Structural Calculations –Phenolic Composite, MDF Laminate, LVL Bamboo, MDF Panel Systems-RECESSED REVEAL SYSTEM, with Connection Elements & Fasteners Analysis
WALL PANEL SYSTEMS, Inc. 421 Business Center Ct, Redlands, CA 92373
JN 3311 B

DECORATIVE INTERIOR WALL PANEL FACING SYSTEM from WALL PANEL SYSTEMS, INC. (WPS)

The wall panel system analyzed herein is comprised of colored and textured panels of homogenous phenolic composites. Panels are fabricated to various modular dimensions to fit interior wall height and length constraints.

Extruded Aluminum alloy clips and rails manufactured by Wall Panel Systems Inc. (WPS) are mounted on non-structural interior wall partitions and to panel assemblies with steel screw fasteners. Fasteners include commercially available steel self-tapping screws, wood screws, machine screws, sheet metal screws, and concrete screws, as appropriate.

The panel wall elements, anchorage, and assemblies are evaluated for vertical and lateral load resistance under the California Building Code (CBC) and International Building Code (IBC) as non-structural architectural finish components. The following is an analysis of the design seismic and gravity forces affecting typical wall panel assembly connections between the respective panel materials and the supporting partition walls.

Panel System:

The decorative wall panel assembly is mounted on interior wall partitions of cold formed steel framing and gypsum wall sheathing. In some cases, panel assemblies may be mounted on solid grouted, reinforced concrete masonry unit (CMU) partition walls. Partition walls supporting the panel assemblies are collectively known as backing. Panels are grouped in modular patterns and assembled with the edges fastened to extruded aluminum edge rails, mid-panel rails, corner rails and with the panel interiors fastened to extruded aluminum clips. The panels and aluminum alloy components are collectively fastened as an assembly to the partition wall backing at prescriptive interval dimensions.

Connections between the decorative panels, aluminum connectors, and partition backing are made using various screw fasteners. Fasteners consist of galvanized steel self-drilling tapping screws, zinc-coated steel machine screws, wood screws, or sheet metal screws, as appropriate. Attachment of panel assemblies to CMU backing is accomplished by use of concrete screws set in drilled holes.

Panel Connection Spacing:

Typical wall connection spacing is given to occur at 24 inch o.c. maximum horizontally. This is the typical maximum horizontal spacing for partition wall studs in commercial applications. Vertical connections are analyzed for a 34 inch o.c. maximum spacing. (This is h/3 for an 8 foot wall height & h/4 for a 12 foot wall height). Panel edge connections to wall panel assemblies occur at the tops, bottoms and all vertical panel edges of partition walls. Panel material properties are referenced elsewhere in this document. Modular panel sizes vary according to the interior dimensions of the surface being faced. For the purposes of connection analysis we will base our calculations on panel dimensions that will result in a typical maximum area tributary to an individual panel to backing connection based upon dimensions of the supporting backing partitions.

5.67 sq. ft. = Typical maximum tributary area per connection = (24 in)(34 in)/ (12 in/ft)^2.

Louis Waldo Flores, P.E. *Civil Engineer* RCE 31666 (909) 213-3957
lwf3858@gmail.com 2164 Larimore Lane, Mentone, CA 92359

Panel System Unit Dead Loads (DL) per square foot (psf) are listed below. Each system is comprised of decorative panels, alloy components, and fasteners that collectively comprise each panel assembly.

4.0 psf DL = Phenolic Composite, 1/2 in thick, Nominal DL for wall panel assembly.
3.0 psf DL = Phenolic Composite, 3/8 in thick, Nominal DL for wall panel assembly.

2.6 psf DL = Acrylic Composite, 3/8 in thick, Nominal DL for wall panel assembly.

3.3 psf DL = MDF 3/4 in thick, Nominal DL for wall panel system assembly.

4.8 psf DL = MDF 1-1/8 in thick, Nominal DL for wall panel system assembly.

3.9 psf DL = MDF ½ in thick with laminated 20 ga steel sheet facing, Nominal DL for assembly.
(2.3 psf for MDF Assembly + 1.6 psf for 20 gauge steel sheet.)

3.0 psf DL = Bamboo LVL 3/4 in thick, Nominal DL for wall panel system assembly.

4.3 psf DL = Bamboo LVL 1-1/8 in thick, Nominal DL for wall panel system assembly

Tributary Dead Loads per connection for various Panel Assemblies:

22.7 lbs = 1/2 in. Phenolic Composite Panel Assembly Tributary DL = (5.67 sq.ft)(4.0 psf)
17.0 lbs = 3/8 in. Phenolic Composite Panel Assembly Tributary DL = (5.67 sq.ft)(3.0 psf)

14.7 lbs = 3/8 in. Acrylic Composite Panel Assembly Tributary DL = (5.67 sq.ft)(2.6 psf)

18.7 lbs = 3/4 in. MDF Panel Assembly Tributary DL = (5.67 sq.ft)(3.3 psf)

27.2 lbs = 1-1/8 in. MDF Panel Assembly Tributary DL = (5.67 sq.ft)(4.8 psf)

20.5 lbs = 1/2 in. MDF with steel sheet facing panel = (5.67 sq.ft)(3.62 lb/ sq.ft)

17.0 lbs = 3/4 in. Bamboo LVL Panel Assembly Tributary DL = (5.67 sq.ft)(3.0 psf)

24.4 lbs = 1-1/8 in. Bamboo LVL Panel Assembly Tributary DL = (5.67 sq.ft)(4.3 psf)

Therefore for system consistency we will analyze various connections based upon the maximum values each connection will likely support utilizing similarly sized fasteners for the various panel materials:

Use 22.7 lbs per connection tributary panel DL for design of machine screw connections.
USE 27.2 lbs per connection tributary panel DL for design of wood screw connections.
Use 27.2 lbs per connection tributary panel DL for design of Panel assembly to backing connections.

Inverted Sloping Panel applications: Panel connections have been analyzed for inverted sloping wall applications, including ceiling applications.

Each panel assembly consists of: Modular Panels, Extruded aluminum alloy clips fastened approximately 16 inches o.c. to each panel at its vertical edges, top panel edges, bottom panel edges. Aluminum clips are also fastened horizontally at mid-panel spaced at 34 inches o.c. maximum. Phenolic edge reveals, phenolic mid-wall joint reveals, and corner reveals are connected to partition wall backing

at 16 in to 24 in intervals with galvanized steel self-drilling countersunk tapping screws conforming to AISI Standard for cold formed steel framing. Panel Reveals of other materials may be connected to partition wall backing in a similar fashion with self-drilling screws. An alternative backing may include reinforced concrete masonry unit walls (CMU). In this case, aluminum alloy rails are fastened to the CMU backing with hardened steel concrete screws set in drilled holes. Aluminum alloy panel clips are connected to decorative phenolic wall panels with zinc-coated steel machine screws.

Continuous panel reveal edges, clips, and trim pieces are connected to each other with fitted joints and fitted tongue and groove slots. Aluminum alloy clips are connected to wall panels with two panel fasteners (machine screws) per clip.

