INGENIEROS CIVILES ESTRUCTURALES DE CHILE A.G.

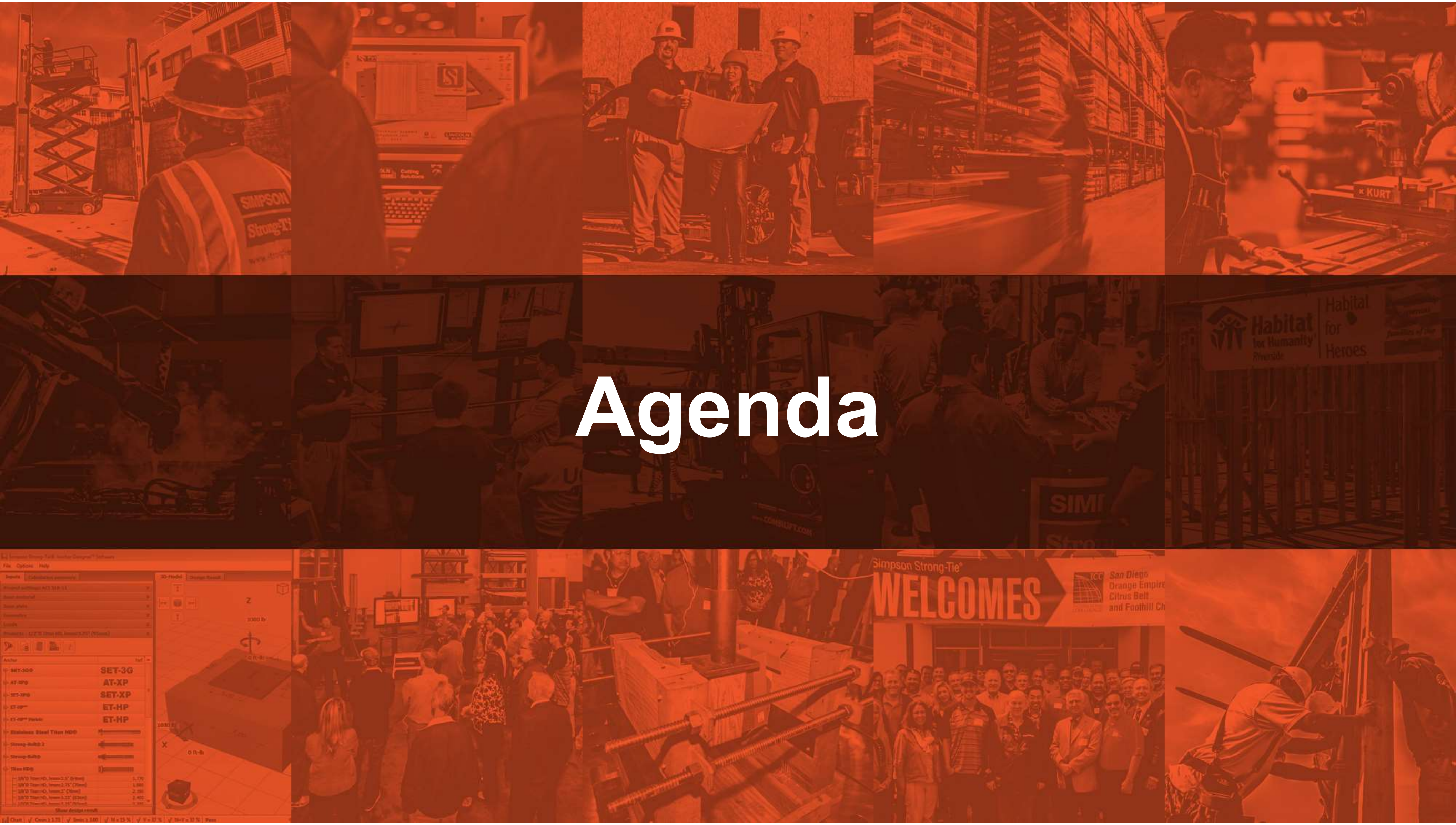
# Design Tools

## Herramientas para facilitar la especificación en edificios de madera


**Diego Valdivieso Cascante**
**dvaldivieso@strongtie.com**

**En colaboración con el Equipo de Ingenieria SST Chile**
**Tomás Garay, Luciano Rodriguez y Matias Urrejola**

# Agenda



SIMPSON
Strong-Tie
KURT
Habitat for Humanity
Riverside
Habitat for Heroes
SET-3G
AT-XP
SET-XP
ET-HP
ET-HP
Simpson Strong-Tie®
WELCOMES
San Diego
Orange Empire
Citrus Belt


# Agenda

- Nuestra Compañía
- ¿Cómo lograr estructuras de madera seguras?
- Design Tools
- Breve revisión de Edificios de Madera Masiva
- Q&A

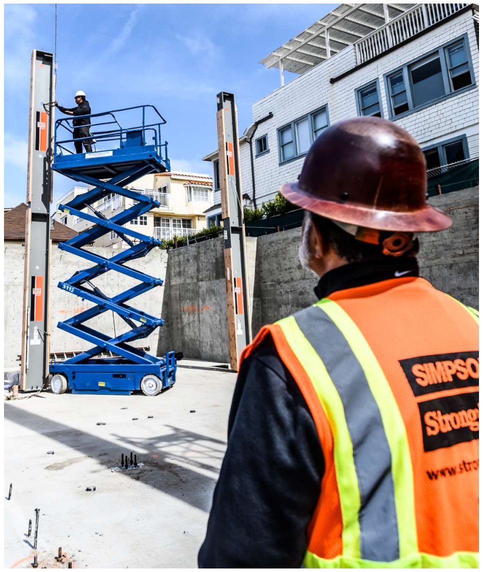
# Nuestra Compañía


# Nuestra Misión

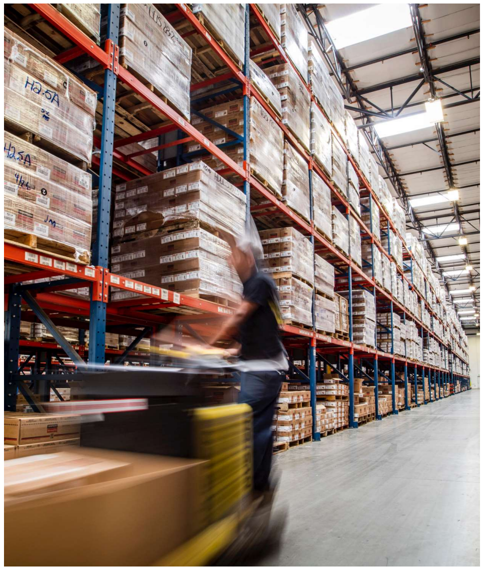
Entregar soluciones que ayuden a las personas a diseñar y construir estructuras seguras y resistentes.


# Nuestros Pilares

Investigación, Testeo e Innovación



Servicio

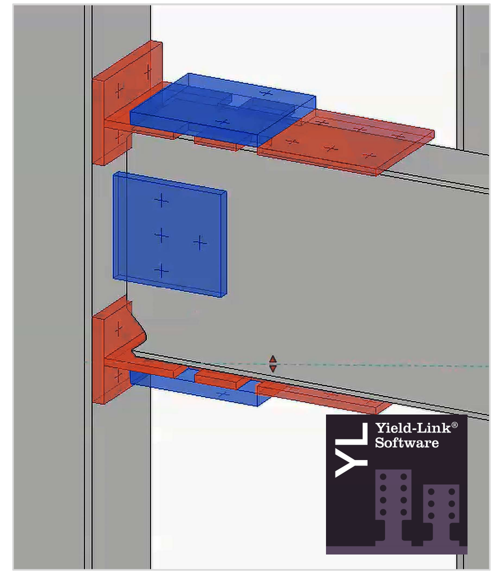


Disponibilidad de Producto

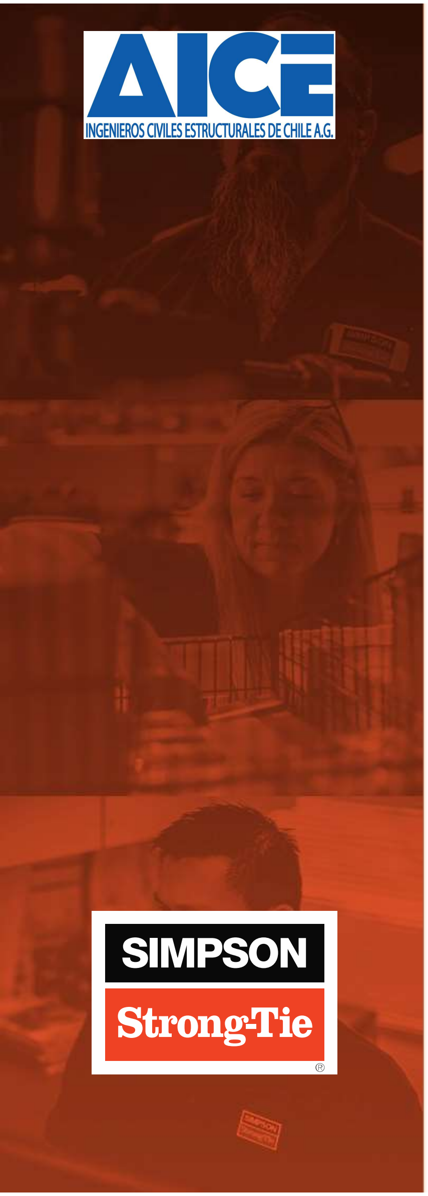

# Nuestros Pilares

Soporte Técnico en Terreno

Educación, Entrenamientos, Workshops & Webinars




Recursos y Tecnologia




# Nuestros Partners

Washington State University
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Clemson University
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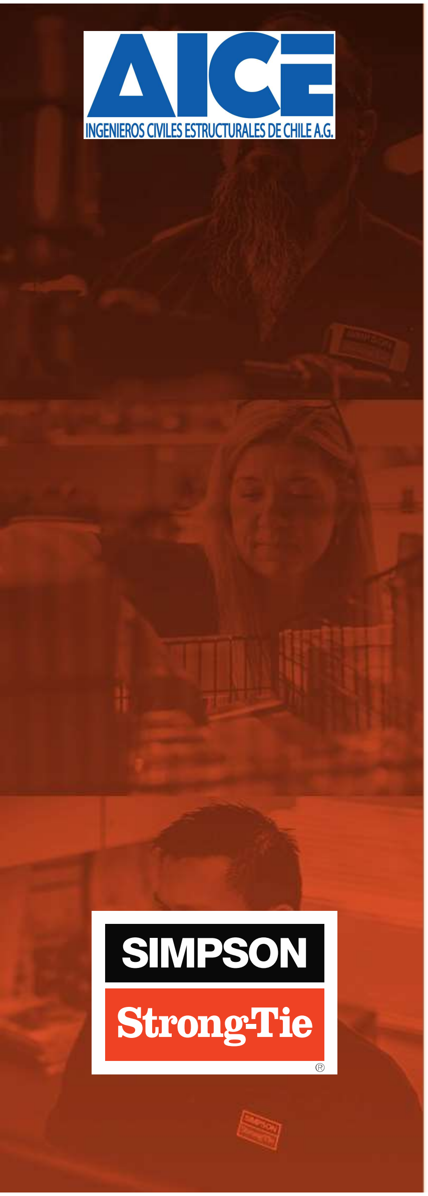
The State University of New York
Colorado State University
UF University of Florida
Johns Hopkins University
University of Virginia
UC San Diego
Cal Poly
San Luis Obispo

Habitat for Humanity

Build Change

Academia




# Nuestros Partners

Habitat for Humanity

Build Change

Centro UC de Innovación en Madera

UdeSantiago de Chile

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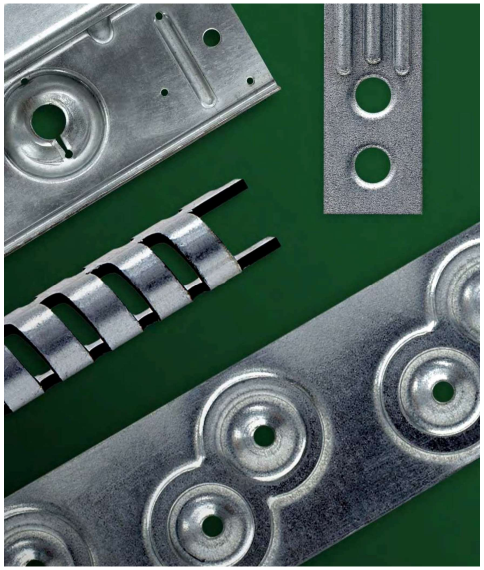
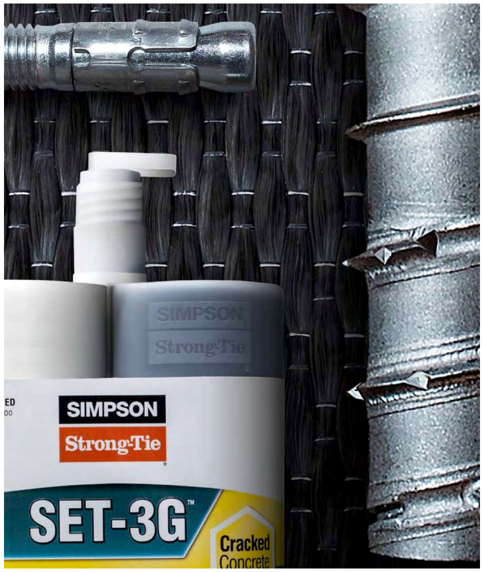
INGENIEROS CIVILES ESTRUCTURALES DE CHILE A.G.

Academia

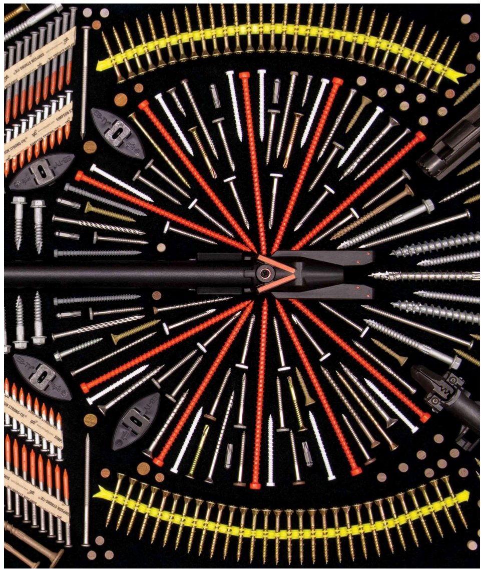
# Soluciones



Conectores



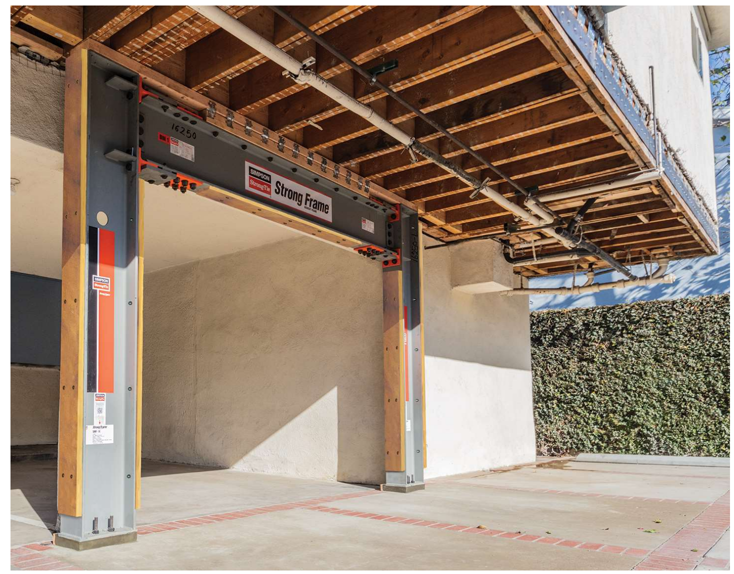

Sistemas de Anclaje



Fijaciones

# Soluciones

Conectores CFS




Sistemas Laterales

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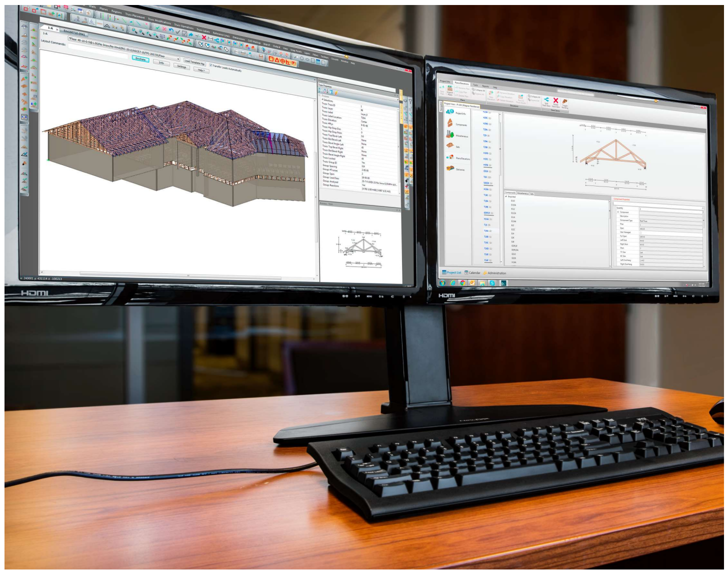
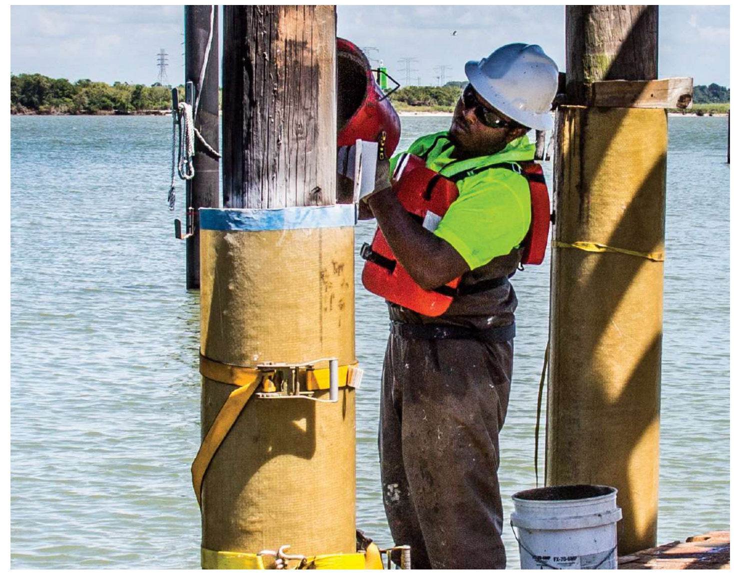
INGENIEROS CIVILES ESTRUCTURALES DE CHILE A.G.

# Soluciones



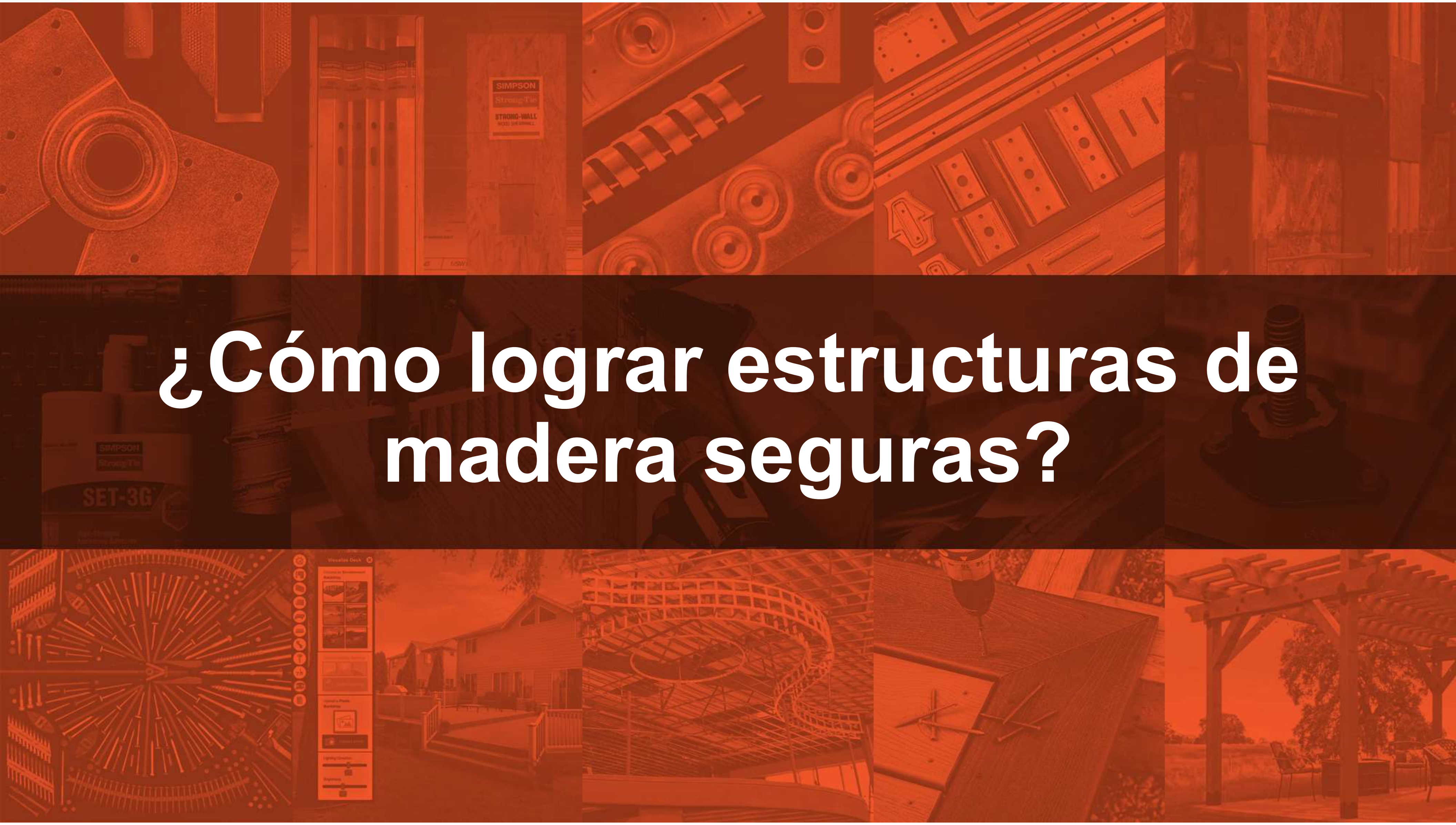
Sistemas Integrados de Diseño



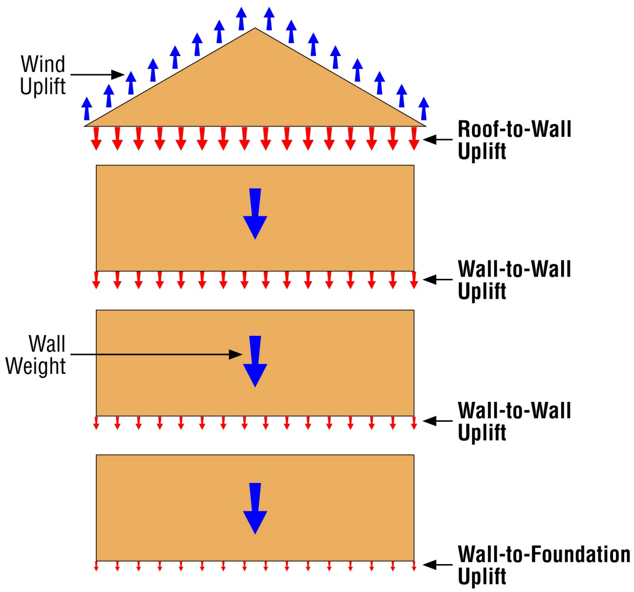
Reparación, Protección y Reforzamiento

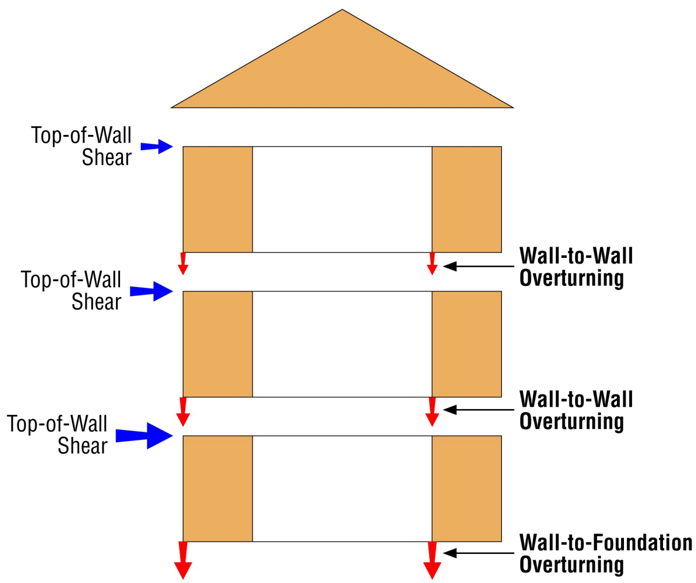
SIMPSON Strong-Tie

# ¿Cómo lograr estructuras de madera seguras?



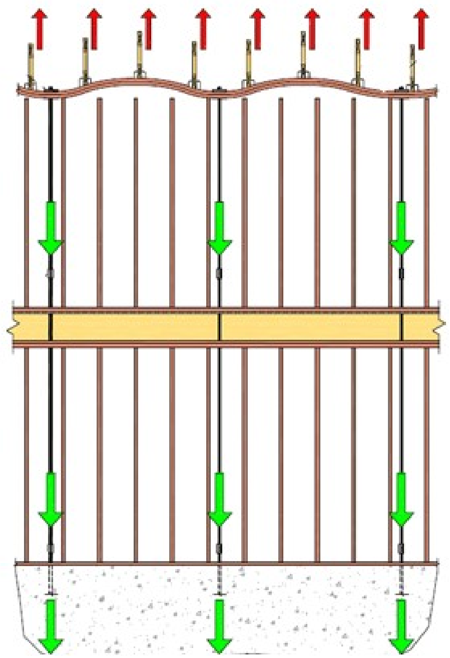
# Comportamiento de la estructura frente a levantamiento y volcamiento.




- Conectores se deben disponer de forma uniforme a lo largo del nivel
- Conectores se deben disponer en ambos extremos del muro de corte.

