**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 Bamboo Laminated Veneer Lumber (LVL) and Medium Density Fiberboard (MDF). 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, and concrete screws. Wood panel assemblies are fastened to interior non-bearing partition walls of either cold formed steel stud framing sheathed in gypsum wall board (drywall) or reinforced Concrete Masonry Unit (CMU) walls.

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. These partitions 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 clips. The panels and aluminum alloy components are collectively fastened as an assembly to the partition wall backing.

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 and zinc-coated steel wood screws, as appropriate. Attachment of panel assemblies to CMU backing is accomplished by use of concrete and masonry screws set in holes drilled in CMU partitions.

**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.

**Each panel assembly consists of**:

Modular Panels, Extruded aluminum alloy clips or rails fastened to each panel at its vertical edges, top panel edges, bottom panel edges, and at mid-wall horizontal rails spaced at 34 inches o.c. maximum. Aluminum alloy edge rails, trim rails, horizontal joint receiver rails, and corner rails are connected to partition wall backing with galvanized steel self-drilling tapping screws conforming to AISI Standard for cold formed steel framing. 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 and midwall clips are connected to decorative wood wall panels with zinc-coated steel wood screws.

Rails, edges, and trim pieces are connected to each other with lapped fitted joints and fitted tongue and groove slots. Aluminum alloy clips and midwall clips are connected to wood wall panels with two panel fasteners (wood screws) per clip rail.

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

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.

**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.**

**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.**

**Tributary Dead Loads per connection for various Wood Panel Assemblies:**

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 )**

11.3 lbs = 7/16 in. MDF Panel Assembly Tributary DL = ( 5.67 sq.ft )( 2.0 psf )

13.0 lbs = 1/2 in. MDF Panel Assembly Tributary DL = ( 5.67 sq.ft )( 2.3 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 )**

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 24.4 lbs per connection Bamboo LVL tributary panel DL for design of all screw connections.**
**Use 27.2 lbs per connection MDF tributary panel DL for design of all screw connections.**

**INVERTED SLOPING PANEL APPLICATIONS**: Panel connections have been analyzed for inverted sloping wall applications, including ceiling applications.

**ALUMINUM ALLOY CLIPS, RAILS, AND TRIM FOR PHENOLIC PANEL SYSTEMS ARE AS FOLLOWS:**

**3/4 " SHA-S SYSTEM**
Panel Clip ( Gen-002 ) ,
Edge Trim ( SHA-S 401 ) , (UAS-202).
Custom Vertical Joint ( SHA-S 410 ) ,
Horizontal Joint ( SHA-S 420 ) ,
Outside Corner ( SHA-S 432 ) ,
Inside Corner ( SHA-S 440 ).

**CAPTURED SYSTEM**
Custom Outside Corner Receiver ( CAP-433 ) ,
Outside Corner Cap ( CAP-135 ).

**OPEN REVEAL SYSTEM**
Panel Clip ( Gen-002 ) ,
Custom Edge ( ORS-403 ) , (UAS-202),
Custom Vertical Joint ( ORS-S 411 ) ,
Custom Horizontal Joint ( ORS-S 421 ) ,
Midwall Clip ( GEN-013 )

**WAINSCOT SYSTEM**
Wainscot Cap ( WSC SHA-161 ) ,
Wainscot Clip ( WSC-160 ) ,
Wainscot Cap ( WSC SHA-162 ).

## IBC 2009/CBC 2010 – BAMBOO LVL - 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 $W_p$ = 24.4 lb Tributary DL (1-1/8" Bamboo LVL)

$I_p$ = 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 BAMBOO LVL PANELS:**

Eq. 13.3-1 $$F_p = 16.1 \text{ lbs} = \frac{(0.4)(a_p)(S_{DS})(W_p)}{(R_p / I_p)} [1 + (2)(Z/h)] = \frac{(12.5)}{(2.5)} [3]$$

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

Eq. 13.3-2 $$\text{min. } F_p = 10.1 \text{ lbs} = (0.3)(S_{DS})(W_p)(I_p)$$

**Therefore, $F_p$ = 53.6 lbs = BAMBOO LVL Maximum Horizontal Out of Plane Seismic force per connection**, perpendicular to panel face, from any direction, in the most severe locale.

