SIMPSON Strong-Tie

Soft-Story Retrofit Guide

DESIGN SOLUTIONS FOR INCREASING RESILIENCE IN SOFT-STORY RETROFITS

(800) 999-5099 | strongtie.com

Soft-Story Retrofit

Meeting the Needs of Soft-Story Retrofits

For years, municipalities in California have recommended the retrofitting of thousands of residential buildings where the housing units sit above the ground-level garage, tuck-under parking garage or a storefront. This type of residential structure is popular on the West Coast and is called a soft-story building because the large openings on the bottom level make it more likely to collapse in the event of a major earthquake. Several soft-story buildings did collapse, causing injuries and deaths from the 1989 Loma Prieta and 1994 Northridge earthquakes. Cities on the West Coast, such as San Francisco and Los Angeles, have passed laws that mandate a retrofit for certain soft-story residential buildings, and many other cities are following suit.

A typical retrofit solution involves adding the necessary bracing to keep the ground story of soft-story buildings strong and prevent collapse in earthquakes. Simpson Strong-Tie is an industry leader of state-of-the-art structural solutions specifically designed to meet the code requirements of soft-story retrofits. Depending on the scope of the retrofit and the particular applications involved, our products can minimize construction time and reduce project risks.

Simpson Strong-Tie soft-story retrofit products include Strong Frame® moment frames, Strong-Wall® shearwalls and an extensive line of wood connectors and anchoring solutions that can help reinforce your soft-story building.

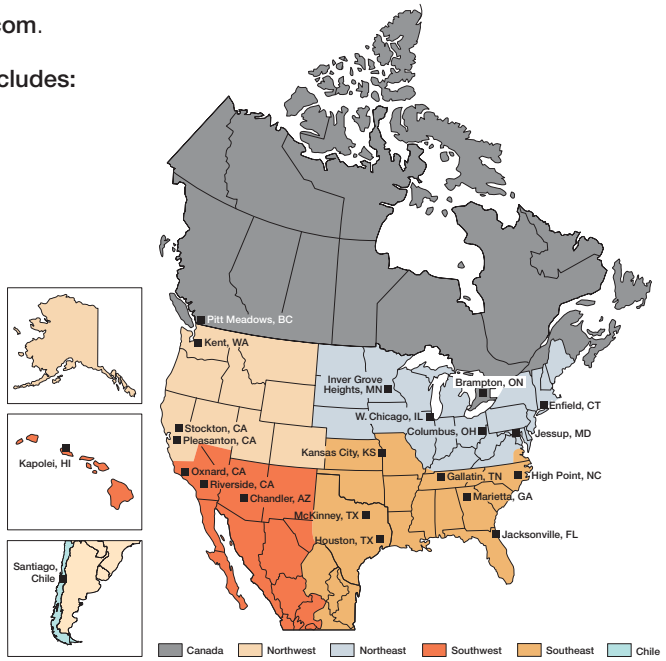
Company Profile

For over 65 years, Simpson Strong-Tie has focused on creating structural products that help people build safer and stronger homes and buildings. A leader in structural systems research and technology, Simpson Strong-Tie is one of the largest suppliers of structural building products in the world. The Simpson Strong-Tie commitment to product development, engineering, testing and training is evident in the consistent quality and delivery of its products and services.

For more information, visit the company's website at **strongtie.com**.

The Simpson Strong-Tie Company Inc. No-Equal Pledge® includes:

- Quality products value-engineered for the lowest installed cost at the highest-rated performance levels
- The most thoroughly tested and evaluated products in the industry
- Strategically located manufacturing and warehouse facilities
- National code agency listings
- The largest number of patented connectors in the industry
- Global locations with an international sales team
- In-house R&D and tool and die professionals
- In-house product testing and quality control engineers
- Member of WWTA, OWTFA, QWTFA, AWTFA, WRLA, LBMAO, ABSDA, TPIC, and PEO



The Simpson Strong-Tie Quality Policy

We help people build safer structures economically. We do this by designing, engineering and manufacturing No-Equal® structural connectors and other related products that meet or exceed our customers' needs and expectations. Everyone is responsible for product quality and is committed to ensuring the effectiveness of the Quality Management System.

Mike Olosky
Chief Executive Officer

Getting Fast Technical Support

When you call for engineering technical support, we can help you quickly if you have the following information at hand.

- Which Simpson Strong-Tie literature piece are you using? (See the back cover for the form number.)
- Which Simpson Strong-Tie product or system are you inquiring about?
- What is your load requirement?

bsi ISO 9001 Quality Management Systems CERTIFIED

FM 767499

Simpson Strong-Tie Supports the US Resiliency Council

The mission of Simpson Strong-Tie is to provide solutions that help people design and build safer, stronger structures. This makes us a perfect partner for the US Resiliency Council. We are proud to be a founding member and to support their work to improve the resilience and sustainability of our communities and livelihoods through natural hazard-building rating systems.

Table of Contents

Why Retrofit Soft-, Weak- or Open-Front Buildings?

Retrofitting buildings can be necessary because of the type of structure, for general mitigation, to meet specific programs, or because of regional hazards. A sizable seismic event can have catastrophic effects on an entire city. A city's ability to perform search and rescue, transport injured people to hospitals, or fight fires started when gas lines rupture and electrical systems short-circuit will be strained by the damage and debris that a major earthquake inevitably brings, even if only a small portion of its multi-unit buildings collapse. When these buildings fail, workforce recovery is halted and social services are strained. Even those buildings that do not completely collapse will likely be unsafe to occupy until they are evaluated and repaired. This displaces the population and increases the demand for shelter beds. This is a major reason why weak-story residential buildings are a top priority for retrofits.

Cities in seismic regions have recognized the magnitude of the danger that unsafe soft-story buildings can pose in a serious earthquake. Therefore, several of these cities, including San Francisco, Oakland and Los Angeles, have already passed ordinances requiring seismic retrofitting of these structures. Refer to p. 13 for information regarding contacting cities to determine if your building needs to be retrofitted.

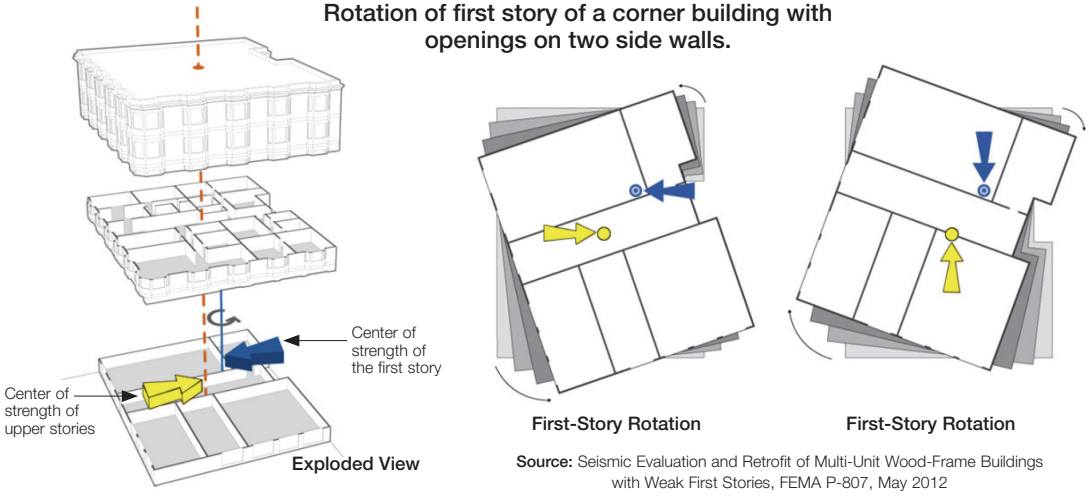
During the 1971 San Fernando earthquake, 1989 Loma Prieta earthquake, and 1994 Northridge earthquake, soft-story buildings sustained major damage or completely collapsed. One reason for this structural vulnerability was the mixed use of the buildings, which often means wider openings and fewer partition walls on the first story than on the upper stories.

1989 Loma Prieta
Six of seven collapsed buildings were four-story corner apartments with first-story parking.

1994 Northridge
Two hundred weak-story buildings suffered damage or collapsed.

A lack of continuous exterior walls or partition walls on the first story creates a considerable difference in lateral strength, stiffness and stability between the first story and the upper stories. During an earthquake, this difference exposes the first story to a concentrated lateral deformation in lieu of distributing it over the height of the structure. The concentrated lateral deformation is exacerbated by the building's preexisting tendency to twist.

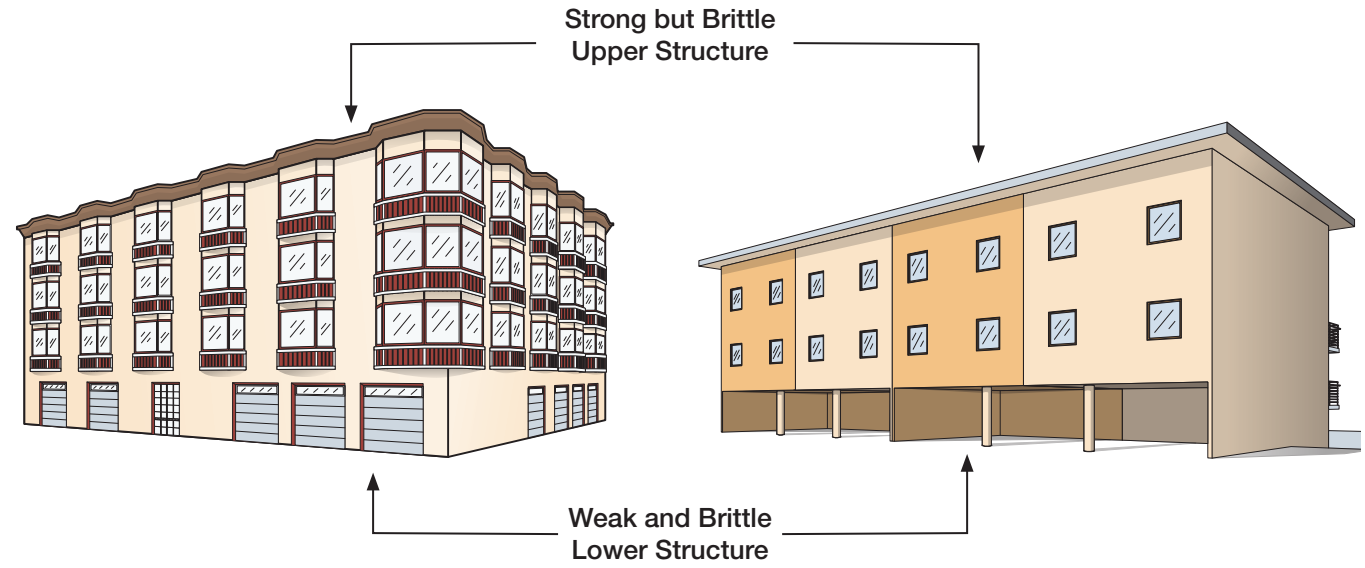
Rotation of first story of a corner building with openings on two side walls.

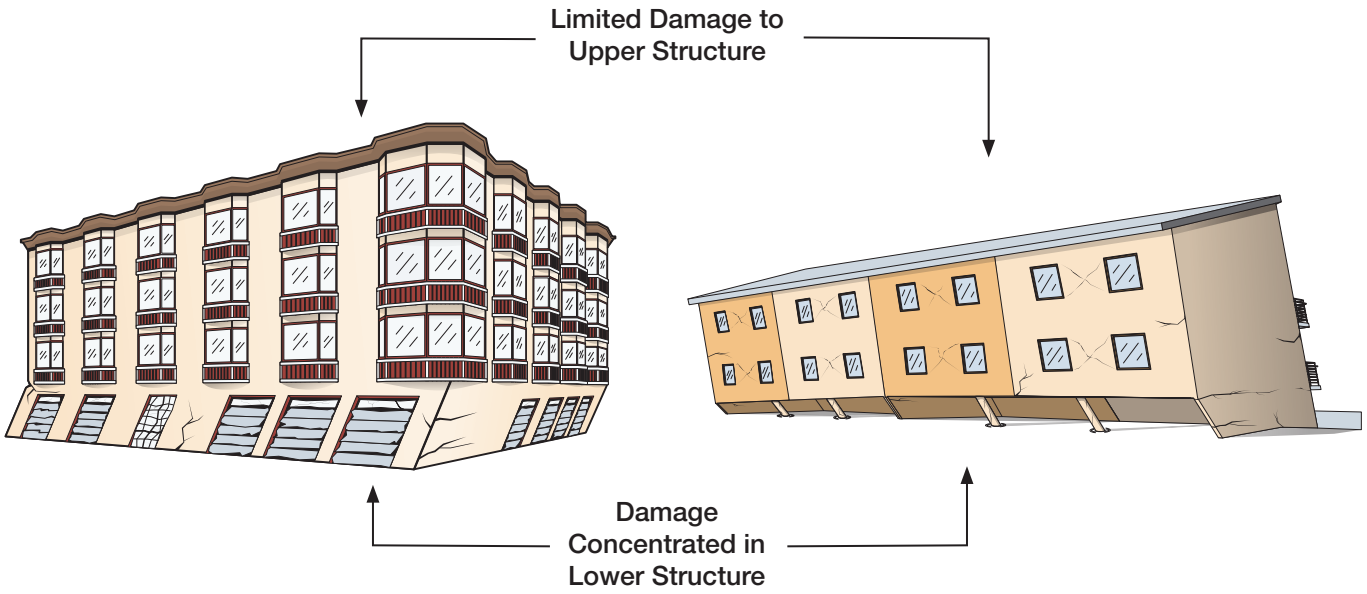


Source: Seismic Evaluation and Retrofit of Multi-Unit Wood-Frame Buildings with Weak First Stories, FEMA P-807, May 2012

Why Retrofit Soft-, Weak- or Open-Front Buildings?

