



American Residential Deck Railing Design Guide



Intended for use by
Designers &
Architects Engineers
& Professional
Installers

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www.vistarailings.com

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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.

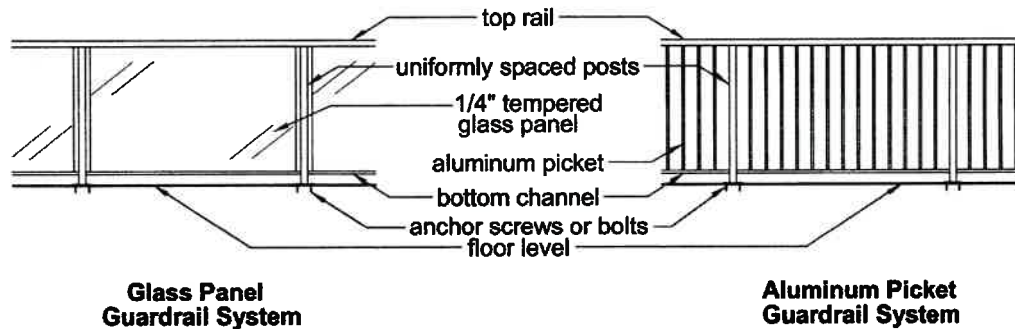


FIGURE 1: MAIN ELEMENTS OF GUARDRAIL SYSTEMS

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 Aluminium Railing 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 less 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 Aluminum Railing 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

| Alloy & products | Tensile ultimate Ftu | <u>NOT WELDED</u> | | <u>WELDED</u> |
|---------------------------------------|----------------------------|-------------------------|-----------------------------|--------------------------|
| | | 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 Aluminum Railing Systems are given in Table 2. Typical cross-sections of these elements are provided in Figure 2. Additional elements are shown in Vista Aluminum Railing Dealer Catalogue.

TABLE 2: PHYSICAL PROPERTIES OF COMMON ELEMENTS

| ELEMENTS | ALLOY | AREA in ² (mm ²) | I_{xx} in ⁴ (10 ⁶ mm ⁴) | S_{xx} in ³ (10 ³ mm ³) | I_{yy} in ⁴ (10 ⁶ mm ⁴) | S_{yy} in ³ (10 ³ mm ³) |
|--|--------------|--|--|--|--|--|
| TOP RAILS | | | | | | |
| 2 1/4" (57.2mm) square retail top rail for picket infill | 6063-T5 | .671 (433) | .388 (.161) | .288 (4.714) | .443 (.185) | .386 (6.318) |
| STAIR RAIL | | | | | | |
| 1 3/4" (44.5mm) square stair rail for picket infill | 6063-T5 | .637 (411) | .202 (.084) | .206 (3.374) | .258 (.107) | .294 (4.824) |
| TOP RAIL SLEEVES/CORNERS | | | | | | |
| outside square retail top rail sleeve/corner | 6063-T5 | .632 (408) | .437 (.182) | .331 (5.417) | .600 (.250) | .480 (7.864) |
| BOTTOM RAILS | | | | | | |
| bottom rail for picket panel system | 6063-T5 | .277 (179) | .053 (.022) | .042 (.687) | .038 (.016) | .111 (1.821) |
| POSTS | | | | | | |
| 2 1/2" (63.5mm) square post | 6005A-T61 | .780 (503) | .772 (.321) | .617 (10.115) | .772 (.321) | .617 (10.115) |
| 2" (50.8mm) square post | 6005A-T61 | .636 (411) | .393 (.163) | .393 (6.434) | .393 (.163) | .393 (6.434) |
| MISCELLANEOUS | | | | | | |
| pickets | 6063-T5 | .092 (60) | .005 (.002) | .017 (.278) | .005 (.002) | .017 (.278) |
| 5/8" (15.9mm) square picket | | | | | | |
| various plates | 6061-T6 | | | | | |

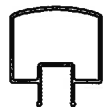
Legend

I - moment of inertia

S - section modulus

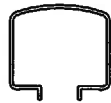
* - element data exclusive property of Vista Aluminum Railing Systems. Use test results from Table 3 for design purposes

TOP RAIL



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

TOP RAIL SLEEVE/CORNER



outside square retail top rail sleeve/corner

STAIR RAIL



1 3/4" (44.5 mm)
square stair top rail for picket infill system

BOTTOM RAIL



bottom rail for picket or glass infill system

BOTTOM RAIL SLEEVE



bottom rail sleeve for picket or glass infill system

POSTS



2 1/2" (63.5 mm)
square post
0.080" (2.03mm) wall thickness



2" (50.8 mm)
square post
0.072" (1.83mm) wall thickness

PICKETS



5/8" (15.9 mm)
square picket
0.039" (1.00mm) wall thickness



5/8" x 1 1/2" (15.9 mm x 38.1mm)
wide picket
0.039" (1.00mm) 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 Aluminum 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 Aluminum Railing 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 Aluminum Railing 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 Aluminum Railing. 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 ALUMINUM RAILINGS TESTING RESULTS

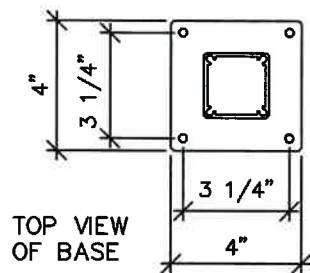
| Element/Component System | Average Ultimate Load Applied | Mode of Failure |
|---|--|--|
| TOP RAILS | | |
| 2 1/4" (57.2 mm) retail square top rail for picket infill | 874 lbs. (3888 N) total load applied at 1/3 span points | buckling @ support |
| TOP RAILS WITH SLEEVES | | |
| 2 1/4" (57.2 mm) retail square top rail with outside sleeve for picket infill | 542 lbs. (2411 N) total load applied at 1/3 span points | bending/deformation of rail ends at midspan connector |
| CORNERS | | |
| 90° square external corner | 670 lbs. (2980 N) in tension and shear | bottom inner weld of sleeve mitre tore open |
| 135° square external corner | 958 lbs. (4263 N) | bottom inner weld of sleeve mitre tore open |
| MISCELLANEOUS | | |
| 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 | | |
| .197" (5 mm) tempered glass panel 36" (914.4 mm) x 12" (304.8 mm) | 117 lbs. (522 N) at midspan edge | fracture |
| .197" (5 mm) tempered glass panel 36" (914.4 mm) x 48" (1219.2 mm) | 261 lbs. (1162 N) at midspan edge | fracture |
| .197" (5 mm) tempered glass panel 36" (914.4 mm) x 48" (1219.2 mm) | 79 psf (37.8 kPa) distributed load over entire panel | glass panel 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" (972 mm) | at midspan over 12" (350 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 | 1491 lbs. (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

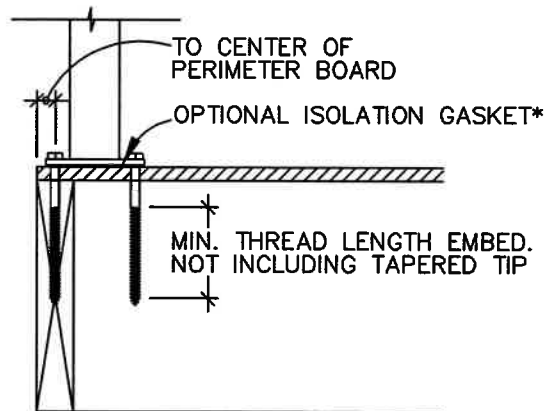
1. Tests conducted by Intertek Testing Services Na Ltd. / Warnock Hersey – reports available upon request.
2. Test procedures in general conformance with ASTM Standard Specification E 985-87 for Permanent Metal Railing Systems and Rails for Buildings and ASTM Standard Test Methods E 935-85a for Performance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

RECOMMENDED MOUNTING AND FASTENING TO WOOD

NO.1/NO.2 OR BETTER WOOD BLOCKING ANCHORAGE TO MAIN STRUCTURE AND MAIN STRUCTURE LOAD CAPACITY RESPONSIBILITY OF OTHERS



TOP VIEW OF BASE



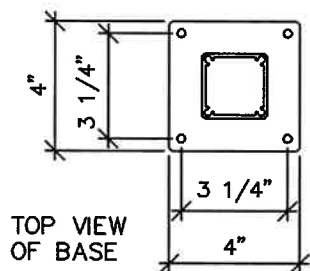
*OPTIONAL CLOSED CELL ISOLATION GASKET BETWEEN DISSIMILAR OR INCOMPATIBLE MATERIALS.
(NOT INTENDED AS A WATER PROOFING ITEM)

| POST SIZE | LAG SCREW DIAMETER | WOOD BLOCKING SPECIES | MIN THREAD LENGTH EMBEDMENT |
|-----------|--------------------|-----------------------|-----------------------------|
| 2" | 5/16" | DOUGLAS FIR | 3" |
| | | SPRUCE-PINE-FIR | 3 1/2" |
| | 3/8" | DOUGLAS FIR | 2 1/2" |
| | | SPRUCE-PINE-FIR | 3" |
| 2 1/2" | 5/16" | DOUGLAS FIR | 4" |
| | | SPRUCE-PINE-FIR | 4 1/2" |
| | 3/8" | DOUGLAS FIR | 3 1/2" |
| | | SPRUCE-PINE-FIR | 4" |