**Vertical Concurrent force = ( DL ) +/- [ (0.2)($S_{DS}$)($W_p$) ] = ( 24.4 lb ) +/- [ 6.6 lb per connection ]**

**BAMBOO LVL - Vertical Concurrent (gravity + seismic) forces = 31.0 lb max, or 17.8 lb min.**

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

## IBC 2009/CBC 2010 – MEDIUM DENSITY FIBERBOARD (MDF) Allowable Stress Design (ASD), out of plane seismic force for vertical wall panel assembly attached to Panel Backing, 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 $W_p$ = 27.2 lb Tributary DL ( 1-1/8" 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

**For PHENOLIC PANELS:**

Eq. 13.3-1 $$F_p = 18.0 \text{ lbs} = \frac{(0.4)(a_p)(S_{DS})(W_p)}{(R_p / I_p)}[1 + (2)(Z/h)] = \frac{(12.5)}{(2.5)}[3]$$

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

Eq. 13.3-2 $$\text{min. } F_p = 11.3 \text{ lbs} = (0.3)(S_{DS})(W_p)(I_p)$$

**Therefore, $F_p$ = 59.8 lbs = MDF 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)($S_{DS}$)($W_p$) ] = ( 27.2 lb ) +/- [ 7.4 lb per connection ]**

**MDF - Vertical Concurrent (gravity + seismic) forces = 34.6 lb max, or 19.8 lb min.**

**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** |

## 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).**

**Sloping BAMBOO LVL 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 | **24.2** | 0 | **12.1** | 0 | **12.1** | 0 |
| | Seismic | 30.8 | 53.2 | 15.4 | 26.6 | 15.4 | 26.6 |
| 70 | Normal | 22.7 | 8.3 | 11.4 | 4.2 | 111.4 | 4.2 |
| | Seismic | 47.1 | 60.0 | 23.6 | 30.0 | 23.6 | 30.0 |
| 60 | Normal | 21.0 | 12.2 | 10.5 | 6.1 | 10.5 | 6.1 |
| | **Seismic** | **53.4** | **61.5** | **26.7** | **30.8** | **26.7** | **30.8** |
| 45 | Normal | 17.2 | 17.2 | 8.6 | 8.6 | 8.6 | 8.6 |
| | Seismic | 59.5 | 59.5 | 29.7 | 29.7 | 29.7 | 29.7 |
| 30 | Normal | 12.2 | 21.0 | 6.1 | 10.5 | 6.1 | 10.5 |
| | Seismic | **61.5** | 53.4 | **30.8** | 26.7 | **30.8** | 26.7 |
| 0 (flat - Horiz.) | Normal | 0 | **24.2** | 0 | **12.1** | 0 | **12.1** |
| | Seismic | 53.2 | 30.8 | 26.6 | 15.4 | 26.6 | 15.4 |

**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** | **24.2** | **24.2** | **12.1** | **12.1** | **12.1** | **12.1** |
| | **Seismic** | **61.5** | **61.5** | **30.8** | **30.8** | **30.8** | **30.8** |

**INTERACTION ANALYSIS – 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: Wood Panel to Panel Fastener.

$V_a$ = 258 lbs = Allowable Seismic Shear / panel backing screw connection = ( 194 )( 1.33 ).
$P_a$ = 113 lbs = Allowable Tension Wall Panel to Panel Fastener connection = ( 85 )( 1.33 ).
$P_s$ = 59.8 lbs = Maximum Applied Seismic out of plane tension per connection.
$V_{G+S}$ = 34.6 lbs = Applied gravity + vertical seismic component per connection.

$$\frac{V_{G+S}}{V_a} + \frac{P_s}{P_a} = \frac{34.6}{258} + \frac{59.8}{113} = 0.13 + 0.53 = 0.66 < 1.0, \text{ OK}$$

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, following these calculations.

