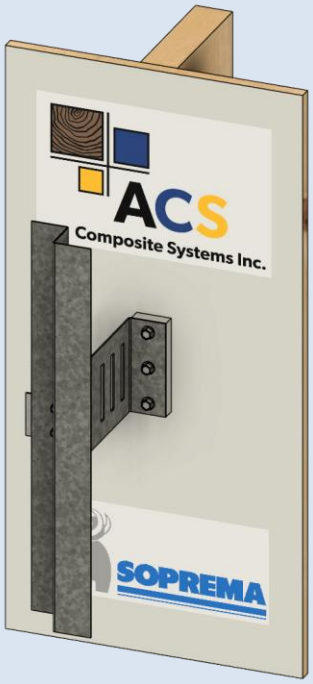
Structural Design Guide
ACS U-Clip – Wood Walls

U-Angle Position 1

U-Angle Position 2

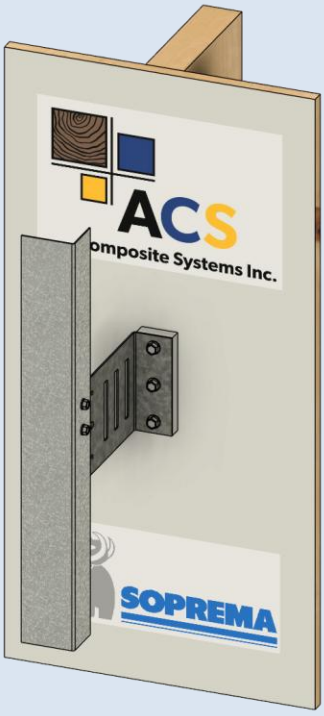
U-Angle Omitted

Horizontal Z-Girt - U-Angle Position 1



Vertical Z-Girt - U-Angle Position 1

Horizontal Angle Girt - U-Angle Position 2



Vertical Angle Girt - U-Angle Omitted

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1 Introduction

This structural design guide is intended to aid with properly specifying the attachment and spacing of the patented ACS Thermal U-Clips for supporting exterior cladding assemblies and is to be used in conjunction with Evoke Buildings Engineering thermal analysis reports or SOPREMA'S BUILD BETTER guide for energy-related objectives in building codes.

The ACS U-Clips are fixed galvanized steel components of an exterior cladding assembly thermal break and may be used in rain-screen cladding systems. The clips are available in several depths and have an ACS Thermal Pad™ thermal break between the clip flange and the supporting structure to enhance thermal performance. The U-Clips are typically attached via suitable screws to wood construction either directly to plywood sheathing (for approved applications), through the exterior sheathing into the wood-stud, or with concrete screws to concrete construction.

The outer edge of the thermal clips typically have continuous girts attached to them, with the girts spanning either vertically or horizontally between thermal clips; with the U-Clip, there are four primary installation methods that this can be achieved:

1) U-Angle in Position 1 to receive horizontal z-girts face-fastened into the U-Angle
2) U-Angle in Position 1 to receive vertical z-girts face-fastened into the U-Angle
3) U-Angle in Position 2 to receive horizontal angle-girts top-fastened into the U-Angle
4) U-Angle omitted, with vertical angle-girt side-fastened directly to the projecting U-Clip

For the above cases, the continuous girt would either receive the specified cladding product, or in situations that call for another plane of girts (e.g. Face-Fastened systems where symmetric fastener layout is required), the inner girts attached to the thermal clips would support another plane of girts perpendicular to the first plane.

2 Structural Concept

Structurally, the clips resist gravity load (cladding assembly self-weight), and transverse loads (wind/seismic). Clip length, spacing, and attachment to the substructure is determined based on the combination of thermal and structural requirements of the assembly.

Gravity load creates both a rotational force and a direct shear in each clip, while wind/seismic forces create a direct tension (or compression) force through each clip. The gravity rotational force is resisted by screw tension in the upper attachment screw and the lower compression region of the clip for the rotational force, and by both screws in direct shear/bearing in the case of direct shear, while wind/seismic forces are resisted by direct screw tension.

While the ACS Thermal Pad™ thermal break between the U-Clip and the structure is a minimally compressive material when correctly installed, the overall system installation guidelines have been limited by permissible strain in the ACS Thermal Pad™/clip rotation. Clip spacing is also limited by attachment screw capacity, steel clip capacity, U-Angle attachment screw capacity (see below for full definitions). These values were calculated and subsequently verified by an independent testing lab with the following tests:

Independent Testing:

- ICC-ES AC359, *Acceptance Criteria for Exterior Wall Coverings of Steel-Backed Veneer Panels Attached to Walls Utilizing Steel Framing and Brackets,* Approved October 2008 – Section 3.8.2 *Gravity Loads*

- ASTM E330/E330M-14, *Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference*

- *6 in. and 10 in. ACS Thermal Clips – Stress-Strain Load Testing to Failure.* Intertek Test Report dated 2024 01 22

The following structural design information is provided as a convenience for the user to determine the general suitability of the clips as part of an overall cladding system. Fastener values are based on one manufacturer's test data and are representative of that manufacturer's fasteners, steel section used, and test apparatus. These values may not be applicable for other screw manufacturers, or to different structural support members.