Buildings built prior to 1978 were constructed to the codes at that time, many using materials and finishes that are non-ductile, with low displacement capabilities and poor detailing that can lead to earthquake damage and, in some cases, to building collapse. Some of these materials are stucco, diagonal sheathing, plaster on wood lath and plaster on gypsum lath that possess a maximum interstory drift ratio of 2% or less. While the first story undergoes large deformations, the upper stories tend to respond as a stiff block over a weak and deformable base. This weak-story mode dominates the dynamic response in the elastic range and especially in the inelastic range, where concentrated damage can lead to collapse.





Do I Need to Retrofit My Building?

Multi-unit wood-frame buildings with more than 80% open area on one first-story wall or more than 50% on two adjacent walls are considered weak-story buildings.

In a soft-story building, the “weakest link” is the soft story, so a retrofit solution that addresses the weakest link can provide a cost-effective performance benefit. Upper stories might have deficiencies that are not addressed, but, as long as they are not made worse, a first-story retrofit improves the building’s overall seismic performance. A weak first story absorbs all the lateral deformation during an event, thus protecting the upper stories. When the weak story is strengthened, the structure becomes more regular, with deformations no longer concentrated in one story. Therefore, it is possible for a first-story retrofit to make upper stories more vulnerable. After the first story is strengthened, the upper stories will have to sustain higher forces and drifts.

Structures with a soft-story irregularity need a retrofit solution that keeps the work limited to the first story. These structures have a dominant deficiency in the first story and, often, their occupied status would make retrofit work in the upper stories disruptive and expensive. It is imperative that these buildings undergo a retrofit that provides adequate benefit for minimal cost. Following this theory, non-dominant upper-story deficiencies typically do not require retrofitting. While this type of retrofit may not achieve the same level of performance as a comprehensive full-height retrofit, it is considered a trade-off that can sometimes be of interest to owners, tenants and jurisdictions because it typically allows the work to be done while the building stays occupied.

The scope of work for a soft-story retrofit is limited to the ground floor, where large openings, such as garages or commercial storefronts, reduce the length of the building’s ground floor shearwalls.

The soft-story retrofit solution can be seen at **strongtie.com/videolibrary/soft-story-retrofit.html**.

Codes and Guidelines for Soft-Story Retrofits

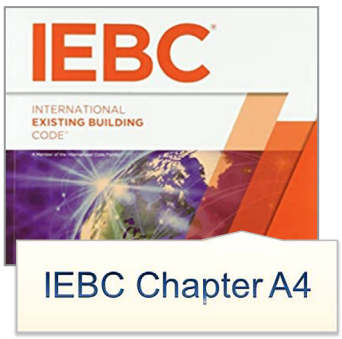
New building codes are not always suitable for existing construction. The ordinances that various jurisdictions are approving give design professionals several options to meet the retrofit requirements. Various building codes and guidelines, with performance objectives, are available to help guide engineers in properly retrofitting buildings. There are four codebooks, including a guideline for existing construction that can be used to retrofit unsafe structures.

- FEMA P-807 Guidelines: Seismic Evaluation and Retrofit of Multi-Unit Wood-Frame Buildings with Weak First Stories
- ASCE 41-17, Seismic Evaluation and Retrofit of Existing Buildings; see Technical Bulletin, TEB-ASCE4122
- ASCE 31-03, Seismic Evaluation of Existing Buildings (Evaluation only)
- 2021 International Existing Building Code (IEBC): Chapter A4, Appendix A (Retrofit only)

In addition to these established codes and guidelines, any other rational design basis that is deemed acceptable by the governing jurisdiction and that meets or exceeds the intent of the above standards might be used as well.

For retrofitting soft-story buildings, this retrofit guide is going to focus on two of the above-listed codes and guidelines — FEMA P-807 and IEBC.

Let's review both IEBC Chapter A4 and FEMA P-807 to determine which is more applicable to your soft- or weak-story building.



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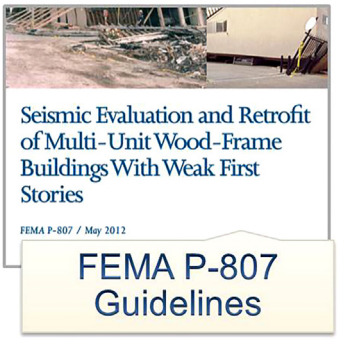


Used with permission from the International Code Council.

IEBC Chapter A4

Appendix Chapter A4 of the International Existing Building Code (IEBC), titled “Earthquake Risk Reduction in Wood-Frame Residential Buildings with Soft, Weak or Open-Front Walls,” relies on the code provisions for new construction, with reduced design base shear, a focus on the critical first story, and some rules to guide application to existing conditions. While useful and adopted by several California jurisdictions with nascent mitigation programs (including San Francisco, Berkeley and prior approval to use within the City of Los Angeles), Chapter A4 covers the design of retrofit elements, but without yielding a careful evaluation of existing conditions. The provisions do not address the possibility of over-strengthening the first story. The chapter’s intent is to improve performance of the structure, but not prevent all seismic-related damage.

Used with permission from the International Code Council.

IEBC Chapter A4 Retrofit Requirements and Design Considerations

GENERAL

- The alteration, repair, replacement or addition of structural elements and their connections shall meet the strength and stiffness requirements of the chapter.
- The design shall include the load path analysis to transfer the forces from the diaphragm immediately over the target story to the lateral resisting elements and down to the foundation.

UPPER STORIES

- Stories above the target story shall be considered in the analysis, but do not need to be modified.

FIRST STORY

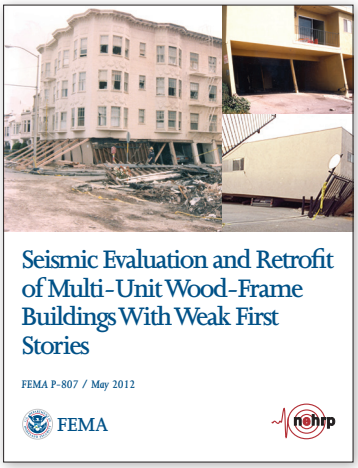
- Design base shear shall be 75% of that required for new construction based on current code.
- Seismic design values (R, Ω_0 and C_d) shall be based on current code requirements and the requirements of IEBC Chapter A4, Section A403.3, including the exceptions provided and as modified in the city ordinance.
- Target story drift shall not exceed the allowable deformation compatible with all vertical load-resisting elements and 0.025 times the story height.

DIAPHRAGM

- Horizontal diaphragms with wood stories above shall not be allowed to transmit lateral forces by rotation or cantilever, except as allowed by the building code. However, rotational effects shall be accounted for when asymmetric wall stiffness increases shear demands.

FEMA P-807

The FEMA P-807 guideline, *Seismic Evaluation and Retrofit of Multi-Unit Wood-Frame Buildings With Weak First Stories*, provides procedures for the analysis and seismic retrofit of weak first-story buildings built with structurally archaic materials. The guideline's design philosophy is to provide a cost-effective seismic retrofit method limited to the first story without disrupting the occupancy of the upper stories. The guideline limits the retrofit to the first story by introducing sheathing materials or structural elements with high lateral-displacement capacity. This method is designed to improve seismic performance and reduce the risk of collapse without driving additional earthquake forces into the upper stories and exposing them to the risk of increased damage or collapse.



FEMA P-807 – Limitations and Eligibility Requirements — (Section 2.6)

GENERAL

- ≤ 4 above-grade stories
- No above-grade concrete podium structure supporting wood-frame stories
- No restrictions on soil type or site class

UPPER STORIES

- Force-resisting system made of wood-frame stud walls
- 8–12 ft. story height
- No story prone to significant torsion
- Upper stories have no vertical mass or geometric irregularities

FIRST STORY

- Maximum story height 8–15 ft.
- Force-resisting system made of wood-frame stud walls
- Walls have continuous perimeter or slab-on-grade foundations
- Force-resisting system doesn't have any full-height concrete or masonry walls
- Additional requirements found in Section 2.6.3

DIAPHRAGM

- Second floor diaphragm has aspect ratio ≤ 2:1
- Second floor diaphragm doesn't cantilever more than 25 ft. from a qualifying wall line
- No diaphragm has a reentrant corner irregularity
- No diaphragm has a vertical offset
- Additional requirements found in Section 2.6.4

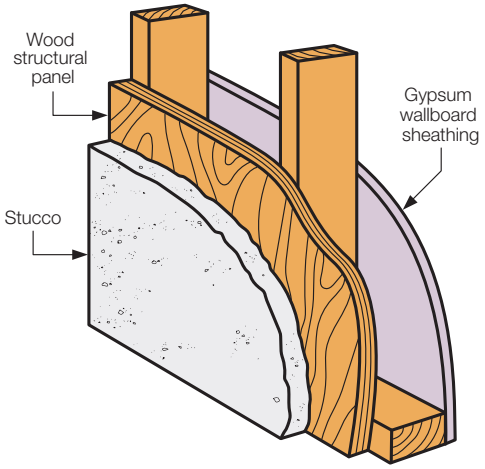
FEMA P-807 procedure is based on statistical data and does not require customized analysis. The conditions in Section 2.6 represent nonlinear models that were analyzed in the FEMA P-807 study. Where condition(s) does not meet the eligibility requirement, a building may be altered or retrofitted to become eligible.

For more information on designs using the FEMA P-807 Weak-Story Tool with Simpson Strong-Tie® Strong Frame® Moment Frames Design Tutorial, refer to p. 32.

Conducting a Building Survey

It is critical that a building identified as having a weak/soft story is surveyed accurately enough to locate and estimate the capacity of each element. The information found will be used differently, depending on the code that is followed for retrofit.

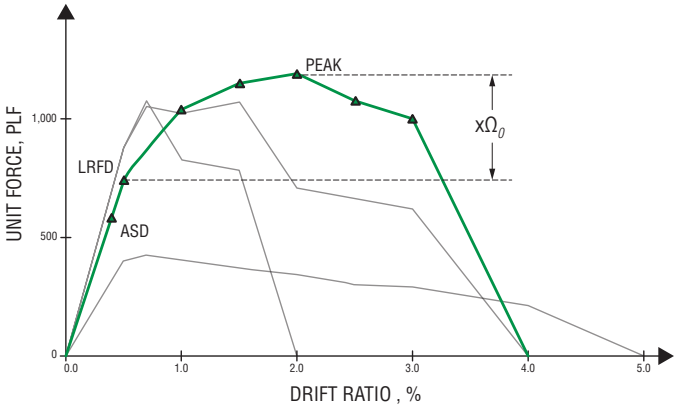
IEBC Chapter A4 does not recognize nonconforming materials such as drywall or stucco, whereas FEMA P-807 assigns strength and stiffness to wall segments constructed with archaic materials and detailing. In new construction, nonconforming elements are considered nonstructural partitions and therefore do not count toward required strength. However, for weak-story structures, this approach may significantly underestimate story strength. Upper stories containing numerous interconnected walls and partitions can be reasonably strong.



Structural Use of Nonconforming Material

By relying on realistic estimates of material strength and corresponding deformation, FEMA P-807 assigns strength values for nonconforming sheathing materials over a range of story drifts. The strength values were derived from wall component tests, as documented in FEMA P-807 Appendix D. The guidelines use “strength” to mean a complete load-drift relationship and not just a single peak value. Procedures for characterizing and combining materials, wall assemblies, wall lines and stories in a way that considers displacement capacity are given.

FEMA P-807 provides guidelines to generate strength versus deflection curves of various common wall assemblies, including stucco and plywood siding, and uses the peak strength when evaluating the structure. Conventional methods of analyzing structures typically use ASD or LRFD design methodologies depending on the type of structure or materials used. Similar to ASCE or building code provisions where the overstrength factor Ω_O is used for design, FEMA P-807 specifies load path elements should be designed to develop the full strength with appropriate strength reduction factors applied to the ultimate strengths. In the following pages, LRFD capacities are provided for various load path connector products, which can be used to develop the full strength of the lateral resisting element to satisfy this requirement.

