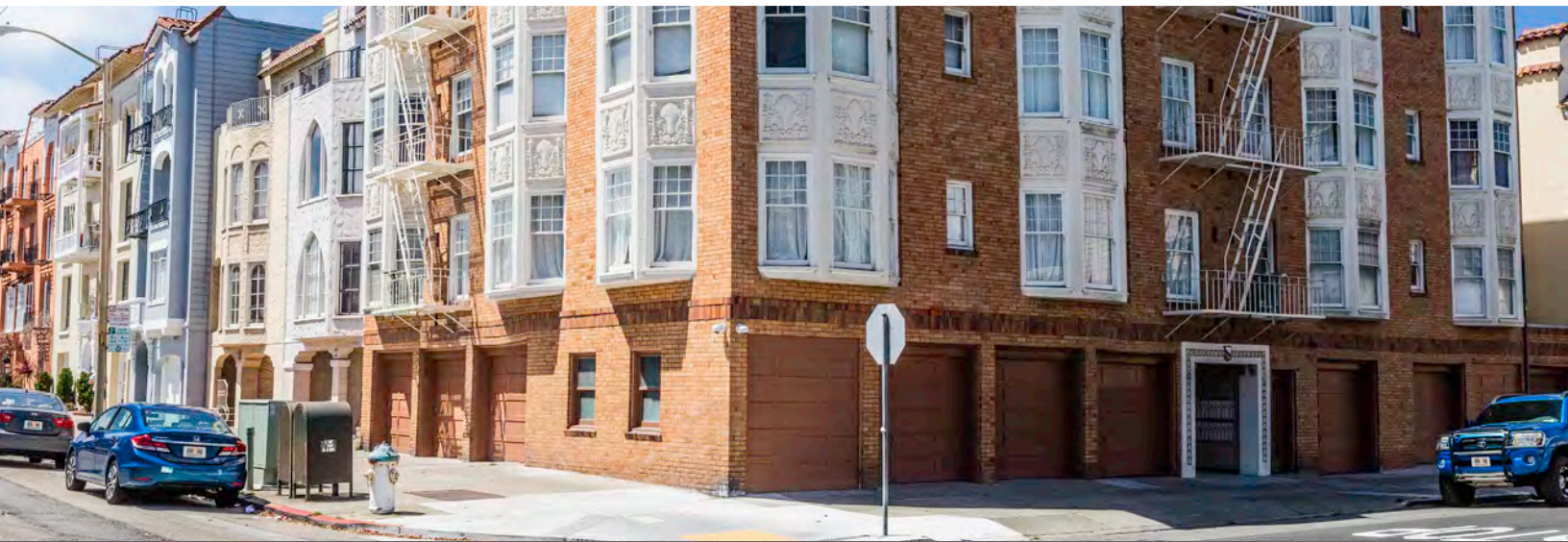


## Soft-Story Retrofit Guide



DESIGN SOLUTIONS FOR INCREASING RESILIENCE IN SOFT-STORY RETROFITS



# Soft-Story Retrofit





**SIMPSON****Strong-Tie**

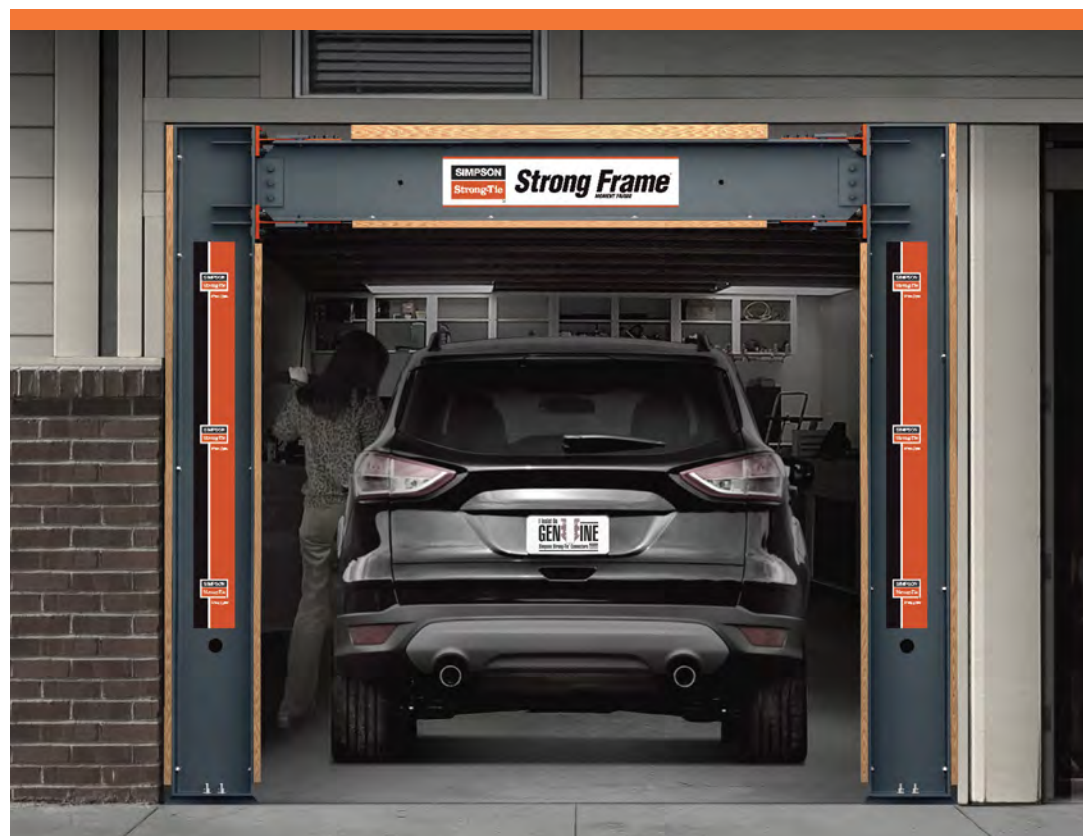
®

# 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. Cities such as San Francisco, Berkeley and Los Angeles have already passed laws that require a mandatory 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 against collapse.



# Company Profile



For 60 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](http://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
- Support of industry groups including AISI, AISI, AITC, ASTM, ASCE, AWC, AWP, ACI, CSI, CFSEI, ICFA, NBMDA, NLBMDA, SDI, SETMA, SFA, SFIA, STAFDA, SREA, NFBA, TPI, WDSC, WIJMA, WTCA and local engineering groups.



## 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.

Karen Colonias  
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 you are using. (See the back cover for the form number.)
- Which Simpson Strong-Tie product or system you are inquiring about.
- Your load requirement.

## We Are ISO 9001-2008 Registered

Simpson Strong-Tie is an ISO 9001-2008 registered company. ISO 9001-2008 is an internationally recognized quality assurance system that lets our domestic and international customers know they can count on the consistent quality of Simpson Strong-Tie® products and services.





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# 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, Berkeley and Los Angeles, have already passed ordinances requiring seismic retrofitting of these structures. Refer to page 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

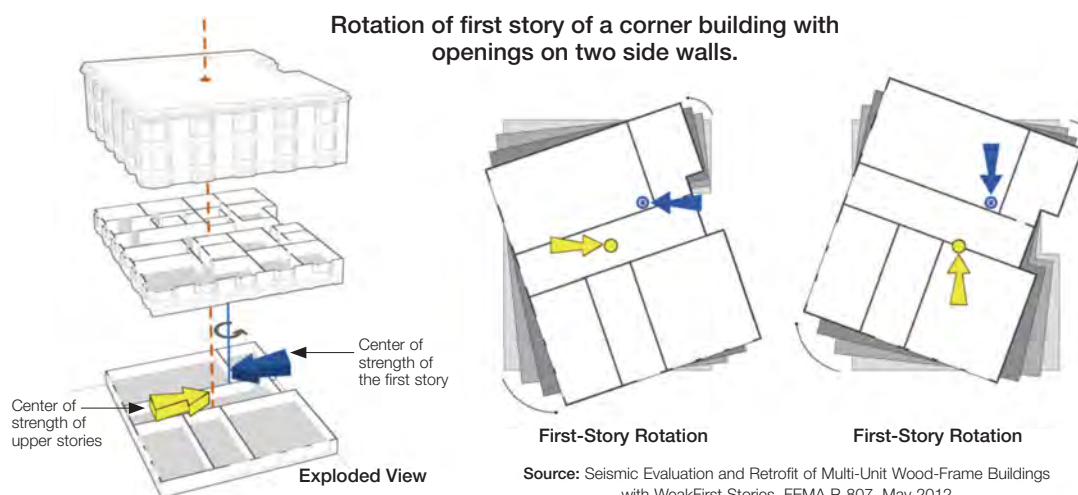
Six of seven collapsed buildings were four-story corner apartments with first-story parking.



