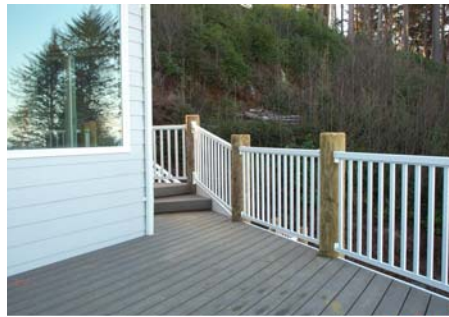


Design Manual

Designers & Architects
Engineers & Installers

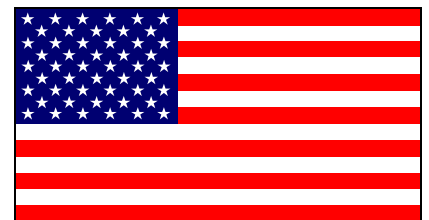
7th Edition - July 2011



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Printed in Canada



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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.

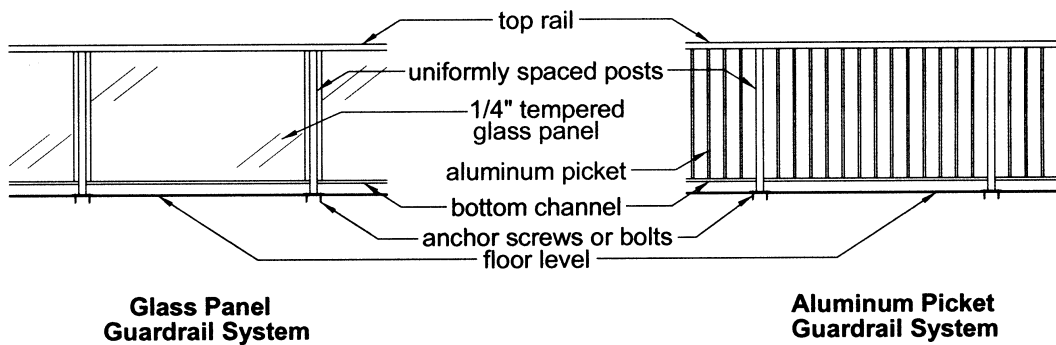


FIGURE 1: MAIN ELEMENTS OF GUARDRAIL SYSTEMS

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 Probuilt 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 special established project design requirements,
2. Mechanical properties of material used in 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.
- 7.

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 2009 International Building Code for guardrails are provided in section 1607.7.1 Handrails and guards as shown below:

1607.7.1 Handrails and guards. Handrails and guards shall be designed to resist a load of 50 pounds per linear foot (plf) (0.73 kN/m) applied in any direction at the top and to transfer this load through the supports to the structure.

Exceptions:

1. For one- and two-family dwellings, only the single concentrated load required by Section 1607.7.1.1 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).

1607.7.1.1 Concentrated load. Handrails and guards shall be able to resist a single concentrated load of 200 pounds (0.89 kN), applied in any direction at any point along the top, and to transfer this load through the supports to the structure. This load need not be assumed to act concurrently with the loads specified in section 1607.7.1.

1607.7.1.2 Components. Intermediate rails (all those except the handrail), balusters and panel fillers shall be designed to withstand a horizontally applied normal load of 50 pounds (0.22 kN) on a area equal to 1 square foot (0.093m²), including openings and space between rails. Reactions due to this loading are not required to be superimposed with those of Section 1607.7.1 or 1607.7.1.1.

2.1.2 Factors of Safety

Factors of safety for a guardrail system can be a somewhat subjective decision to be determined by the designer or certifying professional. 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 2009 International Building Code, AA ASM 35 AA ADM 1, and Parts 1-A and 1-B of the Aluminum Association's (AA) 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 Probuilt Guardrail Systems are provided in AA ASM 35 and Parts 1-A and 1-B of the 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	NOT WELDED			WELDED		
	Tensile ultimate Fu	Tensile yield Fy	Compressive yield Fy	Tensile ultimate Fwu	Tensile yield Fwy	Elastic modulus E
Extrusions and drawn tube						
6063-T5	22 ksi (151.7 MPa)	16 ksi (110.3 MPa)				10 000 ksi (68948 MPa)
6063-T54	33 ksi (207.6 MPa)	30 ksi (206.8 MPa)	30 ksi (206.8 MPa)	17 ksi (117.2 MPa)	10 ksi (68.9 MPa)	10 000 ksi (68948 MPa)
6063-T6	30 ksi (206.8 MPa)	25 ksi (172.4 MPa)	25 ksi (172.4 MPa)	17 ksi (117.2 MPa)	10 ksi (68.9 MPa)	10 000 ksi (68948 MPa)
Extrusions sheet, plate, and drawn tube						
6061-T6	38 ksi (262.0 MPa)	35 ksi (241.3 MPa)	35 ksi (241.3 MPa)	25 ksi (172.4 MPa)	16 ksi (110.3 MPa)	10 000 ksi (68948 MPa)
6005A-T61	38 ksi (262.0 MPa)	35 ksi (241.3 MPa)	35 ksi (241.3 MPa)			10 000 ksi (68948 MPa)

2.2.2 Physical Properties Of Guardrail Elements

Physical properties of sections of commonly used elements in Probuilt’s Guardrail Systems are given in Table 2. Typical cross-sections of these elements are provided in Figure 2. Additional elements are shown in ProBuilt’s 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 in ³ (10 ³ mm ⁴)
TOP RAILS						
2 1/4" (57.2 mm) square retail top rail for picket infill	6063-T5	.587 (379)	.341 (.142)	.260 (4.263)	.375 (.156)	.326 (5.349)
TOP RAIL SLEEVES/CORNERS						
outside square retail top rail sleeve/corner	6063-T5	.629 (406)	.432 (.180)	.330 (5.404)	.599 (.249)	.479 (7.854)
BOTTOM RAILS						
bottom rail for picket panel system	6063-T5	.245 (158)	.047 (.020)	.053 (.870)	.034 (.014)	.071 (1.162)
POSTS						
2 1/2" (63.5 mm) square post	6005A-T61	*	*	*	*	*
2" (50.8 mm) square post	6005A-T61	*	*	*	*	*
MISCELLANEOUS						
pickets 5/8" (15.9 mm) square picket	6063-T5	.098 (63)	.006 (.002)	.018 (.293)	.006 (.002)	.018 (.293)
various plates	6061-T6					

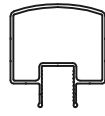
Legend

I - moment of inertia

S - section modulus

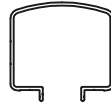
* - element data exclusive property of Probuilt. Use test results from Table 3 for design purposes

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

BOTTOM RAIL



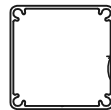
bottom rail for picket or glass infill system

BOTTOM RAIL SLEEVE



bottom rail sleeve for picket or glass infill system

POSTS



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



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

FIGURE 2: TYPICAL CROSS-SECTIONS OF COMMON GUARDRAIL ELEMENTS

2.3 ELEMENT AND SYSTEM LOAD CAPACITIES

AA ASM 35 and Parts 1-A and 1-B of the Aluminum Association's (AA) 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. Complicated analysis procedures are necessary 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 2009 International Building Code in Chapter 17: Structural Tests and Special Inspections. Probuilt 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, Probuilt 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 approach. Probuilt 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 Probuilt. 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: PROBUILT TESTING RESULTS