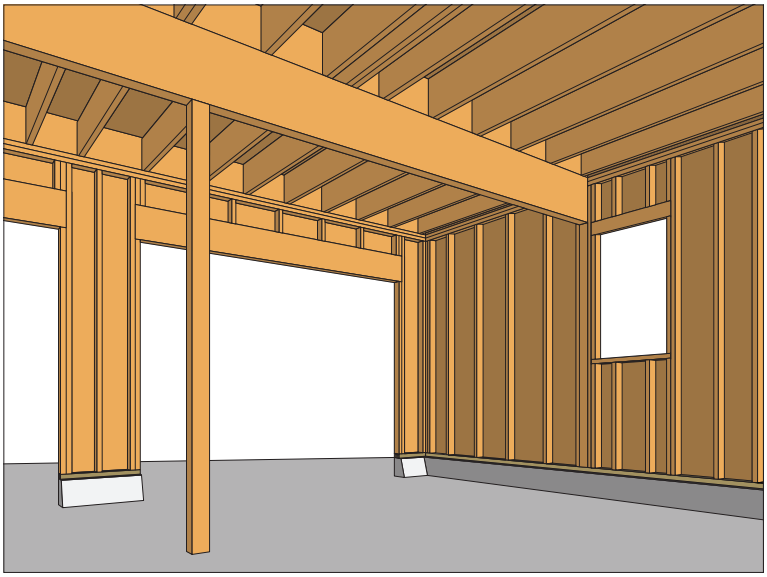


FEMA P-807 Composite Sheathing Assembly Load-Deflection Curves

Different jurisdictions may require additional specific information. Conduct an investigation that complies with the specific engineering criteria from the selected retrofit design standard. Have a registered design professional document procedures, findings and conclusions. They can then incorporate the information into the permit submittal documents.

Detailed Building Survey May Include:

- Wall locations and size of openings
- Floor, roof and wall assembly descriptions
- Diaphragm geometry
- Wall sheathing materials
- Wall nailing size and spacing
- Condition of walls
- Direction of floor and roof framing
- Locations and sizes of holdowns
- Existence of anchor bolts (size and spacing)
- Structurally connected walls
- Continuous load path through walls to resist overturning
- Foundation elements



Building Example

Refer to pp. 14 and 15 for retrofit solutions.

Retrofit Checklist for Building Owners

If you think your building might be affected by your city's mandatory soft-story retrofit program, we encourage building owners to do the following as soon as possible to meet the appropriate deadlines from the city.

1. Determine if your building has a soft story.

Multi-unit wood-frame buildings with more than 80% open area on one first-story wall or more than 50% on two adjacent walls are considered weak-story buildings.

2. Verify with your city's department of building and safety regarding the following:

- Your building is within the scope of the mandatory retrofit program for soft-story buildings
- Important deadlines regarding submittal documentation, permits, construction completion and certificates of compliance
- Additional information on city programs that might be available to help building owners

3. Find and schedule a licensed engineer to survey and assess your soft-story building according to the requirements of the city's retrofit ordinances.

For a licensed retrofit engineer, visit **www.seaosc.org/find-an-engineer** for Southern California and **www.seaonc.org/structural-engineer-referral-list** for Northern California.

4. Should a licensed engineer determine a retrofit is needed, hire a contractor and, if desired, an architect.

- For licensed and insured contractors in California, visit the Contractors State License Board at **www.cslb.ca.gov**
- For information on licensed architects in California, visit **www.cab.ca.gov**

5. Submit plans for your building's retrofit to the city's department of building and safety including:

- Previous retrofit work
- Structural analysis/calculation package
- Architectural plans
- Structural plans

The Department of Building and Safety will assist building owners with all the steps needed to obtain the appropriate retrofit permits, including clearances from all agencies during your building's retrofit work.

Retrofitting Your Building with Simpson Strong-Tie® Products

The illustration on the right and the list below provide some of the product solutions that Simpson Strong-Tie offers. In the following pages, ASD load tables are provided for use with the IEBC A4, and LRFD load tables are provided for use with both FEMA P-807 and AISC 41. Some tables may contain only LRFD values; for ASD values, please see the current *Wood Construction Connectors* catalog. Holdowns' ultimate capacities are also provided for use only with FEMA P-807, Section 2.6, and do not apply to IEBC A4.

Callouts on the general picture are for the following product details pages.

Lateral Systems

- (A) Strong Frame® Special Moment Frames — pp. 16–17
- (B) Strong-Wall® Shearwalls — p. 18
- (C) Site-Built Shearwalls — p. 18

Connection to the Structure

- (D) A35 / LTP4 / Framing Angles and Plates (not shown in diagram) — pp. 19–20
- (E) A35 with Pan Head Screws — p. 21
- (F) HSLQ Heavy Shear Transfer Angle — p. 22
- (G) Strap Ties — pp. 23–24

Connection to the Foundation

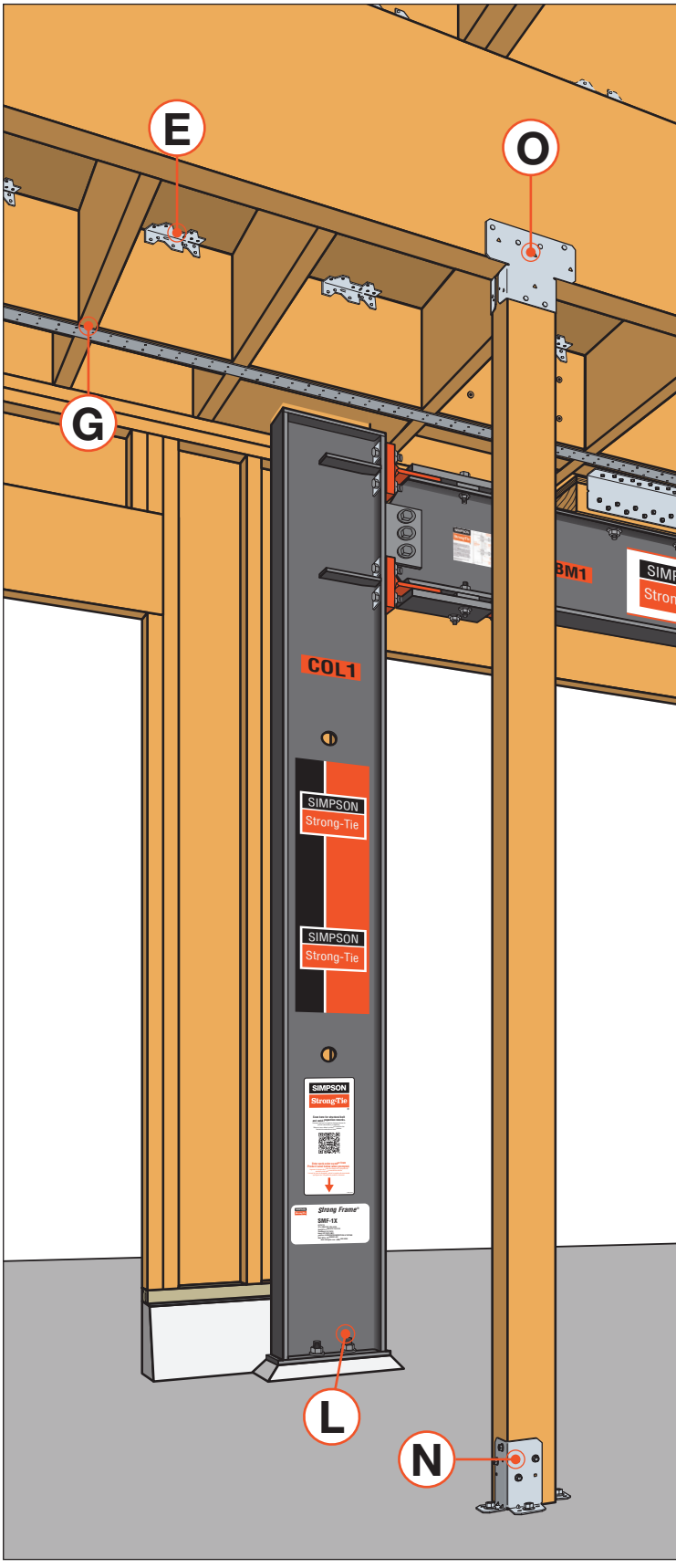
- (H) HDU Holdowns — p. 25
- (I) URFP (Universal Retrofit Foundation Plate) (not shown in diagram) — p. 26
- (J) Titen HD® Heavy-Duty Screw Anchors — p. 26
- (K) SET-3G™ / AT-XP® Adhesives with RFB — p. 27
- (L) Strong Frame® Anchor Kits – MFAB/MFSL — p. 27

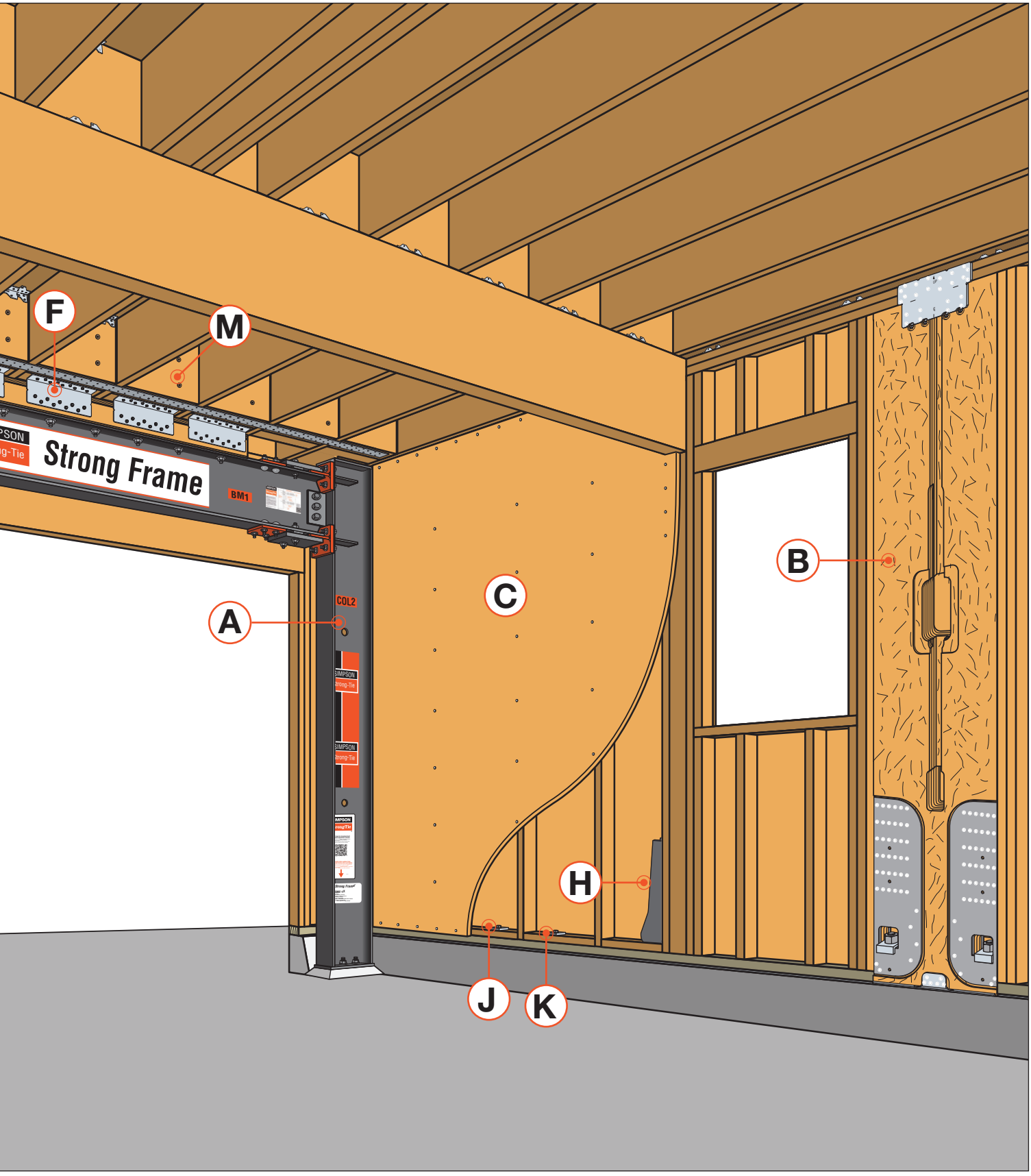
Fasteners

- (M) SDS / SDWS / SDWH Screws — pp. 28–29

Additional Retrofit Products and Resources

- (N) RPBZ Retrofit Post Base — p. 30
- (O) AC Post Caps — p. 30
- (P) RFB Retrofit Bolts (not shown in diagram) — p. 30




F
M
Strong Frame
BM1
A
COL2
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H
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K

Lateral Systems

A Strong Frame® Special Moment Frame

Simpson Strong-Tie provides solutions using special moment frames, which can be used in new construction as well as retrofit applications.

Retrofit elements designed based on the requirements of FEMA P-807 need to be ductile and meet the minimum strength degradation ratio, C_d, of 0.8. The Strong Frame special moment frame meets these requirements for use in the FEMA P-807 guideline.

When designing per IEBC Chapter A4 and ASCE 7 with the applicable R, Ω_o and C_d factors employed, the Strong Frame special moment frame can be used.