## 1994 Northridge

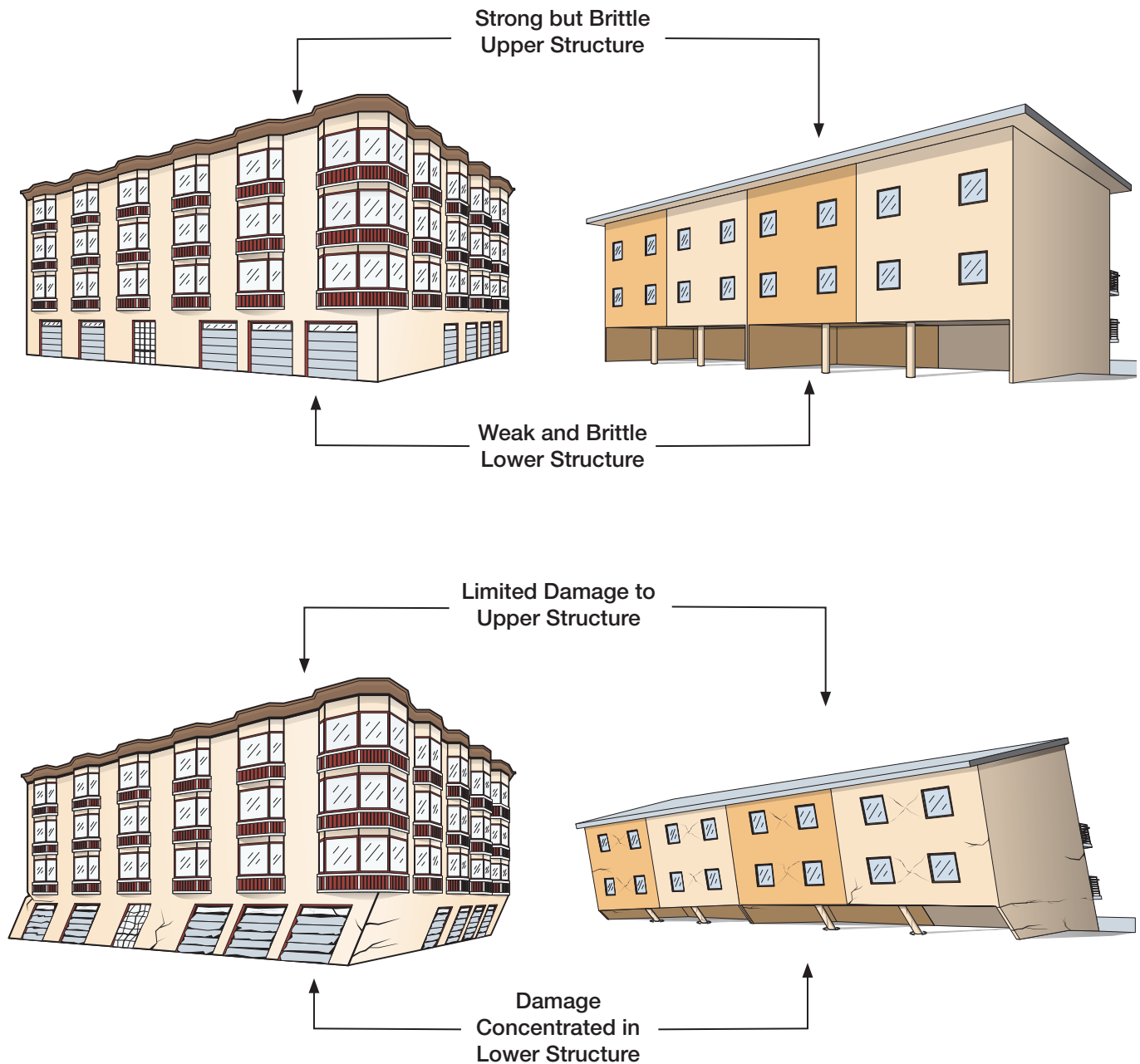
Two hundred weak-story buildings suffered damage or collapsed.

A lack of continuous exterior walls or of 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 pre-existing tendency to twist.



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

Buildings built prior to 1978 were constructed to the codes at that time 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 inter-story 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 shear walls.

The soft-story retrofit solution can be seen at [strongtie.com/videolibrary/soft-story-retrofit.html](https://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 41-13, Seismic Evaluation and Rehabilitation of Existing Buildings
- ASCE 41-06, Seismic Rehabilitation of Existing Buildings
- ASCE 31-03, Seismic Evaluation of Existing Buildings (Evaluation only)
- 2015 International Existing Building Code (IEBC) Appendix A4 (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 2015 IEBC.

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

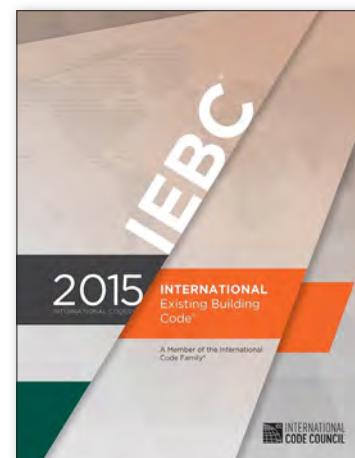


Used with permission from the  
International Code Council.

# Codes and Guidelines for Soft-Story Retrofits

## 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

<b>GENERAL</b>	<ul style="list-style-type: none"> <li>• The alteration, repair, replacement or addition of structural elements and their connections shall meet the strength and stiffness requirements of the chapter.</li> <li>• 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.</li> </ul>
<b>UPPER STORIES</b>	<ul style="list-style-type: none"> <li>• Stories above the target story shall be considered in the analysis, but do not need to be modified.</li> </ul>
<b>FIRST STORY</b>	<ul style="list-style-type: none"> <li>• Design base shear shall be 75% of that required for new construction based on current code.</li> <li>• Seismic design values (<math>R</math>, <math>\Omega_o</math>, and <math>C_d</math>) 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.</li> <li>• Target story drift shall not exceed the allowable deformation compatible with all vertical load-resisting elements and 0.025 times the story height.</li> </ul>
<b>DIAPHRAGM</b>	<ul style="list-style-type: none"> <li>• 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.</li> </ul>



# Codes and Guidelines for Soft-Story Retrofits

## 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	<ul style="list-style-type: none"> <li>• <math>\leq 4</math> above-grade stories</li> <li>• No above-grade concrete podium structure supporting wood-frame stories</li> <li>• No restrictions on soil type or site class</li> </ul>
UPPER STORIES	<ul style="list-style-type: none"> <li>• Force-resisting system made of wood-frame stud walls</li> <li>• 8–12 ft. story height</li> <li>• No story prone to significant torsion</li> <li>• Upper stories have no vertical mass or geometric irregularities</li> </ul>
FIRST STORY	<ul style="list-style-type: none"> <li>• Maximum story height 8–15 ft.</li> <li>• Force-resisting system made of wood-frame stud walls</li> <li>• Walls have continuous perimeter or slab-on-grade foundations</li> <li>• Force-resisting system doesn't have any full-height concrete or masonry walls</li> <li>• Additional requirements found in Section 2.6.3</li> </ul>
DIAPHRAGM	<ul style="list-style-type: none"> <li>• Second-floor diaphragm has aspect ratio <math>\leq 2:1</math></li> <li>• Second-floor diaphragm doesn't cantilever more than 25 ft. from a qualifying wall line</li> <li>• No diaphragm has a reentrant corner irregularity</li> <li>• No diaphragm has a vertical offset</li> <li>• Additional requirements in Section 2.6.4</li> </ul>

FEMA P-807 procedure is based on statistical data and does not require customized analysis. The conditions in Section 2.6 represent non-linear 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 page 31.

# Conducting a Building Survey

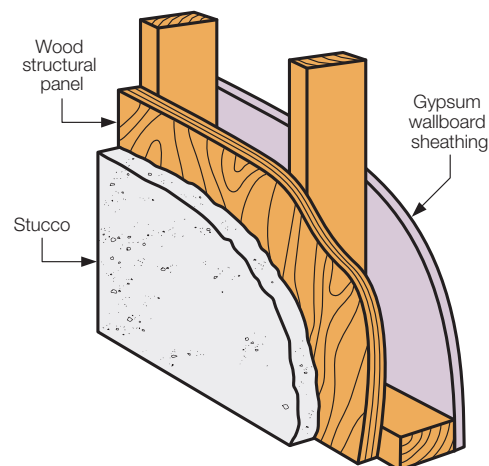
It is critical that a building identified as having a weak/soft story is surveyed accurately enough to locate and estimate the capacity of each element. The information found will be used differently, depending on the code that is followed for retrofit.

The 2015 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.

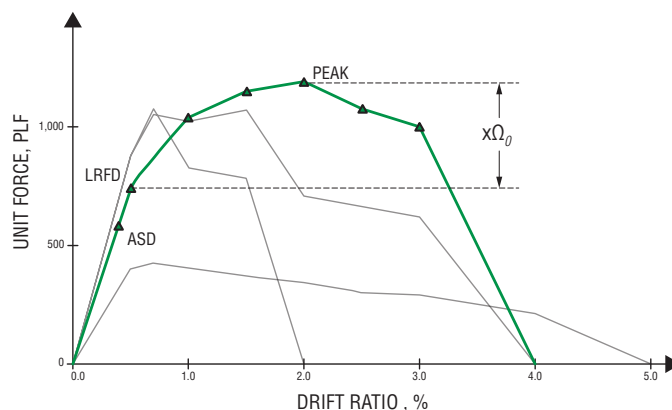
By relying on realistic estimates of material strength and corresponding deformation, FEMA P-807 assigns strength values for nonconforming sheathing materials over a range of story drifts. The strength values were derived from wall component tests, as documented in FEMA P-807 Appendix D. The guidelines 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 vs. 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,  $\Omega_o$  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.

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.