ALUMINUM ALLOY CLIPS AND TRIM FOR RECESSED REVEAL PHENOLIC SYSTEMS ARE AS FOLLOWS:

RECESSED REVEAL SYSTEM
Panel Clip (Gen-005),
Aluminum Spline Joint

IBC 2009/CBC 2010 - Allowable Stress Design (ASD), out of plane seismic force for vertical wall panel assembly attached to steel framing, per ASCE 7-05, Sec 13.3.1:
Lateral loads for out of plane seismic forces are evaluated as normal to the wall panel face, and for the vertical seismic force component in addition to gravity. Lateral analysis will be done under allowable stress design for non-structural components per IBC 2009/CBC 2010.

a_p = 1.0 per Table 13.5-1 S_{DS} = 1.373 most severe locale W_p = 22.7 lb Tributary DL (1/2 in. Phenolic)

I_p = 1.0 per Sec.13.1.3, ASCE R_p = 2.5 per 13.5-1 ASCE Z_{max} = 12 ft h_{max} = 12 ft

For 1/2 IN PHENOLIC PANELS:

Eq. 13.3-1 $$F_p = 15.0 \text{ lbs} = \frac{(0.4)(a_p)(S_{DS})(W_p)}{(R_p / I_p)}[1 + (2)(Z/h)] = \frac{(12.5)}{(2.5)}[3]$$

Eq. 13.3-2 $$\max. F_p = 49.9 \text{ lbs} = (1.6)(S_{DS})(W_p)(I_p)$$

Eq. 13.3-2 $$\min. F_p = 9.4 \text{ lbs} = (0.3)(S_{DS})(W_p)(I_p)$$

Therefore, F_p = 49.9 lbs = PHENOLIC Maximum Horizontal Out of Plane Seismic force / connection, perpendicular to panel face, from any direction, in the most severe locale.

Vertical Concurrent force = (DL) +/- [(0.2)(S_{DS})(W_p)] = (22.7 lb) +/- [6.2 lb per connection]
1/2 IN PHENOLIC - Vertical Concurrent (gravity + seismic) forces = 28.9 lb max, or 16.5 lb min.

For 3/8 IN PHENOLIC PANELS:

a_p = 1.0 per Table 13.5-1 S_{DS} = 1.373 most severe locale W_p = 17.0 lb Tributary DL (3/8 in. Phenolic)

I_p = 1.0 per Sec.13.1.3, ASCE R_p = 2.5 per 13.5-1 ASCE Z_{max} = 12 ft h_{max} = 12 ft

Eq. 13.3-1 $$F_p = 11.2 \text{ lbs} = \frac{(0.4)(a_p)(S_{DS})(W_p)}{(R_p / I_p)} [1 +(2)(Z/h)] = \frac{(12.5)}{(2.5)} [3]$$

Eq. 13.3-2 $$\text{max. } F_p = 37.3 \text{ lbs} = (1.6)(S_{DS})(W_p)(I_p)$$

Eq. 13.3-2 $$\text{min. } F_p = 7.0 \text{ lbs} = (0.3)(S_{DS})(W_p)(I_p)$$

Therefore, F_p = 37.3 lbs = PHENOLIC 3/8 IN Max. Horiz. Out of Plane Seismic Force / connection, perpendicular to panel face, from any direction.

Vertical Concurrent force = (DL) +/- [(0.2)(S_{DS})(W_p)] = (17.0 lb) +/- [4.7 lb per connection]
3/8 IN PHENOLIC - Vertical Concurrent (gravity + seismic) forces = 21.7 lb max, or 12.3 lb min.

For 1-1/8" THICK MDF (Medium Density Fiberboard) PANELS:

a_p = 1.0 per Table 13.5-1 S_{DS} = 1.373 most severe locale W_W = 27.2 Tributary DL (1-1/8 in. MDF)

I_p = 1.0 per Sec.13.1.3, ASCE R_p = 2.5 per 13.5-1 ASCE Z_{max} = 12 ft h_{max} = 12 ft

Eq. 13.3-1 $$F_W = 18.0 \text{ lbs} = \frac{(0.4)(a_p)(S_{DS})(W_W)}{(R_p / I_p)} [1 +(2)(Z/h)] = \frac{(14.9)}{(2.5)} [3]$$

Eq. 13.3-2 $$\text{max. } F_W = 59.8 \text{ lbs} = (1.6)(S_{DS})(W_W)(I_p)$$

Eq. 13.3-2 $$\text{min. } F_W = 11.2 \text{ lbs} = (0.3)(S_{DS})(W_W)(I_p)$$

Therefore, F_W = 59.8 lbs = MDF Maximum Horizontal Out of Plane Seismic force / connection, perpendicular to panel face, from any direction.
Vertical Concurrent force = (DL) +/- [(0.2)(S_{DS})(W_W)] = (27.2 lb) +/- [7.4 lb per connection]
1-1/8" MDF - Vertical Concurrent (gravity + seismic) forces = 34.6 lb maximum, or 19.8 lb minimum.

For 1-1/8" THICK BAMBOO LVL (Laminated Veneer Lumber) PANELS:

a_p = 1.0 per Table 13.5-1 S_{DS} = 1.373 most severe locale W_W = 24.4 Tributary DL (1-1/8 in. MDF)

I_p = 1.0 per Sec.13.1.3, ASCE R_p = 2.5 per 13.5-1 ASCE Z_{max} = 12 ft h_{max} = 12 ft

Eq. 13.3-1 $$F_W = 16.1 \text{ lbs} = \frac{(0.4)(a_p)(S_{DS})(W_W)}{(R_p / I_p)}[1 + (2)(Z/h)] = \frac{(13.4)}{(2.5)}[3]$$

Eq. 13.3-2 $$\text{max. } F_W = 53.6 \text{ lbs} = (1.6)(S_{DS})(W_W)(I_p)$$

Eq. 13.3-2 $$\text{min. } F_W = 10.0 \text{ lbs} = (0.3)(S_{DS})(W_W)(I_p)$$

Therefore, F_W = 53.6 lbs = LVL Maximum Horizontal Out of Plane Seismic force / connection, perpendicular to panel face, from any direction.

Vertical Concurrent force = (DL) +/- [(0.2)(S_{DS})(W_W)] = (24.4 lb) +/- [6.7 lb per connection]

1-1/8" BAMBOO LVL - Vertical Concurrent (gravity + seismic) forces = 31.1 lb maximum, or 17.7 lb minimum.

For 3/8 IN ACRYLIC PANELS:

a_p = 1.0 per Table 13.5-1 S_{DS} = 1.373 most severe locale W_p = 14.7 lb Tributary DL (3/8 in. Acrylic)

I_p = 1.0 per Sec.13.1.3, ASCE R_p = 2.5 per 13.5-1 ASCE Z_{max} = 12 ft h_{max} = 12 ft

Eq. 13.3-1 $$F_p = 9.7 \text{ lbs} = \frac{(0.4)(a_p)(S_{DS})(W_p)}{(R_p / I_p)}[1 + (2)(Z/h)] = \frac{(8.07)}{(2.5)}[3]$$

Eq. 13.3-2 $$\text{max. } F_p = 32.3 \text{ lbs} = (1.6)(S_{DS})(W_p)(I_p)$$

Eq. 13.3-2 $$\text{min. } F_p = 6.1 \text{ lbs} = (0.3)(S_{DS})(W_p)(I_p)$$

Therefore, F_p = 32.3 lbs = ACRYLIC 3/8 IN Max. Horiz. Out of Plane Seismic Force / connection, perpendicular to panel face, from any direction.

Vertical Concurrent force = (DL) +/- [(0.2)(S_{DS})(W_p)] = (14.7 lb) +/- [4.0 lb per connection]

ACRYLIC - Vertical Concurrent (gravity + seismic) forces = 18.7 lb max, or 10.7 lb min.

Sloping PHENOLIC 1/2" Thick Wall Panel Assemblies – APPLIED LOAD ANALYSIS
Applied Loads per fastener, Dead Loads and Seismic (values in pounds).