# Comportamiento de la estructura frente a levantamiento y volcamiento.



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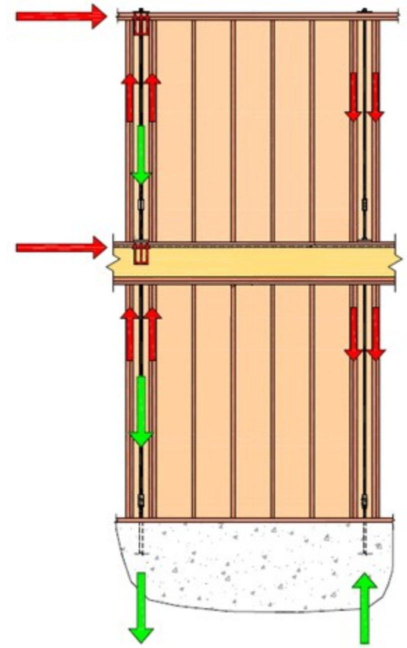

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# Independiente de la naturaleza del movimiento, es necesario garantizar transferencia de carga continua

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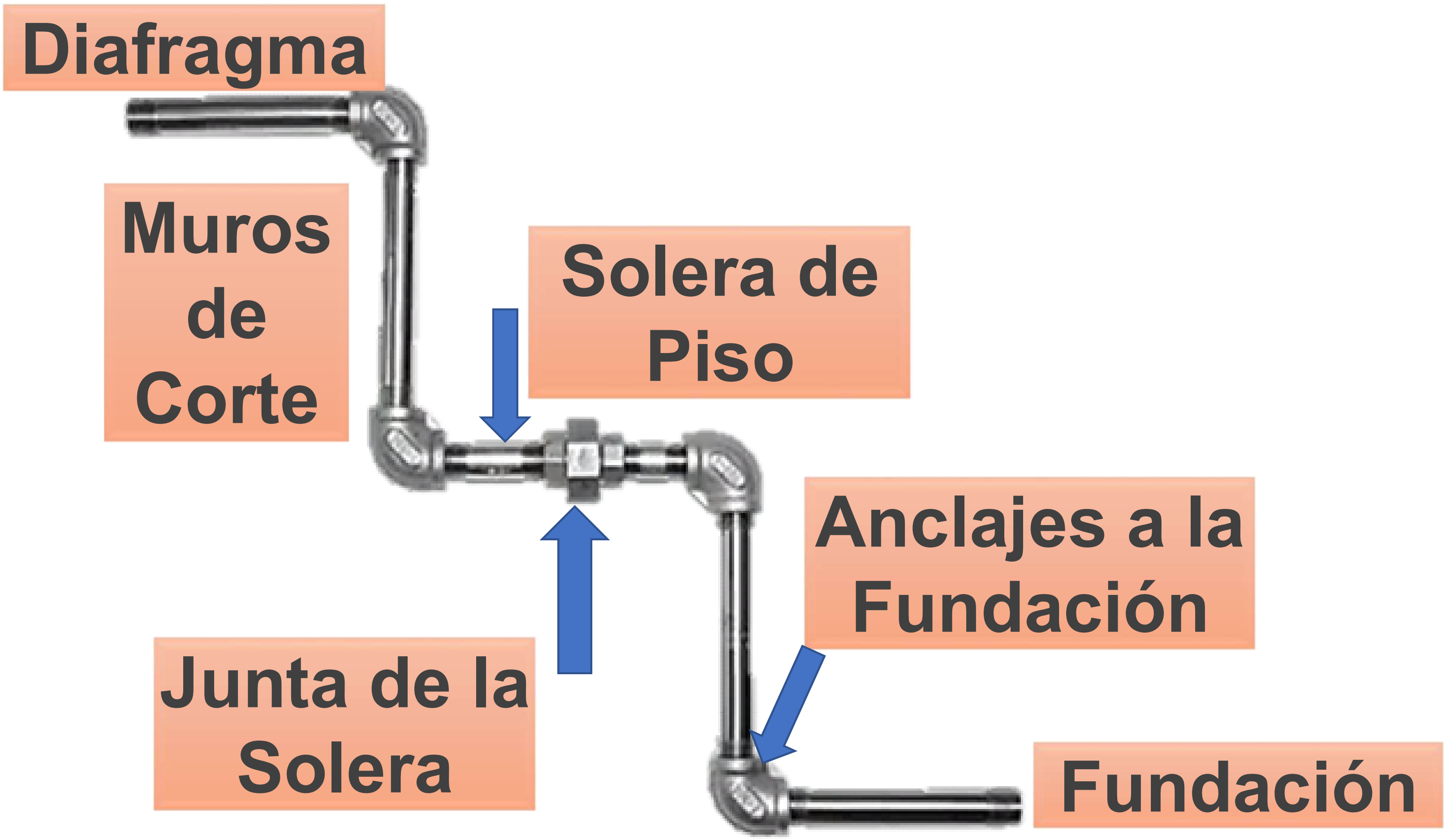


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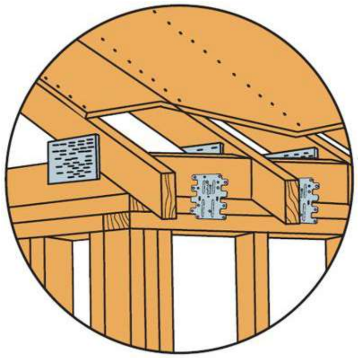
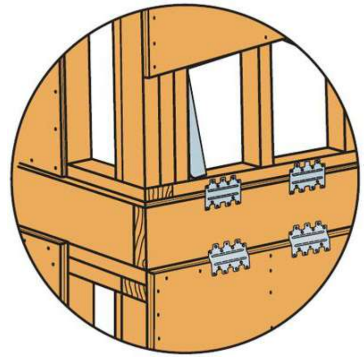
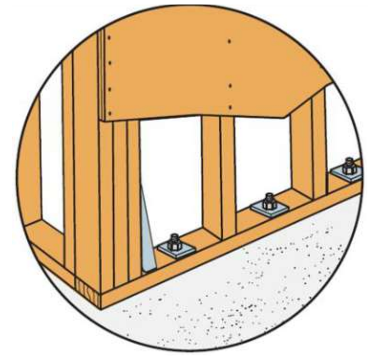


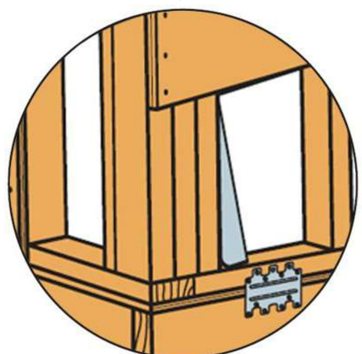
1 | Diafragma de Techo-A Muro



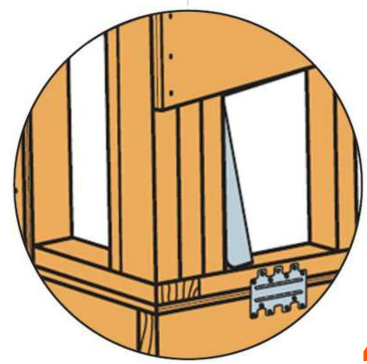
3 | Piso a Piso



5 | Muro-a-Fundación

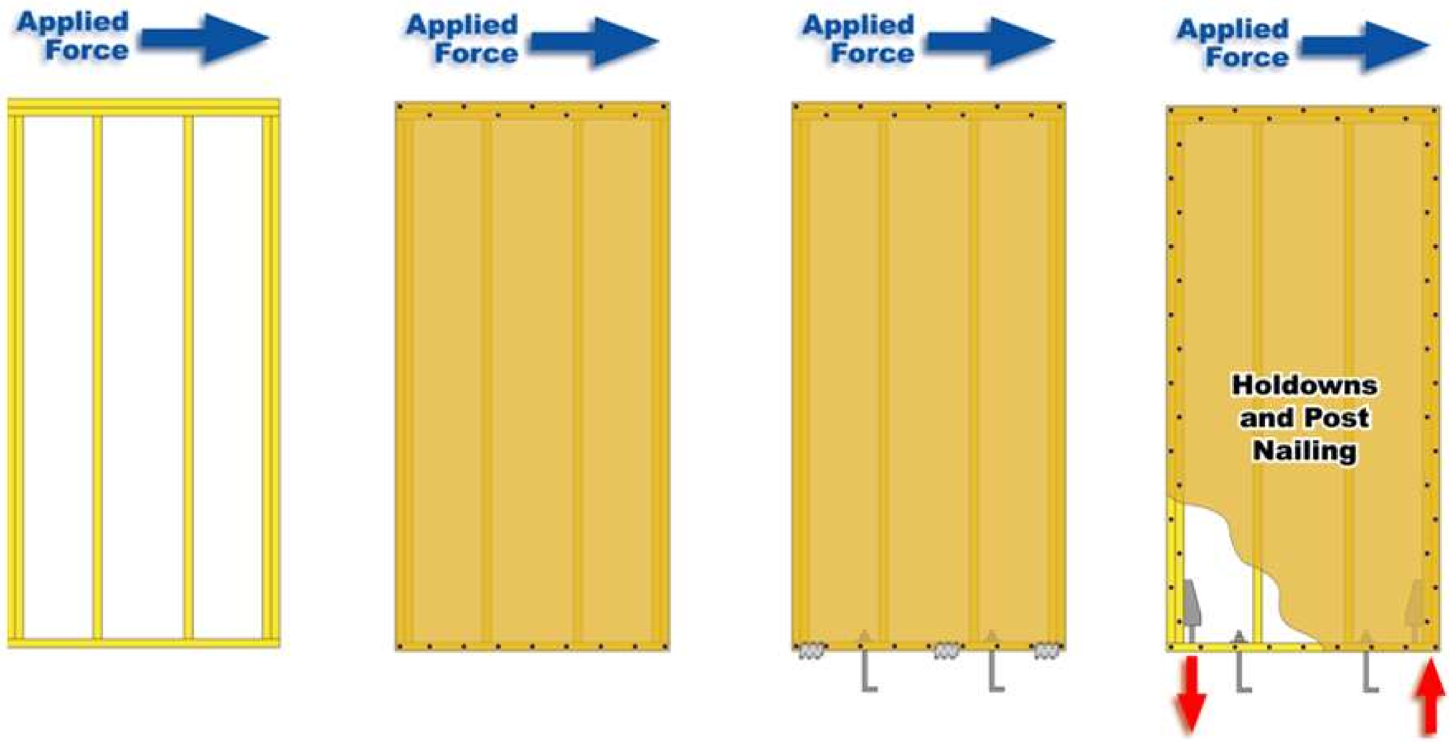


2 | A través del Muro



4 | A través Del Muro

# Muros de corte en estructuras de madera sometidas a carga lateral



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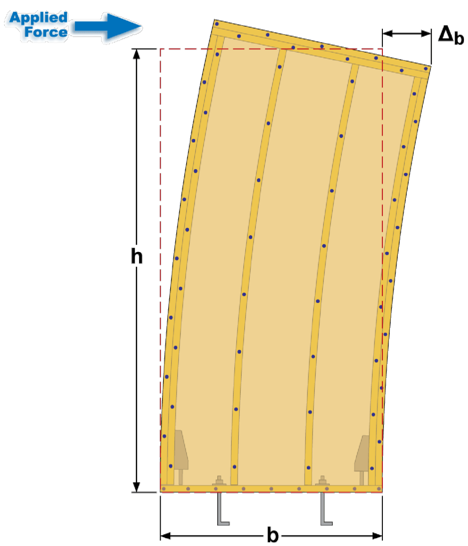
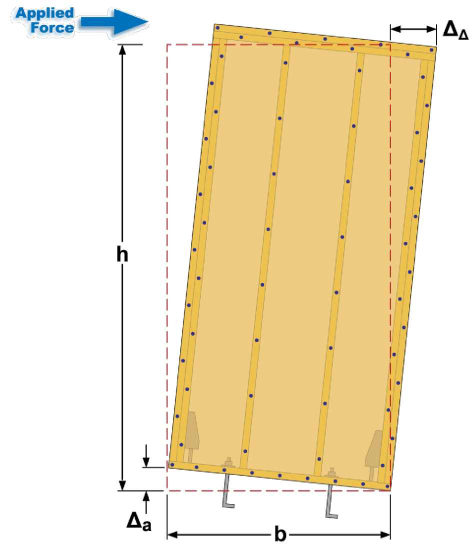
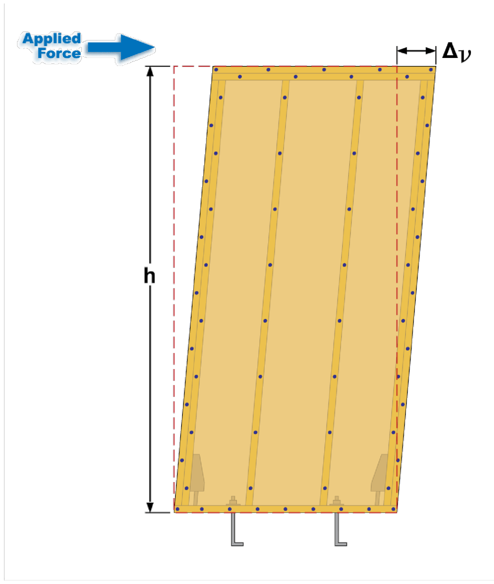



Flexión

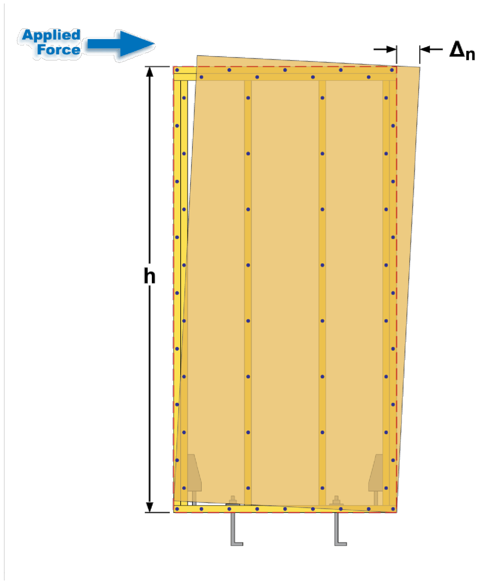



Levantamiento Anclaje

# Muros de corte en estructuras de madera sometidas a carga lateral

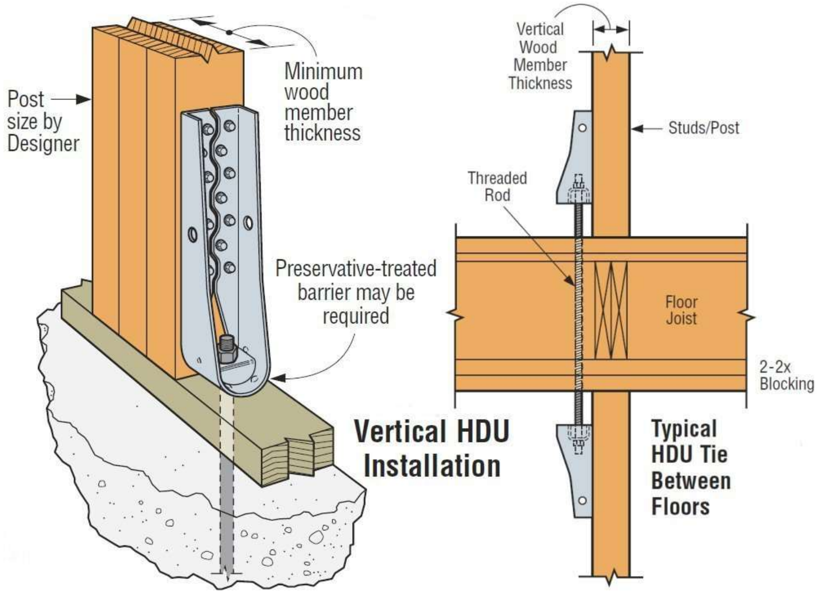



Corte




Deslizamiento unión clavada

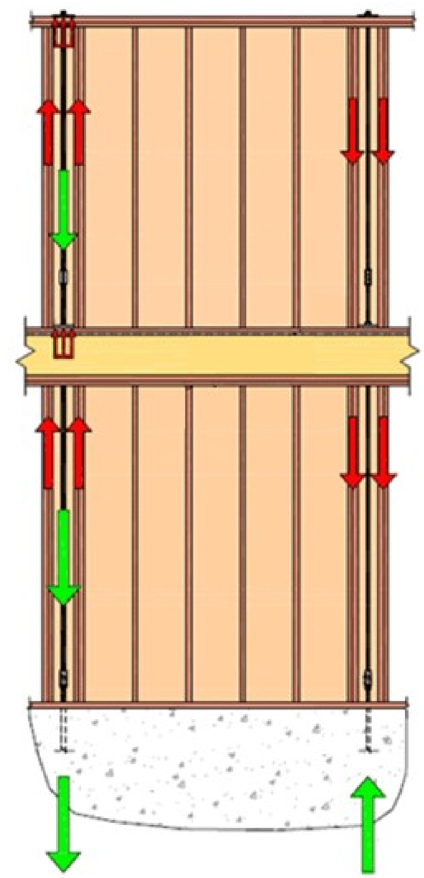
# Se debe disponer de un sistema lateral resistente adecuado para resistir el volcamiento inducido por la carga lateral.




Sistema Discreto

Sistema Continuo

# Se debe disponer de un sistema lateral resistente adecuado para resistir el volcamiento inducido por la carga lateral.



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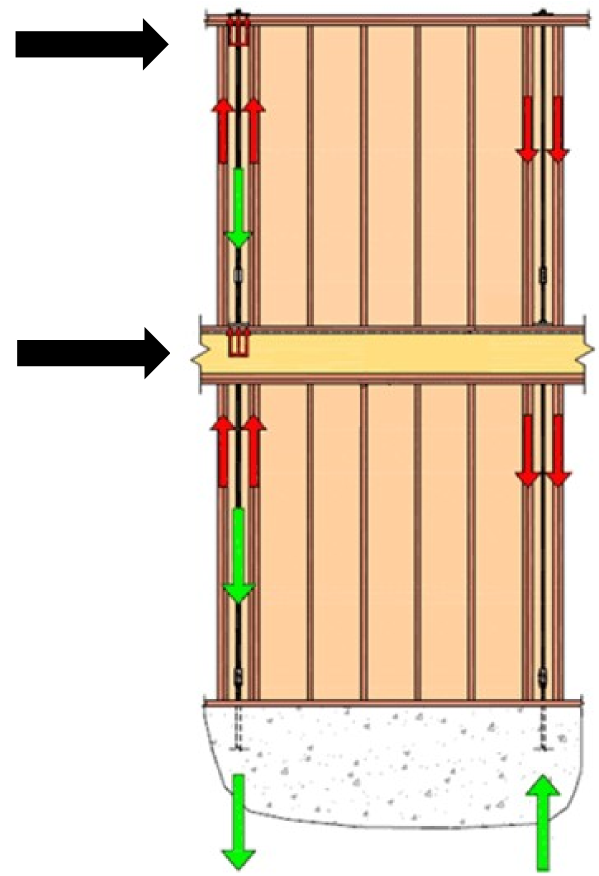
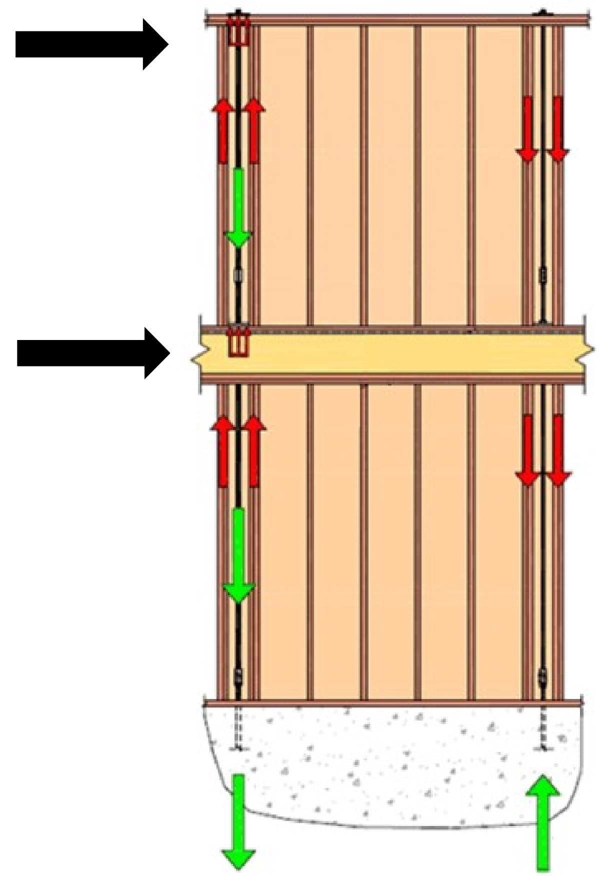


- Unión clavada transfiere carga en los pie derecho de borde, genenerando compresión sobre las soleras y sistemas de bloqueo en la medida que el volcamiento ocurre.

- Fuerzas inducidas por el volcamiento son incrementales

## Se debe disponer de un sistema lateral resistente adecuado para resistir el volcamiento inducido por la carga lateral.

- Pies derecho de borde (en cada nivel) transfieren fuerzas de compresión a los elementos de madera, esto genera una reacción en los BP



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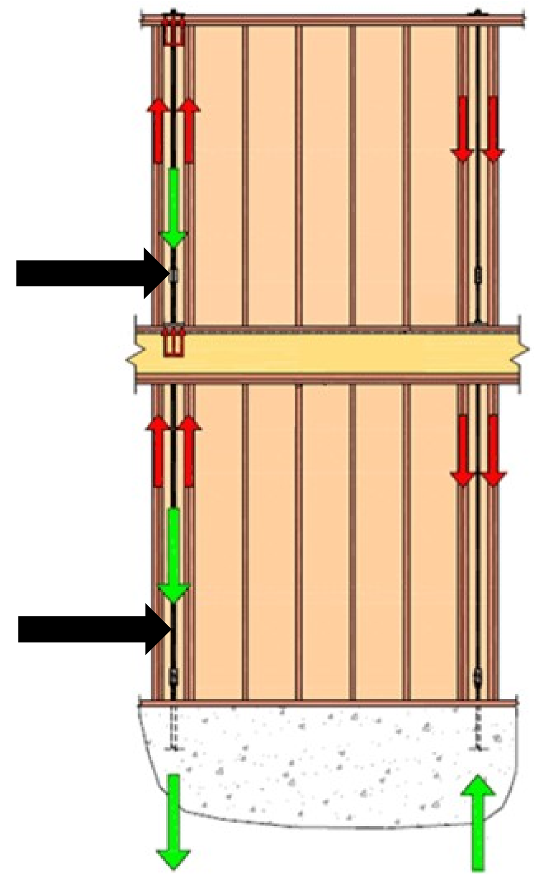
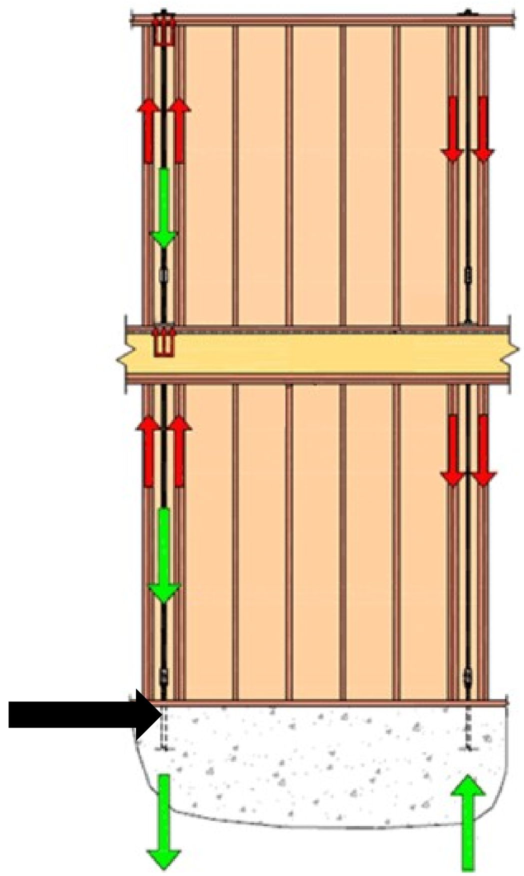


- Rods descargan las fuerzas de tracción originadas por el volcamiento hacia los niveles inferiores

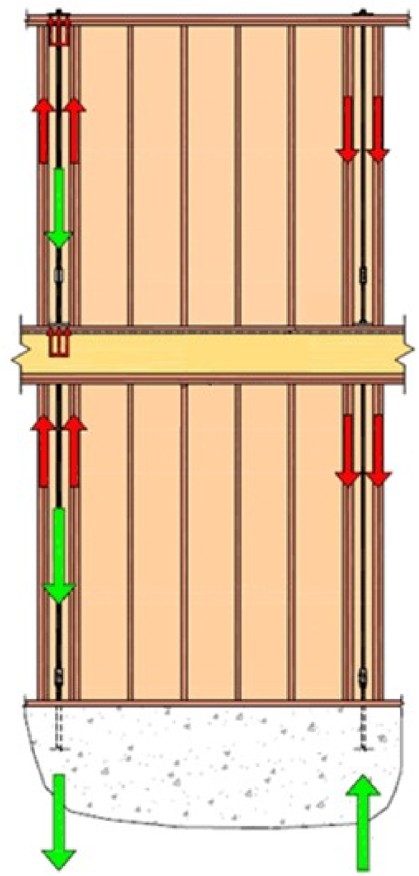
# Se debe disponer de un sistema lateral resistente adecuado para resistir el volcamiento inducido por la carga lateral.

- Anclaje transfiere las cargas originadas por el volcamiento a las fundaciones



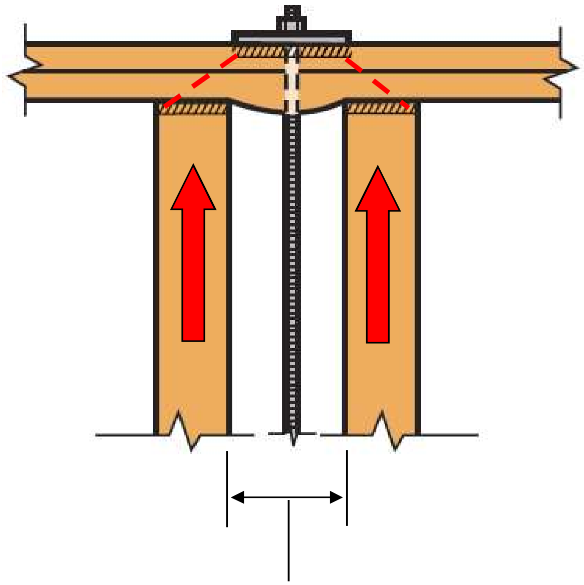
# Se debe disponer de un sistema lateral resistente adecuado para resistir el volcamiento inducido por la carga lateral.

Este lado está en TENSIÓN.



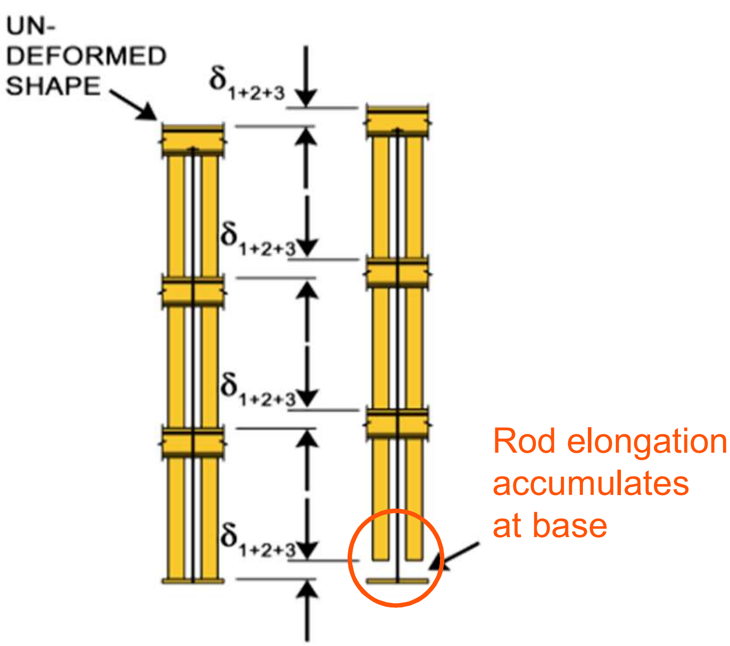
Este lado está en COMPRESIÓN, las fuerzas son transferidas a la fundación por medio de los elementos de madera

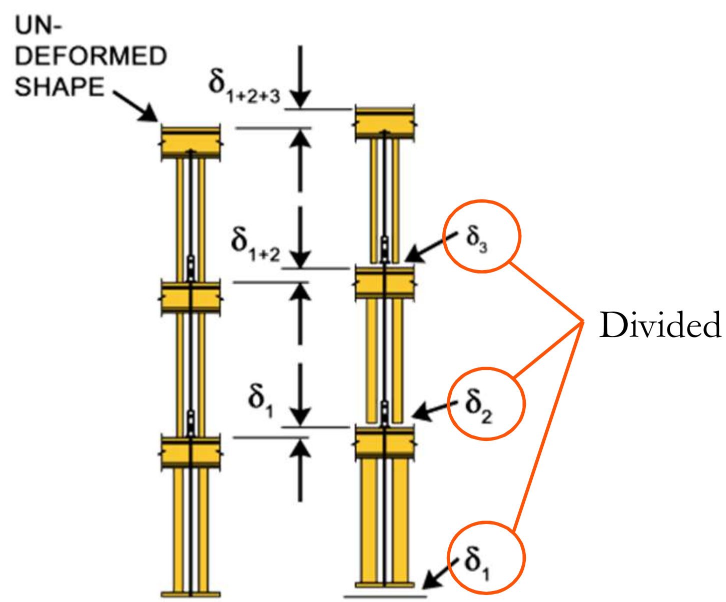
## Se debe disponer de un sistema lateral resistente adecuado para resistir el volcamiento inducido por la carga lateral.