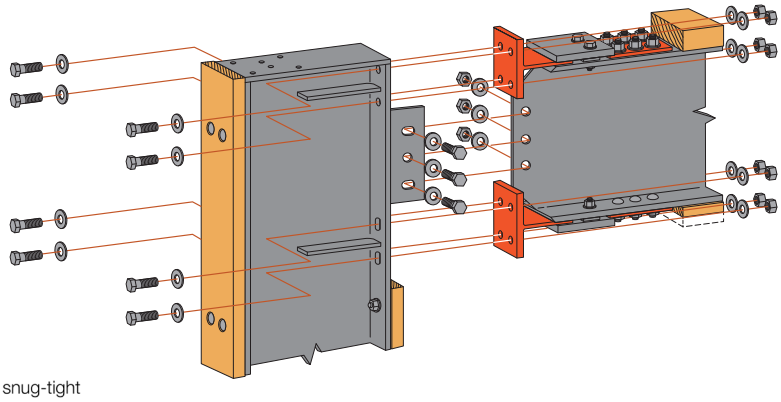
The Strong Frame special moment frame is an ideal choice for soft-story retrofit of mid-rise wood structures. Because of the unique ductility characteristics of our patented Yield-Link® moment connection structural fuse, the Strong Frame special moment frame can be easily integrated into older buildings. Yielding during a seismic event is confined in the replaceable structural fuses at the beam-to-column connections, allowing this frame to utilize a true capacity-based design approach.

In many cases of retrofit design, it is necessary to provide access to the frame on the interior of the structure in tight quarters. A bolted frame solution allows the beam and columns to be assembled in parts. This reduces demolition that might otherwise be required for a preassembled frame and allows easy integration into the project's construction schedule.

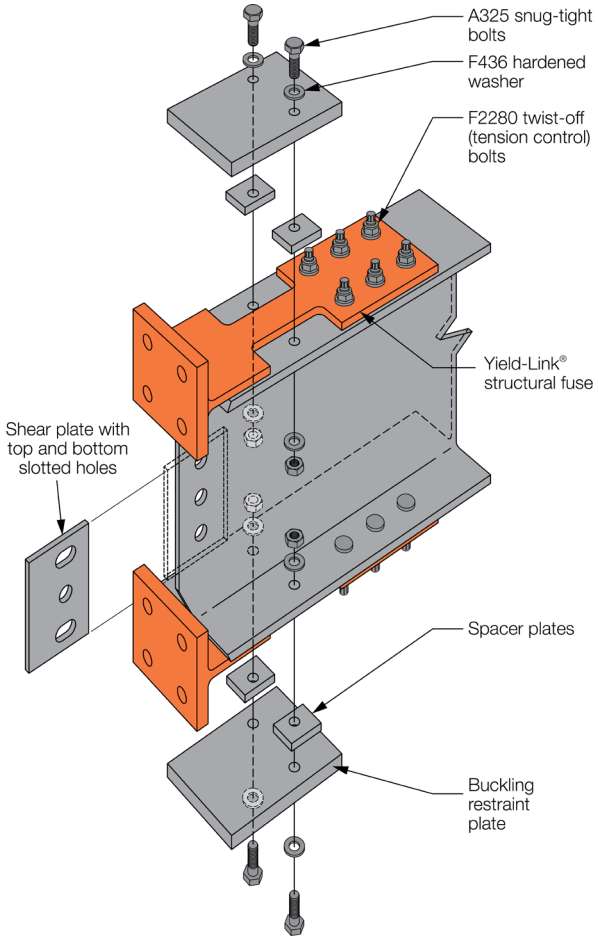
Lateral Systems (cont.)

The bolt-on/bolt-off structural fuses can be replaced after an earthquake, if necessary. The all-bolted Strong Frame® special moment frame requires no onsite welding and therefore can be safely installed under occupied living or commercial spaces. The field-installed bolts at the beam-to-column connection are approved using a snug-tight installation. This simplifies the installation, requires no specific tools or special bolting and reduces installed costs.

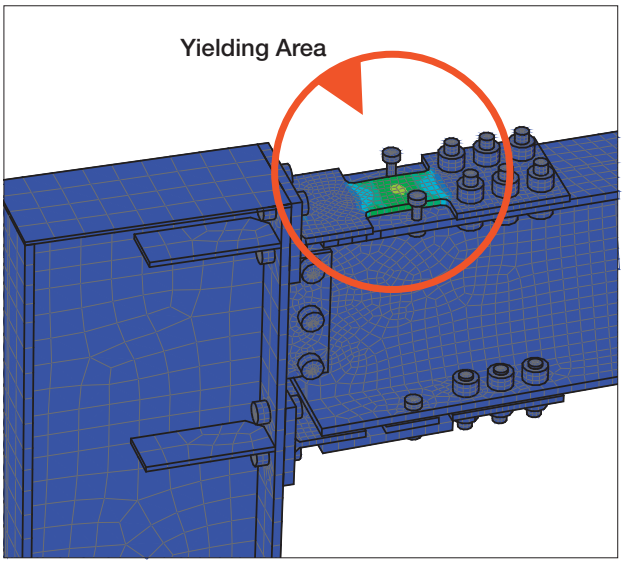
The connection and frame design procedures have been specifically engineered to eliminate the need for beam bracing, while still delivering the performance expected of a special moment frame solution. In addition, foundation demands are minimized by tuning the yielding area to the specified loads.



Field Installation of Beam to Column



Factory-installed Yield-Link® Moment Connection for the Structural Fuse Special Moment Frame Joint



The highlighted green section from Finite Element Analysis illustrates the yielding area on the Strong Frame special moment frame connection.

Lateral Systems (cont.)

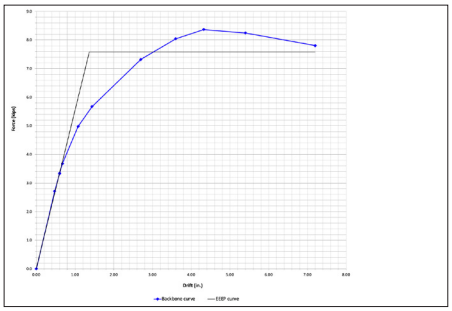
B Strong-Wall® High-Strength Wood Shearwall and Steel Strong-Wall®

Simpson Strong-Tie Strong-Wall shearwalls can be the appropriate choice for providing added lateral support where conventional shearwalls are not able to be used and moment frames are not required based on available wall space and additional strength required. Strong-Wall shearwalls provide the needed added lateral strength in a strong, ductile and compact prefabricated panel. Our Strong-Wall product line includes the Steel Strong-Wall (SSW) and Strong-Wall High-Strength Wood Shearwalls (WSWH) in various widths and heights. The WSWH can be field trimmed to meet your specific project heights. For both panel types, designs under IEBC/ASCE can utilize an R of 6.5. For FEMA P-807 designs, please contact Simpson Strong-Tie to request load drift curves for the Strong-Wall high-strength wood shearwalls that can be imported into the Weak-Story Tool.

Strong-Wall High-Strength Wood Shearwalls

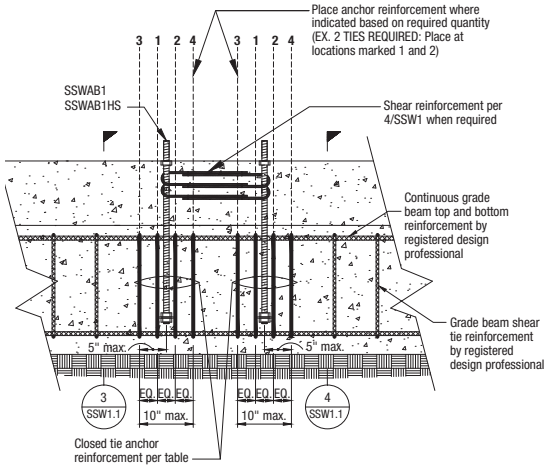
Strong-Wall High-Strength Wood Shearwall Pushover Curve

Backbone Curve		
Drift, %H	Drift, in.	Force, kips
0.00%	0.00	0.00
0.44%	0.47	2.72
0.56%	0.60	3.32
0.63%	0.68	3.68
1.00%	1.08	4.98
1.33%	1.44	5.67
2.50%	2.70	7.32
3.33%	3.60	8.04
4.00%	4.32	8.37
5.00%	5.40	8.25
6.67%	7.20	7.81

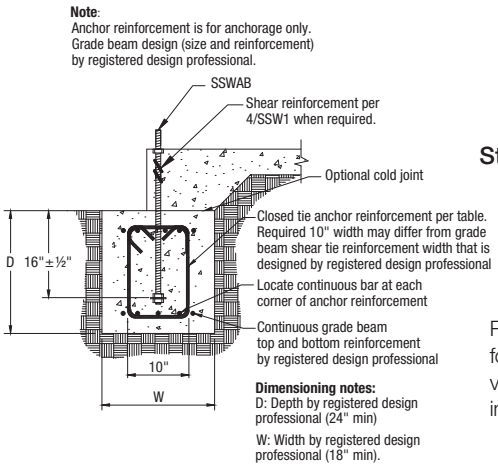


Steel Strong-Wall

Strong-Wall Anchor Reinforcement Solutions on Grade Beams



Strong-Wall Grade Beam Anchorage Detail



Strong-Wall Grade Beam Anchorage Reinforcement

Refer to **strongtie.com** for recommended design values and additional information.

C Site-Built Shearwalls

Soft- or weak-story retrofits are not always limited to the open front line. Sometimes, the entire target story may need to be evaluated if archaic brittle materials have been used for lateral support. In these locations, or where narrow higher-strength manufactured systems are not required, conventional site-built shearwalls may be used. These walls can adequately provide additional ductility and strength to the structure where the configuration allows for longer wall panels. The shearwalls should have adequate connection to the framing above (framing angles, strap ties, etc.) and be tied to the foundation using holdowns and anchor bolts.

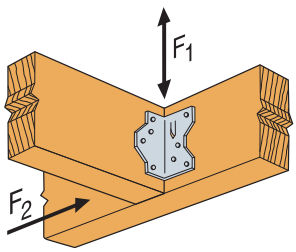
SBSD Site-Built Shearwall Designer

Connection to the Structure

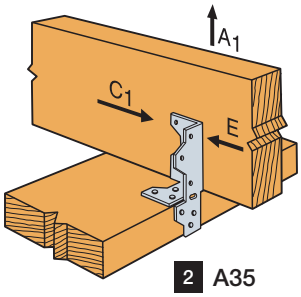
D LTP4 / LTP5 / A34 / A35 Framing Angles and Plates

Model No.	Type of Connection	Fasteners	Direction of Load	DF/SP LRFD Capacity		SPF/HF LRFD Capacity	
				λ = 0.8	λ = 1.0	λ = 0.8	λ = 1.0
A34	1	(8) 0.131" x 1½"	F_1	685	705	590	605
			F_2[5]	560	560	480	480
A35	2	(9) 0.131" x 1½"	A_1, E	460	460	395	395
			C_1	245	245	210	210
	3	(12) 0.131" x 1½"	A_2	425	425	365	365
			C_2	430	430	370	370
			D	290	290	250	250
	4	(12) 0.131" x 1½"	F_1	840	840	720	720
			F_2[5]	875	875	755	755
	5	(12) 0.131" x 1½"	F_1	720	720	620	620
LTP4	6	(12) 0.131" x 1½"	G	815	815	700	700
			H	685	685	590	590
LTP5	7	(12) 0.131" x 1½"	G	730	730	630	630
			H	635	635	545	545

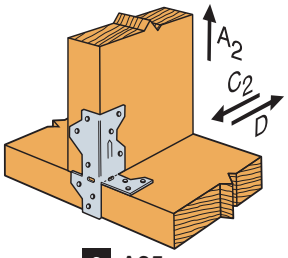
1. LRFD loads are for one anchor. When anchors are installed on each side of the joist, the minimum joist thickness is 3".
2. Some illustrations show connections that could cause cross-grain tension or bending of the wood during loading if not reinforced sufficiently. In this case, mechanical reinforcement should be considered.
3. LTP4 can be installed over ⅜" wood structural panel sheathing with 8d x 1½" nails and achieve 0.72 of the listed loads, or over ½" and achieve 0.64 of the listed load, 8d commons will achieve 100% load.
4. The LTP5 may be installed over wood structural panel sheathing up to ½" thick using 8d x 1½" nails with no load reduction.
5. Connectors are required on both sides to achieve F_2 loads in both directions.
6. **Fasteners:** Nail dimensions in the table are listed diameter by length.



