Niagara Column Bracket™

Design Guide

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The Niagara Column Bracket™ is used in Post Frame construction to connect wood columns to a concrete foundation. This design guide explains that intended use, offers a technical description of the product, and offers design capacities for the product.

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The Niagara Column Bracket™

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Design Guide

1. INTENDED USE

1.1. General Use of Product

Niagara Column Brackets™ are a structural connector to anchor wood columns (or posts) to a concrete foundation or footing in Post Frame construction. The International Building Code (IBC) and International Residential Code (IRC) require that column-and-post end connections be fastened to resist lateral and net induced uplift forces (IBC §2304.9.7 and IRC §407.3). The Niagara Column Brackets™ are designed to meet these requirements when used according to the limitations and recommendations of this design guide (ref. Figure 1).

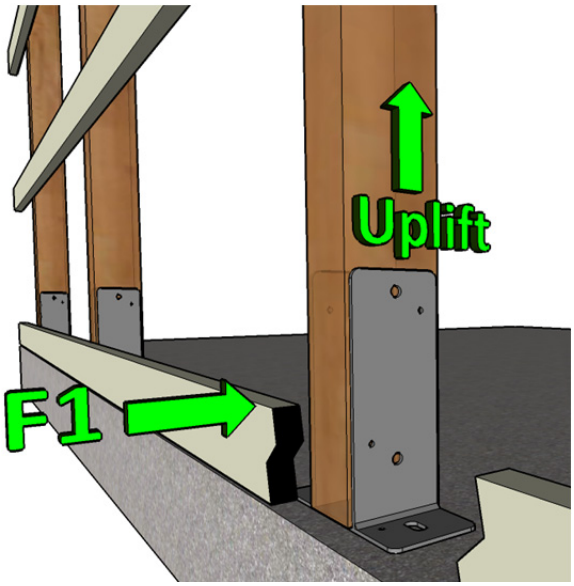


Figure 1.1 – Lateral and Uplift Forces Illustrated

1.2. Limitations of Use

This report is a general summary of the design capabilities and is not intended to recommend or endorse the Niagara Column Bracket™ for any specific application. The calculation of the force requirements for the Niagara Column Bracket™ must be determined by the person responsible for the structural design of the building.

1.3. Recommendations for Post Frame Design

Because Post Frame construction is very efficient with the amount of material required to achieve large spans and heights, it is even more important to have the materials properly analyzed and specified by someone knowledgeable in the engineering principles used in Post Frame construction. It is recommended that all Post Frame buildings be fully engineered and then constructed by a competent builder that specializes in Post Frame construction. The designer and builder will be able to provide properly installed components with proper connections in critical locations. The engineer's scope of work would include the analysis and specification of the post frame columns to be used in the building and the selection of the proper Niagara Column Bracket™ and hardware to connect these properly sized columns to the properly sized foundation system.

1.4. Pin Connection – Not a Moment Connection

A properly installed Niagara Column Bracket™ does not have the ability to resist bending about the base. The product must be installed so that the rotation of the column within the bracket is resisted by other means. This could include a system of structural diaphragms that pass wind load from the laterally loaded surface into the ground or into another structural diaphragm which eventually passes the applied load into the ground, or it could include a system of X-Bracing (cables or similar), or a combination of diaphragm and X-Bracing, or other lateral resistance system.

The difference in a building that requires a Pin Connection vs. a Moment Connection is shown by comparing Figure 1.4A to Figure 1.4B. In both figures, the wind load is applied to the structure (blue arrows) and the forces are resisted by the Niagara Column Bracket™ (green arrows). Figure 1.4A shows two reaction forces to the top of the column coming from the building's structural diaphragm system (black arrows). These forces resist the lateral movement at the top of the column, which means the Niagara Column Bracket™ is not subject to any significant rotational force. In Figure 1.4B, without this diaphragm system present, the column will try to rotate with the wind, requiring a rotational resisting force (red arrow) from the Niagara Column Bracket™ which it cannot provide. This situation will lead to excessive building deflection or building collapse.