**Structural Use of Nonconforming Material**



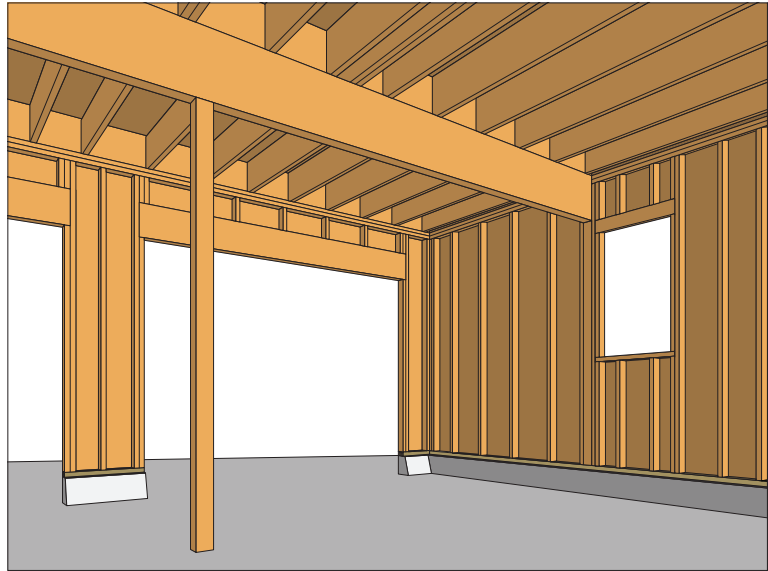
**FEMA P-807 Composite Sheathing Assembly Load-Deflection Curves**



# Conducting a Building Survey

## 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 pages 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](http://www.seaosc.org/find-an-engineer) for Southern California and [www.seaonc.org/structural-engineer-referral-list](http://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](http://www.cslb.ca.gov)
- Visit [www.cab.ca.gov](http://www.cab.ca.gov) for information on licensed architects in California

### 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 IEBC A4. 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 — pages 16–17
- B** Strong-Wall® Shearwalls — page 18
- C** Site-Built Shear Walls — page 18

## Connection to the Structure

- D** A35 / LTP4 / LS Framing Angles and Plates (not shown in diagram) — pages 19–20
- E** A35 with SPAX Screws — page 21
- F** HSLQ Heavy Shear Transfer Angle — page 22
- G** Strap Ties — pages 23–24

## Connection to the Foundation

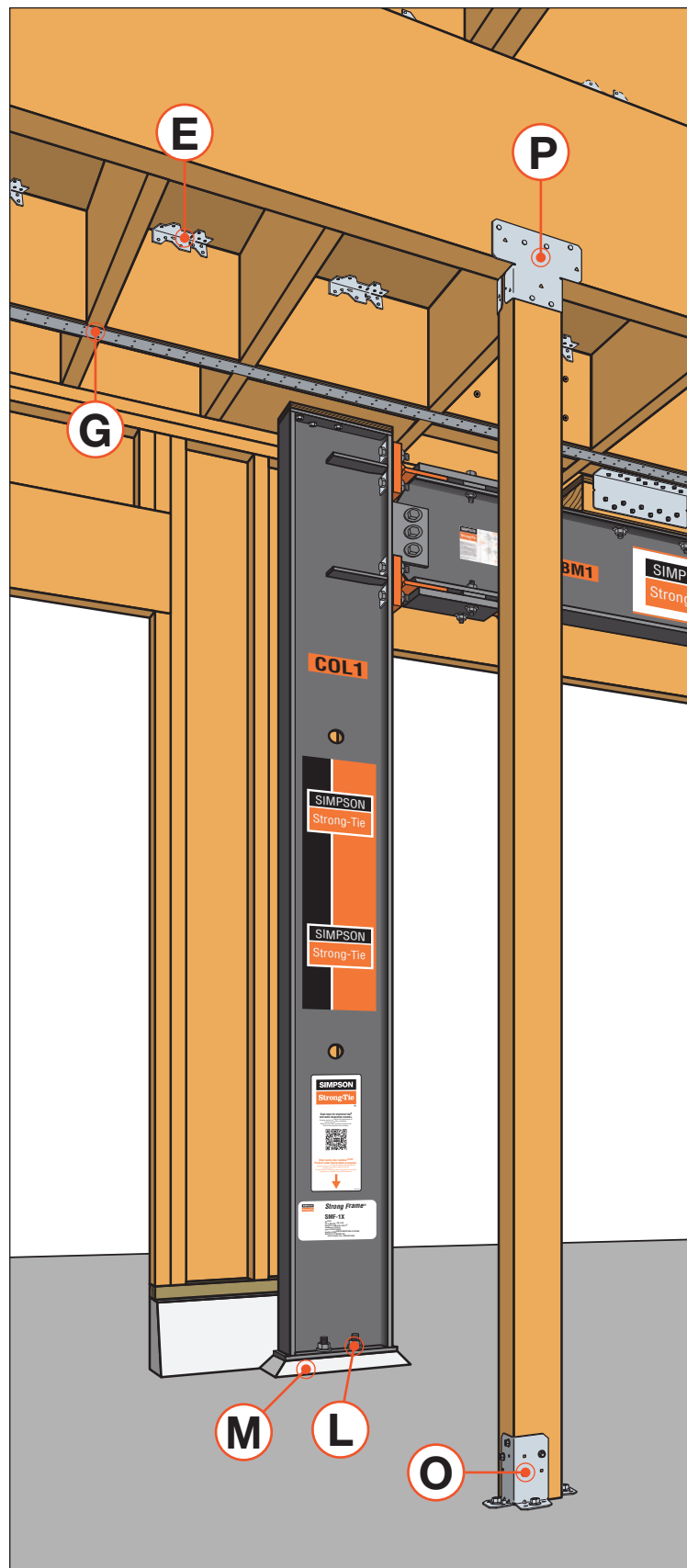
- H** HDU Holdown — page 25
- I** URFP Universal Retrofit Foundation Plate (not shown in diagram) — page 26
- J** Titen HD® Heavy-Duty Screw Anchors — page 26
- K** SET-XP® / AT-XP® Adhesives with RFB — page 27
- L** Strong Frame Anchor Kits – MFAB/MFSL — page 27
- M** Non-Shrink Grout — page 28

## Fasteners

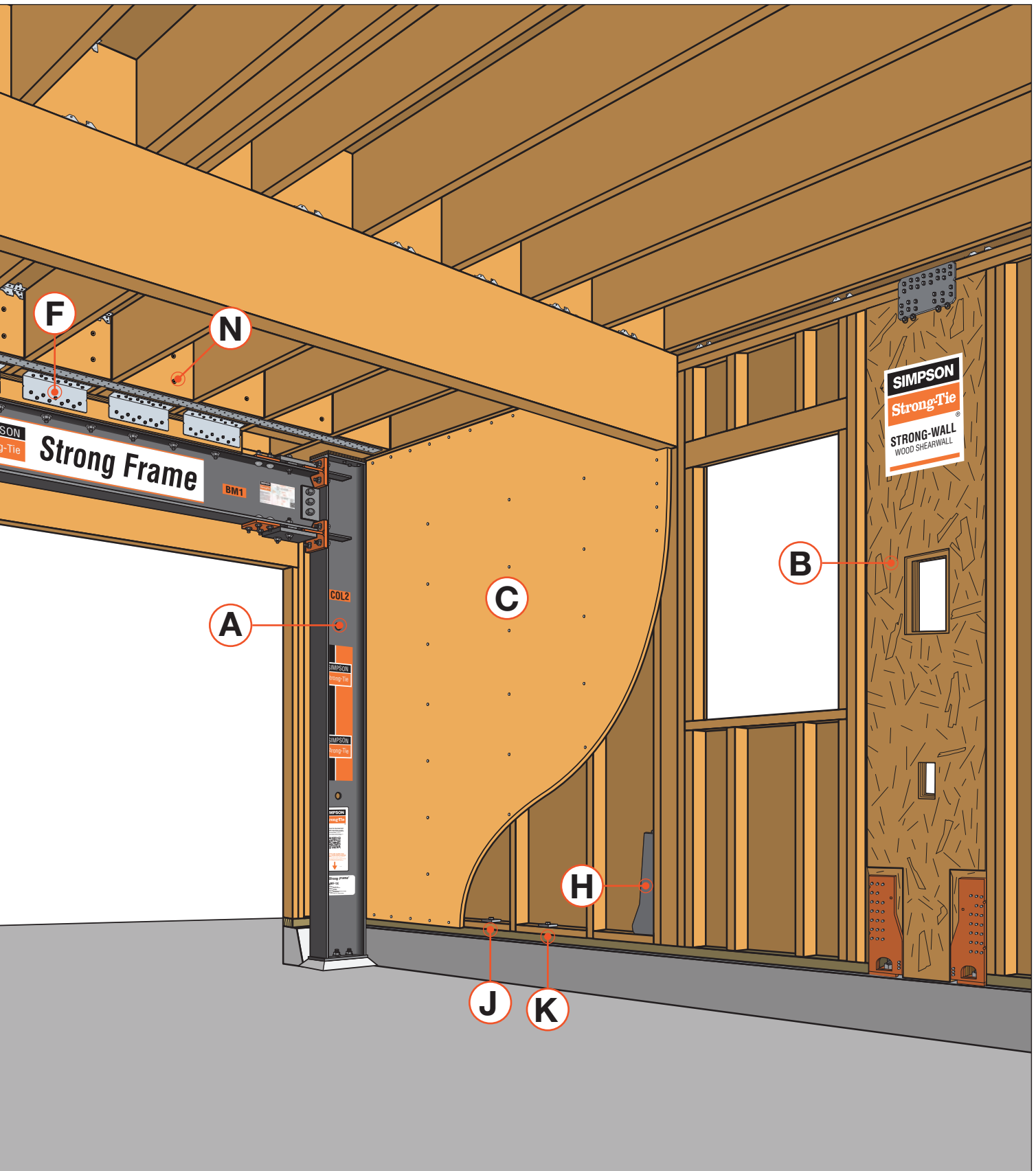
- N** SDS / SDWS / SDWH Screws — pages 28–29

## Additional Retrofit Products

- O** RPBZ Retrofit Post Base — page 30
- P** AC Post Caps — page 30
- Q** RFB Retrofit Bolts (not shown in diagram) — page 30







## Lateral Systems

### **A** Strong Frame® Special Moment Frame

Simpson Strong-Tie provides solutions using both ordinary moment frames and special moment frames, either of 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  $R$ ,  $\Omega_o$ , and  $C_d$  factors employed, both the Strong Frame special moment frame and the Strong Frame ordinary moment frame can be used.



U.S. and Foreign Patent Pending



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™ 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.



