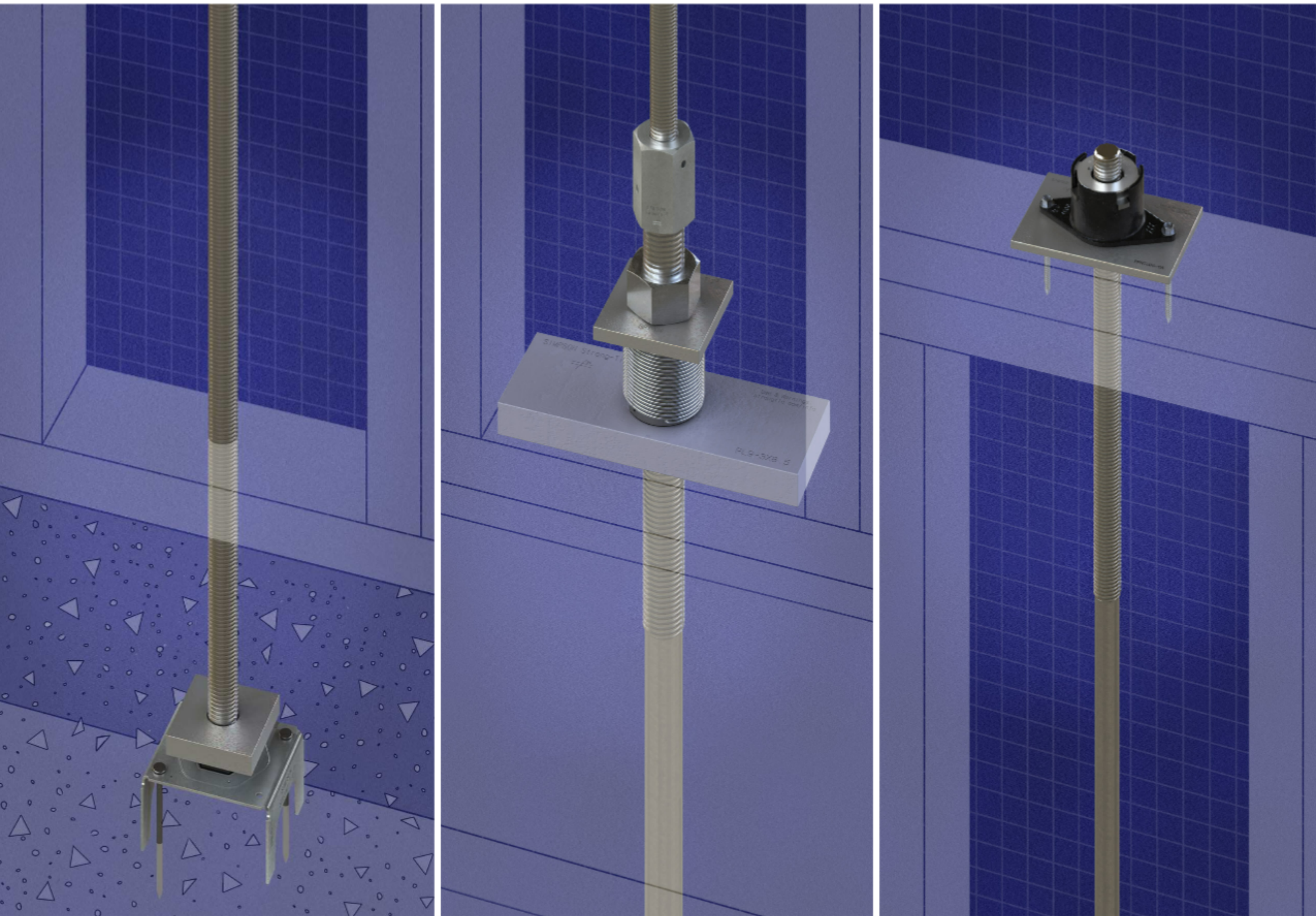
Strong-Rod® Systems



SEISMIC AND WIND RESTRAINT SYSTEMS GUIDE

(800) 999-5099 | strongtie.com

Smart design from product to project

Product Design

We put our product designs through rigorous testing at our cutting-edge research and development facilities in order to deliver best-in-class structural solutions to the market. Our high-performance Strong-Rod® systems are designed with code-listed take-up devices for securing mid-rise, wood-framed buildings against forces caused by seismic and wind events. With innovative components that work together to create a continuous load path, Simpson Strong-Tie® rod systems are built for maximum resilience and installation efficiency.

Engineering Design Services

No company knows light-frame wood construction better than Simpson Strong-Tie. Our design support services provide the technical expertise needed to tackle the complex challenges posed by mid-rise buildings. Using your project's unique design considerations and specifications, we can quickly create whole system designs, providing you a submittal-ready package of code-compliant components and plans to keep your project on time and within budget.

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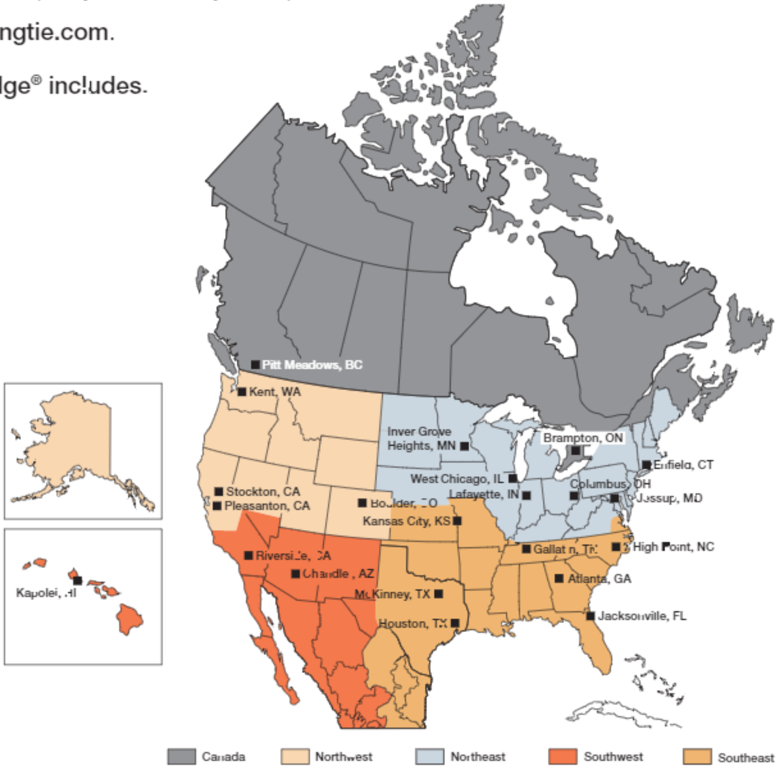
For over 60 years, Simpson Strong-Tie has focused on creating structural products that help people build safer and stronger homes and buildings. A leader in structural systems research and technology, Simpson Strong-Tie is one of the largest suppliers of structural building products in the world. The 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**.

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 AISC, AISI, AITC, ASTM, ASCE, AWC, AWPA, 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 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?