Due to the number of variables inherent in the design of exterior cladding, structural review of cladding installations is required on any project. These variables include, but are not limited to, building height, building exposure, design wind pressure, cladding weight, cladding flexibility/brittleness, cladding fastening requirements, cladding assembly depth, substructure construction tolerances, and substructure material type. As a result of the large number of variables involved with cladding design, a project structural engineer (independent of ACS) is required to review and provide the necessary design/assurance that the overall system is structurally acceptable.

Additionally, cladding which is inherently prone to cracking such as stucco or some types of stone veneer, may require more onerous structural constraints or safety factors over and above those indicated here to reduce the probability of cracking during the design life of the wall assembly.

3 Recommended Clip Spacing & Fastener Data

Tabulated spacing indicated is based on least of:

- Maximum 1/8" (3.2 mm) deflection due to cladding gravity load (equivalent to 20 lbs of cladding weight on nominal 11" wall assembly depth)
- Screw pullout/tension, shear/bearing, and combined tension/shear interaction for relevant screws
- For U-Clip attachment screws (2 - #12-14 x ¾" TEKS, Vallow = 2 x 184 = 368 lbs)
- Other limiting conditions that must be addressed by the project specific engineer including, but not limited to: Sub-structure girt strength/deflection, cladding span/connections to sub-girt assembly, and all load-path screw connections.

NOTE: Charts Represent Wall Assembly Depth, which is defined as the distance from face of support wall/contact of ACS clip to Center of Gravity (C.O.G.) of Cladding:

Wall Assembly Depth = [Clip Depth] + [Sub-Girt(s) Depth] + [Outer Girt to Cladding C.O.G.
(Cladding C.O.G. is Typically ½ cladding product depth)
Example: 6" ACS Thermal Clip, 2 – 1" z-girts (vertical & horizontal girts), 1 ½" Composite System
Total Wall Assembly Depth = 6" + 2 x 1" + 0.5 x 1 ½" = 8 ¾" – Use 9" Wall Assembly Chart

Wood Stud Substructure – up to 40 psf Specified Wind

– 9” to 3” Load Tables:

Attachment Spacing (H” x V”) of ACS U-Clips based on:

- All assemblies require 3 - ¼” Leland MasterGrippers or equivalent, with at least 1 ½” penetration into studs. Installation should be as per manufacturer’s recommendations for installation
- Note that wood species (DF/SPF) attachments have the same spacing, with most assemblies being deflection limited, not fastener capacity limited.

Note: Minimum 1 ½” Penetration into Main Member - Plywood Attachment Only is not Sufficient

See Plywood Section for Direct Fastening to Sheathing

9” Wall Assembly – Vertical Clip Spacing (in) - 3 attachment screws

Cladding Weight (psf)	DF/SPF	
	16” H	24” H
3	48	32
4	48	32
5	48	32
6	45	30
7	39	26
8	34	23
10	27	18
15	18	12

8” Wall Assembly – Vertical Clip Spacing (in) - 3 attachment screws

Cladding Weight (psf)	DF/SPF	
	16” H	24” H
3	48	32
4	48	32
5	48	32
6	48	32
7	43	29
8	38	25
10	30	20
15	20	14

7” Wall Assembly – Vertical Clip Spacing (in) - 3 attachment screws

Cladding Weight (psf)	DF/SPF	
	16” H	24” H
3	48	32
4	48	32
5	48	32
6	48	32
7	48	32
8	43	29
10	35	23
15	23	15

6” Wall Assembly – Vertical Clip Spacing (in) - 3 attachment screws

Cladding Weight (psf)	DF/SPF	
	16” H	24” H
3	48	32
4	48	32
5	48	32
6	48	32
7	48	32
8	48	32
10	41	27
15	27	18

Wood Stud Substructure – up to 40 psf Specified Wind

5” Wall Assembly – Vertical Clip Spacing (in) - 3 attachment screws

Cladding Weight (psf)	DF/SPF	
	16” H	24” H
3	48	32
4	48	32
5	48	32
6	48	32
7	48	32
8	48	32
10	48	32
15	32	22

4” Wall Assembly – Vertical Clip Spacing (in) - 3 attachment screws

Cladding Weight (psf)	DF/SPF	
	16” H	24” H
3	48	32
4	48	32
5	48	32
6	48	32
7	48	32
8	48	32
10	48	32
15	41	27

