TOP RAILS


2 1/4" (57.2 mm)
round top rail for glass panel system


2 1/4" (57.2 mm)
round top rail for picket infill system


2 1/4" (57.2 mm)
square top rail for glass panel system

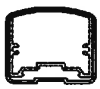

2 1/4" (57.2 mm)
square top rail for picket infill system

## TOP RAIL SLEEVES/CORNERS


inside round top rail sleeve/corner


outside round top rail sleeve/corner


inside square top rail sleeve/corner

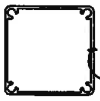

outside square top rail sleeve/corner

## BOTTOM RAILS


bottom rail for glass panel system


bottom rail for picket infill system

## POSTS

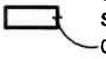

2 1/2" (63.5 mm)
square post
0.080" wall thickness


2" (50.8 mm)
square post
0.072" wall thickness


1 1/2" (38.1 mm)
square post
0.065" wall thickness

## PICKETS


5/8" x 5/8" (15.9 mm)
square picket
0.049" wall thickness


5/8" x 1 1/2" (15.9 x 38.1 mm)
square picket
0.050" wall thickness

# FIGURE 2: TYPICAL CROSS-SECTIONS OF COMMON GUARDRAIL ELEMENTS

## 2.3 ELEMENT AND SYSTEM LOAD CAPACITIES

The Aluminum Association Aluminum Design Manual can be used in determining individual component capacities using conventional engineering design procedures. This method is somewhat conservative and limiting since it does not give consideration to the varying interactions of the elements in determining the load carrying capacity of the guardrail system. Analysis and testing procedures are applied to achieve information for a more efficient design.

Alternatively, aluminum guardrail element and system load capacities can be determined following the applicable provisions of the 2018 International Building Code in Chapter 17 Special Inspections and Tests. Vista Pro Railings has conducted an extensive testing program using the services of Intertek Testing Services Na Ltd./Warnock Hershey, some of the results of which are provided in Table 3. Reports of the tests are available upon request. Since test results generally reflect more accurately the actual load carrying capacity of elements and systems, Vista Pro Railings recommends the use of test results, where possible, in determining acceptable guardrail designs.

## 2.4 LOAD DISTRIBUTION

Proper determination of load distribution is a necessary step in the efficient design of guardrail systems. Load distribution is affected by numerous factors, including but not limited to, the stiffness of the top rail relative to the stiffness of the posts, the continuity of the top rail, the length of each straight segment, the total number of spans in a segment, the type of panel infill and the end support conditions. Accurately determining the load distribution characteristics of a guardrail system requires a sophisticated analysis approach. Vista Pro Railings has developed specialized computer modelling used to determine the load distribution for its various systems and has performed extensive testing to verify the results.

Analysis and design of unique configurations requires specialized engineering which can be provided by Vista Pro Railings. Use of this information in combination with test results is essential for the efficient design of safe guardrail systems.

## 2.5 ANCHORAGE

Proper anchorage of guardrail posts and rails to a sound and structurally adequate supporting structure is essential for a guardrail system. These elements must be as secure and rigid as possible. A structurally adequate supporting structure is as important as the anchorage elements themselves. One without the other compromises the load carrying capacity and performance of the guardrail system. Building designers and general contractors must be made aware of their responsibility to provide for proper support conditions since this is beyond the normal scope and control of the guardrail system designer and installer.

The anchorage and supporting structure for each post must be designed to carry the applied loads and their associated overturning moments at the post base. These loads comprise of shear, tension and compression forces which must be resisted. Figure 3 indicates some common and approved post base connections.

The anchorage and supporting structure of each top (and bottom) rail to base building components (wall, column, etc) connection must be designed to carry the applied loads transferred from the top and bottom rail. The connection is assumed to provide pivot support with no flexural resistance. Shear loads and, depending upon the system configuration, pullout loads must be resisted. Figure 3 indicates some common and approved top and bottom rail to base building component connections

## TABLE 3: VISTA PRO RAILINGS. TESTING RESULTS

| Element/Component System | Average Ultimate Load Applied | Mode of Failure |
|---|---|---|
| **TOP RAILS** | | |
| 2 1/4" (57.2 mm) round top rail for glass panel infill | 872 lbs. (3879 N) total load applied at 1/3 span points | buckling @ load point |
| 2 1/4" (57.2 mm) square top rail for glass panel infill | 1047 lbs. (4657 N) total load applied at 1/3 span points | buckling @ support |
| 2 1/4" (57.2 mm) round top rail for picket infill | 1054 lbs. (4688 N) total load applied at 1/3 span points | buckling @ load point |
| 2 1/4" (57.2 mm) square top rail for picket infill | 1261 lbs. (5609 N) total load applied at 1/3 span points | buckling @ support |
| **TOP RAILS WITH SLEEVES** | | |
| 2 1/4" (57.2 mm) round top rail with inside sleeve for picket infill | 892 lbs. (3966 N) total load applied at 1/3 span points | fastener tearing inner sleeve flange |
| 2 1/4" (57.2 mm) square top rail with outside sleeve for picket infill | 1071 lbs. (4763 N) total load applied at 1/3 span points | bending/deformation of rail ends at midspan connector |
| **CORNERS** | | |
| 90° round external corner | 978 lbs. (4350 N) in tension and shear | bottom inner weld of sleeve mitre tore open |
| 90° square external corner | 670 lbs. (2980 N) in tension and shear | bottom inner weld of sleeve mitre tore open |
| 135° round external corner | 1193 lbs. (5308 N) | bottom inner weld of sleeve mitre tore open |
| 135° square external corner | 958 lbs. (4263 N) | bottom inner weld of sleeve mitre tore open |

## TABLE 3: VISTA PRO RAILINGS. TESTING RESULTS CONTINUED

| Element/Component System | Average Ultimate Load Applied | Mode of Failure |
|---|---|---|
| **MISCELLANEOUS** | | |
| 1 1/4"(31.8 mm) schedule 40 handrail | 344 lbs. (1530 N) total load applied at 1/3 span points | uniform bending failure |
| top rail end clip | 1447 lbs. (6437 N) in shear | top forward screw pulled laterally out of chase |
| bottom channel end clip | 1779 lbs. (7915 N) in shear | top forward screw pulled laterally out of chase |
| handrail bracket | 254 lbs. (1130 N) | bracket yielded |
| **GLASS PANELS** | | |
| .25" (6 mm) tempered glass panel 36" (914.4 mm) x 12" (304.8 mm) | 215 lbs. (955 N) at midspan edge | fracture |
| .25" (6 mm) tempered glass panel 36" (914.4 mm) x 48" (1219.2 mm) | 366 lbs. (1627 N) at midspan edge | fracture |
| .25" (6 mm) tempered glass panel 36" (914.4 mm) x 48" (1219.2 mm) | 92 psf (4.40 kPa) distributed load over entire panel | glass panels slips out of bottom rail |
| **PICKET** | | |
| 5/8" (15.9 mm) picket | 256 lbs. (1140 N) at midspan | weld failure at end connection |
| 5/8" (15.9 mm) picket panel | 696 psf (33.3 kPa) distributed loading | weld failure at end connection |
| 44" (1118 mm) x 38 1/4" (972mm) | at midspan over 12" (305 mm) x 12" (305 mm) area | |
| **FASTENERS** | | |
| #14 x 2 1/2" screw secured to solid fir lumber | 2104 lbs. (9359 N) withdrawal | screw pulled out of wood |
| #14 x 2 1/2" screw secured to solid spruce lumber | 1491lbs. (6632 N) withdrawal | screw pulled out of wood |
| #14 x 2 " screw in post screw chase | 4821 lbs. (21445 N) withdrawal | restraining bolt tore through the aluminum post |
| #8 x 1 1/2" screw in top rail sleeve | 1120 lbs. (4982 N) withdrawal | screw neck elongated and broke below head |

**NOTES**

1. Tests conducted by Intertek Testing Services Na Ltd. / Warnock Hersey – reports available upon request.
2. Test procedures in general conformance with ASTM Standard Specification E 985-87 for Permanent Metal Railing Systems and Rails for Buildings and ASTM Standard Test Methods E 935-85a for Performance of Permanent Metal Railing Systems and Rails for Buildings.
3. Testing reviewed by Lang Structural Engineering Inc.
4. Design load for elements as specified by 2018 International Building Code section 1607.8.1 Handrails and guards.

lang structural engineering inc.

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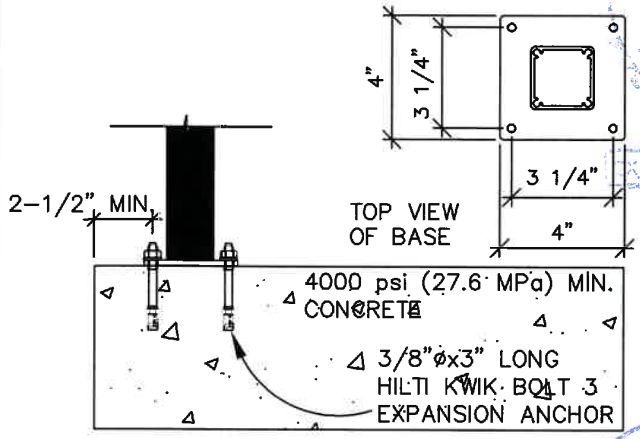
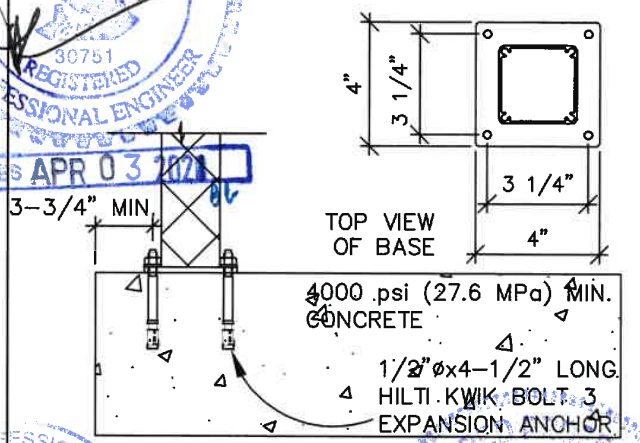
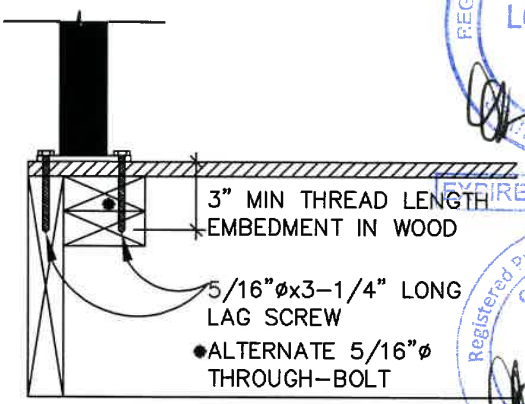


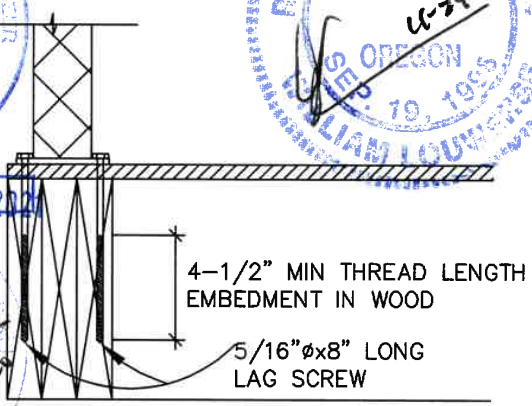

**1 1/2" OR 2" POST**
**TOP MOUNT TO CONCRETE**



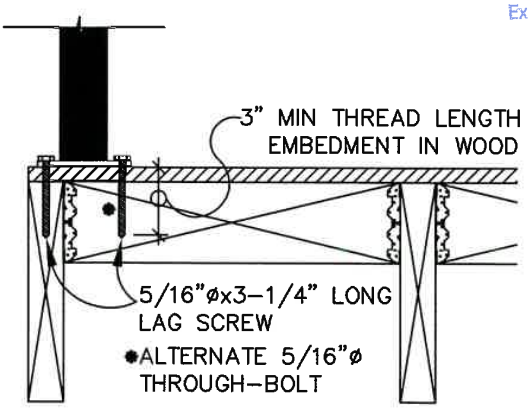

**2 1/2" POST**
**TOP MOUNT TO CONCRETE**



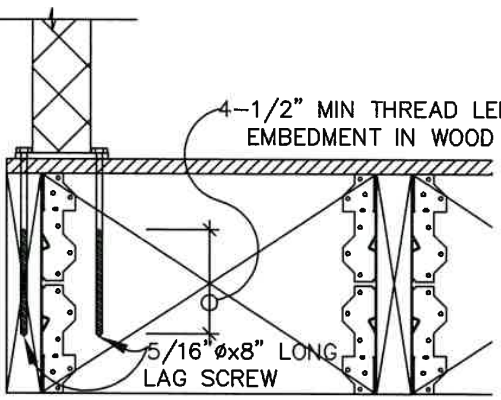

**1 1/2" OR 2" POST**
**TOP MOUNT TO S-P-F WOOD**
**FLOOR JOISTS PERPENDICULAR**




**2 1/2" POST**
**TOP MOUNT TO S-P-F WOOD**
**FLOOR JOISTS PERPENDICULAR**




**1 1/2" OR 2" POST**
**TOP MOUNT TO S-P-F WOOD**
**FLOOR JOISTS PARALLEL**




**2 1/2" POST**
**TOP MOUNT TO S-P-F WOOD**
**FLOOR JOISTS PARALLEL**

S–P–F WOOD BLOCKING ANCHORAGE TO MAIN STRUCTURE AND MAIN STRUCTURE LOAD CAPACITY RESPONSIBILTY OF OTHERS

# FIGURE 3: ACCEPTABLE GUARDRAIL MOUNTING CONFIGURATIONS

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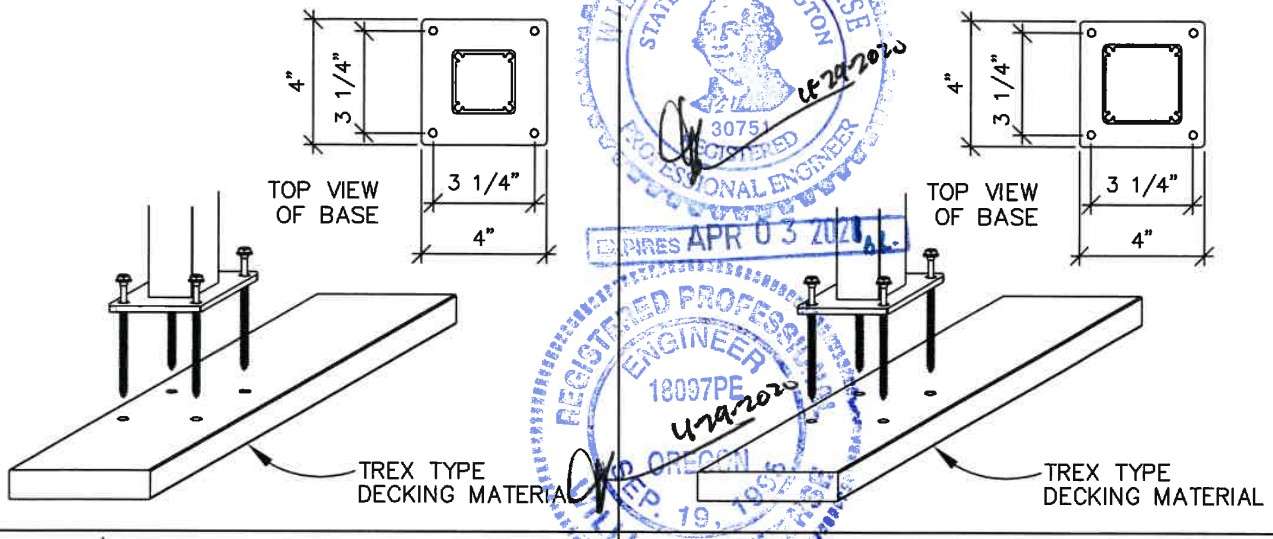
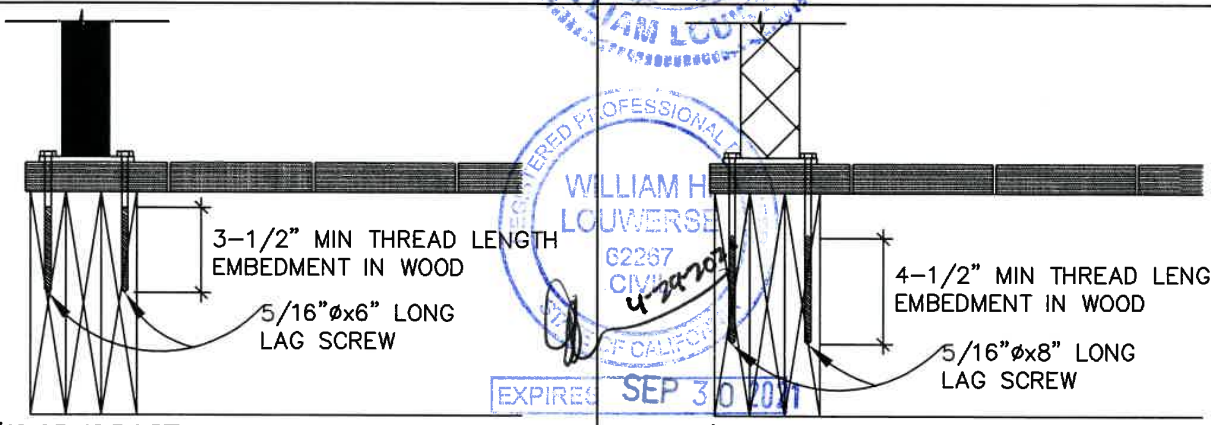
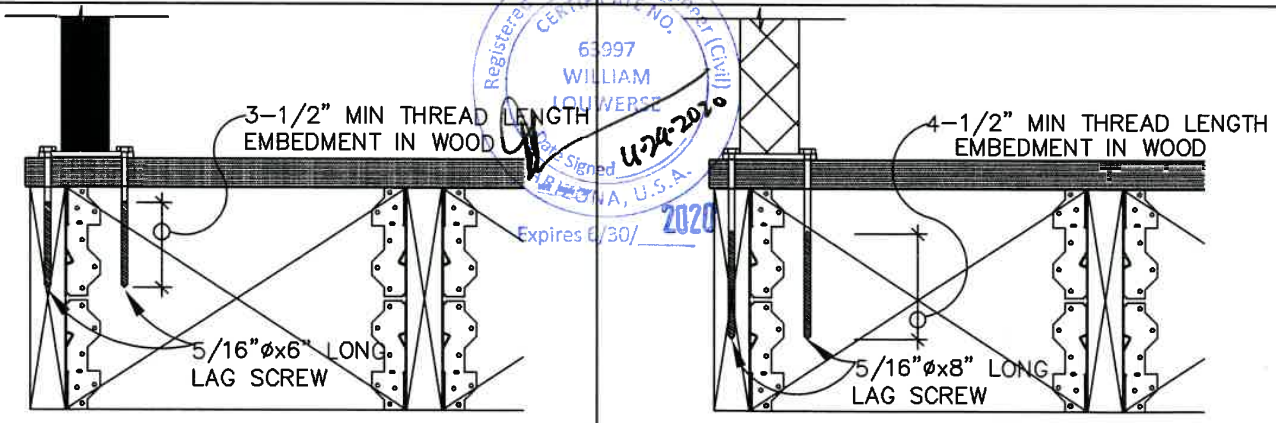



**1 1/2" OR 2" POST TOP MOUNT TO S-P-F WOOD FLOOR JOISTS PERPENDICULAR**

**2 1/2" POST TOP MOUNT TO S-P-F WOOD FLOOR JOISTS PERPENDICULAR**




**1 1/2" OR 2" POST TOP MOUNT TO S-P-F WOOD FLOOR JOISTS PARALLEL**

**2 1/2" POST TOP MOUNT TO S-P-F WOOD FLOOR JOISTS PARALLEL**

S–P–F WOOD BLOCKING ANCHORAGE TO MAIN STRUCTURE AND MAIN STRUCTURE LOAD CAPACITY RESPONSIBILTY OF OTHERS

## FIGURE 3continued: ACCEPTABLE GUARDRAIL MOUNTING CONFIGURATIONS

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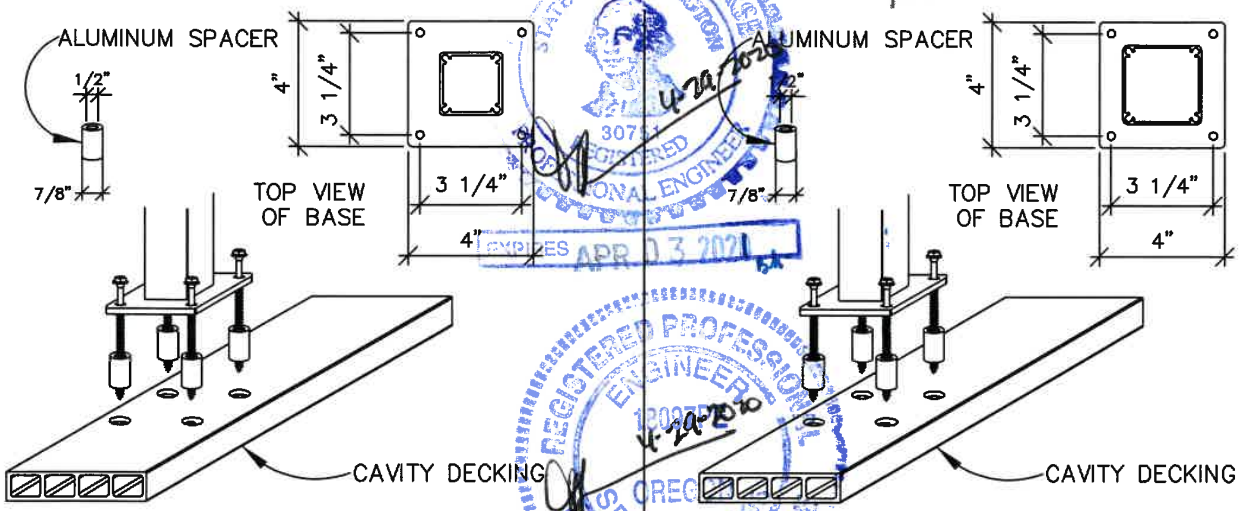
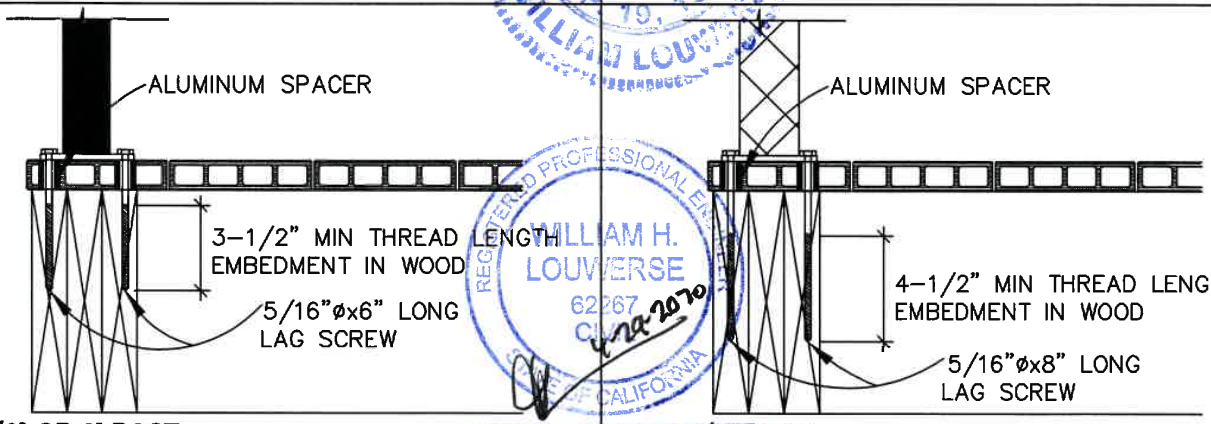
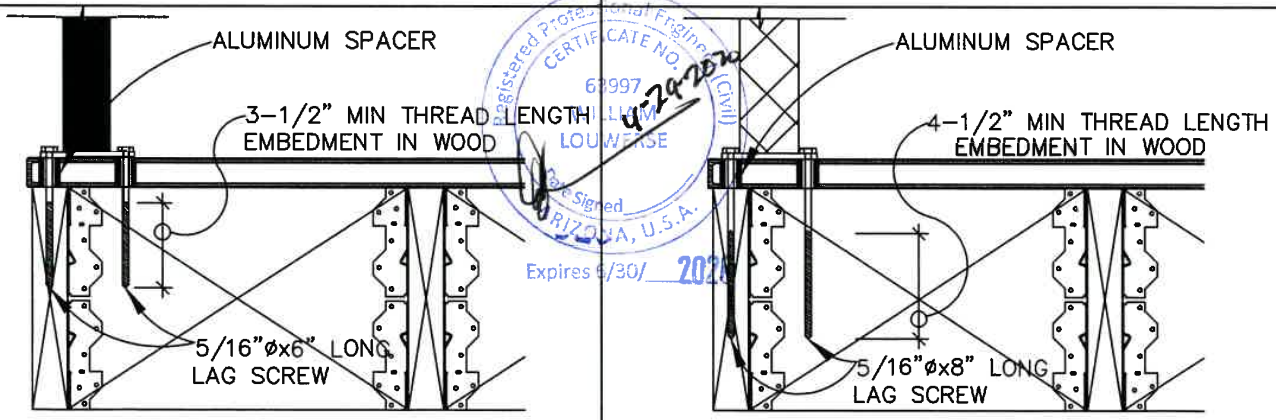