We Are ISO 9001 Registered

Simpson Strong-Tie is an ISO 9001 registered company. ISO 9001 is an internationally recognized quality management 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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Strong-Rod® ATS Anchor Tiedown System for Shearwall Overturning Restraint

Strong-Rod® URS Uplift Restraint System for Roofs

Important Information and General Notes

1. Simpson Strong-Tie reserves the right to change specifications, designs. and models without notice or liability for such changes.
2. Steel used for each Simpson Strong-Tie® product is individually selected based on the product's steel specifications, including strength, thickness, formability, finish and ability to weld. Contact Simpson Strong-Tie for steel information on specific products.
3. Unless otherwise noted, dimensions are in inches, loads are in pounds.
4. All installations should be designed in accordance with the published allowable load values. The designer is responsible for verifying that all design loads do not exceed the allowable loads listed for each component in the restraint system. Do not exceed published allowable loads that would jeopardize the connectors.
5. Wood shrinks and expands as it loses and gains moisture content, particularly perpendicular to its grain. Take wood shrinkage into account when designing and installing connections. The effects of wood shrinkage are increased in multiple lumber connections, such as floor-to-floor installations. This may result in the nuts for the vertical rod system becoming loose, requiring tightening (unless shrinkage compensating devices are installed). Section 2304.3.3 of the 2018 IBC requires wood structures supporting more than two floors and a roof be analyzed for the effects of wood shrinkage. Refer to the wood shrinkage web application on **strongtie.com/software** for more information. See ICC-ES ESR-2320 for additional information on Simpson Strong-Tie take-up devices.
   a. Simpson Strong-Tie recommends notifying the designer or stating the project lumber moisture content on the construction documents if the anticipated moisture content exceeds or falls below general industry standards. Simpson Strong-Tie assumes structural dry lumber and considers a range of a 10% change from Initial moisture content to equilibrium moisture content when calculating the estimated building shrinkage as used for determining the rated deformation compensation capacity for take-up devices (ATUD/TUD).
6. The term "designer" used throughout this guide is intended to mean a qualified licensed professional engineer or a qualified licensed architect.
7. All connected members and related elements shall be designed by the designer. Where multiple members of lumber are intended to act as one unit, they must be fastened together to resist the applied load. This design must be determined by the designer.
8. Local and/or regional building codes may require meeting special conditions, such as rod elongation limits. Also, building codes often require special inspection of anchors installed in concrete and masonry. For compliance with these requirements, it is necessary to contact the local and/or regional building authority. Except where mandated by code, Simpson Strong-Tie products do not require special inspection.
9. Corrosion information may be found at **strongtie.com/corrosion**.
10. Components should be kept dry and away from corrosive materials and away from steel that has already shown signs of corrosion.
11. Once installed, take precautions to prevent the RTUD from getting wet and freezing. Permanent damage may result if the installed device freezes when it has water inside it.
12. When fire caulking or spray-on insulation is required, the specified material shall not be corrosive to metal when used in contact with the ATS system. Shrinkage compensating devices (e.g., RTUD, ATUD, TUD) have moving components and may not function properly with debris interference, direct contact with fire caulking or spray insulation shall be avoided. Indirect contact shall also be avoided, as remnants of the caulking material may still be held in the rod threads, which can be detrimental to the performance of the components when the rod passes through the device during building shrinkage. The fire caulking or spray insulation material material should also be pliable in order to be compatible with wood shrinkage and general light frame construction residual movement.

General Notes for Shearwall Overturning Restraint

1. When designing for shearwall overturning restraint, the designer is responsible for verifying that the building drift is within the acceptable code limitations. The designer should include project specific deformation limits for shearwall overturning restraint (Strong-Rod ATS) in the construction drawings and specifications including whether deformation is to include wood crushing under the bearing plate as well as any requirements set forth by local jurisdictions. Serviceability should also be considered.
2. Studs, posts and blocking details shall be specified by the designer and are not provided by Simpson Strong-Tie. Refer to **strongtie.com/srs** for compression member allowable capacities, design assumptions and general notes.
3. Anchorage solutions shall be specified by the designer. Foundation size and reinforcement shall be specified by the designer. Contact Simpson Strong-Tie to coordinate connecting components at the first level.
4. The Simpson Strong-Tie Strong-Rod Anchor Tiedown System for shearwall overturning restraint (Strong-Rod ATS) is designed to be installed floor-by-floor as the structure is built. Installation in this manner, with shearwalls, will provide lateral stability during construction.
5. Do not specify welding of products listed in this design guide unless this publication specifically identifies a product as acceptable for welding, or unless specific approval for welding is provided in writing by Simpson Strong-Tie. Cracked steel due to unapproved welding must be replaced. For more information, read our blog at **strongtie.com/seblog**.
6. Simpson Strong-Tie strongly recommends the following addition to construction drawings and specifications: "Simpson Strong-Tie connectors and tiedown components are specifically designed to meet the structural loads specified on the plans or provided by the designer. Before substituting an alternate rod system, confirm load capacity and system displacement (rod elongation and shrinkage compensation device displacement) are based on reliable published testing data and/or calculations and meet the design intent requirements specified by the designer. The designer should evaluate and give written approval for substitution prior to installation.
7. The allowable loads published in this guide are for use when utilizing the Allowable Stress Design methodology. A method for using Load and Resistance Factor Design (LRFD) for wood has been published in ANSI/AWC NDS-2018. If LRFD capacities are required, contact Simpson Strong-Tie.
8. Local and/or regional building codes may have additional requirements. Building codes often require special inspection of anchors installed in concrete and masonry. For compliance with these requirements, it is necessary to contact the local and/or regional building authority.
9. Steel bearing plates shall be sized for proper length, width and thickness based on steel bending capacity and wood bearing. Deflection of bearing compression (up to 0.04") must be included in overall shearwall deflection calculations where applicable by local and/or regional building authorities.
10. Available Strong-Rods, fully threaded rod sizes and material grades are listed at **strongtie.com/srs**.
11. When drilling thru-holes to accommodate the threaded rods, Simpson Strong-Tie strongly recommends that one continuous hole be drilled upon completion of the entire floor system at each level. Misalignment may occur when drilling is staged over several different construction steps, which leads to binding and bending of the threaded rod. See installation animations for further description at **strongtie.com/srs**.

