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TO **Mr. Michael Bousfield**
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B9417.000
Cascadia Clip
Structural Design

DATE March 29, 2017

REGARDING **Cascadia Clip® Structural Design Tables**

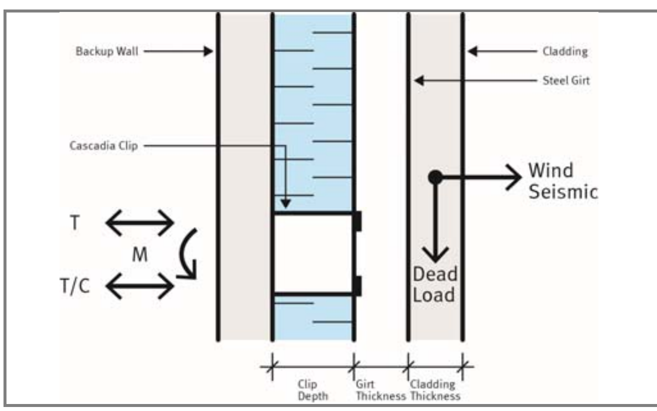
Dear Mr. Bousfield,

RDH Building Science Inc. (RDH) was retained by Cascadia Windows Ltd. (Cascadia), to perform structural calculations for attachment of the Cascadia Clip® fiberglass thermal cladding support spacer in typical service conditions.

The results of this analysis are included in the digital spreadsheet that accompanies this letter. The purpose of this letter is to outline the design methodology and assumptions included in the data that has been provided within the spreadsheet. The spreadsheet and any accompanying online calculators prepared by Cascadia should be used in the context of the parameters outlined in this letter. This work was completed for Cascadia and should not relied upon by others.

BACKGROUND

Design aids and load tables for utilizing the Cascadia Clip have previously been established, and written design guidance has been previously published by Cascadia. A schematic force diagram of a typical wall assembly utilizing the Cascadia Clip is shown below for reference.



General arrangement of typical wall assembly with the Cascadia Clip

As shown above, the cladding is generally attached to steel girts using self-tapping fasteners. The size and distribution of this attachment is dependent on the type of cladding and the applicable wind and seismic loads corresponding to the location and exposure of the building; the cladding to girt connection is typically designed by the cladding manufacturer. Girts are secured directly to the backup wall with fasteners that pass through the Cascadia Clip. The clip includes holes for fasteners to provide a direct connection from girt to backup wall. The clip acts as a shim equal to the thickness of the exterior insulation layer.

The existing published load tables include a number of different scenarios for backup wall construction and clip depth; however, the new spreadsheet expands the number of variables significantly. The existing published load tables are still valid, and this new information is intended to supplement the previous tables, while also increasing design flexibility using the clip.

The table below shows each of the conditions included in the new load tables.

BackUp Wall		Exterior Insulation Depth	Clip Fastener Type	Clip Spacing
Steel Stud	20ga 18ga 16ga	2” 2.5” 3” 3.5” 4” 5” 6” 8”	2x Galv. Steel 2x Stainless Steel 1x Stainless Steel & 1x Anti Rotation Screw	16” 24” 32” Horiz. 26” 36” 48” Vert.
Concrete				
Wood Studs				

STRUCTURAL DESIGN METHODOLOGY

The structural load transfer mechanism for cladding systems using clips is well established in theory and in practice. Vertical (dead load) and horizontal forces (seismic and wind) are transferred from the cladding into the girt, through the clip fasteners, and into the backup wall.

In the case of the Cascadia Clip, the girt is connected to the structure though the clip using two fasteners spaced 2.75” vertically. The clips resist vertical gravity loads load equally (because of their equal stiffness) and receive horizontal loads based on their tributary areas. This load resistance path is applicable to both serviceability (deflection) and ultimate limit states. The design is generally controlled by the pullout resistance of the upper screw through the clip, which is under tension from the overturning moment caused by cladding dead load, and from horizontal wind suction pressures (and seismic loading).

This interaction between the dead load, wind load, and allowable force in the controlling fastener connection is described by the inequality below.

FACTORS AFFECTING TENSION FORCE IN UPPER SCREW				
F_A	>	F_{DL}	+	F_W
→ The allowable force in the fastener is a dependent on the fastener type and the backup wall material		→ The force associated with the cladding dead load is dependent on the eccentricity of the load from the backup wall, and the weight of the cladding material		→ The force associated with the wind load is dependent on the building location, height, exposure, and other project specific variables, as defined by the local building code
		→ Increasing the spacing of the clip increases both the dead load and wind load contributions to the screw force		

For the purposes of preparing design tables, the selected output variable is the allowable cladding wind pressure for a given wall assembly design. The designer is required to input data for backup wall material, cladding weight, clip and insulation thickness, fastener arrangement, and clip spacing. The allowable fastener loads are based on testing data provided to RDH for the fasteners that Cascadia recommends in each application. The outputted allowable wind pressure should be compared to the specified wind pressure acting on the cladding, as determined by the local building code in the area of jurisdiction.

TERMS OF REFERENCE

As noted above, the clip load resistance values provided in the spreadsheet are based on specific load resistance values for the clip fasteners. Changes to the fasteners will change the allowable clip load. In general, the fastener resistance data is based on testing data completed for Cascadia by Leland Industries. Although users of the clip are free to use whichever fasteners suit their particular needs, Leland fasteners are very commonly used, and are distributed with the clips.

Where testing data by Leland has not been completed, the values have been supplemented by published data, as referenced in the table below. A factor of safety of 3.0 has been applied to ultimate resistance values.

STRUCTURAL DESIGN CRITERIA		
Geometric Assumptions		
Depth of girt		1 inch
Thickness of sheathing		1/2 inch
Thickness of cladding		3/4 inch
Dead load eccentricity		1-7/8 inch + Cascadia clip depth
Allowable Fastener Loads (FS = 3.0)		
20 gauge studs	Tension	163 lbs
	Shear	158 lbs
18 gauge studs	Tension	230 lbs
	Shear	234 lbs
16 gauge studs	Tension	295 lbs
	Shear	234 lbs
Wood Studs	Tension	220 lbs
	Shear	147 lbs
Concrete / CMU	Tension	151 lbs
	Shear	408 lbs

Notes:

- Pullout resistance of fasteners in steel studs are based on pullout testing data provided by Leland

- Shear resistance of fasteners in steel studs are based on published data by Dietrich for sheet metal screws into metal studs.

- Pullout and shear resistance values for wood are based on an embedment depth of 1" + ½" into standard dimensional lumber (CWC Wood Design Manual).

- Pullout resistance in concrete / CMU is based on test data provided by Leland with 1" embedment into CMU.

CLOSURE

We trust that this letter meets your needs at this time and provides clarification on how the structural portion of the excel spreadsheet function. Please call or email us if there are any points that need further discussion or clarification.

Yours truly,

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2017-03-29