3” Wall Assembly – Vertical Clip Spacing (in) - 3 attachment screws

Cladding Weight (psf)	DF/SPF	
	16” H	24” H
3	48	32
4	48	32
5	48	32
6	48	32
7	48	32
8	48	32
10	48	32
15	48	32

Plywood Substructure – up to 40 psf Specified Wind

– 6” to 3” Load Tables:

Attachment Spacing (H” x V”) of ACS U-Clips based on:

- Maximum 1/8” (3.2 mm) deflection due to cladding gravity load
- ¾”, 5/8”, or ½” Plywood, using wood screws or metal screws, as per APA Technical Note E830E – Fastener Loads for Plywood – Screws (Factor of Safety FS = 4)
    - Screw length selected must allow point to protrude past inside of plywood min ¼”, and threads must engage entire plywood thickness
    - Plywood must be exterior grade D-Fir sheathing or equivalent
- For U-Clip attachment screws (2 - #12-14 x ¾” TEKS, Vallow = 2 x 184 = 368 lbs)

6” Wall Assembly – Vertical Clip Spacing (in)
- 3 attachment screws

Cladding Weight (psf)	¾” Plywood		5/8” Plywood		½” Plywood	
	16” H	24” H	16” H	24” H	16” H	24” H
3	48	32	47	31	38	25
4	48	32	43	29	35	23
5	47	32	39	26	32	21
6	44	29	36	24	29	20
7	41	27	34	23	27	18
8	38	26	32	21	26	17
10	34	23	28	19	23	15
15	26	18	22	15	18	12

5” Wall Assembly – Vertical Clip Spacing (in)
- 3 attachment screws

Cladding Weight (psf)	¾” Plywood		5/8” Plywood		½” Plywood	
	16” H	24” H	16” H	24” H	16” H	24” H
3	48	32	48	32	40	27
4	48	32	45	30	37	24
5	48	32	42	28	34	23
6	47	32	39	26	32	21
7	45	30	37	25	30	20
8	42	28	35	23	28	19
10	37	25	31	21	25	17
15	30	20	25	16	20	13

4” Wall Assembly – Vertical Clip Spacing (in)
- 3 attachment screws

Cladding Weight (psf)	¾” Plywood		5/8” Plywood		½” Plywood	
	16” H	24” H	16” H	24” H	16” H	24” H
3	48	32	48	32	42	28
4	48	32	48	32	39	26
5	48	32	45	30	37	24
6	48	32	43	29	35	23
7	48	32	40	27	33	22
8	46	31	38	26	31	21
10	42	28	35	23	28	19
15	34	23	28	19	23	15

3” Wall Assembly – Vertical Clip Spacing (in)
- 3 attachment screws

Cladding Weight (psf)	¾” Plywood		5/8” Plywood		½” Plywood	
	16” H	24” H	16” H	24” H	16” H	24” H
3	48	32	48	32	44	30
4	48	32	48	32	42	28
5	48	32	48	32	40	27
6	48	32	47	31	38	25
7	48	32	45	30	36	24
8	48	32	43	29	35	23
10	47	32	39	26	32	21
15	40	26	33	22	27	18

Concrete Wall Substructure

- Attachment to 4000 psi (28 MPa) concrete – based on Simpson Strong-tie Titen Stainless Steel Screws, ¼" dia. x min. 1 ½" embed - typically require 2 ¼" (or longer) fasteners

- Up to 40 psf Specified Wind – 12" to 3" Load Tables:

12" Wall Assembly – Vertical Clip Spacing (in)
- 3 attachment screws

Cladding Weight (psf)	Concrete	
	16" H	24" H
3	48	32
4	47	31
5	41	27
6	34	23
7	29	19
8	25	17
10	20	14
15	14	9

10" Wall Assembly – Vertical Clip Spacing (in)
- 3 attachment screws

Cladding Weight (psf)	Concrete	
	16" H	24" H
3	48	32
4	48	32
5	46	31
6	41	27
7	35	23
8	30	20
10	24	16
15	16	11

9" Wall Assembly – Vertical Clip Spacing (in)
- 3 attachment screws

Cladding Weight (psf)	Concrete	
	16" H	24" H
3	48	32
4	48	32
5	48	32
6	44	29
7	39	26
8	34	23
10	27	18
15	18	12

8" Wall Assembly – Vertical Clip Spacing (in)
- 2 attachment screws

Cladding Weight (psf)	Concrete	
	16" H	24" H
3	48	32
4	48	32
5	48	32
6	47	31
7	43	29
8	38	25
10	30	20
15	20	14