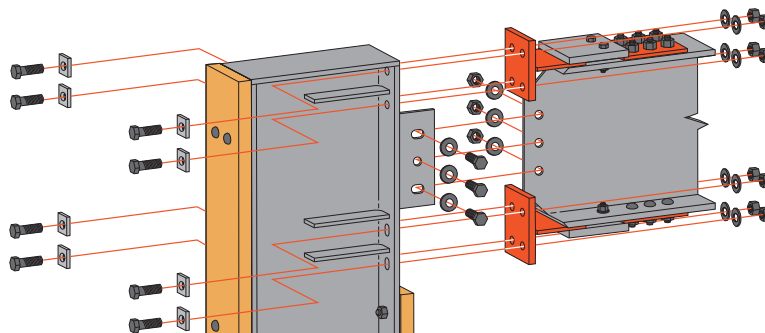


# Simpson Strong-Tie® Soft-Story Retrofit Solutions

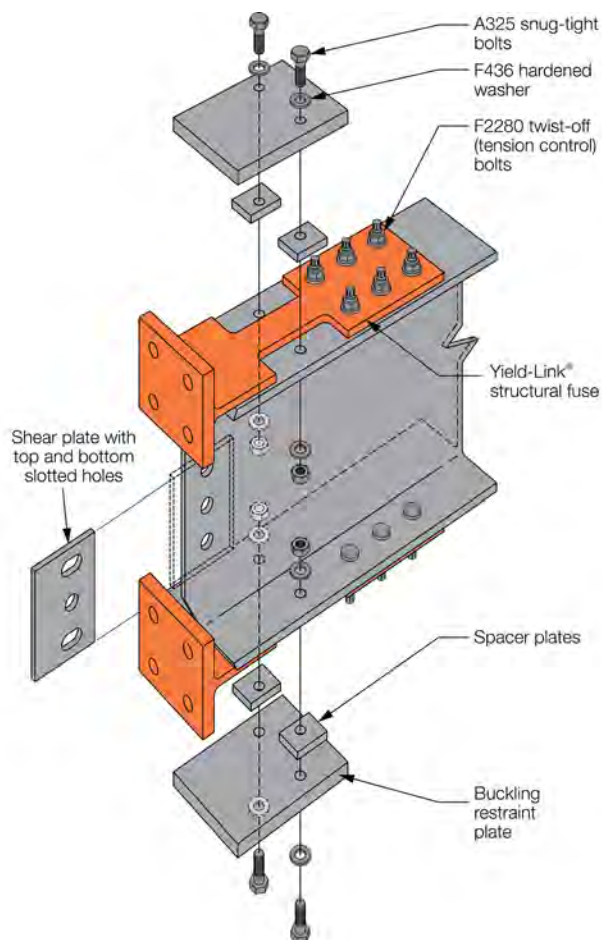
## Lateral Systems (cont.)

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 safely be 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.

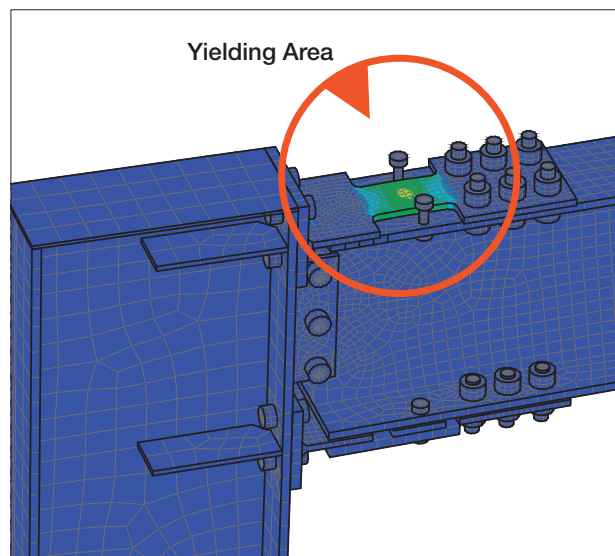
The connection and frame design procedures have been specifically engineered to eliminate the need for beam bracing, while still delivering the performance expected of a special moment frame solution. In addition, foundation demands are minimized by tuning the yielding area to the specified loads.



Field Installation of Beam to Column



Factory-Installed Strong Frame  
Yield-Link 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.

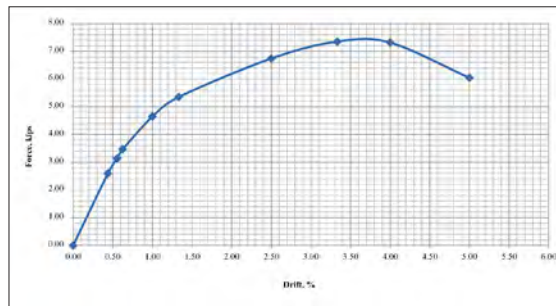
## Lateral Systems (cont.)

### B Strong-Wall® 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 Wood Shearwalls (WSW) in various widths and heights. The WSW 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 Wood Shearwalls that can be imported into the Weak Story Tool.

**Strong-Wall Wood Shearwall Pushover Curve Spreadsheet**

WSW18x8	
Drift, %	Force, kips
0.00	0.00
0.44	2.59
0.56	3.14
0.63	3.47
1.00	4.65
1.33	5.36
2.50	6.74
3.33	7.35
4.00	7.31
5.00	6.05

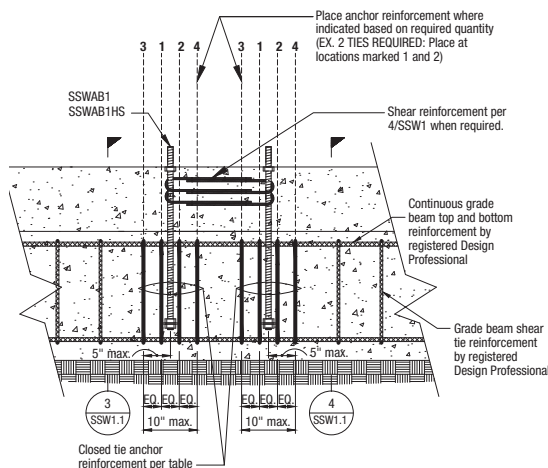


**Strong-Wall Wood Shearwalls**

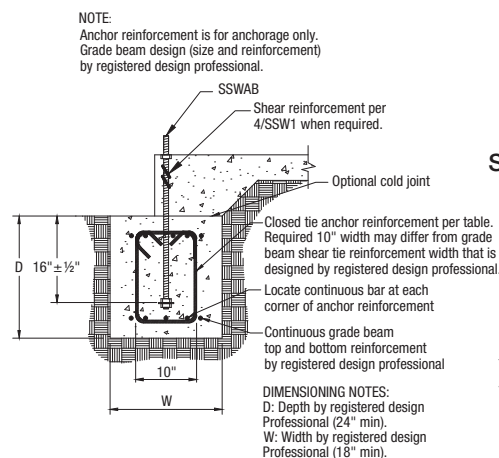


**Steel Strong-Wall**  
U.S. Patent  
8,281,551  
8,689,518

### Strong-Wall Anchor Reinforcement Solutions on Grade Beams



**Strong-Wall Grade Beam Anchorage Detail**



**Strong-Wall Grade Beam Anchorage Reinforcement**

Refer to [strongtie.com](http://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.

# Simpson Strong-Tie® Soft-Story Retrofit Solutions

## 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 Capacities		SPF/HF LRFD Capacities	
				$\lambda = 0.8$	$\lambda = 1.0$	$\lambda = 0.8$	$\lambda = 1.0$
A34	<b>1</b>	(8) 8d x 1 1/2"	F <sub>1</sub>	668	668	575	575
			F <sub>2</sub> <sup>5</sup>	642	642	552	552
A35	<b>2</b>	(9) 8d x 1 1/2"	A <sub>1</sub> , E	513	544	441	468
			C <sub>1</sub>	299	299	257	257
	<b>3</b>	(12) 8d x 1 1/2"	A <sub>2</sub>	513	528	441	454
			C <sub>2</sub>	478	478	411	411
	<b>4</b>	(12) 8d x 1 1/2"	D	302	302	259	259
			F <sub>1</sub>	906	906	779	779
LTP4 <sup>3</sup>	<b>5</b>	(12) 8d x 1 1/2"	F <sub>2</sub> <sup>5</sup>	874	874	751	751
			G	872	872	750	750
LTP5 <sup>4</sup>	<b>6</b>	(12) 8d x 1 1/2"	H	777	777	669	669
			G	807	807	694	694
			H	710	710	610	610

1. LRFD loads are for one anchor. When anchors are installed on each side of the joist, the minimum joist thickness is 3".

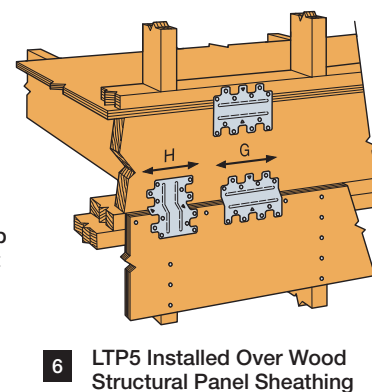
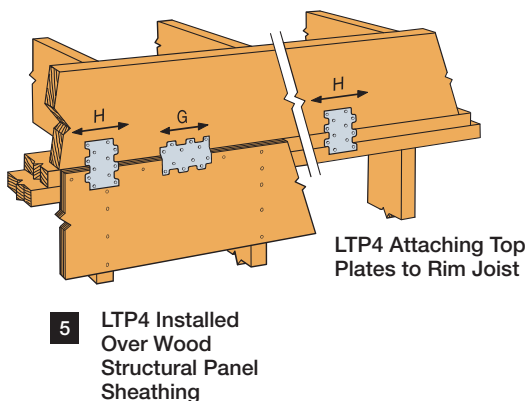
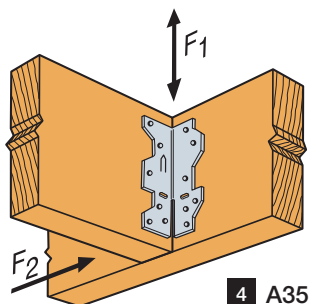
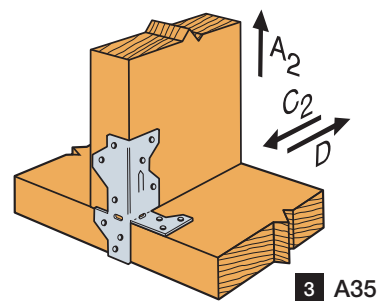
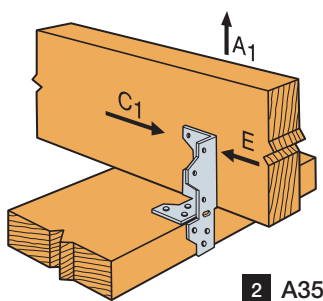
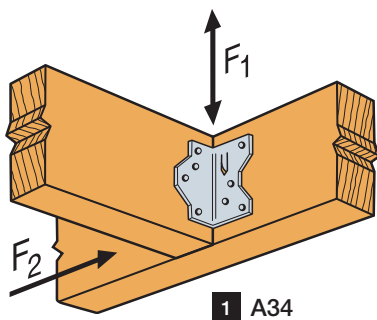
2. Some illustrations show connections that could cause cross-grain tension or bending of the wood during loading if not reinforced sufficiently. In this case, mechanical reinforcement should be considered.