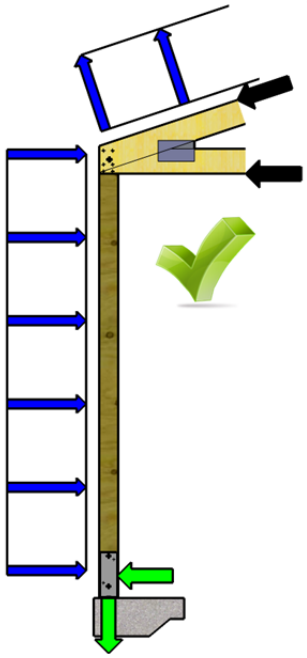


Figure 1.4A – Bracket Use with Diaphragm Design

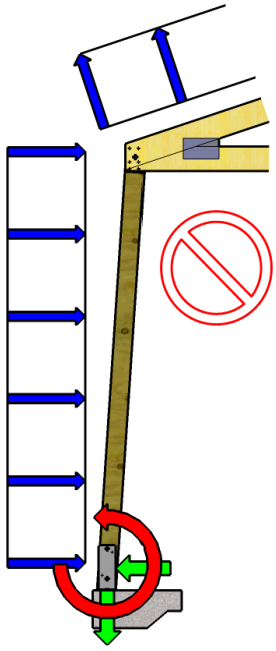


Figure 1.4B –Without Lateral Restraint at Column Top, bracket shows rotation

2. PRODUCT DESCRIPTION

2.1. General

Niagara Column Brackets™ are manufactured from ASTM 1008 commercial steel plate (CS Type B) having a yield strength of 30,000 psi and an ultimate tensile strength of 46, 000 psi. The ¼" thick steel plates are punched with the fastener clearance holes and slots in the proper positions and then joined together using a robotic welder to form the completed bracket.

2.2. Bracket Sizes

Brackets are manufactured for column sizes commonly used in the Post Frame Industry. Refer to Figure 2.2 and Table 2.2 for proper part number selection.

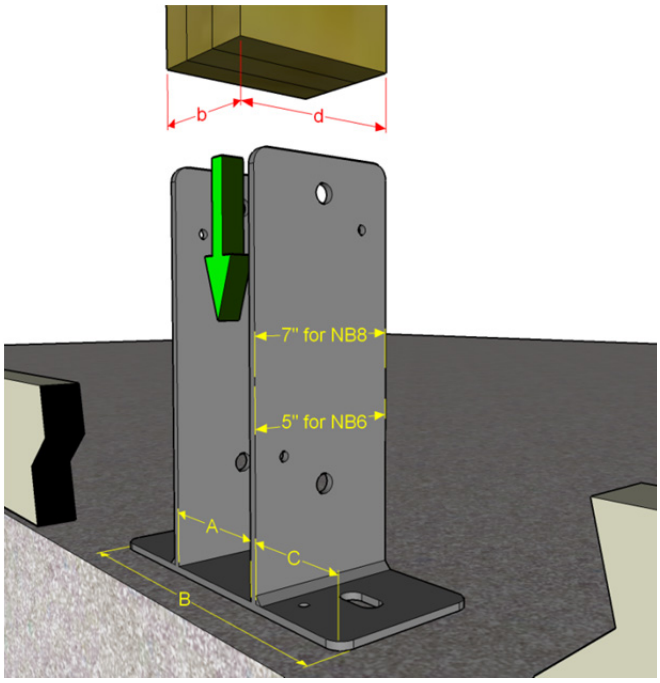


Figure 2.2 - Column and Bracket Dimension Illustration

Post Frame Column Information				Niagara Column Bracket™	Bracket Dimensions		
Column Size	Column Type	Column Width, b	Column Depth, d		"A"	"B"	"C"
3Ply 2x6	Glue-Lam	4.13	5.38	NB63	4.25	12.13	3.69
4Ply 2x6	Glue-Lam	5.50	5.38	NB64	5.63	13.63	3.75
3Ply 2x8	Glue-Lam	4.13	7.13	NB83	4.25	12.13	3.69
4Ply 2x8	Glue-Lam	5.50	7.13	NB84	5.63	13.63	3.75
3Ply 2x6	Nail-Lam	4.50	5.50	NB63A	4.63	12.13	3.50
4Ply 2x6	Nail-Lam	6.00	5.50	NB64A	6.13	13.63	3.50
3Ply 2x8	Nail-Lam	4.50	7.25	NB83A	4.63	12.13	3.50
4Ply 2x8	Nail-Lam	6.00	7.25	NB84A	6.13	13.63	3.50
4x6 Post	Solid Sawn	3.50	5.50	NB46	3.63	12.13	4.00
6x6 Post	Solid Sawn	5.50	5.50	NB66	5.63	13.63	3.75

Table 2.2 – Part Numbers organized by Column Type and Size

2.3. Clearance Holes for Fasteners

The brackets can be used with various fasteners, but they are manufactured with clearance holes and slots intended for certain fastener sizes:

- 1/4"Ø lag screws (5/16"Ø holes) into the concrete and into the column
- 1/2"Ø bolts (5/8"Ø holes) into the column
- 5/8"Ø or 3/4"Ø anchors (3/4"Ø slots) into the concrete

2.5. Hardware Kits

Niagara Column Brackets™ can be ordered with a Hardware kit by adding the letter "H" to the end of the part number (i.e. NB63H, NB83AH). The hardware kits include the fasteners in the quantities shown in Table 2, which will allow the installation to achieve the design loads listed in this Design Guide.

Niagara Column Bracket™ Part #	1/4"Ø x 3" Hex Lag Screws	1/2"Ø Carriage Bolt, Nut & Washer	Carriage Bolt Length	3/4"Ø x 5-½" LDT Redhead Anchors
NB63H	4	2	6"	2
NB64H			7"	
NB63AH			6"	
NB64AH			7"	
NB46H			5"	
NB66H			7"	
NB83H	8	2	6"	2
NB84H			7"	
NB83AH			6"	
NB84AH			7"	

Table 2.4 –Hardware Kit Contents by Part Number

2.6. Universal Brackets

Niagara Column Brackets™ are also available in a Universal Bracket offering which is a single "L" shape which may be useful to the building designer in applications where the columns have an unusual size or for applications where the column size is not known. Universal brackets are intended to be used in pairs and are available in two sizes: NB60 is the same width (5") as the NB6_ brackets and NB80 is the same width (7") as the NB8_ brackets.