Element/Component System	Average Ultimate Load Applied	Mode of Failure
TOP RAILS		
2 1/4" (57.2 mm) square retail top rail for picket infill (cross-sectional area = .671in ² (433mm ²))	874 lbs. (3888 N) total load applied at 1/3 span points	buckling @ support
TOP RAILS WITH SLEEVES		
2 1/4" (57.2 mm) square retail 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
POSTS		
2 1/2" (63.5 mm) square post anchored to steel post	413 lbs. (1837 N) horizontal load @ 42" (1067 mm) height	bottom screws pulled through base plate
2" (50.8 mm) square post light wall anchored to steel post	308 lbs. (1370 N) horizontal load @ 42" (1067 mm) height	bottom screws pulled through base plate
MISCELLANEOUS		
top rail end clip	1447 lbs. (6437 N) in shear	forward screw top laterally out of chase
bottom channel end clip	1779 lbs. (7915 N) in shear	forward screw top 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 (cross-sectional area = .115 in ² (74 mm ²))	256 lbs. (1140 N) at midspan	weld failure at end connection
5/8" (15.9 mm) picket panel 44" (1118 mm) x 38 1/4" (972 mm)	696 psf (33.3 kPa) distributed loading at midspan over 12" (305 mm) x 12" (305 mm) area	weld failure at end connection
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

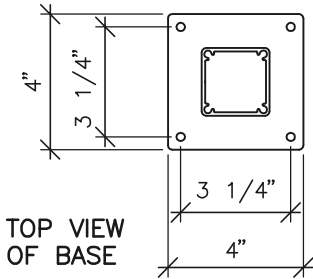
1. Tests conducted by Intertek Testing Services Na Ltd. / Warnock Hersey – reports available upon request.
2. Test procedures in general conformance with ASTM Standard Specification E 985-87 for Permanent Metal Railing Systems and Rails for Buildings and ASTM Standard Test Methods E 935-85a for Performance 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 2009 International Building Code section 1607.7.1 Handrails and guards.



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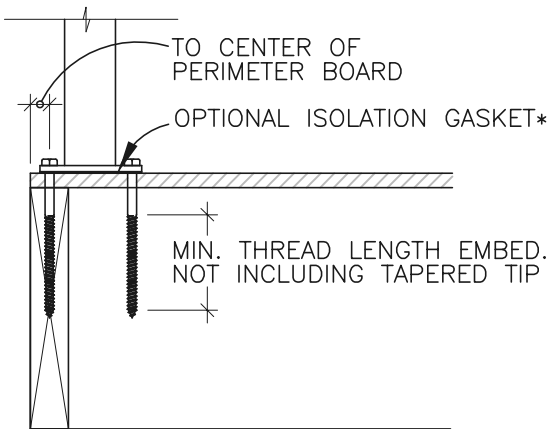
RECOMMENDED MOUNTING AND FASTENING TO WOOD

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. (Probuilt catalogue No. 7000) (NOT INTENDED AS A WATER PROOFING ITEM)**

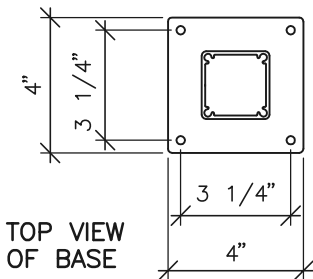


POST SIZE	LAG SCREW DIAMETER	WOOD BLOCKING SPECIES	MIN THREAD LENGTH EMBEDMENT
2"	5/16"	DOUGLAS FIR	3"
		SPRUCE-PINE-FIR	3 1/2"
	3/8"	DOUGLAS FIR	2 1/2"
		SPRUCE-PINE-FIR	3"
2 1/2"	5/16"	DOUGLAS FIR	4"
		SPRUCE-PINE-FIR	4 1/2"
	3/8"	DOUGLAS FIR	3 1/2"
		SPRUCE-PINE-FIR	4"

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

RECOMMENDED MOUNTING AND FASTENING TO CONCRETE

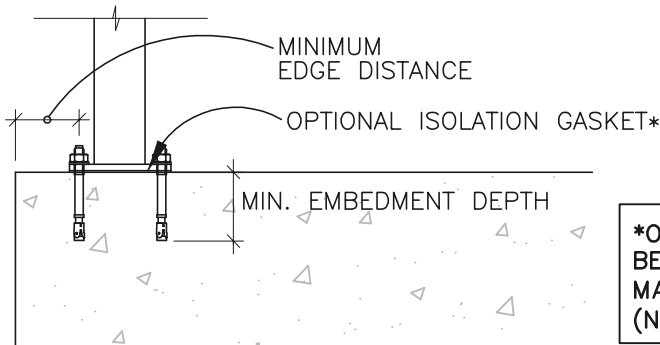
MAIN STRUCTURE LOAD CAPACITY RESPONSIBILITY OF OTHERS



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"φ HILTI KWIK BOLT III EXPANSION ANCHOR	2 1/2"	2 1/2"
2 1/2"	4000 psi (27.6 MPa)	1/2"φ HILTI KWIK BOLT III EXPANSION ANCHOR	3 3/4"	4"

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



***OPTIONAL CLOSED CELL ISOLATION GASKET BETWEEN DISSIMILAR OR INCOMPATIBLE MATERIALS. (Probuilt catalogue No. 7000) (NOT INTENDED AS A WATER PROOFING ITEM)**

FIGURE 3: ACCEPTABLE GUARDRAIL MOUNTING CONFIGURATIONS

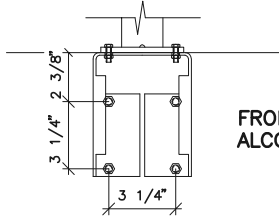


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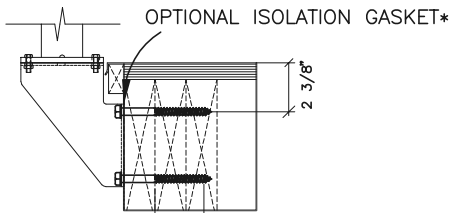
FASCIA (SIDE) MOUNTING DETAILS RECOMMENDED MOUNTING AND FASTENING TO WOOD

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

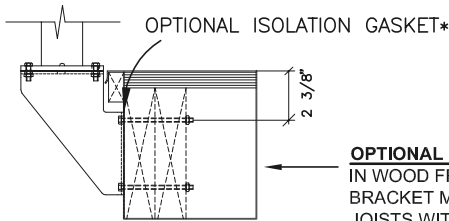
***OPTIONAL CLOSED CELL ISOLATION GASKET BETWEEN DISSIMILAR OR INCOMPATIBLE MATERIALS. (Probuilt catalogue No. 7000) (NOT INTENDED AS A WATER PROOFING ITEM)**



FRONT VIEW OF ALCO FASCIA BRACKET



MIN. THREAD LENGTH EMBEDMENT NOT INCLUDING TAPERED TIP



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

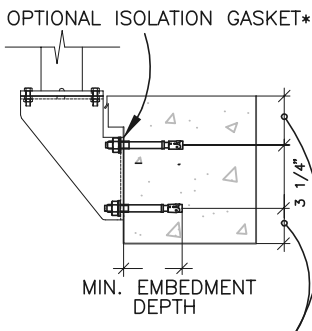
POST SIZE	LAG SCREW DIAMETER	WOOD BLOCKING SPECIES	MIN THREAD LENGTH EMBEDMENT
2"	5/16"	DOUGLAS FIR	3"
		SPRUCE-PINE-FIR	3 1/2"
	3/8"	DOUGLAS FIR	2 1/2"
		SPRUCE-PINE-FIR	3"
2 1/2"	5/16"	DOUGLAS FIR	4"
		SPRUCE-PINE-FIR	4 1/2"
	3/8"	DOUGLAS FIR	3 1/2"
		SPRUCE-PINE-FIR	4"