Controlar el espaciamiento para evitar flexión en la placa

# En caso de ser un sistema continuo, ¿es necesario fijar en cada uno de los niveles?



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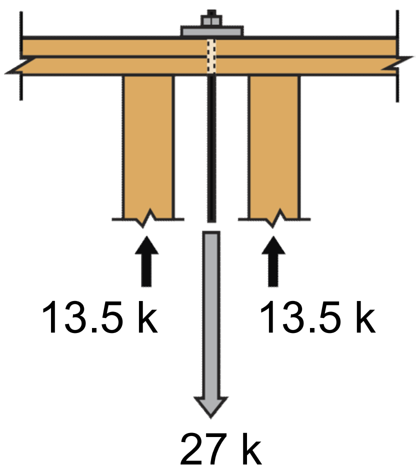
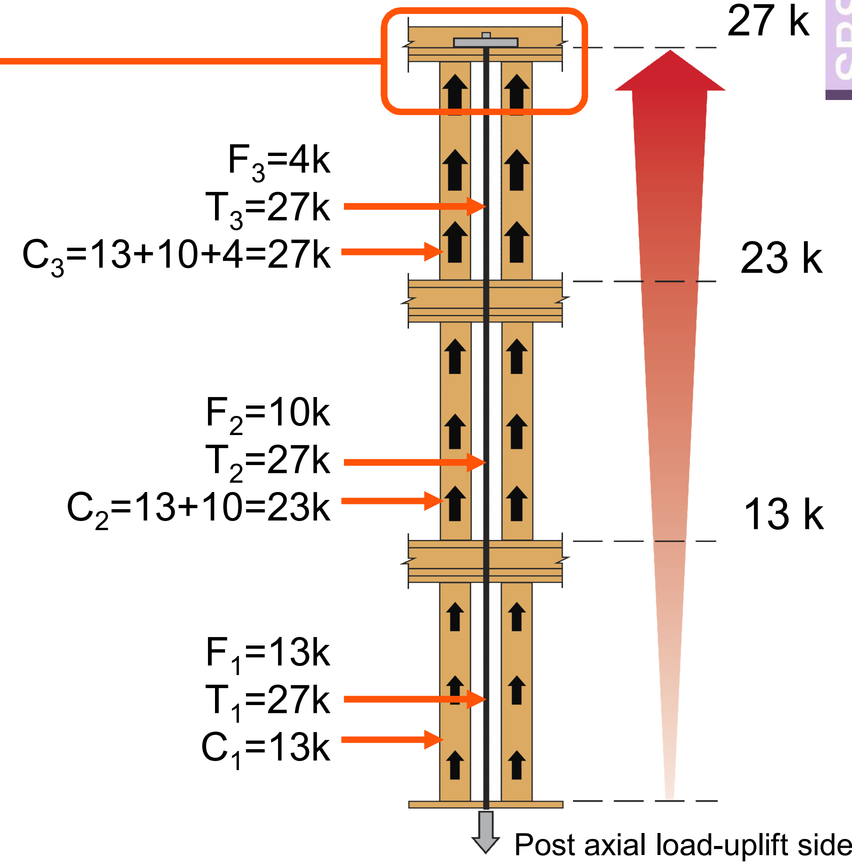



Detail A



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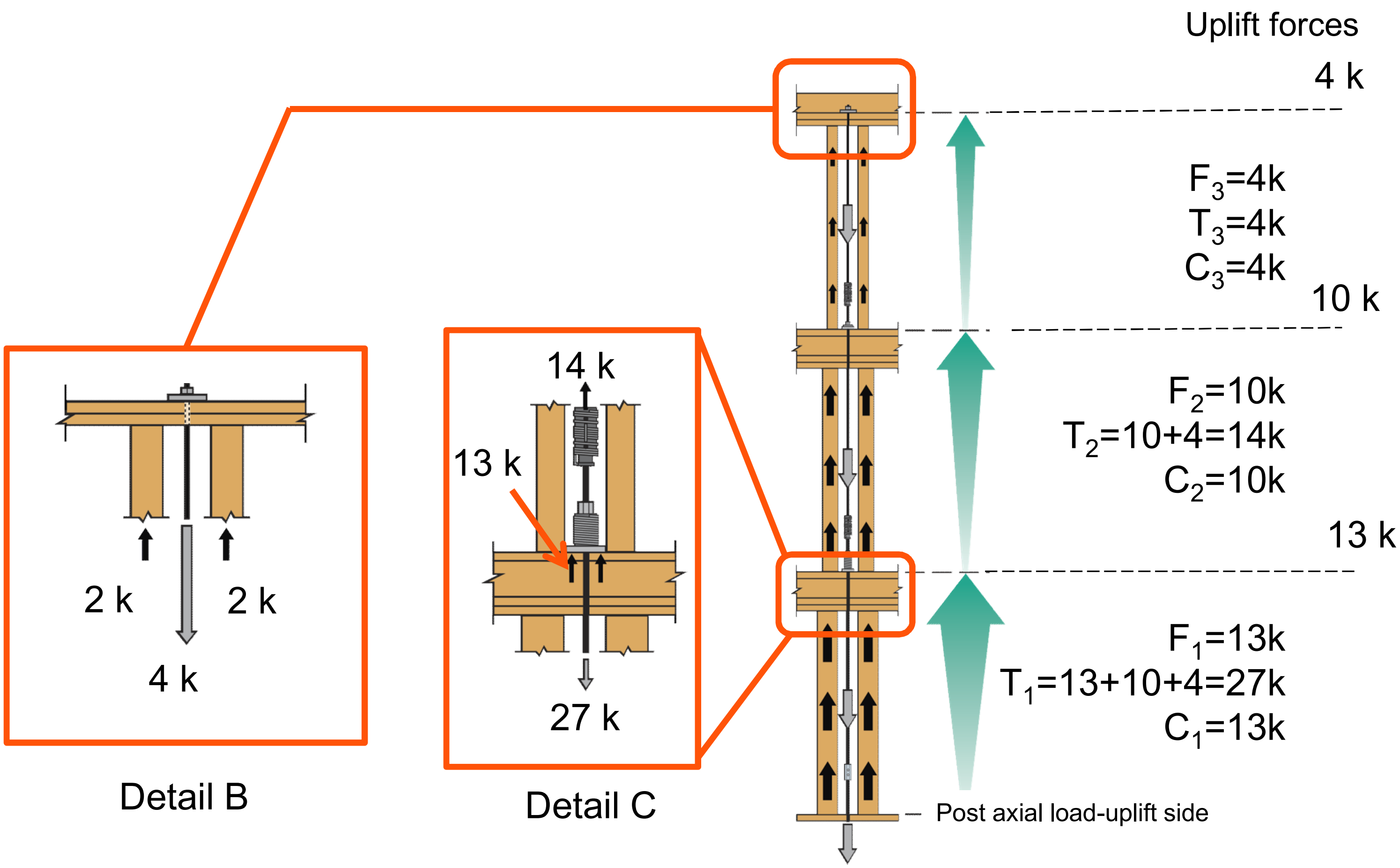

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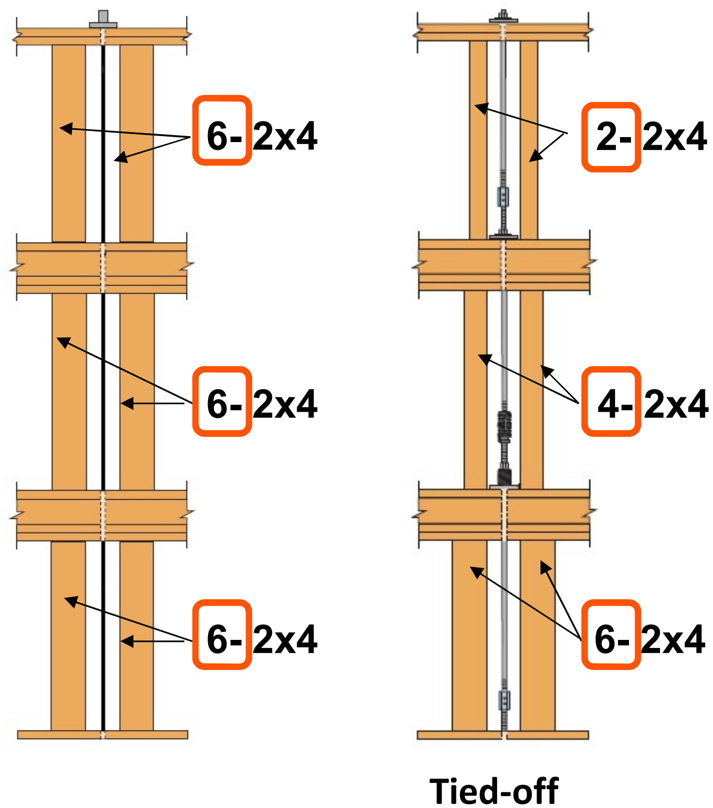
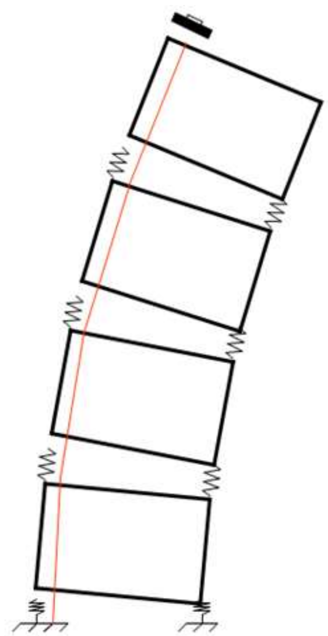
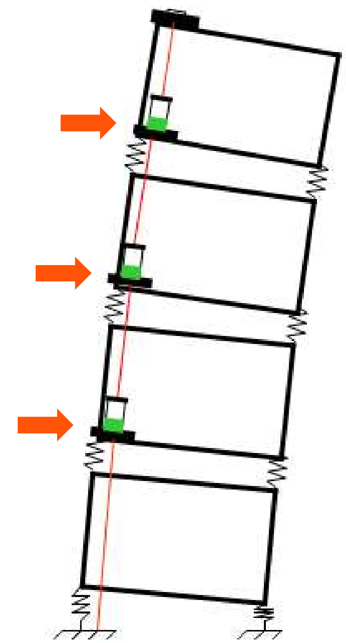


## Al fijar en cada uno de los niveles entrego redundancia al sistema lateral resistente.



Sin Redundancia



Redundancia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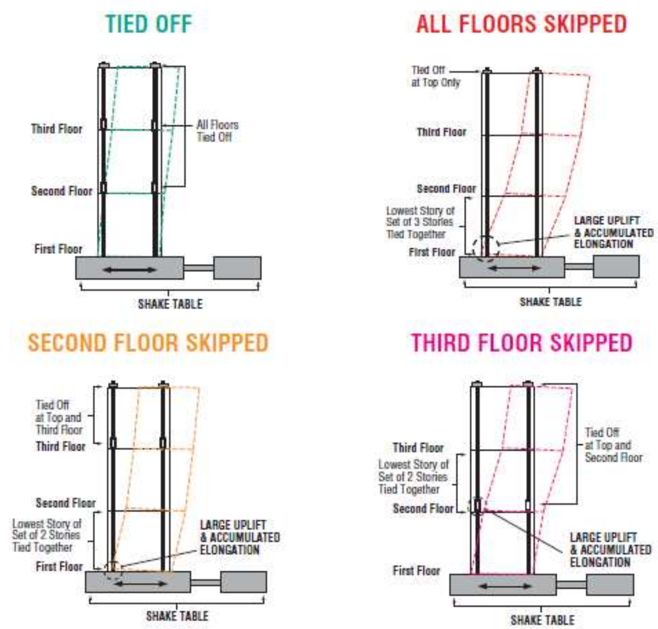
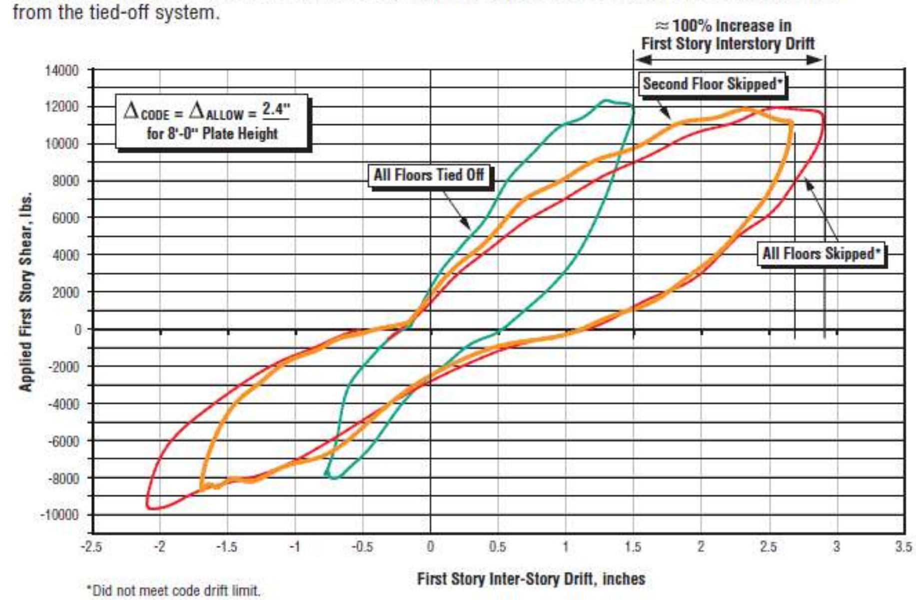



## FIRST STORY INTER-STORY DRIFT COMPARISON

For the all-floors-skipped and the second-floor-skipped configurations, the first story is the bottom story of the group of stories tied together (see system illustrations on page 6). This story experiences the greatest increase in inter-story drift. The graph below compares this drift with that from the tied-off system.



# Efecto de las pérdidas de humedad en estructuras de madera.

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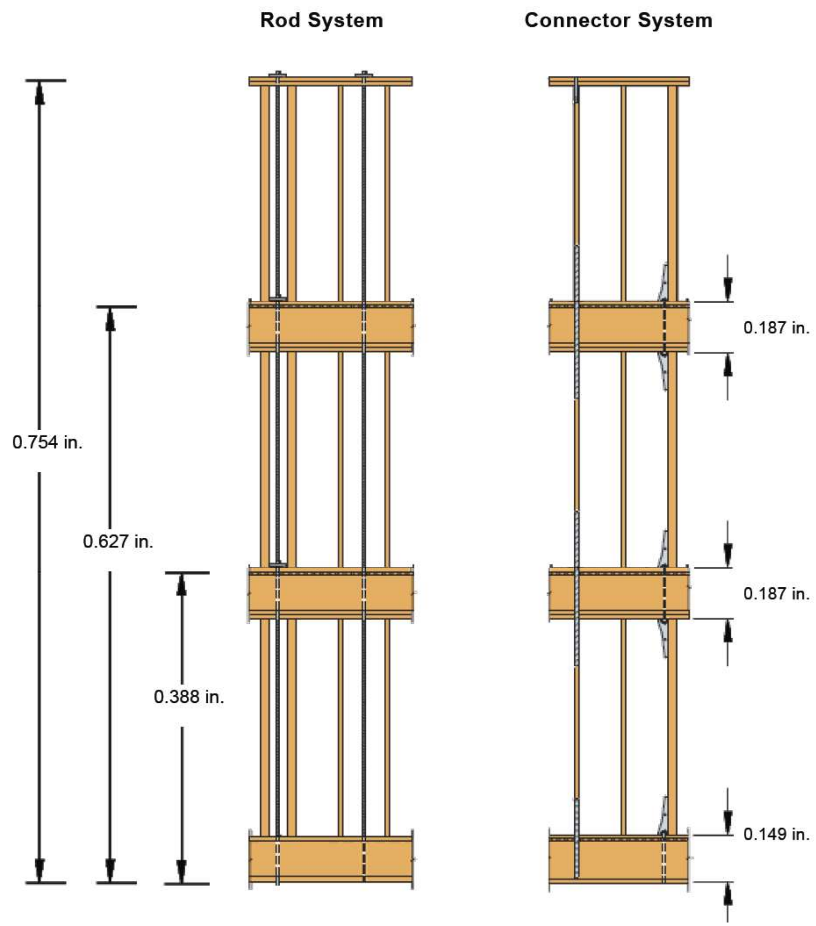

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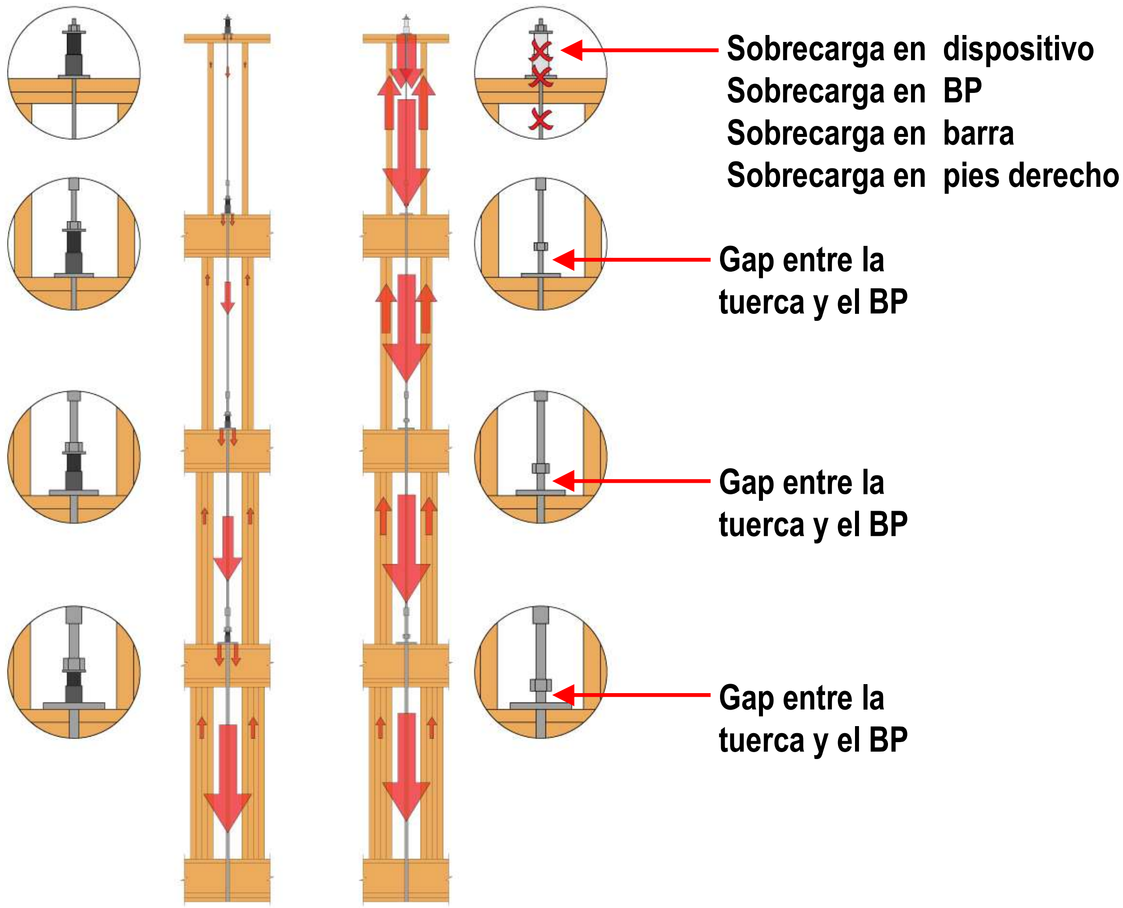
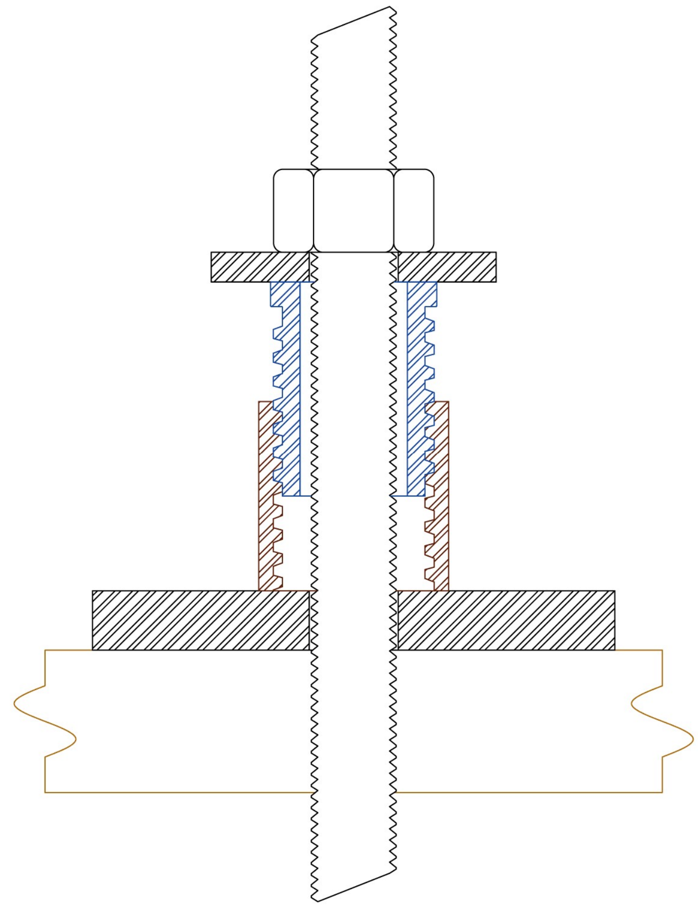


# Se deben implementar dispositivos que permitan compensar estas pérdidas de humedad



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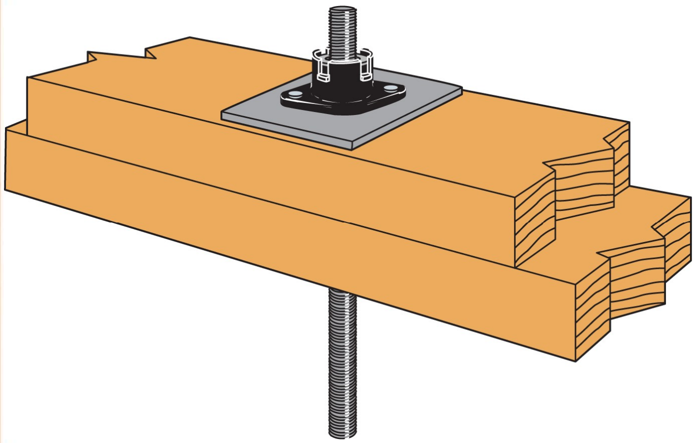
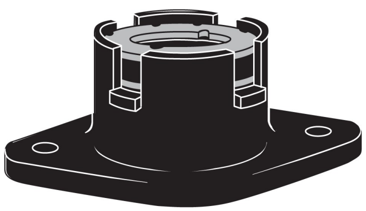
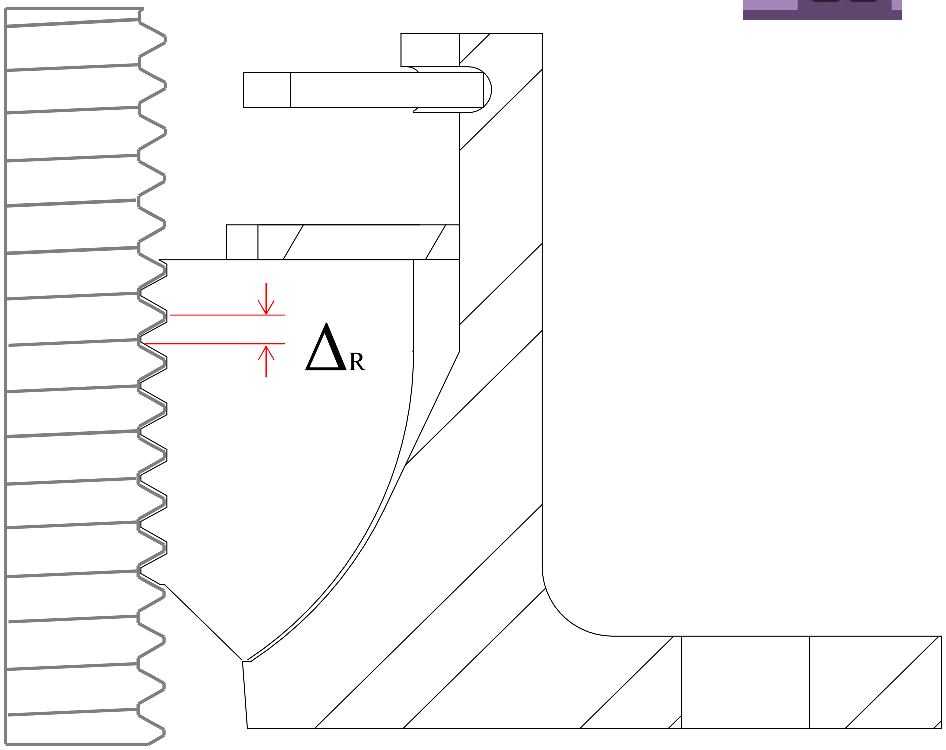
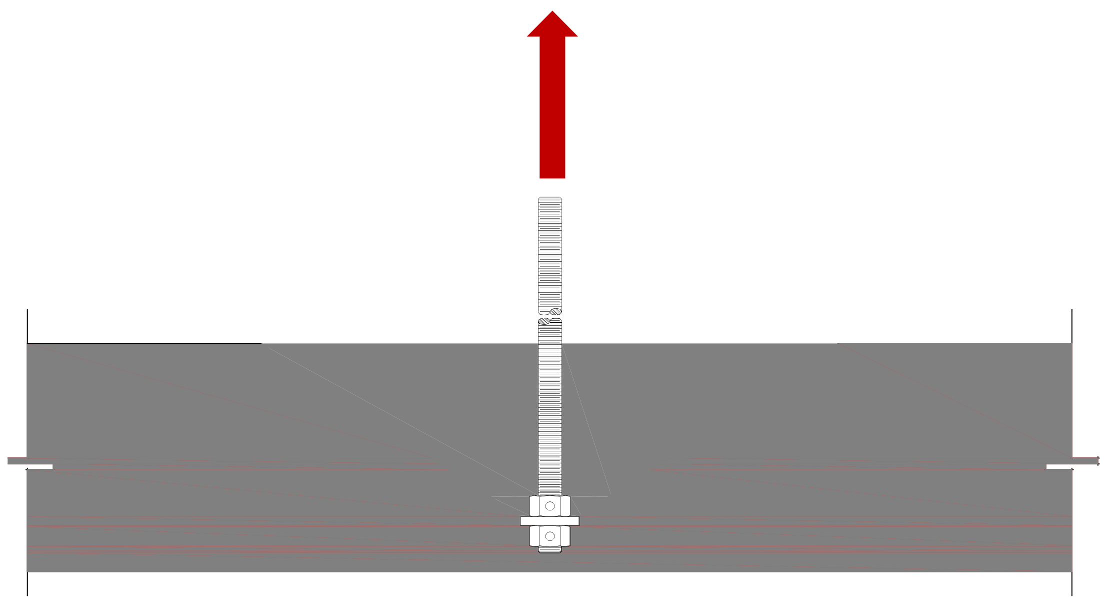






Al anclar el sistema a la fundación, el cono de falla por corte típicamente limita el diseño. Para esta situación el cono se proyecta en un ángulo de 35°.



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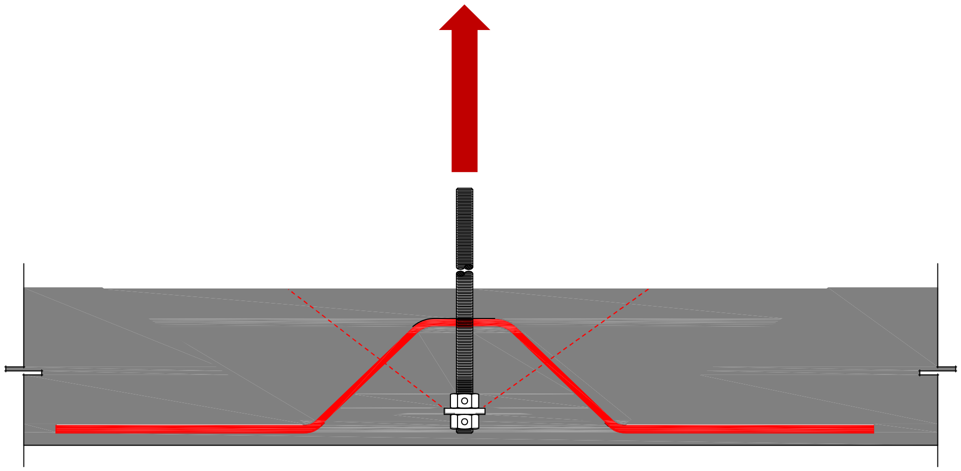

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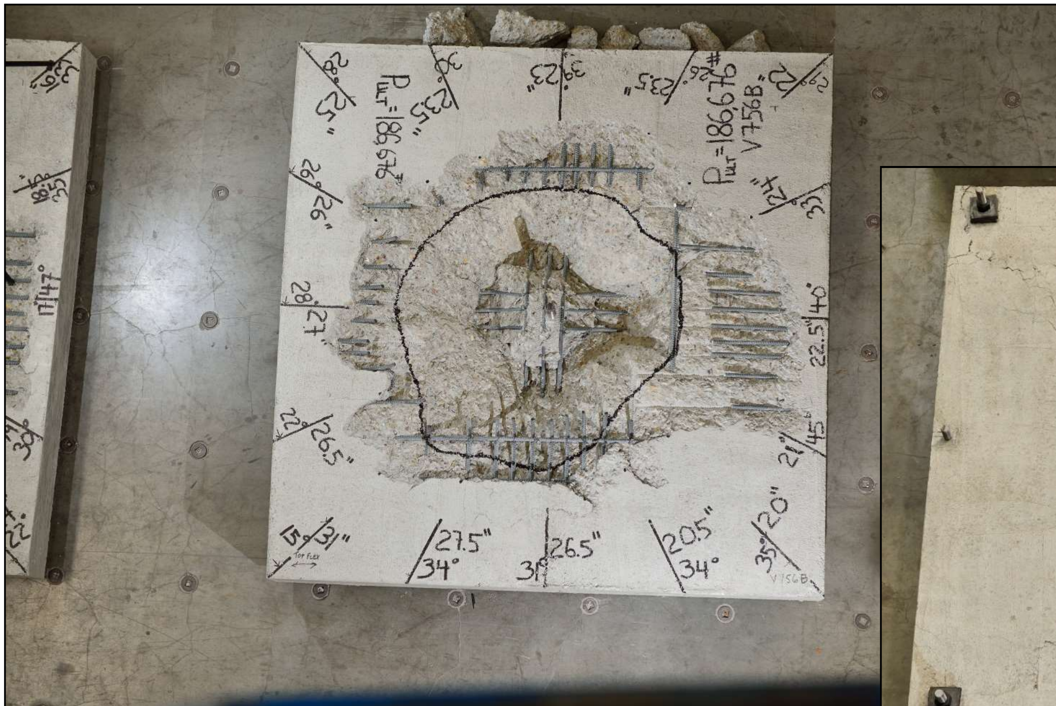