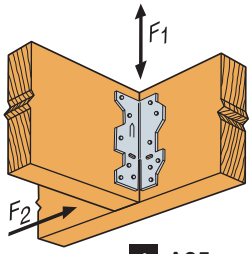
1 A34



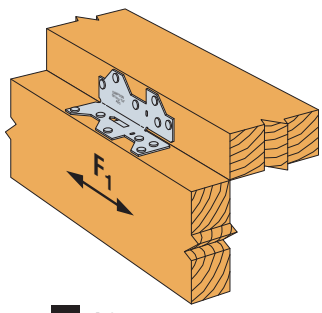
2 A35



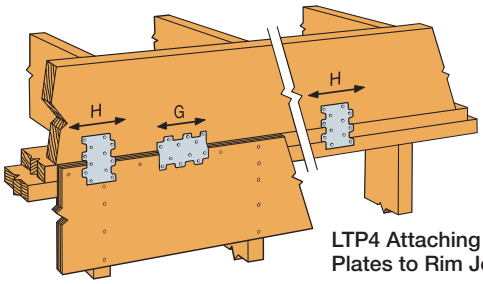
3 A35



4 A35

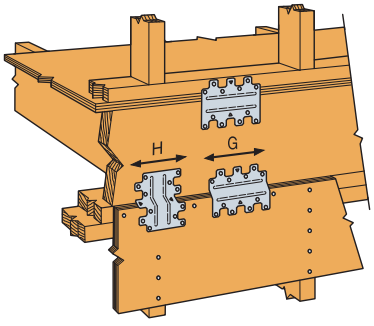


5 A35



LTP4 Attaching Top Plates to Rim Joist

6 LTP4 Installed over Wood Structural Panel Sheathing



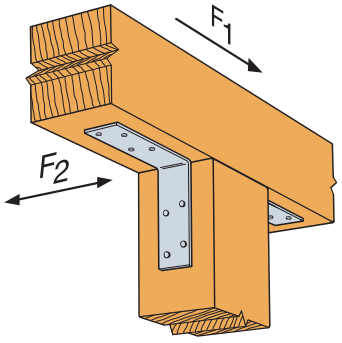
7 LTP5 Installed over Wood Structural Panel Sheathing

Connection to the Structure (cont.)

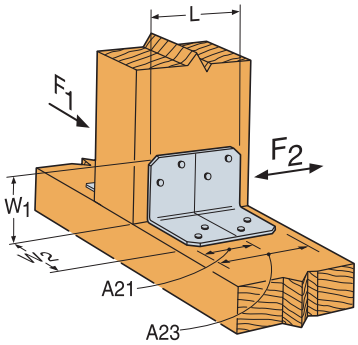
D A21 / A23 / A33 / A44 Framing Angles

Model No.	Dimensions (in.)			Fasteners		DF/SP LRFD Capacities				SPF/HF LRFD Capacities			
						λ = 0.8		λ = 1.0		λ = 0.8		λ = 1.0	
	W_1	W_2	L	Base	Post	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2
A21	2	1½	1⅜	(2) 0.148" x 1½"	(2) 0.148" x 1½"	410	190	430	190	350	165	370	165
A23	2	1½	2¾	(4) 0.148" x 1½"	(4) 0.148" x 1½"	820	695	880	695	705	600	760	600
A33	3	3	1½	(4) 0.148" x 3"	(4) 0.148" x 3"	970	330	995	330	835	330	855	330
A44	4⁹⁄₁₆	4⅜	1½	(4) 0.148" x 3"	(4) 0.148" x 3"	970	330	1010	330	835	325	870	325

1. Connectors are required on both sides to achieve F_1 loads in both directions.
2. **Fasteners:** Nail dimensions in the table are listed diameter by length.



A44 Installation
(A33 similar)



A21 / A23 Installation

Connection to the Structure (cont.)

E A35 / L90 Angles Installed with Pan Head Screws to Sheathing

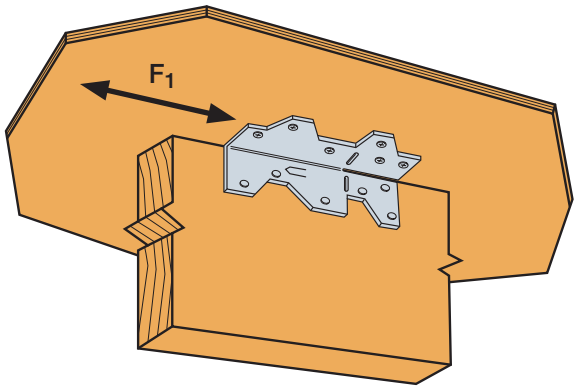
Simpson Strong-Tie A35 and L90 framing angles can be used in retrofit applications to connect framing members to existing floor sheathing. Testing has been performed with A35 and L90 framing angles installed with #8 x ⅝" and #10 x ⅝" pan head screws, respectively. Common sheathing materials were tested to provide solutions for various applications where traditional nails cannot be used.

Material: A35 — 18 gauge; L90 — 16 gauge

Finish: G90, available in ZMAX®

Installation:

- Use all specified fasteners; see General Notes.
- Use specified pan head fasteners on both the sheathing and the framing member.



A35 Installation
(L90 similar)

Model No.	Fasteners[5]	Sheathing	Allowable Loads, F_1 (100/115/125/160)	LRFD Capacities, F_1 (λ = 0.8/1.0)
A35	(12) #8 x ⅝"	T&G[1]	405	525
	(12) #8 x ⅝"	OSB[2]	435	565
	(12) #8 x ⅝"	Plywood[2]	505	655
L90	(10) #10 x ⅝"	T&G[1]	420	545
	(10) #10 x ⅝"	OSB[2]	410	535
	(10) #10 x ⅝"	Plywood[2]	580	750

1. T&G 1x6 are assumed equivalent of pine or better material.
2. Tabulated loads are based on testing with 23/32" thick APA-rated sheathing with a span rating of 48/24.
3. A35 and L90 loads are for condition F_1 only.
4. Allowable Loads/LRFD Capacities have been increased for wind or earthquake loading with no further increase allowed.
5. Fasteners shall be fully threaded wood screws with a pan head.

Connection to the Structure (cont.)

F HSLQ Heavy Shear Transfer Angle

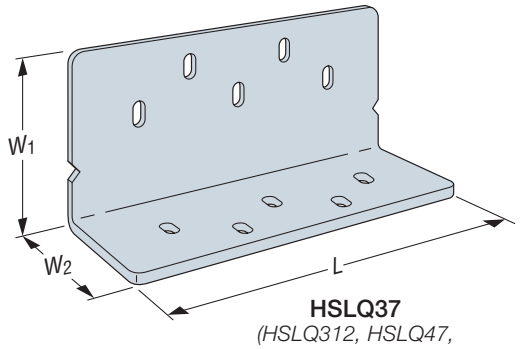
The HSLQ heavy shear transfer angle is designed to transfer lateral loads from wood solid-sawn joists or blocking into a wood solid-sawn element such as a moment frame nailer. The angle offers versatility by allowing up to a two-inch gap between the structural members and easy installation with Simpson Strong-Tie Strong-Drive® SDS Heavy-Duty Connector screws that are included with the HSLQ. The HSLQ is manufactured with a gap indication notch to make proper installation easy.

Material: 12 gauge

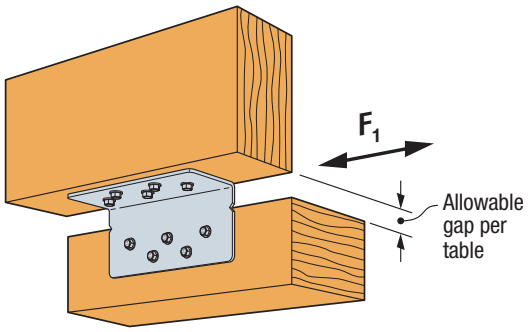
Finish: Galvanized, available in HDG

Installation:

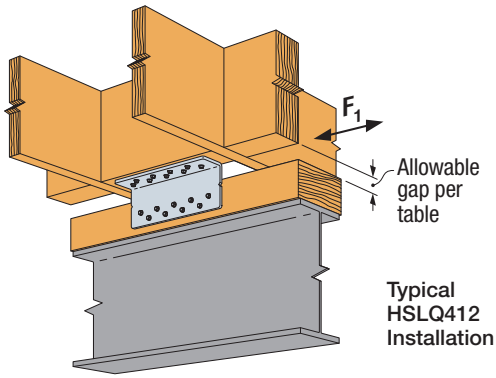
- Use all specified fasteners: see General Notes.
- Use long leg with notch indicator. (Notch indicates maximum allowed gap.)
- Minimum 4x8 wood members are required.
- Add filler shims where required in order not to load the angle in any direction other than lateral, as indicated.



HSLQ37
(HSLQ312, HSLQ47, HSLQ412 similar)



Typical HSLQ37 Installation



Typical HSLQ412 Installation

Model No.	Allowable Gap	Dimensions (in.)			Fasteners
		W_1	W_2	L	
HSLQ37-SDS2.5	0" – 1"	3¼	2¾	7¼	(10) ¼" x 2½" SDS
HSLQ312-SDS2.5	0" – 1"	3¼	2¾	11¾	(18) ¼" x 2½" SDS
HSLQ47-SDS2.5	1" – 2"	4¼	2¾	7¼	(10) ¼" x 2½" SDS
HSLQ412-SDS2.5	1" – 2"	4¼	2¾	11¾	(18) ¼" x 2½" SDS

Model No.	Allowable Gap	Allowable Loads DF/SP (100/115/125/160)	Allowable Loads SPF/HF (100/115/125/160)	LRFD Capacities DF/SP (λ = 0.8/1.0)	LRFD Capacities SPF/HF (λ = 0.8/1.0)
		Lateral (F_1)	Lateral (F_1)	Lateral (F_1)	Lateral (F_1)
HSLQ37-SDS2.5	0" – 1"	1,340	1,150	1,645	1,415
HSLQ312-SDS2.5	0" – 1"	2,900	2,495	3,770	3,240
HSLQ47-SDS2.5	1" – 2"	1,015	870	1,015	875
HSLQ412-SDS2.5	1" – 2"	2,290	1,970	2,980	2,560

1. Table loads are for one angle.
2. Loads are applicable to installation on either the narrow or the wide face of member.
3. Minimum 4x8 wood members are required.
4. SPF/HF values are based on DF/SP with reduction factor of 0.86.
5. HSLQ is used for in-plane lateral load transfer only. Designer to provide for frame out-of-plane stability as required.

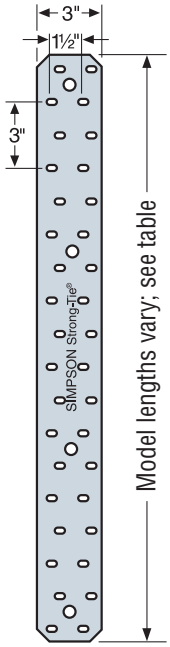
Connection to the Structure (cont.)

G HRS / ST / PS / HST / HTP / LSTA / LSTI / MST / MSTA / MSTC / MSTI Strap Ties

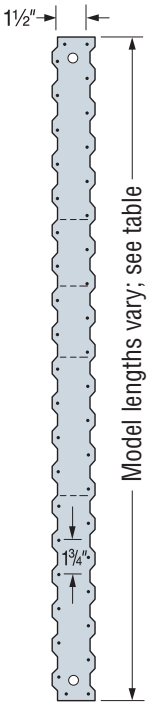
LRFD Tension Capacities

Model No.	Ga.	Dimensions (in.) W	Dimensions (in.) L	Fasteners (Total)	DF/SP (λ = 1.0)	SPF/HF (λ = 1.0)
LSTA9	20	1¼	9	(8) 0.148" x 2½"	1,030	880
LSTA12		1¼	12	(10) 0.148" x 2½"	1,285	1,100
LSTA15		1¼	15	(12) 0.148" x 2½"	1,540	1,320
LSTA18		1¼	18	(14) 0.148" x 2½"	1,800	1,540
LSTA21		1¼	21	(16) 0.148" x 2½"	1,850	1,760
LSTA24		1¼	24	(18) 0.148" x 2½"	1,850	1,850
ST292		2⅛	9⅝	(12) 0.162" x 2½"	1,800	1,540
ST2122		2⅛	12⅜	(16) 0.162" x 2½"	2,295	2,070
ST2115		¾	16⅝	(10) 0.162" x 2½"	995	995
ST2215		2⅛	16⅝	(20) 0.162" x 2½"	2,815	2,620
LSTA30	18	1¼	30	(22) 0.148" x 2½"	2,460	2,460
LSTA36		1¼	36	(24) 0.148" x 2½"	2,460	2,460
LSTI49		3¾	49	(32) 0.148" x 1½"	4,160	3,585
LSTI73		3¾	73	(48) 0.148" x 1½"	6,240	5,375
MSTA9		1¼	9	(8) 0.148" x 2½"	1,060	910
MSTA12		1¼	12	(10) 0.148" x 2½"	1,325	1,135
MSTA15		1¼	15	(12) 0.148" x 2½"	1,590	1,360
MSTA18		1¼	18	(14) 0.148" x 2½"	1,855	1,590
MSTA21		1¼	21	(16) 0.148" x 2½"	2,120	1,815
MSTA24		1¼	24	(18) 0.148" x 2½"	2,385	2,045
MSTA30	16	1¼	30	(22) 0.148" x 2½"	3,035	2,605
MSTA36		1¼	36	(26) 0.148" x 2½"	3,070	3,070
MSTA49		1¼	49	(26) 0.148" x 2½"	3,025	3,025
ST6215		2⅛	16⅝	(20) 0.162" x 2½"	3,110	2,670
ST6224		2⅛	23⅝	(28) 0.162" x 2½"	3,810	3,810
ST9		1¼	9	(8) 0.162" x 2½"	1,245	1,070
ST12		1¼	11⅝	(10) 0.162" x 2½"	1,555	1,335
ST18		1¼	17¾	(14) 0.162" x 2½"	2,125	1,870
ST22		1¼	21⅝	(18) 0.162" x 2½"	2,125	2,125
MSTC28		3	28¼	(36) 0.148 x 3¼	4,970	4,265
MSTC40		3	40¼	(52) 0.148 x 3¼	6,880	6,160
MSTC52		3	52¼	(62) 0.148 x 3¼	6,880	6,880
MSTC66	14	3	65¾	(68) 0.148 x 3¼	8,495	8,495
MSTC78		3	77¾	(76) 0.148 x 3¼	8,495	8,495
ST6236		2⅛	33⅜	(40) 0.162" x 2½"	5,770	5,770
HRS6	12	1⅜	6	(6) 0.148" x 2½"	910	790
HRS8		1⅜	8	(10) 0.148" x 2½"	1,520	1,315
HRS12		1⅜	12	(14) 0.148" x 2½"	2,130	1,840
MSTI26		2⅛	26	(26) 0.148" x 1½"	4,160	3,405
MSTI36		2⅛	36	(36) 0.148" x 1½"	5,760	4,715
MSTI48		2⅛	48	(48) 0.148" x 1½"	7,620	6,290
MSTI60		2⅛	60	(60) 0.148" x 1½"	7,620	7,620
MSTI72		2⅛	72	(72) 0.148" x 1½"	7,620	7,620
HRS416Z		3¼	16	(16) ¼" x 1½" SDS	3,825	3,110