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. (Probuilt catalogue No. 7000) (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"Ø HILTI KWIK BOLT III EXPANSION ANCHOR	2 1/2"	2 1/2"
2 1/2"	4000 psi (27.6 MPa)	1/2"Ø HILTI KWIK BOLT III EXPANSION ANCHOR	3 3/4"	4"

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

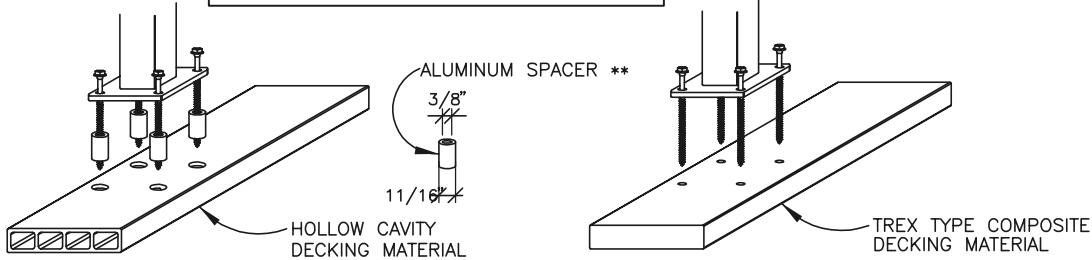
FIGURE 3: ACCEPTABLE GUARDRAIL MOUNTING CONFIGURATIONS



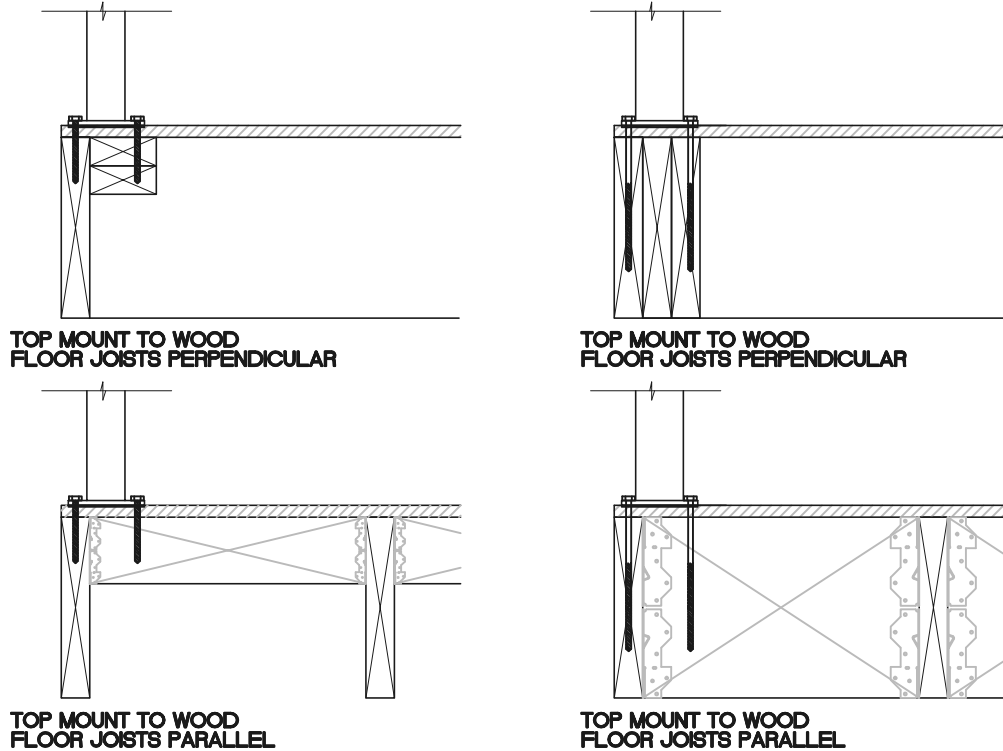
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RECOMMENDED MOUNTING THROUGH COMPOSITE DECKING

****RECOMMENDED ALUMINUM SPACER FOR USE WHEN MOUNTING TO HOLLOW COMPOSITE DECKING . (Probuilt catalogue No. 7590)**



RECOMMENDED WOOD BLOCKING DETAILS

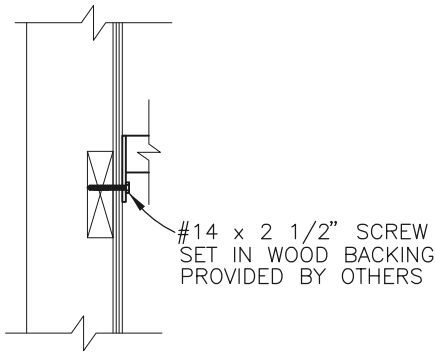


NO.1/NO.2 OR BETTER WOOD BLOCKING ANCHORAGE TO MAIN STRUCTURE AND MAIN STRUCTURE LOAD CAPACITY RESPONSIBILITY OF OTHERS

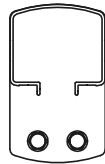
FIGURE 3continued: ACCEPTABLE GUARDRAIL MOUNTING CONFIGURATIONS



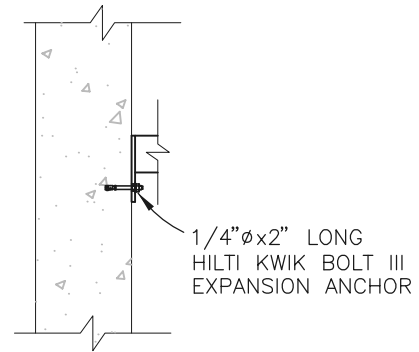
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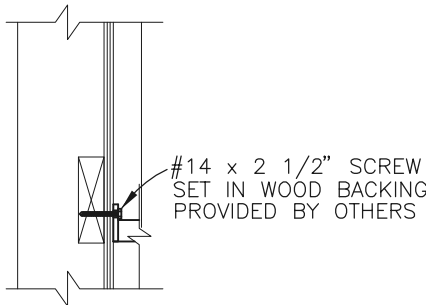
**TOP RAIL
 MOUNT TO WOOD**



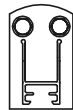
**TOP RAIL
 END CLIP**



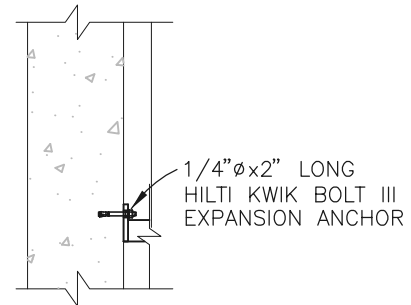
**TOP RAIL
 MOUNT TO CONCRETE**



**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 summarised below for each type of post and anchorage configuration:

post	anchorage configuration
	top mount using ProBuilt base plate
2"	1092 lbs (4857 N)
2 1/2"	1692 lbs (7526 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 Probuilt mechanical fastening. Tests conducted by Intertek Testing Services Na Ltd./ Warnock Hershey indicate that 38.1mm (1 1/2") posts with welded base plates fail at loads an average of 35% lower than identical posts with Probuilt 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 Probuilt's) that uses a welded base plate failed at loads an average of 30% lower than the Probuilt 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.