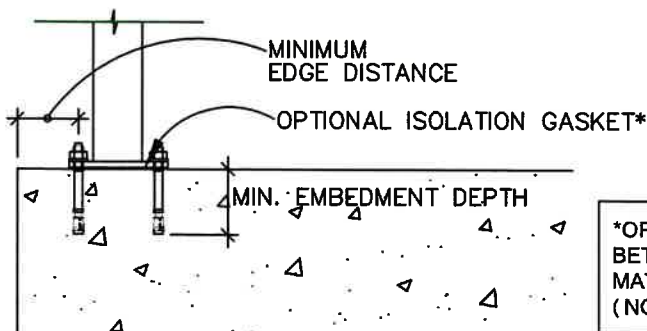
ALL LAGS SCREWS TO BE SET IN NO.1/NO.2 OR BETTER WOOD BLOCKING

RECOMMENDED MOUNTING AND FASTENING TO CONCRETE

MAIN STRUCTURE LOAD CAPACITY RESPONSIBILITY OF OTHERS



TOP VIEW OF BASE



| POST SIZE | MIN. CONCRETE COMPRESSIVE STRENGTH | FASTENER TYPE | MIN. EDGE DISTANCE | MIN. EMBEDMENT DEPTH |
|-----------|------------------------------------|--|--------------------|----------------------|
| 2" | 4000 psi (27.6 MPa) | 3/8"Ø HILTI KWIK BOLT 3 EXPANSION ANCHOR | 2 1/2" | 2 1/2" |
| 2 1/2" | 4000 psi (27.6 MPa) | 3/8"Ø HILTI KWIK BOLT 3 EXPANSION ANCHOR | 3 3/4" | 3 1/2" |

CONCRETE ANCHORS WITH EQUIVALENT OR BETTER ALLOWABLE TENSION AND SHEAR LOADS CAN BE SUBSTITUTED.

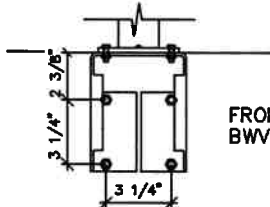
*OPTIONAL CLOSED CELL ISOLATION GASKET BETWEEN DISSIMILAR OR INCOMPATIBLE MATERIALS.
(NOT INTENDED AS A WATER PROOFING ITEM)

FIGURE 3: ACCEPTABLE GUARDRAIL MOUNTING CONFIGURATIONS

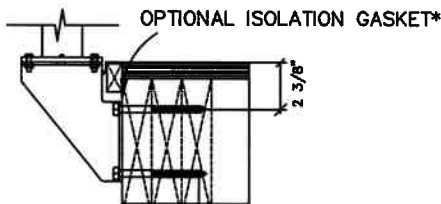
FASCIA (SIDE) MOUNTING DETAILS RECOMMENDED MOUNTING AND FASTENING TO WOOD

NO.1/NO.2 OR BETTER WOOD BLOCKING ANCHORAGE TO MAIN STRUCTURE
AND MAIN STRUCTURE LOAD CAPACITY RESPONSIBILITY OF OTHERS

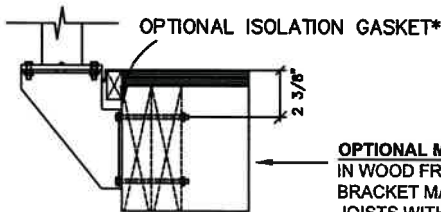
*OPTIONAL CLOSED CELL ISOLATION GASKET
BETWEEN DISSIMILAR OR INCOMPATIBLE
MATERIALS.
(NOT INTENDED AS A WATER PROOFING ITEM)



FRONT VIEW OF
BWV FASCIA BRACKET



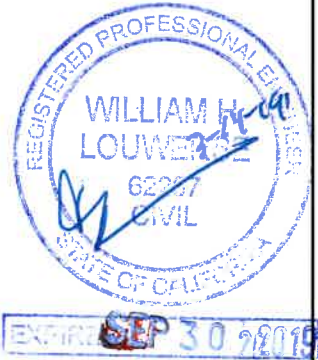
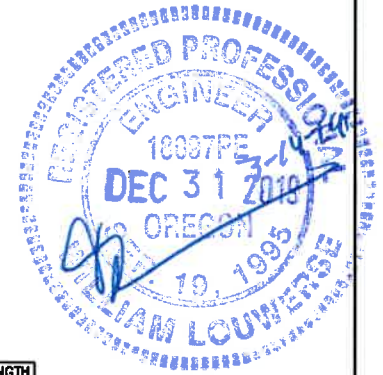
MIN. THREAD LENGTH EMBEDMENT
NOT INCLUDING TAPERED TIP



OPTIONAL MOUNTING METHOD:
IN WOOD FRAMING APPLICATIONS ALSO FASCIA
BRACKET MAY ALSO BE ATTACHED TO THE RIM
JOISTS WITH THRU BOLTS AS INDICATED.

| POST SIZE | LAG SCREW DIAMETER | WOOD BLOCKING SPECIES | MIN THREAD LENGTH EMBEDMENT |
|--------------|-----------------------|--------------------------|--------------------------------|
| 2" | 5/16" | DOUGLAS FIR | 3" |
| | | SPRUCE-PINE-FIR | 3 1/2" |
| | 3/8" | DOUGLAS FIR | 2 1/2" |
| | | SPRUCE-PINE-FIR | 3" |
| 2 1/2" | 5/16" | DOUGLAS FIR | 4" |
| | | SPRUCE-PINE-FIR | 4 1/2" |
| | 3/8" | DOUGLAS FIR | 3 1/2" |
| | | SPRUCE-PINE-FIR | 4" |

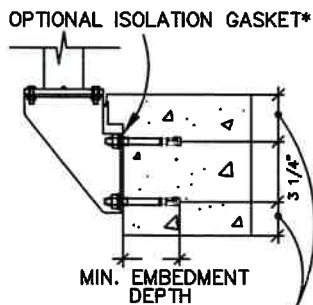
ALL LAGS SCREWS TO BE SET IN NO.1/NO.2 OR BETTER
WOOD BLOCKING



FASCIA (SIDE) MOUNTING DETAILS RECOMMENDED MOUNTING AND FASTENING TO CONCRETE

MAIN STRUCTURE LOAD CAPACITY RESPONSIBILITY OF OTHERS

*OPTIONAL CLOSED CELL ISOLATION GASKET
BETWEEN DISSIMILAR OR INCOMPATIBLE
MATERIALS.
(NOT INTENDED AS A WATER PROOFING ITEM)



MIN. EMBEDMENT
DEPTH

MIN. EDGE DISTANCE

| POST SIZE | MIN. CONCRETE COMPRESSIVE STRENGTH | FASTENER TYPE | MIN. EDGE DISTANCE | MIN. EMBEDMENT DEPTH |
|--------------|---------------------------------------|---|-----------------------|-------------------------|
| 2" | 4000 psi (27.6 MPa) | 3/8" # HILTI KWIK BOLT 3 EXPANSION ANCHOR | 2 1/2" | 3 1/2" |
| 2 1/2" | 4000 psi (27.6 MPa) | 3/8" # HILTI KWIK BOLT 3 EXPANSION ANCHOR | 3 3/4" | 3 1/2" |

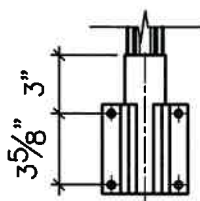
CONCRETE ANCHORS WITH EQUIVALENT OR BETTER ALLOWABLE
TENSION AND SHEAR LOADS CAN BE SUBSTITUTED.



FIGURE 3: ACCEPTABLE GUARDRAIL MOUNTING CONFIGURATIONS

FASCIA (SIDE) MOUNTING DETAILS RECOMMENDED MOUNTING AND FASTENING TO WOOD

NO.1/NO.2 OR BETTER WOOD BLOCKING ANCHORAGE TO MAIN STRUCTURE
AND MAIN STRUCTURE LOAD CAPACITY RESPONSIBILITY OF OTHERS

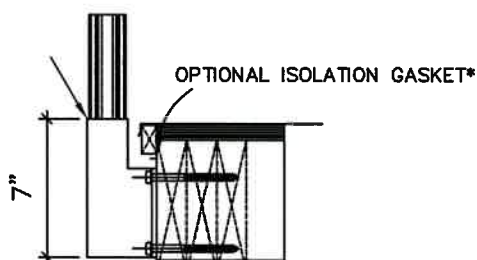


FRONT VIEW OF
BWC SLIM LINE
FASCIA BRACKET

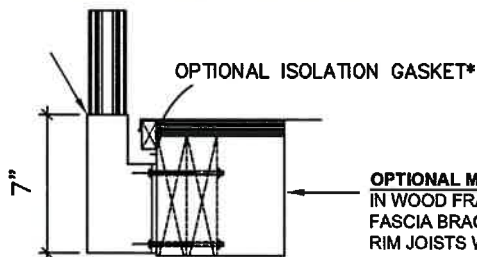
*OPTIONAL CLOSED CELL ISOLATION GASKET
BETWEEN DISSIMILAR OR INCOMPATIBLE
MATERIALS.
(NOT INTENDED AS A WATER PROOFING ITEM)

MOUNTING METHOD:

Ensure the top of the Slim Line
Fascia Bracket is 1/4" above the
top of the deck surface so that
railing height is maintained.