		#8 Self Tapping Screw		# 8 Wood Screw		#8 Machine screw	
Wall Angle	**Load Type**	**Shear**	**Tension**	**Shear**	**Tension**	**Shear**	**Tension**
Degrees from level							
90 (Vert. Wall)	Normal	**22.7**	0	**11.4**	0	**11.4**	0
	Seismic	28.9	49.9	14.5	25.0	14.5	25.0
70	Normal	21.3	7.8	10.7	3.9	10.7	3.9
	Seismic	44.2	56.3	22.1	28.2	22.1	28.2
60	Normal	19.7	11.4	9.9	5.7	9.9	5.7
	Seismic	50.1	**57.7**	25.1	**28.9**	25.1	**28.9**
45	Normal	16.1	16.1	8.0	8.0	8.0	8.0
	Seismic	55.8	55.8	27.9	27.9	27.9	27.9
30	Normal	11.4	19.7	5.7	9.9	5.7	9.9
	Seismic	**57.7**	50.1	**28.9**	25.1	**28.9**	25.1
0 (flat - Horiz.)	Normal	0	**22.7**	0	**11.4**	0	**11.4**
	Seismic	49.9	28.9	25.0	14.5	25.0	14.5

Load Summary: IBC 2009/CBC 2010
Sloping PHENOLIC 1/2" Thick Wall Panel Assemblies
Dead Loads and Seismic for all sloping configurations. (values in pounds).

MAXIMUM APPLIED LOADS PER FASTENER

		#8 Self Tapping Screw		# 8 Wood Screw		#8 Machine screw	
	Load Type	**Shear**	**Tension**	**Shear**	**Tension**	**Shear**	**Tension**
Use for Design of Connections	**Normal**	**22.7**	**22.7**	**11.4**	**11.4**	**11.4**	**11.4**
	Seismic	**57.7**	**57.7**	**28.9**	**28.9**	**28.9**	**28.9**

Sloping PHENOLIC 3/8" Thick Wall Panel Assemblies – APPLIED LOAD ANALYSIS
Applied Loads per fastener, Dead Loads and Seismic (values in pounds).

		#8 Self Tapping Screw		# 8 Wood Screw		#8 Machine screw	
Wall Angle	**Load Type**	**Shear**	**Tension**	**Shear**	**Tension**	**Shear**	**Tension**
Degrees from level							
90 (Vert. Wall)	Normal	17.0	0	8.5	0	8.5	0
	Seismic	21.6	37.4	10.8	18.7	10.8	18.7
70	Normal	16.0	5.8	8.0	2.9	8.0	2.9
	Seismic	30.6	42.5	15.3	21.3	15.3	21.3
60	Normal	**19.7**	11.4	**9.9**	5.7	**9.9**	5.7
	Seismic	37.9	**43.4**	19.0	**21.7**	19.0	**21.7**
45	Normal	12.0	12.0	6.0	6.0	6.0	6.0
	Seismic	41.7	41.7	20.9	20.9	20.9	20.9
30	Normal	11.4	**19.7**	5.7	**9.9**	5.7	**9.9**
	Seismic	**43.4**	37.9	**21.7**	19.0	**21.7**	19.0
0 (flat - Horiz.)	Normal	0	17.0	0	8.5	0	8.5
	Seismic	37.4	21.6	18.7	10.8	18.7	10.8

Load Summary: IBC 2009/CBC 2010
Sloping PHENOLIC 3/8" Thick Wall Panel Assemblies
Dead Loads and Seismic for all sloping configurations. (values in pounds).

MAXIMUM APPLIED LOADS PER FASTENER

		#8 Self Tapping Screw		# 8 Wood Screw		#8 Machine screw	
	Load Type	**Shear**	**Tension**	**Shear**	**Tension**	**Shear**	**Tension**
Use for Design of Connections	**Normal**	**19.7**	**19.7**	**9.9**	**9.9**	**9.9**	**9.9**
	Seismic	**43.4**	**43.4**	**21.7**	**21.7**	**21.7**	**21.7**

Sloping MEDIUM DENSITY FIBERBOARD (MDF) 1-1/8" Thick Wall Panel Assemblies
APPLIED LOAD ANALYSIS
Applied Loads per fastener, Dead Loads and Seismic (values in pounds).

		#8 Self Tapping Screw		# 8 Wood Screw		#8 Machine screw	
Wall Angle	**Load Type**	**Shear**	**Tension**	**Shear**	**Tension**	**Shear**	**Tension**
Degrees from level							
90 (Vert. Wall)	Normal	**27.2**	0	**13.6**	0	**13.6**	0
	Seismic	34.6	57.8	17.3	28.9	17.3	28.9
70	Normal	25.5	9.3	12.8	4.7	12.8	4.7
	Seismic	53.0	67.5	26.5	33.8	26.5	33.8
60	Normal	23.6	13.7	11.9	6.8	11.8	6.8
	Seismic	60.0	**69.1**	30.1	**34.6**	30.1	**34.6**
45	Normal	19.3	19.3	9.7	9.7	9.7	9.7
	Seismic	66.9	66.9	33.5	33.5	33.5	33.5
30	Normal	13.7	23.6	6.8	11.9	6.8	11.9
	Seismic	**69.1**	60.0	**34.6**	30.1	**34.6**	30.1
0 (flat - Horiz.)	Normal	0	**27.2**	0	**13.6**	0	**13.6**
	Seismic	57.8	34.6	28.9	17.3	28.9	17.3

Load Summary: IBC 2009/CBC 2010

Sloping MEDIUM DENSITY FIBERBOARD (MDF) 1-1/8" Thick Wall Panel Assemblies
Dead Loads and Seismic for all sloping configurations. (values in pounds).
MAXIMUM APPLIED LOADS PER FASTENER

		#8 Self Tapping Screw		# 8 Wood Screw		#8 Machine screw	
	Load Type	**Shear**	**Tension**	**Shear**	**Tension**	**Shear**	**Tension**
Use for Design of Connections	**Normal**	**27.2**	**27.2**	**13.6**	**13.6**	**13.6**	**13.6**
	Seismic	**69.1**	**69.1**	**34.6**	**34.6**	**34.6**	**34.6**

Louis Waldo Flores, P.E. *Civil Engineer* RCE 31666 (909) 213-3957
lwf3858@gmail.com 2164 Larimore Lane, Mentone, CA 92359

Load Summary: IBC 2009/CBC 2010

Sloping BAMBOO LAMINATED VENEER LUMBER (LVL) 1-1/8" Thick Wall Panel Assemblies
Dead Loads and Seismic for all sloping configurations. (values in pounds).
MAXIMUM APPLIED LOADS PER FASTENER

		#8 Self Tapping Screw		# 8 Wood Screw		#8 Machine screw	
	Load Type	Shear	Tension	Shear	Tension	Shear	Tension
Use for Design of Connections	Normal	23.8	23.8	11.9	11.9	11.9	11.9
	Seismic	60.5	60.5	30.3	30.3	30.3	30.3

Sloping ACRYLIC COMPOSITE 3/8" THICK Wall Panel Assemblies
Dead Loads and Seismic for all sloping configurations. (values in pounds).
MAXIMUM APPLIED LOADS PER FASTENER

		#8 Self Tapping Screw		# 8 Wood Screw		#8 Machine screw	
	Load Type	Shear	Tension	Shear	Tension	Shear	Tension
Use for Design of Connections	Normal	17.6	17.6	8.8	8.8	8.8	8.8
	Seismic	44.7	44.7	23.5	23.5	23.5	23.5

INTERACTION ANALYSIS – 1/2 IN PHENOLIC PANELS – COMBINED SHEAR / TENSION

Seismic force acts perpendicular (out-of-plane) in tension on fastener – panel connection.
Gravity + vertical component of seismic force acts in shear.
Combined forces interaction for the limiting connection: Phenolic Panel to Panel Fastener.