The design tables are based upon the loading criteria set out in the 2009 International Building Code section 1607.7.1 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 2009 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 procedures for determining net design wind pressures, p_{net} , for the components and cladding of building is provided in subsection 1609.6.4.4.1 Components and cladding of the 2009 International Building Code Section 1609 Wind Loads and chapter 6 of ASCE 7. Using the code provisions, a 12.7 psf (0.61kPa) net design wind pressure is given the following conditions:

- Exposure B – Urban and suburban areas, wood areas or other terrain with numerous closely spaced obstructions having the size of single-family dwellings or larger. Exposure B shall be assumed unless the site meets the definition of another type of exposure.
- Mean roof height of 30 ft (9.144m) or less
- Importance factor of 1.0
- 50 sq.ft (4.645m²) effective wind area
- 85 mile per hour (37.4 m/s) nominal design 3-second gust wind speed.

Many residential guardrail conditions fit within these criteria. Consult the 2009 International Building Code 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

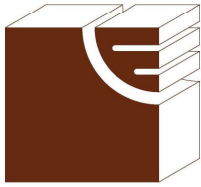
3.3 GUARDRAIL SYSTEMS WITH ALUMINUM PICKET INFILL

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 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.

File No. 109-246

July 27, 2011

PROBUILT

9747 199A Street
Langley, BC Canada V1M 2X7

Attention: Mr. Dale Rasmussen

RE: **ALUMINUM GUARDRAIL 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 20 to 28 inclusive and pages 11 to 14 inclusive respectively of the Probuilt Aluminum Railings Design Manual. These configurations are in conformance with the structural load requirements for balcony guardrails as specified in the following code:

- 2009 International Building Code section 1607.7.1 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/lsc



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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 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

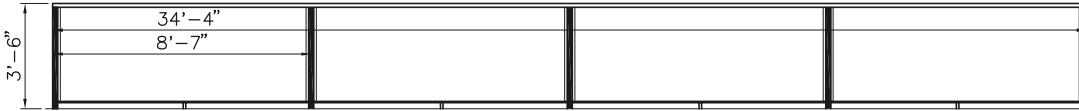
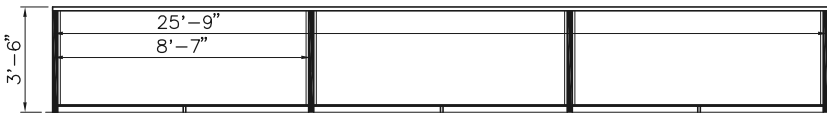
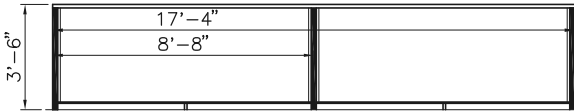
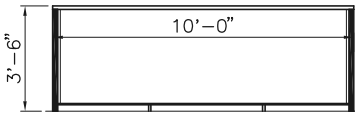


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TYPE 1 – FREE-STANDING



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

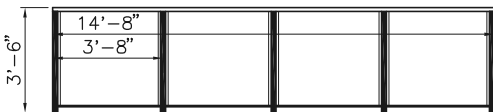
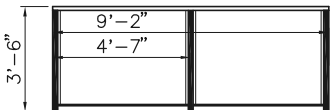
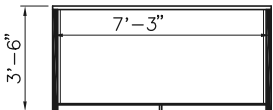


SEE FIGURE 3 AND SECTION 2.5 ANCHORAGE OF THE DESIGN MANUAL FOR DETAILS REGARDING ACCEPTABLE GUARDRAIL MOUNTING CONFIGURATIONS AND MAXIMUM SERVICE PULL-OUT LOAD REQUIREMENTS FOR ANCHORS.

POST LEGEND		
2"	2 1/2"	5/8"
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 2009 IBC SECTION 1607.7.1 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 LESS 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 2009 INTERNATIONAL BUILDING CODE SECTION 1607.7.1

50 LBS/FOOT OR 200 LBS. TOP RAIL LOADING

FOR CONDITIONS NOT MENTIONED ABOVE

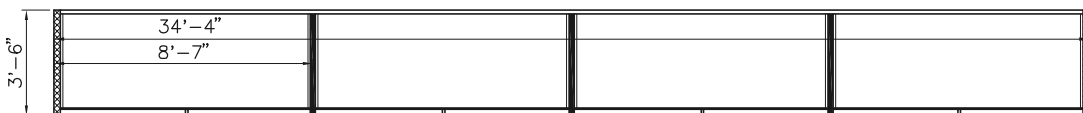
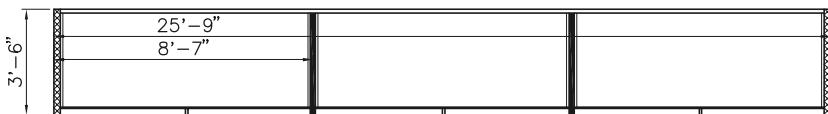
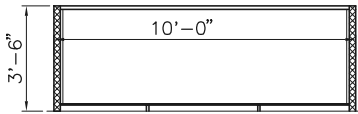
FIGURE 4A: 42" HIGH ALLOWABLE CONFIGURATIONS – TYPE 1A

TYPE 1 – FREE-STANDING



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

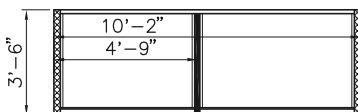
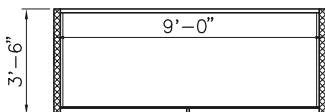
SEE FIGURE 3 AND SECTION 2.5 ANCHORAGE OF THE DESIGN MANUAL FOR DETAILS REGARDING ACCEPTABLE GUARDRAIL MOUNTING CONFIGURATIONS AND MAXIMUM SERVICE PULL-OUT LOAD REQUIREMENTS FOR ANCHORS.



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"		

20 LBS/FOOT OR 200 LBS. TOP RAIL LOADING

AS PER 2009 IBC SECTION 1607.7.1 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 LESS 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 2009 INTERNATIONAL BUILDING CODE SECTION 1607.7.1

50 LBS/FOOT OR 200 LBS. TOP RAIL LOADING

FOR CONDITIONS NOT MENTIONED ABOVE

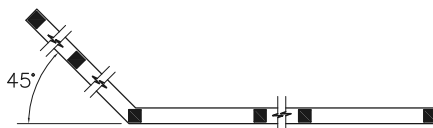
FIGURE 4B: 42" HIGH ALLOWABLE CONFIGURATIONS TYPE 1B