MIN. THREAD LENGTH EMBEDMENT
NOT INCLUDING TAPERED TIP



MOUNTING METHOD:

Ensure the top of the Slim Line
Fascia Bracket is 1/4" above the
top of the deck surface so that
railing height is maintained.

| POST SIZE | LAG SCREW DIAMETER | WOOD BLOCKING SPECIES | MIN THREAD LENGTH EMBEDMENT |
|-----------|--------------------|-----------------------|-----------------------------|
| 2" | 5/16" | DOUGLAS FIR | 3" |
| | | SPRUCE-PINE-FIR | 3 1/2" |
| | 3/8" | DOUGLAS FIR | 2 1/2" |
| | | SPRUCE-PINE-FIR | 3" |
| 2 1/2" | 5/16" | DOUGLAS FIR | 4" |
| | | SPRUCE-PINE-FIR | 4 1/2" |
| | 3/8" | DOUGLAS FIR | 3 1/2" |
| | | SPRUCE-PINE-FIR | 4" |

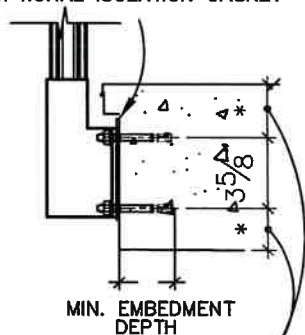
ALL LAGS SCREWS TO BE SET IN NO.1/NO.2 OR BETTER
WOOD BLOCKING

OPTIONAL MOUNTING METHOD:
IN WOOD FRAMING APPLICATIONS BWC SLIM LINE
FASCIA BRACKET MAY ALSO BE ATTACHED TO THE
RIM JOISTS WITH THRU BOLTS AS INDICATED.

FASCIA (SIDE) MOUNTING DETAILS RECOMMENDED MOUNTING AND FASTENING TO CONCRETE

MAIN STRUCTURE LOAD CAPACITY RESPONSIBILITY OF OTHERS

OPTIONAL ISOLATION GASKET*



MIN. EMBEDMENT
DEPTH

MIN. EDGE DISTANCE

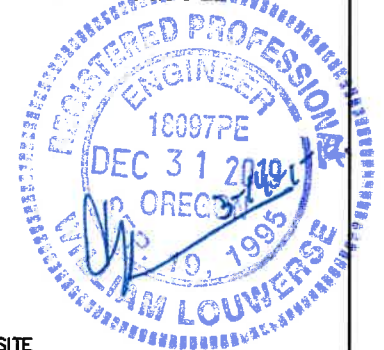
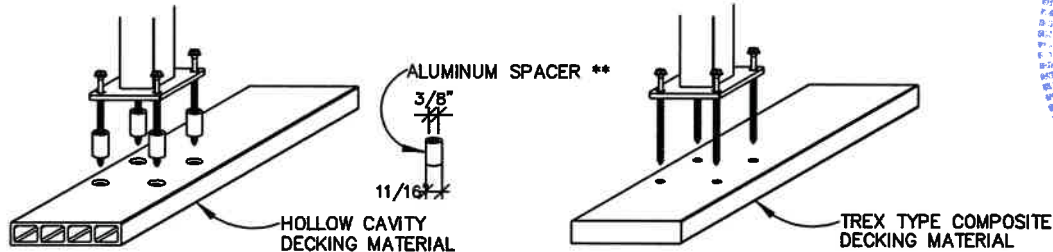
| POST SIZE | MIN. CONCRETE COMPRESSIVE STRENGTH | FASTENER TYPE | MIN. EDGE DISTANCE | MIN. EMBEDMENT DEPTH |
|-----------|------------------------------------|--|--------------------|----------------------|
| 2" | 4000 psi (27.6 MPa) | 3/8"Ø HILTI KWIK BOLT 3 EXPANSION ANCHOR | 2 1/2" | 3 1/2" |
| 2 1/2" | 4000 psi (27.6 MPa) | 3/8"Ø HILTI KWIK BOLT 3 EXPANSION ANCHOR | 3 3/4" | 3 1/2" |

CONCRETE ANCHORS WITH EQUIVALENT OR BETTER ALLOWABLE
TENSION AND SHEAR LOADS CAN BE SUBSTITUTED.

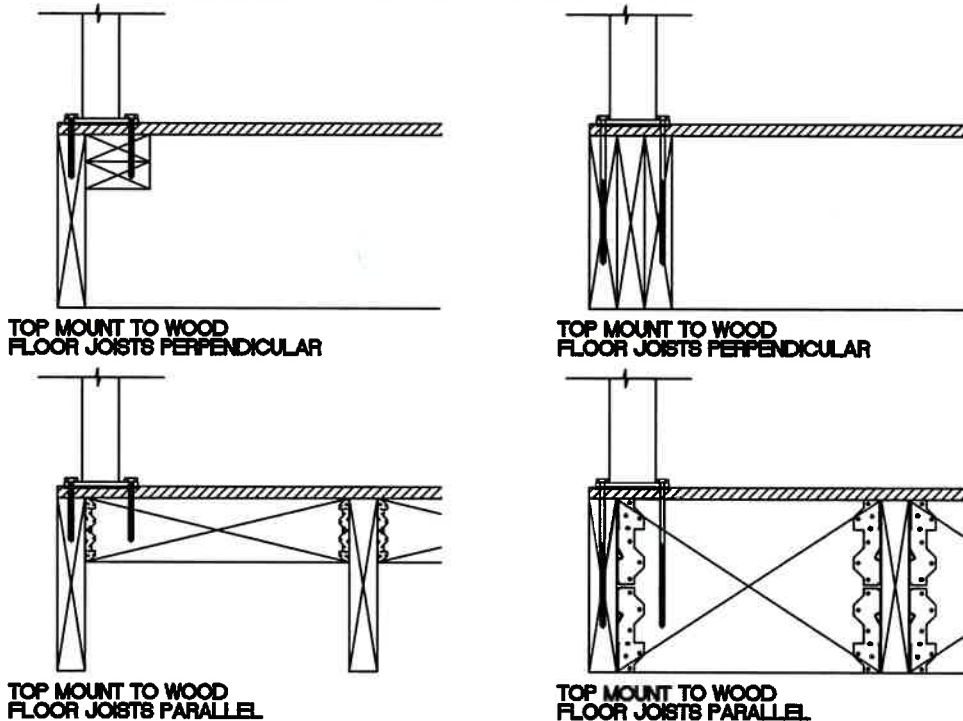
*OPTIONAL CLOSED CELL ISOLATION GASKET
BETWEEN DISSIMILAR OR INCOMPATIBLE
MATERIALS.
(NOT INTENDED AS A WATER PROOFING ITEM)

FIGURE 3: ACCEPTABLE GUARDRAIL MOUNTING CONFIGURATIONS

RECOMMENDED MOUNTING THROUGH COMPOSITE DECKING



RECOMMENDED WOOD BLOCKING DETAILS

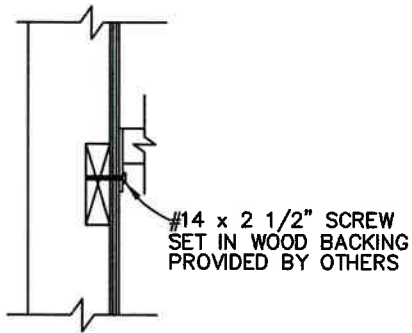


NO.1/NO.2 OR BETTER WOOD BLOCKING ANCHORAGE TO MAIN STRUCTURE
AND MAIN STRUCTURE LOAD CAPACITY RESPONSIBILITY OF OTHERS

FIGURE 3continued: ACCEPTABLE GUARDRAIL MOUNTING CONFIGURATIONS


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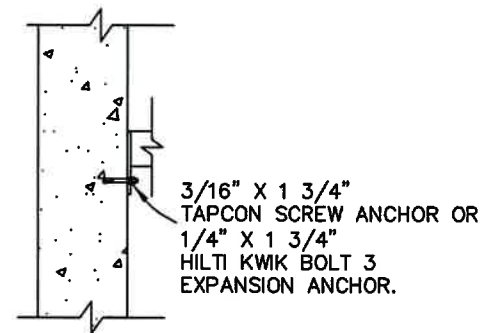
23282 RIVER ROAD
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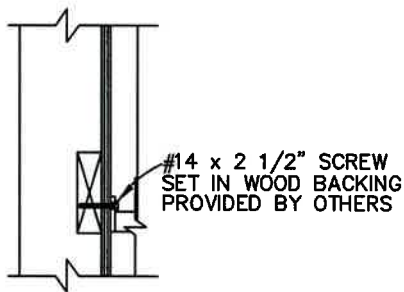
**TOP RAIL
MOUNT TO WOOD**