Horizontal (Out of plane) force To wall fastener (self drilling tapping screws ) at steel stud, Base Edge Trim Rail, maximum of 29.0 lbs per screw connection.

$$\frac{(34.6 \text{ lb})(2.25 \text{ in})}{(0.85 \text{ in})} = \mathbf{91.6\ lb} \text{ tension in wall fasteners} < 113 \text{ lb allowable seismic tension at backing}$$

Apply horiz. force to Wall fasteners at steel studs lb along Horiz. Joint Receiver

$$\frac{(59.8 \text{ lb})(2.6 \text{ in})}{(1.9 \text{ in})} = 81.8 \text{ lb} \quad \text{or} \quad \frac{(59.8)(1.9)}{(1.4)} = 81.2 \text{ lb tension in fastener at backing (max)} < 113 \text{ allowable tension}$$

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

$$\frac{(34.6 \text{ lb})(0.70 \text{ in})}{(0.75 \text{ in})} = 32.3 \text{ lb} < 113 \text{ lb}$$ Allowable seismic in backing fastener

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

$$\frac{(34.6 \text{ lb})(0.70 \text{ in})}{(0.75 \text{ in})} = 32.3 \text{ lb} < 113 \text{ lb}$$ Allowable seismic in backing fastener

**ANALYSIS OF SEISMIC LOAD APPLIED causing PRYING ACTION ON MIDWALL HORIZONTAL JOINT RAIL FASTENERS and EDGE RAIL FASTENERS – Horizontal ( Ceiling or soffit ) Installation.**
Refer to typical connection drawing details "A" & "E", rotated 90 degrees, of Typical Connection Diagrams for Extruded Aluminum Rails and Clips, following these calculations.
.

| | | | |
|---|---|---|---|
| Vertical (Out of plane force) For Horizontal Joint Receiver Rail (UAS 220) max. of 58.0 lbs per screw connection. | ( 34.6 lb )( 2.6 in ) / ( 1.20 in) | = 75.0 lb tension in wall fastener at backing | < 113 lb allowable seismic tension |
| Apply vertical force to Wall fastener screw at backing. | ( 34.6 lb )( 2.25 in ) / ( 0.85 in) | = **91.6 lb** tension in wall fastener at backing | < 113 lb allowable seismic tension |
| Vertical component of seismic force plus gravity per 2 screw connection at edge rail backing. | ( 34.6 lb )( 0.70 in ) / ( 0.75 in ) | = 32.3 lb tension | < 113 lb Allowable seismic in backing fastener |
| Vertical component of seismic force plus gravity per screw connection at horiz. joint rail. | ( 59.8 lb )( 0.70 in ) / ( 0.75 in ) | = 55.8 lb tension | < 113 lb Allowable seismic in backing fastener |

| **CONNECTION SUMMARY** | **Calculated Load Capacity Between Elements** | | |
|---|---|---|---|
| **Typical Panel Assembly** | **PULLOUT** | **SHEAR** | **CLIP SHEAR** |
| **ELEMENT** | **( lbs )** | **( lbs )** | **( lbs )** |
| 3/4 in thick Bamboo LVL Panel | | | |
| **Normal** | **105** | **141** | |
| **Seismic** | **140** | **188** | |
| Panel fasteners – (2) #8 x 1/2 in wood screws | | | |
| Normal | 425 | 232 | |
| Seismic | 565 | 308 | |
| Panel Clip (Gen 002) | | | |
| 1-1/8 in thick Bamboo LVL Panel | | | |
| **Normal** | **210** | **234** | |
| **Seismic** | **350** | **312** | |
| Panel fastener – (2) #8 x 3/4 in wood screws | | | |
| Normal | 425 | 232 | |
| Seismic | 565 | 308 | |
| Panel Clip ( Gen 002) | | | |
| 3/4 in thick MDF Panel | | | |
| **Normal** | **133** | **93** | |
| **Seismic** | **176** | **124** | |
| Panel fasteners – (2) #8 x 1/2 in wood screws | | | |
| Normal | 425 | 232 | |
| Seismic | 565 | 308 | |
| Panel Clip (Gen 002) | | | |
| 1-1/8 in thick MDF Panel | | | |
| **Normal** | **264** | **188** | |
| **Seismic** | **350** | **248** | |
| Panel fastener – (2) #8 x 3/4 in wood screws | | | |
| Normal | 425 | 232 | |
| Seismic | 565 | 308 | |
| Panel Clip ( Gen 002) | | | |