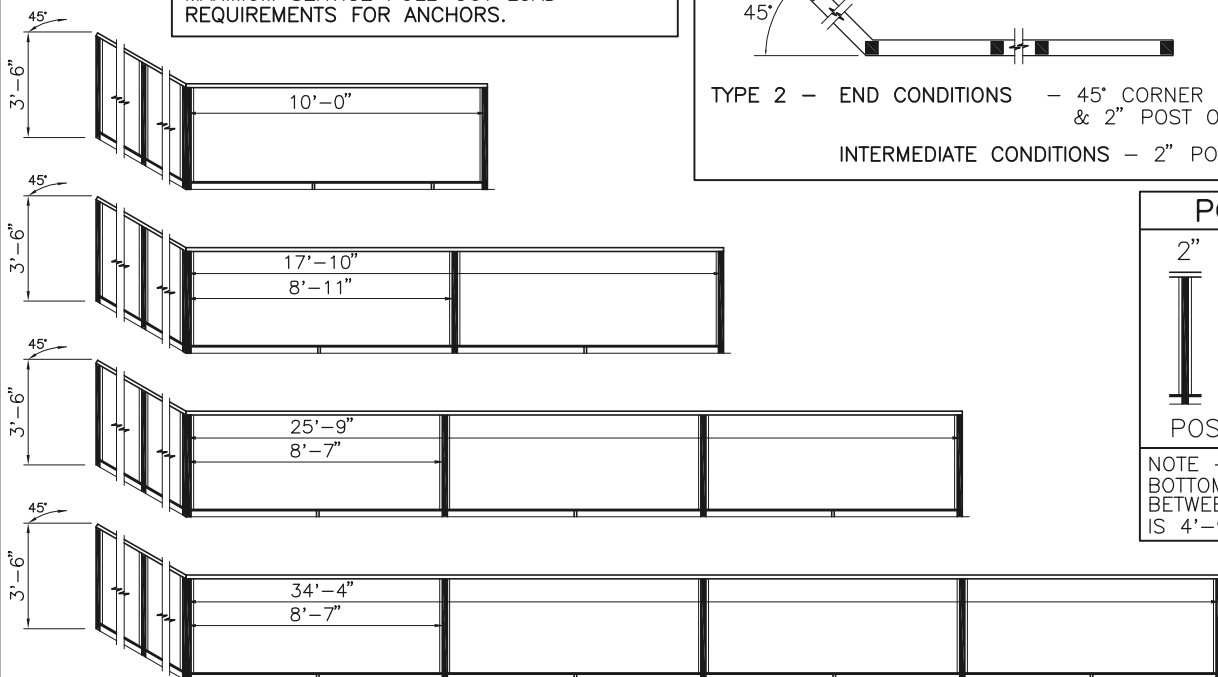
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SEE FIGURE 3 AND SECTION 2.5 ANCHORAGE OF THE DESIGN MANUAL FOR DETAILS REGARDING ACCEPTABLE GUARDRAIL MOUNTING CONFIGURATIONS AND MAXIMUM SERVICE PULL-OUT LOAD REQUIREMENTS FOR ANCHORS.

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

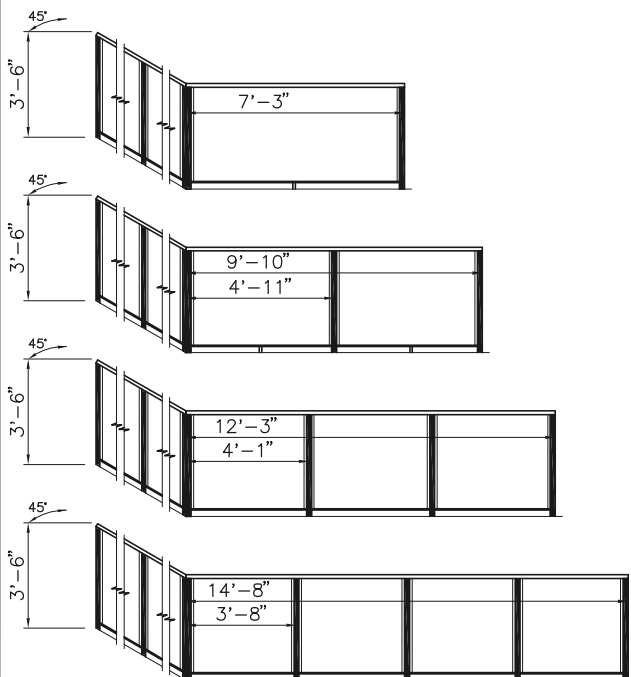


POST LEGEND

2"	2 1/2"	5/8"	
			PICKET LEG POST
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 2009 IBC SECTION 1607.7.1 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 LESS 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
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 –ALLOWABLE CONFIGURATIONS ARE IN CONFORMANCE WITH THE APPLICABLE STRUCTURAL REQUIREMENTS SPECIFIED IN THE 2009 INTERNATIONAL BUILDING CODE SECTION 1607.7.1

50 LBS/FOOT OR 200 LBS. TOP RAIL LOADING

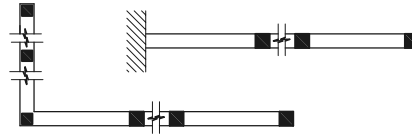
FOR CONDITIONS NOT MENTIONED ABOVE

FIGURE 4C: 42" HIGH ALLOWABLE CONFIGURATIONS TYPE 2

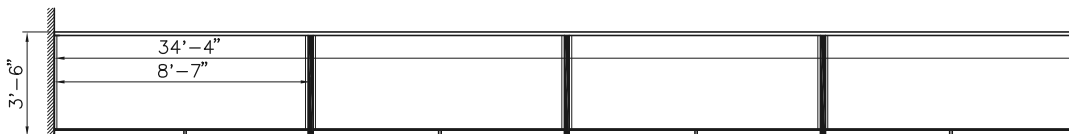
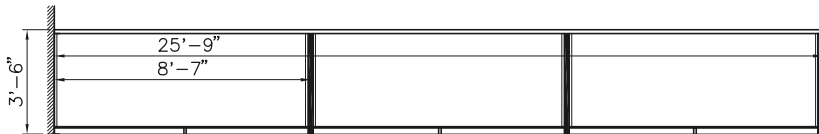
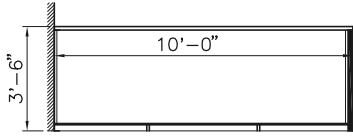


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TYPE 3 – FIXED ONE END

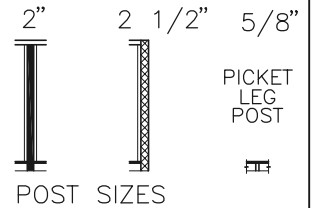


TYPE 3A – END CONDITIONS – TOP RAIL END CLIP TO STRUCTURE OR 90° CORNER w/ MIN 2-2" POSTS & 2" POST OPPOSITE END
INTERMEDIATE CONDITIONS – 2" POSTS EVENLY SPACED



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

POST LEGEND



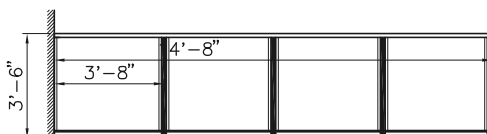
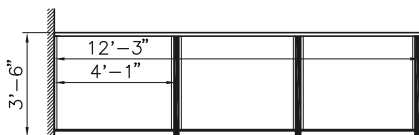
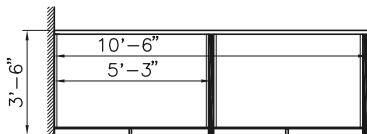
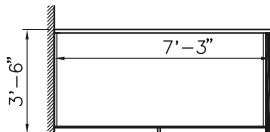
NOTE – MAXIMUM PERMITTED BOTTOM CHANNEL SPAN BETWEEN POST SUPPORTS IS 4'-9"