**TOP RAIL
END CLIP**



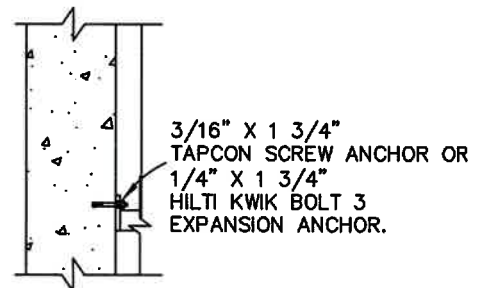
**TOP RAIL
MOUNT TO CONCRETE**



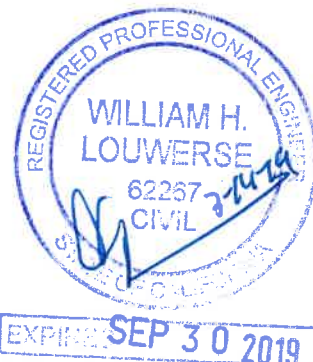
**BOTTOM RAIL
MOUNT TO WOOD**



**BOTTOM RAIL
END CLIP**



**BOTTOM RAIL
MOUNT TO CONCRETE**



NO.1/NO.2 OR BETTER WOOD BLOCKING ANCHORAGE TO MAIN STRUCTURE
AND MAIN STRUCTURE LOAD CAPACITY RESPONSIBILITY OF OTHERS

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:

| post | anchorage configuration | | | | |
|--------------------|---|--|----------------------|--|----------------------|
| | top mount using standard Vista base plate | fascia mount using Vista Aluminum Fascia Bracket | | fascia mount using Vista Aluminum Slim Line Fascia Bracket | |
| | | <u>Wood</u> | <u>Concrete</u> | <u>Wood</u> | <u>Concrete</u> |
| 2" (50.8mm) | 1092 lbs. (4857 N) | 1368 lbs (6085 N) | 1371 lbs (6100 N) | 1255 lbs (5582 N) | 1248 lbs (5553 N) |
| 2 1/2" (63.5mm) | 1692 lbs. (7526 N) | 1368 lbs (6085 N) | 1407 lbs (6259 N) | 1255 lbs (5582 N) | 1281 lbs (5697 N) |

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 Aluminum Railing mechanical fastening. Tests conducted by Intertek Testing Services Na Ltd./ Warnock Hershey indicate that 1 1/2" (38.1mm) posts with welded base plates fail at loads an average of 35% lower than identical posts with Vista Aluminum Railing mechanical base plate connections. Tests conducted by Intertek Testing Services NA Ltd./Warnock Hershey of a 2 1/4" aluminium post of top deck mount configuration (an actual competitor of Vista Aluminum Railing) that uses a welded base plate failed at loads an average of 30% lower than the Vista Aluminum 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 segment, 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) or alternatively from analysis of test results. 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 these 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 allowable 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" (1070 mm). For guardrail heights other than 42" (1070 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" (1070 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 |

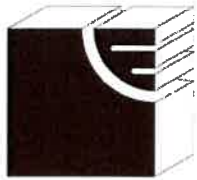
3.3 GUARDRAIL SYSTEMS WITH ALUMINUM PICKET INFILL

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 1/4" tempered glass panel infill, consideration must be given to the size of the glass panels. Although testing has shown that 1/4" tempered 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, 1/4" tempered glass panel infills should be limited to not greater than 5'-6" (1676 mm) in length.



lang
structural
engineering
inc.

Vista Aluminum Railing Design Guide—AMERICAN
/20

File No. 112-064

March 14, 2019

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

Attention: Mr. Ed Granholm

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

As requested, a series of 42" high allowable guardrail configurations infilled with 1/4" tempered glass or pickets and acceptable guardrail mounting configurations have been determined and are assembled on pages 21 to 30 inclusive and pages 11 to 15 inclusive respectively of the American Vista Aluminum Railing 8th Edition Updated January 2019 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.

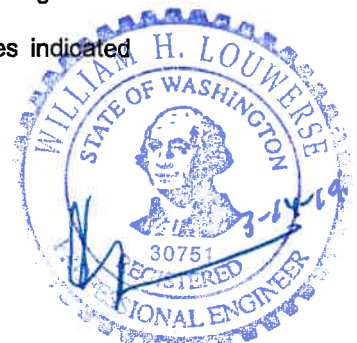
Bill Louwerse, P.Eng., Struct.Eng., PE
BL/jk

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

VISTA ALUMINUM RAILINGS—8th EDITION 2018



EXPIRES SEP 30 2019



EXPIRES APR 03 2021



Expires 5/31/2020

| POST LEGEND | |
|-------------|--------------------------------|
| ■ | 2" POST |
| ⊠ | 2 1/2" POST |
| ▨ | TOP RAIL END CLIP TO STRUCTURE |

TYPE 1 – FREE-STANDING

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

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

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

TYPE 2 – PARTIAL FIXED ONE END

TYPE 2 – 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 2-2" POSTS
& 2" POST OPPOSITE END
INTERMEDIATE CONDITIONS – 2" POSTS EVENLY SPACED

TYPE 3B – 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

TYPE 4 – PARTIAL FIXED BOTH ENDS

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

TYPE 5 – FIXED & PARTIAL FIXED ENDS

TYPE 5 – 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 6 – END CONDITIONS – TOP RAIL END CLIPS TO STRUCTURE
OR 90° CORNERS w/ MIN 2-2" POSTS
INTERMEDIATE CONDITIONS – 2" POSTS EVENLY SPACED

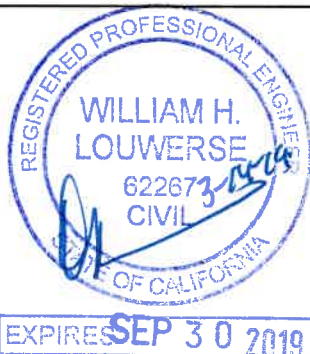


FIGURE 4: GUARDRAIL MOUNTING CONFIGURATIONS

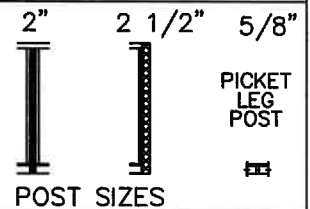
TYPE 1 – FREE-STANDING



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

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

POST LEGEND



NOTE – MAXIMUM PERMITTED BOTTOM CHANNEL SPAN BETWEEN POST SUPPORTS IS 4'-9"

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

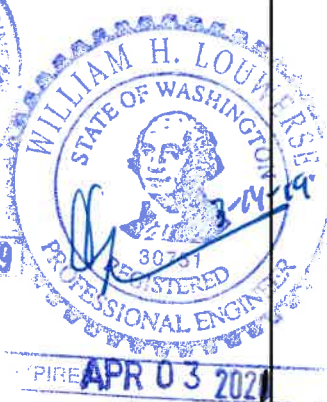


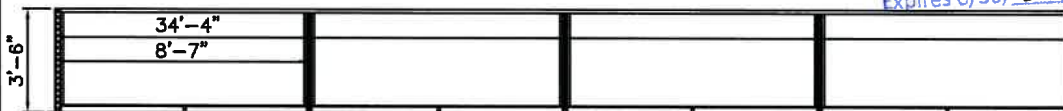
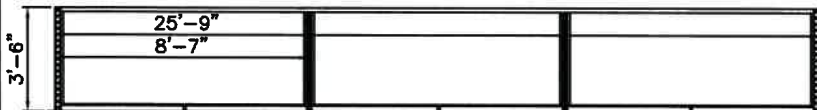
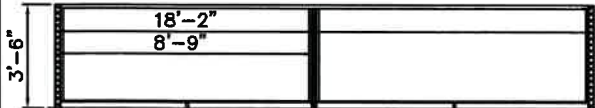
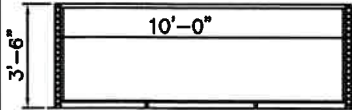
FIGURE 4A: 42" HIGH ALLOWABLE CONFIGURATIONS – TYPE 1A

TYPE 1 – FREE-STANDING

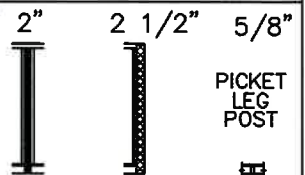


TYPE 1B – END CONDITIONS – 2 1/2" POST EACH END
INTERMEDIATE CONDITIONS – 2" POSTS EVENLY SPACED

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



POST LEGEND

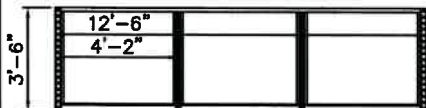
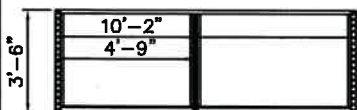
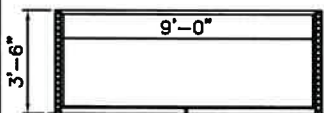