**1 1/2" OR 2" POST**
**TOP MOUNT TO S-P-F WOOD**
**FLOOR JOISTS PERPENDICULAR**

**2 1/2" POST**
**TOP MOUNT TO S-P-F WOOD**
**FLOOR JOISTS PERPENDICULAR**




**1 1/2" OR 2" POST**
**TOP MOUNT TO S-P-F WOOD**
**FLOOR JOISTS PARALLEL**

**2 1/2" POST**
**TOP MOUNT TO S-P-F WOOD**
**FLOOR JOISTS PARALLEL**

S–P–F WOOD BLOCKING ANCHORAGE TO MAIN STRUCTURE AND MAIN STRUCTURE LOAD CAPACITY RESPONSIBILTY OF OTHERS

## FIGURE 3continued: ACCEPTABLE GUARDRAIL MOUNTING CONFIGURATIONS

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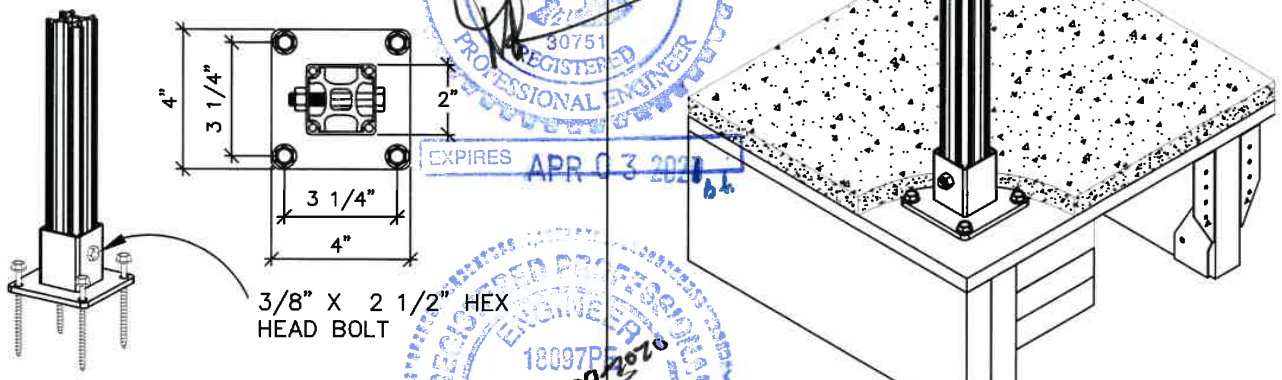
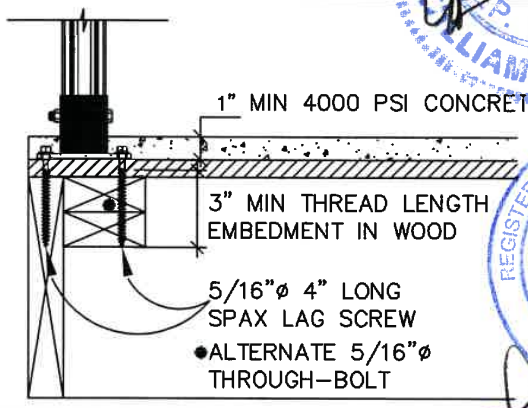


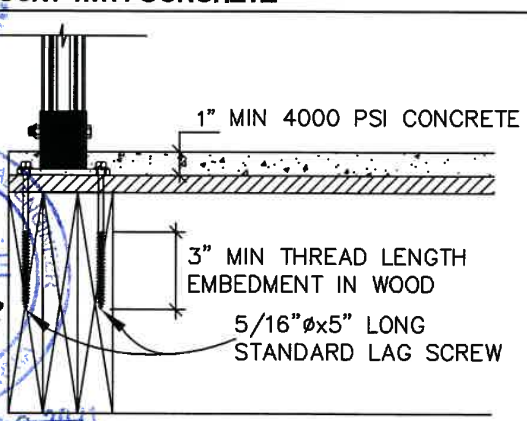

**2" POST STANCHION TOP MOUNT WITH CONCRETE**



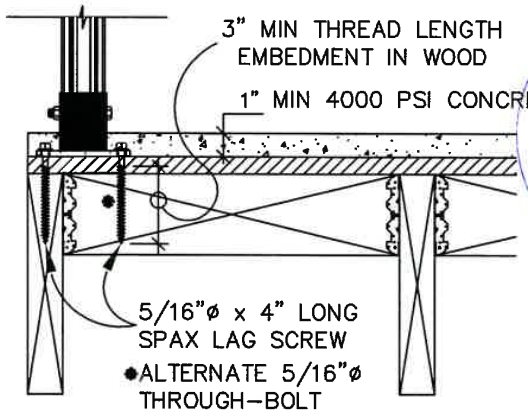
**2" POST STANCHION TOP MOUNT WITH CONCRETE**



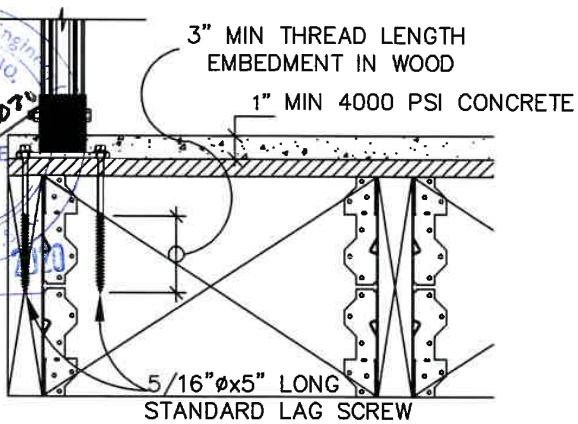

**2" POST STANCHION TOP MOUNT TO S-P-F WOOD FLOOR JOISTS PERPENDICULAR**




**2" POST STANCHION TOP MOUNT TO S-P-F WOOD FLOOR JOISTS PERPENDICULAR**




**2" POST STANCHION TOP MOUNT TO S-P-F WOOD FLOOR JOISTS PARALLEL**




**2" POST STANCHION TOP MOUNT TO S-P-F WOOD FLOOR JOISTS PARALLEL**

S-P-F WOOD BLOCKING ANCHORAGE TO MAIN STRUCTURE AND MAIN STRUCTURE LOAD CAPACITY RESPONSIBILTY OF OTHERS

## FIGURE 3continued: ACCEPTABLE GUARDRAIL MOUNTING CONFIGURATIONS

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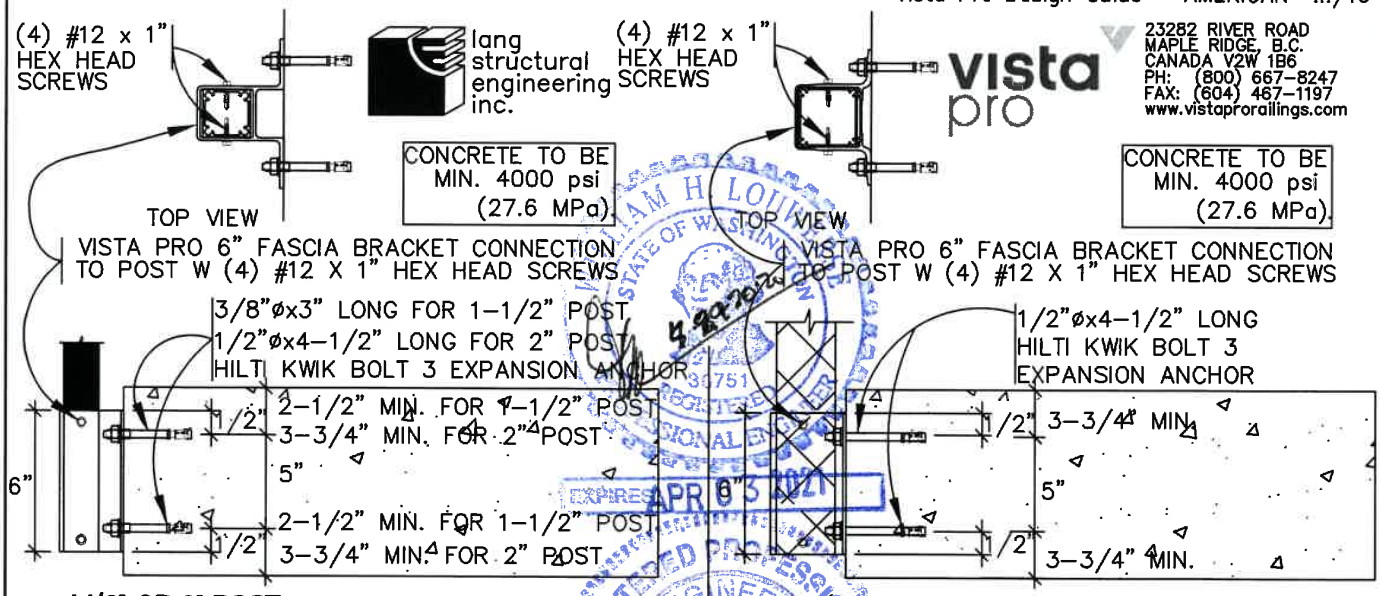


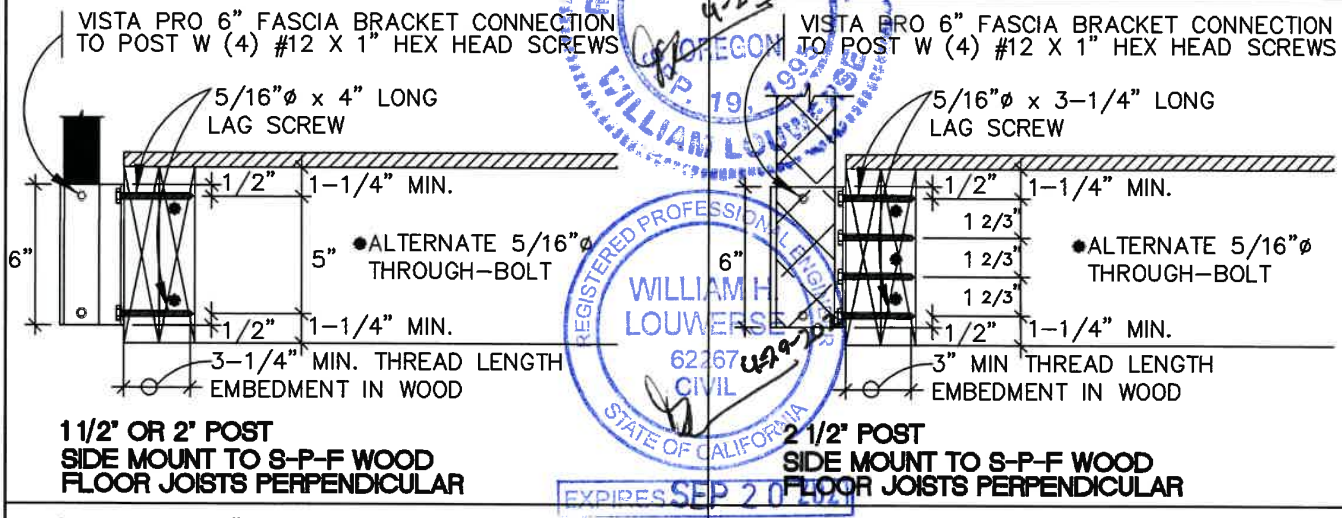


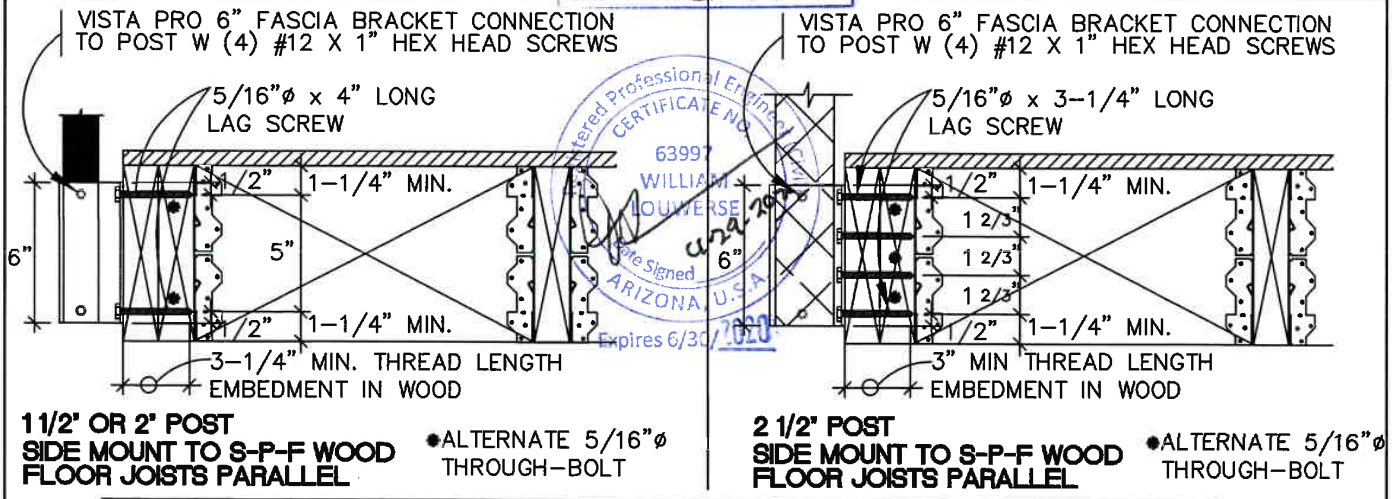


WOOD BLOCKING ANCHORAGE TO MAIN STRUCTURE AND MAIN STRUCTURE LOAD CAPACITY RESPONSIBILTY OF OTHERS

## FIGURE 3continued: ACCEPTABLE GUARDRAIL MOUNTING CONFIGURATIONS

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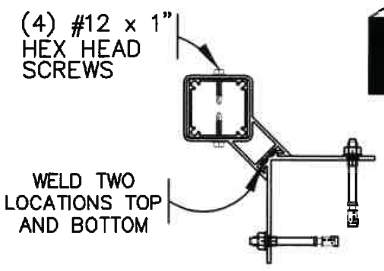
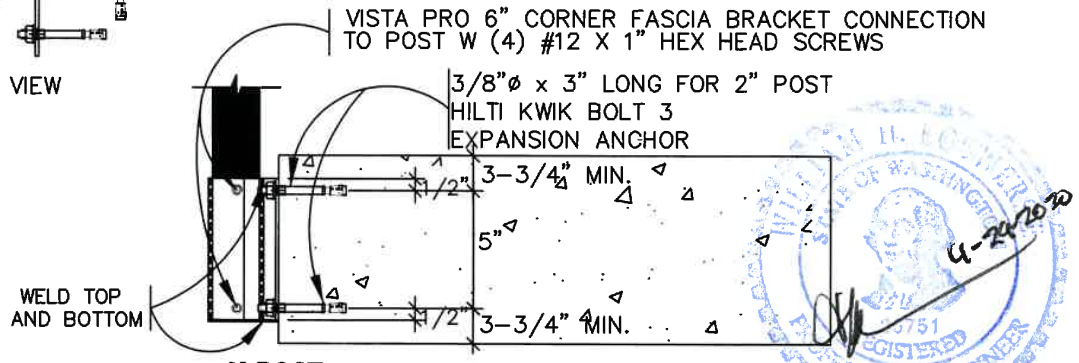
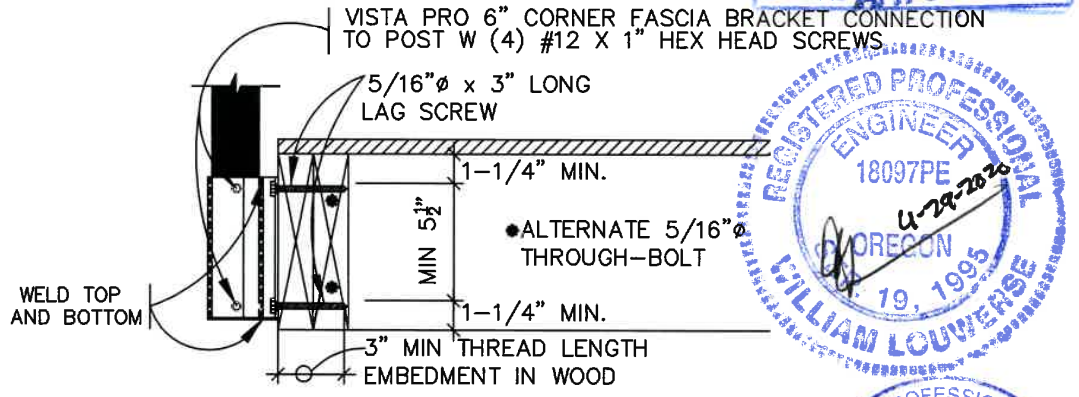


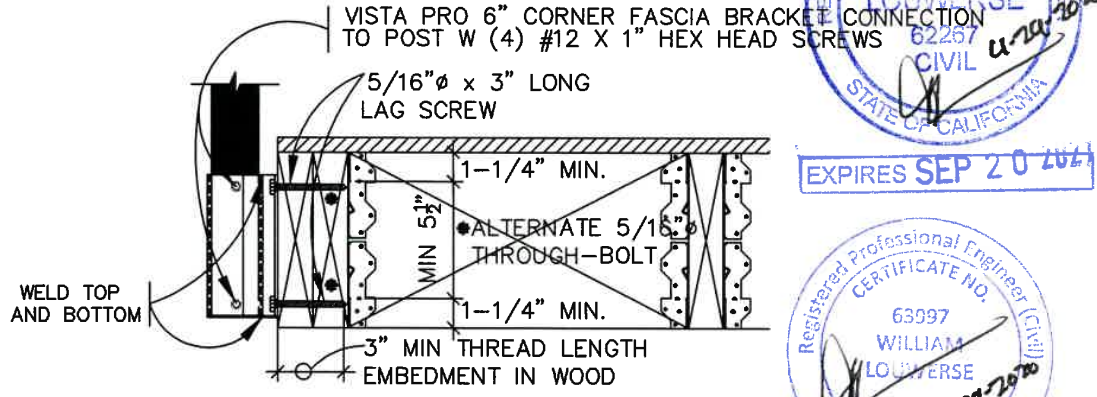

CONCRETE TO BE MIN. 4000 psi (27.6 MPa)




**2" POST**
**CORNER MOUNT TO CONCRETE**




**2" POST**
**CORNER MOUNT TO S-P-F WOOD FLOOR JOISTS PERPENDICULAR**




**2" POST**
**CORNER MOUNT TO S-P-F WOOD FLOOR JOISTS PARALLEL**

WOOD BLOCKING ANCHORAGE TO MAIN STRUCTURE AND MAIN STRUCTURE LOAD CAPACITY RESPONSIBILTY OF OTHERS

## FIGURE 3continued: ACCEPTABLE GUARDRAIL MOUNTING CONFIGURATIONS

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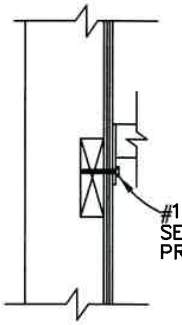
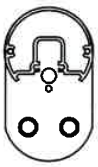
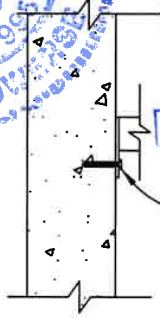


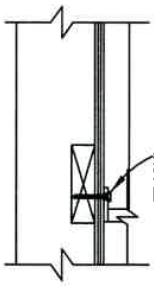

**TOP RAIL MOUNT TO WOOD**



**TOP RAIL END CLIP**

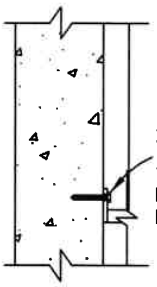



**TOP RAIL MOUNT TO CONCRETE**




**BOTTOM RAIL MOUNT TO WOOD**

**BOTTOM RAIL END CLIP**




**BOTTOM RAIL MOUNT TO CONCRETE**

**FIGURE 3continued: ACCEPTABLE GUARDRAIL MOUNTING CONFIGURATIONS**

To assist in design, the maximum service pull-out loads to be resisted by each anchor is summarized below for each type of post and anchorage configuration. These service (allowable) loads have safety factors (3-5) included:

| Post | Anchorage Configuration | | | | |
|---|---|---|---|---|---|
| | top mount using Vista Pro base plates | fascia mount to wood using double Vista Pro fascia brackets | fascia mount to concrete using double Vista Pro fascia brackets | fascia mount to wood using single Vista Pro fascia bracket | fascia mount to concrete using single Vista Pro fascia bracket |
| 1 1/2" (38.1mm) | 576 lbs (2562 N) | 504 lbs. (2242 N) 5 ½" vertical spacing between anchors* | 646 lbs. (2874 N) 3" vertical spacing between anchors* | 505 lbs. (2246 N) 5 " vertical spacing between outer anchors* | 484 lbs. (2153 N) 5 " vertical spacing between outer anchors* |
| 2" (50.8mm) | 1092 lbs (4857 N). | 964 lbs. (4228 N) 5 ½" vertical spacing between anchors* | 1084 lbs.(4822 N) 3 ¾" vertical spacing between anchors* | 968 lbs. (4306 N) 5 " vertical spacing between outer anchors* | 950 lbs. (4226 N) 5 " vertical spacing between outer anchors* |
| 2 1/2" (63.5mm) | 1692 lbs (7526 N). | | | 905 lbs. (4030 N) 5 " vertical spacing between outer anchors* | 1314 lbs. (5845 N) 5 " vertical spacing between outer anchors* |

* As per Figure 3

## 2.6 WEAKNESS IN WELDED ALUMINUM

A review of the mechanical properties of aluminum alloys and elements in Table 1 indicates that tensile strength is significantly reduced in aluminum when it is welded. This has a significant impact on the strength capacity of aluminum guardrail components, connections and systems. At the bottom connection of posts to base plates, the connection and post capacity is substantially less in welded configurations compared to those using Vista Pro Railings mechanical fastening. Tests conducted by Intertek Testing Services Na Ltd./ Warnock Hershey indicate that 38.1mm (1 ½") posts with welded base plates fail at loads an average of 35% lower than identical posts with Vista Pro Railings mechanical base plate connections. Tests conducted by Intertek Testing Services NA Ltd./Warnock Hershey of a 2 ¼" aluminium post of top deck mount configuration (an actual competitor of Vista Pro Railings) that uses a welded base plate failed at loads an average of 30% lower than the Vista Pro Railings 2" post. A copy of the report can be provided upon request. For these reasons, welded post base connections are generally not recommended.

## 2.7 DESIGN PROCEDURES

### 2.7.1 Top Rail Design

Top rail design normally involves using conventional engineering design procedures in determining and comparing section resisting moment capacities to resultant bending moments from applied loads. Connections between posts and rails are assumed to provide no flexural restraint. The bending moments in top rails are affected by the number and length of spans between posts in a straight run. Computer analysis of guardrail systems most accurately determines bending moments in top rails. The top rail moment capacity calculated using the section modulus (S) and material yield strength (Fy) (or alternatively from analysis of test results) must exceed the resultant bending moment from the applied loads.