1. Loads include a λ=1.0 time effect factor on the fasteners for wind or seismic loading.
2. For straight straps in tension, use half of the fasteners in each member being connected to achieve the listed loads.
3. Calculate the connector value for a reduced number of nails as follows:
   Allowable Load = (No. of Nails Used / No. of Nails in Table) x Table Load
4. Tension loads apply for uplift when installed vertically.
5. **Fasteners:** Nail dimensions in the table are listed diameter by length. See *Wood Construction Connectors* catalog for other nail sizes and information.
6. These products are approved for installation with the Strong-Drive® SD Connector screw. See *Wood Construction Connectors* catalog for additional information.



MSTC



ST292, ST2122, ST2215, ST6215, ST6224, ST6236

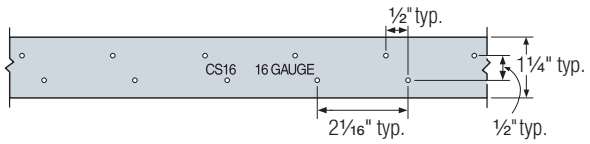
Connection to the Structure (cont.)

G CS / CMST Coiled Straps

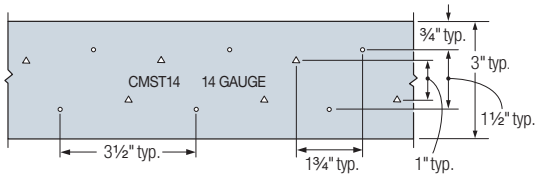
LRFD Capacities

Model No.	Total (Length)	Ga.	DF/SP		SPF/HF		Allowable Tension Loads (160)	LRFD Tension Loads (λ = 1.0)
			Fasteners	End Length	Fasteners	End Length		
CMST12	40'	12	(74) 0.162" x 2½"	33"	(84) 0.162" x 2½"	38"	9,215	13,850
			(86) 0.148" x 2½"	39"	(98) 0.148" x 2½"	44"	9,215	13,850
CMST14	52½'	14	(56) 0.162" x 2½"	26"	(66) 0.162" x 2½"	30"	6,475	9,545
			(66) 0.148" x 2½"	30"	(76) 0.148" x 2½"	34"	6,475	9,595
CMSTC16	54'	16	(50) 0.148 x 3¼"	20"	(58) 0.148" x 3¼"	25"	4,690	6,885
CS14	100'	14	(26) 0.148" x 2½"	15"	(30) 0.148" x 2½"	16"	2,490	3,735
			(30) 0.131" x 2½"	16"	(36) 0.131" x 2½"	19"	2,490	3,690
CS16	150'	16	(20) 0.148" x 2½"	11"	(22) 0.148" x 2½"	12"	1,705	2,560
			(22) 0.131" x 2½"	13"	(26) 0.131" x 2½"	1"	1,705	2,470
CS20	250'	20	(12) 0.148" x 2½"	7"	(14) 0.148" x 2½"	8"	1,030	1,525
			(14) 0.131" x 2½"	9"	(16) 0.131" x 2½"	9"	1,030	1,450
CSHP18	75'	18	(14) 0.148" x 2½"	9"	(16) 0.148" x 2½"	10"	1,540	2,080
			(16) 0.131" x 2½"	10"	(18) 0.131" x 2½"	11"	1,540	2,080
CSHP20	75'	20	(12) 0.148" x 2½"	8"	(12) 0.148" x 2½"	8"	1,160	1,565
			(12) 0.131" x 2½"	8"	(14) 0.131" x 2½"	9"	1,160	1,565

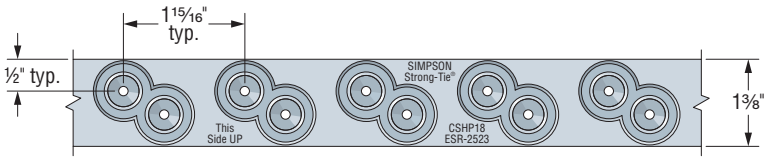
1. Loads include a λ =1.0 time effect factor on the fasteners for wind or seismic loading.
2. For straight straps in tension, use half of the fasteners in each member being connected to achieve the listed loads.
3. Calculate the connector value for a reduced number of nails as follows:
   Allowable Load = (No. of Nails Used / No. of Nails in Table) x Table Load
4. Tension loads apply for uplift when installed vertically.
5. **Fasteners:** Nail dimensions in the table are listed diameter by length. See *Wood Construction Connectors* catalog for other nail sizes and information.
6. These products are approved for installation with the Strong-Drive® SD Connector screw. See *Wood Construction Connectors* catalog for additional information.



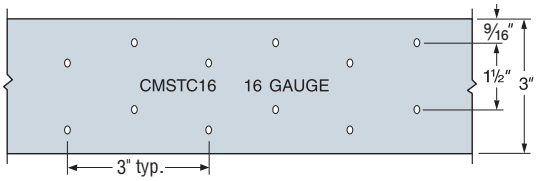
CS16 Hole Pattern
(all other CS straps similar)



CMST14 Hole Pattern
(CMST12 similar)



CSHP
CSHP18
CSHP20

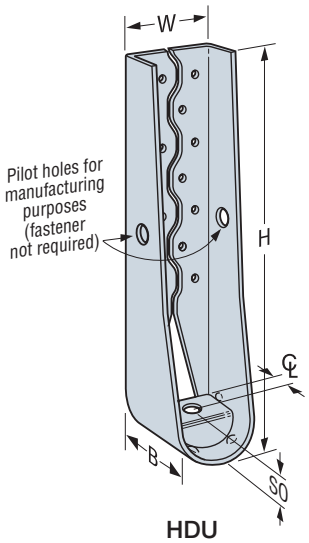


CMSTC16 Hole Pattern

Connection to the Foundation

H HDU Holdowns

Simpson Strong-Tie holdowns provide a tension connection between a site-built shearwall and the foundation. They attach to the wood member with our Strong-Drive® SDS Heavy-Duty Connector screw and to the concrete with an anchor bolt or an anchoring adhesive.



HDU

HDU Holdowns
LRFD and Nominal Capacities

Model No.	Ga.	Fasteners		Minimum Wood Member Size (in.)	LRFD Capacities (λ= 1.0)			Nominal Capacities
		Anchor Bolt Dia. (in.)	Post Fasteners (in.)		DF/SP (lb.)	SPF/HF (lb.)	Deflection at LRFD Load (in.)	DF/SP (lb.)
HDU2-SDS2.5	14	⅝	(6) ¼ x 2½ SDS	3 x 3½	4,305	3,100	0.118	9,840
HDU4-SDS2.5	14	⅝	(10) ¼ x 2½ SDS	3 x 3½	6,390	4,600	0.154	13,695
HDU5-SDS2.5	14	⅝	(14) ¼ x 2½ SDS	3 x 3½	7,905	6,075	0.158	17,685
HDU8-SDS2.5	10	⅞	(20) ¼ x 2½ SDS	3 x 3½	9,470	8,150	0.161	17,945
				3½ x 3½	9,760	8,395	0.161	21,265
				3½ x 4½	11,020	9,210	0.161	25,625
HDU11-SDS2.5	10	1	(30) ¼ x 2½ SDS	3½ x 5½	13,350	11,240	0.182	28,600
				3½ x 7¼ / 5½ x 5½	15,645	13,455	0.182	34,245

1. See Holdown and Tension Tie General Notes in the *Wood Construction Connectors* catalog.
2. Loads include a λ = 1.0 time effect factor on the fasteners for wind or seismic loading.
3. Nominal capacities are the average ultimate tested load.

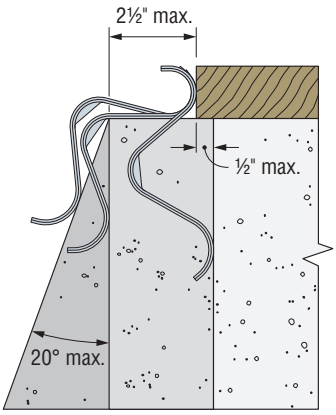
Connection to the Foundation (cont.)

Simpson Strong-Tie offers holdowns and mechanical and adhesive anchoring solutions that are particularly effective for soft-story retrofits where wood structures need to be securely connected to older concrete foundations.

I Universal Retrofit Foundation Plate (URFP)

In applications where minimal vertical clearance exists, the URFP universal retrofit foundation plate enables the cripple wall to be anchored to the foundation from the side.

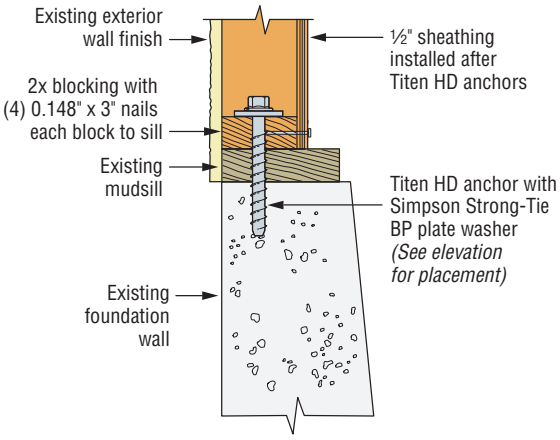
URFP Installed on a Foundation



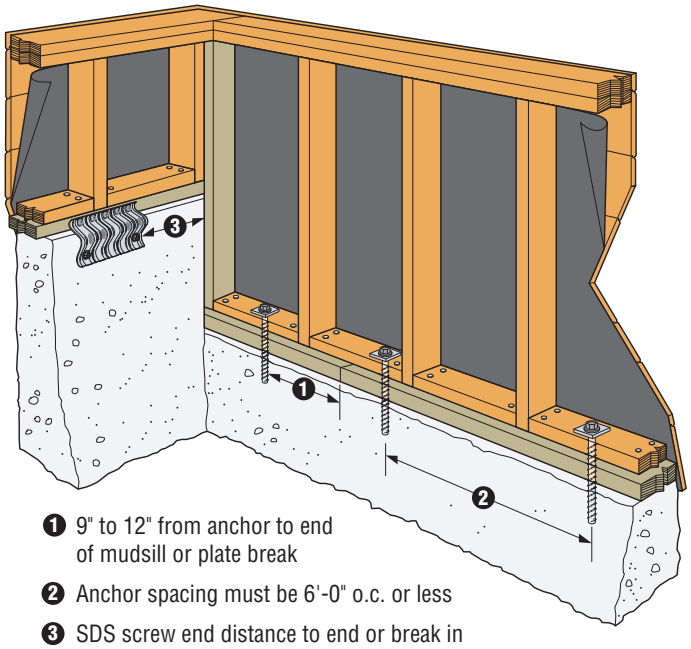
URFP Installed

J Titen HD® Heavy-Duty Screw Anchors

For securing a soft-story structure to its foundation by bolting the mudsill to the foundation or to secure a wood ledger to concrete or masonry, the patented Titen HD screw anchor provides optimal performance in both cracked and uncracked concrete.



Anchoring Mudsill to Foundation with Titen HD Screw Anchor



❶ 9" to 12" from anchor to end of mudsill or plate break

❷ Anchor spacing must be 6'-0" o.c. or less

❸ SDS screw end distance to end or break in sill plate (mudsill) = 3" min. – 12" max.

Refer to our Anchor Designer™ Software on p. 33 of this guide for more information.

Titen HD Screw Anchor

Connection to the Foundation (cont.)

K SET-3G™ and AT-XP® High-Strength Anchoring Adhesives

SET-3G anchoring adhesive is frequently used to install anchor bolts for holdowns and tension ties in site-built shearwalls. This high-strength anchoring adhesive offers increased strength and reliability in adverse conditions, including performance under static and seismic loading.