POST SIZES

NOTE – MAXIMUM PERMITTED BOTTOM CHANNEL SPAN BETWEEN POST SUPPORTS IS 4'-9"

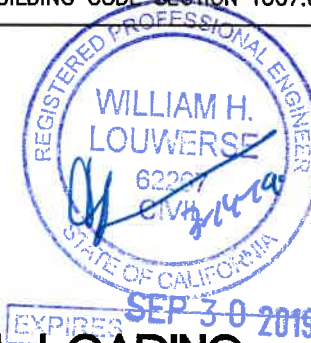
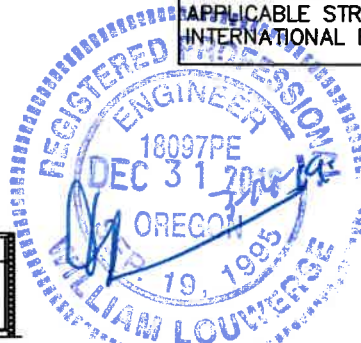
20 LBS/FOOT OR 200 LBS. TOP RAIL LOADING

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



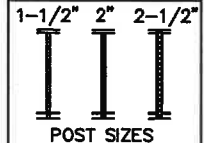
50 LBS/FOOT OR 200 LBS. TOP RAIL LOADING

FOR CONDITIONS NOT MENTIONED ABOVE

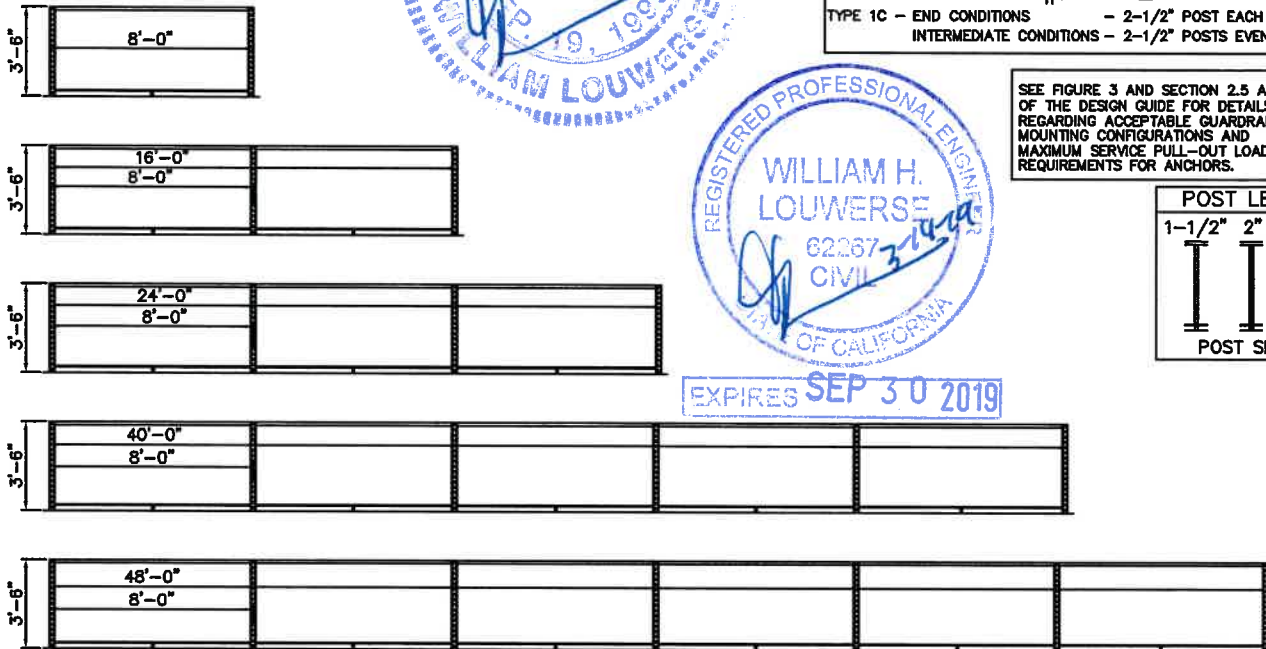
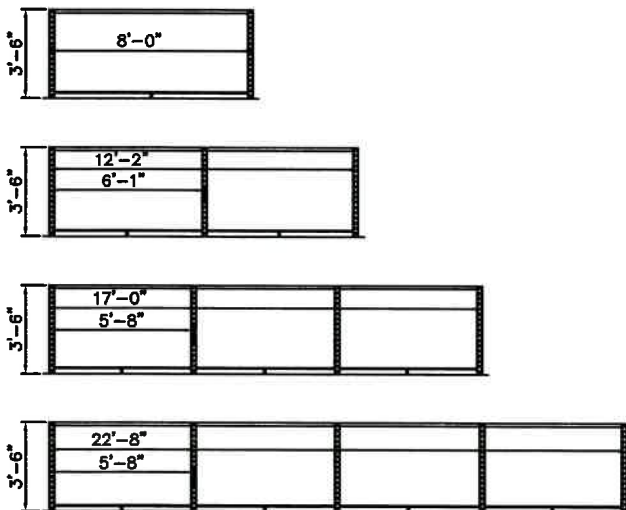
FIGURE 4B: 42" HIGH ALLOWABLE CONFIGURATIONS TYPE 1B

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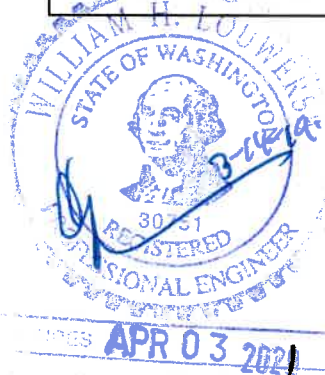
EXPIRES SEP 30 2019

TYPE 1 – FREE-STANDINGTYPE 1C – END CONDITIONS – 2-1/2" POST EACH END
INTERMEDIATE CONDITIONS – 2-1/2" POSTS EVENLY SPACEDSEE FIGURE 3 AND SECTION 2.5 ANCHORAGE
OF THE DESIGN GUIDE 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 1/4" TEMPERED GLASS (AS SHOWN) AND PICKET GUARDRAILS AND FOR MAXIMUM ALLOWABLE POST SPACING FOR CABLE RAILING 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

Expires 6/30/2020

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

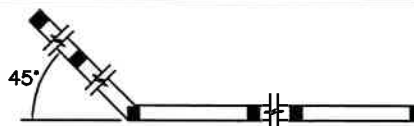


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SEE FIGURE 3 AND SECTION 2.5 ANCHORAGE OF THE DESIGN GUIDE FOR DETAILS REGARDING ACCEPTABLE GUARDRAIL MOUNTING CONFIGURATIONS AND MAXIMUM SERVICE PULL-OUT LOAD REQUIREMENTS FOR ANCHORS.

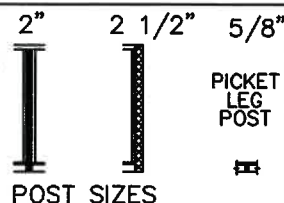
TYPE 2 – PARTIAL FIXED ONE END



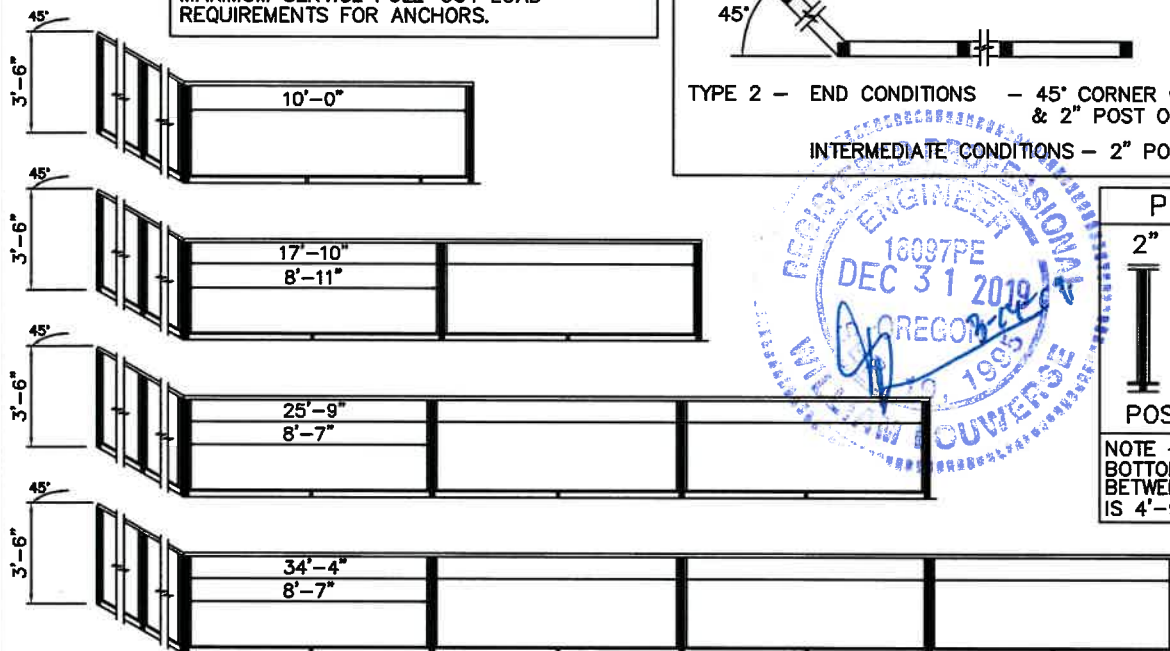
TYPE 2 – END CONDITIONS – 45° CORNER w/ MIN 2'-2" POSTS & 2" POST OPPOSITE END

INTERMEDIATE CONDITIONS – 2" POSTS EVENLY SPACED

POST LEGEND



NOTE – MAXIMUM PERMITTED BOTTOM CHANNEL SPAN BETWEEN POST SUPPORTS IS 4'-9"