General Notes for Uplift Restraint System for Roofs

1. Simpson Strong-Tie® Strong-Rod® Uplift Restraint System for roofs (Strong-Rod URS) provides tiedown solutions comprising steel components, which include threaded rods, bearing plates, nuts, coupler nuts and take-up devices. Top plate(s), blocking, and other wood members that transfer uplift load to the tiedown runs are not provided by Simpson Strong-Tie.
2. Simpson Strong-Tie provides uplift restraint systems for roofs to meet the design uplift forces. These forces are provided and determined by the designer and governing jurisdiction requirements. During preliminary design, Simpson Strong-Tie may determine estimated loading; however, the designer is responsible for final design, calculations or derivation of structural forces related to the building. Simpson Strong-Tie has not confirmed and is not responsible for verifying the uplift restraint system adherence to the governing jurisdiction's deflection requirements or its performance in consideration of structural deformation compatibility.
3. The rod system that provides uplift restraint for roofs should be continuous from the roof-level top plate(s) to the foundation or to the underside of the level where the designer has determined the tiedown run can terminate due to dead load resistance.
4. Spacing tables for uplift restraint runs shall be found at **strongtie.com/srs**. The designer may establish specific detailing and provide calculations approved by the local jurisdiction to allow for increased spacing.
5. Wood framing members used in top plate and wall stud applications must be either sawn dimensional lumber complying with IBC Section 2303.1.1 or IRC Section R602.1.1, or structural composite lumber (SCL) recognized in a current ICC-ES or IAPMO UES evaluation report, with nominal dimensions of either 2x4 or 2x6 sizes with a Specific Gravity (SG) in a range of 0.42 to 0.55. Sawn dimension lumber must have a moisture content of 19 percent or less (16 percent for SCL members), both at the time of installation and in service.
6. Where connection hardware between the roof framing members and the wall top plate induces eccentric loading about the centerline of the top plate, Simpson Strong-Tie top plate-to-stud connections must be installed to prevent top plate rotation. The top plate-to-stud connector used to resist this rotational force must be on the same side of the wall as the roof-to-wall connectors. See p. 57 for more information.
7. The top-plate splice details shown on p. 56 apply to the "reinforced" top-plate tables available at **strongtie.com/srs**. The splice reinforcement must be attached using ¼"x 4½" Simpson Strong-Tie Strong-Drive® SDS Heavy-Duty Connector screws. Otherwise, the "unreinforced" top-plate tables must be used.
8. Fully threaded steel rods used with the roof uplift restraint tiedown runs have diameters of ⅜" through ¾". The threaded rods are made of ASTM F1554 Grade 36 or A307 Grade A, steel.
9. Threaded rod couplers used to attach threaded rods end to end require proof of positive connection between threaded rods and rod couplers, such as the use of Witness Holes.
10. Tabulated values given for the roof uplift restraint runs in ICC-ES ESR-1161 are available at **strongtie.com/srs** and take into account the following serviceability limits:
    a. 0.18" inch of total rod elongation along the length of the roof uplift restraint run.
    b. A bending deflection limit of L/240 for the top plate(s), where L is the span of the top plate between adjacent tiedown runs.
    c. 0.25" of roof uplift restraint total system deflection between the top plate(s) and the termination of the run that includes the total elongation of the rod run and the bending of the top plate(s) between rod runs. The contribution of wood shrinkage to the overall deflection of the continuous rod tiedown system must be analyzed by the designer. Simpson Strong-Tie recommends the use of a shrinkage compensation device (take-up device) at each run to mitigate wood shrinkage. The tables included in this design guide include the effect of RTUD or ATUD shrinkage compensation devices.
    d. Wood bearing compression under steel bearing plates (up to 0.04").

Simpson Strong-Tie Limited Warranty

For the Limited Warranty that applies to Simpson Strong-Tie products, please consult strongtie.com/limited-warranties. **See p. 74 for the Limited Warranty in effect when this design guide was first published**. To obtain a copy of the current Limited Warranty, contact us at limited_warranty@strongtie.com, (800) 999-5099 or Simpson Strong-Tie Company Inc., 5956 West Las Positas Boulevard, Pleasanton, CA 94588.

The Limited Warranty contains important disclaimers, limitations and exclusions, and applies only if the products have been properly specified, installed, maintained, and used in accordance with the design limits and the structural, technical, and environmental specifications in the Simpson Strong-Tie Documentation. All future purchases of Simpson Strong-Tie products are subject to the terms of the Limited Warranty in effect as of the purchase date.

Although products are designed for a wide variety of uses, Simpson Strong-Tie assumes no liability for confirming that any product is appropriate for an intended use, and each intended use of a product must be reviewed and approved by qualified professionals. Each product is designed for the load capacities and uses listed in the Simpson Strong-Tie Documentation, subject to the limitations and other information set forth therein. Due to the particular characteristics of potential impact events such as earthquakes and high velocity winds, the specific design and location of the structure, the building materials used, the quality of construction, or the condition of the soils or substrates involved, damage may nonetheless result to a structure and its contents even if the loads resulting from the impact event do not exceed Simpson Strong-Tie's specifications and the products are properly installed in accordance with applicable building codes, laws, rules and regulations.

Terms and Conditions of Sale

Product Use

Products in this guide are designed and manufactured for the specific purposes shown, and should not be used with other connectors not approved by a qualified designer. Modifications to products or changes in installations should only be made by a qualified designer. The performance of such modified products or altered installations is the sole responsibility of the designer.

Indemnity

Customers or designers modifying products or installations, or designing non-catalog products for fabrication by Simpson Strong-Tie Company Inc. shall, regardless of specific instructions to the user, indemnify, defend and hold harmless Simpson Strong-Tie Company Inc. for any and all claimed loss or damage occasioned in whole or in part by non-catalog or modified products.

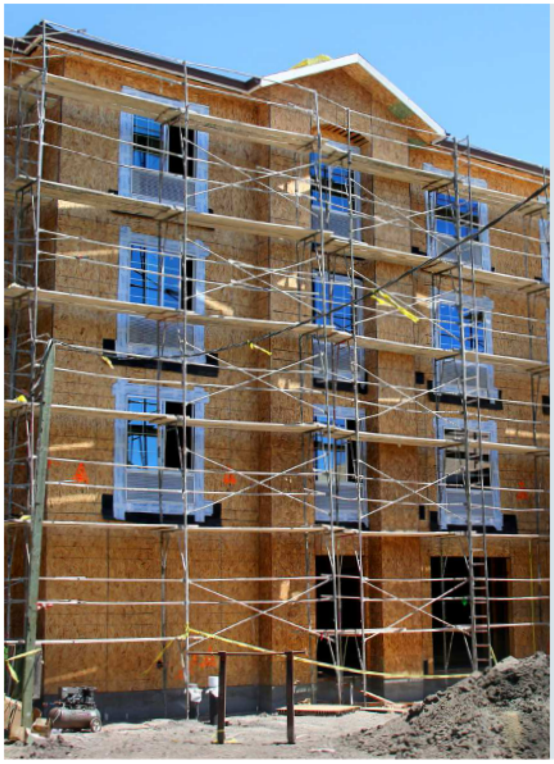
Non-Catalog and Modified Products

Consult Simpson Strong-Tie Company Inc. for applications for which there is no catalog product, or for connectors for use in hostile environments, with excessive wood shrinkage, or with abnormal loading or erection requirements.

Non-catalog products must be designed by the customer and will be fabricated by Simpson Strong-Tie in accordance with customer specifications.

Simpson Strong-Tie cannot and does not make any representations regarding the suitability of use or load-carrying capacities of non-catalog products. Simpson Strong-Tie provides no warranty, express or implied, on non-catalog products. F.O.B. Shipping Point unless otherwise specified.

Why Continuous Rod Tiedown Systems?



Seismic and wind events are serious threats to structural integrity and occupant safety. All wood-framed buildings need to be designed to resist shearwall overturning and roof-uplift forces. For one- and two-story structures, connectors (straps, hurricane ties and holdowns) have been the traditional answer. With the growth in mid-rise, wood-framed structures, however, rod systems have become an increasingly popular lateral and uplift restraint solution.

Multi-story structures present complicated design challenges. Frequently, the structures have larger windows and door openings, providing less space for traditional restraint systems. For all these reasons, there is increased need for restraint systems that can meet multi-story structural demands without sacrificing installation efficiency or cost considerations.

Continuous rod tiedown systems are able to answer these demands by restraining both lateral and uplift loads, while maintaining reasonable costs on material and labor. Instead of using metal connector brackets as in a holdown system, continuous rod tiedown systems consist of a combination of rods, coupler nuts, bearing plates and shrinkage-compensation devices. These all work together to create a continuous load path to the foundation.