Because the L-shaped brackets do not provide any steel material under the wood column, some barrier between the endgrain of the wood column and the concrete should be used to prevent direct contact between the concrete and the endgrain.

Design loads for pairs of Universal Brackets installed with the provided hardware kit should have the same design capacity as the similarly sized Niagara Column Bracket™ as shown in Table 3.1 which follows. No guidance is available on using a single Universal Bracket for any given wood column.

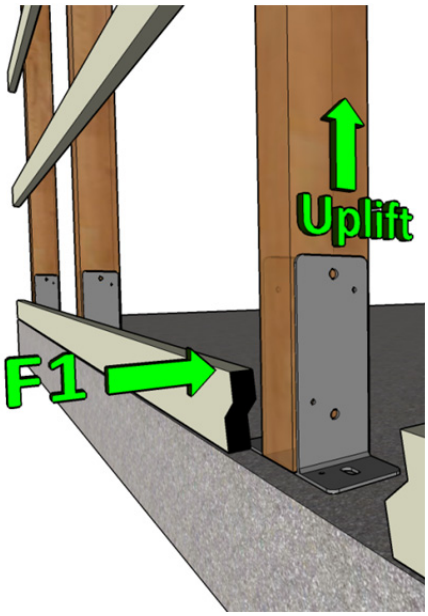
3. DESIGN LOADS

3.1. Allowable Loads with Hardware Kit

The functional bracket capacity of the Niagara Column Bracket™ as installed is the smallest of three values: the Post Frame Column to Bracket connection, the Bracket to Foundation connection, and the capacity of the Niagara Column Bracket™ itself. When used with the fasteners supplied with the Hardware Kit, the allowable lateral and uplift capacity can be used directly from Table 3.1 if the Notes and conditions following the table are met.

	Allowable Loads using Fasteners from Hardware Kit (lbs)[1,2,3,4]					
Column Species:	*Southern Pine S.G. = 0.55*		*Douglas Fir-Larch S.G. = 0.50*		*Spruce-Pine-Fir S.G. = 0.42*	
Bracket Part #	**F1** Horizontal	**Uplift** Vertical	**F1** Horizontal	**Uplift** Vertical	**F1** Horizontal	**Uplift** Vertical
NB46/NB66 NB63/NB63A NB64/NB64A	4,540	6,910	4,250	6,620	3,580	6,110
NB83/NB83A NB84/NB84A	5,560	7,210[5]	5,210	7,210[5]	4,410	7,210[5]

Table 3.1 – Design Load Table



Notes:

1. Allowable Loads assume that ALL of the fasteners provided with the hardware kit as indicated in Table 2.4 are installed in accordance with the manufacturer's recommendations and the National Design Specification for Wood Construction and that the foundation is concrete with compressive strength, f'_c = 3,000 psi.
2. If alternate fasteners that fit within the clearance holes provided (see §2.3) are used for connecting the bracket to either the wood column or the foundation, the building designer (see §1.3) shall be responsible for determining the load capacity for those fasteners and ensuring it exceeds the required loads placed on the bracket under design conditions.
3. Allowable Loads for Fasteners in the Wood column are based on NDS 2005 Table 11G for the Carriage Bolts and Table 11K for the Lag Screws multiplied by the Load Duration Increase factor assuming the controlling load combination includes wind ($Z' = C_D \times Z = 1.6 \times Z$)
4. Anchor bolt spacing and embedment depth requirements shall be met according to the manufacturer's requirements or a reduction to the anchor bolt values that Table 3.1 is based on may need to be reduced in accordance with ITW's information. Find information about LDT Redhead Anchors and installation requirements at http://www.itwredhead.com
5. Certain values ("[5]") are based on the Concrete Anchor tension values and not the NDS values for the column connection using Bolts and Lag Screws. No increase for duration of load was added to the published design capacity for the LDT Anchors by ITW. All values not labeled with ([5]) are controlled by the NDS values for the bracket to column connection.

3.2. Niagara Column Bracket™ Capacity

Destructive product testing was performed on the Niagara Column Bracket™ to determine bracket capacity. The bracket capacity was found to be higher than the bracket connection strength using the supplied hardware kit for both shear (F1) and tension (Uplift). If other hardware is used, the allowable loads for the fasteners actually used will determine bracket capacity as long as they are lower than the allowable bracket loads listed in Table 3.2.

Niagara Column Bracket™	**F1** Horizontal	**Uplift** Vertical
NB46/NB66 NB63/NB63A NB64/NB64A NB83/NB83A NB84/NB84A	15,000	12,000

Table 3.2 – Niagara Column Bracket™ Capacity Without Consideration for Fastener Values