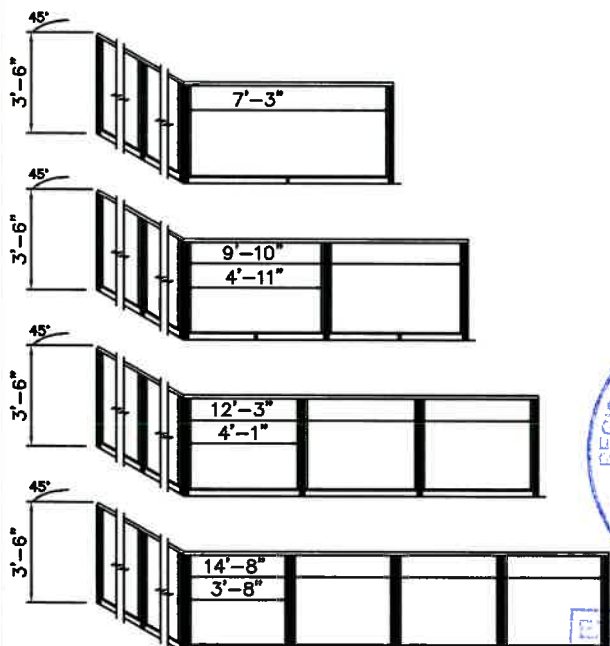


20 LBS/FOOT OR 200 LBS. TOP RAIL LOADING

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

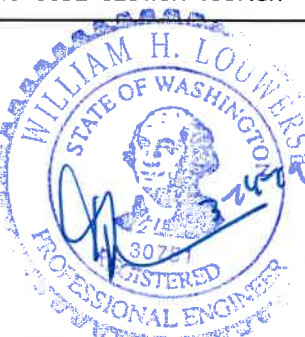
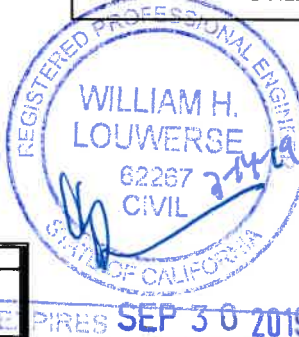
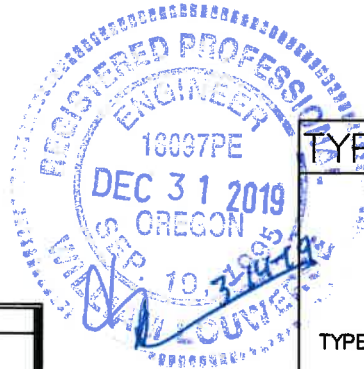
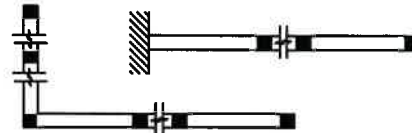


FIGURE 4D: 42" HIGH ALLOWABLE CONFIGURATIONS TYPE 2


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TYPE 3 – FIXED ONE END



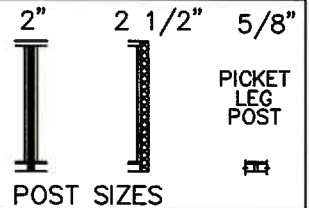
TYPE 3A – END CONDITIONS

– 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 GUIDE FOR DETAILS REGARDING ACCEPTABLE GUARDRAIL MOUNTING CONFIGURATIONS AND MAXIMUM SERVICE PULL-OUT LOAD REQUIREMENTS FOR ANCHORS.

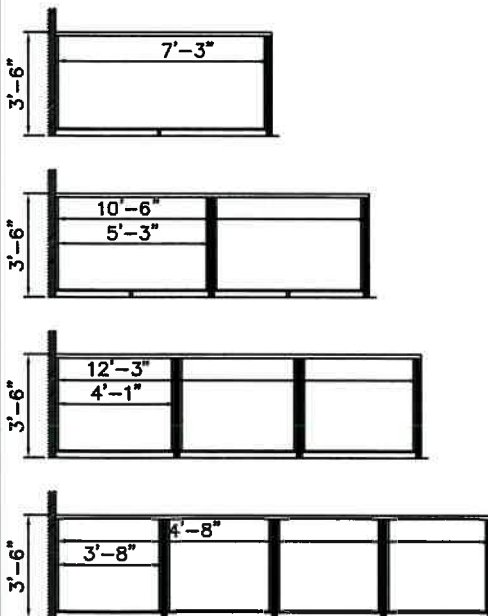
POST LEGEND



NOTE – MAXIMUM PERMITTED BOTTOM CHANNEL SPAN BETWEEN POST SUPPORTS IS 4'–9"

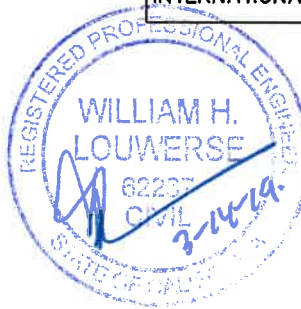
20 LBS/FOOT OR 200 LBS. TOP RAIL LOADING

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:

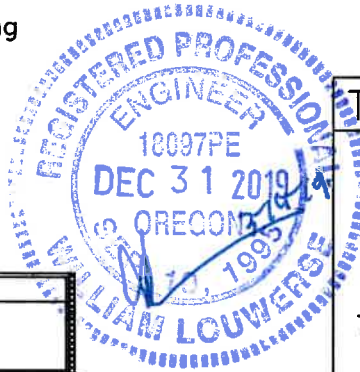
- CONFIGURATIONS SHOWN ACCEPTABLE FOR TOP MOUNT (AS SHOWN) AND SIDE/FASCIA MOUNT CONDITIONS FOR BOTH 1/4" TEMPERED GLASS (AS SHOWN) AND PICKET GUARDRAIL SYSTEMS
- ALLOWABLE CONFIGURATIONS ARE BASED UPON ANALYSIS, CALCULATIONS AND RESULTS OF TESTS CONDUCTED BY INTERTEK TESTING SERVICES NA LTD./WARNOCK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



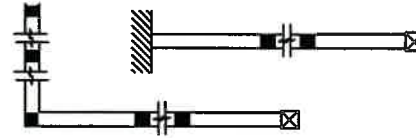
50 LBS/FOOT OR 200 LBS. TOP RAIL LOADING