3. LTP4 can be installed over 3/8" wood structural panel sheathing with 8d x 1 1/2" nails and achieve 0.72 of the listed loads, or over 1/2" 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 1/2" thick using 8d x 1 1/2" nails with no load reduction.

5. Connectors are required on both sides to achieve F<sub>2</sub> loads in both directions.

6. Nails: 8d x 1 1/2" = 0.131" dia. x 1 1/2" long.



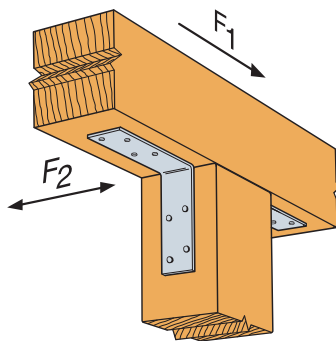


## Connection to the Structure (cont.)

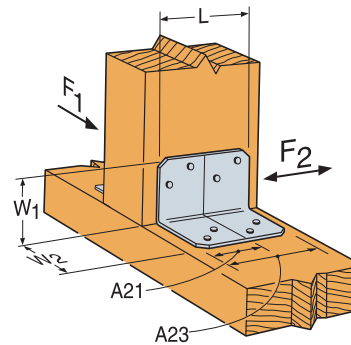
### D A21 / A23 / A33 / A44 Framing Angles

Model No.	Dimensions (in.)			Fasteners		DF/SP LRFD Capacities				SPF/HF LRFD Capacities			
						$\lambda = 0.8$		$\lambda = 1.0$		$\lambda = 0.8$		$\lambda = 1.0$	
	W <sub>1</sub>	W <sub>2</sub>	L	Base	Post	F <sub>1</sub>	F <sub>2</sub>	F <sub>1</sub>	F <sub>2</sub>	F <sub>1</sub>	F <sub>2</sub>	F <sub>1</sub>	F <sub>2</sub>
A21	2	1½	1¾	(2) 10d x 1½"	(2) 10d x 1½"	409	200	511	200	352	172	440	172
A23	2	1½	2¾	(4) 10d x 1½"	(4) 10d x 1½"	600	818	600	932	516	704	516	801
A33	3	3	1½	(4) 10d	(4) 10d	972	330	1,037	330	836	284	892	284
A44	4⅞	4⅞	1½	(4) 10d	(4) 10d	330	972	330	1,043	284	836	284	897

1. Connectors are required on both sides to achieve F<sub>1</sub> loads in both directions.
2. Nails: 10d x 1½" = 0.148" dia. x 1½" long, 10d = 0.148" dia. x 3" long.



**A44 Installation**  
(A33 similar)



**A21 / A23 Installation**

## Connection to the Structure (cont.)

### **E** A35 / L90 Angles Installed with SPAX Unidrive Pan Head Screws to Sheathing

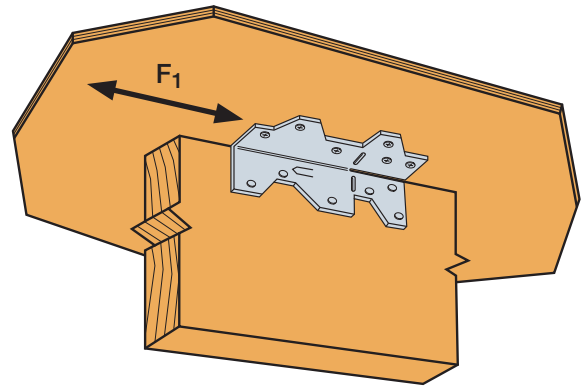
Simpson Strong-Tie A35 and L90 framing angles can be used in retrofit applications to connect framing members to existing floor sheathing. Testing has been performed with A35 and L90 framing angles installed with SPAX #8 x 5/8" and SPAX #10 x 5/8" Unidrive Pan Head screws, respectively. Common sheathing 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 SPAX screws on both the sheathing and the framing member.



**A35 Installation**  
(L90 similar)

Model No.	Fasteners	Sheathing	Allowable Loads, F <sub>1</sub> (100 / 115 / 125 / 160)	LRFD Capacities, F <sub>1</sub> (λ = 0.8 / 1.0)
A35	(12) SPAX #8 x 5/8"	T&G <sup>1</sup>	405	525
	(12) SPAX #8 x 5/8"	OSB <sup>2</sup>	435	565
	(12) SPAX #8 x 5/8"	Plywood <sup>2</sup>	505	655
L90	(10) SPAX #10 x 5/8"	T&G <sup>1</sup>	420	545
	(10) SPAX #10 x 5/8"	OSB <sup>2</sup>	410	535
	(10) SPAX #10 x 5/8"	Plywood <sup>2</sup>	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<sub>1</sub> only.

4. Allowable loads/LRFD Capacities have been increased for wind or earthquake loading with no further increase allowed.

## 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.

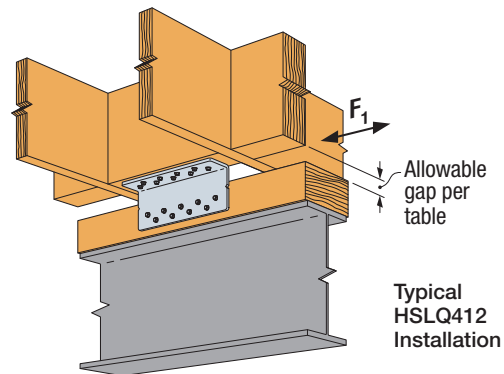
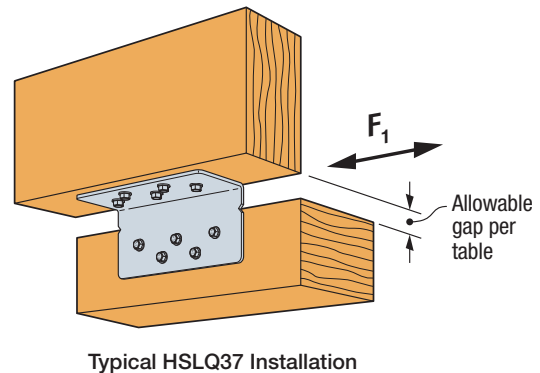
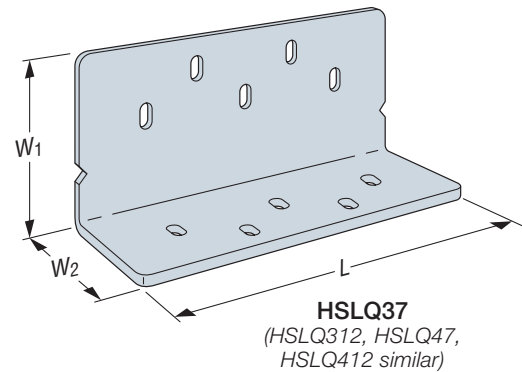
**Material:** 12 gauge

**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.

Model No.	Allowable Gap	Dimensions (in.)			Fasteners
		W <sub>1</sub>	W <sub>2</sub>	L	
HSLQ37-SDS2.5	0" – 1"	3 ¼	2 ¾	7 ¼	(10) ¼" x 2 ½" SDS
HSLQ312-SDS2.5	0" – 1"	3 ¼	2 ¾	11 ¾	(18) ¼" x 2 ½" SDS
HSLQ47-SDS2.5	1" – 2"	4 ¼	2 ¾	7 ¼	(10) ¼" x 2 ½" SDS
HSLQ412-SDS2.5	1" – 2"	4 ¼	2 ¾	11 ¾	(18) ¼" x 2 ½" 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 <sub>1</sub> )	Lateral (F <sub>1</sub> )	Lateral (F <sub>1</sub> )	Lateral (F <sub>1</sub> )
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. Tables 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.



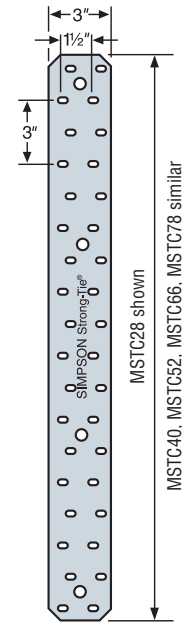
## Connection to the Structure (cont.)