20 LBS/FOOT OR 200 LBS. TOP RAIL LOADING

AS PER 2009 IBC SECTION 1607.7.1 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 LESS 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 2006, INTERNATIONAL BUILDING CODE SECTION 1607.7.1



50 LBS/FOOT OR 200 LBS. TOP RAIL LOADING

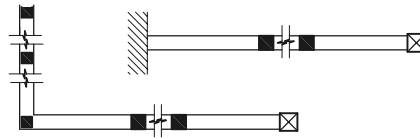
FOR CONDITIONS NOT MENTIONED ABOVE

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

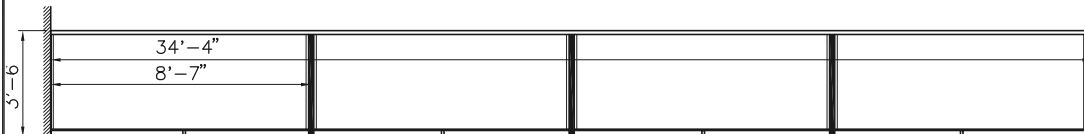
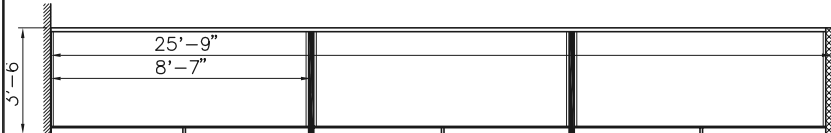
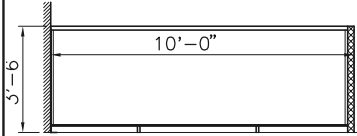


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TYPE 3 – FIXED ONE END

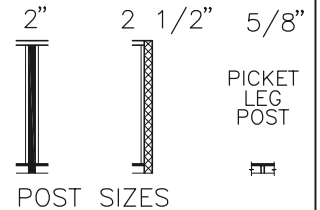


TYPE 3B – END CONDITIONS – TOP RAIL END CLIP TO STRUCTURE OR 90° CORNER w/ MIN 2-2" POSTS & 2 1/2" POST OPPOSITE END
INTERMEDIATE CONDITIONS – 2" POSTS EVENLY SPACED



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

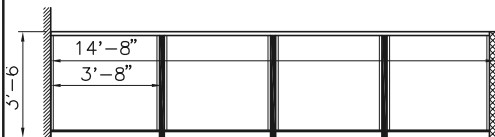
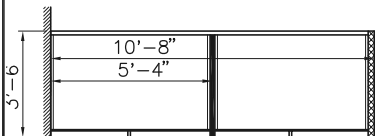
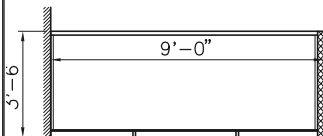
POST LEGEND



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

20 LBS/FOOT OR 200 LBS. TOP RAIL LOADING

AS PER 2009 IBC SECTION 1607.7.1 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 LESS THAN 50.



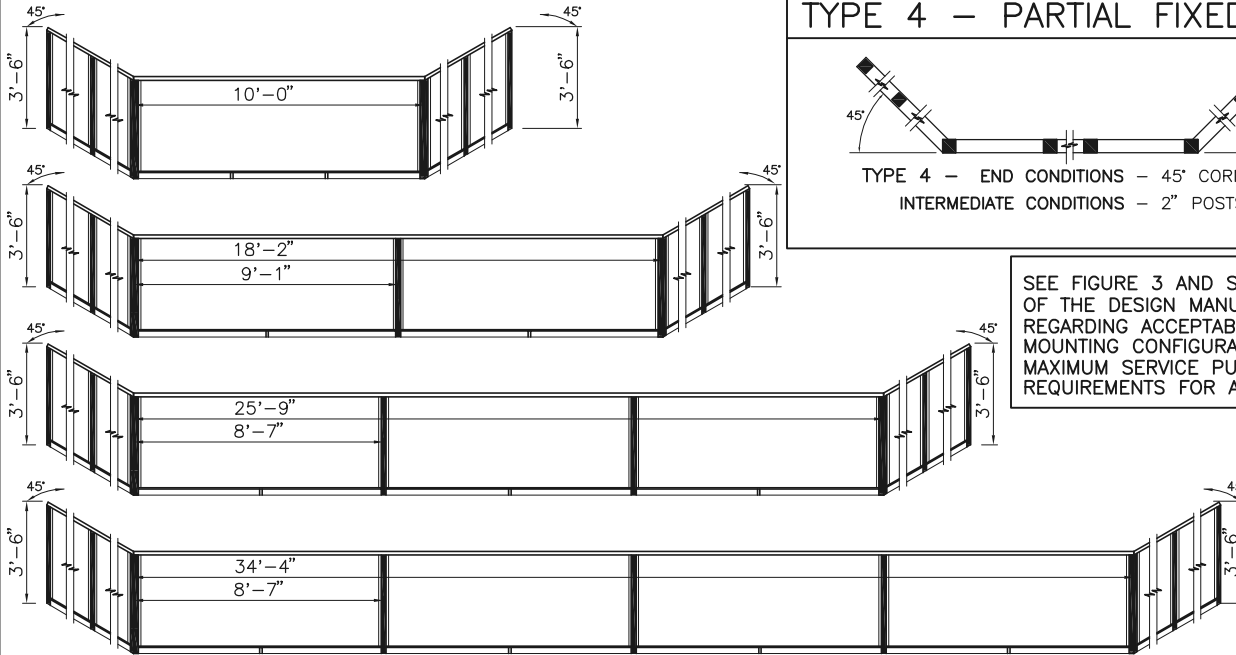
NOTES:

- 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 2009 INTERNATIONAL BUILDING CODE SECTION 1607.7.1

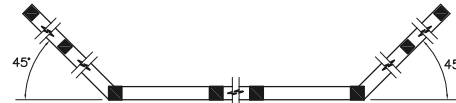
50 LBS/FOOT OR 200 LBS. TOP RAIL LOADING

FOR CONDITIONS NOT MENTIONED ABOVE

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



TYPE 4 – PARTIAL FIXED BOTH ENDS

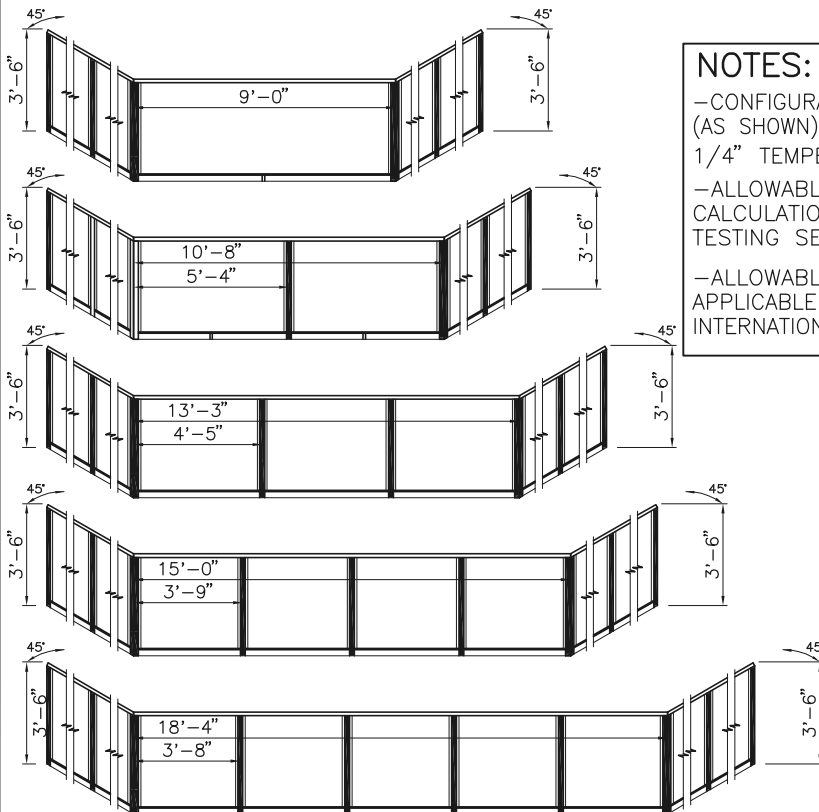


TYPE 4 – END CONDITIONS – 45° CORNERS w/ MIN 2'-2" POSTS
INTERMEDIATE CONDITIONS – 2" POSTS EVENLY SPACED

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.