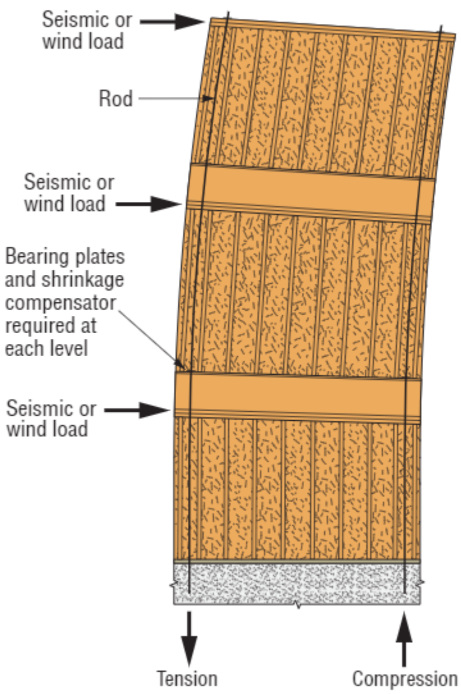
To contact a Simpson Strong-Tie representative for help designing your Strong-Rod® continuous rod tiedown solution, call (800) 999-5099 or visit **strongtie.com/srscontact**.

Tension Forces Resisted by Continuous Rod Tiedown Systems

Continuous rod tiedown systems are used to resist two types of tension forces — shearwall-overturning forces and uplift forces on roofs.

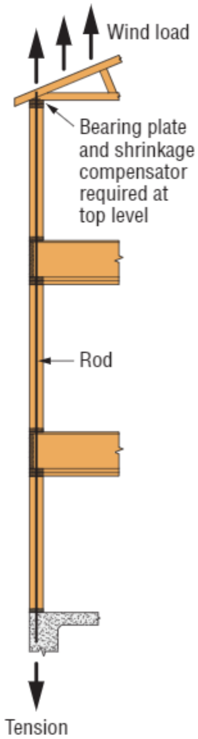
Shearwall Overturning Restraint System

One type of tension force is a result of lateral (horizontal) forces due to a wind or seismic event. This force occurs at the end of shearwalls and its magnitude increases at lower levels as it accumulates the tension force from each level or shearwall above.



Uplift Restraint System for Roofs

Roof uplift tension forces are those net vertical wind forces that occur as uplift loads at the bearing points of roof trusses or rafters of a structure. In moderate-to high-wind areas, these forces are generally resisted by rafter-to-top-plate connections in combination with tiedown systems spaced uniformly along exterior and interior bearing walls.



Simpson Strong-Tie® Strong-Rod® Systems

To ensure structural stability, a continuous rod tiedown system can be used in a mid-rise wood-framed structure to resist shearwall overturning and roof uplift.

Simpson Strong-Tie Strong-Rod Systems provide both an Anchor Tiedown System for shearwall overturning restraint (Strong-Rod ATS) and an Uplift Restraint System for roofs (Strong-Rod URS).

Strong-Rod ATS solutions address the many factors that must be considered during design to ensure proper performance against shearwall overturning — such as rod elongation, wood shrinkage, shrinkage compensating device deflection, incremental loads, bearing plate bending, cumulative tension loads and anchorage.

Strong-Rod URS solutions address the many factors that must be considered during design to ensure proper performance to resist roof uplift — such as rod elongation, wood shrinkage, rod-run spacing, wood top-plate design (connection to roof framing, reinforcement at splices, bending and rotation restraint) and anchorage.

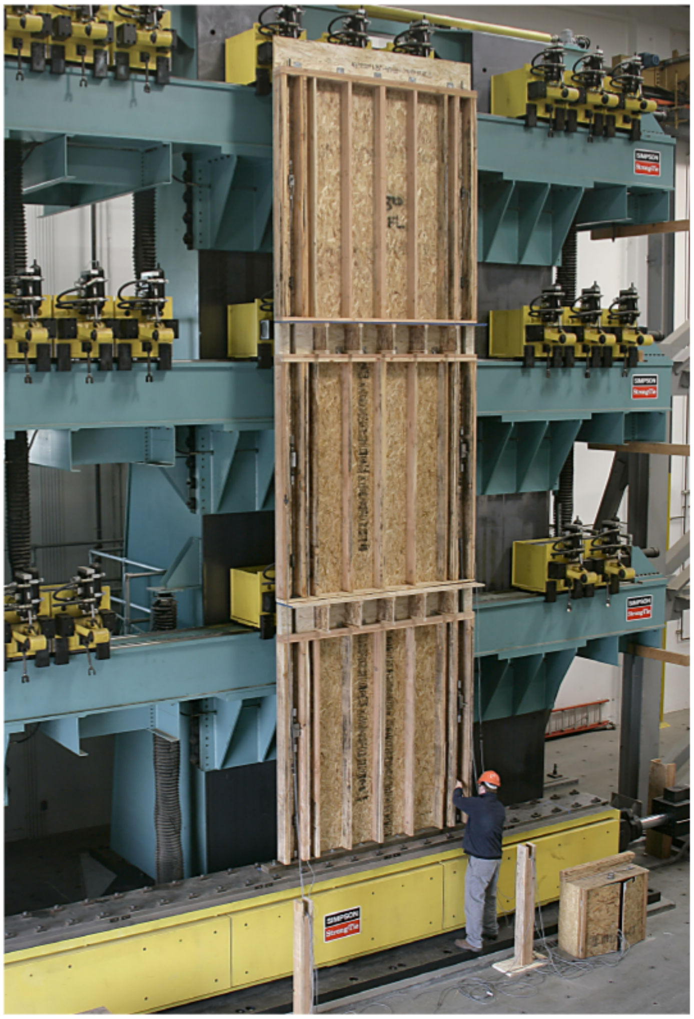
Simpson Strong-Tie Strong-Rod Systems have been extensively tested by our engineering staff at our state-of-the-art, accredited labs. Our testing and expertise have been crucial in providing customers with code-listed solutions. The Strong-Rod URS solution is code-listed in evaluation report ICC-ES ESR-1161 in accordance with AC391, while the take-up devices used in both the ATS and URS solutions are code-listed in evaluation report ICC-ES ESR-2320 in accordance with AC316.

Leverage Our Expertise to Help with Your Rod System Designs

A large number of factors need to be considered when specifying a rod system:

- Wood shrinkage
- Fire-treated wood
- Rod elongation
- Take-up device deflection
- Local code limitations
- Sill/Sole plate crushing

Simpson Strong-Tie is here to help you. We provide complimentary design services to help engineers with their continuous rod design. Since no two buildings are alike, each project is optimally designed to the designer's individual specifications. Run-assembly elevation drawings and load tables are provided to the designer for approval. For our design support services, contact your Simpson Strong-Tie representative at (800) 999-5099 or visit **strongtie.com/srscontact**.



Strong-Rod® ATS Anchor Tiedown System for Shearwall Overturning Restraint

To complement its research and design expertise, Simpson Strong-Tie has all the components needed to optimally design and build a continuous rod tiedown system for withstanding shearwall overturning forces. From our threaded rod to our plates and nuts, to our latest shrinkage compensators and design services, we offer designers a complete solution.

For installation instructions, refer to p. 27.