| **CONNECTION SUMMARY** | **Calculated Load Capacity Between Elements** | | |
|---|---|---|---|
| **ELEMENT** | **PULLOUT ( lbs )** | **SHEAR ( lbs )** | **CLIP SHEAR ( lbs )** |
| Panel Clip ( Gen 002 ) | | | 320 Normal<br>425 Seismic |
| Horizontal Joint Rails ( SHA-S 420, ORS-421, | | | 82 Normal #8<br>109 Seismic #8<br>95 Normal #10<br>126 Seismic #10 |
| Midwall Clip ( GEN-013 ) | | | 82 Normal<br>109 Seismic<br>95 Normal #10<br>126 Seismic #10 |
| Edge Trim Rails ( SHA-S 401, ORS-403, WSC SHA-161, WSC-160, WSC SHA-162 ), (UAS-202). | | | |
| Corner Rails ( SHA-432, SHA-S 440, CAP-433, CAP-135 ) | | | 164 Normal<br>218 Seismic |

---

Horizontal Joint Rails, Edge Trim Rails , Midwall Clips

| | | |
|---|---|---|
| Normal | 85 | 194 |
| Seismic | 113 | 258 |

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

---

Horizontal Joint Rails, Edge Trim Rails , Midwall Clips

| | | |
|---|---|---|
| Normal | 150 | 250 |
| Seismic | 200 | 333 |

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

---

Horizontal Joint Rails, Edge Trim Rails, Midwall Clips

| | | |
|---|---|---|
| Normal | 99 | 209 |
| Seismic | 132 | 278 |

Backing – 20 ga ( 39 mil ) Cold Formed Steel Stud Wall // Fasteners - # 10 x 2 in self-drilling screws

**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, MIDWALL CLIP RAILS, HORIZONTAL EDGE RAILS, VERTICAL EDGE RAILS, AND CORNER EDGE RAILS**

**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 |
| $F_y$ = 21 ksi | Tensile (yield) strength |
| $F_b$ = 12 ksi | Bending Stress |
| $F_p$ = 8 ksi | Bearing stress |
| E = 10 x $10^3$ 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 x $10^3$ ksi | Modulus of Elasticity |

**BAMBOO LVL WALL PANELS ( Laminated Veneer Lumber ) – ¾ 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 = ¾ 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 |

**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

| 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 | |

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 are estimated as a proportion of the Modulus of Rupture (MOR) between MDF and Visually graded Douglas Fir ( DF No.2 ) except for compression stress and Modulus of Elasticity (E). Modulus of Elasticity for MDF is as given above. Compression stress was estimated per lateral bearing for single shear, with a wood side plate proportioned for ¼ in, with SG=0.77 per Table 11 L of NDS-2005.

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

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

MDF Panel Unit Weights per square foot:

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)].

**Panel Assembly Unit Weights per square foot, including aluminum alloy panel clips, edge trim, & rails:**

**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.**

**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 002 )**
Shear Allowable, normal, per fastener, **Panel clips**
160 lbs = (0.164 in) (0.122)(8 ksi)(1000 lbs/k)
**Shear Allowable, normal, per connection, Panel clips**
**320 lbs** = (2)(0.164 in) (0.122)(8 ksi)(1000 lbs/k)
**Seismic Shear Allowable load/connection on Panel clip**
**425 lbs** = ( 320 )( 1.33 ) lbs,

**EDGE TRIM RAILS** ( SHA-S 401, ORS-403, WSC SHA-161, WSC-160, WSC SHA-162 ), (UAS-202).
**CORNER RAILS** ( SHA-432, SHA-S 440, CAP-433, CAP-135,
Shear, normal allowable, **Edge Trim & Corner Rails** per fastener
82 lbs = (0.164 in)(0.0625)(8 ksi)(1000 lbs/k)
**Shear, seismic allowable shear load/connection on Edge Trim & /Corner rails**
**109 lbs** = (1.33)(82 lbs).