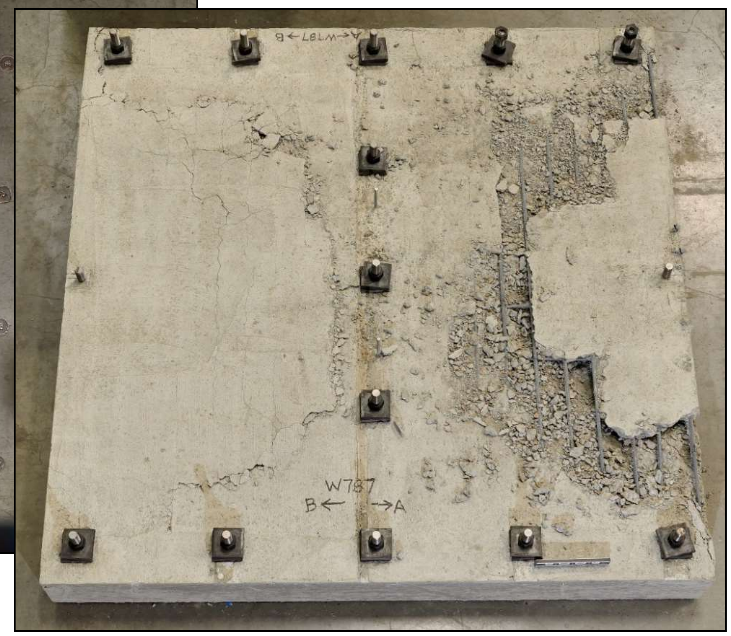

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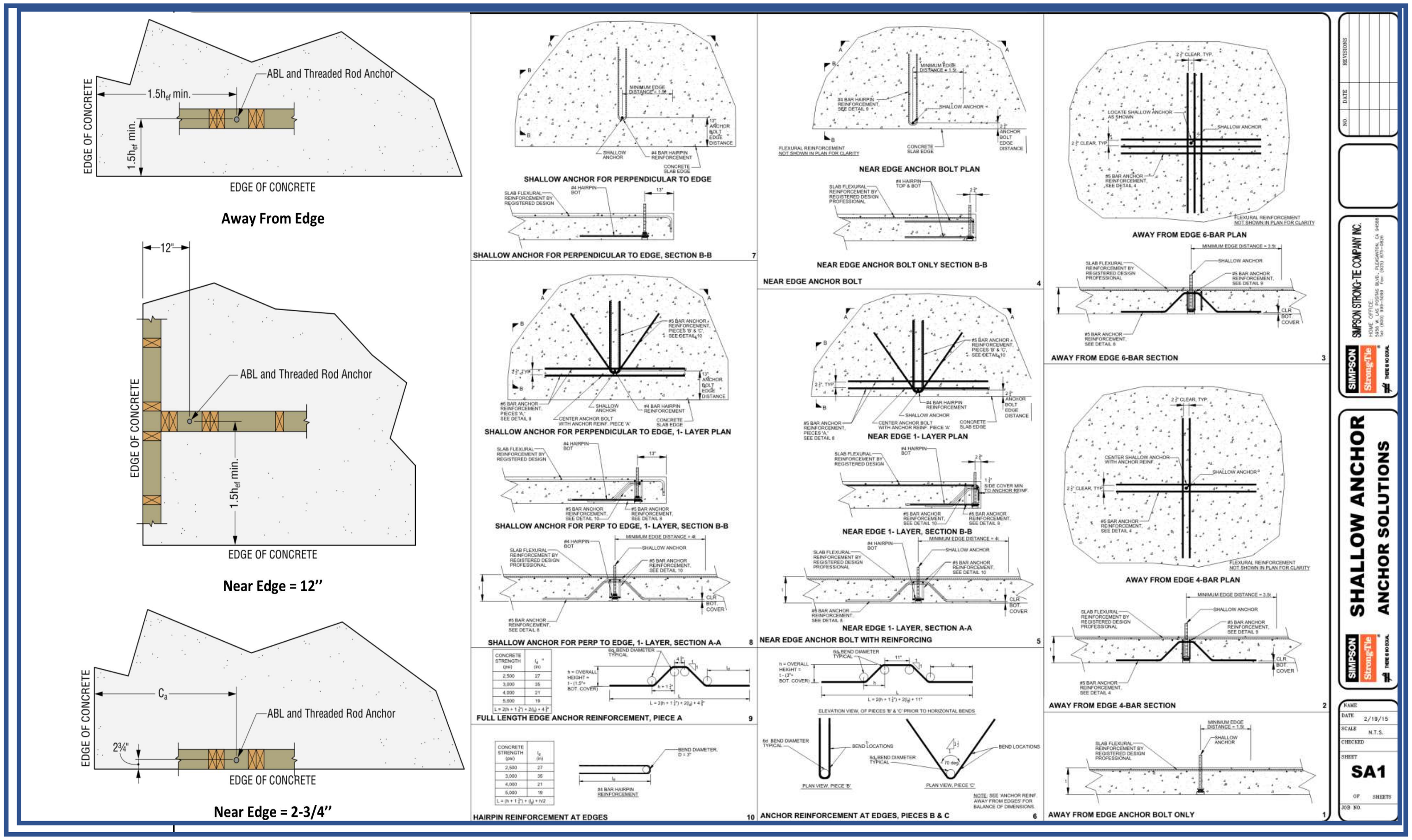


# Garantizar la estabilidad durante la construcción

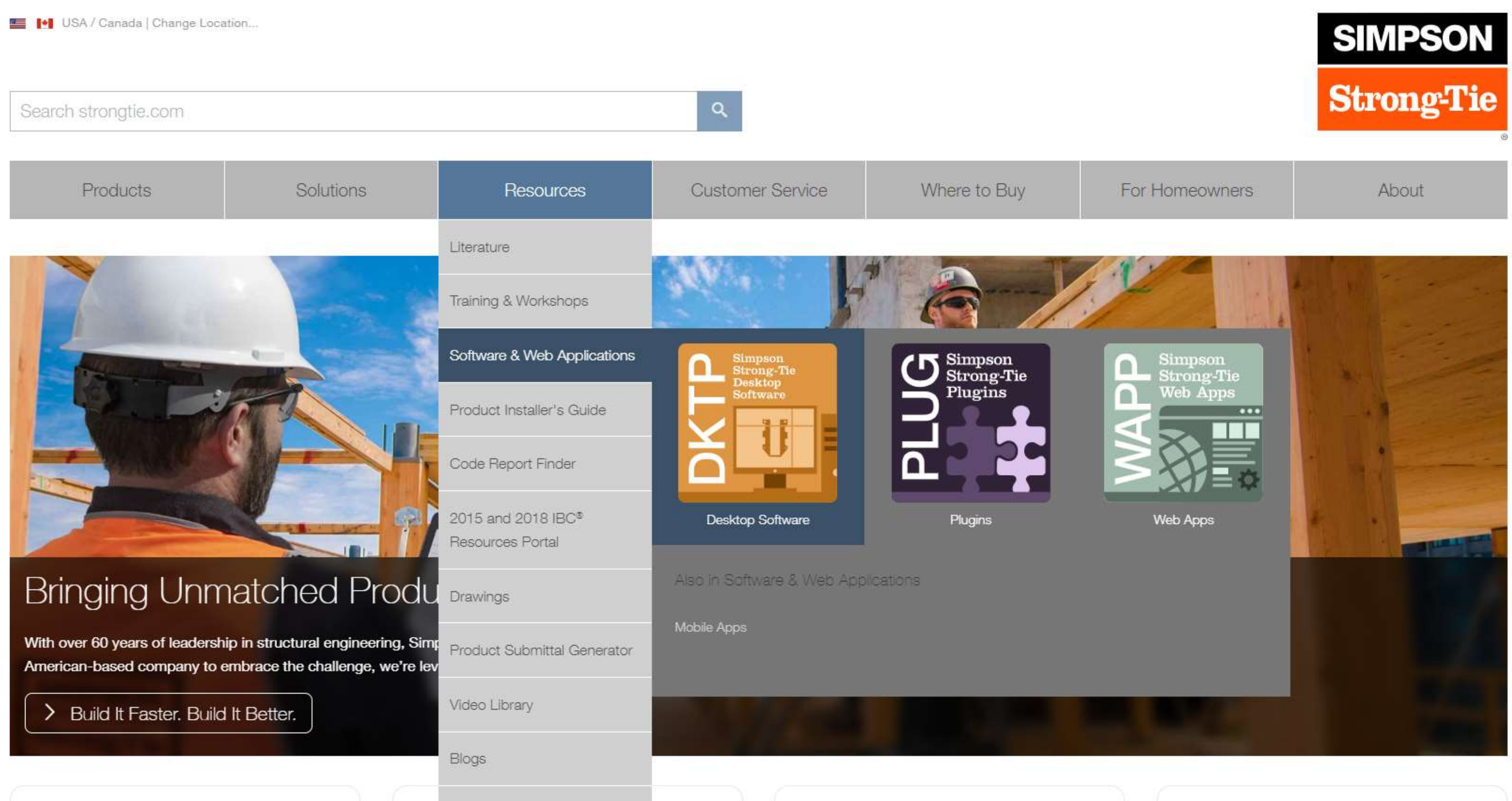
# Design Tools

# A fin de facilitar la aplicación de varios de los principios desarrollados anteriormente

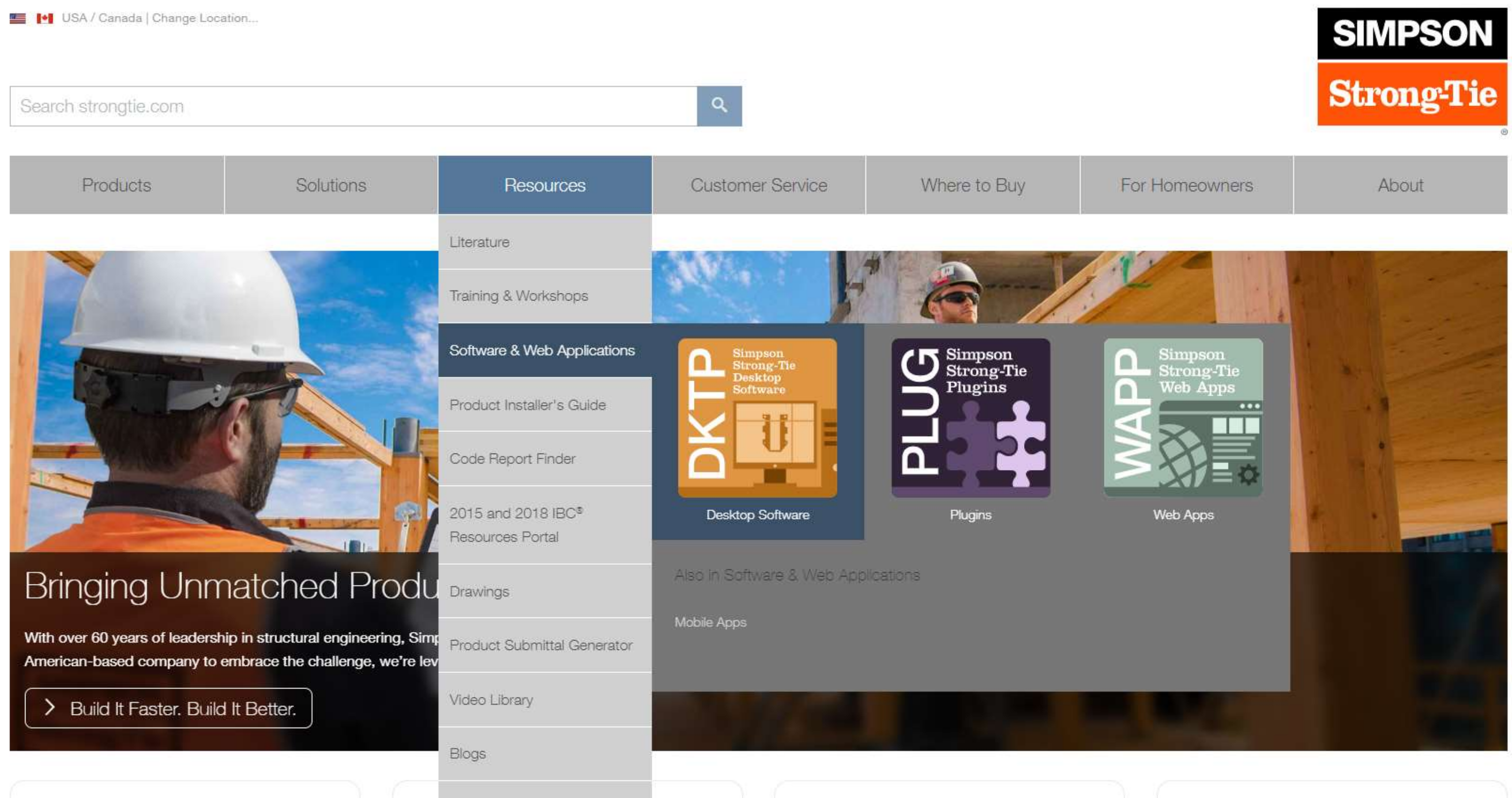

Denotes Desktop App

Denotes Web-Based App

# A fin de facilitar la aplicación de varios de los principios desarrollados anteriormente



# A fin de facilitar la aplicación de varios de los principios desarrollados anteriormente



# Diseño de Muros de corte con base a SDPWS

## Wood Shearwall Selector: Solutions Report

Report Generated: August 25, 2019

### Material Summary

| Sheathing | | | | Nailing[5] | | Holdown[6] | | Endpost | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Sheathing Material | Sheathing Type | Thickness | Number Of Sides | Type And Size | Edge / Field Spacing | Holdown Model | Fasteners | End Studs | Wood Species | Minimum Lumber Grade |
| Sheathing | OSB | 19/32" | 1 | 10d | 3/12 | HDU8-SDS2.5 | 20-SDS 1/4"X2 1/2" | 3-2x4 | DF | Stud |

### Design Summary

| Loading Type | Allowable $v_{ASD}$ (plf) | HD Capacity (lb) | Panel Shear DCR | Post Compression Parallel To Grain DCR | Post Compression Perpendicular To Grain DCR | Post Net Section Tension DCR | Holdown Tension DCR |
|---|---|---|---|---|---|---|---|
| Wind | 698 | 7870 | 0.956 | 0.822 | 0.712 | 0.962 | 0.866 |
| Seismic | 499 | 7870 | 0 | 0 | 0.014 | 0 | 0 |

### Shearwall Deflection Summary[1,2,3]

| Loading Type | Bending Term (in) | Panel Shear And Nail Slip Term (in) | Deflection Due To Vertical Components (in) | Total Wall Horizontal Deflection (in) | Shearwall Drift (in) | Allowable Drift (in) | Drift DCR |
|---|---|---|---|---|---|---|---|
| Wind | 0.041 | 0.162 | 0.261 | 0.464 | 0.464 | 0.533 | 0.870 |
| Seismic | 0 | 0 | 0 | 0 | 0 | 2.400 | 0 |

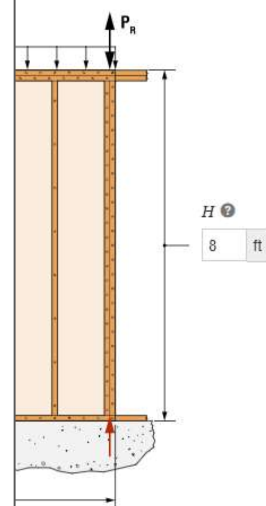
### Shear Anchorage[7]

| Sill Plate Material | |
|---|---|
| Wood Species | DF |
| Minimum Lumber Grade | Stud |
| Sill Size | 2x |

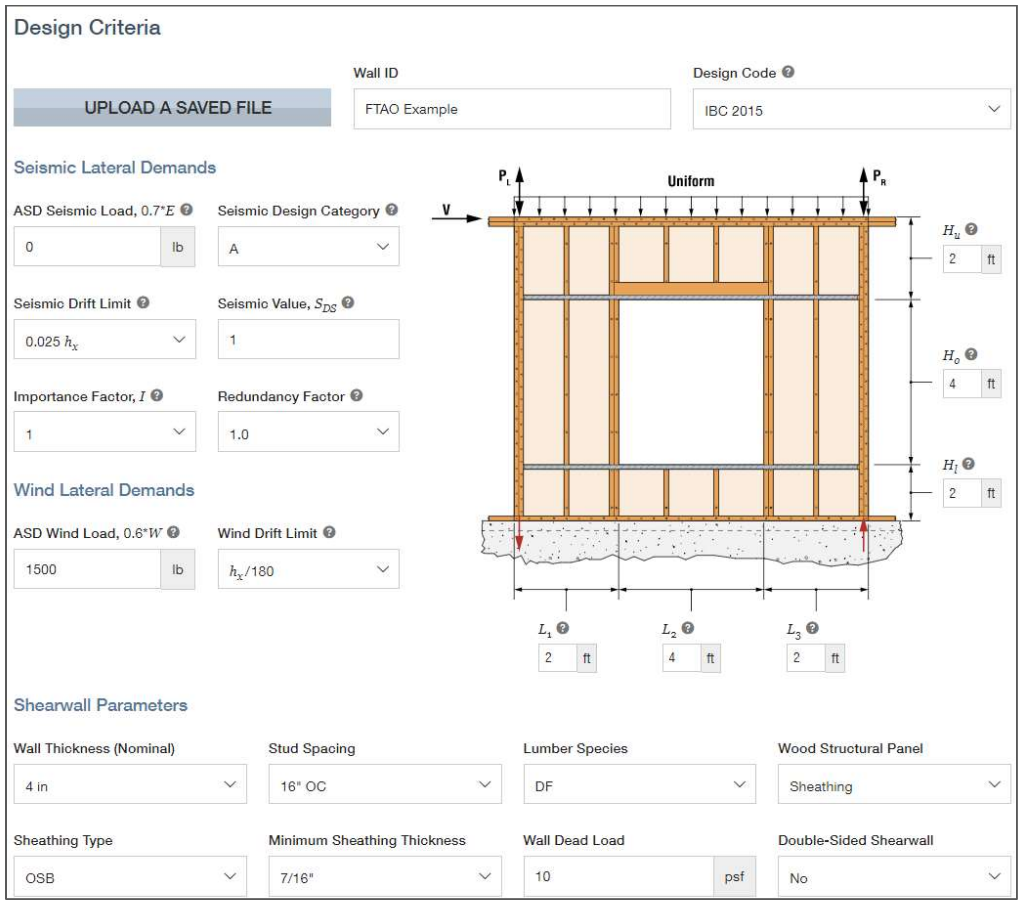
| MASA Solution[4] | |
|---|---|
| Minimum Number of MASA | 2 |
| Side Fasteners | 3-10dx1-1/2 |
| Top Fasteners | 6-10dx1-1/2 |

| Anchor Bolt Solution | |
|---|---|
| Diameter | (2) - 1/2" Diameter |

| Titen HD Solution | |
|---|---|
| Model Number | (2) - THD50600H |



# Diseño de Muros de corte con base a SDPWS




# Determinación de la elongación de las barras del sistema continuo de anclaje

**Tension Load**

Demand Load: 5500 lbs.

**Rod Properties**

Rod Diameter: 5/8"

Length of Rod: 10 ft – 0 in

CALCULATE RESTART

## Calculation Results

**Elongation: 0.101 inches**

1) Rod elongation = PL/(AexE)

Where,

P = **5500 lbs.**

L = **120 inches**

Ae = **0.226 square inches** which is the rod effective net area from AISC.

E = **29000000 psi**

REC Rod Elongation Calculator


# Distema discreto de anclaje

## Post Installed Input Information

Demand Load: 7500 lbs

Wood Species: SPF/HF

CALCULATE

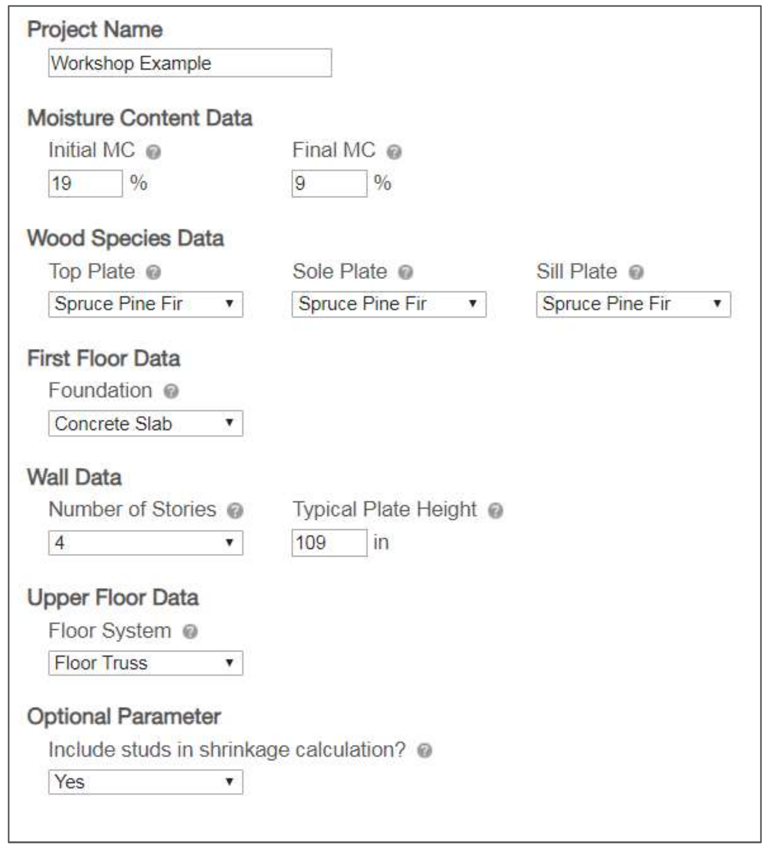
CALCULATION RESULTS | HOLDOWN SELECTOR (US) | AUGUST 25, 2019

### Post Installed Holdown Solutions

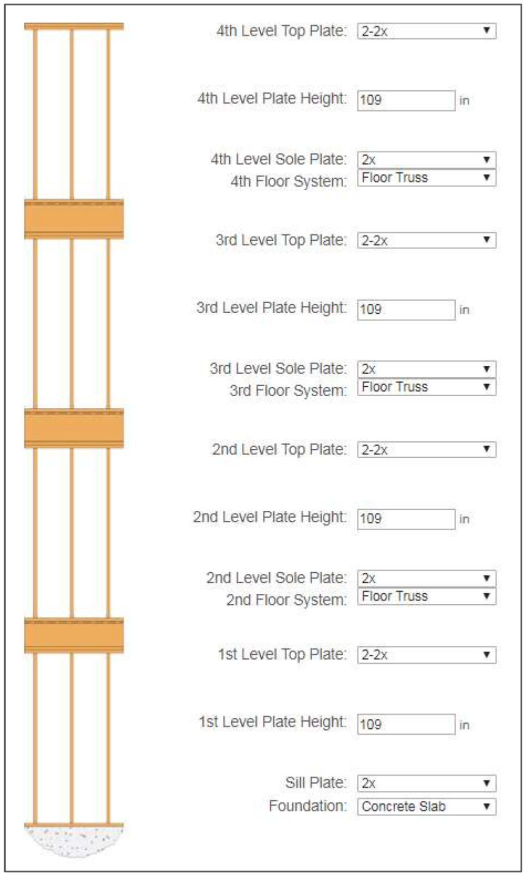
| Holdown Application | Holdown Model | Holdown Capacity | Deflection at Demand Load | Minimum Post Thickness | Anchor Bolt Diameter | Required Fasteners | Installed Cost Index* |
|---|---|---|---|---|---|---|---|
| **Screwed** | **HDU11-SDS2.5** | **8045 lbs** | **0.128 in.** | **7.25 in.** | **1 in.** | **30-SDS 1/4"X2 1/2"** | **Lowest** |
| Screwed | HDU14-SDS2.5 | 10350 lbs | 0.128 in. | 5.5 in. | 1 in. | 36-SDS 1/4"X2 1/2" | +23% |
| Screwed | HHDQ11-SDS2.5 | 8505 lbs | 0.116 in. | 5.5 in. | 1 in. | 24-SDS 1/4"X2 1/2" | +125% |
| Screwed | HHDQ14-SDS2.5 | 9370 lbs | 0.086 in. | 7.25 in. | 1 in. | 30-SDS 1/4"X2 1/2" | +128% |
| **Bolted** | **HD9B** | **8435 lbs** | **0.158 in.** | **4.5 in.** | **7/8 in.** | **3-7/8"x6" M.B.** | **+102%** |

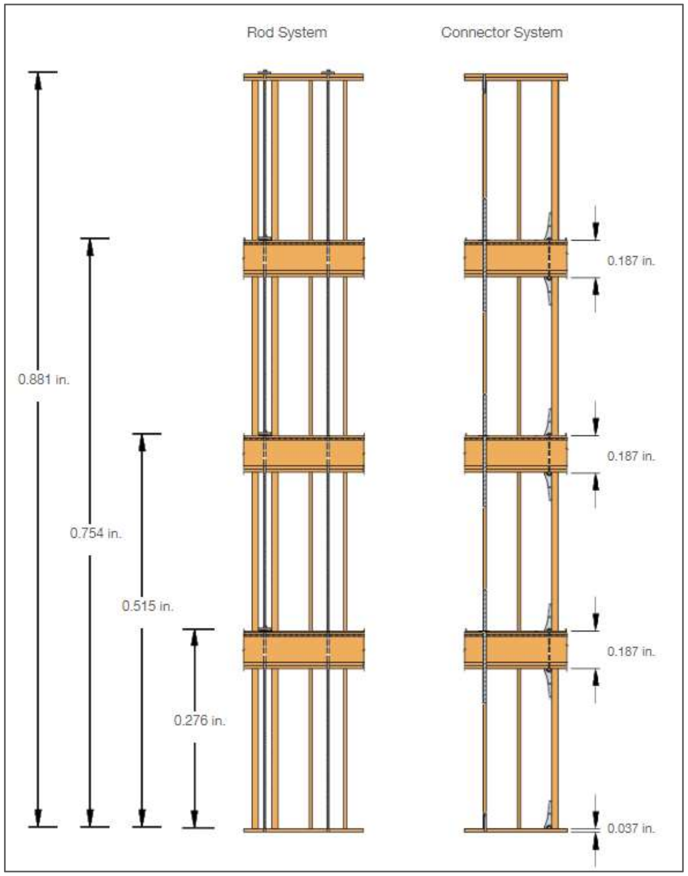
HS Holdown Selector

# Estimación de la pérdida de humedad


Project Name
Workshop Example
Moisture Content Data
Initial MC
19 %
Final MC
9 %
Wood Species Data
Top Plate
Spruce Pine Fir
Sole Plate
Spruce Pine Fir
Sill Plate
Spruce Pine Fir
First Floor Data
Foundation
Concrete Slab
Wall Data
Number of Stories
4
Typical Plate Height
109 in
Upper Floor Data
Floor System
Floor Truss
Optional Parameter
Include studs in shrinkage calculation?
Yes

# Estimación de la pérdida de humedad



# Transferencia de carga continua

## Load Data

Enter Demand Load

4580 lbs.

## Strap Data

Coiled Strap Model

CMSTC16

☑ Installed over Sheathing

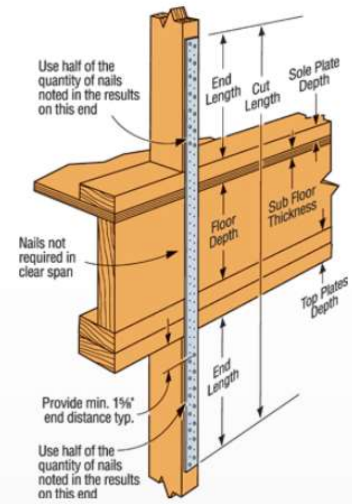
## Nail Data

Nail Diameter: 0.148 in.

Nail length: 2 1/2 in.