Anchor Tiedown System for Shearwall Overturning Restraint

A continuous load path is essential to a building's structural performance. Directing the diaphragm loads from roofs, floors and walls to the foundation in a prescribed continuous path is a widely accepted method to prevent shearwall overturning. The installation of continuous rod systems has grown in popularity with the increase in mid-rise wood (3- to 6-story) construction. Specifying a Strong-Rod Anchor Tiedown System (ATS) for shearwall overturning restraint from Simpson Strong-Tie offers several advantages for Specifiers and installers alike:

- An ATS restraint provides the high load capacities required for mid-rise wood construction
- System components provide low deflection to help limit shearwall drift
- Steel tension elements of the structural lateral force resisting system can be designed for the Specifier by Simpson Strong-Tie® Engineering Services
- Wood compression components of the shearwall system can be designed for the Specifier by Simpson Strong-Tie Engineering Services
- Simpson Strong-Tie Engineering Services can perform checks to ensure that your plans have the optimally designed system
- Our knowledge of rod system performance through years of testing ensures that all system design considerations have been met

Beyond the tension and compression aspects of a continuous rod tiedown system, wood shrinkage must also be addressed. In these types of structures, shrinkage and settlement can cause a gap to develop between the steel nut and bearing plate on the wood sole or top plate (see photo below), as the shrinkage increases cumulatively up the building and is the greatest at the uppermost floor. This can cause the system not to perform as designed and can add to system deflection. As a result, take-up devices must be used with most wood structures greater than two stories tall as is noted in the 2018 IBC Section 2304.3.3 at each level to mitigate any gap creation and therefore ensure optimum system performance.

What Is the Load Path?

Traditional Shearwall Load Path

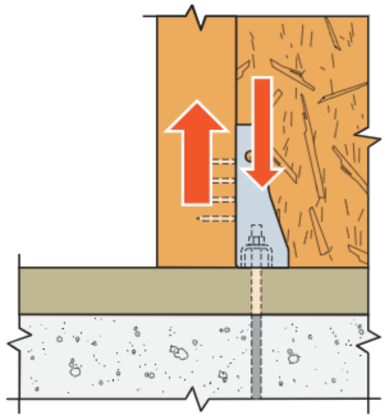
A traditional shearwall relies either on holdowns or straps attached to posts to transfer the net shearwall overturning forces to the foundation.

Lateral forces are transferred from the floor/roof to the boundary members (top plates) to the plywood sheathing. The following steps describe the traditional load path:

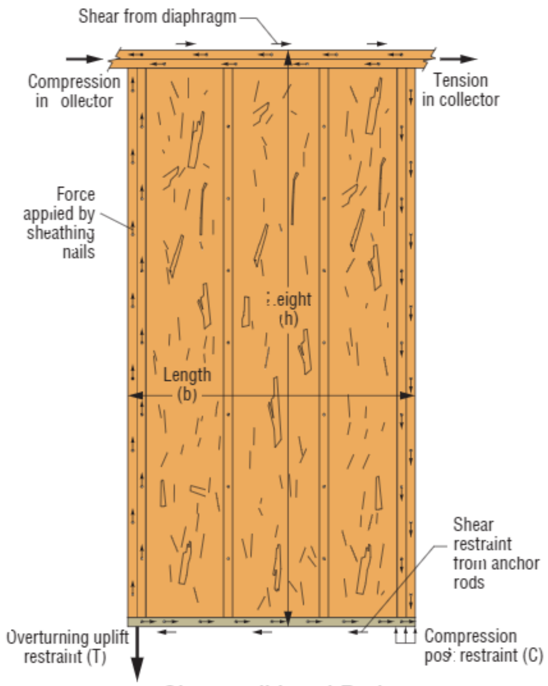
Step 1. Nails are typically used to transfer loads from the sheathing to the wall framing.

Step 2. The outermost framing boundary elements transfer the tensile forces, resulting from the net overturning, to the holdown that is attached to the post at the boundary at the bottom.

Step 3. The holdown system then transfers the load in tension to an anchor that is embedded into a concrete foundation.



Traditional System

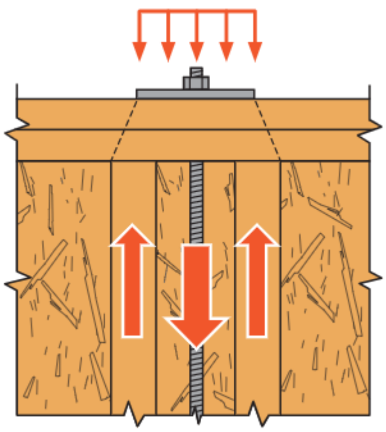


Shearwall Load Path

Continuous Rod Tiedown System Load Path

A continuous rod tiedown system utilizes a combination of threaded rods with bearing plates and take-up devices at each level to transfer the forces to the foundation. The following steps describe the continuous rod tiedown system load path:

1. The end posts deliver the sheathing load to the top plates and bearing plate.
2. Bearing plate transfers the load through a nut into the rod system.
3. Rod system transfers the load from the plate through tension in the rods to the foundation.