**HORIZONTAL JOINT RAILS** ( SHA-S 420, ORS-421, )
**Shear, normal allowable, per connection, Horizontal Joint Rails**
**82 lbs** = (0.164 in)(0.0625)(8 ksi)(1000 lbs/k)
**Shear, seismic allowable per connection, Horizontal Joint Rails**
**109 lbs** = (1.33)(0.164 in)(0.0625)(8 ksi)(1000 lbs/k)

**MIDWALL CLIP** (GEN-013)
**Shear normal allowable, per connection, Midwall Clip**
**82 lbs** = (0.164 in)(0.0625)(8 ksi)(1000 lbs/k)
**Shear, seismic allowable, per connection, Midwall Clip**
**109 lbs** = (1.33)(0.164 in) (0.0625)(8 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 = ( 150 )( 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,**
**WOOD SCREWS - Allowable Tension & Shear (Steel)- based upon Working Strength & Shank Diameter:**
#8 Wood 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 working load per screw = 212.5 lbs = 850/4.
Tension, Seismic load allowable per screw = 282.6 lbs = ( 212.5)(1.33) lbs.
Shear, normal working load per screw = 127.0 lbs = ( 212.5 )( 0.6 ) lbs
Shear, seismic load allowable per screw = 169.5 lbs = ( 282.6 )( 0.6 )lbs.

When we use two #8 screws, per connection :
Tension, normal allowable load (pullout)/connection = 425 lbs.
Tension, seismic allowable/connection = 565 lbs.

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

**SUMMARY:**
**TENSION CONNECTION CAPACITY OF WOOD SCREWS IN WOOD PANELS (Based upon screw strength)**
**Tension, normal working load per screw = 212.5 lbs.**
**Tension, Seismic load allowable per screw = 282.6 lbs.**
Using two #8 screws, per connection :
**Tension, normal allowable load (pullout)/connection = 425 lbs.**
**Tension, seismic allowable/connection = 565 lbs.**

**SHEAR CONNECTION CAPACITY OF WOOD SCREWS IN WOOD PANELS (Based upon screw strength)**
The governing values for this connection will be the lowest values of the conditions given above.
Use for design the following allowable fastener / material shear loads for the machine screw connection:
**Shear, Normal allowable lateral load /screw = 116 lbs,**
**Shear, Seismic allowable lateral load /screw = 154 lbs** = (1.33)(116 lbs).
Using 2 screws / connection:
**Shear, Normal allowable lateral load /connection = 232 lbs,**
**Shear, Seismic allowable lateral load /connection = 308 lbs** = (1.33)(232 lbs).

These are values based upon screw strength. For comparison, we will check tension and shear based upon panel material properties:

**TENSION CAPACITY (PULLOUT) OF WOOD SCREWS IN BAMBOO LVL PANELS:**
Screw pullout capacity in Bamboo LVL panels is based upon NDS 2005, (pg 69) Table 11.2B,
With Bamboo SG= 0.67, per Table 11.2B, #8 wood screw withdrawal capacity is at 209 lb/in.

**1/2 Inch Wood Screws:**
Effective thread length in screw = (thread length) – (thickness of Midway Clip GEN-016)-(tip taper).
Effective thread length in screw for tension = 0.253 in = (0.50 in) – (0.122 in)-(0.125).
**Normal Loads:** Allowable tension per screw = 52.8 lbs = (0.253 in )(209 lbs per in).
**Allowable tension per connection = 105.6 lbs** = (52.8 lbs / screw)(2 screws/connection).
**Seismic Loads:** Allowable tension per screw = 70.3 lbs = (1.33)(52.8 lbs),
**Allowable tension per connection = 140.6 lbs** = (2)(70.3 lbs).

**3/4 Inch Wood Screws:**
Effective thread length in screw = (thread length) – (thickness of Midway Clip GEN-016)-(tip taper ).
Effective thread length in screw for tension = 0.503 in = (0.75 in) – (0.122 in)-(0.125).
**Normal Loads:** Allowable tension per screw = 105 lbs = (0.503 in )(209 lbs per in).
**Allowable tension per connection = 210 lbs** = (105 lbs / screw)(2 screws/connection).
**Seismic Loads:** Allowable tension per screw = 175 lbs = (1.33)(105 lbs),
**Allowable tension per connection = 350 lbs** = (2)(175 lbs).