Wood Species: SPF

CALCULATE




| CALCULATION RESULTS | COILED STRAP DESIGNER | AUGUST 25, 2019 |
|---|---|---|

COILED STRAP MODEL: **CMSTC16**

NAIL SIZE: **0.148 in. x 2 1/2 in.**

END NAILS: **28**

TOTAL NAILS: **56**

NUMBER OF STUDS: **Double**

STRAP CAPACITY: **4585 lbs**

RESTART | PRINT | EXPORT DATA TO CUT LENGTH CALCULATOR

CSC Coiled Strap Calculator

# Diseño de muros de alta resistencia


**Design Criteria:**

* 2012 International Bldg Code
* Seismic R=6.5
* 2500 psi concrete
* 2nd Story Wall Design Shear = 1000 lbs
* 1st Story Wall Design Shear = 1000 lbs
* Floor Joist Dept

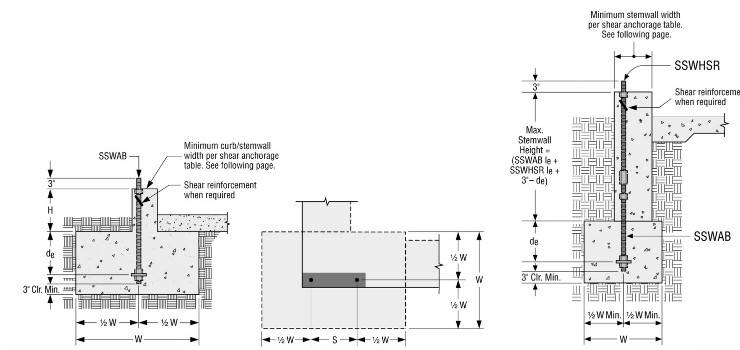
**Selected Stror**

| Model |
|---|
| SSW18x8 |
| SSW18x8 |
| SSW18x8-STK |
| SSW18x8-STK |

**Actual Shear &**

| Model |
|---|
| SSW18x8 |
| SSW18x8 |
| SSW18x8-STK |
| SSW18x8-STK |

**Anchor Solution Details:**




Curb or Stemwall Section View

Footing Plan

Section at Stemwall SSWAB and SSWHSR Extension Application

**Anchor Solution Assuming Cracked Concrete Design:**

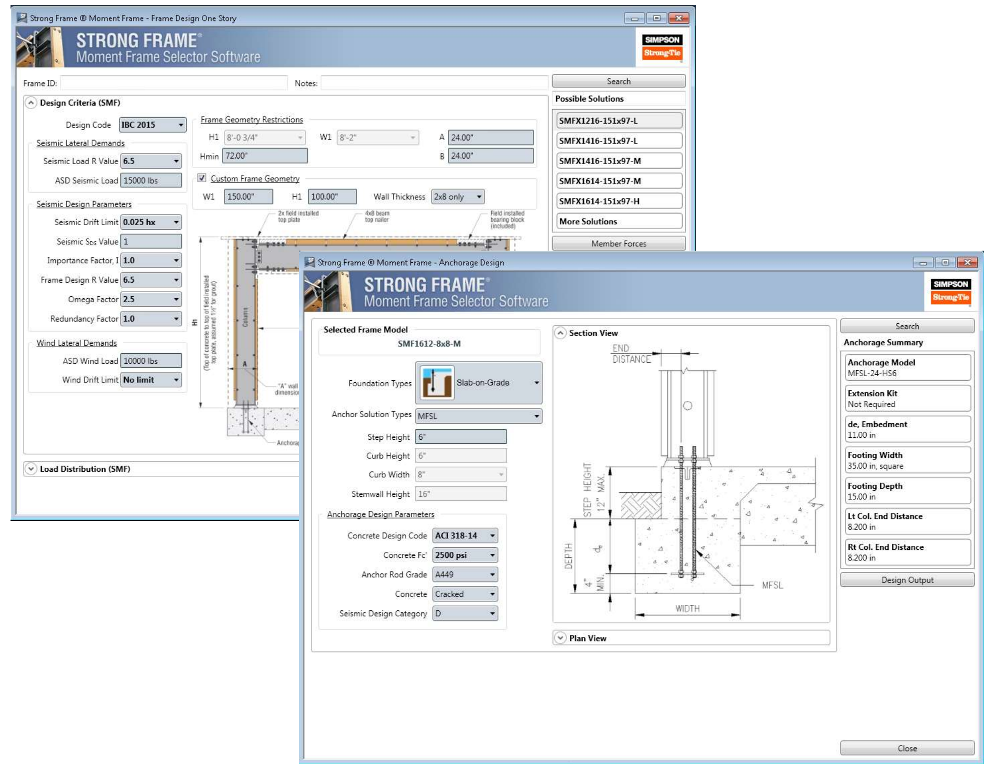
| Model | W | de | S | Anchor Bolt | Strength |
|---|---|---|---|---|---|
| SSW18 | 33 | 11 | 12.25 | SSWAB1 | Standard |

**Anchor Solution Assuming Uncracked Concrete Design:**

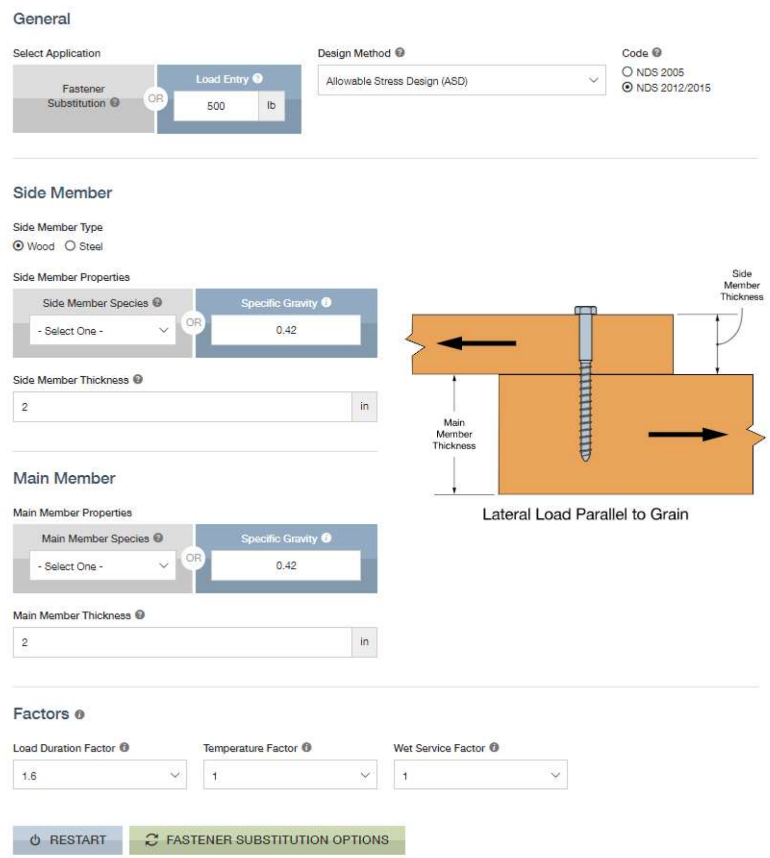
| Model | W | de | S | Anchor Bolt | Strength |
|---|---|---|---|---|---|
| SSW18 | 28 | 10 | 12.25 | SSWAB1 | Standard |

SWSS Strong-Wall® Shearwall Selector

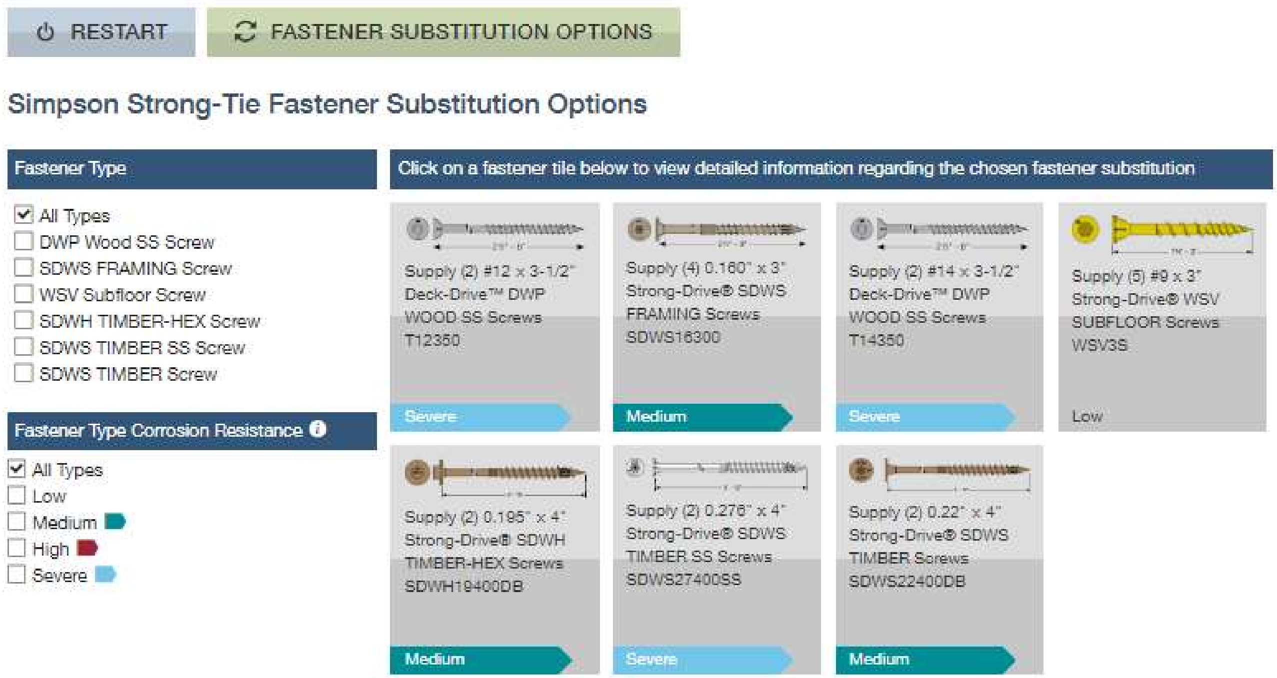
# Diseño de Muros Especiales de Momento



# Diseño de Fijaciones basado en modelo de fluencia de la NDS



# Diseño de Fijaciones basado en modelo de fluencia de la NDS




Fastener Designer

# Diseño de Fijaciones basado en modelo de fluencia de la NDS


## Input

| Input | SST Fastener Capacity |
|---|---|
| Design Method | Allowable Stress Design (ASD) |
| Code | NDS 2012/2015 |
| Main Member Thickness, $t_m$ (in) | 2 |
| Side Member Thickness, $t_s$ (in) | 2 |
| Dowel Length, l (in) | 4.0 |
| Main Member Bearing Angle, $\theta_m$ (deg) | 0 |
| Side Member Bearing Angle, $\theta_s$ (deg) | 0 |
| Main Member Specific Gravity, $G_m$ | 0.42 |
| Side Member Specific Gravity, $G_s$ | 0.42 |
| Actual Diameter, D (in) | 0.219 |
| Load (lb) | 500 |
| Load Duration Factor, $C_D$ | 1.6 |
| Temperature Factor, $C_t$ | 1 |
| Wet Service Factor, $C_M$ | 1 |
| End Grain Factor, $C_{eg}$ | 1 |


# Diseño de Fijaciones basado en modelo de fluencia de la NDS

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| Wet Service Factor, $C_M$ | 1 |
| End Grain Factor, $C_{eg}$ | 1 |

Fastener Designer


# Diseño de Fijaciones basado en modelo de fluencia de la NDS

Penetration Check

| Penetration Check Detail | SST Fastener Capacity |
|---|---|
| Penetration, p (in) | 1.78 |
| Minimum Penetration Requirement, $p_{min}$ (in) | 6D = 1.31 |
| Minimum Penetration Requirement Met | Yes |

End/Edge Distance and Spacing

| End Distance, Edge Distance, and Spacing | SST Fastener Capacity |
|---|---|
| | See figure below the fastener image for end distance, edge distance, and spacing requirements |

Calculated Reference Design Value

| Yield Mode | Yield Limit Equation | SST Fastener Capacity | |
|---|---|---|---|
| | | Yield Limit, Z | Reduction Term, $R_D$ |
| Mode $I_m$ | $Z = \frac{D l_m F_{em}}{R_d}$ | Z = 478 lb | $R_D = 2.5$ |
| Mode $I_s$ | $Z = \frac{D l_s F_{es}}{R_d}$ | Z = 537 lb | $R_D = 2.5$ |
| Mode II | $Z = \frac{k_1 D l_s F_{es}}{R_d}$ | Z = 211 lb | $R_D = 2.5$ |
| Mode $III_m$ | $Z = \frac{k_2 D l_m F_{em}}{(1+2R_e)R_d}$ | Z = 203 lb | $R_D = 2.5$ |
| Mode $III_s$ | $Z = \frac{k_3 D l_s F_{em}}{(2+R_e)R_d}$ | Z = 219 lb | $R_D = 2.5$ |
| Mode IV | $Z = \frac{D^2}{R_d}\sqrt{\frac{2F_{em}F_{yb}}{3(1+R_e)}}$ | Z = 212 lb | $R_D = 2.5$ |

| | |
|---|---|
| Minimum Yield Value | Z = 203 lb |
| Tested Yield Value | Z = 285 lb |
| Adjusted Yield Value | Z = 456 lb |

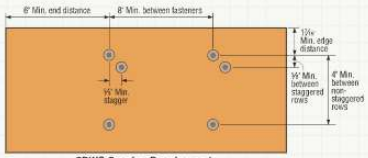
**40% de ganancia en capacidad**

# Diseño de Fijaciones basado en modelo de fluencia de la NDS

### Solution

Supply (2) 0.22" × 4" Strong-Drive® SDWS TIMBER Screws SDWS22400DB

Strong-Drive® SDWS TIMBER Screw


SDWS Spacing Requirements

**Structural Wood-to-Wood Connections Including Ledgers**

Designed to provide an easy-to-install, high-strength alternative to through-bolting and traditional lag screws. The SDWS structural wood screws are ideal for the contractor and do-it-yourselfer alike.

**Features:**

- Bold thread design that provides superior holding power.
- Patented SawTooth™ point ensures fast starts, reduces installation torque and eliminates the need for pre-drilling in most applications.
- Under-head nibs that offer greater control when seating the head.
- Large low-profile washer head provides maximum bearing area(0.75" head dia.).
- Size identification on all SDWS screw heads.
- 6-lobe T-40 drive reduces driver-bit cam-outs, resulting in easier installations and longer bit life.

Double-barrier coating provides corrosion resistance equivalent to hot-dip galvanization, making it suitable for certain exterior and preservative-treated wood applications, as described in the evaluation report.

**Notes:**

1. Loads are based on installation into side grain of the wood with the screw axis perpendicular to the face of the member.
2. Adjusted yield value includes the adjustment factors selected above.
3. The tested yield value is based on testing conducted in accordance with AC233. It is the average ultimate test value divided by 5. If no testing was done for the selected thickness then the minimum yield value is calculated based on National Design Specification for Wood Construction.
4. View our literature for more information on ledger connections
5. For all other general information refer to the Fastening Systems Catalog

**Codes/Standards:** IAPMO-UES ER-192, State of Florida FL13975

**Product Information:** Strong-Drive SDWS TIMBER Screw

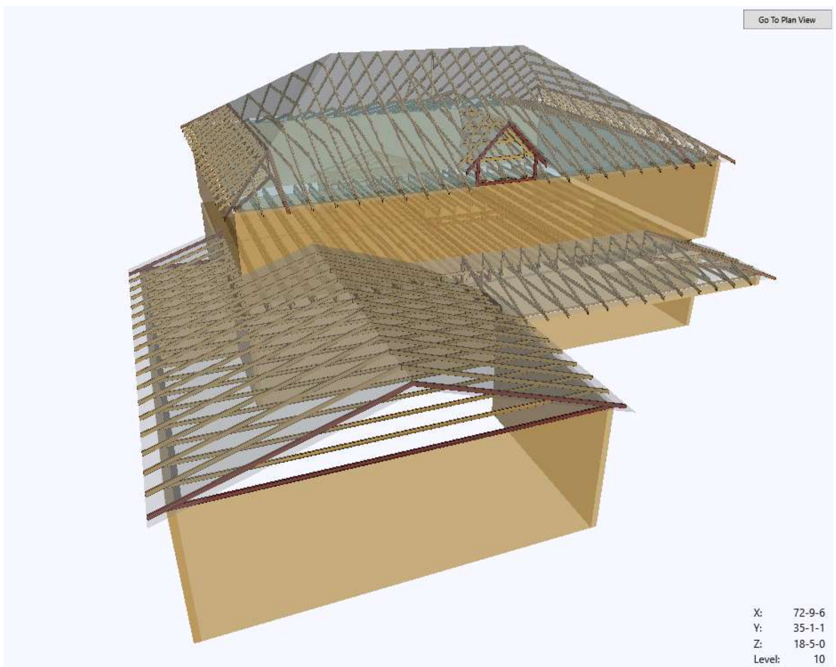
**U.S. Patents:** 5,897,280 and 7,101,133

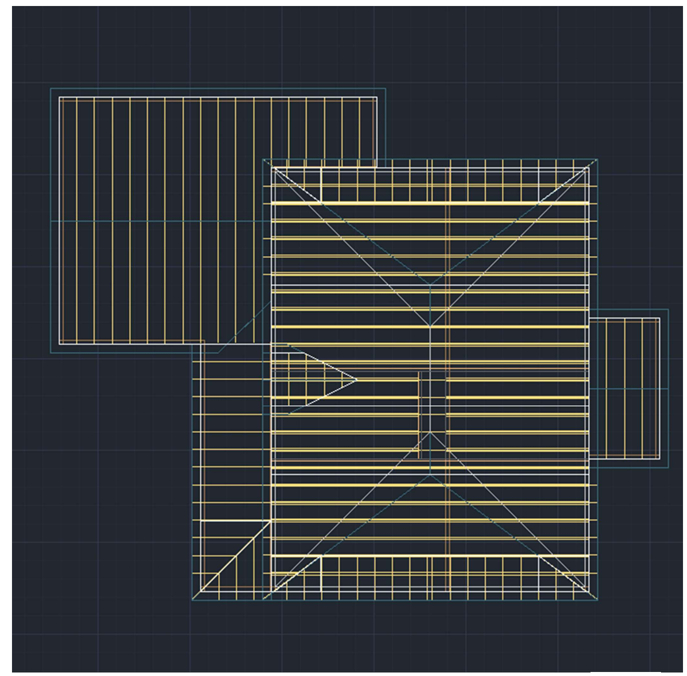
RESTART　CREATE PDF

Fastener Designer

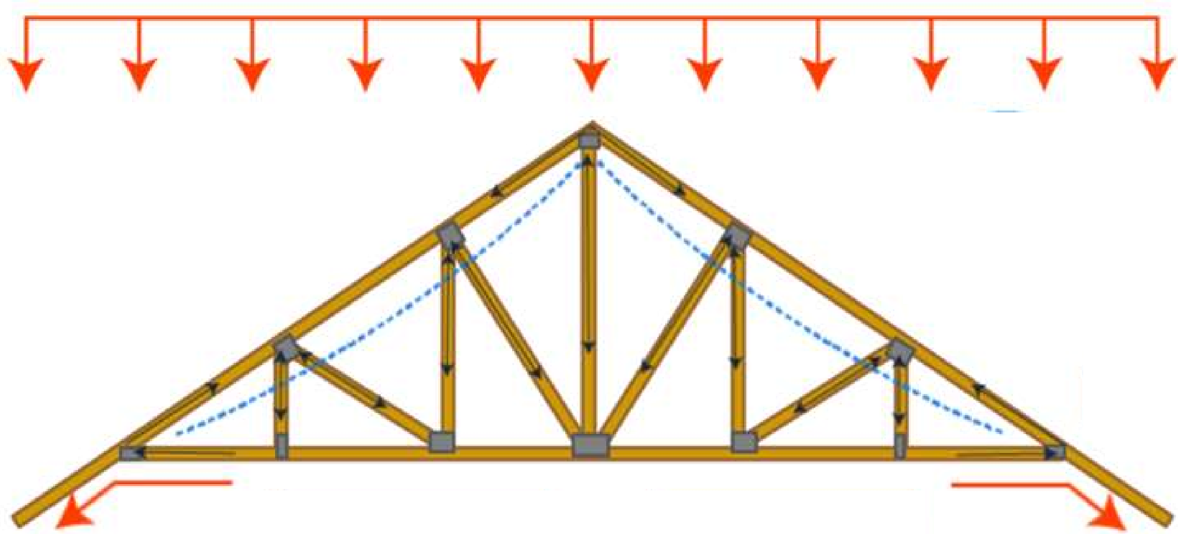
# Sistema Integrado para el diseño de cerchas

# Sistema Integrado para el diseño de cerchas



# Sistema Integrado para el diseño de cerchas

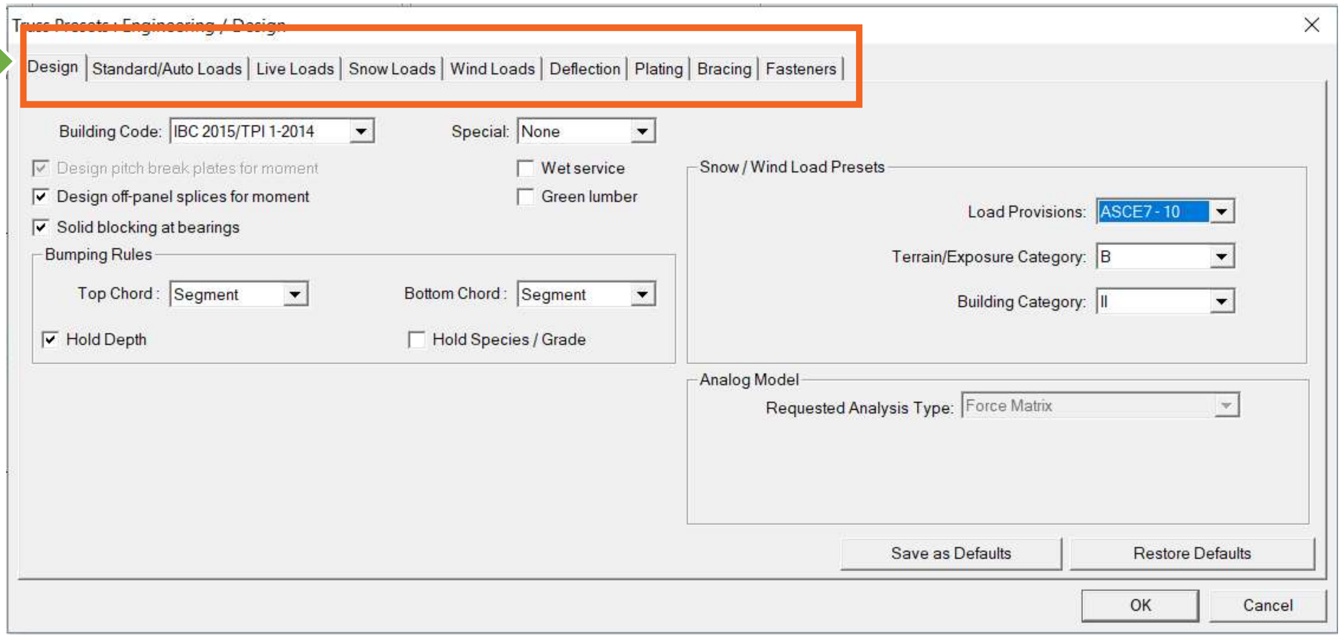


Tensiones Solicitantes $\leq$ Tensiones Admisibles

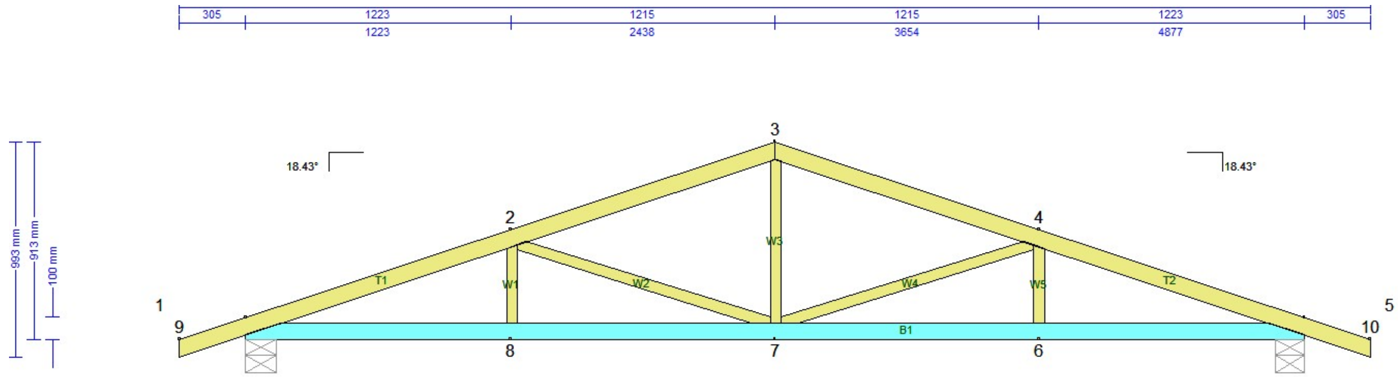
# Sistema Integrado para el diseño de cerchas

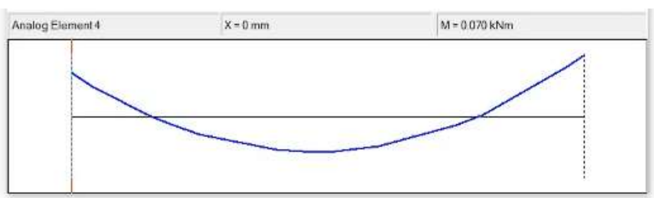
**Inputs para el Diseño:**

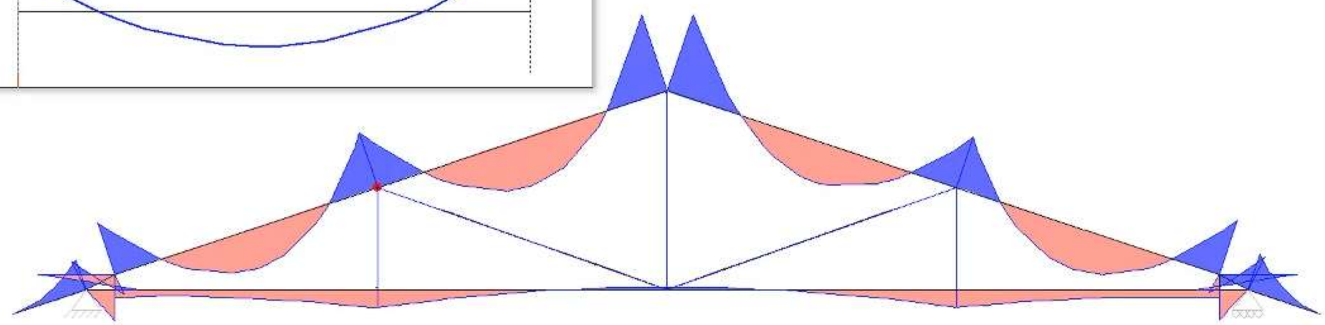
- Carga Muerta
- Carga Viva
- Carga Nieve
- Carga Viento
- Deflexión



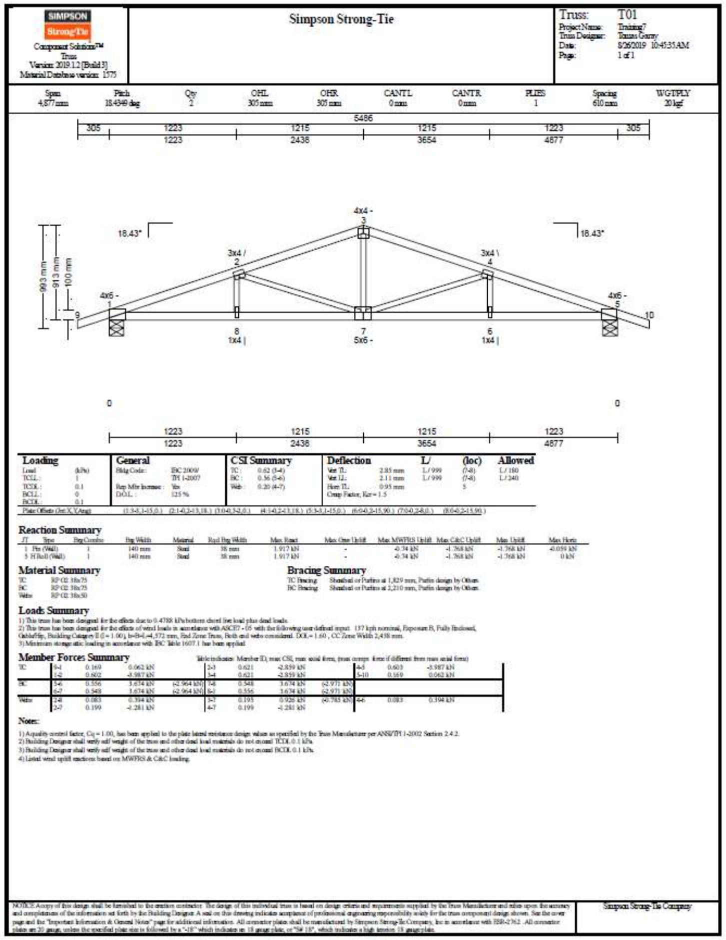
# Sistema Integrado para el diseño de cerchas



# Sistema Integrado para el diseño de cerchas


Simpson Strong-Tie

Truss: T01

Loading | General | CSI Summary | Deflection | L/ | (loc) | Allowed

Reaction Summary

Material Summary

Bracing Summary

Loads Summary

Member Forces Summary

Notes:

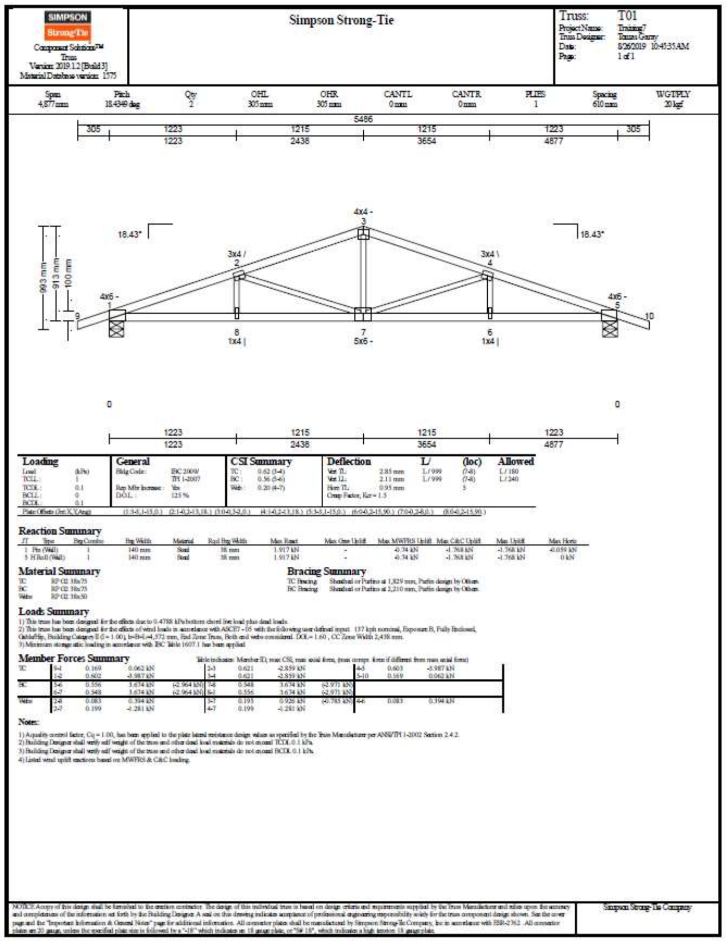
## Elementos:

- Piezas de madera
- Placas dentadas

## Análisis:

- Reacciones en apoyos
- Deflexión máxima
- Esfuerzos máximos


# Sistema Integrado para el diseño de cerchas


Simpson Strong-Tie

Truss: T01

Loading

General

CSI Summary

Deflection

Reaction Summary

Material Summary

Bracing Summary

Loads Summary

Member Forces Summary

Notes:

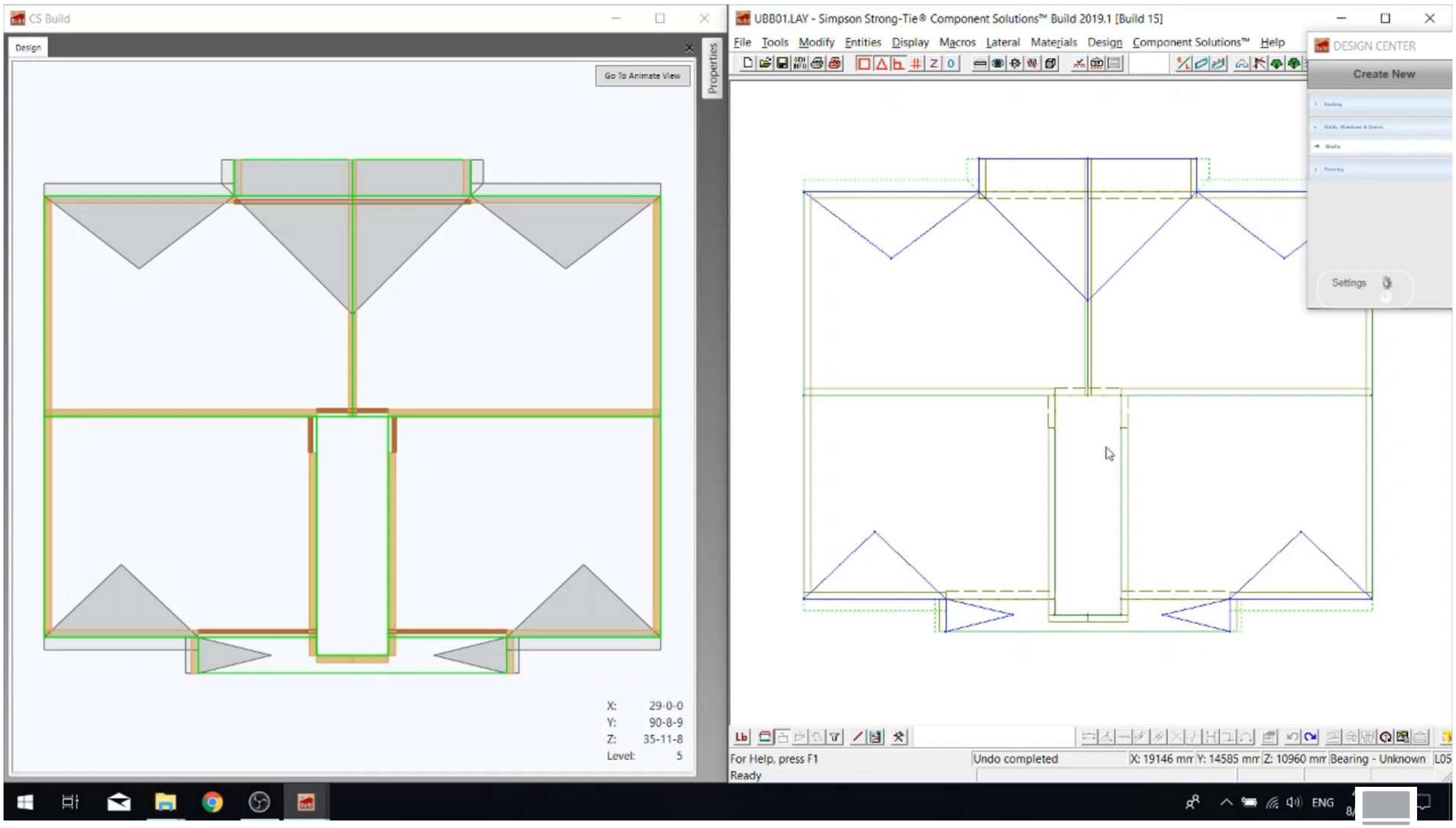
```
T1,T2                                    OL: 2,917 mm

     71.6/ /    2,892 mm  ^/71.6/

(4) 38x75 RP G2-3,000 mm                   Default
```

```
W1                                         OL: 362 mm

                     345 mm
    90|              354 mm        71.6\
                     362 mm
(4) 38x50 RP G2-500 mm                     Default
```

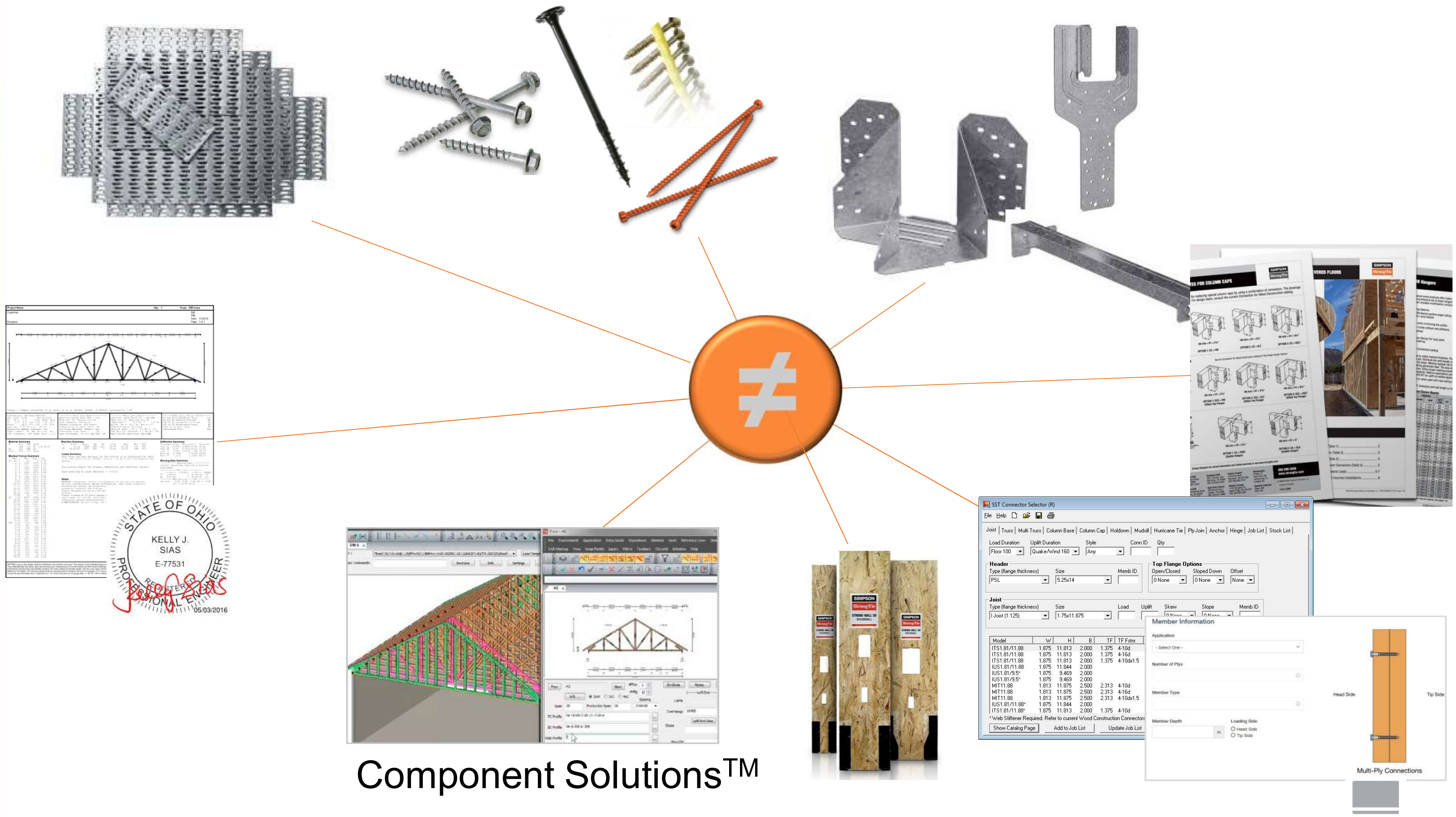
```
B1,B2
                                  162 mm
SCARF: 171 mm
BUTT:  21 mm                             54 mm
                                         21 mm
```

```
W3                                         OL: 759 mm

                                   71.6\
    90|             759 mm
                                   71.6/
(2) 38x50 RP G2-1,000 mm                   Default
```

# Sistema Integrado para el diseño de cerchas

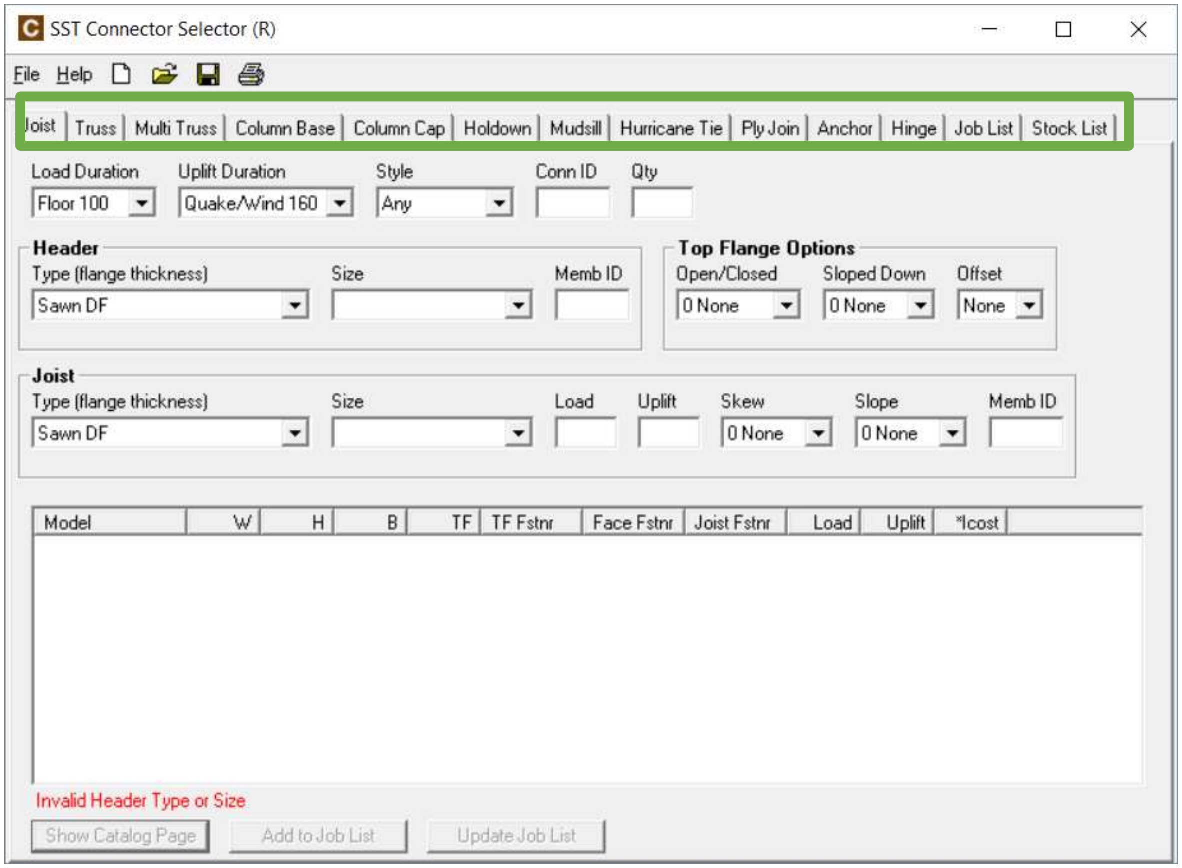



# Sistema Integrado para el diseño de cerchas

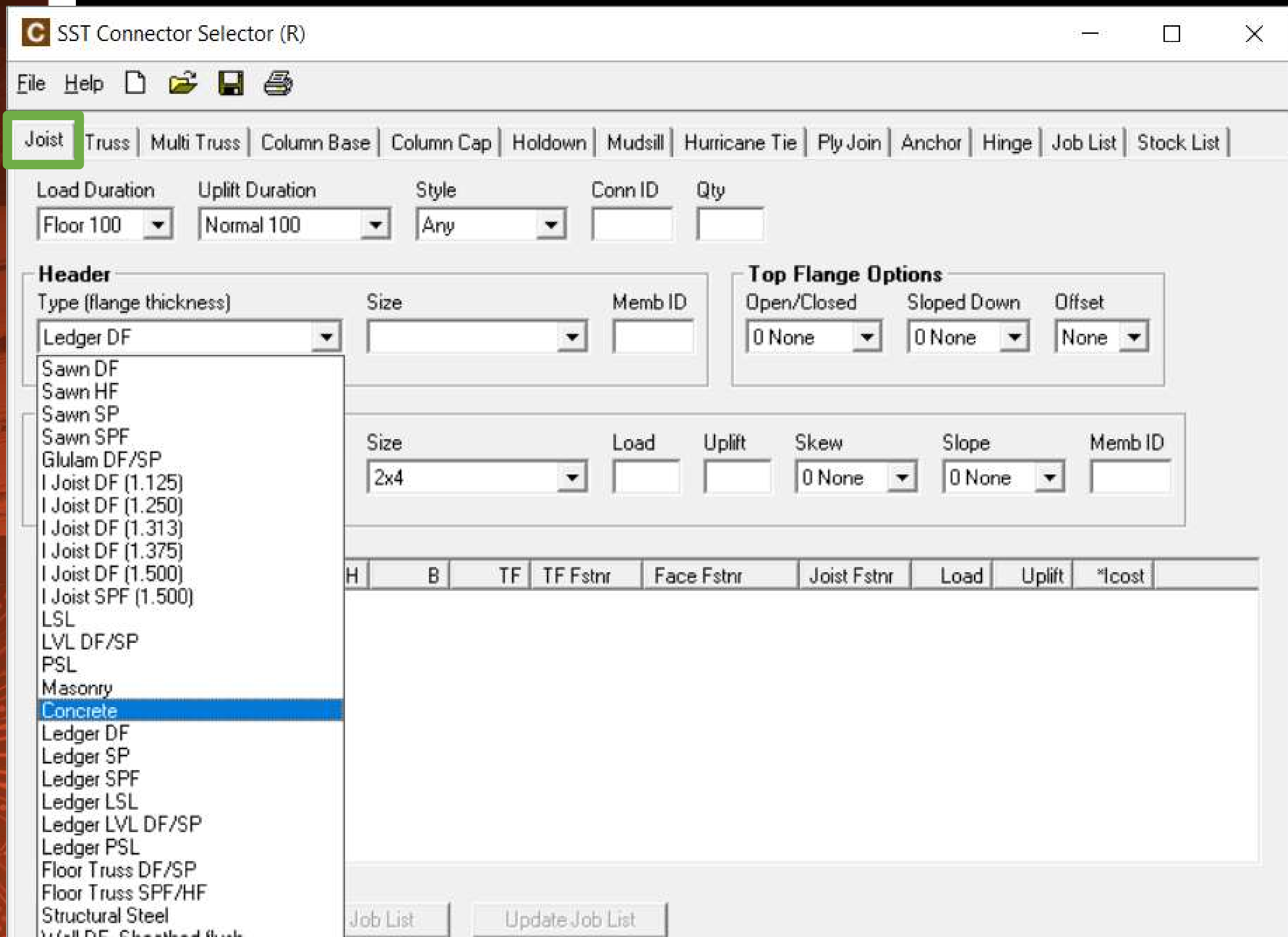


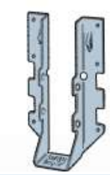

Component Solutions™

# Selección y diseño de conectores

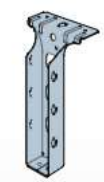


# Selección y diseño de conectores

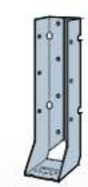


**Face Mount**

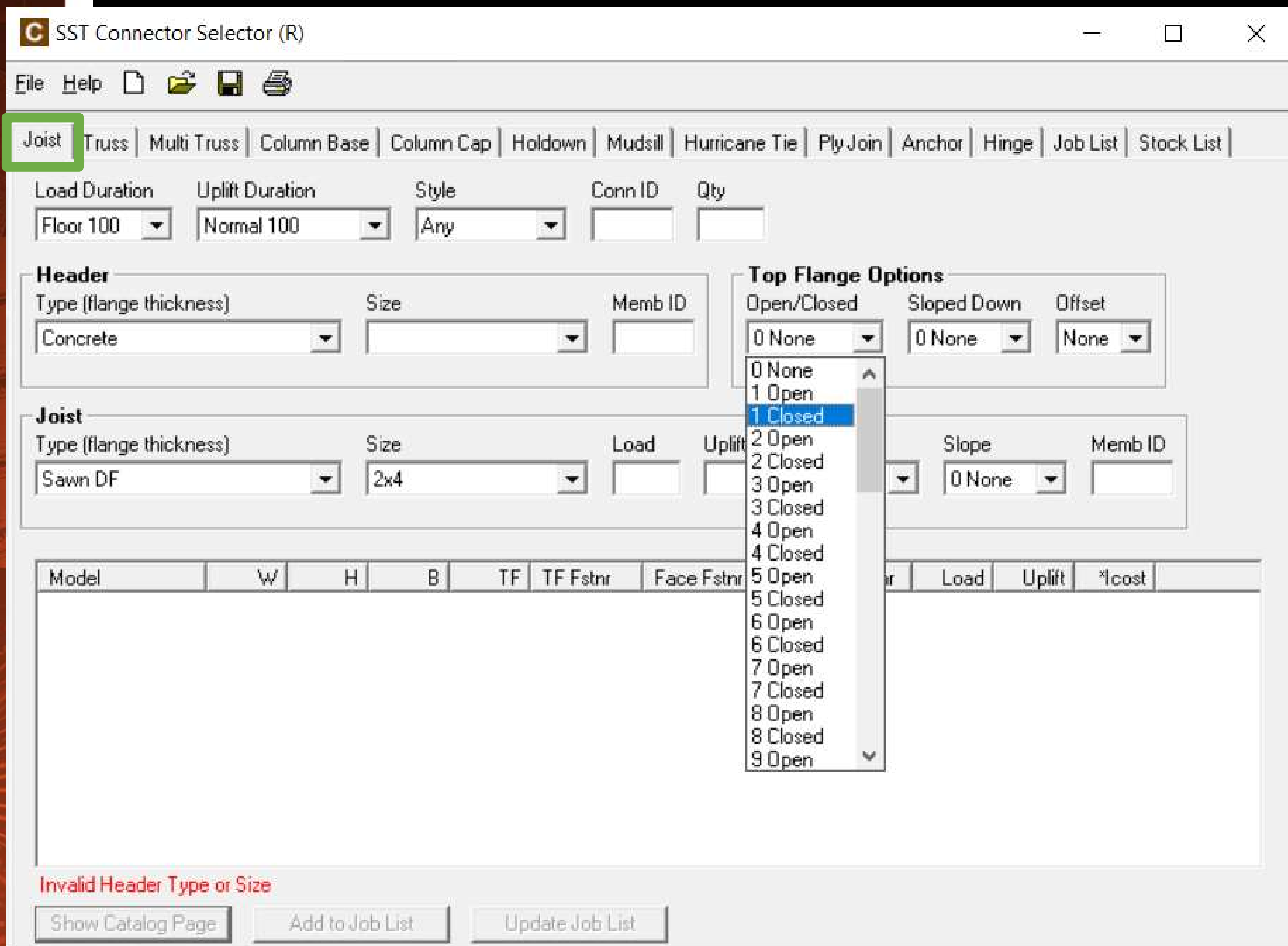


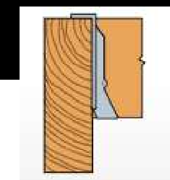
**Top Flange**



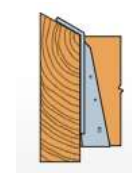
**Concealed Flange**

# Selección y diseño de conectores

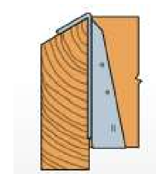


**Normal Top-**

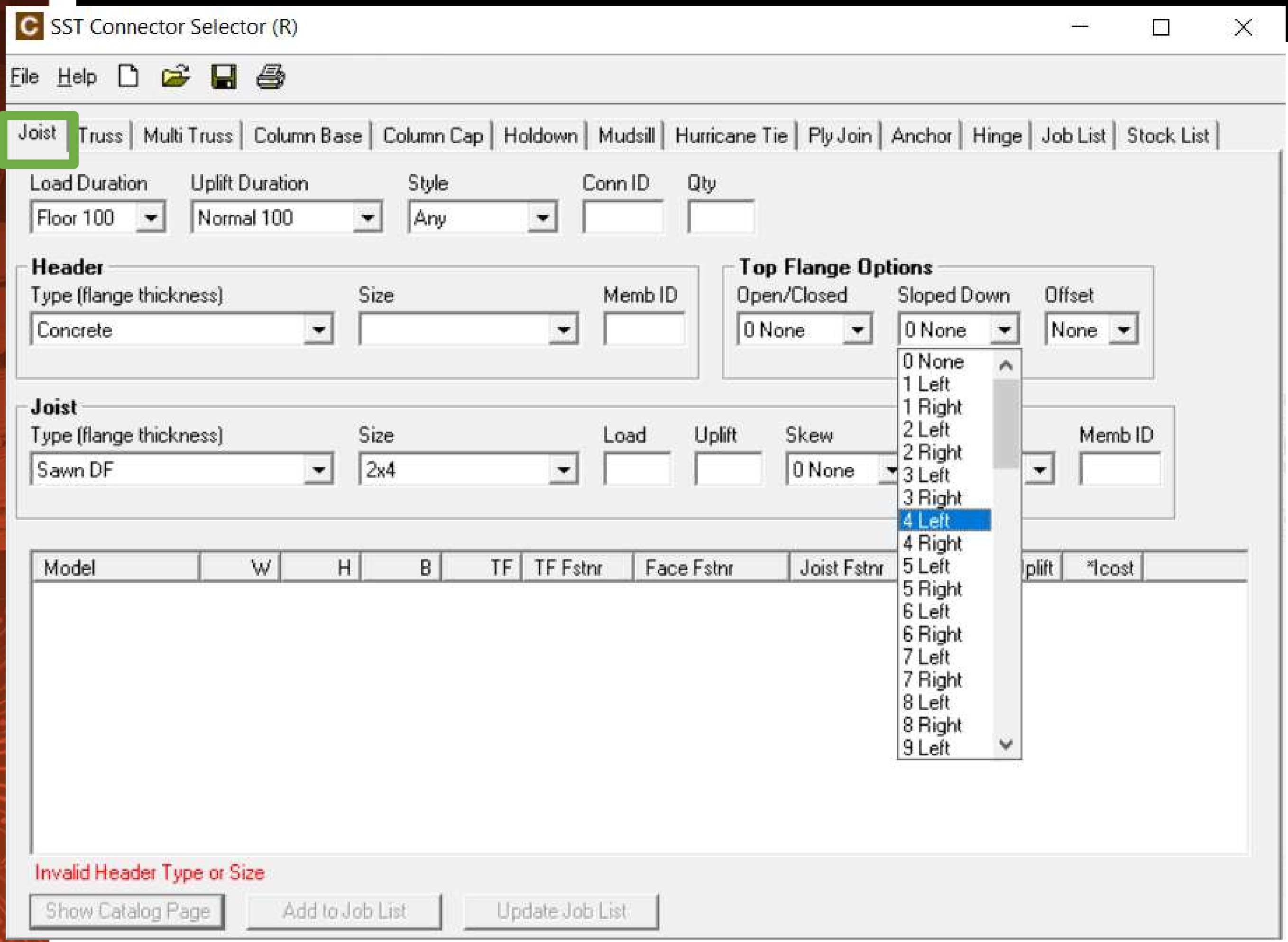


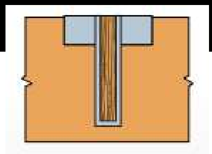
**Top-Flange Opened**



**Top-Flange Closed**

# Selección y diseño de conectores



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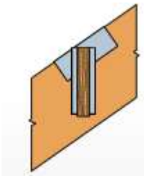
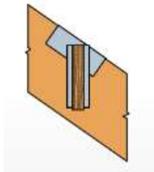
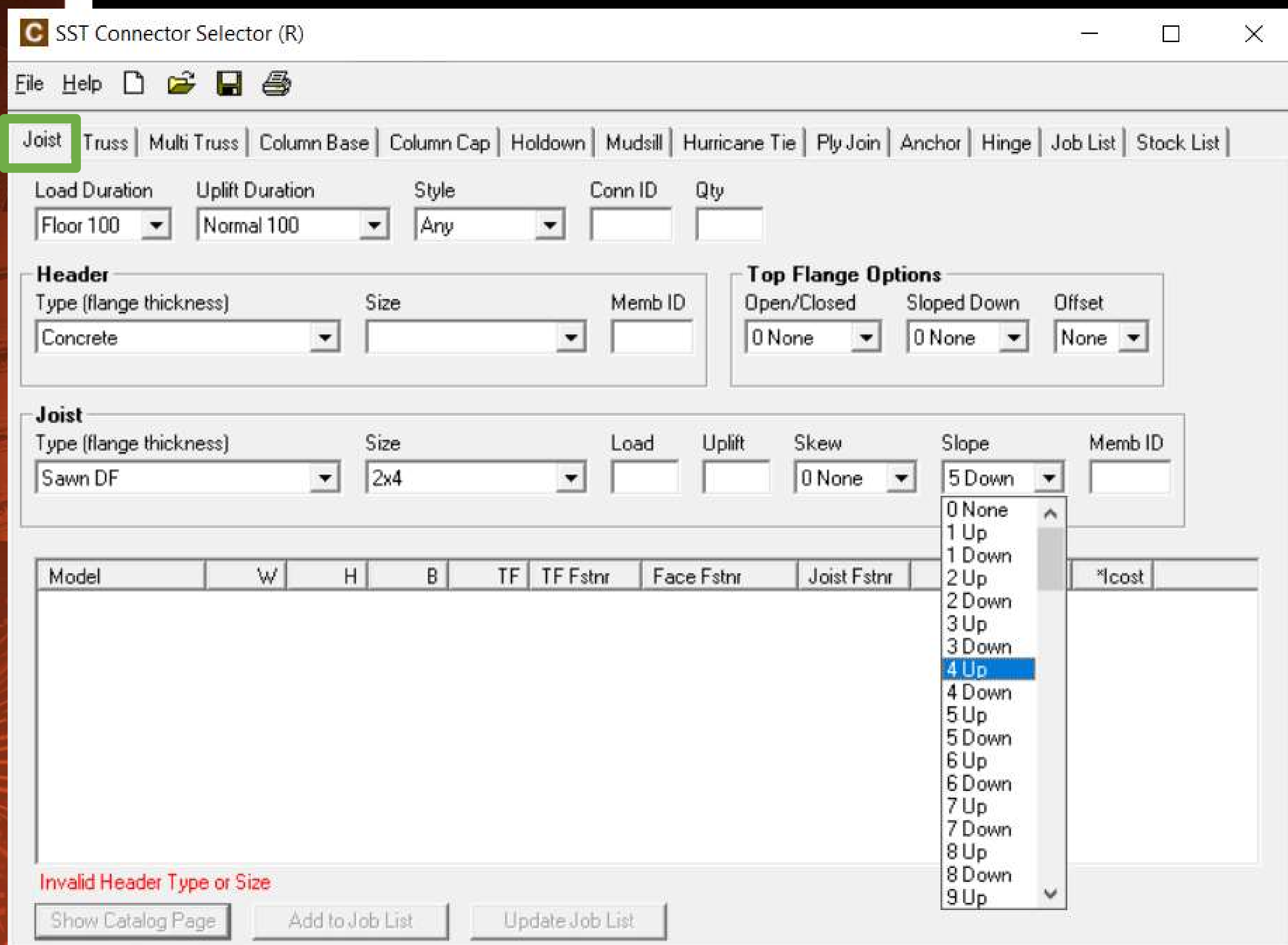


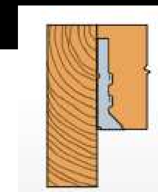
Sloped Down



Sloped Down Right

# Selección y diseño de conectores



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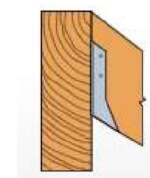
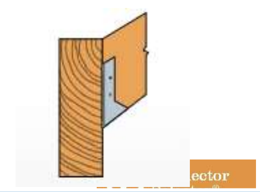
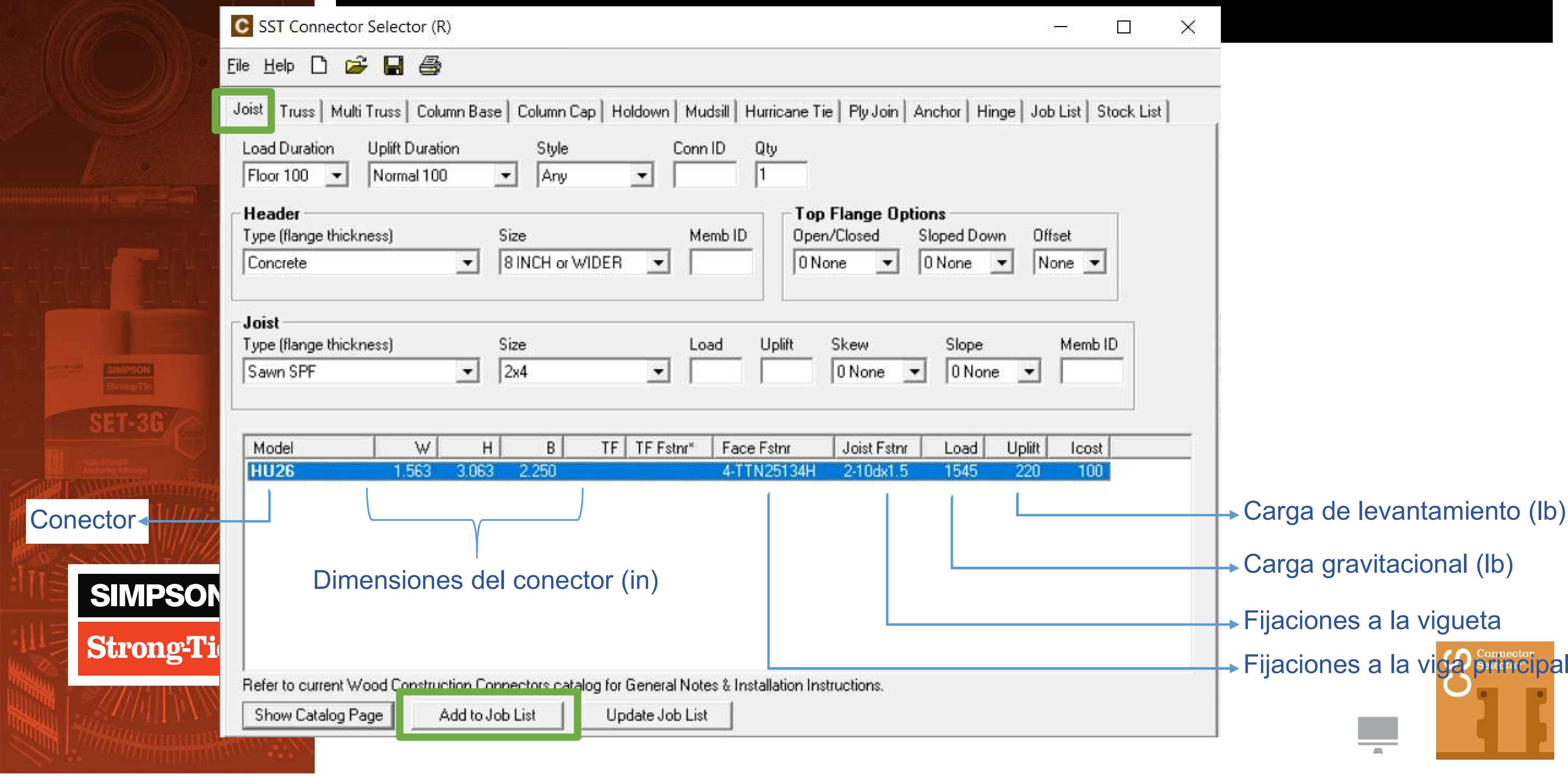