Formulated for high-strength anchorage of threaded rod and rebar into cracked and uncracked concrete and masonry under a wide range of conditions, AT-XP adhesive dispenses easily in cold or warm environments and in below-freezing temperatures with no need to warm the cartridge. When mixed properly, this low-odor formula is a dark teal color for easy post-installation identification.

SET-3G Adhesive

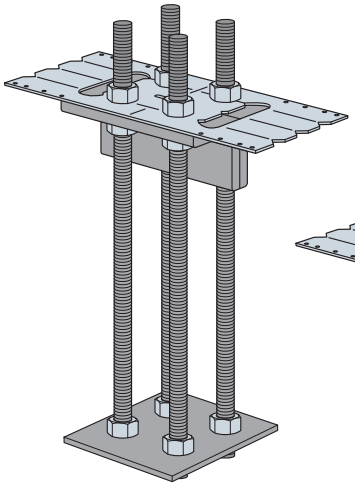
AT-XP Adhesive

L Strong Frame® Special Moment Frame – Preassembled Anchor Bolt Assemblies

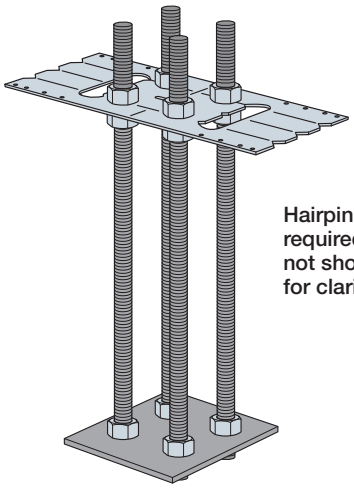
Two pre-engineered anchorage solutions are available, the MFSL and the MFAB. The MFSL comes with preinstalled shear lugs and allows smaller edge distances. Both types are preassembled on the MF-TPL template that attaches directly to the concrete form. Extension kits are also available for deeper anchorage embeds.

Calculations for the anchorage are provided and typically assume a cracked concrete design based on ACI 318 with no supplementary reinforcing and a centered square pad. Loads are based on minimum of Omega amplified forces or the yielding mechanism of the frame. Alternate design and detailing of the anchorage can be specified by the designer.

For more information regarding designing anchorage with our Strong Frame moment frame selector software, refer to p. 31 of this guide.



MFSL Anchorage Assembly



MFAB Anchorage Assembly

Hairpins are required but not shown for clarity.

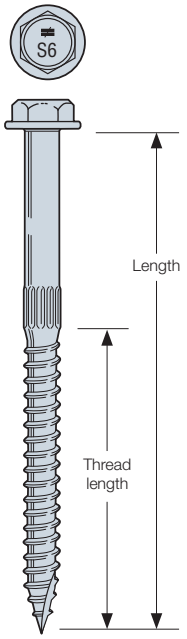
Fasteners

M Strong-Drive® SDS HEAVY-DUTY CONNECTOR Screw, SDWS TIMBER Screw (Exterior Grade) and SDWH TIMBER-HEX Screw in LRFD

Strong-Drive SDS HEAVY-DUTY CONNECTOR Screws

Dia. x Length (in.)	Model No.	Thread Length (in.)	Finish / Material	DF/SP LRFD Capacities					
				Shear (λ = 0.8)			Shear (λ = 1.0)		
				Steel Side Member Thickness (in.)			Steel Side Member Thickness (in.)		
				16 ga.	14 ga. and 12 ga.	10 ga. or greater	16 ga.	14 ga. and 12 ga.	10 ga. or greater
¼ x 1½	SDS25112	1	Double-Barrier Coating	430	430	430	540	540	540
¼ x 2	SDS25200	1¼		430	500	500	540	625	625
¼ x 2½	SDS25212	1½		430	670	725	540	840	905
¼ x 3	SDS25300	2		430	725	725	540	905	905
¼ x 3½	SDS25312	2¼		430	725	725	540	905	905
¼ x 4½	SDS25412	2¾		430	725	725	540	905	905
¼ x 5	SDS25500	2¾		430	725	725	540	905	905
¼ x 6	SDS25600	3¼		430	725	725	540	905	905
¼ x 8	SDS25800	3¼		430	725	725	540	905	905

1. All applications are based on full penetration into the main member.
   Full penetration is the screw length minus the side member thickness.
2. LRFD loads are shown at the time effect factor listed.
   Tabulated values must be multiplied by all applicable adjustment factors per the NDS.
3. See ICC-ES ESR-2236 for spacing, withdrawal, basic fastener properties and corrosion.

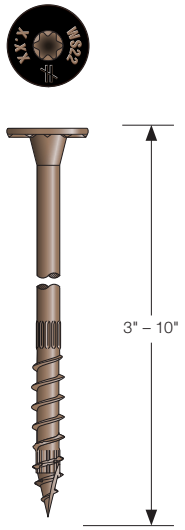


Strong-Drive SDS HEAVY-DUTY CONNECTOR Screws

Strong-Drive SDWS TIMBER Screws (Exterior Grade)

Dia. x Length (in.)	Model No.	Thread Length (in.)	DF/SP LRFD Capacities								
			Shear (λ = 0.8)								
			Wood Side Member Thickness (in.)								
			1.5	2	2.5	3	3.5	4	4.5	6	8
0.221 x 3	SDWS22300DB	1½	440	—	—	—	—	—	—	—	—
0.221 x 4	SDWS22400DB	2⅜	695	695	525	—	—	—	—	—	—
0.221 x 5	SDWS22500DB	2¾	695	695	620	620	560	—	—	—	—
0.221 x 6	SDWS22600DB	2¾	695	695	700	700	630	630	610	—	—
0.221 x 8	SDWS22800DB	2¾	695	695	700	700	680	680	680	680	—
0.221 x 10	SDWS221000DB	2¾	695	695	700	700	680	680	680	680	680

See footnotes on next page for SDWS Timber screws (Exterior Grade) and SDWH Timber-Hex screws.



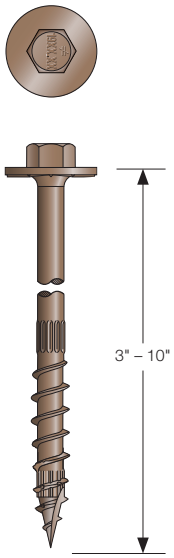
Strong-Drive SDWS TIMBER Screws (Exterior Grade)

Fasteners (cont.)

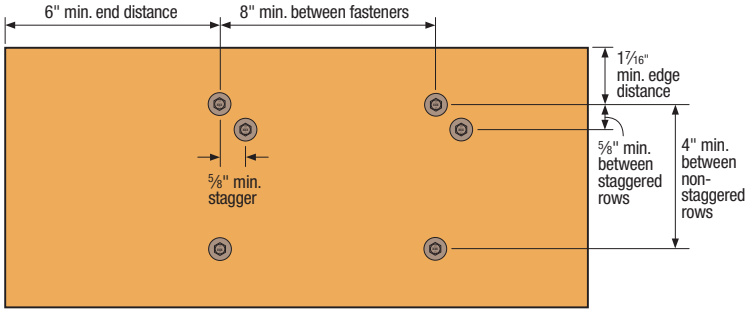
M Strong-Drive® SDWH TIMBER-HEX Screws

Dia. x Length (in.)	Model No.	Thread Length (in.)	DF/SP LRFD Capacities								
			Shear (λ = 0.8)								
			Wood Side Member Thickness (in.)								
			1.5	2	2.5	3	3.5	4	4.5	6	8
0.195 x 3	SDWH19300DB	1½	490	—	—	—	—	—	—	—	—
0.195 x 4	SDWH19400DB	2⅜	635	515	515	—	—	—	—	—	—
0.195 x 6	SDWH19600DB	2¾	635	455	455	455	455	420	420	—	—
0.195 x 8	SDWH19800DB	2¾	635	455	455	455	455	455	445	425	—
0.195 x 10	SDWH191000DB	2¾	635	455	455	455	455	455	445	450	425

1. All applications are based on full penetration into the main member. Full penetration is the screw length minus the side member thickness.
2. LRFD loads are shown at the time effect factor listed. For λ = 1.0, multiply tabulated values by 1.25. Tabulated values must be multiplied by all applicable adjustment factors per the NDS.
3. Minimum fastener spacing requirements: 6" end distance, 1 7/16" edge distance, ⅝" between staggered rows of fasteners, 4" between non-staggered rows of fasteners and 8" between fasteners in a row.
4. For in-service moisture content greater than 19%, use C_M = 0.7.
5. See IAPMO UES ER-192 for withdrawal, lateral design in other species, basic fastener properties and corrosion.



Strong-Drive SDWH TIMBER-HEX Screws

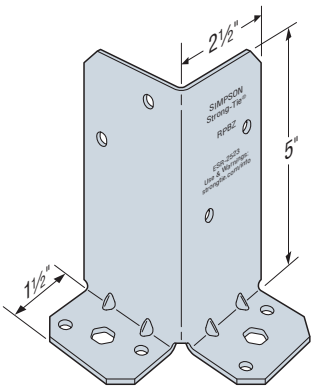


SDWH Spacing Requirements

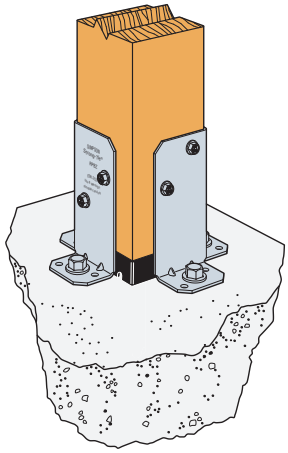
Additional Retrofit Products and Resources

N RPBZ Retrofit Post Base

The RPBZ retrofit post base is designed to reinforce the connection of existing posts and columns to the foundation. The single, versatile model will fit on any size post consisting of a double 2x4 or larger.



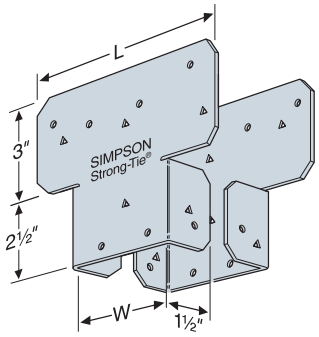
RPBZ



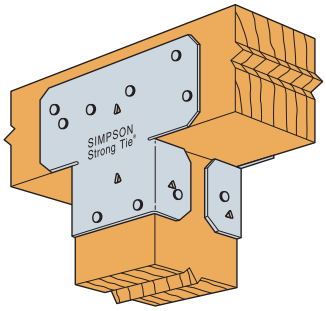
RPBZ Installation

O AC Post Caps

In addition to strengthening the lateral system of the structure, ensuring an adequate connection exists between beams and posts in the middle of the structure is also recommended. One method is the AC post cap, a unique two-piece solution that accommodates a variety of lumber sizes.



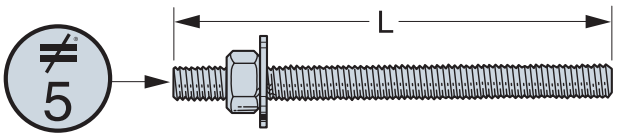
AC



AC Installation

P RFB Retrofit Bolts

RFBs are clean, oil-free, pre-cut threaded rod, supplied with a nut and washer. They offer a complete engineered anchoring system when used with Simpson Strong-Tie anchoring adhesive. Inspection is easy; the head is stamped with rod length and No-Equal® symbol for identification after installation.