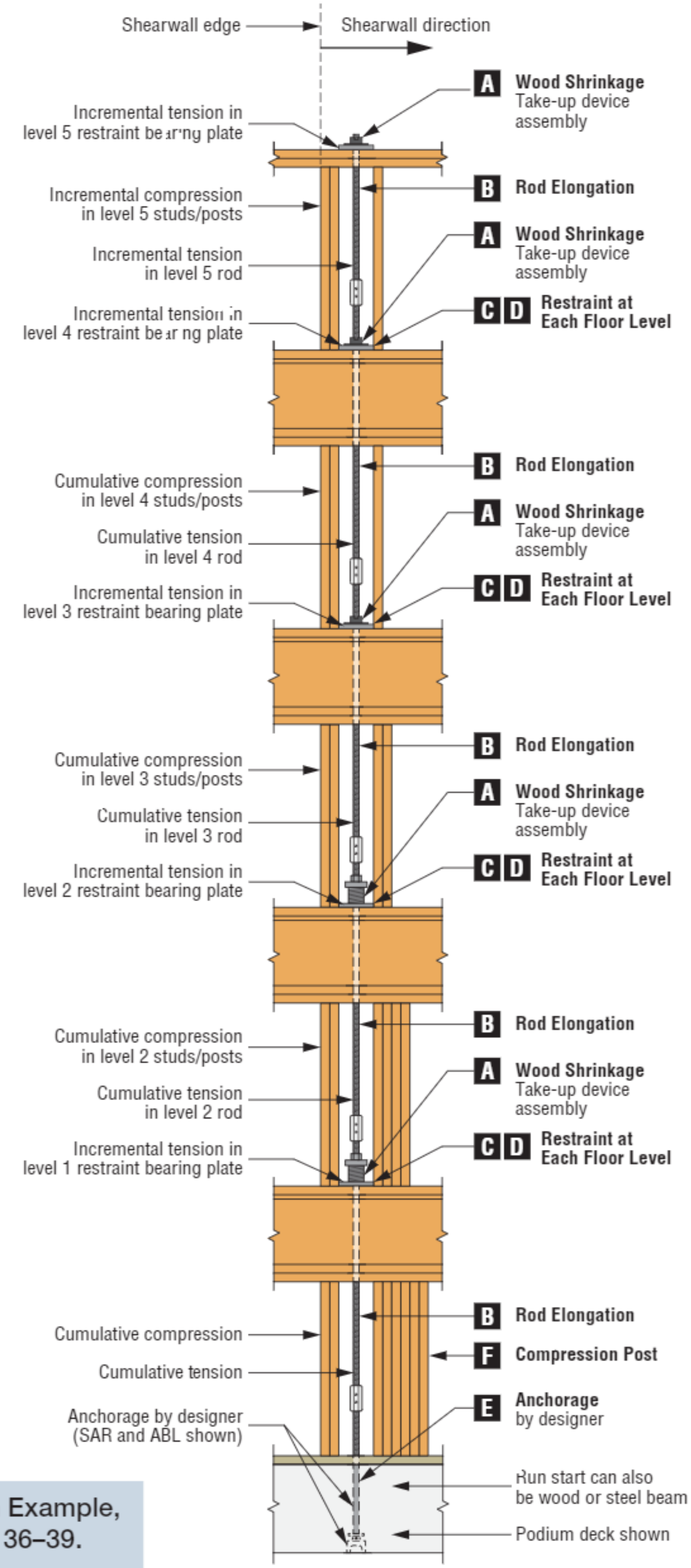


Continuous Rod Tiedown System

Strong-Rod System Components to Achieve This Load Path

- Aluminum take-up devices (ATUD) allow for multiple rod diameters.
- Ratcheting take-up devices (RTUD) fit ½", ⅝", ¾", ⅞" and 1" diameter rods.
- Optimized bearing plates accommodate the new ATUD and RTUD sizes.
- New options for compression post configurations that standardize anchor layout and reduce non-structural lumber in the upper stories.
- Shallow podium anchors provide test-proven solutions for anchoring high loads to relatively shallow podium slabs at interior and edge conditions in conformity with ACI 318-14, Anchor Provisions.

Key Considerations for Designing an Anchor Tiedown System for Shearwall Overturning Restraint



For Design Example, see pp. 36–39.

Note: For Asymmetrical Post layout, third stud may be required at shearwall edge.

A Wood Shrinkage

2018 International Building Code® (IBC) Section 2304.3.3 requires that designers evaluate the impact of wood shrinkage on the building structure when bearing walls support more than two floors and a roof. It is important to consider the effects of wood shrinkage when designing any continuous rod tiedown system. As wood loses moisture, it shrinks, but the continuous steel rod does not, which potentially forms gaps in the system.

ICC-ES AC316 limits rod elongation and shrinkage compensating device deflection to 0.20" at each level or between restraints unless shearwall drift is determined to be within code limits. Rod diameter and take-up device choice are obviously important.

Simpson Strong-Tie® take-up devices (TUDs), aluminum TUDs (ATUDs) and ratcheting TUDs (RTUDs) have been designed to minimize deflection ($\Delta_A + \Delta_R$) in the device and therefore reduce the contribution of device displacement to the 0.20" deflection limit, which allows for smaller rod diameters.

- Delta R is the device average travel and seating increment.
- Delta A is the deflection limit of the device at allowable load.

See **strongtie.com/srs** for additional information regarding wood shrinkage and how Simpson Strong-Tie take-up devices mitigate wood shrinkage within an Anchor Tiedown System for shearwall overturning restraint. To access our Wood Shrinkage Calculator, visit **strongtie.com/software**.

For Design Example, see pp. 36–39.

B Rod Elongation

A continuous rod tiedown run will deflect under load. The amount of stretch depends on the magnitude of load, length of rod, net tensile area of steel and modulus of elasticity.

In a continuous rod tiedown system designed to restrain shearwall overturning, the rod length is defined since it is tied to the story heights and floor depths. The modulus of steel is also a constant (29,000 ksi for steel) and steel strength does not affect elongation. The only variables then per run are the load and rod net tensile area, which will be controlled by:

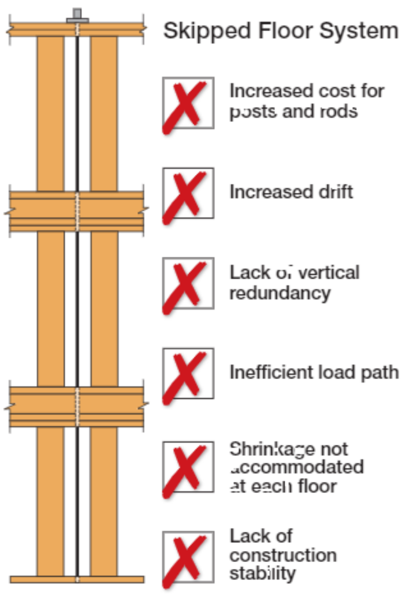
- Quantity, location and length of shearwalls provided to support the structure.
- Choice of rod diameter, which will be used in determining the rod net tensile area, A_e.

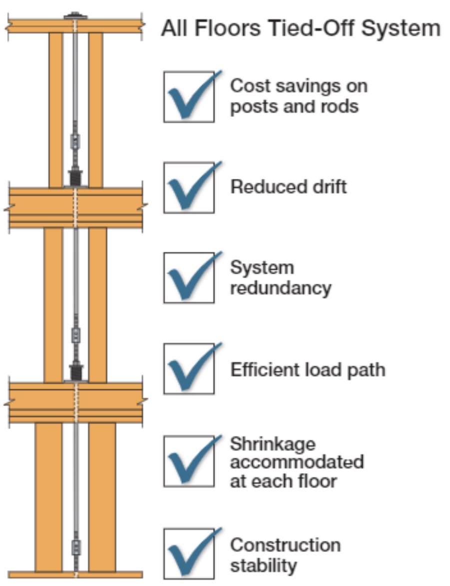
Note: It is important to use the net tensile area, A_e, for determining rod elongation. Gross rod area, A_g, will be used for the strength calculation.

Access the Simpson Strong-Tie Rod Elongation Calculator by visiting **strongtie.com/software**.

C Restrain Each Floor

A skipped floor system restrains two or more floors with a single restraint point to provide overturning resistance. A continuous rod tiedown system with all floors tied-off provides overturning restraint at every floor.





See **strongtie.com/srs** for additional information about the importance of providing restraint systems at each floor level.

D Bearing Plates

Bearing plates are key components in transferring loads from the posts and top plates to the rods in an Anchor Tiedown System for shearwall overturning restraint. Bearing plates must be designed to spread the loads across the sole/sill plates to minimize the effects of wood crushing. Bearing plate bending must also be checked to ensure proper steel plate thickness. These plates transfer the incremental bearing loads via compression of the sole/sill plates and bending of the bearing plates to a tension force in the rod. For additional information, visit **strongtie.com/srs**.

E Anchorage by Designer

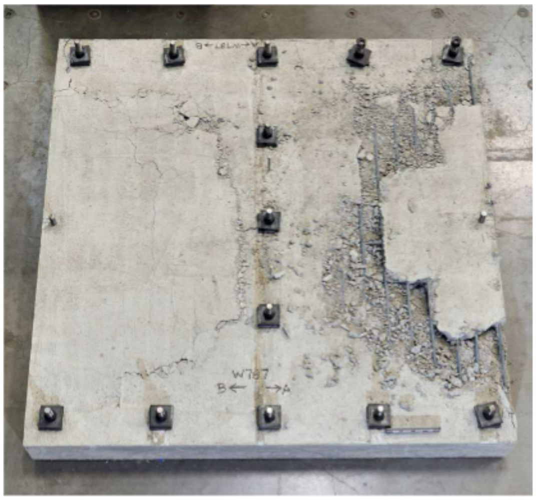
Many variables affect anchorage design, such as foundation type, concrete strength, anchor embedment and edge distances. Design tools, such as the Simpson Strong-Tie® Anchor Designer™ Software, are available to help the designer navigate the complex anchorage provisions contained in the ACI 318-14 reference design standard. Anchor products, including the Pre Assembled Anchor Bolt (PAB) or Shallow Anchor Rod (SAR) are also available to simplify specification.