**Sloped**



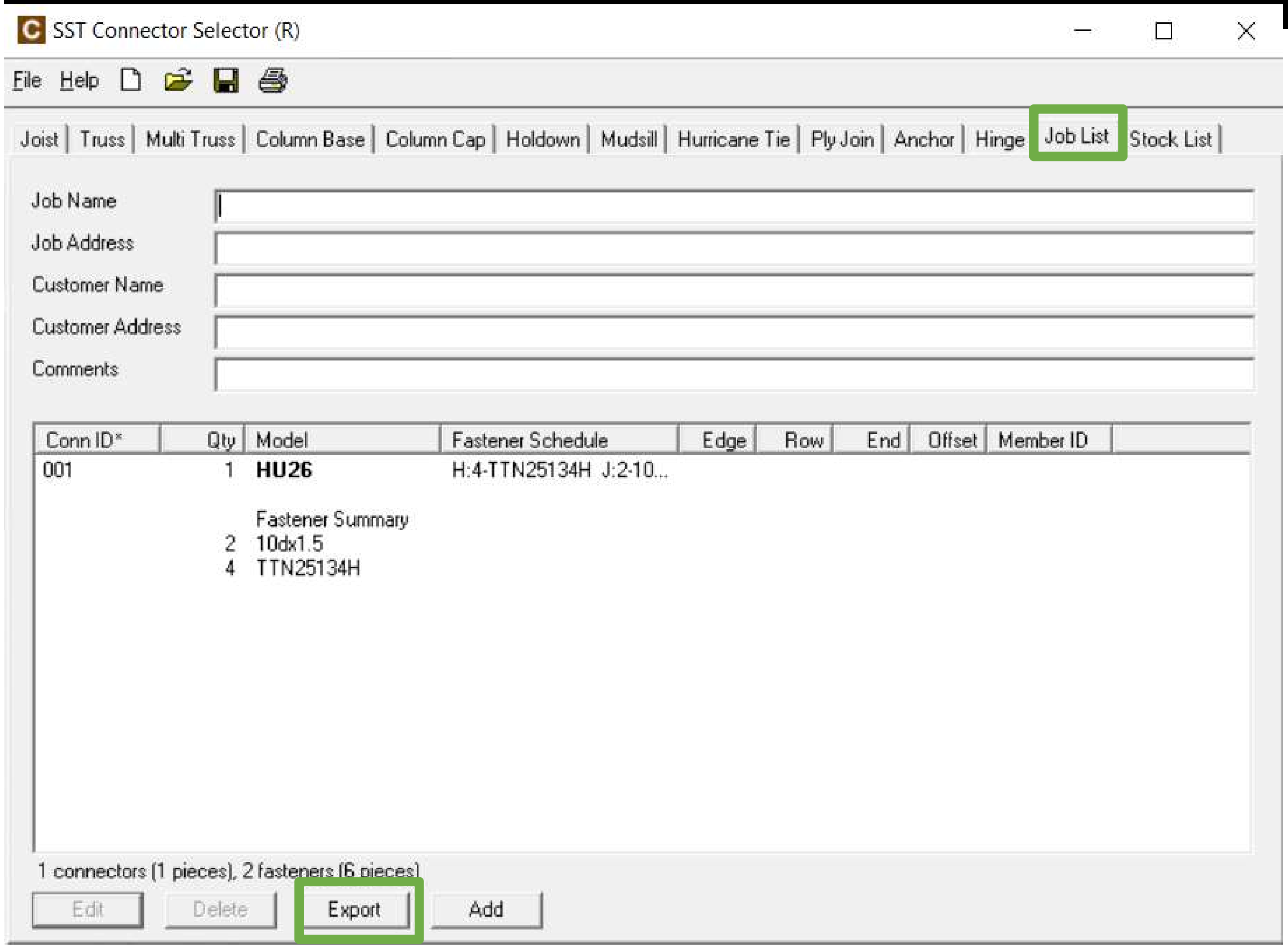
**Sloped Up**

# Selección y diseño de conectores



AICE
INGENIEROS CIVILES ESTRUCTURALES DE CHILE A.G.

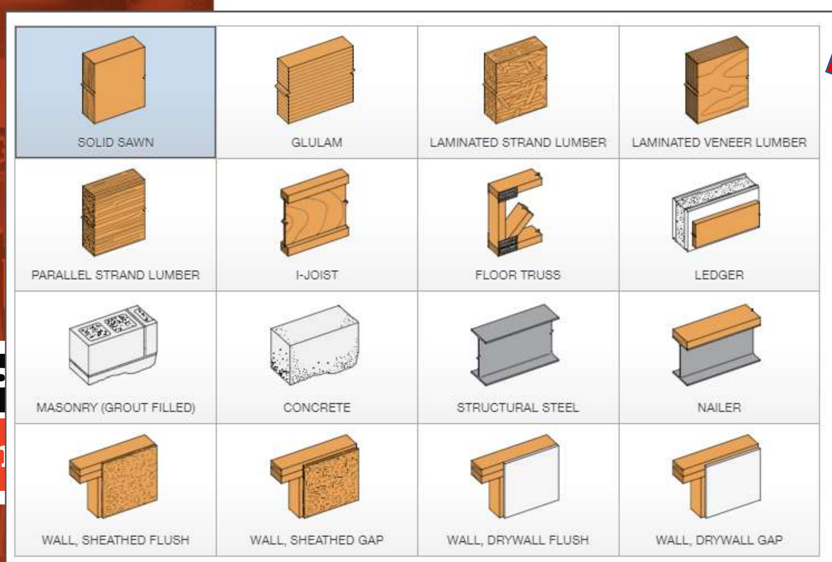
# Selección y diseño de conectores

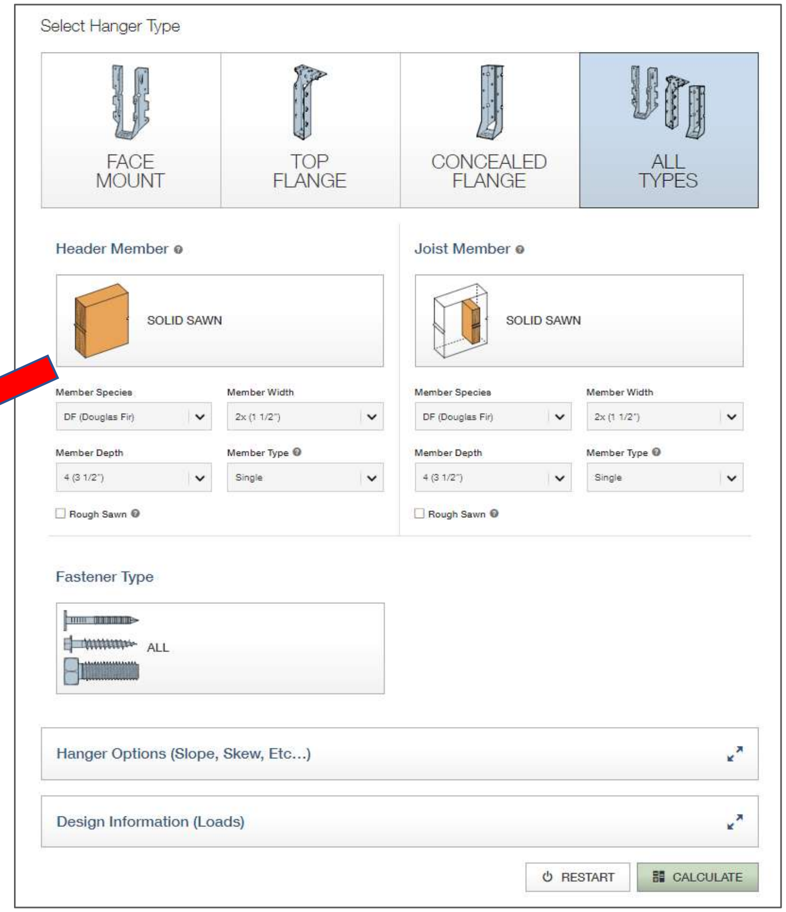



SIMPSON
Strong-Tie

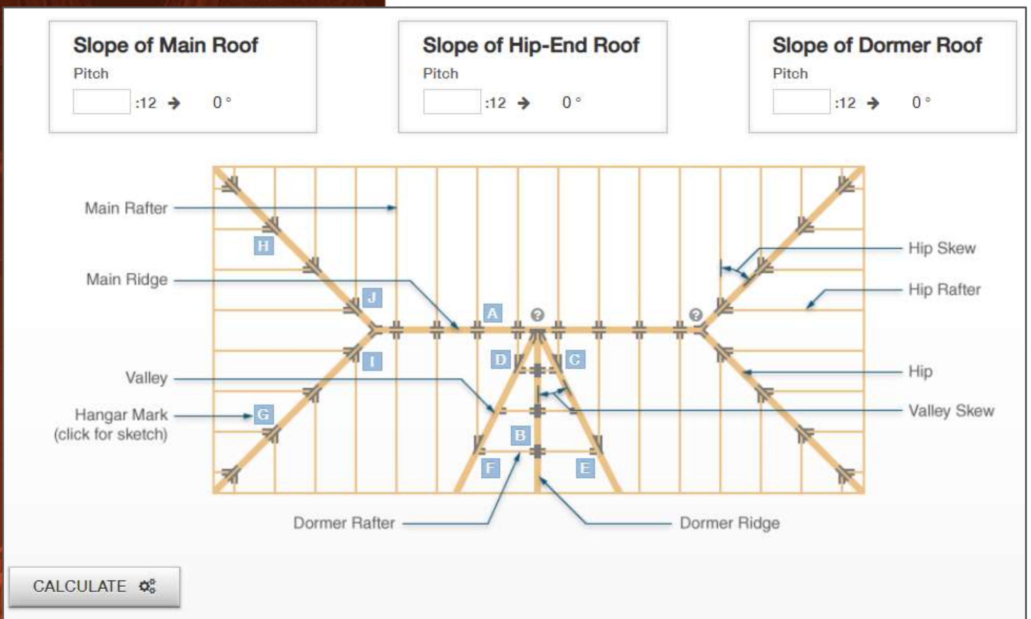
CS Connector Selector

# Selección y diseño de conectores



# Selección y diseño de conectores




| Hanger Mark | Carried Member | Carrying Member | Slope | Skew | Top Flange Slope (Top Flange Hangers Only) |
|---|---|---|---|---|---|
| A | Main Rafter | Main Ridge | SLD37° | N/A | N/A |
| B | Dormer Rafter | Dormer Ridge | SLD30° | N/A | N/A |
| C | Main Rafter | Valley | SLU37° | SKR38° | TFDL 25° |
| D | Main Rafter | Valley | SLU37° | SKL38° | TFDR 25° |
| E | Dormer Rafter | Valley | SLU30° | SKL52° | TFDR 25° |
| F | Dormer Rafter | Valley | SLU30° | SKR52° | TFDL 25° |

Example: 9:12 Main Roof, 7:12 Dormer


# Diseño de Anclajes


**Códigos**

- ACI318 (2005-2014)
- ETAG (Europa)
- EOTA (exposición al fuego)
- CSA (Canada)

# Diseño de Anclajes

**Datos de entrada**

Método de Diseño: ACI 318-08
Anclaje: 1/4"Ø Titen HD, hnom:1.75" (44mm)
Profundidad Efectiva de Empotramiento: 33 mm
Concreto: Peso Normal
Estado: Fisurado
Resistencia a la Compresión: 20.68 N/mm²
Diseño sísmico: Si

**Relación de tensión que gobierna: 68.9% (Pasa)**

| | Relación | $N_{ua}$ [kN] | $\Phi N_n$ [kN] |
|---|---|---|---|
| Resistencia del acero | 13.3% | 2.00 | 15.02 |
| Arrancamiento del concreto | 57.9% | 2.00 | 3.45 |
| Extracción por deslizamiento | 68.9% | 2.00 | 2.90 |

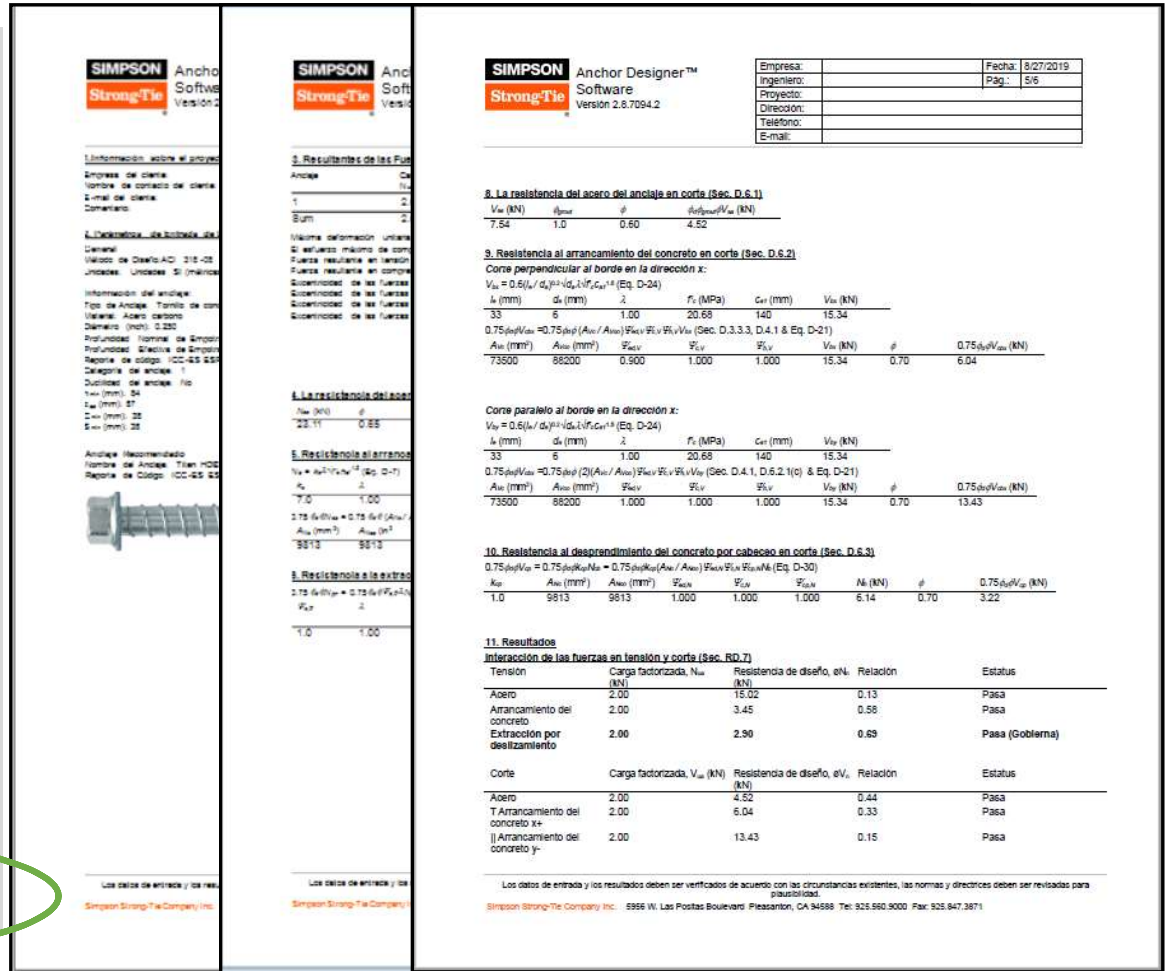
**Relación de corte que gobierna: 62.1% (Pasa)**

| | Relación | $V_{ua}$ [kN] | $\Phi V_n$ [kN] |
|---|---|---|---|
| Resistencia del acero | 44.2% | 2.00 | 4.52 |
| T Arrancamiento del concreto x+ | 33.1% | 2.00 | 6.04 |
| \|\| Arrancamiento del concreto y- | 14.9% | 2.00 | 13.43 |
| Desprendimiento del concreto por cabeceo | 62.1% | 2.00 | 3.22 |

**Relación de Interacción: 98.9% (Pasa)**

| | Relación | $(N_{ua}/\Phi N_n)^{5/3}$ | $(V_{ua}/\Phi V_n)^{5/3}$ |
|---|---|---|---|
| Sec. RD.7 | 98.9% | 0.54 | 0.45 |

**1/4"Ø Titen HD, hnom:1.75" (44mm) cumple con los criterios de diseño seleccionados.**



SIMPSON Strong-Tie Anchor Designer™ Software Versión 2.6.7094.2

| | | | |
|---|---|---|---|
| Empresa: | | Fecha: | 8/27/2019 |
| Ingeniero: | | Pág.: | 5/6 |
| Proyecto: | | | |
| Dirección: | | | |
| Teléfono: | | | |
| E-mail: | | | |

**8. La resistencia del acero del anclaje en corte (Sec. D.6.1)**

| $V_{sa}$ (kN) | $\alpha_{grout}$ | $\phi$ | $\phi\alpha_{grout}V_{sa}$ (kN) |
|---|---|---|---|
| 7.54 | 1.0 | 0.60 | 4.52 |

**9. Resistencia al arrancamiento del concreto en corte (Sec. D.6.2)**

*Corte perpendicular al borde en la dirección x:*

$V_{bx} = 0.6(l_e/d_a)^{0.2}\sqrt{d_a}\lambda\sqrt{f'_c}c_{a1}^{1.5}$ (Eq. D-24)

| $l_e$ (mm) | $d_a$ (mm) | $\lambda$ | $f'_c$ (MPa) | $c_{a1}$ (mm) | $V_{bx}$ (kN) |
|---|---|---|---|---|---|
| 33 | 6 | 1.00 | 20.68 | 140 | 15.34 |

$0.75\phi_{seis}\phi V_{cbx} = 0.75\phi_{seis}\phi(A_{Vc}/A_{Vco})\Psi_{ed,V}\Psi_{c,V}\Psi_{h,V}V_{bx}$ (Sec. D.3.3.3, D.4.1 & Eq. D-21)

| $A_{Vc}$ (mm²) | $A_{Vco}$ (mm²) | $\Psi_{ed,V}$ | $\Psi_{c,V}$ | $\Psi_{h,V}$ | $V_{bx}$ (kN) | $\phi$ | $0.75\phi_{seis}\phi V_{cbx}$ (kN) |
|---|---|---|---|---|---|---|---|
| 73500 | 88200 | 0.900 | 1.000 | 1.000 | 15.34 | 0.70 | 6.04 |

*Corte paralelo al borde en la dirección x:*

$V_{by} = 0.6(l_e/d_a)^{0.2}\sqrt{d_a}\lambda\sqrt{f'_c}c_{a1}^{1.5}$ (Eq. D-24)

| $l_e$ (mm) | $d_a$ (mm) | $\lambda$ | $f'_c$ (MPa) | $c_{a1}$ (mm) | $V_{by}$ (kN) |
|---|---|---|---|---|---|
| 33 | 6 | 1.00 | 20.68 | 140 | 15.34 |

$0.75\phi_{seis}\phi V_{cbx} = 0.75\phi_{seis}\phi(2)(A_{Vc}/A_{Vco})\Psi_{ed,V}\Psi_{c,V}\Psi_{h,V}V_{by}$ (Sec. D.4.1, D.6.2.1(c) & Eq. D-21)

| $A_{Vc}$ (mm²) | $A_{Vco}$ (mm²) | $\Psi_{ed,V}$ | $\Psi_{c,V}$ | $\Psi_{h,V}$ | $V_{by}$ (kN) | $\phi$ | $0.75\phi_{seis}\phi V_{cbx}$ (kN) |
|---|---|---|---|---|---|---|---|
| 73500 | 88200 | 1.000 | 1.000 | 1.000 | 15.34 | 0.70 | 13.43 |

**10. Resistencia al desprendimiento del concreto por cabeceo en corte (Sec. D.6.3)**

$0.75\phi_{seis}\phi V_{cp} = 0.75\phi_{seis}\phi k_{cp}N_{cb} = 0.75\phi_{seis}\phi k_{cp}(A_{Nc}/A_{Nco})\Psi_{ed,N}\Psi_{c,N}\Psi_{cp,N}N_b$ (Eq. D-30)

| $k_{cp}$ | $A_{Nc}$ (mm²) | $A_{Nco}$ (mm²) | $\Psi_{ed,N}$ | $\Psi_{c,N}$ | $\Psi_{cp,N}$ | $N_b$ (kN) | $\phi$ | $0.75\phi_{seis}\phi V_{cp}$ (kN) |
|---|---|---|---|---|---|---|---|---|
| 1.0 | 9813 | 9813 | 1.000 | 1.000 | 1.000 | 6.14 | 0.70 | 3.22 |

**11. Resultados**

**Interacción de las fuerzas en tensión y corte (Sec. RD.7)**

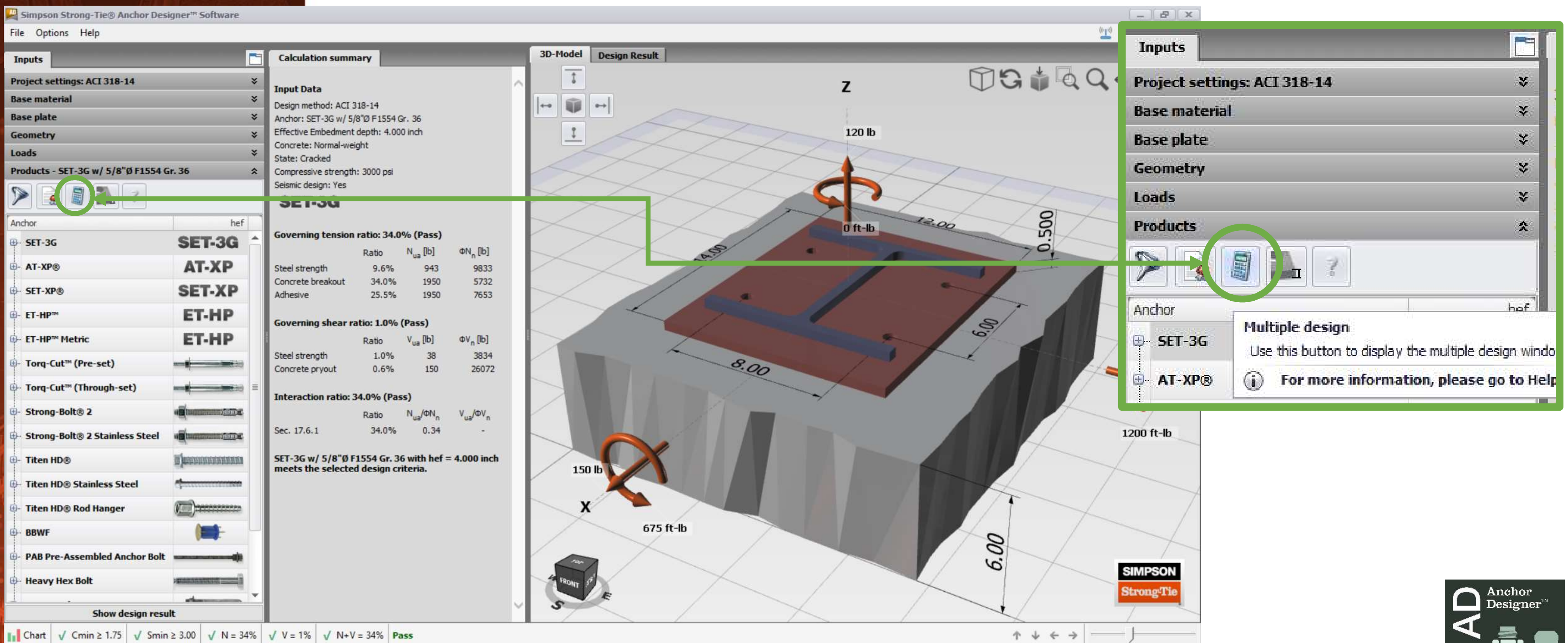
| Tensión | Carga factorizada, $N_{ua}$ (kN) | Resistencia de diseño, $\phi N_n$ (kN) | Relación | Estatus |
|---|---|---|---|---|
| Acero | 2.00 | 15.02 | 0.13 | Pasa |
| Arrancamiento del concreto | 2.00 | 3.45 | 0.58 | Pasa |
| **Extracción por deslizamiento** | **2.00** | **2.90** | **0.69** | **Pasa (Gobierna)** |

| Corte | Carga factorizada, $V_{ua}$ (kN) | Resistencia de diseño, $\phi V_n$ (kN) | Relación | Estatus |
|---|---|---|---|---|
| Acero | 2.00 | 4.52 | 0.44 | Pasa |
| T Arrancamiento del concreto x+ | 2.00 | 6.04 | 0.33 | Pasa |
| \|\| Arrancamiento del concreto y- | 2.00 | 13.43 | 0.15 | Pasa |

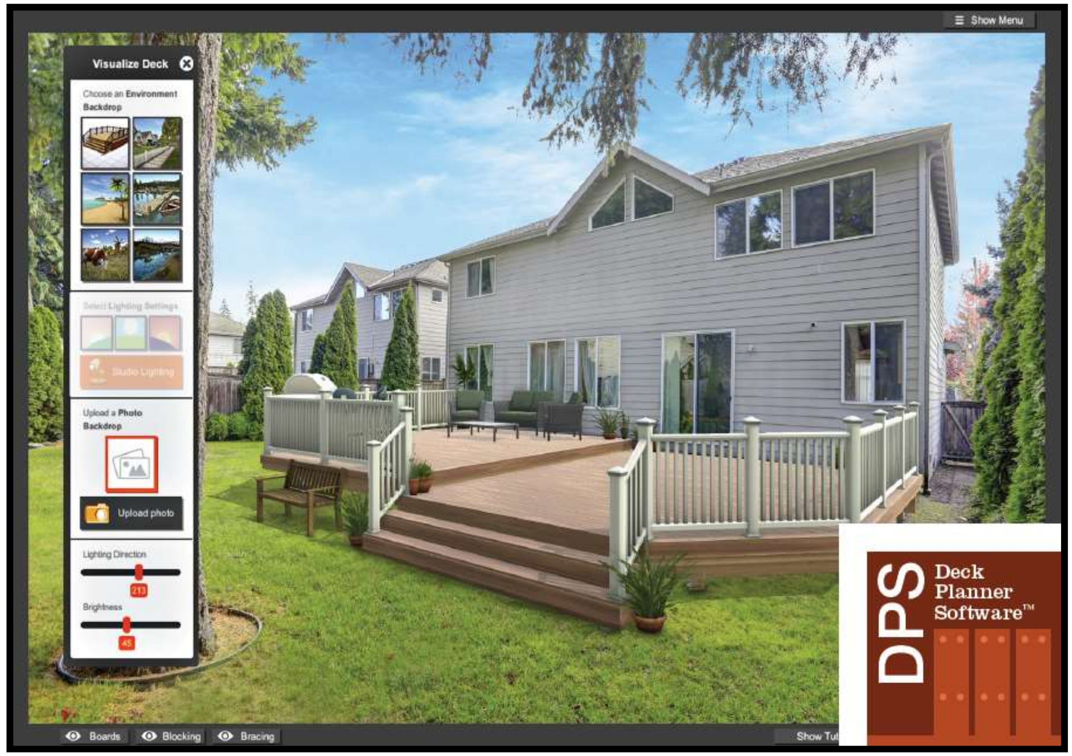
Los datos de entrada y los resultados deben ser verificados de acuerdo con las circunstancias existentes, las normas y directrices deben ser revisadas para plausibilidad.