**SHEAR (Bearing )CAPACITY OF WOOD SCREWS IN BAMBOO LVL PANELS:**
BAMBOO Structural Poles Bearing stress = 1140 psi
Use Bamboo LVL for design bearing stress = 1140 psi for wood screws

1/2 inch wood screw. Effective screw bearing length in Bamboo panel = 0.378 in
= ( 0.50 in ) – ( 0.122 in ) = (Panel thickness ) – ( Clip thickness ).
Effective bearing area on Wood panel = 0.062 sq in = ( 0.164 in )( 0.378 in ).
Normal Loads: Allowable Bearing/screw on Bamboo panel = 70.7 lbs = (1140 psi) ( 0.062 sq in ),
Seismic Loads: Allowable Bearing/screw on Bamboo panel = 94 lbs = (1.33)( 62 lbs ).

3/4 inch wood screw. Effective screw bearing length in Bamboo panel = 0.503 in
= ( 0.75 in ) – ( 0.122 in ) = (Panel thickness ) – ( Clip thickness ).
Effective bearing area on Bamboo panel = 0.103 sq in = ( 0.164 in )( 0.628 in ).
Normal Loads: Allowable Bearing/screw on panel = 117.4 lbs = (1140 psi) ( 0.103 sq in ),
Seismic Loads: Allowable Bearing/screw on panel = 156.1 lbs = (1.33)( 117.4 lbs ).

**1/2 inch wood screw (3/4 in thick bamboo panels) :**
**Shear, Normal Allowable Loads /connection = 141.4 lbs = (70.7 lbs/screw)(2 /connection),**
**Shear, seismic Allowable Loads /connection = 188 lbs = (2)(94 lbs ).**

**3/4 inch wood screw (1-1/8 in thick bamboo panels) :**
**Shear, Normal Allowable Loads /connection = 234.8 lbs = (117.4 lbs/screw)(2 /connection),**
**Shear, seismic Allowable Loads /connection = 312 lbs = (2)(156 lbs ).**

**TENSION CAPACITY (PULLOUT) OF WOOD SCREWS IN MDF PANELS:**
MDF Panels Bearing stress = 1292 psi.
Screw pullout capacity is based upon NDS 2005, Table 11.2B, with SG= 0.77. 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). For a 1/2 in long screw:

**1/2 Inch Wood Screws:**
Effective thread length in screw = (thread length) – (thickness of Midway Clip GEN-016)-(tip taper).
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).
**Allowable tension per connection = 133.0 lbs** = (66.5 lbs / screw)(2 screws/connection).
**Seismic Loads:** Allowable tension per screw = 88.1 lbs = (1.33)(66.5 lbs),
**Allowable tension per connection = 176.2 lbs** = (2)(88.1 lbs).

**3/4 Inch Wood Screws:**
Effective thread length in screw = (thread length) – (thickness of Midway Clip GEN-016)-(tip taper ).
Effective thread length in screw for tension = 0.503 in = (0.75 in) – (0.122 in)-(0.125).
**Normal Loads:** Allowable tension per screw = 132.2 lbs = (0.503 in )(263 lbs per in).
**Allowable tension per connection = 264.4 lbs** = (132.2 lbs / screw)(2 screws/connection).
**Seismic Loads:** Allowable tension per screw = 175 lbs = (1.33)(132.2 lbs),
**Allowable tension per connection = 350 lbs** = (2)(175 lbs).

**SHEAR (Bearing )CAPACITY OF WOOD SCREWS IN MDF PANELS:**
1/2 inch wood screw. Effective screw bearing length in MDF panel = 0.253 in
= ( 0.50 in ) – ( 0.122 in ) – (0.125 in ) = (Panel thickness ) – ( Clip thickness )-(tip taper).
Effective bearing area on Wood panel = 0.041 sq in = ( 0.164 in )( 0.253 in ).
Normal Loads: Allowable Bearing/screw on MDF panel = 46.7 lbs = (1140 psi) ( 0.041 sq in ),
Seismic Loads: Allowable Bearing/screw on MDF panel = 62.1 lbs = (1.33)( 46.7 lbs ).