### 2.7.2 Post Design

Posts in railing systems behave somewhat as vertical cantilevered beams in resisting horizontal loads applied to the top rail. Bending moments caused by horizontal loads normally control allowable post spacing and design. The first step in post design is determining the actual horizontal load that each post would be expected to carry. Horizontal load distribution from the top rail to each post is affected by a number of factors including the relative stiffness of the post and top rail, the length of each straight run, the number of spans in the railing, and the end support conditions.

Computer modelling and analysis based on test results of guardrail systems most accurately assimilates top rail load distribution to each of the supporting posts and end conditions. The post moment capacity is calculated using the section modulus (S) and material yield strength (Fy). This must exceed the resultant bending moment from the applied loads or the post spacing is reduced to create an acceptable condition.

## 3.0 DESIGN TABLES

The design procedures described in the previous section have been carried out for a wide range of possible guardrail configurations. The results are summarized in the tables which follow. By knowing the overall dimensions and layout of the guardrail system under design, an acceptable configuration can be selected using the tables. **For each configuration, the maximum allowable post spacing indicated for the longest straight run shown is also the maximum allowable post spacing for straight runs exceeding in length what is shown.**

The design tables are based upon the loading criteria set out in the 2018 International Building Code section 1607.8.1 Handrails and guards. The actual load conditions for the guardrail system under design must be identical to or less than those used in the development of the tables. The tables should not be used for other applications where different loading conditions and configurations exist.

## 3.1 WIND LOADING

For glass infill guardrail systems, the structural strength requirements imposed by design wind loading may exceed those imposed by specified guardrail design loads. Guardrail design loads (as specified in the 2018 International Building Code) of 20 plf and 50 plf top rail load are the governing criteria for 42" (1067 mm) high guardrail system designs when compared to uniform lateral specific wind pressures of not greater than 12.7 psf and 28.7 psf respectively. The respective allowable guardrail configurations provided in figures 4 are all capable of withstanding this uniform lateral specific wind pressures.

The procedure for determining allowable wind pressures for solid freestanding walls is provided using Chapters 1, 2, 26 and 29 of ASCE 7 Standard. Using the provisions, a 12.13 psf (0.58 kPa) allowable wind pressure is given for the following conditions:

- Basic Wind Speed for Occupancy Category II Buildings and Other Structures - nominal design 3-second gust wind speed of 115 miles per hour at 33 feet (10m) above ground for Exposure C category, Figure 26.5 - 1A
- Exposure B Category, Section 26.7
- Wind directionality factor, Kd, 0.85, Section 26.6
- Topographic factor, Kzt, 1.0, Section 26.8
- Gust Effect Factor, G, 0.85, Section 26.9
- Velocity pressure exposure coefficient Kz, 0.57, Table 29.2 - 1
- Force coefficient, Cf, solid freestanding walls, 1.45, Figure 29.4 - 1

Many residential guardrail conditions fit within these criteria. Consult the ASCE 7 Standard and local building jurisdictional authorities where other conditions apply for determination of the net design wind pressure.

For wind pressure greater than 12.7 psf, adjust the allowable post spacing based on a 20 plf top rail load using the following formula:

$$\text{modified post spacing} = \text{allowable post spacing} \times \frac{12.7}{\text{wind pressure in psf}}$$

For wind pressure greater than 28.7 psf, adjust the allowable post spacing based on a 50 plf top rail load using the following formula:

$$\text{modified post spacing} = \text{allowable post spacing} \times \frac{28.7}{\text{wind pressure in psf}}$$

## 3.2 GUARDRAIL HEIGHT VARIATIONS

The most common guardrail system height is 42" (1067 mm). For guardrail heights other than 42" (1067 mm), adjust the allowable post spacings as indicated in the allowable guardrail configurations of figures 4 using the following formula:

$$\text{modified post spacing} = \text{allowable post spacing} \times \text{allowable post spacing multiplier (see table below)}$$

| guardrail height | allowable post spacing multiplier for picket infill guardrail | allowable post spacing multiplier for glass infill guardrail |
|---|---|---|
| 18" (457 mm) | 2.33 | 2.33 |
| 24" (610 mm) | 1.75 | 1.75 |
| 30" (762 mm) | 1.40 | 1.40 |
| 36" (914 mm) | 1.17 | 1.17 |
| 42" (1067 mm) | 1.00 | 1.00 |
| 48" (1219 mm) | 0.88 | 0.76 |
| 54" (1372 mm) | 0.78 | 0.60 |
| 60" (1524 mm) | 0.70 | 0.49 |
| 66" (1676 mm) | 0.64 | 0.40 |
| 72" (1829 mm) | 0.58 | 0.34 |

## 3.3 GUARDRAIL SYSTEMS WITH ALUMINUM PICKET INFILL

Corner posts for aluminum picket infill guardrail systems may be eliminated and replaced with a picket corner provided one of the following conditions are met:

1) the end of the return portion of the top rail is anchored to the building, or

2) the return portion of the guardrail system is supported by a minimum of 2 posts.

## 3.4 GUARDRAIL SYSTEMS WITH GLASS PANEL INFILL

Post spacing for guardrail systems is generally determined by the strength of the supporting posts and applied loads. However, for guardrail systems with glass panel infill, consideration must be given to the size of the glass panels. Although testing has shown that glass panels supported by the top and bottom rails meet code requirements regardless of length of run, for practical purposes from the point of view of the installer, glass panel infills should be limited to not greater than 5'-6" (1676 mm) in length.

## 3.5 FASCIA MOUNTED POSTS

Guardrail systems using fascia or side mounted posts instead of top mounted posts are becoming more widely used. These systems have the advantage of not penetrating the building envelope. Furthermore, test results for fascia or side mounted posts have produced higher load values for the same posts in top mounted configurations. Consequently the post spacing indicated for the allowable configurations in figure 4 may be increased using the following multiplies:

| modified post spacing | = | allowable post spacing | x | allowable post spacing multiplier (see table below) |
|---|---|---|---|---|

| post | allowable post spacing multiplier |
|---|---|
| 1 ½" (38.1 mm) square post | 1.10 |
| 2" (50.8 mm) square post | 1.12 |

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structural
engineering
inc.



File No. 112-064

May 8, 2020

**Vista Railing Systems Inc.**
23282 River Road
Maple Ridge, B.C.
Canada V2W 1B6

Attention: Mr. Ed Granholm

RE: **ALUMINUM GUARDRAIL SYSTEMS**
**BUILDING CODE COMPLIANCE**

As requested, a series of 42" high allowable guardrail configurations infilled with ¼" tempered glass or pickets and acceptable guardrail mounting configurations have been determined and are assembled on pages 23 to 45 inclusive and pages 12 to 17 inclusive respectively of the American Vista Pro 8th Edition Updated April, 2020 Design Guide. These configurations are in conformance with the structural load requirements for balcony guardrails as specified in the following code:

- 2018 International Building Code section 1607.8.1 Handrails and guards

The seals applied are current for details and tables assembled for the codes indicated above. Annual resealing of these documents is not necessary.

Contact us with any further questions concerning this.

Yours truly,
**LANG STRUCTURAL ENGINEERING INC.**

Bill Louwerse, P.Eng., Struct.Eng., PE
BL/jk

#201-2313 WEST RAILWAY STREET, ABBOTSFORD, BC V2S 2E3 (604) 853-8522 (604) 857-1757 FAX (604) 853-0158 mail@langeng.com

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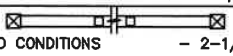
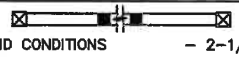
## TYPE 1 – FREE-STANDING

TYPE 1A – END CONDITIONS – 2" POST EACH END
INTERMEDIATE CONDITIONS – 1-1/2" POSTS EVENLY SPACED

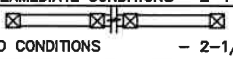


TYPE 1B – END CONDITIONS – 2-1/2" POST EACH END
INTERMEDIATE CONDITIONS – 1-1/2" POSTS EVENLY SPACED

TYPE 1C – END CONDITIONS – 2" POST EACH END
INTERMEDIATE CONDITIONS – 2" POSTS EVENLY SPACED

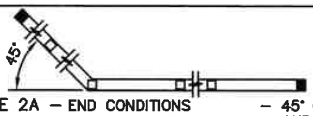


TYPE 1D – END CONDITIONS – 2-1/2" POST EACH END
INTERMEDIATE CONDITIONS – 2" POSTS EVENLY SPACED

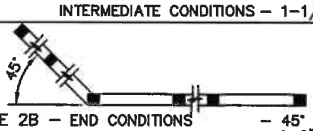


TYPE 1E – END CONDITIONS – 2-1/2" POST EACH END
INTERMEDIATE CONDITIONS – 2-1/2" POSTS EVENLY SPACED

## TYPE 2 – PARTIAL FIXED ONE END

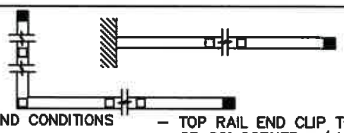



TYPE 2A – END CONDITIONS – 45° CORNER w/ MIN 1– 1-1/2" POST AND 1–2" POST AT END & 2" POST OPPOSITE END
INTERMEDIATE CONDITIONS – 1-1/2" POSTS EVENLY SPACED

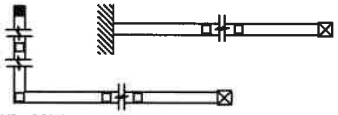



TYPE 2B – END CONDITIONS – 45° CORNER w/ MIN 2–2" POSTS & 2" POST OPPOSITE END
INTERMEDIATE CONDITIONS – 2" POSTS EVENLY SPACED

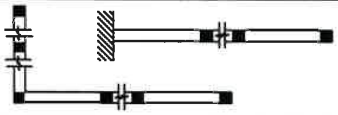
## TYPE 3 – FIXED ONE END



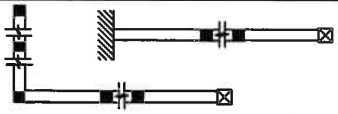
TYPE 3A – END CONDITIONS – TOP RAIL END CLIP TO STRUCTURE OR 90° CORNER w/ MIN 1– 1-1/2" POST AND 1–2" POST AT END & 2" POST OPPOSITE END
INTERMEDIATE CONDITIONS – 1-1/2" POSTS EVENLY SPACED



TYPE 3B – END CONDITIONS – TOP RAIL END CLIP TO STRUCTURE OR 90° CORNER w/ MIN 1– 1-1/2" POST AND 1–2" POST AT END & 2-1/2" POST OPPOSITE END
INTERMEDIATE CONDITIONS – 1-1/2" POSTS EVENLY SPACED



TYPE 3C – END CONDITIONS – TOP RAIL END CLIP TO STRUCTURE OR 90° CORNER w/ MIN 2–2" POSTS & 2" POST OPPOSITE END
INTERMEDIATE CONDITIONS – 2" POSTS EVENLY SPACED

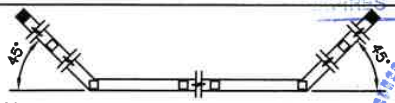


TYPE 3D – END CONDITIONS – TOP RAIL END CLIP TO STRUCTURE OR 90° CORNER w/ MIN 2–2" POSTS & 2-1/2" POST OPPOSITE END
INTERMEDIATE CONDITIONS – 2" POSTS EVENLY SPACED

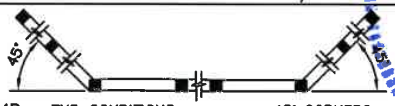
## POST LEGEND

- 1-1/2" POST
- 1-1/2" BRACED POST
- 2" POST
- 2-1/2" POST
- TOP RAIL END CLIP TO STRUCTURE

## TYPE 4 – PARTIAL FIXED BOTH ENDS

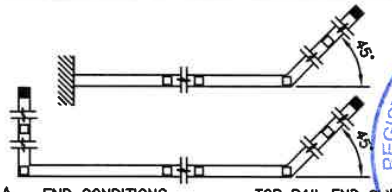



TYPE 4A – END CONDITIONS – 45° CORNERS w/ MIN 1– 1-1/2" POST AND 1–2" POST AT END
INTERMEDIATE CONDITIONS – 1-1/2" POSTS EVENLY SPACED

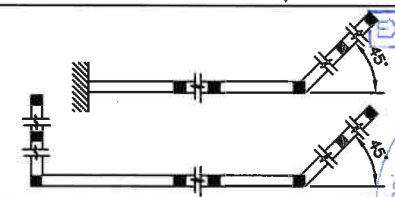



TYPE 4B – END CONDITIONS – 45° CORNERS w/ MIN 2–2" POSTS
INTERMEDIATE CONDITIONS – 2" POSTS EVENLY SPACED

## TYPE 5 – FIXED & PARTIAL FIXED ENDS

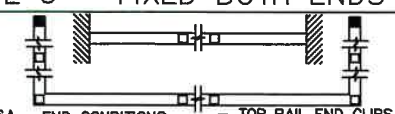



TYPE 5A – END CONDITIONS – TOP RAIL END CLIP TO STRUCTURE OR 90° CORNER w/MIN 1– 1-1/2" POST AND 1–2" POST AT END & 45° CORNER w/ MIN 1– 1-1/2" POST AND 1–2" POST AT END
INTERMEDIATE CONDITIONS – 1-1/2" POSTS EVENLY SPACED

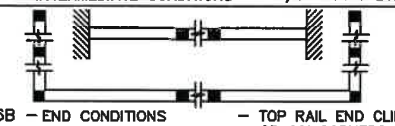



TYPE 5B – END CONDITIONS – TOP RAIL END CLIP TO STRUCTURE OR 90° CORNER w/ MIN 2–2" POSTS & 45° CORNER w/ MIN 2–2" POSTS
INTERMEDIATE CONDITIONS – 2" POSTS EVENLY SPACED

## TYPE 6 – FIXED BOTH ENDS



TYPE 6A – END CONDITIONS – TOP RAIL END CLIPS TO STRUCTURE OR 90° CORNERS w/ MIN 1– 1-1/2" POST AND 1–2" POST AT END
INTERMEDIATE CONDITIONS – 1-1/2" POSTS EVENLY SPACED



TYPE 6B – END CONDITIONS – TOP RAIL END CLIPS TO STRUCTURE OR 90° CORNERS w/ MIN 2–2" POSTS
INTERMEDIATE CONDITIONS – 2" POSTS EVENLY SPACED

# FIGURE 4: GUARDRAIL CONFIGURATIONS

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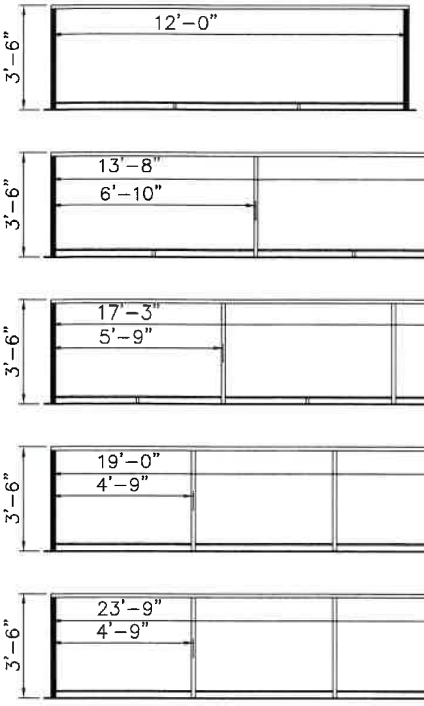
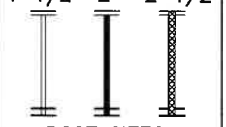



TYPE 1 – FREE-STANDING

TYPE 1A – END CONDITIONS – 2" POST EACH END
INTERMEDIATE CONDITIONS – 1-1/2" POSTS EVENLY SPACED

SEE FIGURE 3 AND SECTION 2.5 ANCHORAGE OF THE DESIGN MANUAL FOR DETAILS REGARDING ACCEPTABLE GUARDRAIL MOUNTING CONFIGURATIONS AND MAXIMUM SERVICE PULL-OUT LOAD REQUIREMENTS FOR ANCHORS.

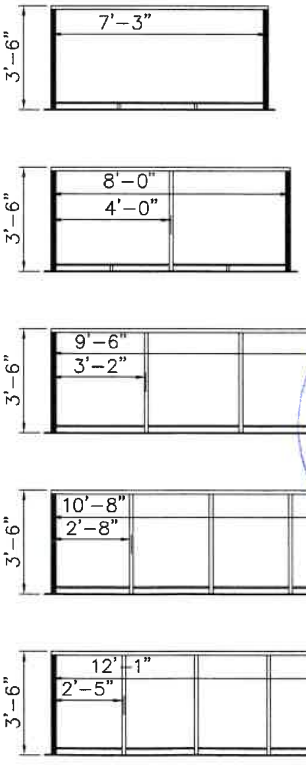
POST LEGEND




POST SIZES

## 20 LBS/FOOT OR 200 LBS. TOP RAIL LOADING

**AS PER 2018 IBC SECTION 1607.8.1 HANDRAILS AND GUARDS FOR ONE AND TWO FAMILY DWELLINGS AND IN GROUP I-3,F,H AND S OCCUPANCIES FOR AREAS THAT ARE NOT ACCESSIBLE TO THE GENERAL PUBLIC AND THAT HAVE AN OCCUPANT LOAD NO GREATER THAN 50.**




NOTES:

- CONFIGURATIONS SHOWN ACCEPTABLE FOR TOP MOUNT (AS SHOWN) AND SIDE/FASCIA MOUNT CONDITIONS FOR BOTH 1/4" TEMPERED GLASS (AS SHOWN) AND PICKET GUARDRAIL SYSTEMS
- ALLOWABLE CONFIGURATIONS ARE BASED UPON ANALYSIS, CALCULATIONS AND RESULTS OF TESTS CONDUCTED BY INTERTEK TESTING SERVICES NA LTD./WARNOCK HERSHEY.
- ALLOWABLE CONFIGURATIONS ARE IN CONFORMANCE WITH THE APPLICABLE STRUCTURAL REQUIREMENTS SPECIFIED IN THE 2018 INTERNATIONAL BUILDING CODE SECTION 1607.8.1

REGISTERED PROFESSIONAL ENGINEER WILLIAM H LOUWERSE 62397 CIVIL STATE OF CALIFORNIA 4-29-2020

EXPIRES SEP 30 2021

Registered Professional Engineer (Civil) CERTIFICATE NO. 63997 WILLIAM LOUWERSE Signed 4-29-2020 ARIZONA, U.S.A. Expires 6/30/2020

WILLIAM H. LOUWERSE STATE OF WASHINGTON 30751 REGISTERED PROFESSIONAL ENGINEER 4-29-2020

EXPIRES APR 03 2021

REGISTERED PROFESSIONAL ENGINEER 18097PE OREGON 4-29-2020

## 50 LBS/FOOT OR 200 LBS. TOP RAIL LOADING

**FOR CONDITIONS NOT MENTIONED ABOVE**

# FIGURE 4A: 42" HIGH ALLOWABLE CONFIGURATIONS TYPE 1A

# TYPE 1A ALTERNATE
OPTIONAL CONFIGURATIONS
w/ 2" POSTS ADDED
IN INTERMEDIATE SPACES

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CANADA V2W 1B6
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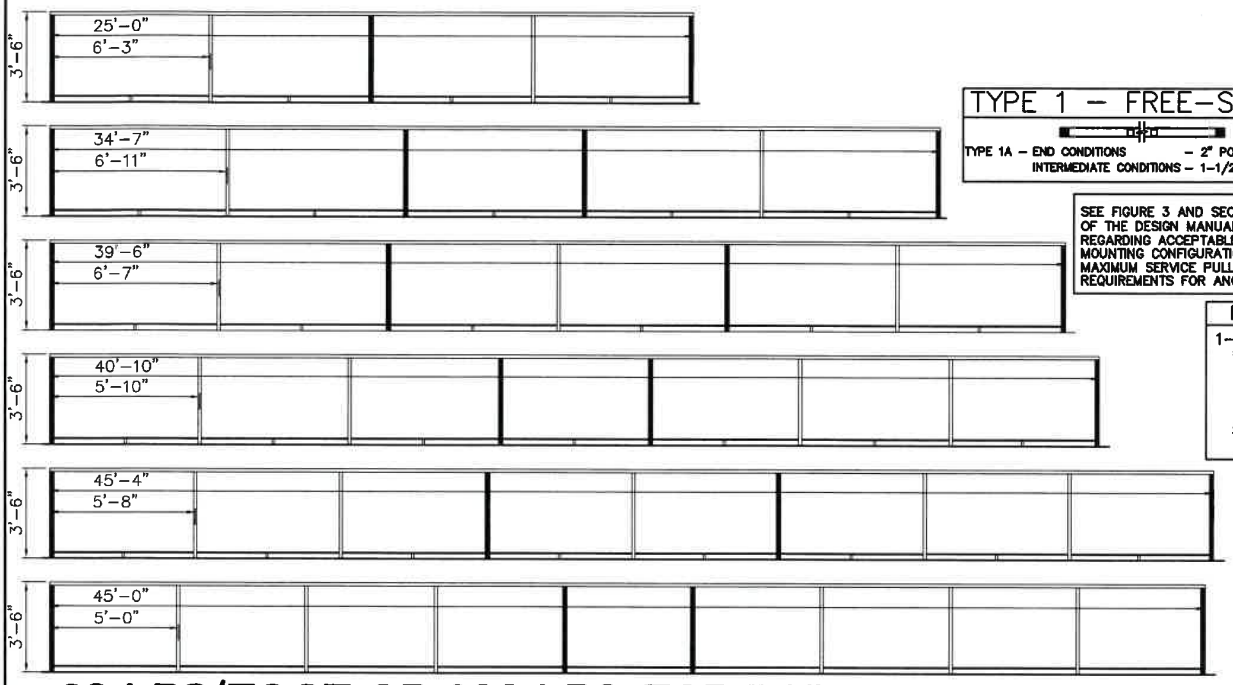
FAX: (604) 467-1197
www.vistaprorailings.com

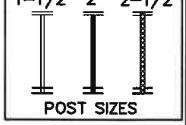



## TYPE 1 – FREE-STANDING

TYPE 1A – END CONDITIONS – 2" POST EACH END
INTERMEDIATE CONDITIONS – 1-1/2" POSTS EVENLY SPACED

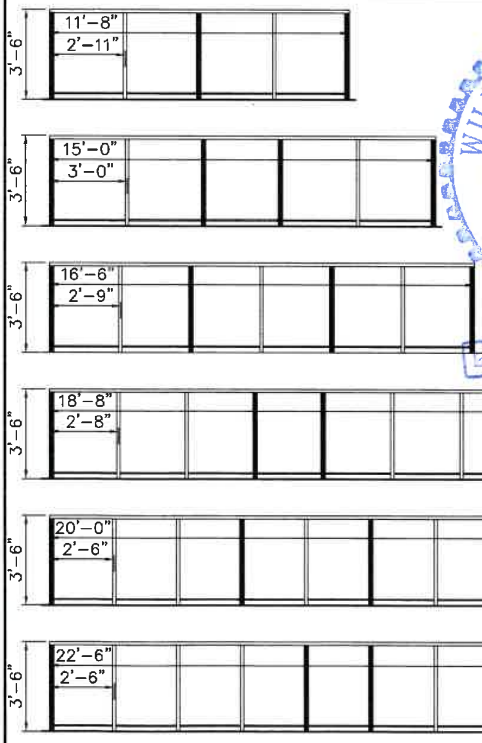
SEE FIGURE 3 AND SECTION 2.5 ANCHORAGE OF THE DESIGN MANUAL FOR DETAILS REGARDING ACCEPTABLE GUARDRAIL MOUNTING CONFIGURATIONS AND MAXIMUM SERVICE PULL-OUT LOAD REQUIREMENTS FOR ANCHORS.