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

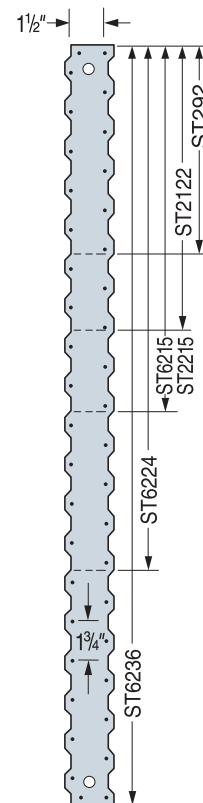
#### LRFD Capacities

Model No.	Ga.	Dimensions (in.)		Fasteners (Total)	DF/SP ( $\lambda = 1.0$ )	SPF/HF ( $\lambda = 1.0$ )
		W	L			
LSTA9	20	1 1/4	9	(8) 10d	1,030	880
LSTA12		1 1/4	12	(10) 10d	1,285	1,100
LSTA15		1 1/4	15	(12) 10d	1,540	1,320
LSTA18		1 1/4	18	(14) 10d	1,800	1,540
LSTA21		1 1/4	21	(16) 10d	1,850	1,760
LSTA24		1 1/4	24	(18) 10d	1,850	1,850
ST292		2 1/8	9 5/8	(12) 16d	1,800	1,540
ST2122		2 1/8	12 1 3/8	(16) 16d	2,295	2,070
ST2115		3/4	16 5/8	(10) 16d	995	995
ST2215		2 1/8	16 3/8	(20) 16d	2,815	2,620
LSTA30	18	1 1/4	30	(22) 10d	2,460	2,460
LSTA36		1 1/4	36	(24) 10d	2,460	2,460
LSTI49		3 3/4	49	(32) 10dx1 1/2	4,160	3,585
LSTI73		3 3/4	73	(48) 10dx1 1/2	6,240	5,375
MSTA9		1 1/4	9	(8) 10d	1,060	910
MSTA12		1 1/4	12	(10) 10d	1,325	1,135
MSTA15		1 1/4	15	(12) 10d	1,590	1,360
MSTA18		1 1/4	18	(14) 10d	1,855	1,590
MSTA21		1 1/4	21	(16) 10d	2,120	1,815
MSTA24		1 1/4	24	(18) 10d	2,385	2,045
MSTA30	16	1 1/4	30	(22) 10d	3,035	2,605
MSTA36		1 1/4	36	(26) 10d	3,070	3,070
MSTA49		1 1/4	49	(26) 10d	3,025	3,025
ST6215		2 1/8	16 5/8	(20) 16d	3,110	2,670
ST6224		2 1/8	23 5/8	(28) 16d	3,810	3,810
ST9		1 1/4	9	(8) 16d	1,245	1,070
ST12		1 1/4	11 5/8	(10) 16d	1,555	1,335
ST18		1 1/4	17 3/4	(14) 16d	2,125	1,870
ST22		1 1/4	21 5/8	(18) 16d	2,125	2,125
MSTC28		3	28 1/4	(36) 16d sinkers	4,970	4,265
MSTC40	14	3	40 1/4	(52) 16d sinkers	6,880	6,160
MSTC52		3	52 1/4	(62) 16d sinkers	6,880	6,880
HTP37Z		3	7	(20) 10dx1 1/2	2,630	2,260
MSTC66		3	65 3/4	(76) 16d sinkers	8,495	8,495
MSTC78		3	77 3/4	(76) 16d sinkers	8,495	8,495
ST6236		2 1/8	33 1 3/8	(40) 16d	5,770	5,770
HRS6	12	1 3/8	6	(6) 10d	910	790
HRS8		1 3/8	8	(10) 10d	1,520	1,315
HRS12		1 3/8	12	(14) 10d	2,130	1,840
MSTI26		2 1/8	26	(26) 10dx1 1/2	4,160	3,405
MSTI36		2 1/8	36	(36) 10dx1 1/2	5,760	4,715
MSTI48		2 1/8	48	(48) 10dx1 1/2	7,620	6,290
MSTI60		2 1/8	60	(60) 10dx1 1/2	7,620	7,620
MSTI72		2 1/8	72	(72) 10dx1 1/2	7,620	7,620
HRS416Z		3 1/4	16	(16) 1/4"x1 1/2" SDS	3,825	3,110

1. Loads capacities include a  $\lambda = 1.0$  time effect factor on the fasteners for wind or seismic loading.
2. Use half of the required nails in each member being connected to achieve the listed loads.
3. Calculate the connector value for a reduced number of nails as follows:  
LRFD Capacity = (No. of Nails Used / No. of Nails in Table) x Table Load.
4. Tension load capacities apply for uplift when installed vertically.
5. Nails: 16d = 0.162" dia. x 3 1/2" long; 16d sinker = 0.148" dia. x 3 3/4" long; 10d = 0.148" dia. x 3" long.  
See *Wood Construction Connectors* catalog for other nail sizes and information.
6. These products are approved for installation using the Strong-Drive® SD Connector screw.  
See *Wood Construction Connectors* catalog for additional information.



**MSTC**



**ST**

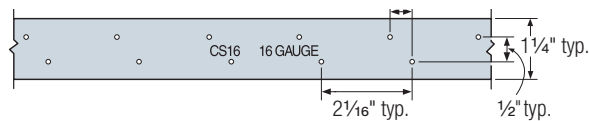
## Connection to the Structure (cont.)

### **G** CS / CMST Coiled Straps

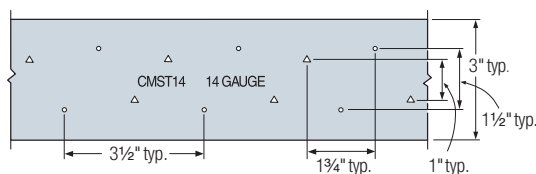
#### LRFD Capacities

Model No.	Total Length	Ga.	DF/SP		SPF/HF		LRFD Tension Capacities ( $\lambda = 1.0$ )
			Fasteners	End Length	Fasteners	End Length	
CMST12	40'	12	(74) 16d	33"	(84) 16d	38"	13,850
			(86) 10d	39"	(98) 10d	44"	13,850
CMST14	52½'	14	(56) 16d	26"	(66) 16d	30"	9,550
			(66) 10d	30"	(76) 10d	34"	9,540
CMSTC16	54'	16	(50) 16d sinker	20"	(58) 16d sinker	25"	6,875
CS14	100'	14	(26) 10d	15"	(30) 10d	16"	3,735
			(30) 8d	16"	(36) 8d	19"	3,705
CS16	150'	16	(20) 10d	11"	(22) 10d	13"	2,550
			(22) 8d	13"	(26) 8d	14"	2,485
CS18	200'	18	(16) 10d	9"	(18) 10d	11"	2,015
			(18) 8d	11"	(22) 8d	12"	1,955
CS20	250'	20	(12) 10d	6"	(14) 10d	9"	1,525
			(14) 8d	9"	(16) 8d	9"	1,450
CS22	300'	22	(10) 10d	7"	(12) 10d	7"	1,255
			(12) 8d	6"	(14) 8d	8"	1,245

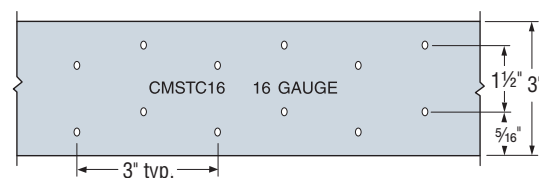
1. Loads capacities include a  $\lambda = 1.0$  time effect factor on the fasteners for wind or seismic loading.
2. Use half of the required nails in each member being connected to achieve the listed loads.
3. Calculate the connector value for a reduced number of nails as follows:  
LRFD Capacity = (No. of Nails Used / No. of Nails in Table) x Table Load.
4. Tension load capacities apply for uplift when installed vertically.
5. Nails: 16d = 0.162" dia. x 3½" long, 16d sinker = 0.148" dia. x 3¼" long, 10d = 0.148" dia. x 3" long.  
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)

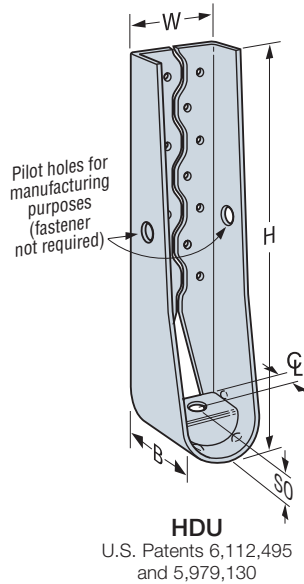


**CMSTC16 Hole Pattern**

## 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 Holdowns LRFD and Ultimate Capacities

Model No.	Ga.	Fasteners		Minimum Wood Member Thickness (in.)	LRFD Capacities ( $\lambda = 1.0$ )			Ultimate Capacity
		Anchor Bolt Diameter (in.)	Post Fasteners		DF/SP	SPF/HF	Deflection at LRFD Load (in.)	DF/SP
HDU2-SDS2.5	14	5/8	(6) 1/4" x 2 1/2" SDS	3	4,305	3,100	0.118	9,840
HDU4-SDS2.5	14	5/8	(10) 1/4" x 2 1/2" SDS	3	6,390	4,600	0.154	13,695
HDU5-SDS2.5	14	5/8	(14) 1/4" x 2 1/2" SDS	3	7,905	5,690	0.158	17,685
HDU8-SDS2.5	10	7/8	(20) 1/4" x 2 1/2" SDS	3	8,370	6,030	0.161	17,945
				3 1/2	9,760	7,030	0.161	21,265
				4 1/2	11,020	7,930	0.161	25,625
HDU11-SDS2.5	10	1	(30) 1/4" x 2 1/2" SDS	5 1/2	13,350	9,610	0.182	28,600
				7 1/4 / 6x6	15,645	11,265	0.182	34,245

1. See Holdown and Tension Tie General Notes in the *Wood Construction Connectors* catalog.
2. Loads are applicable to installation on either narrow or wide face of post.
3. Loads include a  $\lambda = 1.0$  time effect factor on the fasteners for wind or seismic loading.



## Connection to the Foundation (cont.)

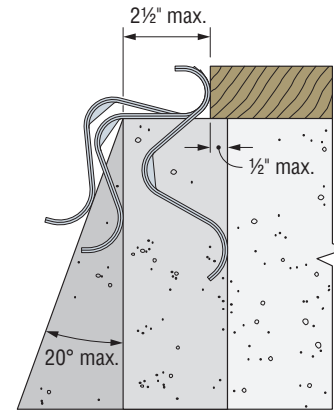
Simpson Strong-Tie offers holdowns, mechanical and adhesive anchoring solutions that are particularly effective for soft-story retrofits where wood structures need to be securely connected to older, harder concrete foundations.