7" Wall Assembly – Vertical Clip Spacing (in)
- 2 attachment screws

Cladding Weight (psf)	Concrete	
	16" H	24" H
3	48	32
4	48	32
5	48	32
6	48	32
7	46	31
8	43	29
10	35	23
15	23	15

6" Wall Assembly – Vertical Clip Spacing (in)
- 2 attachment screws

Cladding Weight (psf)	Concrete	
	16" H	24" H
3	48	32
4	`	32
5	48	32
6	48	32
7	48	32
8	47	31
10	41	27
15	27	18

Concrete Wall Substructure - Up to 40 psf Specified Wind

5” Wall Assembly – Vertical Clip Spacing (in)
- 2 attachment screws

Cladding Weight (psf)	Concrete	
	16” H	24” H
3	48	32
4	48	32
5	48	32
6	48	32
7	48	32
8	48	32
10	46	31
15	32	22

4” Wall Assembly – Vertical Clip Spacing (in)
- 2 attachment screws

Cladding Weight (psf)	Concrete	
	16” H	24” H
3	48	32
4	48	32
5	48	32
6	48	32
7	48	32
8	48	32
10	48	32
15	41	27

3” Wall Assembly – Vertical Clip Spacing (in)
- 2 attachment screws

Cladding Weight (psf)	Concrete	
	16” H	24” H
3	48	32
4	48	32
5	48	32
6	48	32
7	48	32
8	48	32
10	45	30
15	39	26

4 Fastener Data

Wood Stud Support Screws:

Leland Master Gripper Wood Screws - 1/4" dia. x 2 1/2" lg.	
Wood Species	SPF/HF
Allowable Tension (lbs)	235
Allowable Shear (lbs)	304

Note – Tension calculated based on Leland Test Data with FS = 3 applied & assumes at least 1 ½" penetration into main member. Shear based on O86 without material safety factor applied, but FS = 3 used
Fastener installation to meet the requirements of the Manufacturer & CSA O86 - Engineering Design in Wood

Concrete Wall Support Screws:

Simpson Strong-Tie Titen Stainless Steel Screws 1/4" dia. x nominal 1 ½" embedment		
Concrete Strength (psi)	2500	4000
Concrete Tensile Capacity (lbs)	1040	1760
Allowable Tension (lbs)	260	440
Concrete Shear Capacity (lbs)	810	810
Allowable Shear (lbs)	200	200

Based on 2021 Simpson Strong-Tie Anchoring, Fastening, Restoration and Strengthening Systems for Concrete & Masonry, Uncracked Concrete, Non-Seismic Design, No Supplementary Reinforcement, Greater Than Critical Edge Distance/Spacing

5 Kolot Structural Engineering Ltd.

20 December 2024

ACS Composite Systems Inc.
35 – 7450 Butler Road
Sooke, BC V9Z 1N1

Dear ACS Composite Systems-

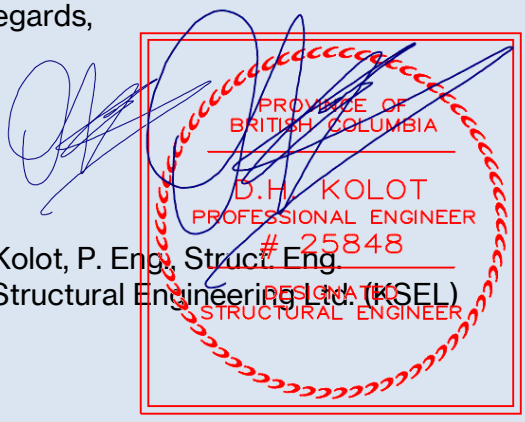
KSEL is pleased to provide the attached ACS Structural Design Guide. This document relates to the ACS Galvanized Steel Thermal Clips (U-Clips) installed on wood stud walls, exterior plywood sheathing, as well as to concrete walls.

The thermal clip design has been based on a combination of analytical design, structural verification from an accredited third-party testing agency, as well as manufacturer data for fasteners for the above-mentioned structural backup assemblies.

It should be noted that due to the complexity of cladding/sub-girt types, local/national building codes, wind/seismic loads due to building location, shape, and size, the design of the complete wall assembly is outside the scope of this structural manual. Each project generally requires a cladding specialty engineer (structural engineer) independent of ACS and KSEL, competent in the design of cladding/wall assemblies, and registered in the region that the cladding assembly is to be installed.

ACS Thermal Clips must be installed in accordance with this Structural Design Guide and any amendments hereto. Failure to do so could lead to failure of the clips and/or damage to or loss of support of the cladding and, furthermore, would render void any warranty and liability of ACS or KSEL, including any liability for resulting loss, damage, or costs. Thus, it is very important for the installation to be carried out in accordance with the specifications and instructions herein and with reliance upon an independent project structural engineer as noted in the said Guide.

Best regards,



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