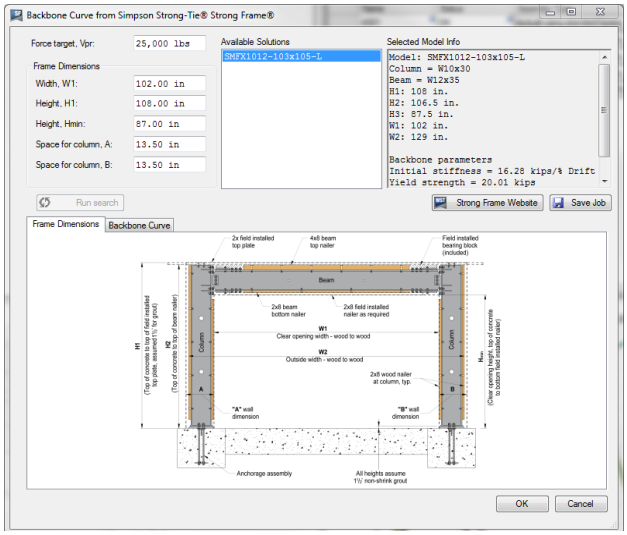


RFB

Strong Frame® Special Moment Frames Design Tools

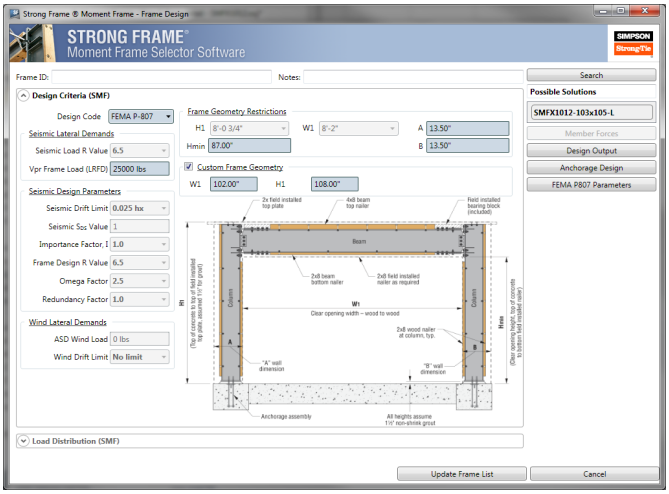
Weak-Story Tool with Simpson Strong-Tie® Strong Frame Moment Frames

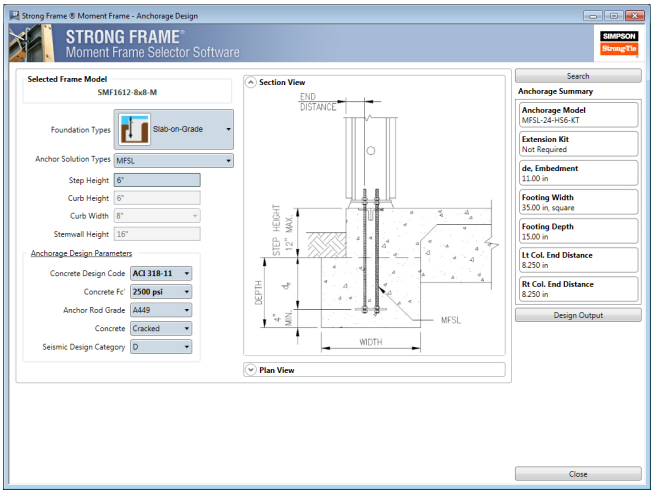
The Weak-Story Tool software for FEMA P-807 utilizing the Simpson Strong-Tie Strong Frame special moment frame can be downloaded from the Simpson Strong-Tie website. The Weak-Story Tool with Simpson Strong-Tie Strong Frame moment frames allows the designer to select the appropriate Strong Frame SMF and then generates the necessary load-drift curve for one-story by one-bay frames. Please contact Simpson Strong-Tie for load-drift curves for other configurations, such as one-story by two-bay frames. Simpson Strong-Tie can also assist where smaller beams or columns are required than what is shown in the software.



Strong Frame Moment Frame Selector Software

Following the retrofit design using the Weak-Story Tool with Simpson Strong-Tie Strong Frame moment frames, the Strong Frame moment frame selector software can design the frame anchorage with square footing and produce calculations in PDF format. For other anchorage solutions, use the Anchor Designer™ software; refer to p. 33. The Strong Frame selector software can also be used to design retrofit moment frames when using the IEBC, Chapter A4 method and can be downloaded for free at **strongtie.com/resources**.





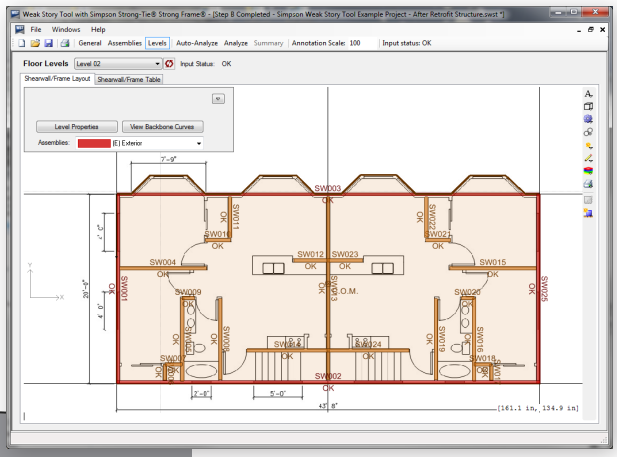
FEMA P-807 Weak-Story Tool with Simpson Strong-Tie® Strong Frame® Moment Frames Design Tutorial

Simpson Strong-Tie Strong Frame moment frames are included in the FEMA's Weak-Story Tool, a convenient electronic tool that graphically tabulates the walls in a building and their respective lateral-resistance capacities during an earthquake.

By applying the FEMA P-807 guidelines, the tool evaluates the building both before and after the retrofit through analytical calculations. This saves the end user a considerable amount of time.

The Weak-Story Tool continues to check the input as the assemblies, Strong Frame moment frames, and walls are added for the seismic retrofit. As soon as the building meets the provisions of FEMA P-807, a report summarizing the data becomes available.

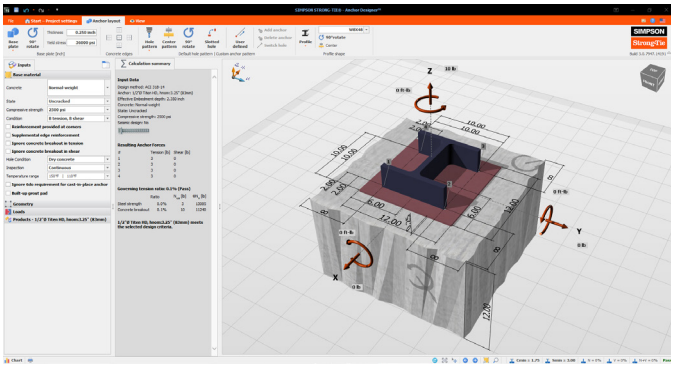
Simpson Strong-Tie has developed several FEMA P-807 Weak-Story Tool tutorial options designed to address different regional needs. Designers can download the tutorial files at **strongtie.com/softstory**. We also provide an accredited Soft-Story Retrofit Training Course that can be taken at **strongtie.com/training**.



Anchor Designer™ Software for ACI 318, ETAG and CSA

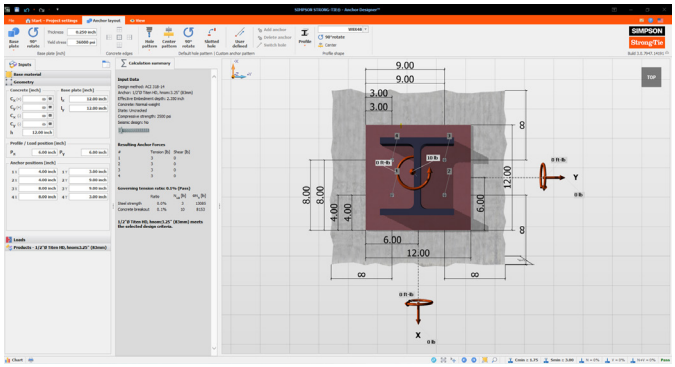
Anchor Designer software for ACI 318 analyzes and suggests anchor solutions using the strength design provisions of ACI 318-14 Chapter 17 / ACI 318-11 Appendix D. It provides anchoring solutions for cracked and uncracked concrete using a variety of Simpson Strong-Tie® mechanical and adhesive anchors. With its easy-to-use graphic interface, the need for laborious cracked-concrete hand calculations is eliminated.

The Anchor Designer software for ACI 318, ETAG and CSA can be downloaded for free at **strongtie.com/software**.



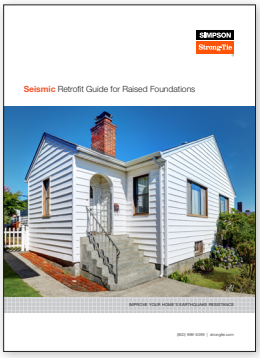
Cast-in-Place Anchorage

Alternative cast-in-place anchorage solutions can be designed where square centered footing is not acceptable, such as in applications near property lines. The designer can specify alternative footing and reinforcing with required configurations using (4) ¾" PAB bolts in the appropriate configuration and still use preassembled anchorage kits.



Post-Installed Anchorage

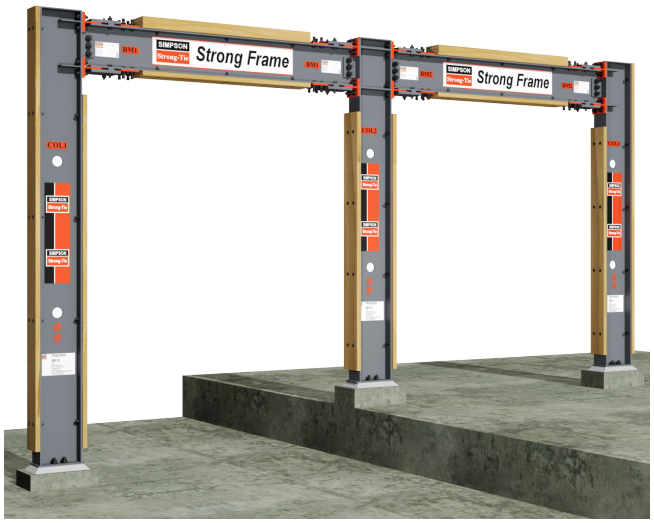
Where cast-in-place anchors are not an option, the designer is permitted to design and specify alternative post-installed anchors. To meet the requirements of ACI 318, the anchor bolt configuration may need to be altered to meet the minimum 6-bar diameter spacing requirement. Simpson Strong-Tie can manufacture frames with alternative base plates as specified by the designer.



A Step-by-Step Guide to Retrofitting Your Home for Earthquakes

The Simpson Strong-Tie *Seismic Retrofit Guide* (F-SEISRETRGD) helps educate homeowners and contractors about how earthquakes affect a home and the steps they can take to reinforce the structural frame of a house. With this guide and the right tools, do-it-yourselfers can increase the structural integrity of their house, making it stronger and safer. For those not inclined to tackle this type of project themselves, the guide can help homeowners make sure their retrofit is done right.

Strong Frame® Special Moment Frame Design Requests

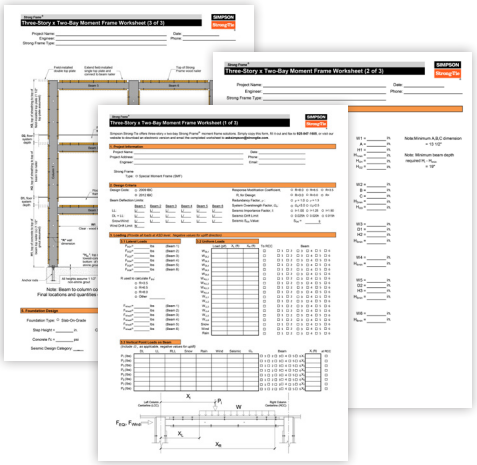


Other configurations or member sizes can be designed for soft-story structures utilizing FEMA P-807, IEBC Chapter A4, or ASCE 7. Options include stepped column heights for sloped hillsides; frames in line with varying heights; designs where existing pipes or features cannot be relocated; and multi-story and multi-bay designs.

Smaller beams and profiles are also available. Contact Simpson Strong-Tie for more information.

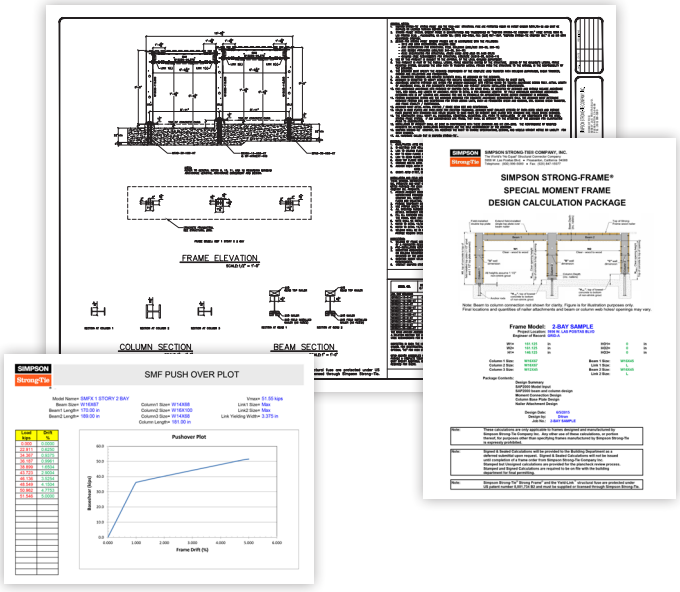
Typical Engagement Process

1. Designer completes the multi-story and multi-bay design worksheet at **strongtie.com/strongframe** or utilizes our Strong Frame Selector Software multi-story, multi-bay input.



2. Designer submits the loading worksheet to Simpson Strong-Tie at **strongframe@strongtie.com**.

3. Simpson Strong-Tie confirms receipt of the worksheet within 24 hours. Using state-of-the-art software, we create a design based on our patented Yield-Link® moment connection structural fuse technology to meet all code requirements — **usually within 48 hours**.



4. Designer receives a submittal-ready design package and drawings in electronic format from Simpson Strong-Tie.

5. Simpson Strong-Tie assists the designer with any post-submittal Strong Frame questions.

6. Simpson Strong-Tie provides No-Equal® jobsite field support.

Design Notes

Every day we work hard to earn your business, blending the talents of our people with the quality of our products and services to exceed your expectations. This is our pledge to you.

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