### 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.



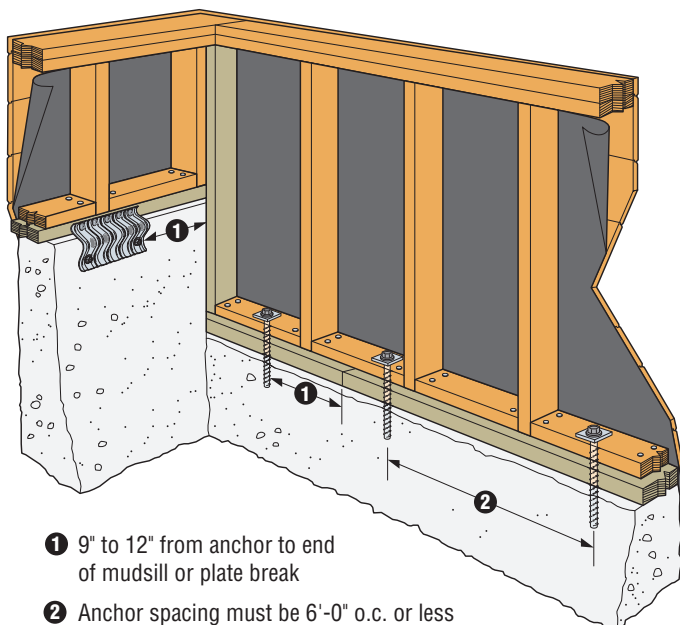
URFP Installed on a Foundation



URFP Installed

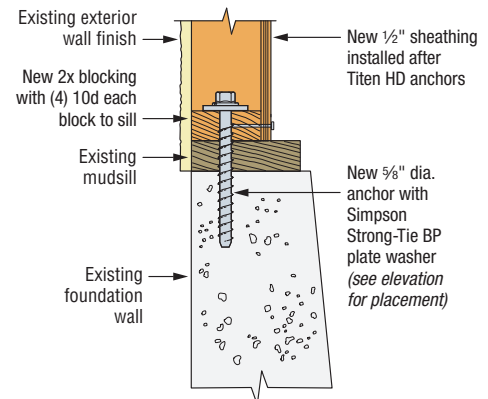
### J Titen HD® Heavy-Duty Screw Anchors

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.



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

- ❶ 9" to 12" from anchor to end of mudsill or plate break
- ❷ Anchor spacing must be 6'-0" o.c. or less



Anchoring Mudsill to Foundation with Titen HD Screw Anchor



**Titen HD Screw Anchor**  
U.S. Patents  
5,674,035 and  
6,623,228

## 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



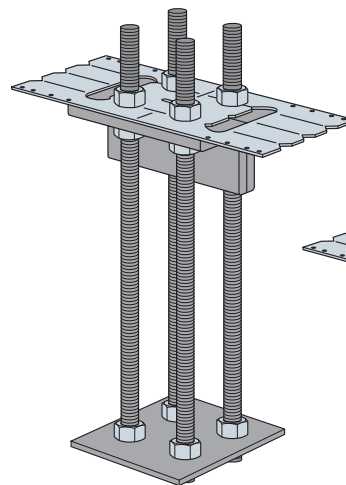
AT-XP Adhesive

### **L** Strong Frame® Special Moment Frame – Pre-Assembled Anchor Bolt Assemblies

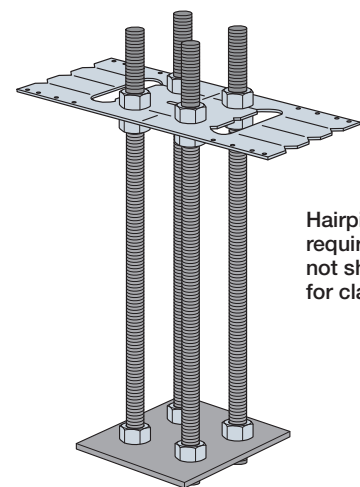
Two pre-engineered anchorage solutions are available, the MFSL and the MFAB. The MFSL comes with pre-installed shear lugs and allows smaller edge distances. Both types are pre-assembled on the MF-TPL template that attaches directly to the concrete form. Extension kits are also available for deeper anchorage 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 page 31 of this guide.



MFSL Anchorage  
Assembly  
U.S. Patent Pending



MFAB Anchorage  
Assembly

Hairpins are required but not shown for clarity.

## Connection to the Foundation (cont.)

### M High-Strength Non-Shrink Grout

Non-shrink grout complying with ASTM C1107 with minimum compressive strength of 5,000 psi shall be placed below the column base plate prior to loading the frame.

The grout pad is assumed as 1½" in standard frame dimensions but can be adjusted to a minimum of ¾" thick to a maximum of 2" thick to allow for frame height adjustments.

For additional connection options, such as a single-bolt pinned-base or fixed-base connection, contact Simpson Strong-Tie at (800) 999-5099.



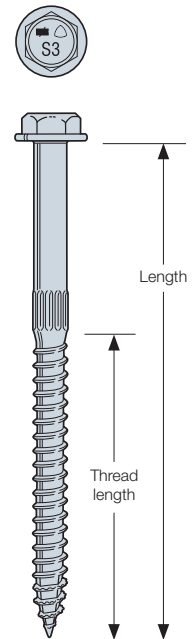
## Fasteners

### N Strong-Drive® SDS HEAVY-DUTY CONNECTOR Screw, SDWS TIMBER Screw and SDWH TIMBER-HEX Screw in LRFD

#### Strong-Drive SDS HEAVY-DUTY CONNECTOR Screws

Size Dia. x Length (in.)	Finish / Material	Model No.	Thread Length (in.)	DF/SP LRFD Capacities					
				Shear ( $\lambda = 0.8$ )			Shear ( $\lambda = 1.0$ )		
				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	Double- Barrier Coating	SDS25112	1	432	432	432	540	540	540
¼ x 2		SDS25200	1¼	432	501	501	540	626	626
¼ x 2½		SDS25212	1½	432	673	725	540	842	906
¼ x 3		SDS25300	2	432	725	725	540	906	906
¼ x 3½		SDS25312	2¼	432	725	725	540	906	906
¼ x 4½		SDS25412	2¾	432	725	725	540	906	906
¼ x 5		SDS25500	2¾	432	725	725	540	906	906
¼ x 6		SDS25600	3¼	432	725	725	540	906	906
¼ x 8		SDS25800	3¼	432	725	725	540	906	906

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 wood load duration factor listed.  
Tabulated values must be multiplied by all applicable adjustment factors per the NDS.
3. Minimum spacing requirements are listed in ICC-ES ESR-2236.



**Strong-Drive  
SDS HEAVY-DUTY  
CONNECTOR Screws**  
U.S. Patents 6,109,850;  
5,897,280; 7,101,133

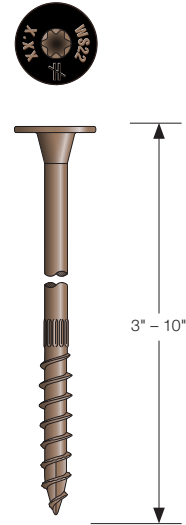


## Fasteners (cont.)

### **N** Strong-Drive® SDWS TIMBER Screws

Size Dia. x Length (in.)	Model No.	Thread Length (in.)	DF/SP LRFD Capacities									
			Shear ( $\lambda = 0.8$ )									
			Wood Side Member Thickness (in.)									
			1.5	2	2.5	3	3.5	4	4.5	6	8	
0.220 x 3	SDWS22300DB	1 ½	440	—	—	—	—	—	—	—	—	—
0.220 x 4	SDWS22400DB	2 ¾	699	699	527	—	—	—	—	—	—	—
0.220 x 5	SDWS22500DB	2 ¾	699	699	622	622	561	—	—	—	—	—
0.220 x 6	SDWS22600DB	2 ¾	699	699	699	699	630	630	613	—	—	—
0.220 x 8	SDWS22800DB	2 ¾	699	699	699	699	682	682	682	682	—	—
0.220 x 10	SDWS221000DB	2 ¾	699	699	699	699	682	682	682	682	682	682

See footnotes below.



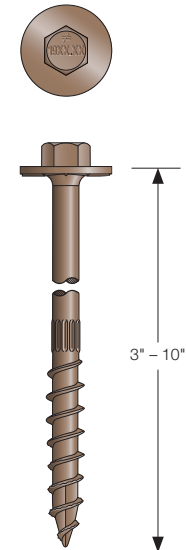
**Strong-Drive  
SDWS TIMBER  
Screws**

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

### **N** Strong-Drive SDWH TIMBER-HEX Screws

Size Dia. x Length (in.)	Model No.	Thread Length (in.)	DF/SP LRFD Capacities									
			Shear ( $\lambda = 0.8$ )									
			Wood Side Member Thickness (in.)									
			1.5	2	2.5	3	3.5	4	4.5	6	8	
0.195 x 3	SDWH19300DB	1 ½	492	—	—	—	—	—	—	—	—	—
0.195 x 4	SDWH19400DB	2 ¾	639	518	518	—	—	—	—	—	—	—
0.195 x 6	SDWH19600DB	2 ¾	639	457	457	457	457	423	423	—	—	—
0.195 x 8	SDWH19800DB	2 ¾	639	457	457	457	457	457	449	423	—	—
0.195 x 10	SDWH191000DB	2 ¾	639	457	457	457	457	457	449	449	423	423

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 wood load duration factor listed. For  $\lambda = 1.0$ , 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 7/8" edge distance,  
¾" 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  $C_M = 0.7$ .