V_a = 258 lbs = Allowable Seismic Shear / panel backing screw connection = (193)(1.33).
P_a = 113 lbs = Allowable Tension Wall Panel to Panel Fastener connection = (85)(1.33).
P_s = 57.7 lbs = Maximum Applied Seismic out of plane tension per connection.
V_{G+S} = 28.9 lbs = Applied gravity + vertical seismic component per connection.

$$\frac{V_{G+S}}{V_a} + \frac{P_s}{P_a} = \frac{28.9}{258} + \frac{57.7}{113} = 0.11 + 0.51 = 0.62 < 1.0, \text{ OK}$$

Interaction Analysis indicates weakest connection link is adequate for most severe load condition (2009 IBC / 2010 CBC).

ANALYSIS OF SEISMIC LOAD APPLIED causing PRYING ACTION ON PHENOLIC EDGE REVEALS AND BACKING FASTENERS – Vertical Wall condition.

Refer to typical connection drawing details “A” & “E” of Typical Connection Diagrams for Extruded Clips & Continuous Phenolic Reveals.

Horizontal force To wall fastener screw at steel stud, Horizontal Joint Reveal, Max of 29.0 lbs / connection.

$$\frac{(49.9 \text{ lb}/2)(1.68 \text{ in})}{(1.3 \text{ in})} + \frac{(49.9 \text{ lb}/2)(1.9 \text{ in})}{(1.3 \text{ in})} = 68.7 \text{ lb} < 113 \text{ lb allowable tension in fasteners at backing}$$

Apply horiz. force to Wall fastener at steel stud along Midwall Reveal

$$\frac{(49.9 \text{ lb})(1.0 \text{ in})}{(0.60 \text{ in})} = \mathbf{83.2} \text{ lb tension in fastener at backing (max)} < 113 \text{ lb allowable tension}$$

Vertical component of seismic force plus gravity per screw connection at Horizontal Joint Reveal to backing fastener

$$\frac{(28.9 \text{ lb})(0.75 \text{ in})}{(1.55 \text{ in})} = 14.0 \text{ lb} < 113 \text{ lb}$$

Allowable seismic in backing fastener

Vertical component of seismic force plus gravity per screw connection at Horizontal joint Receiver at backing fastener

$$\frac{(28.9 \text{ lb})(0.75 \text{ in})}{(0.60 \text{ in})} = 36.1 \text{ lb} < 113 \text{ lb}$$

Allowable seismic in backing fastener

ANALYSIS OF SEISMIC LOAD APPLIED causing PRYING ACTION ON PHENOLIC EDGE REVEALS AND BACKING FASTENERS – Horizontal (Ceiling or soffit) Installation.

Refer to typical connection drawing details "A" & "E", rotated 90 degrees, of Typical Connection Diagrams for Extruded Aluminum Clips and Phenolic Reveals.

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Vertical (Out of plane force) For Horizontal Joint Reveal per screw connection.

$$\frac{(49.9\ \text{lb})(0.75\ \text{in})}{(0.38 + 1.3)/2\ \text{in at backing}} = 44.6\ \text{lb tension in wall fastener} < 113\ \text{lb allowable seismic tension}$$

Apply vertical force to Wall fastener screw at backing. Midwall Reveal

$$\frac{(49.9\ \text{lb})(0.75\ \text{in})}{(0.60\ \text{in})} = 62.4\ \text{lb tension in wall fastener at backing} < 113\ \text{lb allowable seismic tension}$$

Vert. component seismic force + gravity / 2 screws in at midwall reveal

$$\frac{(28.9/2)(1.68\ \text{in})}{(1.3\ \text{in})} + \frac{(28.9/2)(1.9\ \text{in})}{(1.3\ \text{in})} = 39.9\ \text{lb tension} < 113\ \text{lb seismic in backing fastener}$$

Allowable

Vertical component of seismic force plus gravity per screw connection at horiz. reveal.

$$\frac{(28.9\ \text{lb})(0.44\ \text{in})}{(0.60\ \text{in})} = 21.2\ \text{lb tension in backing fastener} < 113\ \text{lb seismic tension}$$

Allowable

WOOD SYSTEMS – 1-1/8 IN BAMBOO LVL & MDF
INTERACTION ANALYSIS - COMBINED SHEAR / TENSION (MDF More severe condition)
Seismic force acts perpendicular (out-of-plane) in tension on fastener – panel connection.
Gravity + vertical component of seismic force acts in shear.
Combined forces interaction for the limiting connection: Wood Panel Clip to Panel Fastener.
V_a = 258 lbs = Allowable Seismic Shear / panel backing screw connection = (193)(1.33).
P_a = 113 lbs = Allowable Tension Wall Panel to Panel Fastener connection = (85)(1.33).
P_s = 69.1 lbs = Maximum Applied Seismic out of plane tension per connection.
V_{G+S} = 34.6 lbs = Applied gravity + vertical seismic component per connection.

$$\frac{V_{G+S}}{V_a} + \frac{P_s}{P_a} = \frac{34.6}{258} + \frac{69.1}{113} = 0.13 + 0.61 = 0.74 < 1.0, \text{ OK}$$

Interaction Analysis indicates weakest connection link is adequate for most severe load condition (2009 IBC / 2010 CBC).

ANALYSIS OF SEISMIC LOAD APPLIED causing PRYING ACTION ON HORIZONTAL JOINT RECEIVER RAIL FASTENERS and EDGE RAIL FASTENERS – Vertical Wall condition.
Refer to typical connection drawing details "A" & "E" of Typical Connection Diagrams for Extruded Aluminum Rails and Clips.

Horizontal (Out of plane) force To wall fastener (self drilling tapping screw) at steel stud, at Horizontal Joint Rails, maximum of 69.1 lbs per screw connection.

$$\frac{(69.1 \text{ lb}/2)(0.57 \text{ in})}{(0.9 + 0.75/2 \text{ in})} = 40.1 \text{ lb tension} < 113 \text{ lb allowable}$$

in wall fasteners seismic tension at backing

Apply horiz. force to Wall fasteners at steel studs along Base Edge Rails

$$\frac{(69.1/2 \text{ lb})(1.4 \text{ in})}{(0.95 \text{ in})} = 50.9 \text{ lb}$$ Custom J Edge

or

$$\frac{(69.1/2)(0.9)}{(0.57)} = \textbf{54.6 lb}$$ tension in fastener at backing (max) <226 lb allowable tension
Edge Trim

Vertical component of seismic force plus gravity per 2 screw connection at Base Edge Rail horiz to backing fastener

$$\frac{(37.6 \text{ lb})(0.90 \text{ in})}{(0.57 \text{ in})} = 59.4 \text{ lb} < 113 \text{ lb}$$

Allowable seismic in backing fastener

Vertical component of seismic force plus gravity per 2 screw connection at Horizontal joint Receiver at backing fastener

$$\frac{(69.1 \text{ lb})(0.57 \text{ in})}{(0.9+0.75/2 \text{ in})} = 47.7 \text{ lb} < 113 \text{ lb}$$

Allowable seismic in backing fastener

CONNECTION SUMMARY		**Calculated Load Capacity Between Elements**		
Typical Panel Assembly		**PULLOUT**	**SHEAR**	**CLIP SHEAR**
ELEMENT		**(lbs)**	**(lbs)**	**(lbs)**
Variable thickness 1/2 "Phenolic Composite or ½ " Acrylic				
	Normal	225	**125**	
	Seismic	299	**167**	
Panel fastener – (2) #8 x 1/2 in machine screws				
	Normal	425	232	
	Seismic	565	308	
Panel Clip (Gen 005)				
Variable thickness 3/8" Phenolic Composite or 3/8" Acrylic				
	Normal	225	**84**	
	Seismic	299	**112**	
Panel fastener – (2) #8 x 3/8 in machine screws				
	Normal	425	232	
	Seismic	565	308	
Panel Clip (Gen 005)				