Simpson Strong-Tie Company Inc. 5956 W. Las Positas Boulevard Pleasanton, CA 94588 Tel: 925.560.9000 Fax: 925.847.3871

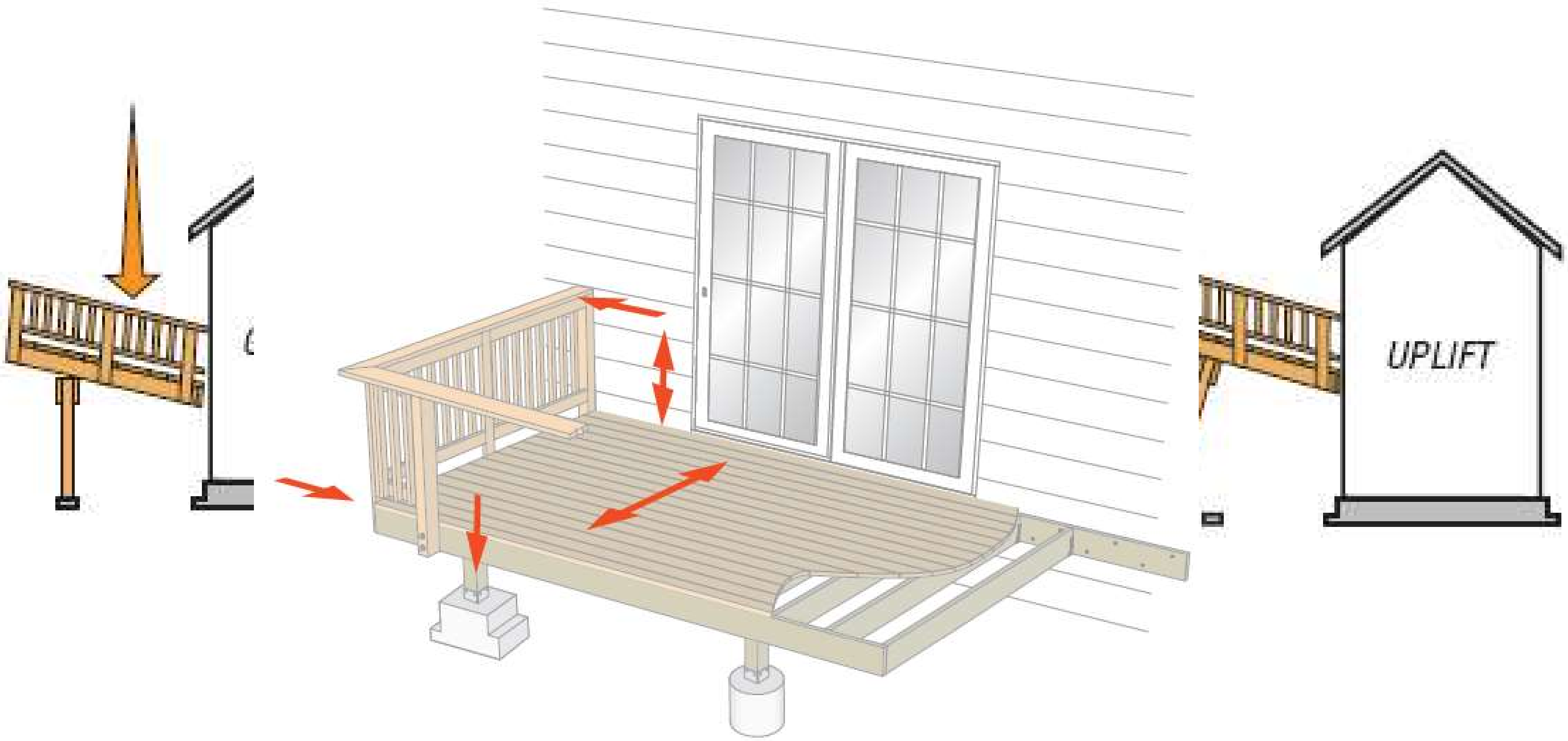
# Selección y diseño de conectores



# Deck Planner y  Pergola Planner



# Deck Planner y  Pergola Planner



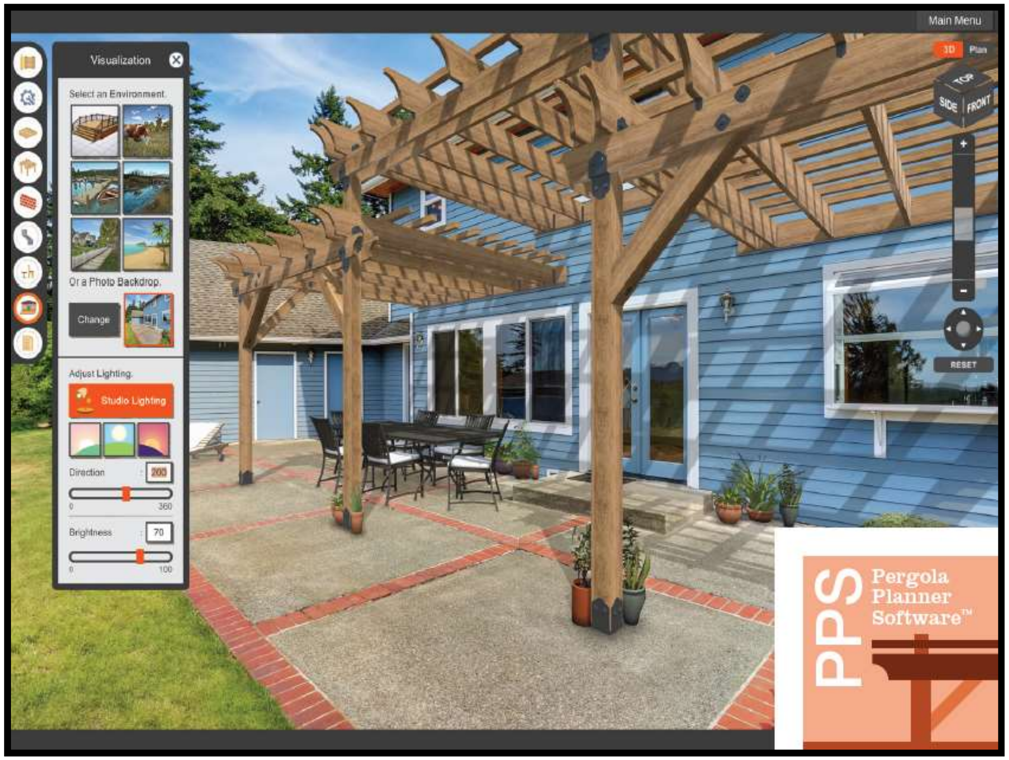
AICE
INGENIEROS CIVILES ESTRUCTURALES DE CHILE A.G.

# Deck Planner y  Pergola Planner

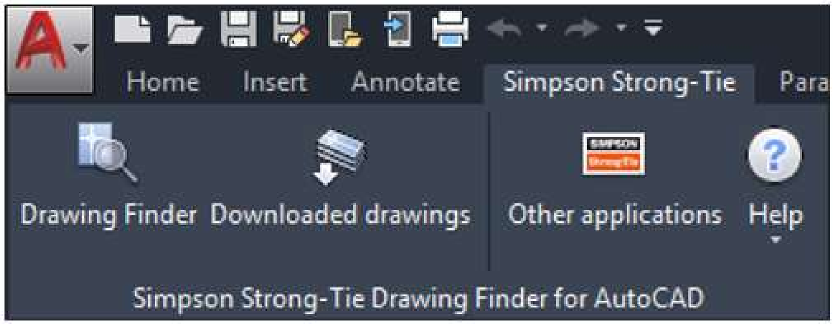
Photo Courtesy of K. Pezzano –


SIMPSON
Strong-Tie

# Deck Planner y  Pergola Planner




# Detalles y notas de ingeniería




Screenshot — Drawing Finder for AutoCAD

AUTODESK
REVIT

**File Format**

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|---|---|
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| DXF | 6917 |
| PDF | 6818 |
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| IFC | 1835 |
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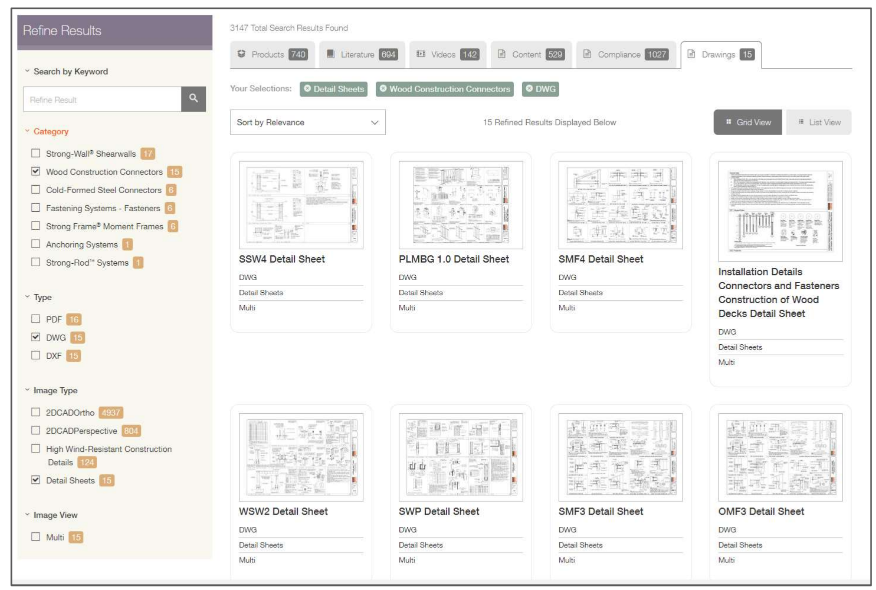
| STL | 1606 |



# Edificios de Madera Masiva

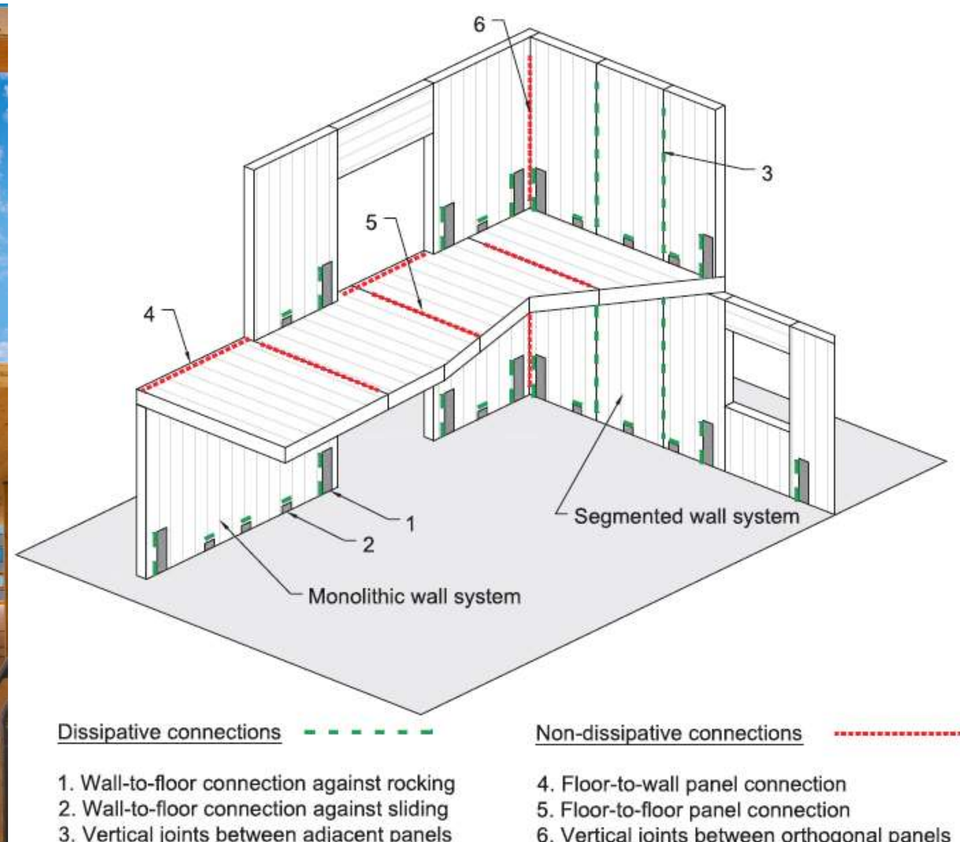




Fig. 4. Schematics of a CLT structure, with indication of the dissipative and non-dissipative connections.

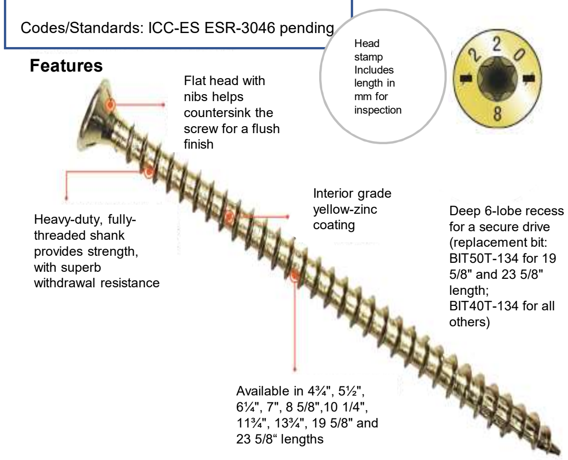

# Edificios de Madera Masiva

SDCF TIMBER-CF screws installed into a CLT butt-joint application

**Applications**
Beam Reinforcement, Wall to Wall, Floor to Floor, Support Beams, Butt Joints

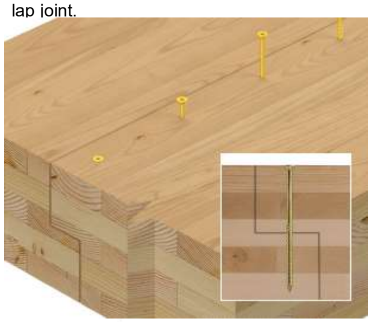
Codes/Standards: ICC-ES ESR-3046 pending

**Features**




* The diameters listed represent the major diameter of the Strong-Drive SDCF Timber-CF screw. Verify that installation procedure ensures that tip of screw does not protrude panel.

SDCP TIMBER-CP screws installed into a CLT lap joint.

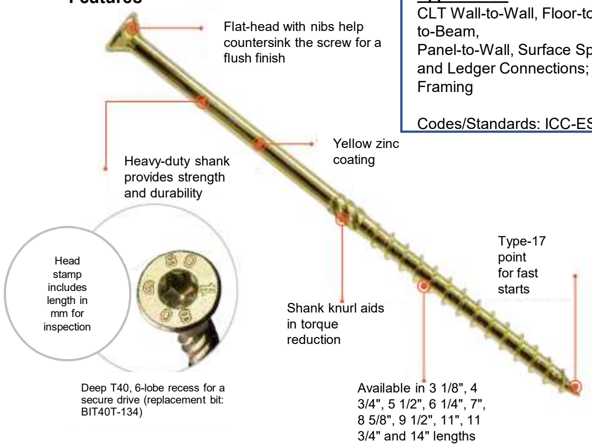


SDCP TIMBER-CP screw installed into a CLT spline

**Features**

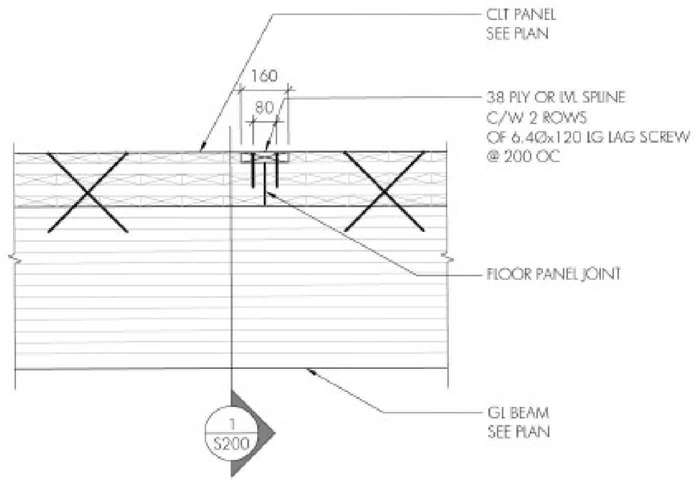
**Applications**
CLT Wall-to-Wall, Floor-to-Floor, Panel-to-Beam,
Panel-to-Wall, Surface Spline, Lap Joint and Ledger Connections; General Timber Framing

Codes/Standards: ICC-ES ESR-3046

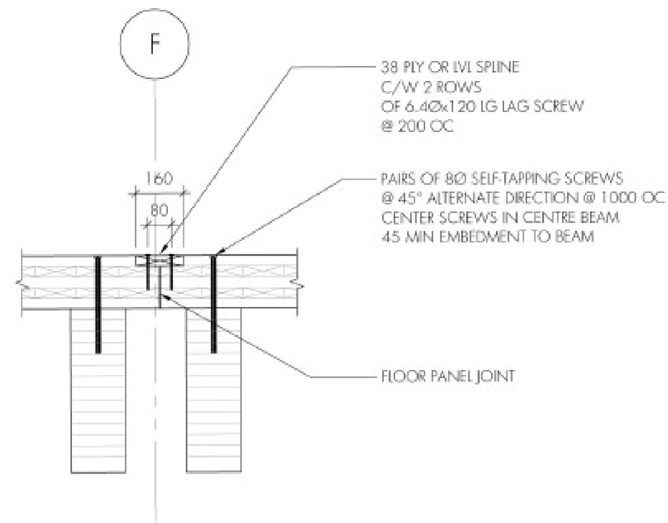



* The diameters listed represent the major diameter of the Strong-Drive SDCP Timber-CP screw.

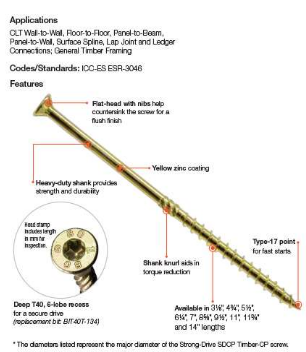
# Edificios de Madera Masiva

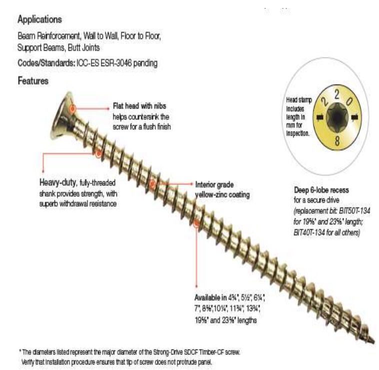



2
S200
SECTION
1:20

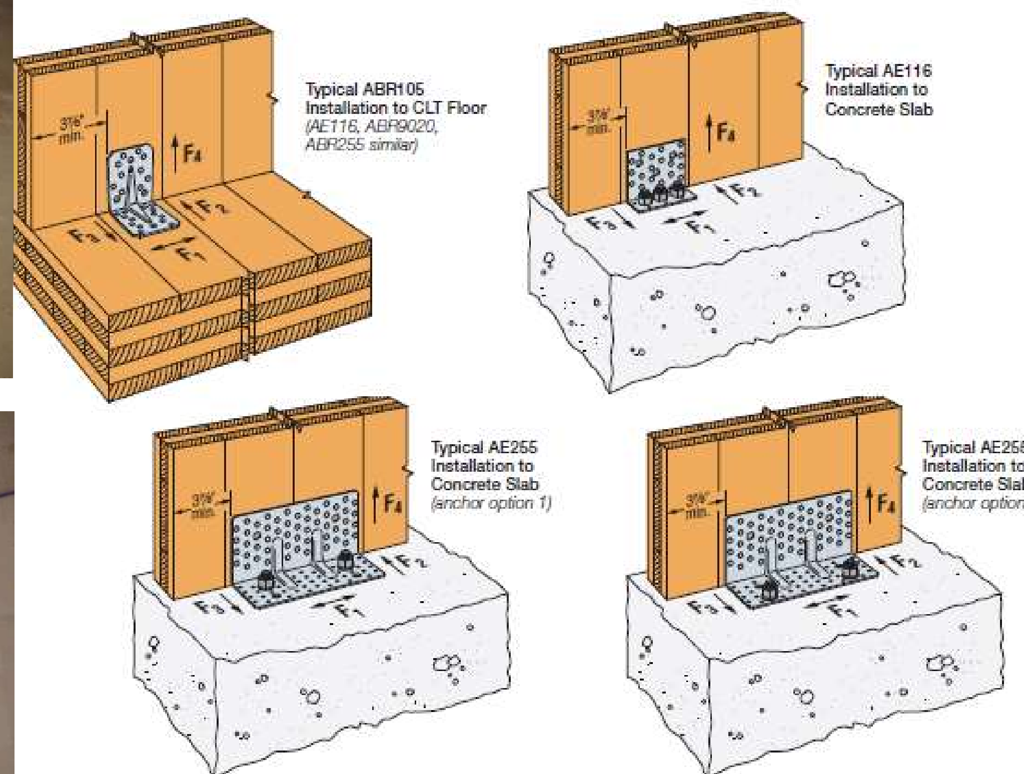



1
S200
SECTION
1:20

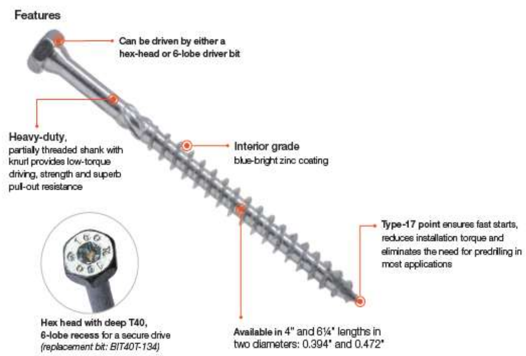


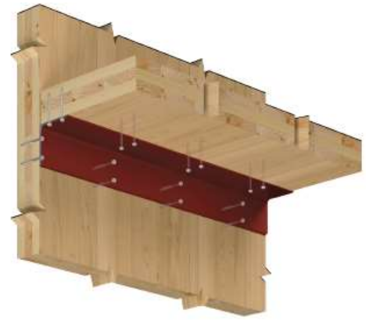



# Edificios de Madera Masiva



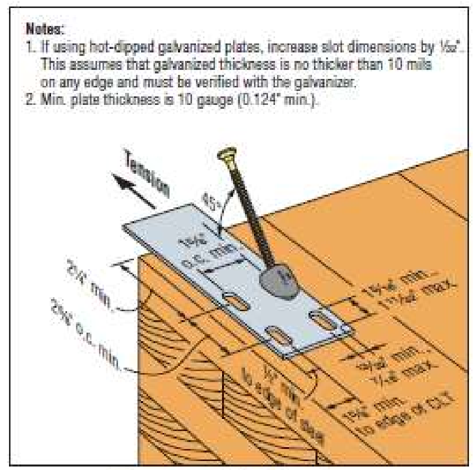
# Edificios de Madera Masiva



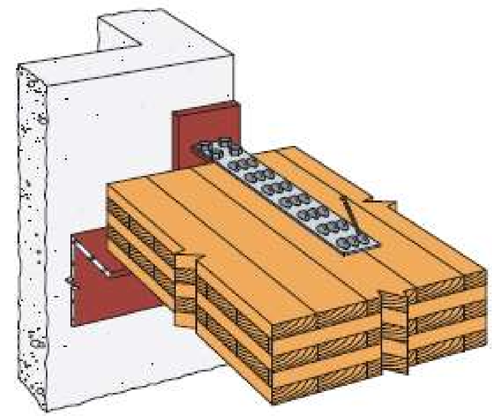



SDHR COMBO-HEAD screws installed into a CLT bracket assembly (steel design by others)

SDHR COMBO-HEAD screw installe for beam installations (steel design b others)

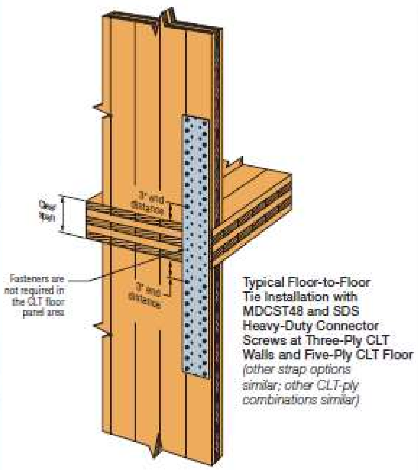


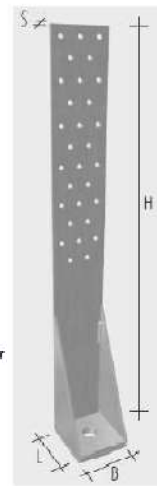

Recommended Plate Dimensions and Placement Relative to CLT End/Edge

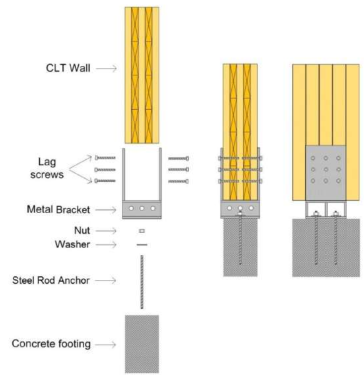


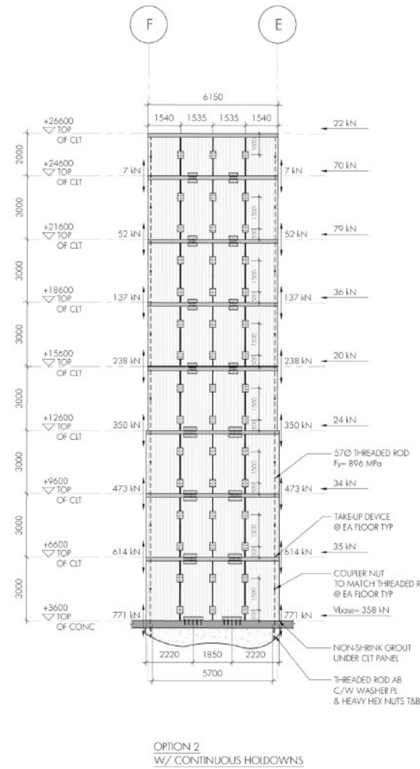
Typical MDW45-8 Installation for CLT Floor Diaphragm Drag Strap at Concrete Core

# Edificios de Madera Masiva





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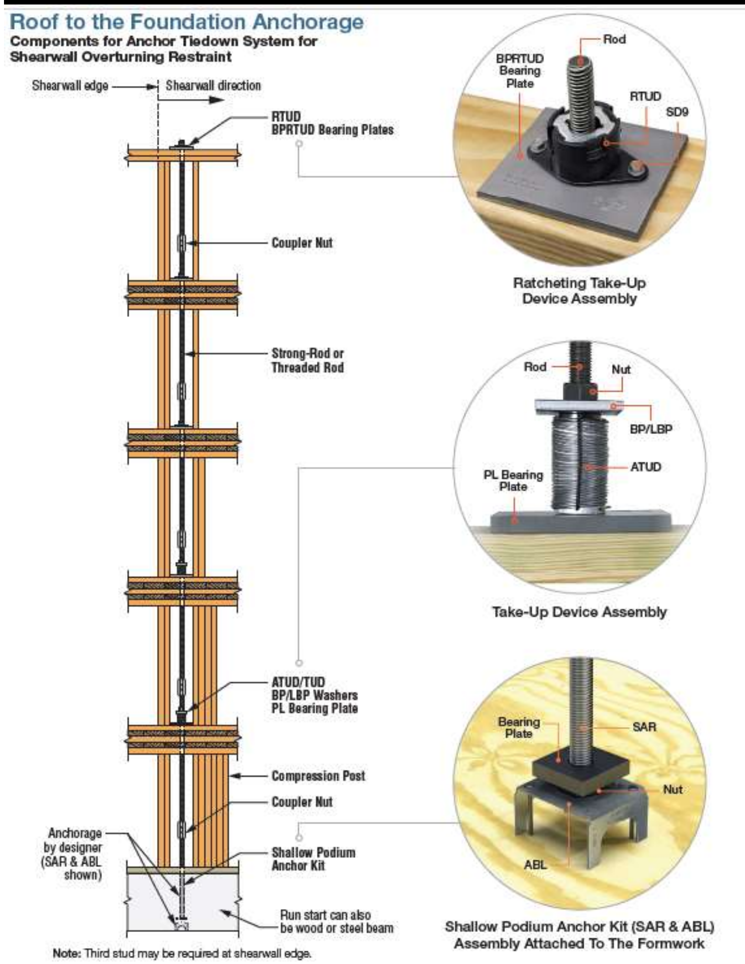


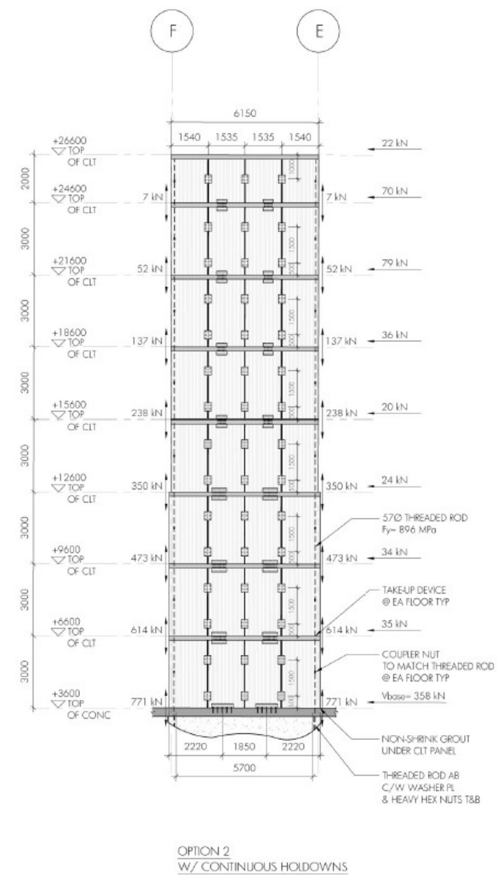


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