3/4 inch wood screw. Effective screw bearing length in MDF panel = 0.503 in
= ( 0.75 in ) – ( 0.122 in ) – (0.125 in ) = (Panel thickness ) – ( Clip thickness )-(tip taper).
Effective bearing area on MDF panel = 0.082 sq in = ( 0.164 in )( 0.503 in ).
Normal Loads: Allowable Bearing/screw on panel = 94.0 lbs = (1140 psi) ( 0.082 sq in ),
Seismic Loads: Allowable Bearing/screw on panel = 125 lbs = (1.33.)( 94.0 lbs ).

**1/2 inch wood screw (3/4 in thick MDF panels) :**
**Normal Loads: Allowable Shear /connection = 93.4 lbs = (46.7 lbs/screw)(2 /connection),**
**Seismic Loads: Allowable Shear /connection = 124.2 lbs = (2)(62.1 lbs ).**

**3/4 inch wood screw (1-1/8 in thick MDF panels) :**
**Normal Loads: Allowable Shear /connection = 188 lbs = (94 lbs/screw)(2 /connection),**
**Seismic Loads: Allowable Shear /connection = 248.4 lbs = (2)(124.2 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 . |

## REFERENCES:

American Institute of Architects (AIA), Architectural Graphic Standards, 7th Edition

American Institute of Steel Construction (AISC) - Steel Construction Manual, 8th Edition

American Institute of Timber Construction (AITC) - Timber Construction Manual, 3rd Edition

American Forest & Paper Association/ American Wood Council, (AFPA/AWC) 2005 National Design Specification for Wood Construction- (NDS)

American Iron & Steel Institute (AISI) – Commentary on the Prescriptive Method for Cold Formed Steel Framing,

AFPA/AWC, 2005 NDS Supplement – Design Values for Wood Construction

American Society of Civil Engineers - Minimum Design Loads of Buildings and Other Structures (ASCE 7-05)

ASTM International – Fastener Standards & Publications web site.

California Building Code, 2010 Edition (2010 CBC; or CBC inclusive).

Composite Panel Association, Medium Density Fiberboard, Mechanical Properties - web site.

Florida Building Code Report No. FL 2355.1 ; Simpson TITEN TTN Concrete & Masonry Screws

International Code Council (ICC) - International Building Code, 2009 Edition (2009 IBC, or IBC, inclusive).

ICC Evaluation Service Inc. ICC-ESR-1636, Structural Bamboo Poles

ICC Evaluation Service Inc. ICC-ESR-1671, Tapcon Screw Fasteners

ICC Evaluation Service Inc. ICC-ESR-2196, Hilti Kwik Pro Self Drilling Screws

International Conference of Building Officials (ICBO) - Maps of Known Active Fault Near-Source Zones in CA

National Earthquake Hazards Reduction Program (NEHRP) - NEHRP Recommended Provisions for Seismic Regulations for New Buildings and Other Structures (2003 NEHRP Provisions).

Smith Fastener, Machine Screw Mechanical Performance Requirements web site

Structures and Codes Institute, S.K. Ghosh Associates, Inc, CodeMaster – Seismic Design

Simpson Strong-Tie Company, Wood Construction Connectors 2011-2012, Catalog C-2011

Simpson Strong-Tie, Anchoring and Fastening Systems for Concrete and Masonry Catalog SAS-2012

Wall Panel Systems, Inc, Construction Details & Installation Guides prepared by www.WallPanelSystems.net

Williams, Alan, Structural Engineering Reference Manual

http://www.matweb.com/
http://www.astm.org/Standards/fastener-standards.html
http://www.smithfast.com/msmechanicals.html
http://www.compositepanel.org/products/medium-density-fiberboard.html
http://www.confast.com/products/technical-info/tapcon-concretescrew.aspx
http://www.huduser.org/publications/pdf/commenton
http://www.strongtie.com/products/anchorsystems/mechanical/index.html?source=topnav#
http://www.strongtie.com/products/fasteners/index.html?source=topnav#
http://www.hilti.com/holcom/page/module/product/prca_rangedetail.jsf?lang=en&nodeId=-10709
http://wallpanelsystems.net/