FOR CONDITIONS NOT MENTIONED ABOVE

FIGURE 4E: 42" HIGH ALLOWABLE CONFIGURATIONS TYPE 3A



TYPE 3 – FIXED ONE END



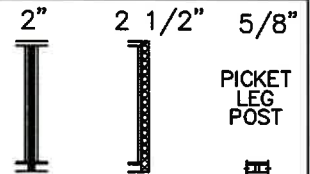
TYPE 3B – END CONDITIONS

– 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

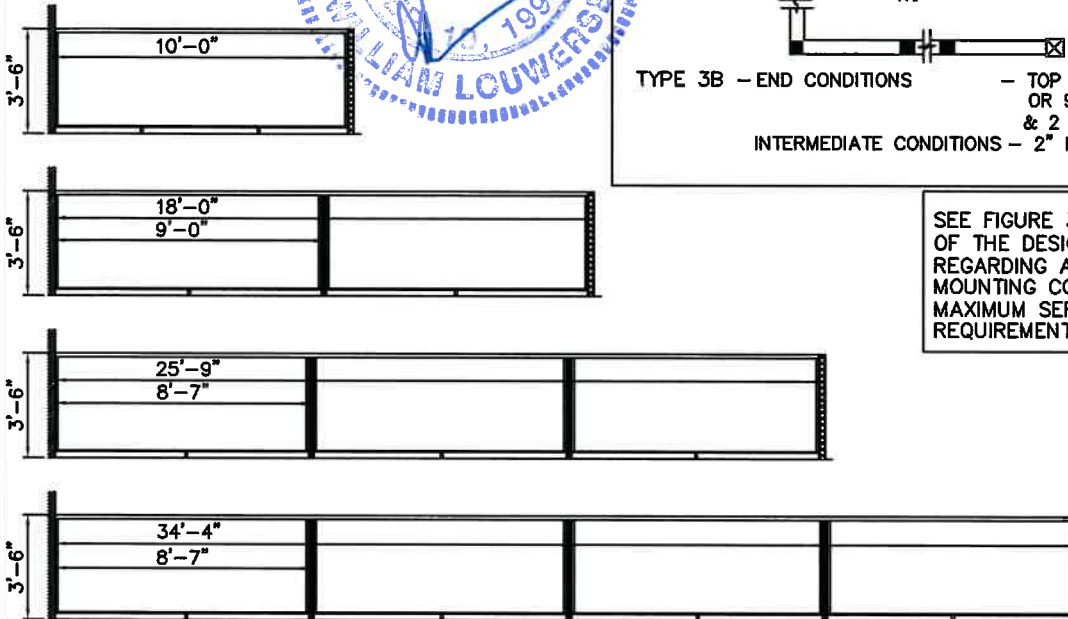
SEE FIGURE 3 AND SECTION 2.5 ANCHORAGE
OF THE DESIGN GUIDE FOR DETAILS
REGARDING ACCEPTABLE GUARDRAIL
MOUNTING CONFIGURATIONS AND
MAXIMUM SERVICE PULL-OUT LOAD
REQUIREMENTS FOR ANCHORS.

POST LEGEND



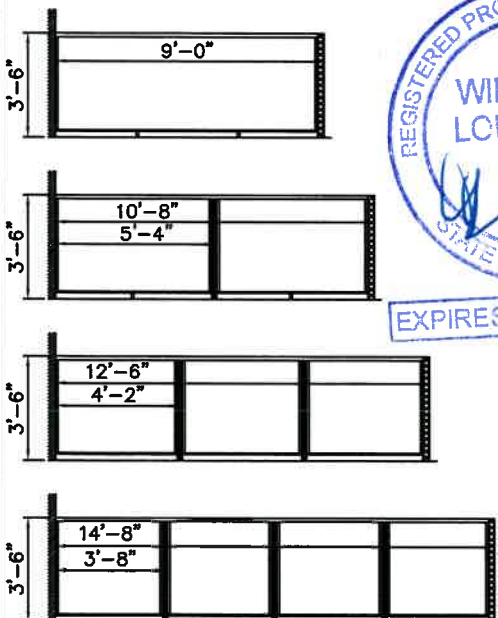
POST SIZES

NOTE – MAXIMUM PERMITTED
BOTTOM CHANNEL SPAN
BETWEEN POST SUPPORTS
IS 4'-9"



20 LBS/FOOT OR 200 LBS. TOP RAIL LOADING

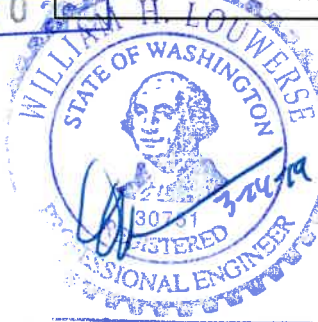
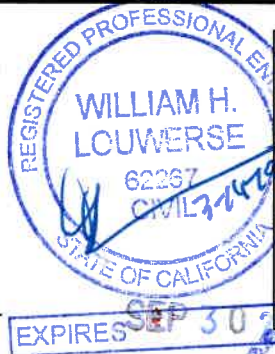
AS PER 2015 IBC SECTION 1607.8.1 HANDRAILS AND GUARDS FOR ONE AND TWO FAMILY DWELLINGS AND IN GROUP I-3,F,H AND S OCCUPANCIES
FOR AREAS THAT ARE NOT ACCESSIBLE TO THE GENERAL PUBLIC AND THAT HAVE AN OCCUPANT LOAD NO GREATER THAN 50.



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



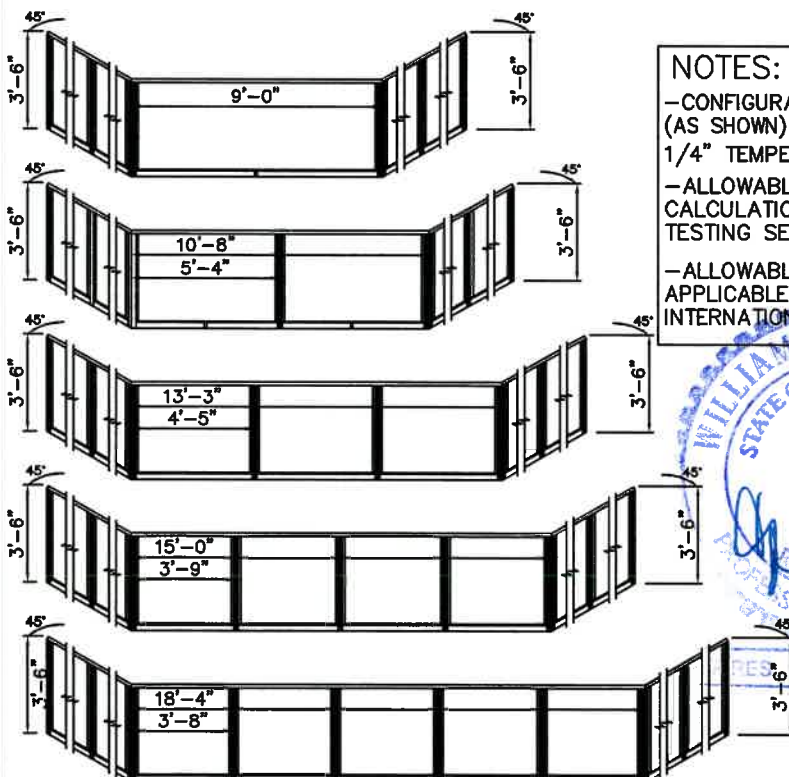
50 LBS/FOOT OR 200 LBS. TOP RAIL LOADING

FOR CONDITIONS NOT MENTIONED ABOVE

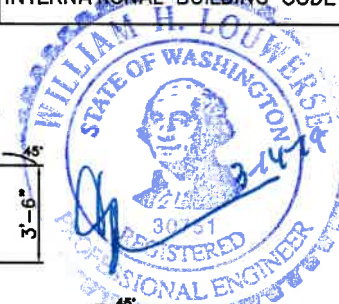
FIGURE 4F: 42" HIGH ALLOWABLE CONFIGURATIONS TYPE 3B

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www.vistarailings.com**TYPE 4 – PARTIAL FIXED BOTH ENDS**TYPE 4 – END CONDITIONS – 45° CORNERS w/ MIN 2" POSTS
INTERMEDIATE CONDITIONS – 2" POSTS EVENLY SPACEDSEE FIGURE 3 AND SECTION 2.5 ANCHORAGE
OF THE DESIGN GUIDE FOR DETAILS
REGARDING ACCEPTABLE GUARDRAIL
MOUNTING CONFIGURATIONS AND
MAXIMUM SERVICE PULL-OUT LOAD
REQUIREMENTS FOR ANCHORS.**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.

SEP 30 2019

**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



| POST LEGEND | | |
|--|--------|------|
| 2" | 2 1/2" | 5/8" |
| | | |
| PICKET LEG POST | | |
| POST SIZES | | |
| NOTE – MAXIMUM PERMITTED BOTTOM CHANNEL SPAN BETWEEN POST SUPPORTS IS 4'-9" | | |

50 LBS/FOOT OR 200 LBS. TOP RAIL LOADING

FOR CONDITIONS NOT MENTIONED ABOVE

**FIGURE 4G: 42" HIGH ALLOWABLE CONFIGURATIONS TYPE 4**



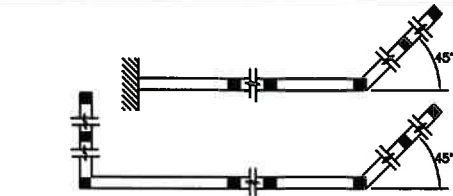
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structural
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TYPE 5 – FIXED & PARTIAL FIXED ENDS