20 LBS/FOOT OR 200 LBS. TOP RAIL LOADING

AS PER 2009 IBC SECTION 1607.7.1 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 LESSR 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 2009 INTERNATIONAL BUILDING CODE SECTION 1607.7.1

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

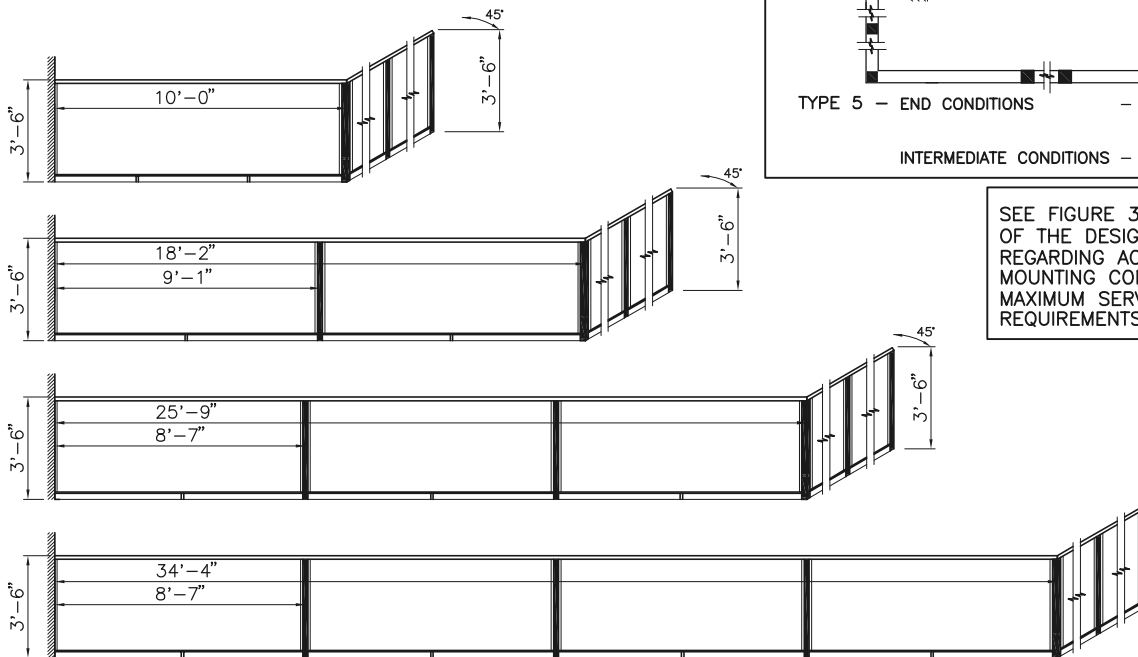
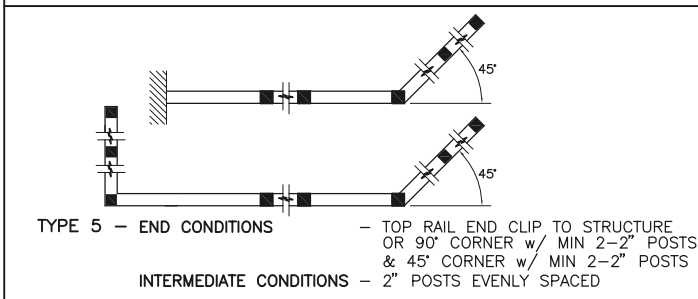
FOR CONDITIONS NOT MENTIONED ABOVE

FIGURE 4F: 42" HIGH ALLOWABLE CONFIGURATIONS TYPE 4



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TYPE 5 – FIXED & PARTIAL FIXED ENDS

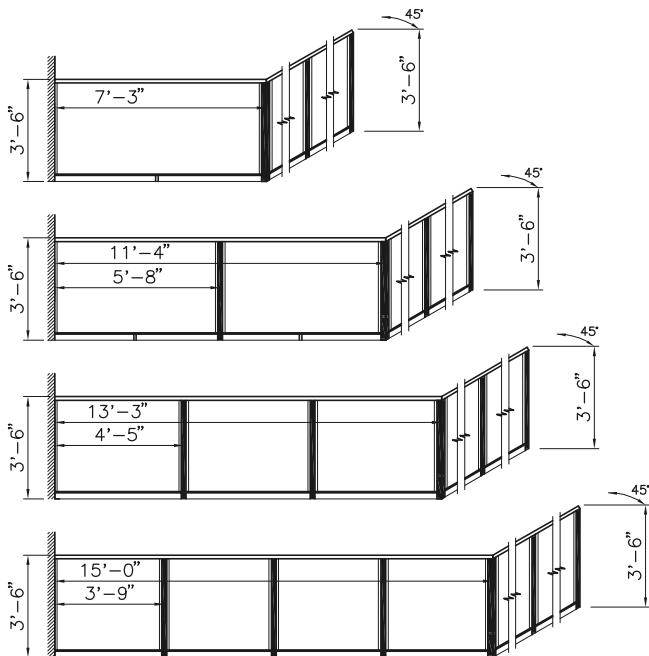


SEE FIGURE 3 AND SECTION 2.5 ANCHORAGE OF THE DESIGN MANUAL FOR DETAILS REGARDING ACCEPTABLE GUARDRAIL MOUNTING CONFIGURATIONS AND MAXIMUM SERVICE PULL-OUT LOAD REQUIREMENTS FOR ANCHORS.