An elevated concrete slab over parking, commonly referred to as a podium slab, is a common anchorage/run start type for mid-rise, light-frame construction. These slabs pose a significant challenge to designers when anchoring the continuous rod tiedown system above.

In designing light-frame structures over concrete podium slabs, understand that lateral loads from the structure above will produce large tensile overturning forces whose demands often far exceed the breakout capacities of these relatively thin slabs. Simpson Strong-Tie has thoroughly researched and tested practical solutions that achieve the expected performance in order to provide designers with additional design options. The use of the special detailing of anchor reinforcement shown in ACI 318-14, Anchorage Provisions, will greatly increase the tensile capacities of the anchors.

The concrete podium slab anchorage was a multi-year test program that commenced with grant funding from the Structural Engineers Association of Northern California and was applied toward the initial concept testing at Scientific Construction Laboratories, Inc. Following that test, a full-scale, detailed test program was completed at the Simpson Strong-Tie Tye Gilb Laboratory. The design approach follows code calculation procedures supported by testing of adequately designed anchor reinforcement specimens. Based on the empirical test data, the inner concrete breakout cone plus the added anchor reinforcement each provided a percentage contribution to the measured peak capacity of the entire anchorage assembly. These contributions are distributed to the overall anchorage capacity and the concept is then utilized for each installation condition being considered for the calculation.

For assistance with your design, visit **strongtie.com/srs** for suggested anchorage-to-podium slab details, slab design requirements, design calculations and Shallow Podium Slab Anchor product information. Also visit our Structural Engineering Blog at **seblog.strongtie.com** for more information.



Anchor reinforcement testing at Tye Gilb Laboratory for edge and away-from-edge conditions.

Shallow Podium Anchorage Design Example

Anchorage Calculation Using Anchor Reinforcement

This example presents the anchorage solution in tension for a cast-in-place anchor bolt in cracked concrete under seismic loading conditions in a reinforced concrete podium slab using anchor reinforcement. It is based on test results using flat bearing plates in which the full bearing surface is situated at the effective embedment depth. Other bearing surface geometries are not compatible with these test results. The calculation follows ACI 318-14 for the design of an anchor in tension, with AISC 360-16 used for the anchor allowable tensile steel strength. The witnessed testing conducted by Simpson Strong-Tie was used to validate ACI 318-14, Chapter 17 design concepts for anchor reinforcement and the need to design the structural slab to meet amplified 17.2.3.4.3 (a) anchor forces for use in SDC C–F. The design strength is based upon the ACI 318-14, Chapter 17 failure modes of tensile steel strength, concrete breakout strength, anchor pullout, concrete side-face blowout and anchor reinforcement strength. Additional failure modes observed in the testing validated greater capacities when anchor reinforcement is used, and those empirical findings are considered for that limit state. See **strongtie.com/srs** for detailed calculations for all solutions shown on Simpson Strong-Tie website design tables.

Code Information

2018 International Building Code® (IRC)
ACI 318-14, Chapter 17 (Tension)
AISC 360-16
SDC C through F, seismic

Material Properties

Concrete:	f'_c = 5,000 psi Type: cracked
Anchor bolt:	Material: ASTM A449 1" diameter, f_y = 92,000 psi, f_{ut} = 120,000 psi
Nut:	Type: heavy hex, Nut, h = 0.98 in., F_{nut} = 1.625 in., G_{nut} = 1.875 in. *Reference: For F_{nut} and G_{nut}, see ASME D18.2.2*
Washer:	Washer width, b_w = 2.75 in. Minimum washer thickness, t = 0.625 in.
Reinforcement:	f_y = 60,000 psi

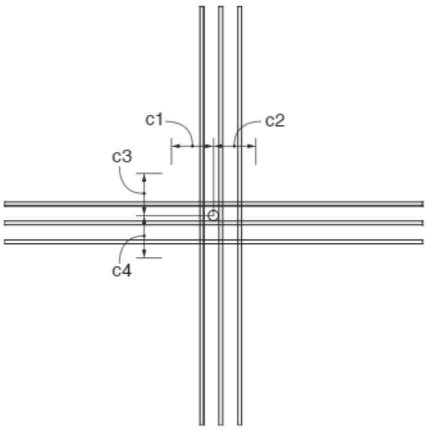
Dimensions

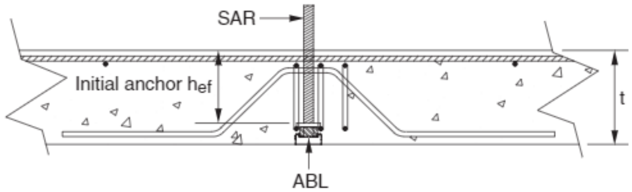
Slab thickness: t = 12 in.
Initial anchor: h_{ef} = 9.39 in.
h_{ef} x 1.5 = 14.09 in.

where h_{ef} is based on Simpson Strong-Tie ABL height, heavy hex nut height and plate thickness.

Anchor reinforcement Bottom cover: 0.75 in.

Per ACI 318-14, 17.4.2.8: Project the failure surface, c, outward $1.5h_{ef}$ from the effective perimeter of the plate.





Tension Design Calculations (ACI 318-14) — Used for 17.2.3.4.3 "Ductility" Tensile Requirements for SDC C–F

17.4.1 — Steel Strength for Anchor in Tension

Where: $N_{sa} = nA_{se}f_{uta}$

$n = 1$ *Reference: [Eq. 17.4.1.2]*

d_c = 1 in

$n_t = 8$

$$A_{se} = \frac{\pi}{4}\left(u_o - \frac{0.9743}{n_t}\right)^2$$

A_{se} = 0.606 in.^{2} *Reference: [R17.4.1.2]*

Not to exceed 1.9 x f_y =174,800 psi or 125,000 psi

f_{uta} = 120,000 psi *Reference: [17.4.1.2]*

$\mathbf{N_{sa}}$ **= 72,689 lb.**

Shallow Podium Anchorage Design Example (cont.)