POST LEGEND




## 20 LBS/FOOT OR 200 LBS. TOP RAIL LOADING

**AS PER 2018 IBC SECTION 1607.8.1 HANDRAILS AND GUARDS FOR ONE AND TWO FAMILY DWELLINGS AND IN GROUP I-3,F,H AND S OCCUPANCIES FOR AREAS THAT ARE NOT ACCESSIBLE TO THE GENERAL PUBLIC AND THAT HAVE AN OCCUPANT LOAD NO GREATER THAN 50.**




NOTES:
- CONFIGURATIONS SHOWN ACCEPTABLE FOR TOP MOUNT (AS SHOWN) AND SIDE/FASCIA MOUNT CONDITIONS FOR BOTH 1/4" TEMPERED GLASS (AS SHOWN) AND PICKET GUARDRAIL SYSTEMS
- ALLOWABLE CONFIGURATIONS ARE BASED UPON ANALYSIS, CALCULATIONS AND RESULTS OF TESTS CONDUCTED BY INTERTEK TESTING SERVICES NA LTD./WARNOCK HERSHEY.
- ALLOWABLE CONFIGURATIONS ARE IN CONFORMANCE WITH THE APPLICABLE STRUCTURAL REQUIREMENTS SPECIFIED IN THE 2018 INTERNATIONAL BUILDING CODE SECTION 1607.8.1

WILLIAM H. LOUWERSE STATE OF WASHINGTON 30751 REGISTERED PROFESSIONAL ENGINEER 4-24-2020
EXPIRES APR 03 2021

REGISTERED PROFESSIONAL ENGINEER WILLIAM H LOUWERSE 62257 CIVIL STATE OF CALIFORNIA 4-24-2020
EXPIRES SEP 30 2021

REGISTERED PROFESSIONAL ENGINEER 18097PE OREGON EXPIRES: 12/31/2020 WILLIAM LOUWERSE 4-24-2020

Registered Professional Engineer (Civil) CERTIFICATE NO. 63907 WILLIAM LOUWERSE Date Signed ARIZONA, U.S.A. 4-24-2020
Expires 6/30/

## 50 LBS/FOOT OR 200 LBS. TOP RAIL LOADING

**FOR CONDITIONS NOT MENTIONED ABOVE**

# FIGURE 4A-A: 42" HIGH ALLOWABLE CONFIGURATIONS TYPE 1A-ALTERNATE

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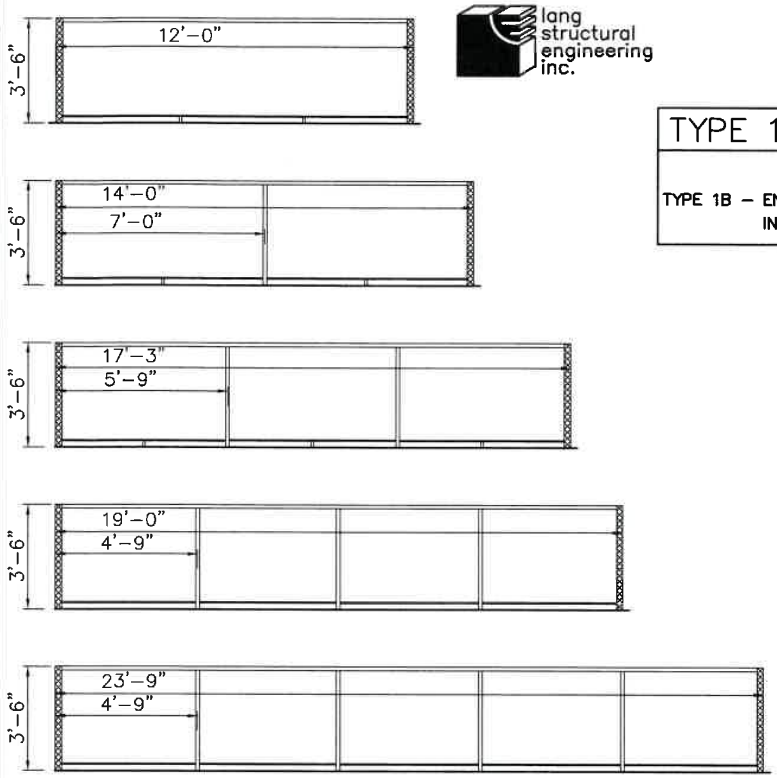
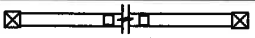
www.vistaprorailings.com



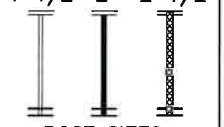

## TYPE 1 – FREE-STANDING



TYPE 1B – END CONDITIONS – 2-1/2" POST EACH END
INTERMEDIATE CONDITIONS – 1-1/2" POSTS EVENLY SPACED

SEE FIGURE 3 AND SECTION 2.5 ANCHORAGE OF THE DESIGN MANUAL FOR DETAILS REGARDING ACCEPTABLE GUARDRAIL MOUNTING CONFIGURATIONS AND MAXIMUM SERVICE PULL-OUT LOAD REQUIREMENTS FOR ANCHORS.

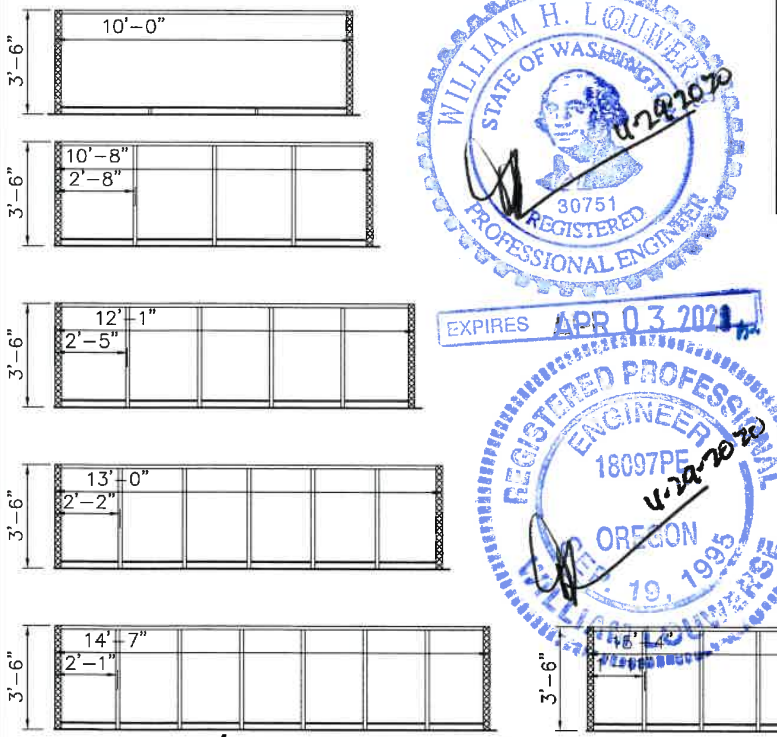
POST LEGEND




POST SIZES

## 20 LBS/FOOT OR 200 LBS. TOP RAIL LOADING

**AS PER 2018 IBC SECTION 1607.8.1 HANDRAILS AND GUARDS FOR ONE AND TWO FAMILY DWELLINGS AND IN GROUP I-3,F,H AND S OCCUPANCIES FOR AREAS THAT ARE NOT ACCESSIBLE TO THE GENERAL PUBLIC AND THAT HAVE AN OCCUPANT LOAD NO GREATER THAN 50.**




NOTES:

–CONFIGURATIONS SHOWN ACCEPTABLE FOR TOP MOUNT (AS SHOWN) AND SIDE/FASCIA MOUNT CONDITIONS FOR BOTH 1/4" TEMPERED GLASS (AS SHOWN) AND PICKET GUARDRAIL SYSTEMS

–ALLOWABLE CONFIGURATIONS ARE BASED UPON ANALYSIS, CALCULATIONS AND RESULTS OF TESTS CONDUCTED BY INTERTEK TESTING SERVICES NA LTD./WARNOCK HERSHEY.

–ALLOWABLE CONFIGURATIONS ARE IN CONFORMANCE WITH THE APPLICABLE STRUCTURAL REQUIREMENTS SPECIFIED IN THE 2018 INTERNATIONAL BUILDING CODE SECTION 1607.8.1

WILLIAM H. LOUWERSE STATE OF WASHINGTON 30751 REGISTERED PROFESSIONAL ENGINEER 4-24-2020

EXPIRES APR 03 2021

REGISTERED PROFESSIONAL ENGINEER WILLIAM H. LOUWERSE 62357 CIVIL STATE OF CALIFORNIA 4-24-2020

EXPIRES SEP 30 2021

Registered Professional Engineer (Civil) CERTIFICATE NO. 63997 WILLIAM LOUWERSE Date Signed 4-24-2020 ARIZONA, U.S.A.

Expires 6/30/2020

REGISTERED PROFESSIONAL ENGINEER 18097PE 4-24-2020 OREGON JULY 19, 1995 WILLIAM LOUWERSE

## 50 LBS/FOOT OR 200 LBS. TOP RAIL LOADING

**FOR CONDITIONS NOT MENTIONED ABOVE**

# FIGURE 4B: 42" HIGH ALLOWABLE CONFIGURATIONS TYPE 1B

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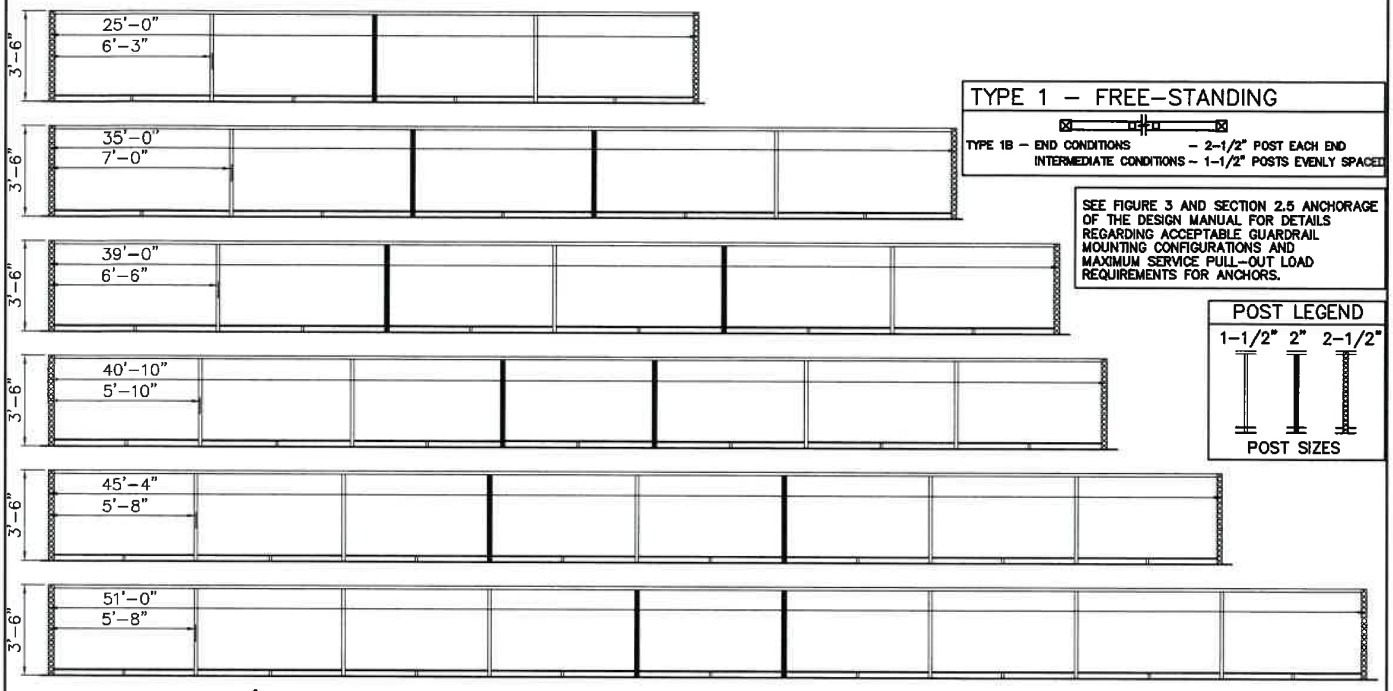
## TYPE 1B ALTERNATE
OPTIONAL CONFIGURATIONS
w/ 2" POSTS ADDED
IN INTERMEDIATE SPACES




TYPE 1 – FREE-STANDING

TYPE 1B – END CONDITIONS – 2-1/2" POST EACH END
INTERMEDIATE CONDITIONS – 1-1/2" POSTS EVENLY SPACED

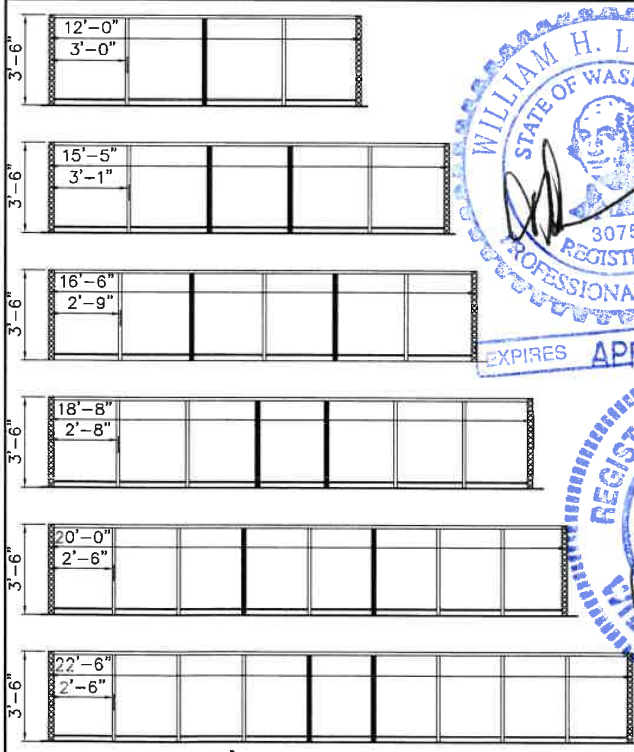
SEE FIGURE 3 AND SECTION 2.5 ANCHORAGE OF THE DESIGN MANUAL FOR DETAILS REGARDING ACCEPTABLE GUARDRAIL MOUNTING CONFIGURATIONS AND MAXIMUM SERVICE PULL-OUT LOAD REQUIREMENTS FOR ANCHORS.

POST LEGEND




## 20 LBS/FOOT OR 200 LBS. TOP RAIL LOADING

**AS PER 2018 IBC SECTION 1607.8.1 HANDRAILS AND GUARDS FOR ONE AND TWO FAMILY DWELLINGS AND IN GROUP I-3,F,H AND S OCCUPANCIES FOR AREAS THAT ARE NOT ACCESSIBLE TO THE GENERAL PUBLIC AND THAT HAVE AN OCCUPANT LOAD NO GREATER THAN 50.**




NOTES:
- CONFIGURATIONS SHOWN ACCEPTABLE FOR TOP MOUNT (AS SHOWN) AND SIDE/FASCIA MOUNT CONDITIONS FOR BOTH 1/4" TEMPERED GLASS (AS SHOWN) AND PICKET GUARDRAIL SYSTEMS
- ALLOWABLE CONFIGURATIONS ARE BASED UPON ANALYSIS, CALCULATIONS AND RESULTS OF TESTS CONDUCTED BY INTERTEK TESTING SERVICES NA LTD./WARNOCK HERSHEY.
- ALLOWABLE CONFIGURATIONS ARE IN CONFORMANCE WITH THE APPLICABLE STRUCTURAL REQUIREMENTS SPECIFIED IN THE 2018 INTERNATIONAL BUILDING CODE SECTION 1607.8.1

WILLIAM H. LOUWERSE STATE OF WASHINGTON 30751 REGISTERED PROFESSIONAL ENGINEER 1-29-2020
EXPIRES APR 0 7 2021

REGISTERED PROFESSIONAL ENGINEER WILLIAM H LOUWERSE 62297 CIVIL STATE OF CALIFORNIA 4-29-2020
EXPIRES SEP 30 2021

REGISTERED PROFESSIONAL ENGINEER 18097PE OREGON APR. 19, 1995 WILLIAM LOUWERSE 4-29-2020

Professional Engineer (Civil) CERTIFICATE NO. 63997 WILLIAM LOUWERSE Date Signed 4-29-2020 ARIZONA, U.S.A.
Expires 6/30/2020

## 50 LBS/FOOT OR 200 LBS. TOP RAIL LOADING

**FOR CONDITIONS NOT MENTIONED ABOVE**

# FIGURE 4B-A: 42" HIGH ALLOWABLE CONFIGURATIONS TYPE 1B-ALTERNATE

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## TYPE 1 – FREE-STANDING

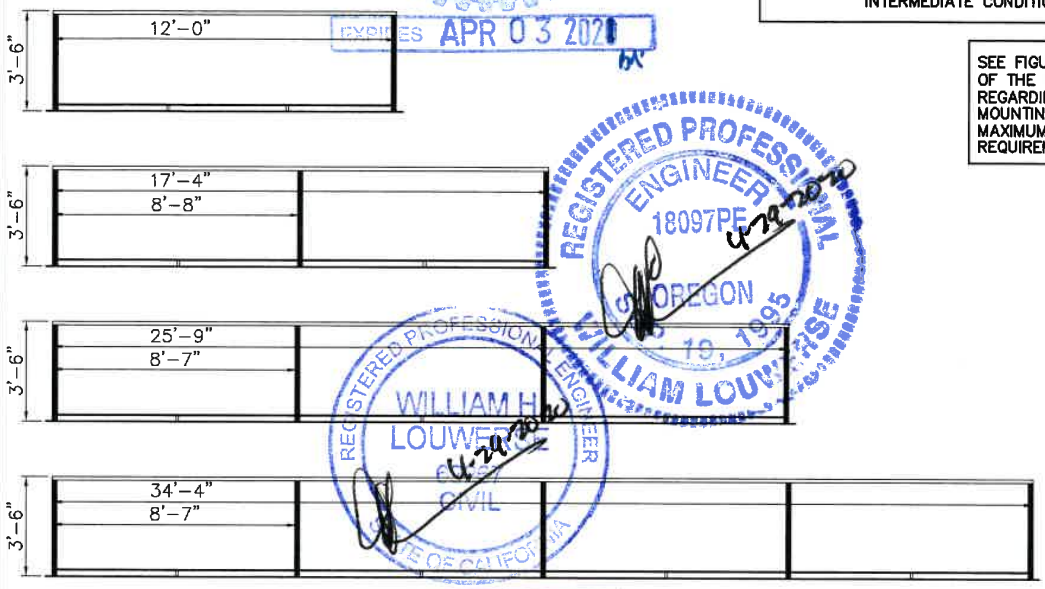
TYPE 1C – END CONDITIONS – 2" POST EACH END
INTERMEDIATE CONDITIONS – 2" POSTS EVENLY SPACED

SEE FIGURE 3 AND SECTION 2.5 ANCHORAGE OF THE DESIGN MANUAL FOR DETAILS REGARDING ACCEPTABLE GUARDRAIL MOUNTING CONFIGURATIONS AND MAXIMUM SERVICE PULL-OUT LOAD REQUIREMENTS FOR ANCHORS.

POST LEGEND

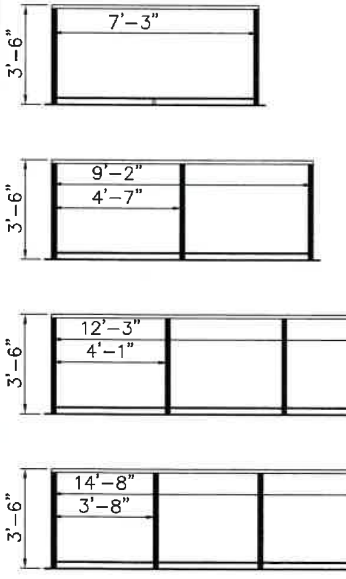
1-1/2" 2" 2-1/2"

POST SIZES




## 20 LBS/FOOT OR 200 LBS. TOP RAIL LOADING

**AS PER 2018 IBC SECTION 1607.8.1 HANDRAILS AND GUARDS FOR ONE AND TWO FAMILY DWELLINGS AND IN GROUP I-3,F,H AND S OCCUPANCIES FOR AREAS THAT ARE NOT ACCESSIBLE TO THE GENERAL PUBLIC AND THAT HAVE AN OCCUPANT LOAD NO GREATER THAN 50.**




NOTES:

–CONFIGURATIONS SHOWN ACCEPTABLE FOR TOP MOUNT (AS SHOWN) AND SIDE/FASCIA MOUNT CONDITIONS FOR BOTH 1/4" TEMPERED GLASS (AS SHOWN) AND PICKET GUARDRAIL SYSTEMS

–ALLOWABLE CONFIGURATIONS ARE BASED UPON ANALYSIS, CALCULATIONS AND RESULTS OF TESTS CONDUCTED BY INTERTEK TESTING SERVICES NA LTD./WARNOCK HERSHEY.

–ALLOWABLE CONFIGURATIONS ARE IN CONFORMANCE WITH THE APPLICABLE STRUCTURAL REQUIREMENTS SPECIFIED IN THE 2018 INTERNATIONAL BUILDING CODE SECTION 1607.8.1

## 50 LBS/FOOT OR 200 LBS. TOP RAIL LOADING

**FOR CONDITIONS NOT MENTIONED ABOVE**

# FIGURE 4C: 42" HIGH ALLOWABLE CONFIGURATIONS TYPE 1C

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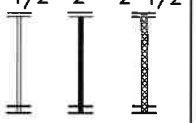
## TYPE 1 – FREE-STANDING

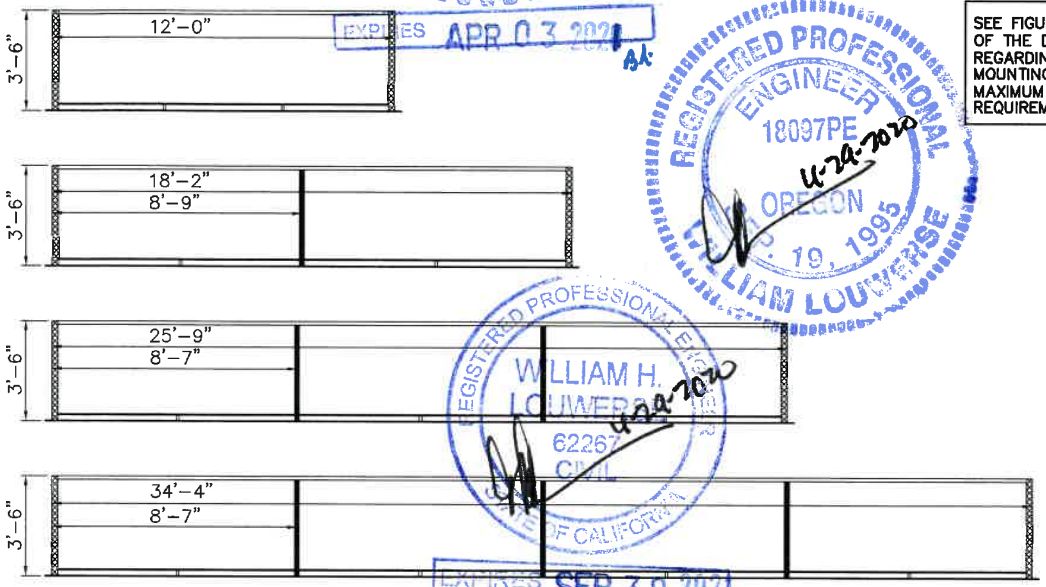
TYPE 1D – END CONDITIONS – 2-1/2" POST EACH END
INTERMEDIATE CONDITIONS – 2" POSTS EVENLY SPACED

SEE FIGURE 3 AND SECTION 2.5 ANCHORAGE OF THE DESIGN MANUAL FOR DETAILS REGARDING ACCEPTABLE GUARDRAIL MOUNTING CONFIGURATIONS AND MAXIMUM SERVICE PULL-OUT LOAD REQUIREMENTS FOR ANCHORS.