POST LEGEND		
2"	2 1/2"	5/8"
		PICKET LEG POST
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 2009 IBC SECTION 1607.7.1 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 LESS 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 2009 INTERNATIONAL BUILDING CODE SECTION 1607.7.1

50 LBS/FOOT OR 200 LBS. TOP RAIL LOADING

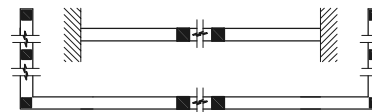
FOR CONDITIONS NOT MENTIONED ABOVE

FIGURE 4G: 42" HIGH ALLOWABLE CONFIGURATIONS TYPE 5



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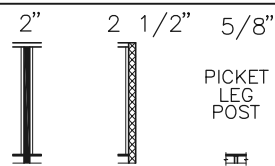
TYPE 6 – FIXED BOTH ENDS



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

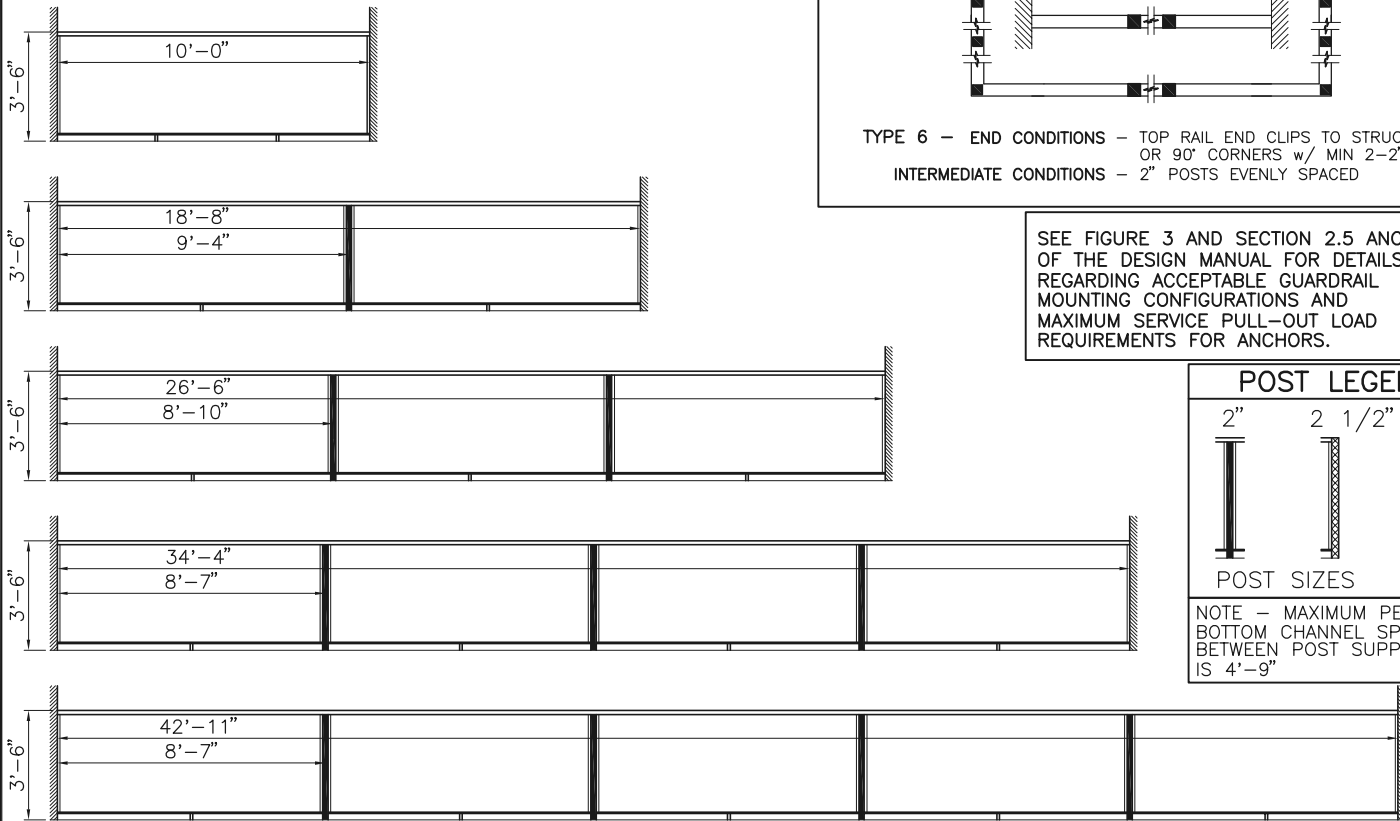
SEE FIGURE 3 AND SECTION 2.5 ANCHORAGE OF THE DESIGN MANUAL FOR DETAILS REGARDING ACCEPTABLE GUARDRAIL MOUNTING CONFIGURATIONS AND MAXIMUM SERVICE PULL-OUT LOAD REQUIREMENTS FOR ANCHORS.

POST LEGEND



POST SIZES

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

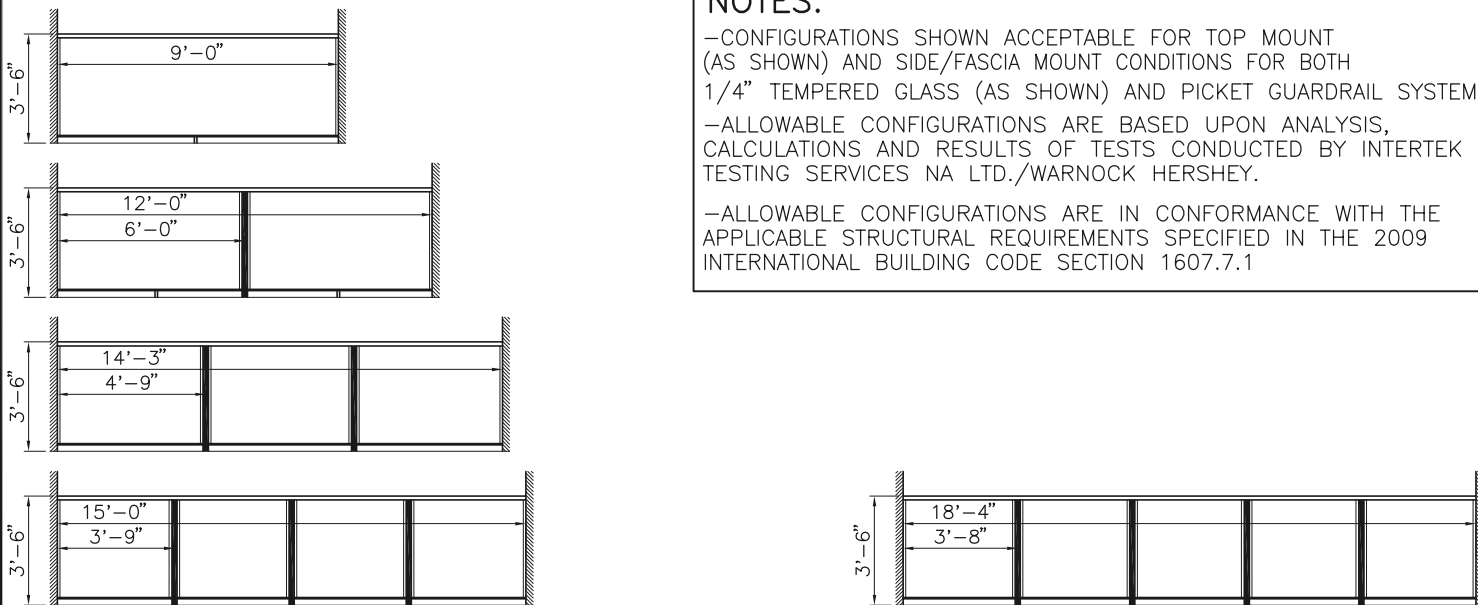


20 LBS/FOOT OR 200 LBS. TOP RAIL LOADING

AS PER 2009 IBC SECTION 1607.7.1 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 LESS 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 2009 INTERNATIONAL BUILDING CODE SECTION 1607.7.1



50 LBS/FOOT OR 200 LBS. TOP RAIL LOADING

FOR CONDITIONS NOT MENTIONED ABOVE

FIGURE 4H: 42" HIGH ALLOWABLE CONFIGURATIONS TYPE 6