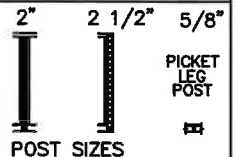


TYPE 5 – END CONDITIONS

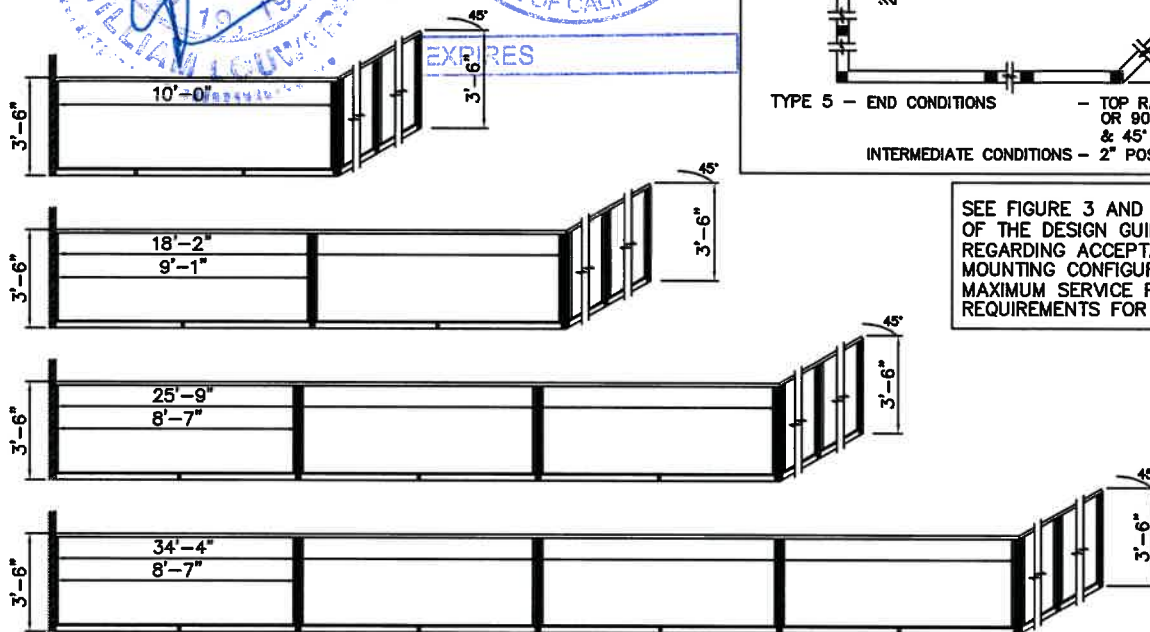
– TOP RAIL END CLIP TO STRUCTURE
OR 90° CORNER w/ MIN 2-2" POSTS
& 45° CORNER w/ MIN 2-2" POSTS
INTERMEDIATE CONDITIONS – 2" POSTS EVENLY SPACED

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

POST LEGEND



NOTE – MAXIMUM PERMITTED
BOTTOM CHANNEL SPAN
BETWEEN POST SUPPORTS
IS 4'-9"



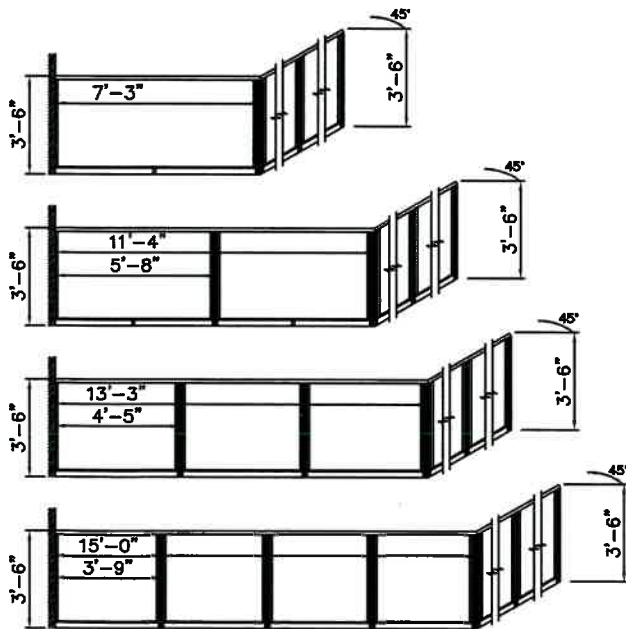
20 LBS/FOOT OR 200 LBS. TOP RAIL LOADING

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
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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

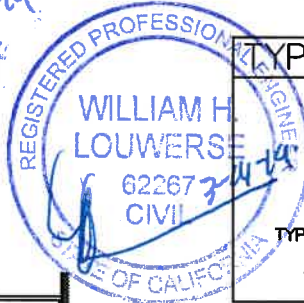
FOR CONDITIONS NOT MENTIONED ABOVE



FIGURE 4H: 42" HIGH ALLOWABLE CONFIGURATIONS TYPE 5



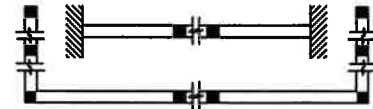
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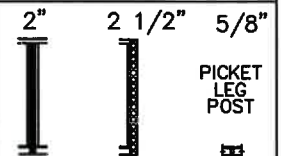
TYPE 6 – FIXED BOTH ENDS



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

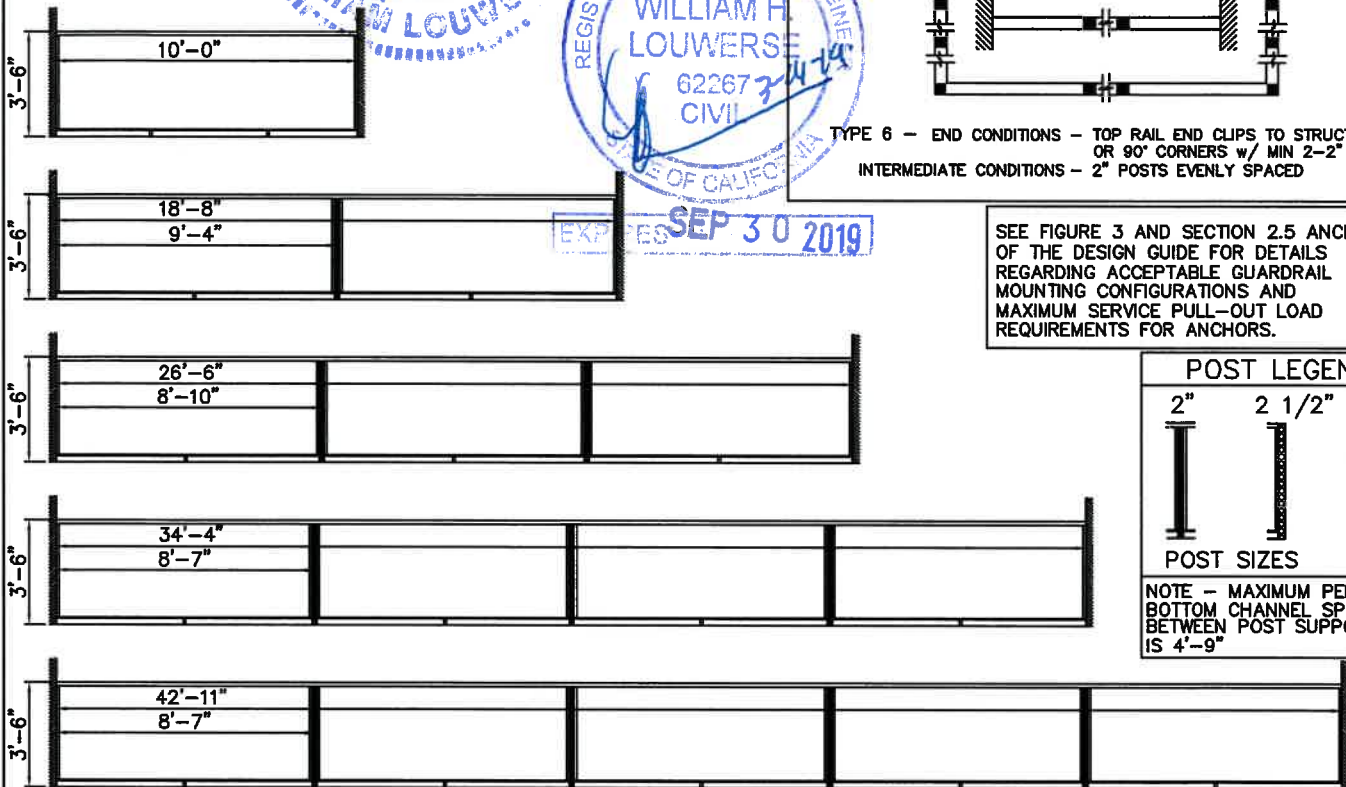
SEE FIGURE 3 AND SECTION 2.5 ANCHORAGE
OF THE DESIGN GUIDE FOR DETAILS
REGARDING ACCEPTABLE GUARDRAIL
MOUNTING CONFIGURATIONS AND
MAXIMUM SERVICE PULL-OUT LOAD
REQUIREMENTS FOR ANCHORS.

POST LEGEND



POST SIZES

NOTE – MAXIMUM PERMITTED
BOTTOM CHANNEL SPAN
BETWEEN POST SUPPORTS
IS 4'-9"



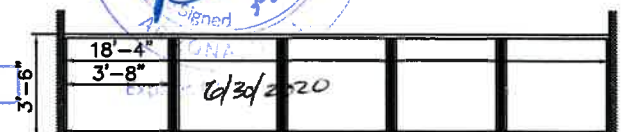
20 LBS/FOOT OR 200 LBS. TOP RAIL LOADING

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
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50 LBS/FOOT OR 200 LBS. TOP RAIL LOADING

FOR CONDITIONS NOT MENTIONED ABOVE

FIGURE 4I: 42" HIGH ALLOWABLE CONFIGURATIONS TYPE 6