POST LEGEND

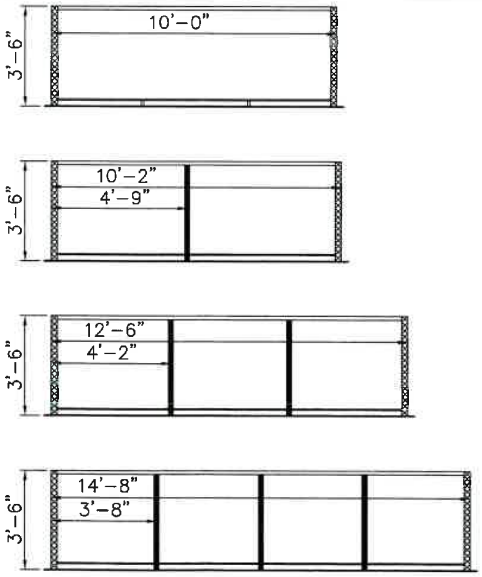



POST SIZES




## 20 LBS/FOOT OR 200 LBS. TOP RAIL LOADING

**AS PER 2018 IBC SECTION 1607.8.1 HANDRAILS AND GUARDS FOR ONE AND TWO FAMILY DWELLINGS AND IN GROUP I-3,F,H AND S OCCUPANCIES FOR AREAS THAT ARE NOT ACCESSIBLE TO THE GENERAL PUBLIC AND THAT HAVE AN OCCUPANT LOAD NO GREATER THAN 50.**




NOTES:

–CONFIGURATIONS SHOWN ACCEPTABLE FOR TOP MOUNT (AS SHOWN) AND SIDE/FASCIA MOUNT CONDITIONS FOR BOTH 1/4" TEMPERED GLASS (AS SHOWN) AND PICKET GUARDRAIL SYSTEMS

–ALLOWABLE CONFIGURATIONS ARE BASED UPON ANALYSIS, CALCULATIONS AND RESULTS OF TESTS CONDUCTED BY INTERTEK TESTING SERVICES NA LTD./WARNOCK HERSHEY.

–ALLOWABLE CONFIGURATIONS ARE IN CONFORMANCE WITH THE APPLICABLE STRUCTURAL REQUIREMENTS SPECIFIED IN THE 2018 INTERNATIONAL BUILDING CODE SECTION 1607.8.1

## 50 LBS/FOOT OR 200 LBS. TOP RAIL LOADING

**FOR CONDITIONS NOT MENTIONED ABOVE**

# FIGURE 4D: 42" HIGH ALLOWABLE CONFIGURATIONS TYPE 1D

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MAPLE RIDGE, B.C.
CANADA V2W 1B6
PH: (800) 667-8247
FAX: (604) 467-1197
www.vistaprorailings.com

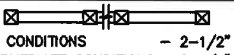
WILLIAM H. LOUWERSE STATE OF WASHINGTON 18075 REGISTERED PROFESSIONAL ENGINEER EXPIRES APR 03 2020

REGISTERED PROFESSIONAL ENGINEER 18097PE OREGON EXP. 19, 1995 WILLIAM LOUWERSE

WILLIAM H. LOUWERSE 6225 CIVIL STATE OF CALIFORNIA EXPIRES SEP 30

Registered Professional Engineer (Civil) CERTIFICATE NO. 63997 WILLIAM LOUWERSE ARIZONA, U.S.A. Expires 6/30/2020

## TYPE 1 – FREE-STANDING

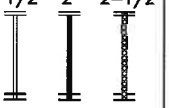


TYPE 1E – END CONDITIONS – 2-1/2" POST EACH END
INTERMEDIATE CONDITIONS – 2-1/2" POSTS EVENLY SPACED

SEE FIGURE 3 AND SECTION 2.5 ANCHORAGE OF THE DESIGN MANUAL FOR DETAILS REGARDING ACCEPTABLE GUARDRAIL MOUNTING CONFIGURATIONS AND MAXIMUM SERVICE PULL-OUT LOAD REQUIREMENTS FOR ANCHORS.

POST LEGEND

1-1/2" 2" 2-1/2"



POST SIZES




## 20 LBS/FOOT OR 200 LBS. TOP RAIL LOADING

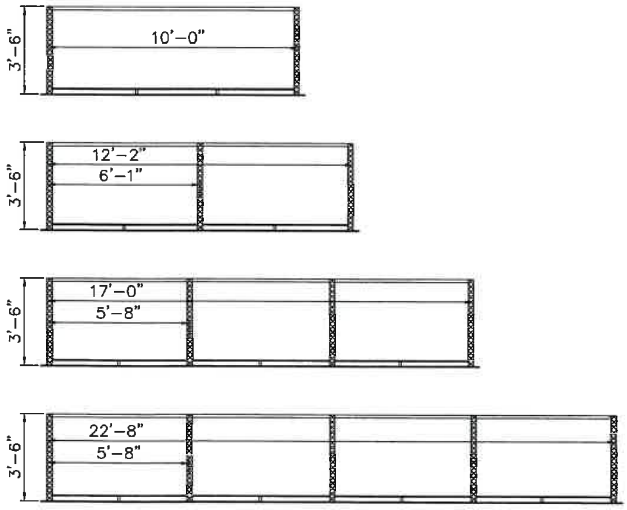
**AS PER 2018 IBC SECTION 1607.8.1 HANDRAILS AND GUARDS FOR ONE AND TWO FAMILY DWELLINGS AND IN GROUP I-3,F,H AND S OCCUPANCIES FOR AREAS THAT ARE NOT ACCESSIBLE TO THE GENERAL PUBLIC AND THAT HAVE AN OCCUPANT LOAD NO GREATER THAN 50.**

NOTES:

–CONFIGURATIONS SHOWN ACCEPTABLE FOR TOP MOUNT (AS SHOWN) AND SIDE/FASCIA MOUNT CONDITIONS FOR BOTH 1/4" TEMPERED GLASS (AS SHOWN) AND PICKET GUARDRAIL SYSTEMS

–ALLOWABLE CONFIGURATIONS ARE BASED UPON ANALYSIS, CALCULATIONS AND RESULTS OF TESTS CONDUCTED BY INTERTEK TESTING SERVICES NA LTD./WARNOCK HERSHEY.

–ALLOWABLE CONFIGURATIONS ARE IN CONFORMANCE WITH THE APPLICABLE STRUCTURAL REQUIREMENTS SPECIFIED IN THE 2018 INTERNATIONAL BUILDING CODE SECTION 1607.8.1




## 50 LBS/FOOT OR 200 LBS. TOP RAIL LOADING

**FOR CONDITIONS NOT MENTIONED ABOVE**

# FIGURE 4E: 42" HIGH ALLOWABLE CONFIGURATIONS TYPE 1E

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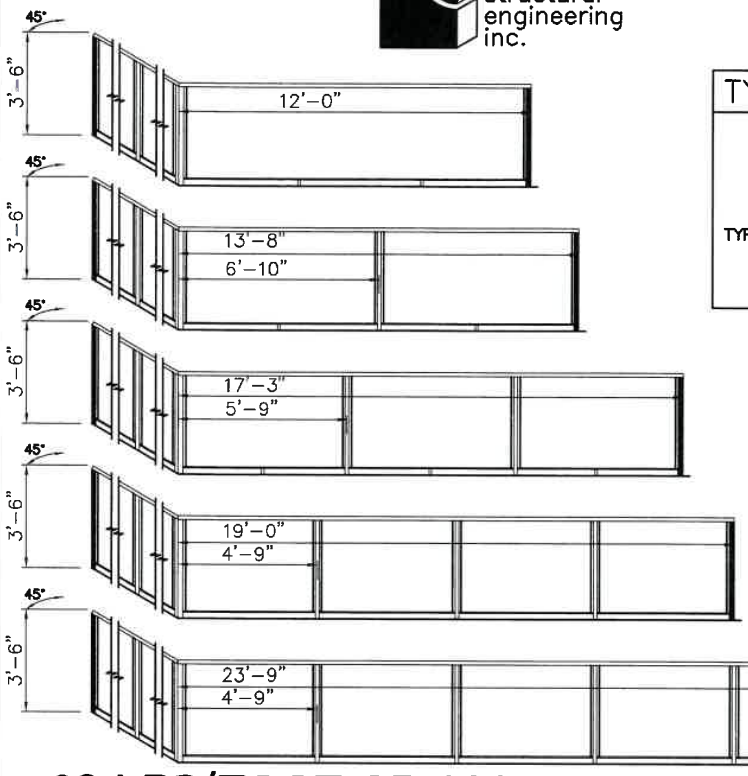
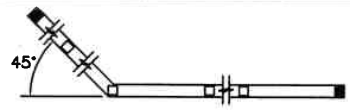



## TYPE 2 – PARTIAL FIXED ONE END




TYPE 2A – END CONDITIONS – 45° CORNER w/ MIN 1– 1-1/2" POST AND 1–2" POST AT END & 2" POST OPPOSITE END

INTERMEDIATE CONDITIONS – 1–1/2" POSTS EVENLY SPACED

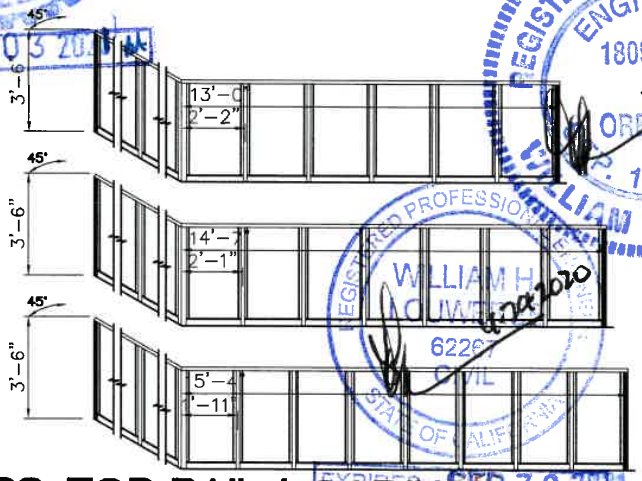
SEE FIGURE 3 AND SECTION 2.5 ANCHORAGE OF THE DESIGN MANUAL FOR DETAILS REGARDING ACCEPTABLE GUARDRAIL MOUNTING CONFIGURATIONS AND MAXIMUM SERVICE PULL–OUT LOAD REQUIREMENTS FOR ANCHORS.

POST LEGEND



## 20 LBS/FOOT OR 200 LBS. TOP RAIL LOADING

**AS PER 2018 IBC SECTION 1607.8.1 HANDRAILS AND GUARDS FOR ONE AND TWO FAMILY DWELLINGS AND IN GROUP I-3,F,H AND S OCCUPANCIES FOR AREAS THAT ARE NOT ACCESSIBLE TO THE GENERAL PUBLIC AND THAT HAVE AN OCCUPANT LOAD NO GREATER THAN 50.**

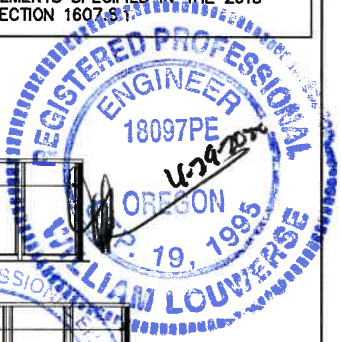

NOTES:

–CONFIGURATIONS SHOWN ACCEPTABLE FOR TOP MOUNT (AS SHOWN) AND SIDE/FASCIA MOUNT CONDITIONS FOR BOTH 1/4" TEMPERED GLASS (AS SHOWN) AND PICKET GUARDRAIL SYSTEMS

–ALLOWABLE CONFIGURATIONS ARE BASED UPON ANALYSIS, CALCULATIONS AND RESULTS OF TESTS CONDUCTED BY INTERTEK TESTING SERVICES NA LTD./WARNOCK HERSHEY.

–ALLOWABLE CONFIGURATIONS ARE IN CONFORMANCE WITH THE APPLICABLE STRUCTURAL REQUIREMENTS SPECIFIED IN THE 2018 INTERNATIONAL BUILDING CODE SECTION 1607.8.1.







## 50 LBS/FOOT OR 200 LBS. TOP RAIL LOADING

**FOR CONDITIONS NOT MENTIONED ABOVE**

# FIGURE 4F: 42" HIGH ALLOWABLE CONFIGURATIONS TYPE 2A

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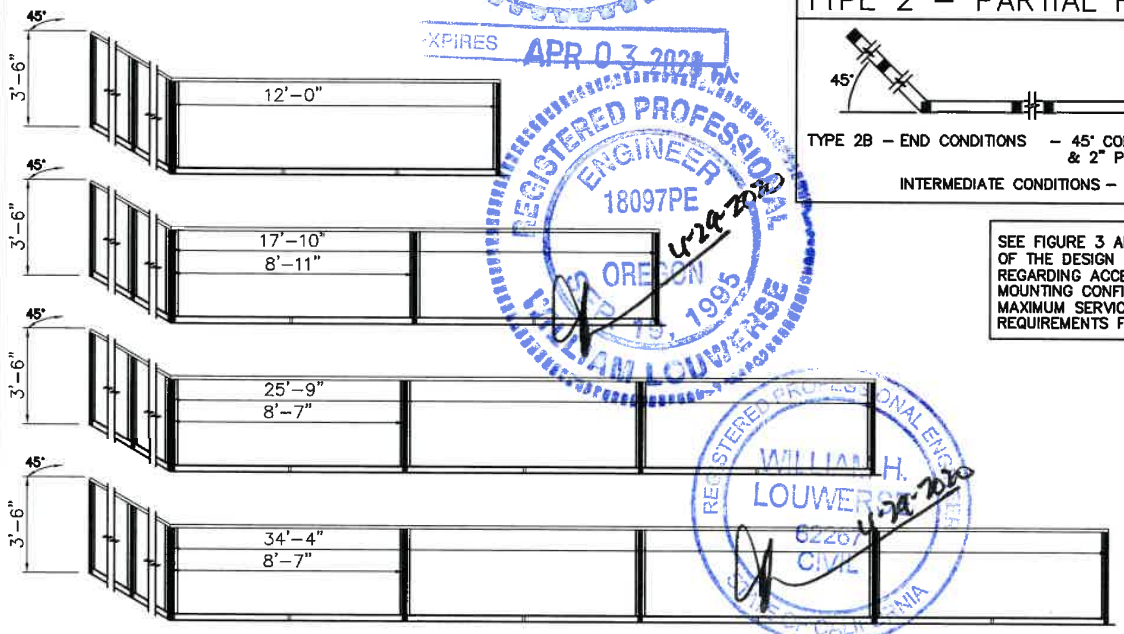



TYPE 2 – PARTIAL FIXED ONE END




TYPE 2B – END CONDITIONS – 45° CORNER w/ MIN 2–2" POSTS & 2" POST OPPOSITE END

INTERMEDIATE CONDITIONS – 2" POSTS EVENLY SPACED

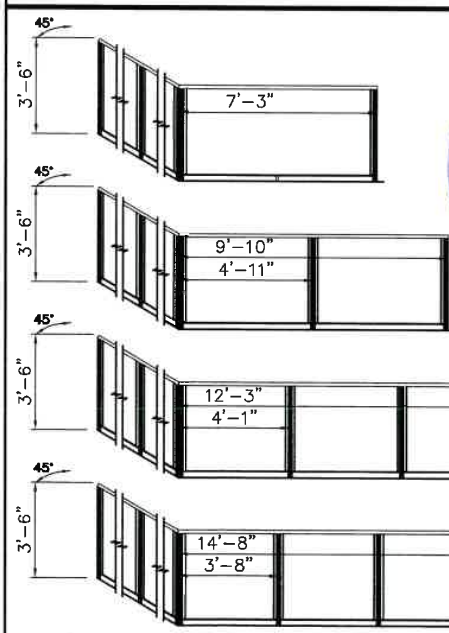
SEE FIGURE 3 AND SECTION 2.5 ANCHORAGE OF THE DESIGN MANUAL FOR DETAILS REGARDING ACCEPTABLE GUARDRAIL MOUNTING CONFIGURATIONS AND MAXIMUM SERVICE PULL-OUT LOAD REQUIREMENTS FOR ANCHORS.

POST LEGEND


POST SIZES

## 20 LBS/FOOT OR 200 LBS. TOP RAIL LOADING

**AS PER 2018 IBC SECTION 1607.8.1 HANDRAILS AND GUARDS FOR ONE AND TWO FAMILY DWELLINGS AND IN GROUP I-3,F,H AND S OCCUPANCIES FOR AREAS THAT ARE NOT ACCESSIBLE TO THE GENERAL PUBLIC AND THAT HAVE AN OCCUPANT LOAD NO GREATER THAN 50.**




NOTES:

- CONFIGURATIONS SHOWN ACCEPTABLE FOR TOP MOUNT (AS SHOWN) AND SIDE/FASCIA MOUNT CONDITIONS FOR BOTH 1/4" TEMPERED GLASS (AS SHOWN) AND PICKET GUARDRAIL SYSTEMS
- ALLOWABLE CONFIGURATIONS ARE BASED UPON ANALYSIS, CALCULATIONS AND RESULTS OF TESTS CONDUCTED BY INTERTEK TESTING SERVICES NA LTD./WARNOCK HERSHEY.
- ALLOWABLE CONFIGURATIONS ARE IN CONFORMANCE WITH THE APPLICABLE STRUCTURAL REQUIREMENTS SPECIFIED IN THE 2018 INTERNATIONAL BUILDING CODE SECTION 1607.8.1

## 50 LBS/FOOT OR 200 LBS. TOP RAIL LOADING

**FOR CONDITIONS NOT MENTIONED ABOVE**

# FIGURE 4G: 42" HIGH ALLOWABLE CONFIGURATIONS TYPE 2B

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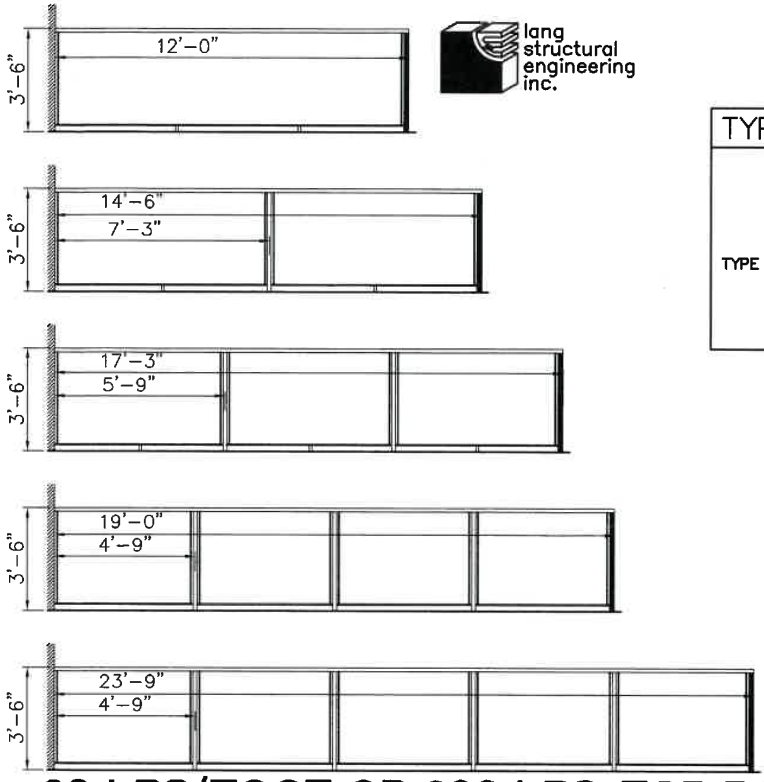
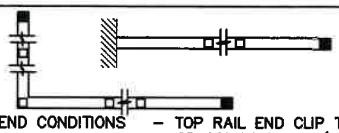



## TYPE 3 – FIXED ONE END

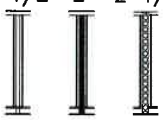


TYPE 3A – END CONDITIONS – TOP RAIL END CLIP TO STRUCTURE OR 90° CORNER w/ MIN 1– 1-1/2" POST AND 1–2" POST AT END & 2" POST OPPOSITE END

INTERMEDIATE CONDITIONS – 1-1/2" POSTS EVENLY SPACED

SEE FIGURE 3 AND SECTION 2.5 ANCHORAGE OF THE DESIGN MANUAL FOR DETAILS REGARDING ACCEPTABLE GUARDRAIL MOUNTING CONFIGURATIONS AND MAXIMUM SERVICE PULL–OUT LOAD REQUIREMENTS FOR ANCHORS.

POST LEGEND




POST SIZES

## 20 LBS/FOOT OR 200 LBS. TOP RAIL LOADING

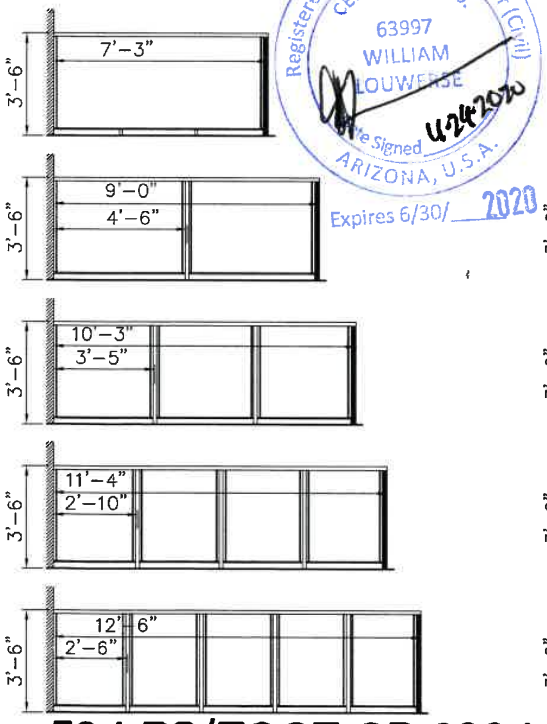
**AS PER 2018 IBC SECTION 1607.8.1 HANDRAILS AND GUARDS FOR ONE AND TWO FAMILY DWELLINGS AND IN GROUP I-3,F,H AND S OCCUPANCIES FOR AREAS THAT ARE NOT ACCESSIBLE TO THE GENERAL PUBLIC AND THAT HAVE AN OCCUPANT LOAD NO GREATER THAN 50.**

NOTES:

–CONFIGURATIONS SHOWN ACCEPTABLE FOR TOP MOUNT (AS SHOWN) AND SIDE/FASCIA MOUNT CONDITIONS FOR BOTH 1/4" TEMPERED GLASS (AS SHOWN) AND PICKET GUARDRAIL SYSTEMS

–ALLOWABLE CONFIGURATIONS ARE BASED UPON ANALYSIS, CALCULATIONS AND RESULTS OF TESTS CONDUCTED BY INTERTEK TESTING SERVICES NA LTD./WARNOCK HERSHEY.

–ALLOWABLE CONFIGURATIONS ARE IN CONFORMANCE WITH THE APPLICABLE STRUCTURAL REQUIREMENTS SPECIFIED IN THE 2018 INTERNATIONAL BUILDING CODE SECTION 1607.8.1




Registered Professional Engineer (Civil) CERTIFICATE NO. 63997 WILLIAM LOUWERSE Date Signed 4-24-2020 ARIZONA, U.S.A. Expires 6/30/2020

REGISTERED PROFESSIONAL ENGINEER WILLIAM H. LOUWERSE 6229 CIVIL CALIFORNIA 4-24-2020

WILLIAM H. LOUWERSE STATE OF WASHINGTON 20751 REGISTERED PROFESSIONAL ENGINEER 4-24-2020

EXPIRES SEP 30 2021

EXPIRES APR 03 2021

REGISTERED PROFESSIONAL ENGINEER 18097PE OREGON APR. 19, 1995 4-24-2020

## 50 LBS/FOOT OR 200 LBS. TOP RAIL LOADING

**FOR CONDITIONS NOT MENTIONED ABOVE**

# FIGURE 4H: 42" HIGH ALLOWABLE CONFIGURATIONS TYPE 3A

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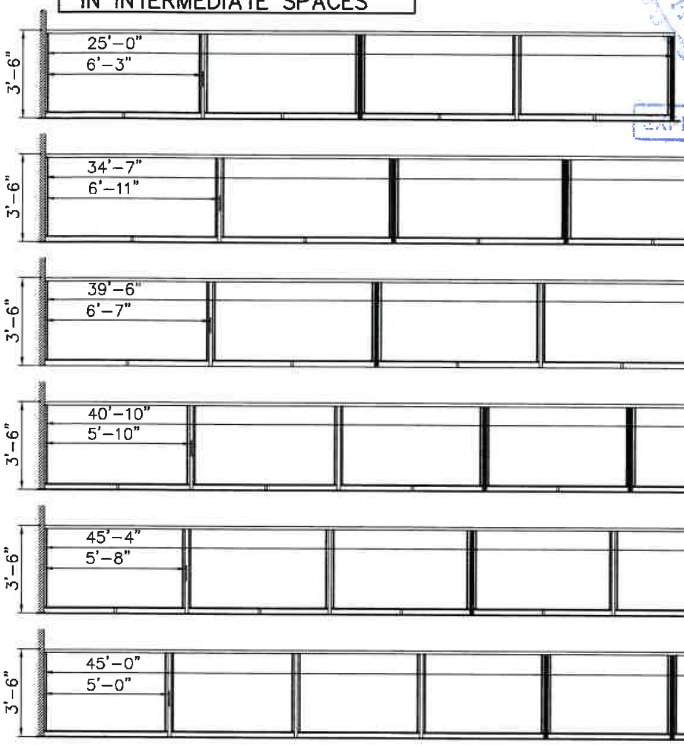
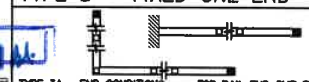
## TYPE 3A ALTERNATE
OPTIONAL CONFIGURATIONS
w/ 2" POSTS ADDED
IN INTERMEDIATE SPACES




TYPE 3 – FIXED ONE END

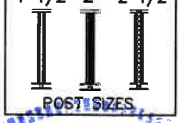


TYPE 3A – END CONDITIONS – TOP RAIL END CLIP TO STRUCTURE OR 90° CORNER w/ MIN 1– 1-1/2" POST AND 1–2" POST AT END & 2" POST OPPOSITE END

INTERMEDIATE CONDITIONS – 1-1/2" POSTS EVENLY SPACED

SEE FIGURE 3 AND SECTION 2.5 ANCHORAGE OF THE DESIGN MANUAL FOR DETAILS REGARDING ACCEPTABLE GUARDRAIL MOUNTING CONFIGURATIONS AND MAXIMUM SERVICE PULL-OUT LOAD REQUIREMENTS FOR ANCHORS.