CONNECTION SUMMARY	**Calculated Load Capacity Between Elements**		
Typical Panel Assembly	**TENSION (pullout)**	**SHEAR**	**CLIP SHEAR**
ELEMENT	**(lbs)**	**(lbs)**	**(lbs)**
3/4 in thick Bamboo LVL Panel			
Normal	**115**	**71**	
Seismic	**153**	**94**	
Panel fasteners – (2) #8 x 1/2 in wood screws			
Normal	425	232	
Seismic	565	308	
Panel Clip (Gen 005)			
1-1/8 in thick Bamboo LVL Panel			
Normal	**230**	**141**	
Seismic	**305**	**187**	
Panel fastener – (2) #8 x 3/4 in wood screws			
Normal	425	232	
Seismic	565	308	
Panel Clip (Gen 005)			
3/4 in thick MDF Panel			
Normal	**133**	**107**	
Seismic	**176**	**142**	
Panel fasteners – (2) #8 x 1/2 in wood screws			
Normal	425	232	
Seismic	565	308	
Panel Clip (Gen 005)			
1-1/8 in thick MDF Panel			
Normal	**264**	**213**	
Seismic	**352**	**283**	
Panel fastener – (2) #8 x 3/4 in wood screws			
Normal	425	232	
Seismic	565	308	
Panel Clip (Gen 005)			

CONNECTION SUMMARY	**Calculated Load Capacity Between Elements**		
	PULLOUT	**SHEAR**	**CLIP SHEAR**
ELEMENT	**(lbs)**	**(lbs)**	**(lbs)**
Panel Clip (Gen 005)			210 Normal 279 Seismic
Midwall Clip Phenolic, Acrylic, or Wood Reveal			135 Normal 180 Seismic
Midwall Clip Phenolic, Acrylic, or Wood Reveal			
Normal	85	194	
Seismic	113	258	

Backing – 20 ga (39 mil) Cold Formed Steel Stud Wall; Fasteners- #8 x 1-1/2 inch self-drilling screw

Panel Clip (Gen 005)			210 Normal 279 Seismic
Midwall Clip Phenolic, Acrylic, or Wood Reveal			135 Normal 180 Seismic
Midwall Clip Phenolic, Acrylic, or Wood Reveal			
Normal	150	250	
Seismic	200	332	

Backing – Reinforced Concrete Masonry (CMU) // Fasteners – 1/4 x 1-1/2 in TITEN TTN CMU Screw

MATERIAL PROPERTIES: Material property allowable stresses that follow are for normal duration of load. For Seismic Loads; these values are increased by 1/3 (1.33), except for Modulus of Elasticity "E".

ALUMINUM ALLOY FOR EXTRUDED PANEL CLIPS

Values are for extruded Aluminum alloy 6063-T5, no welds or welded joints, as per the Aluminum Association, Inc, datasheet available on www.matweb.com

SG = 2.7	Specific Gravity	DD = 168.5 pcf	Dry Density

Design Working Stress (normal loading conditions)

F_v = 17 ksi	Horizontal Shear stress	F_b = 12 ksi	Bending Stress
F_y = 21 ksi	Tensile (yield) strength	F_p = 8 ksi	Bearing stress
E = 10×10^3 ksi	Modulus of Elasticity		

COLD FORMED GALVANIZED STEEL WALL FRAMING (Wall partitions; sill plate, wall studs & top plates)

Values per AISI Specification – Prescriptive Method – 2004 Commentary

Galvanized cold formed steel framing – 20 gauge (39 mil) = 0.396 in thick
22 gauge (33 mil) = 0.336 in thick

SG = 7.9	Specific Gravity	DD = 490 pcf	Dry Density

Design Working Stress (normal loading conditions)

F_y = 33 ksi	Yield Strength	E = 29×10^3 ksi	Modulus of Elasticity

SOLID PHENOLIC COMPOSITE WALL PANELS – 5/16 in, 3/8 in, & 1/2 in thicknesses.

Values for allowable stresses as per Material Property Data Sheets available online for phenolic wall panels fabricated for interior applications comprised of 3/8 in or 1/2 in thicknesses.

SG = 1.42	Specific Gravity	DD = 88.3 pcf	Dry Density

Design Working Stresses (for normal loading conditions)

F_b = 12.0 ksi	Bending (Flexural) Stress	
F_c = 6.0 ksi	Compression stress	[estimated @ (0.6)(F_t)]
F_v = 4.06 ksi	Horizontal Shear stress	[estimated @ (0.4)(F_t)]
F_t = 10.1 ksi	Tensile strength	
E = 1.3×10^3 ksi	Modulus of Elasticity	
450 lbs	Pullout strength/screw	[(2000 N / 4.448 lb per N) @ 0.24 in depth]

5/16 in thick Panel Dead Load (DL) = 2.30 PSF = [88.3 pcf x (0.3125 in / 12 in per ft)].
3/8 in thick Panel Dead Load (DL) = 2.76 PSF = [88.3 pcf x (0.375 in / 12 in per ft)].
1/2 in thick Panel Dead Load (DL) = 3.68 PSF = [88.3 pcf x (0.50 in / 12 in per ft)].

2.6 PSF, DL = 5/16 in. thick Phenolic Composite Panel Assembly Design DL – Wt with clips.
3.0 PSF, DL = 3/8 in. thick Phenolic Composite Panel Assembly Design DL – Weight with clips.
4.0 PSF, DL = ½ in. thick Phenolic Composite Panel Assembly Design DL – Weight with clips.

MEDIUM DENSITY FIBERBOARD (MDF) SOLID COMPOSITE LAMINATED WALL PANELS & BACKING
Panel Thicknesses: 7/16 in, ½ in, 3/4 in, 1-1/8 in.

SG = 0.77 Specific Gravity
DD = 48 pcf Dry Density

7/16 in thick Panel Dead Load (DL) = 1.75 PSF = [48 pcf x (0.4375 in / 12 in per ft)].
1/2 in thick Panel Dead Load (DL) = 2.0 PSF = [48 pcf x (0.50 in / 12 in per ft)].
3/4 in thick Panel Dead Load (DL) = 3.0 PSF = [48 pcf x (0.75 in / 12 in per ft)].
1-1/8 in thick Panel Dead Load (DL) = 4.5 PSF = [48 pcf x (1.125 in / 12 in per ft)].

2.0 PSF, DL = 7/16 in thick MDF Panel Assembly Design DL - Weight with clips.
2.3 PSF, DL = 1/2 in thick MDF Panel Assembly Design DL - Weight with clips.
3.3 PSF, DL = 3/4 in thick MDF Panel Assembly Design DL - Weight with clips.
4.8 PSF, DL = 1-1/8 in thick MDF Panel Assembly Design DL - Weight with clips.

MDF Standards are per ANSI 208.2-2009, Interior applications. Modulus of Rupture (MOR) and Modulus of Elasticity (E) values for MDF are per the Forest Products Journal Vol. 45, No. 7/8, dated July/August 1995. MOR and E for Visually graded Douglas Fir (DF No.2) were taken from the 2010 edition of the Wood Handbook by the USDA-US Forest Service.

MDF Allowable stresses, except for compression stresses and Modulus of Elasticity are estimated as a proportion of the Modulus of Rupture (MOR) between MDF and Visually graded Douglas Fir (DF No.2). Modulus of Elasticity (E) for MDF is as given above.
Compression stresses were estimated per lateral bearing for single shear, with a wood side plate proportioned for ¼ in, with SG=0.67 per Table 11 L of NDS-2005.