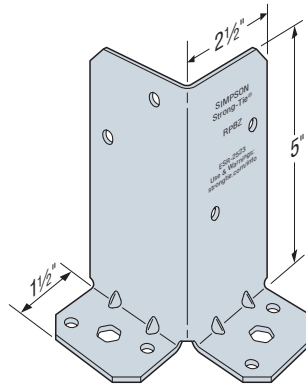
**Strong-Drive  
SDWH  
TIMBER-HEX  
Screws**

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

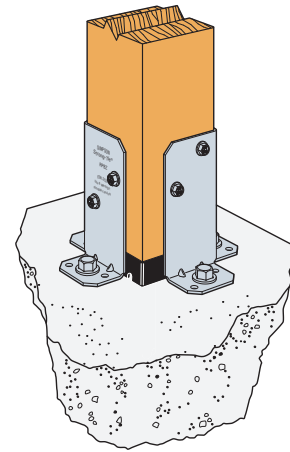
## Additional Retrofit Products and Resources

### O RPBZ Retrofit Post Base

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



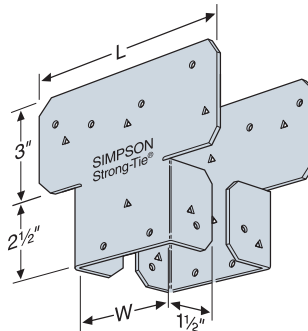
RPBZ



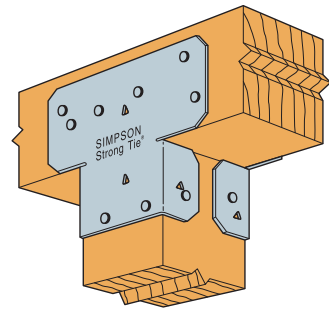
RPBZ Installation

### P 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.



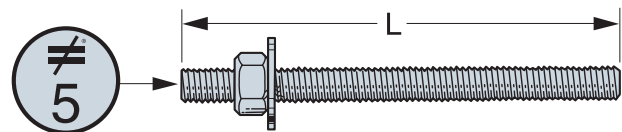
AC



AC Installation

### Q 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.



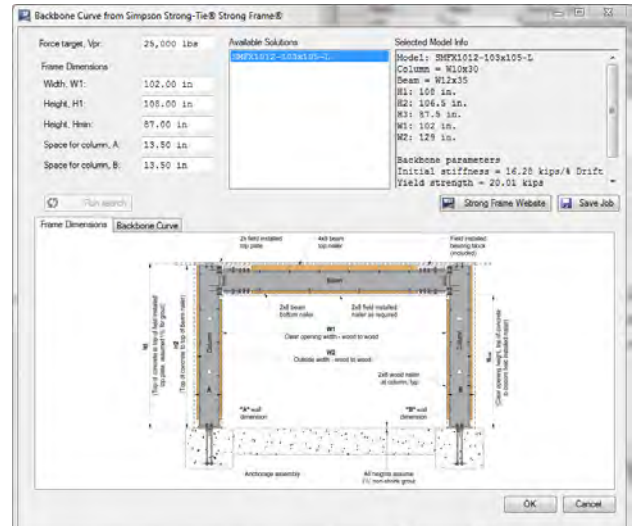
RFB

## Strong Frame® Special Moment Frames Design Tools



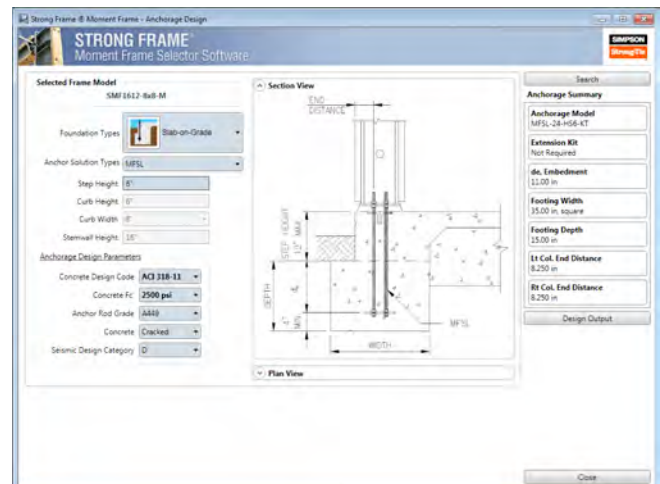
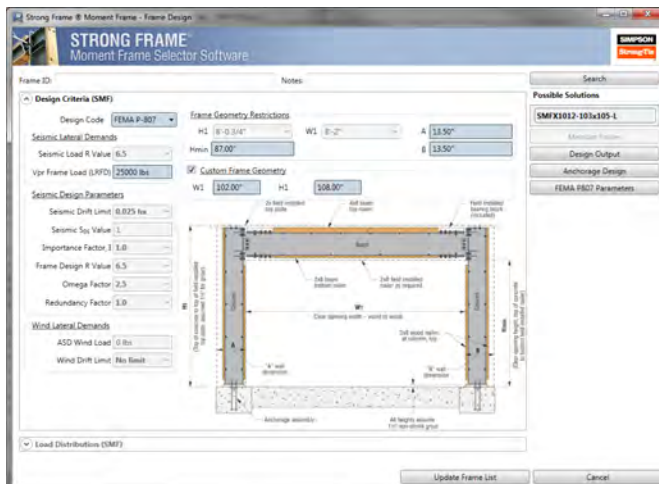
### Weak Story Tool with Simpson Strong-Tie® Strong Frame Moment Frames

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 page 33. The Strong Frame selector software can also be used to design retrofit moment frames when using the IEBC, Chapter A4 method and is available for free download from [strongtie.com/resources](http://strongtie.com/resources).





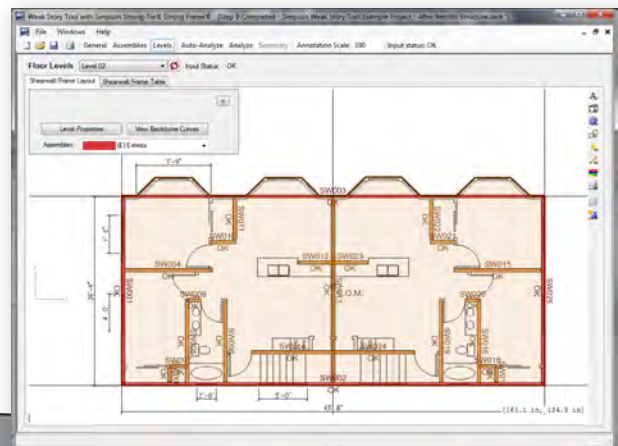
## FEMA P-807 Weak Story Tool with Simpson Strong-Tie® Strong Frame® Moment Frames Design Tutorial

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](http://strongtie.com/softstory). We also provide an accredited Soft-Story Retrofit Training Course that can be taken at [strongtie.com/training](http://strongtie.com/training).



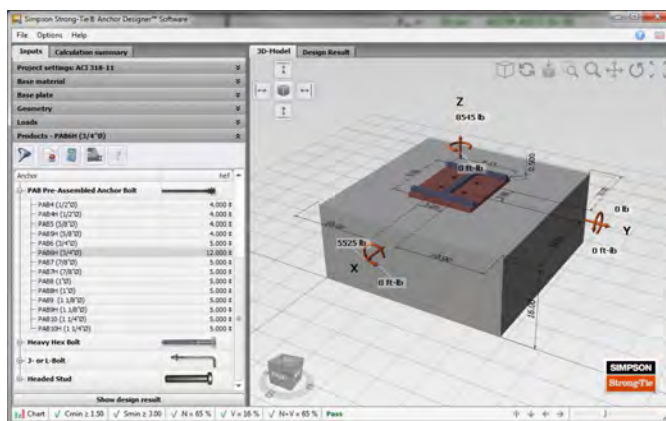
# Design Tools



## Anchor Designer™ Software for ACI 318, ETAG and CSA

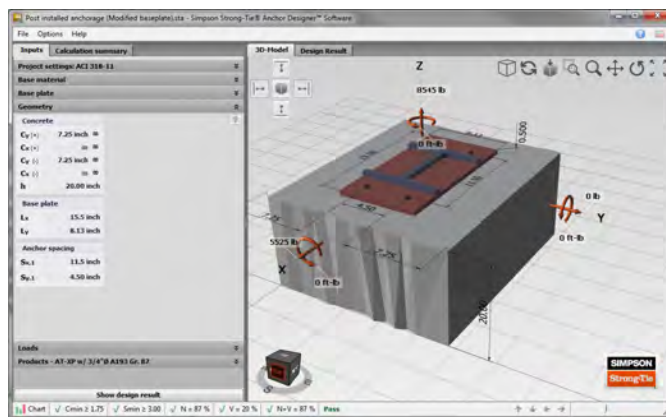
Anchor Designer software for ACI 318 analyzes and suggests anchor solutions using the ACI 318, Appendix D Strength Design methodology. It provides anchoring solutions for cracked and uncracked concrete using a variety of Simpson Strong-Tie® mechanical and adhesive anchors. With its easy-to-use graphic 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 the following website [strongtie.com/software](http://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 pre-assembled 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

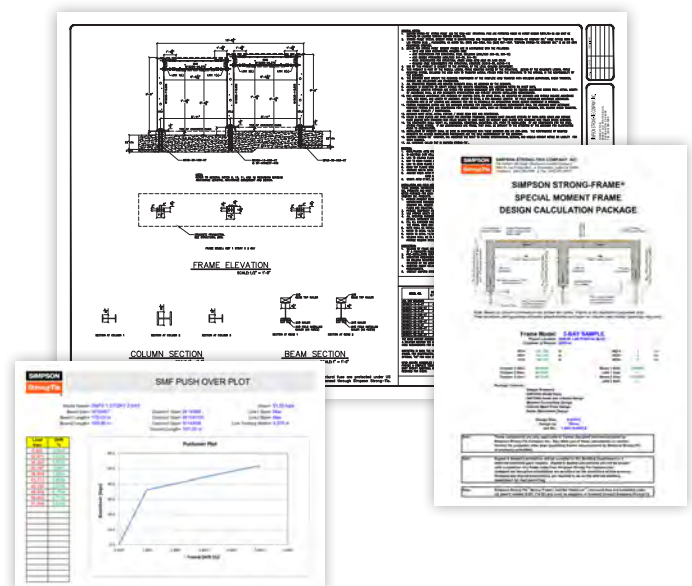
Other configurations or member sizes can be designed for soft-story structures utilizing FEMA P-807, IEBC Chapter A4, or ASCE 7. Options include stepped column heights for sloped hillsides; frames in line with varying heights; designs where existing pipes or features cannot be relocated; and multi-story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