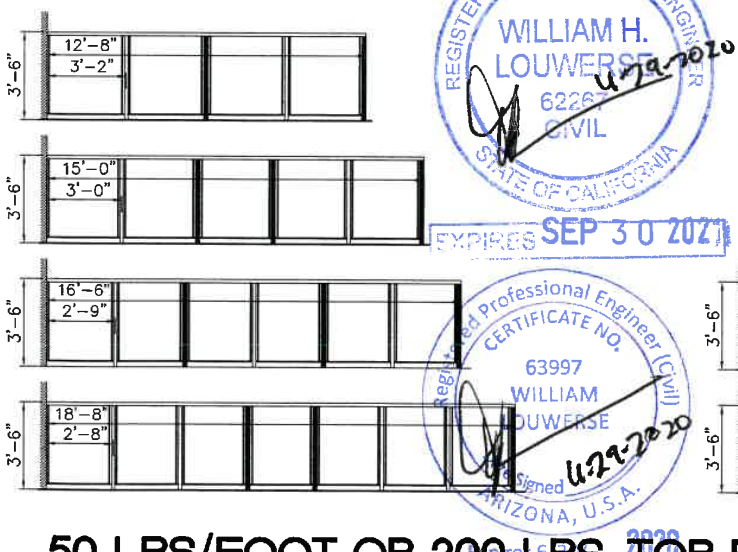
POST LEGEND




POST SIZES

## 20 LBS/FOOT OR 200 LBS. TOP RAIL LOADING

**AS PER 2018 IBC SECTION 1607.8.1 HANDRAILS AND GUARDS FOR ONE AND TWO FAMILY DWELLINGS AND IN GROUP I-3,F,H AND S OCCUPANCIES FOR AREAS THAT ARE NOT ACCESSIBLE TO THE GENERAL PUBLIC AND THAT HAVE AN OCCUPANT LOAD NO GREATER THAN 50.**




NOTES:
- –CONFIGURATIONS SHOWN ACCEPTABLE FOR TOP MOUNT (AS SHOWN) AND SIDE/FASCIA MOUNT CONDITIONS FOR BOTH 1/4" TEMPERED GLASS (AS SHOWN) AND PICKET GUARDRAIL SYSTEMS
- –ALLOWABLE CONFIGURATIONS ARE BASED UPON ANALYSIS, CALCULATIONS AND RESULTS OF TESTS CONDUCTED BY INTERTEK TESTING SERVICES NA LTD./WARNOCK HERSHEY.
- –ALLOWABLE CONFIGURATIONS ARE IN CONFORMANCE WITH THE APPLICABLE STRUCTURAL REQUIREMENTS SPECIFIED IN THE 2018 INTERNATIONAL BUILDING CODE SECTION 1607.8.1

## 50 LBS/FOOT OR 200 LBS. TOP RAIL LOADING

**FOR CONDITIONS NOT MENTIONED ABOVE**

# FIGURE 4H-A: 42" HIGH ALLOWABLE CONFIGURATIONS TYPE 3A-ALTERNATE

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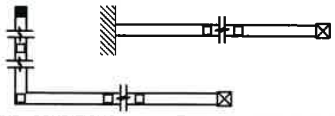
## TYPE 3 – FIXED ONE END



TYPE 3B – END CONDITIONS – TOP RAIL END CLIP TO STRUCTURE OR 90° CORNER w/ MIN 1– 1–1/2" POST AND 1–2" POST AT END & 2–1/2" POST OPPOSITE END

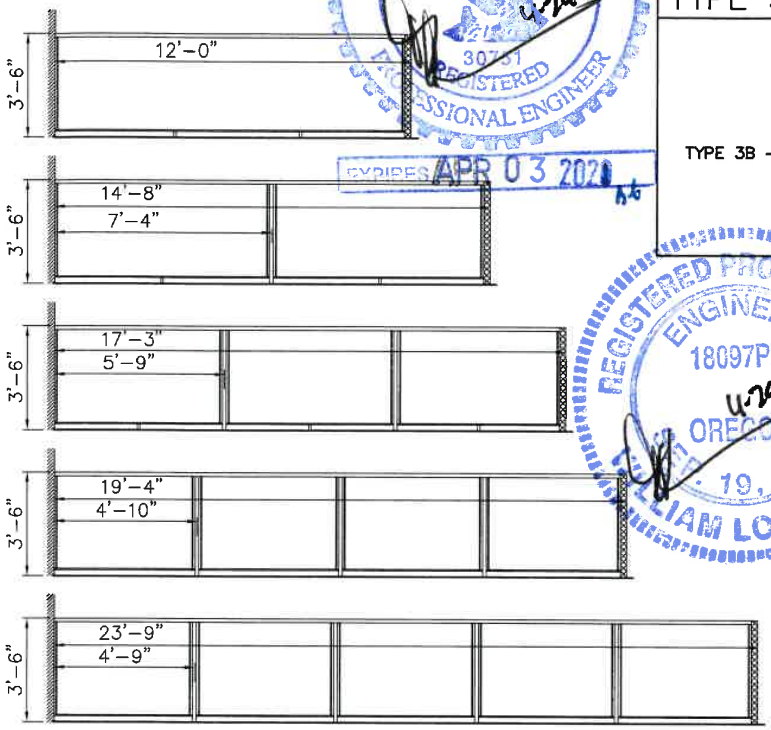
INTERMEDIATE CONDITIONS – 1–1/2" POSTS EVENLY SPACED

SEE FIGURE 3 AND SECTION 2.5 ANCHORAGE OF THE DESIGN MANUAL FOR DETAILS REGARDING ACCEPTABLE GUARDRAIL MOUNTING CONFIGURATIONS AND MAXIMUM SERVICE PULL–OUT LOAD REQUIREMENTS FOR ANCHORS.

POST LEGEND

1–1/2" 2" 2–1/2"

POST SIZES




## 20 LBS/FOOT OR 200 LBS. TOP RAIL LOADING

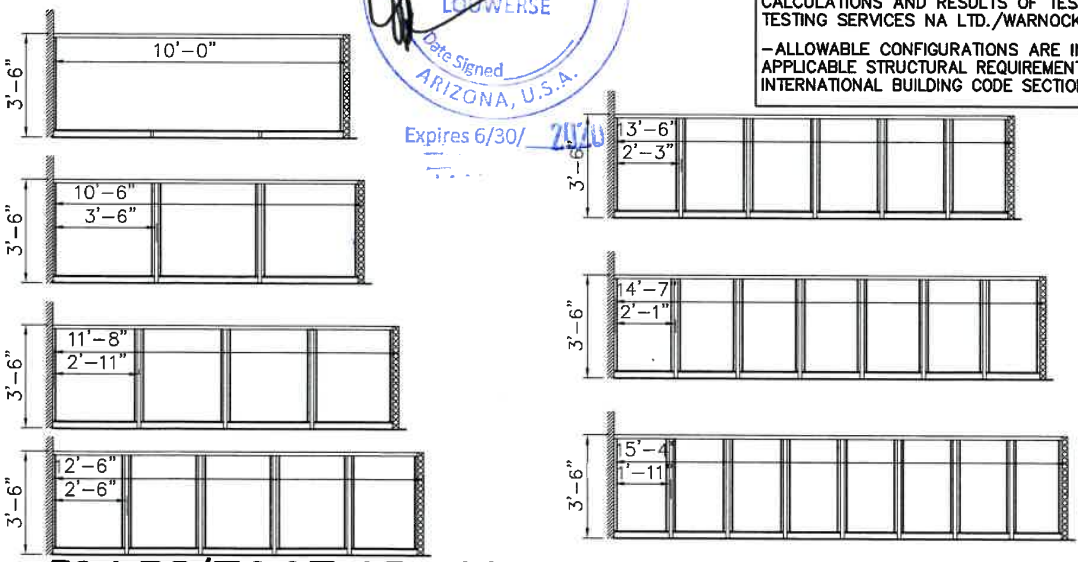
**AS PER 2018 IBC SECTION 1607.8.1 HANDRAILS AND GUARDS FOR ONE AND TWO FAMILY DWELLINGS AND IN GROUP I-3,F,H AND S OCCUPANCIES FOR AREAS THAT ARE NOT ACCESSIBLE TO THE GENERAL PUBLIC AND THAT HAVE AN OCCUPANT LOAD NO GREATER THAN 50.**

NOTES:

–CONFIGURATIONS SHOWN ACCEPTABLE FOR TOP MOUNT (AS SHOWN) AND SIDE/FASCIA MOUNT CONDITIONS FOR BOTH 1/4" TEMPERED GLASS (AS SHOWN) AND PICKET GUARDRAIL SYSTEMS.

–ALLOWABLE CONFIGURATIONS ARE BASED UPON ANALYSIS, CALCULATIONS AND RESULTS OF TESTS CONDUCTED BY INTERTEK TESTING SERVICES NA LTD./WARNOCK HERSHEY.

–ALLOWABLE CONFIGURATIONS ARE IN CONFORMANCE WITH THE APPLICABLE STRUCTURAL REQUIREMENTS SPECIFIED IN THE 2018 INTERNATIONAL BUILDING CODE SECTION 1607.8.1




## 50 LBS/FOOT OR 200 LBS. TOP RAIL LOADING

**FOR CONDITIONS NOT MENTIONED ABOVE**

# FIGURE 41: 42" HIGH ALLOWABLE CONFIGURATIONS TYPE 3B

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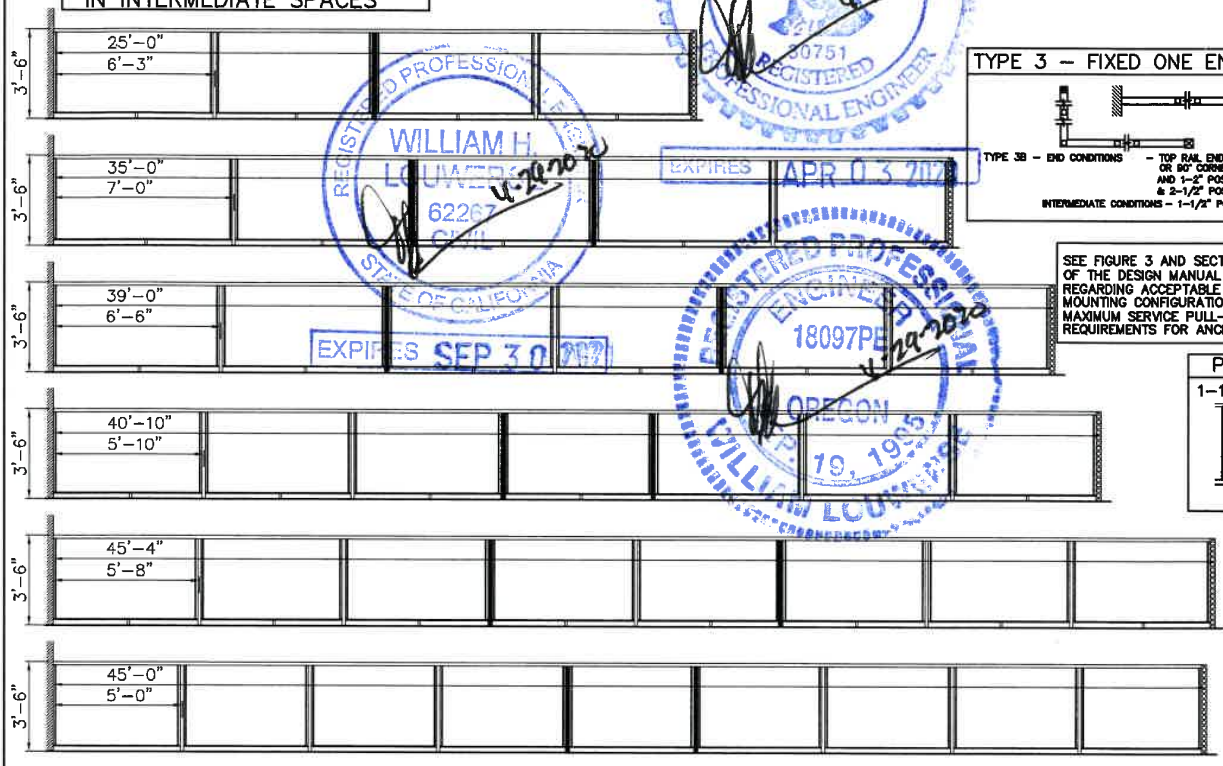
# TYPE 3B ALTERNATE
OPTIONAL CONFIGURATIONS
w/ 2" POSTS ADDED
IN INTERMEDIATE SPACES



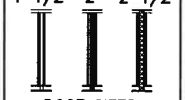

TYPE 3 – FIXED ONE END



TYPE 3B – END CONDITIONS – TOP RAIL END CLIP TO STRUCTURE OR 90° CORNER w/ MIN 1– 1-1/2" POST AND 1–2" POST AT END & 2-1/2" POST OPPOSITE END
INTERMEDIATE CONDITIONS – 1-1/2" POSTS EVENLY SPACED

SEE FIGURE 3 AND SECTION 2.5 ANCHORAGE OF THE DESIGN MANUAL FOR DETAILS REGARDING ACCEPTABLE GUARDRAIL MOUNTING CONFIGURATIONS AND MAXIMUM SERVICE PULL–OUT LOAD REQUIREMENTS FOR ANCHORS.

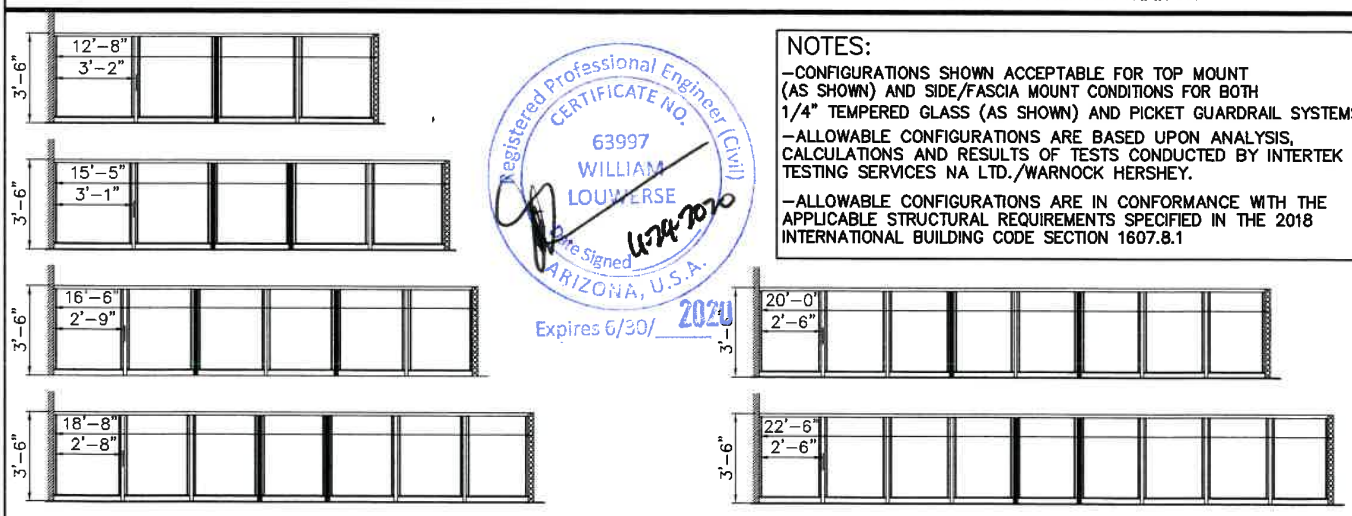
POST LEGEND




POST SIZES

## 20 LBS/FOOT OR 200 LBS. TOP RAIL LOADING

**AS PER 2018 IBC SECTION 1607.8.1 HANDRAILS AND GUARDS FOR ONE AND TWO FAMILY DWELLINGS AND IN GROUP I-3,F,H AND S OCCUPANCIES FOR AREAS THAT ARE NOT ACCESSIBLE TO THE GENERAL PUBLIC AND THAT HAVE AN OCCUPANT LOAD NO GREATER THAN 50.**




NOTES:
–CONFIGURATIONS SHOWN ACCEPTABLE FOR TOP MOUNT (AS SHOWN) AND SIDE/FASCIA MOUNT CONDITIONS FOR BOTH 1/4" TEMPERED GLASS (AS SHOWN) AND PICKET GUARDRAIL SYSTEMS
–ALLOWABLE CONFIGURATIONS ARE BASED UPON ANALYSIS, CALCULATIONS AND RESULTS OF TESTS CONDUCTED BY INTERTEK TESTING SERVICES NA LTD./WARNOCK HERSHEY.
–ALLOWABLE CONFIGURATIONS ARE IN CONFORMANCE WITH THE APPLICABLE STRUCTURAL REQUIREMENTS SPECIFIED IN THE 2018 INTERNATIONAL BUILDING CODE SECTION 1607.8.1

## 50 LBS/FOOT OR 200 LBS. TOP RAIL LOADING

**FOR CONDITIONS NOT MENTIONED ABOVE**

# FIGURE 4I-A: 42" HIGH ALLOWABLE CONFIGURATIONS TYPE 3B-ALTERNATE

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## TYPE 3 – FIXED ONE END

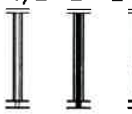
TYPE 3C – END CONDITIONS – TOP RAIL END CLIP TO STRUCTURE OR 90° CORNER w/ MIN 2–2" POSTS & 2" POST OPPOSITE END

INTERMEDIATE CONDITIONS – 2" POSTS EVENLY SPACED

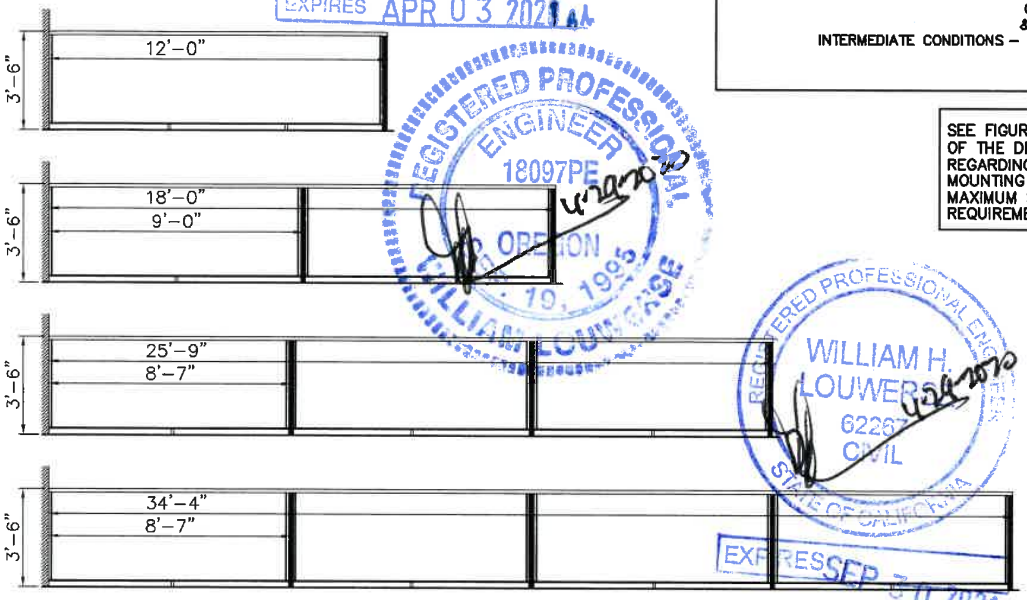
SEE FIGURE 3 AND SECTION 2.5 ANCHORAGE OF THE DESIGN MANUAL FOR DETAILS REGARDING ACCEPTABLE GUARDRAIL MOUNTING CONFIGURATIONS AND MAXIMUM SERVICE PULL–OUT LOAD REQUIREMENTS FOR ANCHORS.

POST LEGEND

1–1/2" 2" 2–1/2"

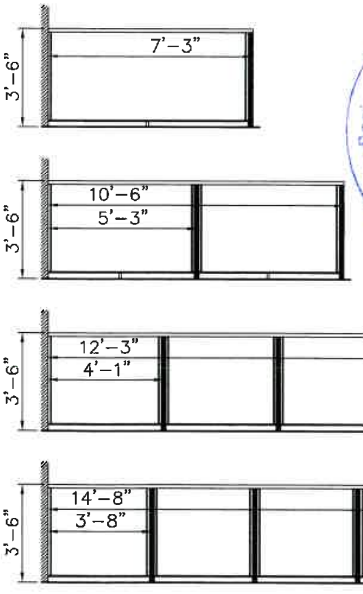


POST SIZES




## 20 LBS/FOOT OR 200 LBS. TOP RAIL LOADING

**AS PER 2018 IBC SECTION 1607.8.1 HANDRAILS AND GUARDS FOR ONE AND TWO FAMILY DWELLINGS AND IN GROUP I-3,F,H AND S OCCUPANCIES FOR AREAS THAT ARE NOT ACCESSIBLE TO THE GENERAL PUBLIC AND THAT HAVE AN OCCUPANT LOAD NO GREATER THAN 50.**




NOTES:

–CONFIGURATIONS SHOWN ACCEPTABLE FOR TOP MOUNT (AS SHOWN) AND SIDE/FASCIA MOUNT CONDITIONS FOR BOTH 1/4" TEMPERED GLASS (AS SHOWN) AND PICKET GUARDRAIL SYSTEMS

–ALLOWABLE CONFIGURATIONS ARE BASED UPON ANALYSIS, CALCULATIONS AND RESULTS OF TESTS CONDUCTED BY INTERTEK TESTING SERVICES NA LTD./WARNOCK HERSHEY.