Allowable compression = 53 lbs for #8 screw (0.164 in dia).

$$\text{Ratio utilized for } \frac{\text{MOR-MDF}}{\text{MOR-DF No.2}} = 0.49 = \frac{3645 \text{ psi}}{7400 \text{ psi}}$$

Design Working Stress MDF (normal loading conditions)		DF#2 Allowable Stresses
F_b = 441 psi	Bending (Flexural) Stress	F_b = 900 psi
F_v = 88 psi	Horizontal Shear stress	F_v = 180 psi
F_t = 282 psi	Tensile strength	F_t = 575 psi
E = 1.3 x 10^3 ksi	Modulus of Elasticity	E = 1.5 x 10^3 ksi
F_c = 1292 psi	Bearing (Compression) stress	

BAMBOO LVL WALL PANELS (Laminated Veneer Lumber) – 3/4 in. and 1-1/8 in. thicknesses.

Values per ICC-ES Report ESR – 1636, for Structural Bamboo Poles
Dry Density = 42 PCF; Specific Gravity = SG = 0.67

¾ in. thick Bamboo Panel DL = 2.62 PSF = [42 pcf x (0.75 in / 12 in per ft)].
1-1/8 in. thick Bamboo Panel DL = 3.94 PSF = [42 pcf x (1.125 in / 12 in per ft)].

3.0 PSF, DL = 3/4 in. thick Bamboo LVL Panel Assembly Design DL - Weight with clips.
4.3 PSF, DL = 1-1/8 in. thick Bamboo LVL Panel Assembly Design DL – Weight with clips.

Bamboo: Allowable Working Stresses Values derived from Test results as per AC 162 (ICC-ES, Acceptance Criteria for Structural Bamboo, dated March 2005). Reduce the working stress values below by 25% for permanent load conditions except for "E". For Normal Load Conditions:

Design Working Stress (75% allowable)		Allowable Full Value per AC 162
F_b = 2205 psi	Bending stress	F_b = 2940 psi
F_c = 855 psi	Compression stress	F_c = 1140 psi
F_v = 154 psi	Horizontal Shear stress	F_v = 205 psi
F_t = 1627 psi	Tensile Strength	F_t = 2170 psi
E = 2.3 x 10^6 PSI	Modulus of Elasticity	E = 2.3 x 10^6 PSI

ACRYLIC COMPOSITE WALL PANELS – 1/4 in. and 3/8 in. thicknesses.

Values for allowable stresses as per Material Property Data Sheets available online for acrylic wall panels fabricated for interior applications comprised of 1/4 in or 3/8 in thicknesses.

SG = 1.19 Specific Gravity
DD = 74.3 pcf Dry Density

Design Working Stresses (for normal loading conditions)

F_b = 16.5 ksi	Bending (Flexural) Stress
F_c = 18.0 ksi	Compression stress
F_v = 9.0 ksi	Horizontal Shear stress
F_t = 1.0 ksi	Tensile strength
E = 0.43 x 10^3 ksi	Modulus of Elasticity

1/4 in thick Panel Dead Load (DL) = 1.55 PSF = [74.3 pcf x (0.25 in / 12 in per ft)].
3/8 in thick Panel Dead Load (DL) = 2.32 PSF = [74.3 pcf x (0.375 in / 12 in per ft)].

1.8 PSF, DL = 1/4 in. thick Acrylic Composite Panel Assembly Design DL – Weight with clips.
2.6 PSF, DL = 3/8 in. thick Acrylic Composite Panel Assembly Design DL – Weight with clips.

ALLOWABLE SHEAR - ALUMINUM ALLOY EXTRUDED CLIPS AND RAILS SUBJECT TO LOADS:
Clip and rail material: Extruded Aluminum alloy 6063-T5, no welds or welded joints, as per the Aluminum Association, Inc, datasheet available on www.matweb.com
Calculated Shear assumes #8 fastener transfers load to Clips and Rails.

PANEL CLIP (GEN 005)
105 lbs = Shear Allowable, normal, per fastener, **Panel clips** = (0.164 in) (0.08)(8 ksi)(1000 lbs/k)
210 lbs = Shear Allowable, normal, per connection, **Panel clips** = (2)(0.164 in) (0.08)(8 ksi)(1000 lbs/k)
279 lbs = Seismic Shear Allowable load/connection on Panel clip = (210)(1.33) lbs,

MIDWALL CLIP - CONTINUOUS PHENOLIC REVEAL
135 lbs = Shear Allowable, normal, Midwall Clip Reveal = ((0.375/2)-0.12 in)(2.0in)(1.0 ksi)(1000 lbs/k)
180 lbs = Seismic Shear Allowable, Midwall Clip Reveal = (1.33) ((0.375/2)-0.12 in)(2.0in)(1.0 ksi)(1000 lbs/k)

FASTENERS - ALLOWABLE TENSION & SHEAR : CONCRETE MASONRY UNIT (CMU) SCREWS
1/4 in dia. Simpson TITEN Concrete &Masonry Screws (TTN). Material: Heat Treated Carbon Steel
Florida FL 2355.1 Report: Allowable tension / screw = 740 lbs. Allowable Shear / screw = 1242 lbs.
Using Factor of safety of 5.0 for installations under IBC.
Normal load tension / screw = 150 lbs. Seismic allowable tension / screw = 200 lbs = (150)(1.33) lbs.
Normal load shear / screw = 250 lbs Seismic allowable shear / screw = 332 lbs = (250)(1.33)lbs.
Using one 1/4 in dia, 1-1/2 in long screw / connection of clip rails or edging to wall backing (1-1/4 in embedment in CMU :
150 lbs = Tension, Normal Allowable load (pullout) / connection
200 lbs = Tension, Seismic Allowable load (pullout) / connection
250 lbs = Shear, Normal Allowable load / connection
332 lbs = Shear, Seismic Allowable load / connection

FASTENERS – SELF DRILLING TAPPING SCREWS – SCREW CAPACITY IN 20 GA STEEL WALL FRAMING.
AISI STANDARD "Commentary on the Standard for Cold-Formed Steel Framing -Prescriptive Method ", 2001 Edition, with2004 Supplement. Given below is Table C-B1, from Section B, "CONNECTIONS",

Table C-B1
Minimum Allowable Fastener Capacity for Steel-to-Steel Connections
[Safety factor = 3.0]

Screw Size	Minimum Shank Diameter (inch)	Minimum Head Diameter (inch)	Minimum Capacity (lbs)			
			Shear Capacity		Pullout Capacity	
			43 mils[1]	33 mils[1]	43 mils[1]	33 mils[1]
#8	0.164	0.322	244	164	94	72
#10	0.190	0.384	263	177	109	84

For SI: 1 inch = 25.4 mm, 1 lb = 4.448 N.
[1] The value represents the smaller thickness of two pieces of steel being connected.
From the values given in Table C-B1 above:

ALLOWABLE LOADS PER SCREW:
One #8 screw, set in 22 ga (33 mil) steel stud framing has:
Allowable normal load tension (pullout) of 72 lbs. Allowable seismic tension =97.8 lbs = (1.33) (72 lbs).
Allowable normal load shear of 164 lbs. Allowable seismic shear = 218.1 lbs = (1.33) (164 lbs)
Similarly, one #8 screw set in 20 ga (39 mil) steel stud framing, interpolating for thickness, we get:
Tension, normal allowable load (pullout) of 85.1 lbs = (39 mil / 33 mil) (72 lbs).
Tension, seismic allowable = 113.2 lbs = (1.33) (85.3 lbs).
Shear, normal allowable load of 193.8 lbs = (39 mil / 33 mil)(164 lbs),
Shear, seismic allowable = 257.8 lbs = (1.33) (193.8 lbs),
Similarly, one #10 screw set in 20 ga (39 mil) steel stud framing, interpolating for thickness, we get:
Tension, normal allowable load (pullout) of 99.3 lbs = (39 mil / 33 mil) (84 lbs).
Tension, seismic allowable = 132 lbs = (1.33) (99.3 lbs).
Shear, normal allowable load of 209.2 lbs = (39 mil / 33 mil)(177 lbs),
Shear, seismic allowable = 278 lbs = (1.33) (209.2 lbs),

ALLOWABLE LOADS - ONE #8 SCREW PER CONNECTION (20 ga):
Tension, normal allowable load (pullout)/connection = 85.1 lbs.
Tension, seismic allowable / connection = 113.2 lbs.
Shear, normal allowable load / connection = 193.8 lbs,
Shear, seismic allowable / connection = 257.7 lbs,

ALLOWABLE LOADS - ONE #10 SCREW PER CONNECTION (20 ga):
Tension, normal allowable load (pullout) / connection = 99.3 lbs.
Tension, seismic allowable /per connection = 132 lbs.
Shear, normal allowable load /connection = 209.2 lbs,
Shear, seismic, allowable /connection = 278 lbs,

FASTENER ALLOWABLE LOADS : WOOD SCREWS AND MACHINE SCREWS
ALLOWABLE TENSION & SHEAR – WORKING STRENGTH & SHANK DIAMETER:
#8 wood screws and #8x32 machine screws for this connection are per the requirements of ANSI & ASME Standards. Tensile Strength of screws = 60 ksi. Shank diameter = 0.164 in.
Tension allowable / screw = 850 lbs. Using Factor of safety of 4.0.
Tension, normal/ screw = 212.5 lbs = 850/4.
Tension, Seismic / screw = 282.6 lbs = (212.5)(1.33) lbs.
Shear, normal/per screw = 127.0 lbs= (212.5)(0.6) lbs.
Shear, seismic / screw = 169.5 lbs= (282.6)(0.6)lbs.
When we use two #8 x 32 screws, per connection :
Tension, normal allowable load (pullout)/connection = 425 lbs.
Tension, seismic allowable/connection = 565 lbs.
Shear, normal allowable load / connection = 254 lbs,
Shear, seismic allowable load / connection = 339 lbs.

WOOD SCREW FASTENER ALLOWABLE SHEAR – WOOD SIDE PANELS:
#8 wood screws for this connection are per the requirements of ANSI ASME Std B18.6.1, in single shear:
Per NDS-2005, table 11L; #8 screw in single shear, with ½" minimum wood side member (SG=0.67),
Normal allowable lateral load/screw = 107 lbs,
Seismic allowable lateral load/screw = 142.3 lbs = (1.33)(107 lbs).
2 screws / connection: **Normal allowable lateral load/connection = 214 lbs,**
2 screws / connection: **Seismic allowable lateral load/connection = 284.6 lbs** = (1.33)(214 lbs).

HORIZONTAL PANEL CLIP CAPACITY, WOOD SCREW ALLOWABLE SHEAR:
Per NDS-2005, table 11M; #8 screw in single shear, two member connection with metal side plate and a wood side member (SG=0.67). Metal side plate comprised of Horiz. Joint Receiver Rail (0.0625 in thick).
Normal allowable lateral load/screw = 116 lbs,
Seismic allowable lateral load/screw = 154.3 lbs = (1.33)(116 lbs).
2 screws / connection: Normal allowable lateral load/connection = 232 lbs,
2 screws / connection: Seismic allowable lateral load/connection = 308.6 lbs = (1.33)(232 lbs).

MACHINE SCREW - ALLOWABLE SHEAR - PANEL CLIP CAPACITY:
Per NDS-2005, table 11M; #8 screw in single shear, two member connection, metal side plates.
Metal side plate is Horizontal Joint Rails (0.0625 in thick).
Shear, Normal load / screw = 116 lbs,
Shear, seismic load / screw = 154.3 lbs = (1.33)(116 lbs).
Using 2 screws / connection:
Shear, Normal load/ connection = 232 lbs,
Shear, seismic load / connection = 308.6 lbs = (1.33)(232 lbs).

TENSION CAPACITY (PULLOUT) OF WOOD SCREWS IN MDF PANELS:
Screw pullout capacity is based upon NDS 2005, Table 11-2B, with SG= 0.73. Ratio of SG MDF / SG=0.73, Pan head wood #8 x ½ in screw @ 263 lb/in = (0.77/0.73)(249 lb/in).

1/2 Inch Wood Screws:
Effective screw thread length = (thread length) – (thickness of Midway Clip GEN-016)-(screw tip length).
Effective thread length in screw for tension = 0.253 in = (0.50 in) – (0.122 in) – (0.125).
Normal Loads: Allowable tension per screw = 66.5 lbs = (0.253 in)(263 lbs per in).
Normal Allowable tension / connection = 133.0 lbs = (66.5 lbs / screw)(2 screws/connection).
Seismic Loads: Allowable tension per screw = 88.4 lbs = (1.33)(66.5 lbs),
Seismic Allowable tension per connection = 176.8 lbs = (2)(88.4 lbs).

3/4 Inch Wood Screws:
Effective screw thread length = (thread length) – (thickness of Midway Clip GEN-016) - (screw tip length).
Effective thread length in screw for tension = 0.503 in = (0.75 in) – (0.122 in) – (0.125).
Normal Loads: Allowable tension per screw = 132.3 lbs = (0.503 in)(263 lbs per in).
Allowable tension per connection = 264.6 lbs = (132.3 lbs / screw)(2 screws/connection).
Seismic Loads: Allowable tension per screw = 176.0 lbs = (1.33)(132.3 lbs),
Allowable tension per connection = 352.0 lbs = (2)(176.0 lbs).

SHEAR (Bearing)CAPACITY OF WOOD SCREWS IN MDF PANELS:
1/2 Inch Wood Screws:
1/2 in screw: Effective bearing length in MDF panel = 0.253 in = (0.5 in) – (0.122 in) – (0.125).
= (thread length) – (Midwall Clip thickness) – (tip length).
Effective bearing area on MDF panel = 0.0415 sq in = (0.164 in)(0.253 in).
Normal Loads: Allowable Bearing/screw on MDF panel = 53.6 lbs = (1292 psi) (0.0415 sq in),
Seismic Loads: Allowable Bearing/screw on MDF panel = 71.3 lbs = (1.33)(53.6 lbs).
1/2 in screw Normal Loads: Bearing/connection = 107.2 lbs = (53.6 lbs/screw)(2 /connection),
1/2 in screw Seismic Loads: Bearing/connection = 142.6 lbs = (2)(71.3 lbs).

3/4 Inch Wood Screws:
3/4 in screw: Effective bearing length in MDF panel = 0.503 in = (0.75 in) – (0.122 in) – (0.125).
= (thread length) – (Midwall Clip thickness) – (tip length).
Effective bearing area on MDF panel = 0.0825 sq in = (0.164 in)(0.503 in).
Normal Loads: Allowable Bearing/screw on MDF panel = 106.6 lbs = (1292 psi) (0.0825 sq in),
Seismic Loads: Allowable Bearing/screw on MDF panel = 141.7 lbs = (1.33)(106.6 lbs).
3/4 in screw Normal loads: Bearing/connection = 213.2 lbs = (106.6 lbs/screw)(2 /connection),
3/4 in screw Seismic Loads: Bearing/connection = 283.4 lbs = (2)(141.7 lbs).