–ALLOWABLE CONFIGURATIONS ARE IN CONFORMANCE WITH THE APPLICABLE STRUCTURAL REQUIREMENTS SPECIFIED IN THE 2018 INTERNATIONAL BUILDING CODE SECTION 1607.8.1

## 50 LBS/FOOT OR 200 LBS. TOP RAIL LOADING

**FOR CONDITIONS NOT MENTIONED ABOVE**

# FIGURE 4J: 42" HIGH ALLOWABLE CONFIGURATIONS TYPE 3C

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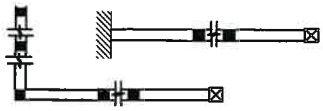
WILLIAM H. LOUWERSE STATE OF WASHINGTON 30751 REGISTERED PROFESSIONAL ENGINEER 4-29-2020
EXPIRES APR 03 2020

REGISTERED PROFESSIONAL ENGINEER 4-29-2020 OREGON JULY 10, 1995

REGISTERED PROFESSIONAL ENGINEER WILLIAM H. LOUWERSE 62267 CIVIL STATE OF CALIFORNIA 4-29-2020
EXPIRES SEP 30 202

## TYPE 3 – FIXED ONE END

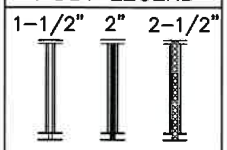


TYPE 3D – END CONDITIONS – TOP RAIL END CLIP TO STRUCTURE OR 90° CORNER w/ MIN 2–2" POSTS & 2–1/2" POST OPPOSITE END

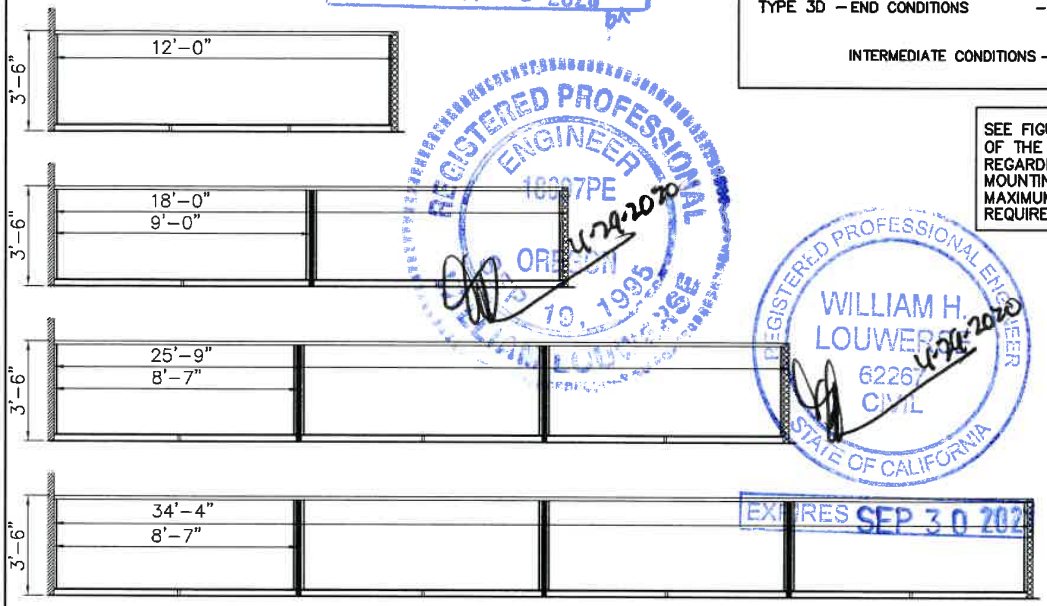
INTERMEDIATE CONDITIONS – 2" POSTS EVENLY SPACED

SEE FIGURE 3 AND SECTION 2.5 ANCHORAGE OF THE DESIGN MANUAL FOR DETAILS REGARDING ACCEPTABLE GUARDRAIL MOUNTING CONFIGURATIONS AND MAXIMUM SERVICE PULL–OUT LOAD REQUIREMENTS FOR ANCHORS.

POST LEGEND




POST SIZES




## 20 LBS/FOOT OR 200 LBS. TOP RAIL LOADING

**AS PER 2018 IBC SECTION 1607.8.1 HANDRAILS AND GUARDS FOR ONE AND TWO FAMILY DWELLINGS AND IN GROUP I-3,F,H AND S OCCUPANCIES FOR AREAS THAT ARE NOT ACCESSIBLE TO THE GENERAL PUBLIC AND THAT HAVE AN OCCUPANT LOAD NO GREATER THAN 50.**

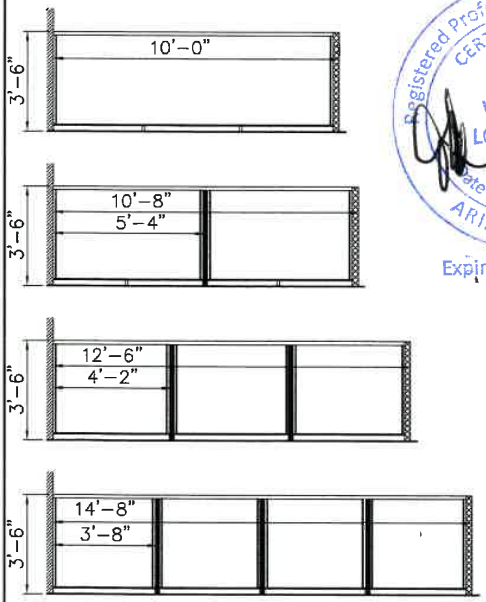
Registered Professional Engineer (Civil) CERTIFICATE NO. 63997 WILLIAM LOUWERSE Date Signed 4-29-2020 ARIZONA, U.S.A. Expires 6/30/2020

NOTES:

–CONFIGURATIONS SHOWN ACCEPTABLE FOR TOP MOUNT (AS SHOWN) AND SIDE/FASCIA MOUNT CONDITIONS FOR BOTH 1/4" TEMPERED GLASS (AS SHOWN) AND PICKET GUARDRAIL SYSTEMS

–ALLOWABLE CONFIGURATIONS ARE BASED UPON ANALYSIS, CALCULATIONS AND RESULTS OF TESTS CONDUCTED BY INTERTEK TESTING SERVICES NA LTD./WARNOCK HERSHEY.

–ALLOWABLE CONFIGURATIONS ARE IN CONFORMANCE WITH THE APPLICABLE STRUCTURAL REQUIREMENTS SPECIFIED IN THE 2018 INTERNATIONAL BUILDING CODE SECTION 1607.8.1




## 50 LBS/FOOT OR 200 LBS. TOP RAIL LOADING

**FOR CONDITIONS NOT MENTIONED ABOVE**

# FIGURE 4K: 42" HIGH ALLOWABLE CONFIGURATIONS TYPE 3D

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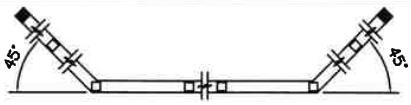
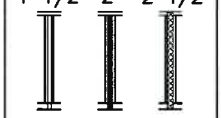
## TYPE 4 – PARTIAL FIXED BOTH ENDS



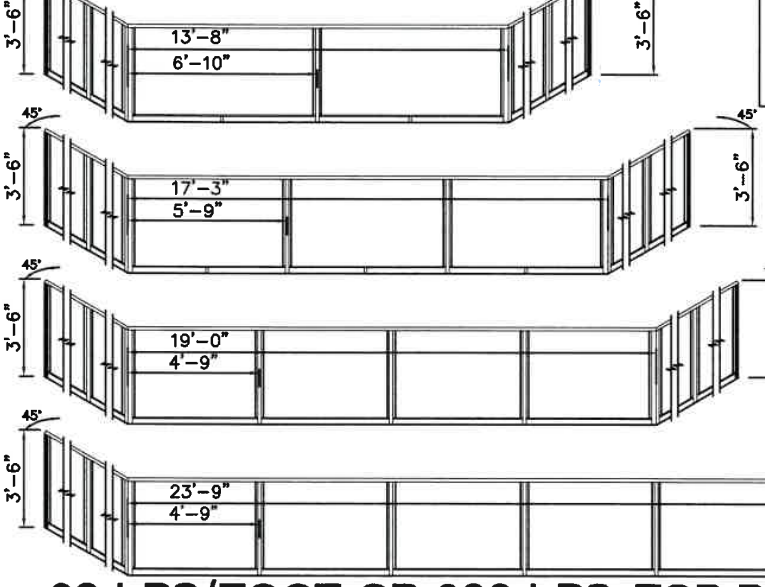

TYPE 4A – END CONDITIONS – 45° CORNERS w/ MIN 1–1–1/2" POST AND 1–2" POST AT END
INTERMEDIATE CONDITIONS – 1–1/2" POSTS EVENLY SPACED

SEE FIGURE 3 AND SECTION 2.5 ANCHORAGE OF THE DESIGN MANUAL FOR DETAILS REGARDING ACCEPTABLE GUARDRAIL MOUNTING CONFIGURATIONS AND MAXIMUM SERVICE PULL-OUT LOAD REQUIREMENTS FOR ANCHORS.

POST LEGEND




POST SIZES




WILLIAM H. LOUWERSE — STATE OF WASHINGTON — 30751 — REGISTERED PROFESSIONAL ENGINEER — 4-24-2020

EXPIRES APR 03 2021

REGISTERED PROFESSIONAL ENGINEER — 18097PE — OREGON — 4-24-2020 — WILLIAM H. LOUWERSE — JULY 10, 1997

## 20 LBS/FOOT OR 200 LBS. TOP RAIL LOADING

**AS PER 2018 IBC SECTION 1607.8.1 HANDRAILS AND GUARDS FOR ONE AND TWO FAMILY DWELLINGS AND IN GROUP I-3,F,H AND S OCCUPANCIES FOR AREAS THAT ARE NOT ACCESSIBLE TO THE GENERAL PUBLIC AND THAT HAVE AN OCCUPANT LOAD NO GREATER THAN 50.**

REGISTERED PROFESSIONAL ENGINEER — WILLIAM H. LOUWERSE — 62267 — CIVIL — STATE OF CALIFORNIA — 4-28-2020

Registered Professional Engineer (Civil) — CERTIFICATE NO. 63997 — WILLIAM LOUWERSE — Signed 4-29-2020 — ARIZONA, U.S.A.

EXPIRES SEP 30 2021

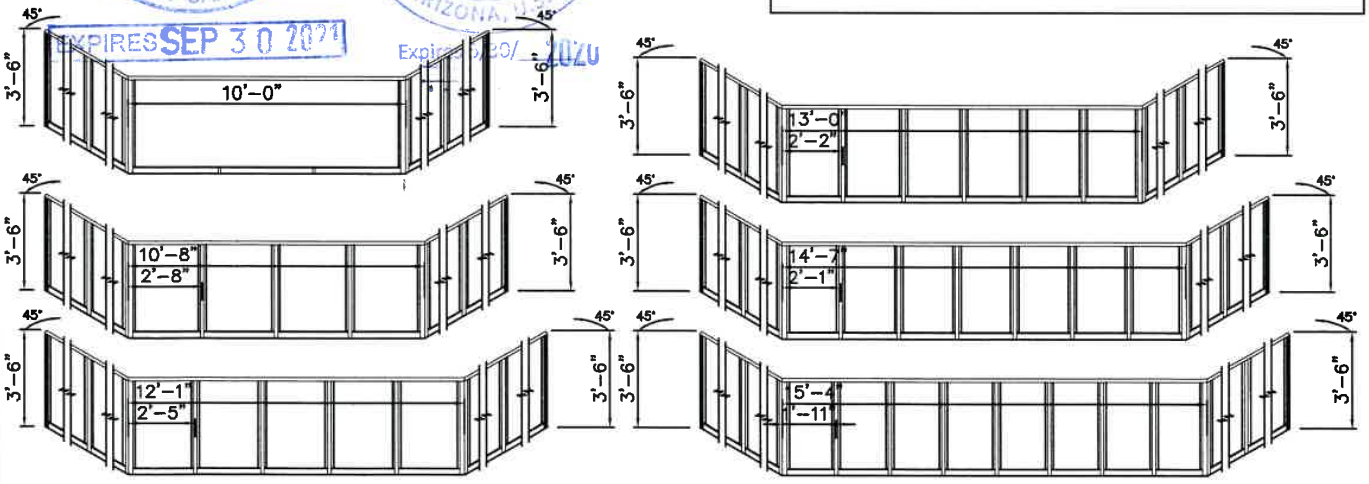
Expires 9/30/2020

NOTES:

–CONFIGURATIONS SHOWN ACCEPTABLE FOR TOP MOUNT (AS SHOWN) AND SIDE/FASCIA MOUNT CONDITIONS FOR BOTH 1/4" TEMPERED GLASS (AS SHOWN) AND PICKET GUARDRAIL SYSTEMS

–ALLOWABLE CONFIGURATIONS ARE BASED UPON ANALYSIS, CALCULATIONS AND RESULTS OF TESTS CONDUCTED BY INTERTEK TESTING SERVICES NA LTD./WARNOCK HERSHEY.

–ALLOWABLE CONFIGURATIONS ARE IN CONFORMANCE WITH THE APPLICABLE STRUCTURAL REQUIREMENTS SPECIFIED IN THE 2018 INTERNATIONAL BUILDING CODE SECTION 1607.8.1




## 50 LBS/FOOT OR 200 LBS. TOP RAIL LOADING

**FOR CONDITIONS NOT MENTIONED ABOVE**

# FIGURE 4L: 42" HIGH ALLOWABLE CONFIGURATIONS TYPE 4A

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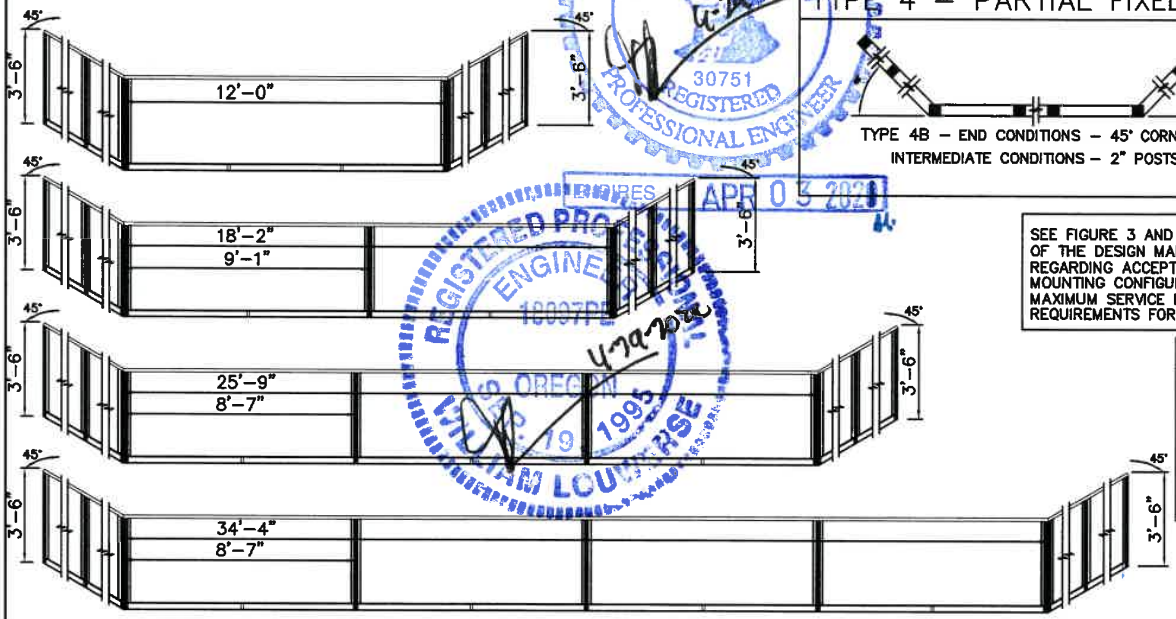


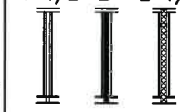

TYPE 4 – PARTIAL FIXED BOTH ENDS



TYPE 4B – END CONDITIONS – 45° CORNERS w/ MIN 2–2" POSTS
INTERMEDIATE CONDITIONS – 2" POSTS EVENLY SPACED

SEE FIGURE 3 AND SECTION 2.5 ANCHORAGE OF THE DESIGN MANUAL FOR DETAILS REGARDING ACCEPTABLE GUARDRAIL MOUNTING CONFIGURATIONS AND MAXIMUM SERVICE PULL–OUT LOAD REQUIREMENTS FOR ANCHORS.

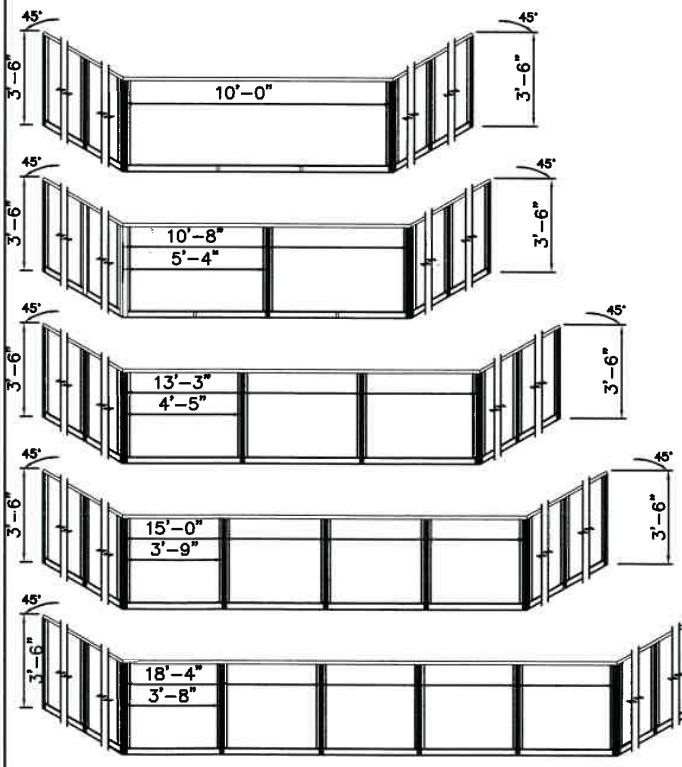
POST LEGEND




POST SIZES

## 20 LBS/FOOT OR 200 LBS. TOP RAIL LOADING

**AS PER 2018 IBC SECTION 1607.8.1 HANDRAILS AND GUARDS FOR ONE AND TWO FAMILY DWELLINGS AND IN GROUP I-3,F,H AND S OCCUPANCIES FOR AREAS THAT ARE NOT ACCESSIBLE TO THE GENERAL PUBLIC AND THAT HAVE AN OCCUPANT LOAD NO GREATER THAN 50.**




NOTES:
–CONFIGURATIONS SHOWN ACCEPTABLE FOR TOP MOUNT (AS SHOWN) AND SIDE/FASCIA MOUNT CONDITIONS FOR BOTH 1/4" TEMPERED GLASS (AS SHOWN) AND PICKET GUARDRAIL SYSTEMS
–ALLOWABLE CONFIGURATIONS ARE BASED UPON ANALYSIS, CALCULATIONS AND RESULTS OF TESTS CONDUCTED BY INTERTEK TESTING SERVICES NA LTD./WARNOCK HERSHEY.
–ALLOWABLE CONFIGURATIONS ARE IN CONFORMANCE WITH THE APPLICABLE STRUCTURAL REQUIREMENTS SPECIFIED IN THE 2018 INTERNATIONAL BUILDING CODE SECTION 1607.8.1

Registered Professional Engineer CERTIFICATE NO. 63997 WILLIAM LOUWERSE Date Signed ARIZONA, U.S.A.
Expires 6/30/2020

REGISTERED PROFESSIONAL ENGINEER WILLIAM H. LOUWERSE 62207 CIVIL STATE OF CALIFORNIA
EXPIRES SEP 30 2021

## 50 LBS/FOOT OR 200 LBS. TOP RAIL LOADING

**FOR CONDITIONS NOT MENTIONED ABOVE**

# FIGURE 4M: 42" HIGH ALLOWABLE CONFIGURATIONS TYPE 4B

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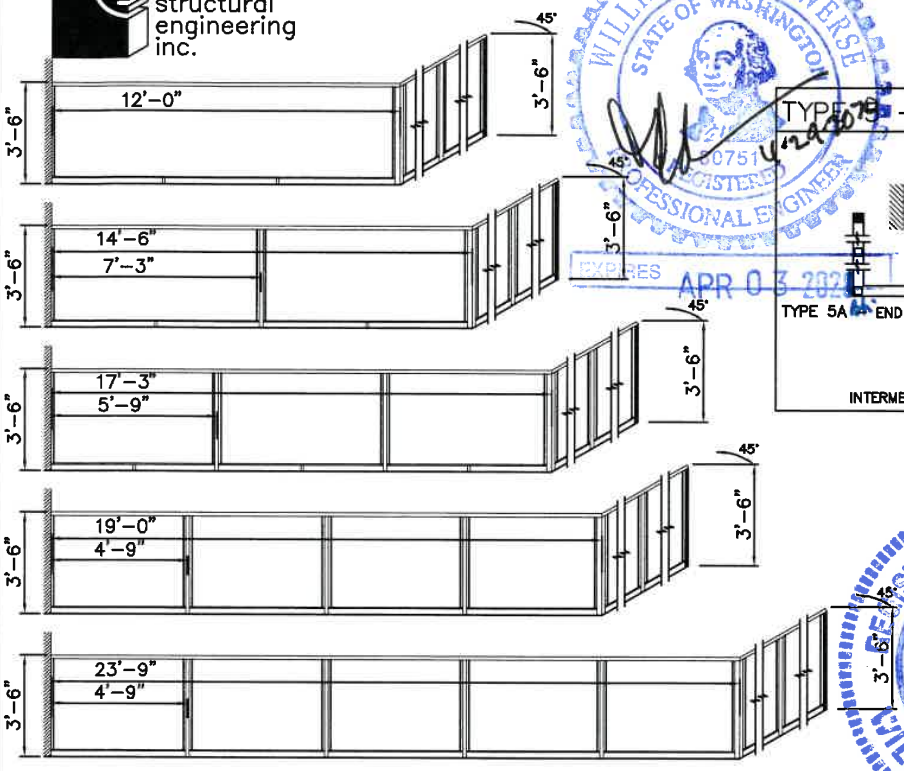
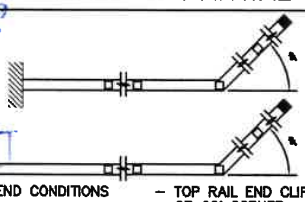



TYPE 5A – FIXED & PARTIAL FIXED ENDS

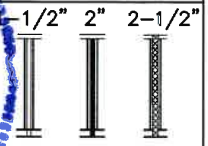


TYPE 5A END CONDITIONS – TOP RAIL END CLIP TO STRUCTURE OR 90° CORNER w/ MIN 1– 1–1/2" POST AND 1–2" POST AT END & 45° CORNER w/ MIN 1– 1–1/2" POST AND 1–2" POST AT END

INTERMEDIATE CONDITIONS – 1–1/2" POSTS EVENLY SPACED

SEE FIGURE 3 AND SECTION 2.5 ANCHORAGE OF THE DESIGN MANUAL FOR DETAILS REGARDING ACCEPTABLE GUARDRAIL MOUNTING CONFIGURATIONS AND MAXIMUM SERVICE PULL–OUT LOAD REQUIREMENTS FOR ANCHORS.

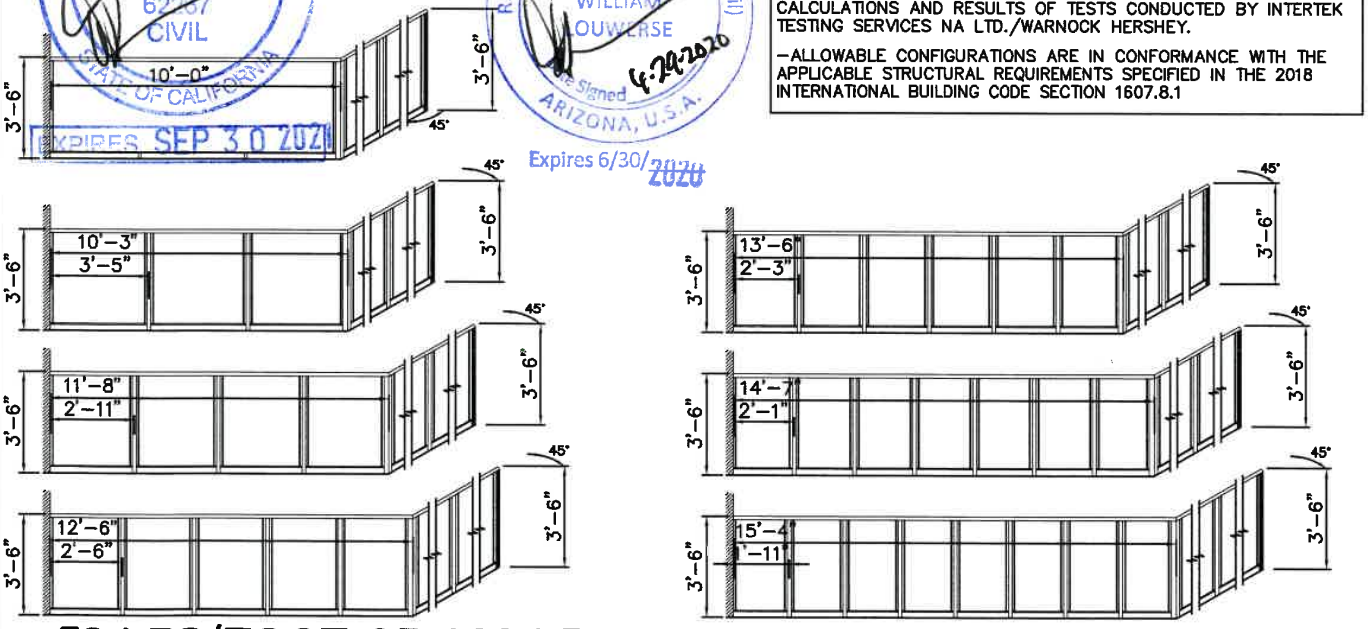
POST LEGEND




POST SIZES

## 20 LBS/FOOT OR 200 LBS. TOP RAIL LOADING

**AS PER 2018 IBC SECTION 1607.8.1 HANDRAILS AND GUARDS FOR ONE AND TWO FAMILY DWELLINGS AND IN GROUP I-3,F,H AND S OCCUPANCIES FOR AREAS THAT ARE NOT ACCESSIBLE TO THE GENERAL PUBLIC AND THAT HAVE AN OCCUPANT LOAD NO GREATER THAN 50.**




NOTES:

–CONFIGURATIONS SHOWN ACCEPTABLE FOR TOP MOUNT (AS SHOWN) AND SIDE/FASCIA MOUNT CONDITIONS FOR BOTH 1/4" TEMPERED GLASS (AS SHOWN) AND PICKET GUARDRAIL SYSTEMS

–ALLOWABLE CONFIGURATIONS ARE BASED UPON ANALYSIS, CALCULATIONS AND RESULTS OF TESTS CONDUCTED BY INTERTEK TESTING SERVICES NA LTD./WARNOCK HERSHEY.

–ALLOWABLE CONFIGURATIONS ARE IN CONFORMANCE WITH THE APPLICABLE STRUCTURAL REQUIREMENTS SPECIFIED IN THE 2018 INTERNATIONAL BUILDING CODE SECTION 1607.8.1

## 50 LBS/FOOT OR 200 LBS. TOP RAIL LOADING

**FOR CONDITIONS NOT MENTIONED ABOVE**

# FIGURE 4N: 42" HIGH ALLOWABLE CONFIGURATIONS TYPE 5A

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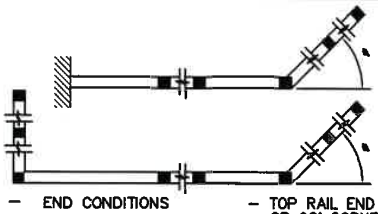
## TYPE 5 – FIXED & PARTIAL FIXED ENDS



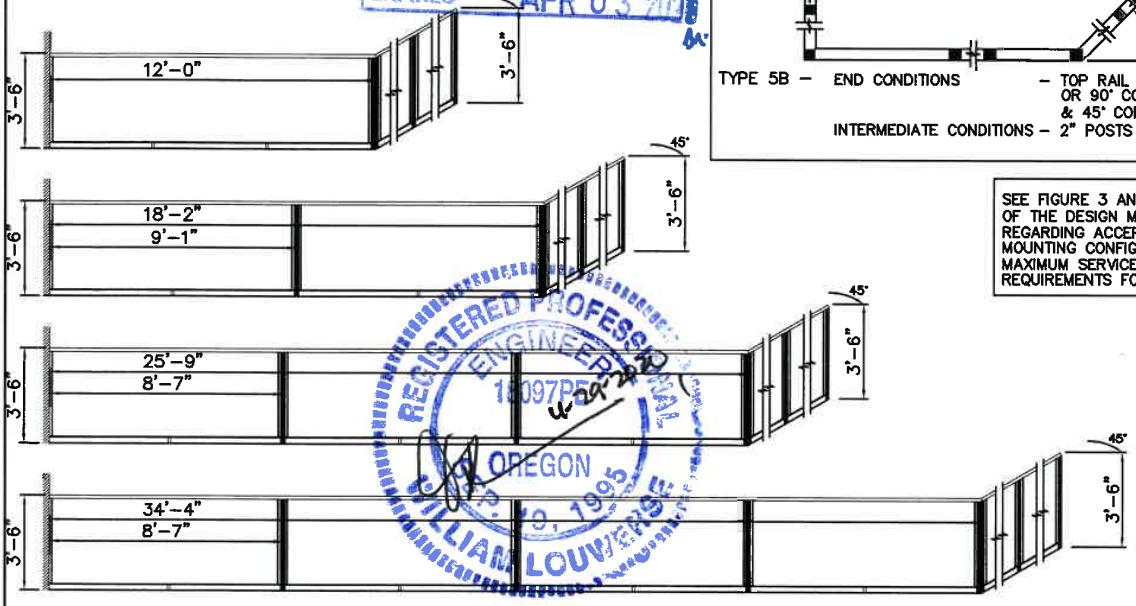
TYPE 5B – END CONDITIONS – TOP RAIL END CLIP TO STRUCTURE OR 90° CORNER w/ MIN 2–2" POSTS & 45° CORNER w/ MIN 2–2" POSTS

INTERMEDIATE CONDITIONS – 2" POSTS EVENLY SPACED

SEE FIGURE 3 AND SECTION 2.5 ANCHORAGE OF THE DESIGN MANUAL FOR DETAILS REGARDING ACCEPTABLE GUARDRAIL MOUNTING CONFIGURATIONS AND MAXIMUM SERVICE PULL-OUT LOAD REQUIREMENTS FOR ANCHORS.

POST LEGEND


POST SIZES






## 20 LBS/FOOT OR 200 LBS. TOP RAIL LOADING

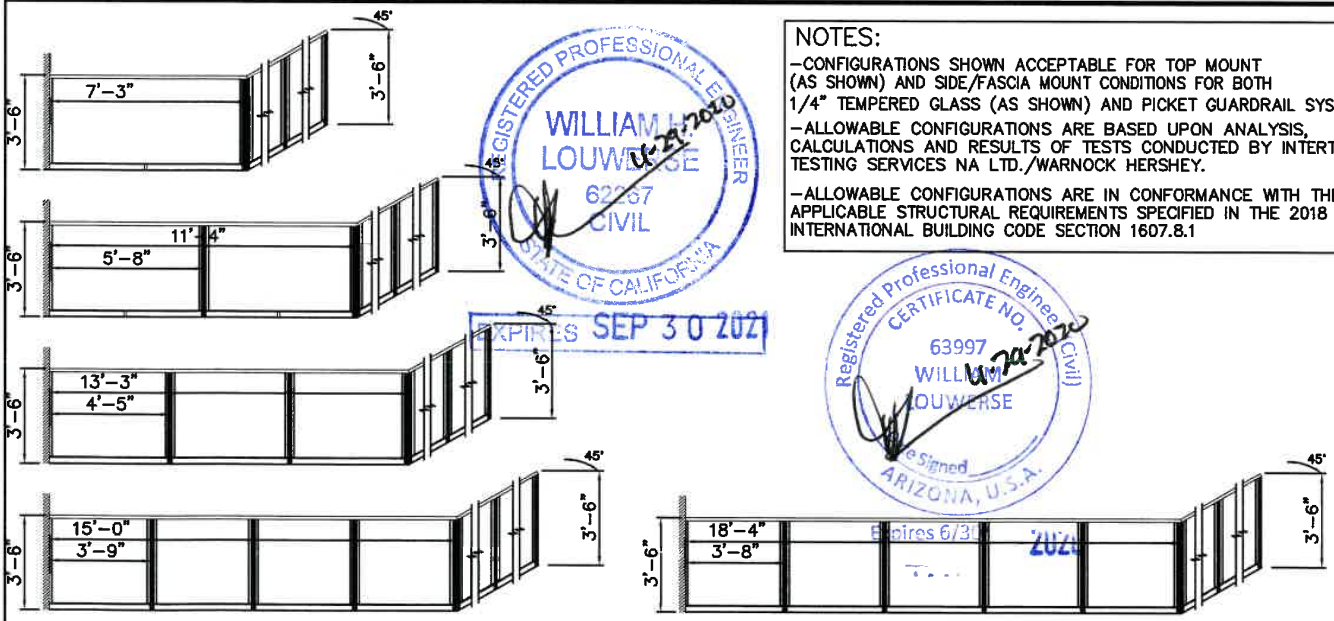
**AS PER 2018 IBC SECTION 1607.8.1 HANDRAILS AND GUARDS FOR ONE AND TWO FAMILY DWELLINGS AND IN GROUP I-3,F,H AND S OCCUPANCIES FOR AREAS THAT ARE NOT ACCESSIBLE TO THE GENERAL PUBLIC AND THAT HAVE AN OCCUPANT LOAD NO GREATER THAN 50.**

NOTES:

–CONFIGURATIONS SHOWN ACCEPTABLE FOR TOP MOUNT (AS SHOWN) AND SIDE/FASCIA MOUNT CONDITIONS FOR BOTH 1/4" TEMPERED GLASS (AS SHOWN) AND PICKET GUARDRAIL SYSTEMS

–ALLOWABLE CONFIGURATIONS ARE BASED UPON ANALYSIS, CALCULATIONS AND RESULTS OF TESTS CONDUCTED BY INTERTEK TESTING SERVICES NA LTD./WARNOCK HERSHEY.

–ALLOWABLE CONFIGURATIONS ARE IN CONFORMANCE WITH THE APPLICABLE STRUCTURAL REQUIREMENTS SPECIFIED IN THE 2018 INTERNATIONAL BUILDING CODE SECTION 1607.8.1






## 50 LBS/FOOT OR 200 LBS. TOP RAIL LOADING

**FOR CONDITIONS NOT MENTIONED ABOVE**

# FIGURE 40: 42" HIGH ALLOWABLE CONFIGURATIONS TYPE 5B

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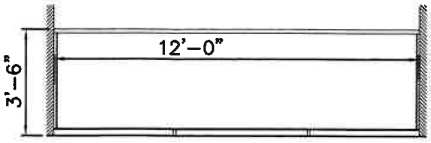
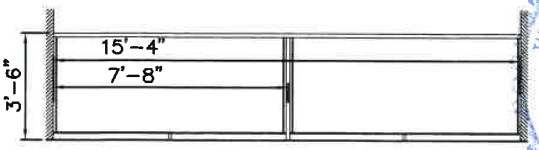
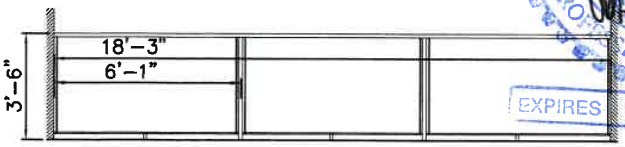
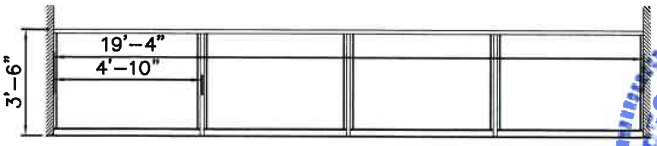
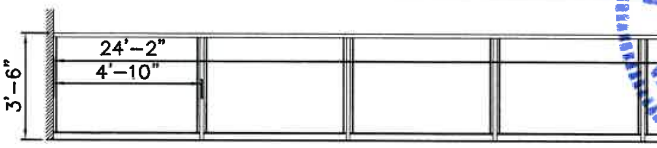


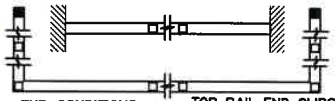



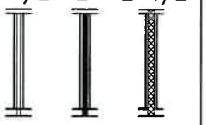

TYPE 6 – FIXED BOTH ENDS



TYPE 6A – END CONDITIONS – TOP RAIL END CLIPS TO STRUCTURE OR 90° CORNERS w/ MIN 1– 1-1/2" POST AND 1–2" POST AT END
INTERMEDIATE CONDITIONS – 1–1/2" POSTS EVENLY SPACED

SEE FIGURE 3 AND SECTION 2.5 ANCHORAGE OF THE DESIGN MANUAL FOR DETAILS REGARDING ACCEPTABLE GUARDRAIL MOUNTING CONFIGURATIONS AND MAXIMUM SERVICE PULL–OUT LOAD REQUIREMENTS FOR ANCHORS.

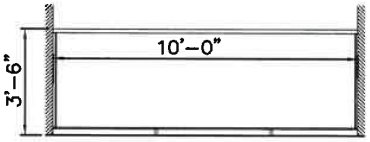
POST LEGEND

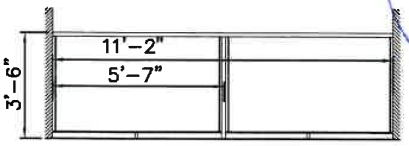


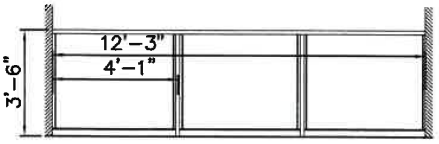

POST SIZES

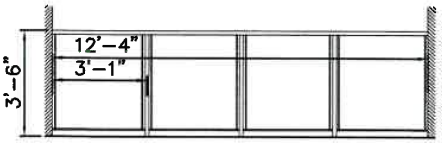
## 20 LBS/FOOT OR 200 LBS. TOP RAIL LOADING

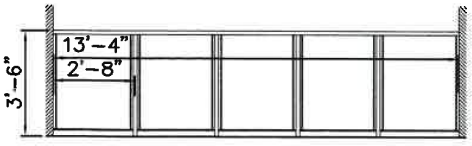
**AS PER 2018 IBC SECTION 1607.8.1 HANDRAILS AND GUARDS FOR ONE AND TWO FAMILY DWELLINGS AND IN GROUP I-3,F,H AND S OCCUPANCIES FOR AREAS THAT ARE NOT ACCESSIBLE TO THE GENERAL PUBLIC AND THAT HAVE AN OCCUPANT LOAD NO GREATER THAN 50.**

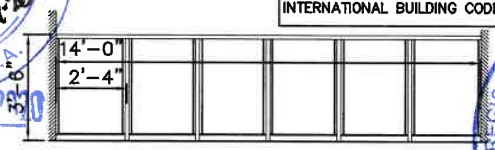


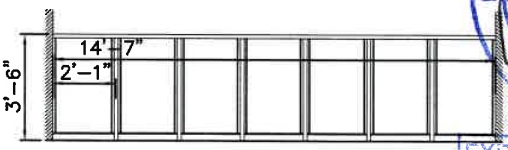



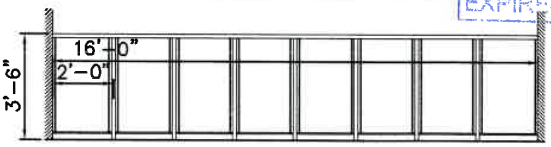



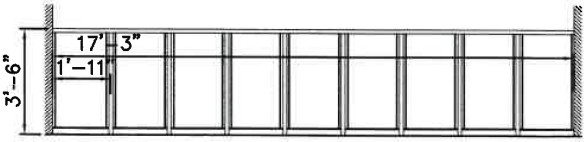




NOTES:
–CONFIGURATIONS SHOWN ACCEPTABLE FOR TOP MOUNT (AS SHOWN) AND SIDE/FASCIA MOUNT CONDITIONS FOR BOTH 1/4" TEMPERED GLASS (AS SHOWN) AND PICKET GUARDRAIL SYSTEMS.
–ALLOWABLE CONFIGURATIONS ARE BASED UPON ANALYSIS, CALCULATIONS AND RESULTS OF TESTS CONDUCTED BY INTERTEK TESTING SERVICES NA LTD./WARNOCK HERSHEY.
–ALLOWABLE CONFIGURATIONS ARE IN CONFORMANCE WITH THE APPLICABLE STRUCTURAL REQUIREMENTS SPECIFIED IN THE 2018 INTERNATIONAL BUILDING CODE SECTION 1607.8.1

## 50 LBS/FOOT OR 200 LBS. TOP RAIL LOADING

**FOR CONDITIONS NOT MENTIONED ABOVE**

# FIGURE 4P: 42" HIGH ALLOWABLE CONFIGURATIONS TYPE 6A

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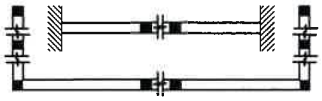
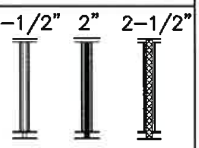
## TYPE 6 – FIXED BOTH ENDS



TYPE 6B – END CONDITIONS – TOP RAIL END CLIPS TO STRUCTURE OR 90° CORNERS w/ MIN 2–2" POSTS
INTERMEDIATE CONDITIONS – 2" POSTS EVENLY SPACED

SEE FIGURE 3 AND SECTION 2.5 ANCHORAGE OF THE DESIGN MANUAL FOR DETAILS REGARDING ACCEPTABLE GUARDRAIL MOUNTING CONFIGURATIONS AND MAXIMUM SERVICE PULL–OUT LOAD REQUIREMENTS FOR ANCHORS.

POST LEGEND

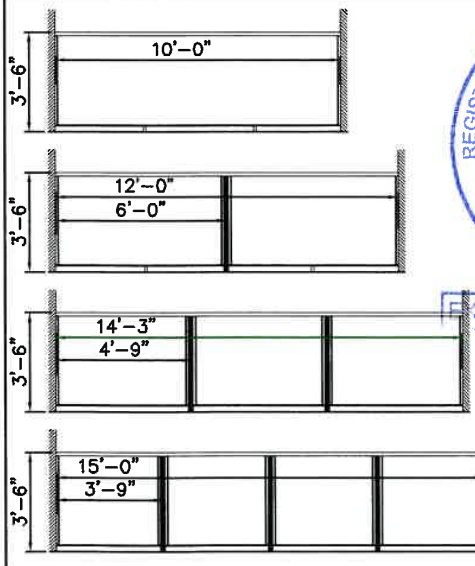



POST SIZES




## 20 LBS/FOOT OR 200 LBS. TOP RAIL LOADING

**AS PER 2018 IBC SECTION 1607.8.1 HANDRAILS AND GUARDS FOR ONE AND TWO FAMILY DWELLINGS AND IN GROUP I-3,F,H AND S OCCUPANCIES FOR AREAS THAT ARE NOT ACCESSIBLE TO THE GENERAL PUBLIC AND THAT HAVE AN OCCUPANT LOAD NO GREATER THAN 50.**

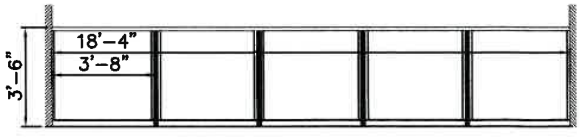



NOTES:

–CONFIGURATIONS SHOWN ACCEPTABLE FOR TOP MOUNT (AS SHOWN) AND SIDE/FASCIA MOUNT CONDITIONS FOR BOTH 1/4" TEMPERED GLASS (AS SHOWN) AND PICKET GUARDRAIL SYSTEMS

–ALLOWABLE CONFIGURATIONS ARE BASED UPON ANALYSIS, CALCULATIONS AND RESULTS OF TESTS CONDUCTED BY INTERTEK TESTING SERVICES NA LTD./WARNOCK HERSHEY.

–ALLOWABLE CONFIGURATIONS ARE IN CONFORMANCE WITH THE APPLICABLE STRUCTURAL REQUIREMENTS SPECIFIED IN THE 2018 INTERNATIONAL BUILDING CODE SECTION 1607.8.1




## 50 LBS/FOOT OR 200 LBS. TOP RAIL LOADING

**FOR CONDITIONS NOT MENTIONED ABOVE**

# FIGURE 4Q: 42" HIGH ALLOWABLE CONFIGURATIONS TYPE 6B

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www.vistaprorailings.com

## TYPE 6B ALTERNATE
OPTIONAL CONFIGURATIONS
w/ 2" POSTS ADDED
IN INTERMEDIATE SPACES


WILLIAM H. LOUWERSE
STATE OF WASHINGTON
30751
REGISTERED
PROFESSIONAL ENGINEER
4-29-2020
EXPIRES APR 03 2021

REGISTERED PROFESSIONAL ENGINEER
OREGON
18097PE
APR. 19 1995
WILLIAM LOUWERSE
4-29-2020

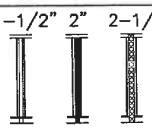
### TYPE 6 – FIXED BOTH ENDS



TYPE 6A– END CONDITIONS –TOP RAIL END CLIPS TO STRUCTURE OR 90° CORNERS w/ MIN 1– 1-1/2" POST AND 1–2" POST AT END
INTERMEDIATE CONDITIONS– 1-1/2" POSTS EVENLY SPACED

SEE FIGURE 3 AND SECTION 2.5 ANCHORAGE OF THE DESIGN MANUAL FOR DETAILS REGARDING ACCEPTABLE GUARDRAIL MOUNTING CONFIGURATIONS AND MAXIMUM SERVICE PULL–OUT LOAD REQUIREMENTS FOR ANCHORS.

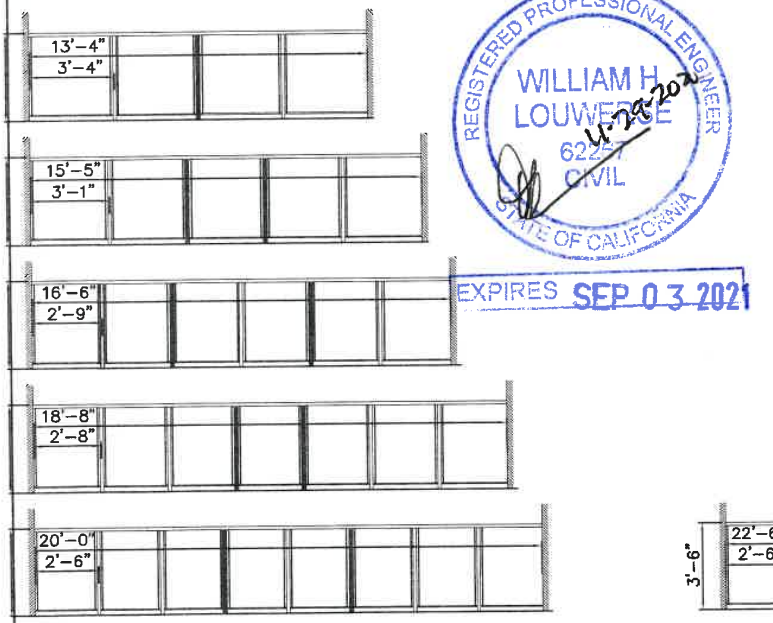
### POST LEGEND




POST SIZES

## 20 LBS/FOOT OR 200 LBS. TOP RAIL LOADING

**AS PER 2018 IBC SECTION 1607.8.1 HANDRAILS AND GUARDS FOR ONE AND TWO FAMILY DWELLINGS AND IN GROUP I-3,F,H AND S OCCUPANCIES FOR AREAS THAT ARE NOT ACCESSIBLE TO THE GENERAL PUBLIC AND THAT HAVE AN OCCUPANT LOAD NO GREATER THAN 50.**




REGISTERED PROFESSIONAL ENGINEER
WILLIAM H. LOUWERSE
62257
CIVIL
STATE OF CALIFORNIA
4-29-2020
EXPIRES SEP 03 2021

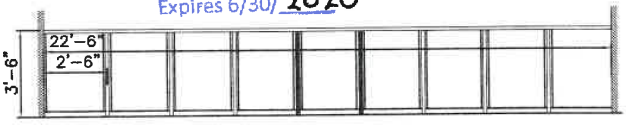
### NOTES:

–CONFIGURATIONS SHOWN ACCEPTABLE FOR TOP MOUNT (AS SHOWN) AND SIDE/FASCIA MOUNT CONDITIONS FOR BOTH 1/4" TEMPERED GLASS (AS SHOWN) AND PICKET GUARDRAIL SYSTEMS

–ALLOWABLE CONFIGURATIONS ARE BASED UPON ANALYSIS, CALCULATIONS AND RESULTS OF TESTS CONDUCTED BY INTERTEK TESTING SERVICES NA LTD./WARNOCK HERSHEY.

–ALLOWABLE CONFIGURATIONS ARE IN CONFORMANCE WITH THE APPLICABLE STRUCTURAL REQUIREMENTS SPECIFIED IN THE 2018 INTERNATIONAL BUILDING CODE SECTION 1607.8.1

Registered Professional Engineer (Civil)
CERTIFICATE NO.
63997
WILLIAM
LOUWERSE
Date Signed 4-29-2020
ARIZONA, U.S.A.
Expires 6/30/2020




## 50 LBS/FOOT OR 200 LBS. TOP RAIL LOADING

**FOR CONDITIONS NOT MENTIONED ABOVE**

# FIGURE 4Q-A: 42" HIGH ALLOWABLE CONFIGURATIONS TYPE 6B ALTERNATE