TENSION CAPACITY (PULLOUT) OF WOOD SCREWS IN BAMBOO LVL PANELS:
Screw pullout capacity is based upon NDS 2005, Table 11-2B, with SG= 0.73. Ratio of SG=0.67 for Bamboo LVL / SG=0.73, Pan head wood #8 x ½ in screw @ 228.5 lb/in = (0.67/0.73)(249 lb/in).

1/2 Inch Wood Screws:
Effective screw thread length = (thread length) – (thickness of Midway Clip GEN-016)-(screw tip length).
Effective thread length in screw for tension = 0.253 in = (0.50 in) – (0.122 in) – (0.125).
Normal Loads: Allowable tension per screw = 57.8 lbs = (0.253 in)(228.5 lbs per in).
Normal Allowable tension / connection = 115.6 lbs = (57.8 lbs / screw)(2 screws/connection).
Seismic Loads: Allowable tension per screw = 76.9 lbs = (1.33)(57.8 lbs),
Seismic Allowable tension per connection = 153.8 lbs = (2)(76.9 lbs).

3/4 Inch Wood Screws:
Effective screw thread length = (thread length) – (thickness of Midway Clip GEN-016) - (screw tip length).
Effective thread length in screw for tension = 0.503 in = (0.75 in) – (0.122 in) – (0.125).
Normal Loads: Allowable tension per screw = 114.9 lbs = (0.503 in)(228.5 lbs per in).
Allowable tension per connection = 229.8 lbs = (114.9 lbs / screw)(2 screws/connection).
Seismic Loads: Allowable tension per screw = 152.8 lbs = (1.33)(114.9 lbs),
Allowable tension per connection = 305.6 lbs = (2)(152.8 lbs).

SHEAR (Bearing)CAPACITY OF WOOD SCREWS IN BAMBOO LVL PANELS:
1/2 Inch Wood Screws:
1/2 in screw: Effective bearing length in MDF panel = 0.253 in = (0.5 in) – (0.122 in) – (0.125).
= (thread length) – (Midwall Clip thickness) – (tip length).
Effective bearing area on MDF panel = 0.0415 sq in = (0.164 in)(0.253 in).
Normal Loads: Allowable Bearing/screw on Bamboo panel = 35.5 lbs = (855 psi) (0.0415 sq in),
Seismic Loads: Allowable Bearing/screw on Bamboo panel = 47.2 lbs = (1.33)(35.5 lbs).
1/2 in screw, Normal: Allowable Bearing/connection = 71.0 lbs = (35.5 lbs/screw)(2 /connection),
1/2 in screw, Seismic Loads: Allowable Bearing/connection = 94.4 lbs = (2)(47.2 lbs).

3/4 Inch Wood Screws:
3/4 in screw: Effective bearing length in MDF panel = 0.503 in = (0.75 in) – (0.122 in) – (0.125).
= (thread length) – (Midwall Clip thickness) – (tip length).
Effective bearing area on MDF panel = 0.0825 sq in = (0.164 in)(0.503 in).
Normal Loads: Allowable Bearing/screw on Bamboo panel = 70.5 lbs = (855 psi) (0.0825 sq in),
Seismic Loads: Allowable Bearing/screw on bamboo panel = 93.8 lbs = (1.33)(70.5 lbs).
3/4 in screw, Normal: Allowable Bearing/connection = 141.0 lbs = (70.5 lbs/screw)(2 /connection),
3/4 in screw, Seismic Loads: Allowable Bearing/connection = 187.6 lbs = (2)(93.8 lbs).

TENSION CAPACITY (PULLOUT) OF MACHINE SCREWS IN PHENOLIC COMPOSITE PANELS:
Use FS = 4 for working strength of screws in material and for capacity based upon fastener strength.
Machine screws based upon ASME B 1.1, with tensile strength of 60 ksi, #8-32 has a capacity of 850 lbs.
Allowable screw tension based upon screw tensile strength = 212.5 lb working strength.
Screw pullout capacity in phenolic panels is based upon Material Property Data Sheets available on
www.trespa.com , www.wilsonart.com , www.formica.com , & others.
Pan head machine #8 -32 screw @ 450 lb pullout capacity for 0.236 in depth. [2000 N / 4.448 lb per N)]
Allowable screw tension based upon phenolic panel material = 112.5 lb working strength.
Effective thread length in screw = (thread length) – (thickness of Midwall Clip GEN-002).
Effective thread length in screw for tension = 0.378 in = (0.50 in) – (0.122 in). 0.378 in > 0.236 in, OK.
Therefore, Allowable machine screw tension = 112.5 lb.
Normal Loads: Allowable tension per screw = 112.5 lbs
Allowable tension per connection = 225 lbs = (112.5 lbs / screw)(2 screws / connection).
Seismic Loads: Allowable tension per screw = 149.6 lbs = (1.33)(112.5 lbs),
Allowable tension per connection = 299.2 lbs = (2)(149.6 lbs)

SHEAR (Bearing) CAPACITY OF MACHINE SCREWS IN PHENOLIC COMPOSITE PANELS:
1/2 inch machine screw. Effective screw bearing length in 1/2 in Phenolic panel = 0.378 in
= (0.50 in) – (0.122 in) = (Panel thickness) – (Clip thickness).
Effective bearing area on Phenolic panel = 0.062 sq in = (0.164 in)(0.378 in).
Normal Loads: Allowable Bearing/screw on Phenolic panel = 62.9 lbs = (4060 psi/4) (0.062 sq in),
Seismic Loads: Allowable Bearing/screw on Phenolic panel = 83.6 lbs = (1.33)(62.9 lbs).

3/8 inch machine screw. Effective screw bearing length in 3/8 in Phenolic panel = 0.253 in
= (0.375 in) – (0.122 in) = (Panel thickness) – (Clip thickness).
Effective bearing area on Phenolic panel = 0.0415 sq in = (0.164 in)(0.253 in).
Normal Loads: Allowable Bearing/screw on Phenolic panel = 42.1 lbs = (4060 psi/4) (0.0415 sq in),
Seismic Loads: Allowable Bearing/screw on Phenolic panel = 56.0 lbs = (1.33)(42.1 lbs).

ABBREVIATIONS / ACRONYMS

Abbreviation	MEANING
AF&PA	American Forest and Paper Association
AISI	American Iron and Steel Institute
ANSI	American National Standards Institute
ASD	Allowable Stress Design
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society of Testing and Materials
AWC	American Wood Council
CBC	California Building Code
CONN	Connection
DIA	Diameter
DL	Dead Load
E	Modulus of Elasticity
ESR	Evaluation Service Report
FT	Foot or Feet
FS	Factor of Safety
GA	Gauge
IBC	International Building Code
ICC-ES	International Code Council – Evaluation Service, Inc.
IN	Inch or Inches
K	Kip or Kips (1000 pounds per kip)
KSI	Kips per Square Inch
LB	Pound or Pounds (weight or force)
LL	Live Load
LVL	Laminated Veneer Lumber
MDF	Medium Density Fiberboard
MIL	Mils or 1/1000 of an inch
MM	Millimeters
MPa	MegaPascals
N	Newtons
NDS-2005	National Design Specification for Wood Construction, 2005 edition
SG	Specific Gravity
PCF	Pounds per Cubic Foot
PSI	Pounds per Square Inch
PSF	Pounds per Square Foot
SG	Specific Gravity (relative to water where SG of water = 1.00)
SQ FT	Square Feet
SQ IN	Square Inches
STD	Standard Number
UBC	Uniform Building Code
WPS	Wall Panel Systems, Inc .

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