Anchorage Calculation Using Anchor Reinforcement

ACI 318-14, 17.4.2 — Concrete Breakout Strength of Anchor Only in Tension

$N_{cb} = \frac{A_{Nc}}{A_{Nco}} \Psi_{ed,N} \Psi_{c,N} N_b$ — *Reference: [Eq. 17.4.2.1 (a)]*

Where: $A_{Nco} = 9h_{ef}^2 = 794$ in.² — *Reference: [Eq. 17.4.2.1 (c)]*

$A_{Nc} = (C_1 + C_2) \times (C_3 + C_4)$ where C_1 to C_4 shall not exceed $1.5h_{eff} = 14.09$ in. — *Reference: [17.4.2.1]*

Increase A_{Nc} per 17.4.2.8

$A_{Nc} = 963.90$ in.²

$\Psi_{ed,N} = 1.00$ — $\Psi_{ed,N} = 1$ if $C_{min} > 1.5h_{eff}$ — *Reference: [Eq. 17.4.2.5 (a)]*

$\Psi_{c,N} = 1.00$ — $\Psi_{c,N} = 1.0$ for cracked concrete — *Reference: [17.4.2.6]*

$N_b = k\sqrt{f'_c}\, h_{ef}^{1.5}$ — *Reference: [Eq. 17.4.2.2 (a)]*

where, $k = 24$ for cast-in-place anchors and if — *Reference: [17.4.2.2]*

11 in. $< h_{eff} <$ 25 in. then $N_b = 16\sqrt{f'_c}\, h_{ef}^{5/3}$ — *Reference: [Eq. 17.4.2.2 (b)]*

$h_{eff} = 9.39$ in.
$N_b = 48{,}836$ lb.

h_{eff} in Eq 17.4.2.1 (a) to 17.4.2.5 (b) shall be limited to $C_{max}/1.5$ when $C_{max} \leq 1.5h_{eff}$ (for 3 or 4 edges) — *Reference: [17.4.2.3]*

N_{cb} = 59,312 lb.

17.4.3 — Anchor Pullout Strength (Initial A_{brg} for Plate Bearing for Pullout)

$N_{pn} = \Psi_{c,P} N_p$ — *Reference: [Eq. 17.4.3.1]*

Where: $\Psi_{c,P} = 1.00$ — $\Psi_{c,P} = 1.0$ for cracked concrete — *Reference: [17.4.3.6]*

$N_p = A_{brg}\, 8 f'_c$ — *Reference: [Eq. 17.4.3.4]*

$A_{brg} = [(\pi \times D_{Abrg}^2/4)]$ – Area of Rod — $D_{Abrg} = \min. (F_{nut} + 2t), b_w$

$A_{brg} = 5.154$ in.²

N_p = 206,167 lb.

17.4.4 — Concrete Side-Face Blowout Strength

$N_{sb} = 160\, c_{a1} \sqrt{A_{brg}} \sqrt{f'_c}$ — Required only if anchor is near an edge where $c_{a1} < 0.4h_{eff}$ — *Reference: [Eq. 17.4.4.1]*

N_{sb} = No close edge — N_{sb} = Not applicable

17.2.3.4.3(a) — Ductility Check (Required for SDC C–F)

Reference: ACI 318-14

$N_{sa} = 72{,}689$ lb. — *Reference: [17.2.3.4.3 (a)]*

$1.2N_{sa} = 87{,}227$ lb.

For initial breakout (without anchor reinforcement), check $1.2N_{sa} < N_{cb}$

$N_{cb} = 59{,}312$ lb. < 87,227 lb., therefore non-ductile. Add anchor reinforcement.

For pullout, check $1.2N_{sa} < N_{pn}$

$N_{pn} = 206{,}167$ lb. > 87,227 lb., therefore ductile for pullout.

Shallow Podium Anchorage Design Example (cont.)

Anchorage Calculation Using Anchor Reinforcement

Anchor Reinforcement Estimate by Applying Sections 17.3.2.1 and 17.4.2.9

Estimate anchor reinforcement quantity by achieving $1.2N_{sa} < N_n$ per 17.2.3.4.3,

Where $N_n = N_n$ rebar

Anchor reinforcement size placed at 45-degree angle #5 $A_s = 0.31$ in.^{2} $f_y = 60{,}000$

$1.2N_{sa} = nA_sf_y\,(0.707)$ d rebar = 0.625 in.

$$n = \text{number of legs} = \frac{1.2N_{sa}}{A_sf_y\,(0.707)} = 6.67\text{, Use 8 legs}$$

Anchor reinforcement to be within $0.5h_{ef}$ of anchor

$N_{n\ rebar\ estimate} = nA_sf_y \times 0.707 = 105{,}202$ lb. > 87,227 lb.

Determine Anchorage System Capacity when Anchor Reinforcement Is Added

Testing performed by Simpson Strong-Tie indicates that when anchor reinforcement (A.R.) is added to these shallow slabs, ultimate capacity is a combination of A.R. resistance acting simultaneously with concrete breakout resistance.

Design Approach Using Empirical Data per Test Output

Using the test results, the % contribution to the measured peak capacity of both the inner concrete cone and the Anchor Reinforcement (A.R.) were determined. Both of these contributions are dependent on slab thickness.

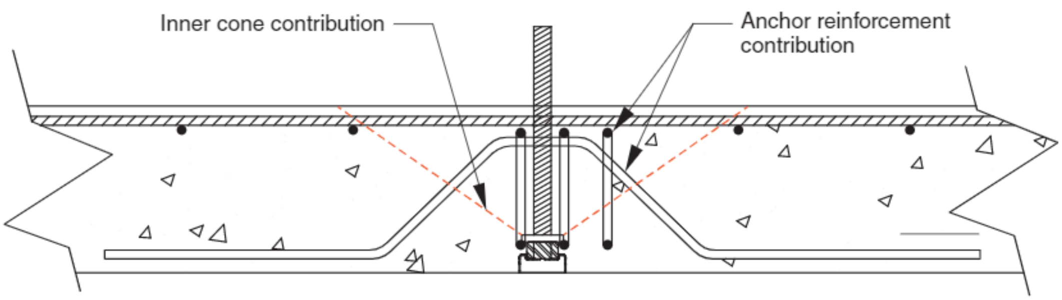
Inner Concrete Cone Contribution:
For inner concrete cone, that percentage contribution is based on a comparison of the Normalized Breakout Capacity vs. the Calculated Uncracked Breakout Capacity.

Anchor Reinforcement Contribution:
For anchor reinforcement contribution, that percentage is based on a comparison of the Maximum Possible A.R. Contribution vs. Measured A.R. Contribution.

Determine Design Limit for Anchor Reinforcement (A.R.) + Inner Concrete Cone

Inner Concrete Cone Contribution:
Based on testing, 41% of the contribution is coming from the inner concrete cone.

Anchor Reinforcement Contribution:
Based on testing, 100% of the anchor reinforcement is contributing.



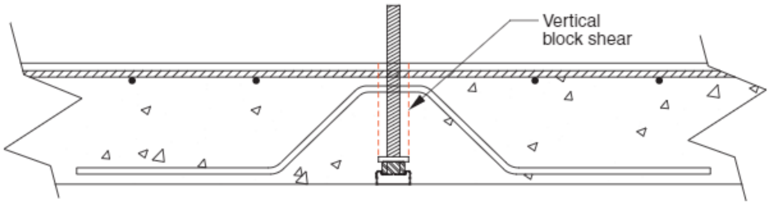
Contributions of Cone and Anchor Reinforcement Based on Empirical Findings

Shallow Podium Anchorage Design Example (cont.)

Anchorage Calculation Using Anchor Reinforcement

Vertical Block Shear Limit State Consideration for Shallow Slabs

Testing indicates that an additional failure mode is possible with a shallow embedment when resisting the breakout area with anchor reinforcement. A vertical "block shear" can form at the outer edges of the bearing plate. This "block shear" is separate from pullout and is dependent on embedment depth, bearing surface area and concrete strength.



Block Shear at Anchor Bearing Plate

Size bearing plate so that "block shear" is not the design limit state.

LRFD Design Strength Capacity Summary

$\phi = 0.70$	For all concrete-governed limit states	*Reference: ACI 318-14*
$\phi = 0.75$	For anchor steel strength limit state	*Reference: [17.3.3]*
$\phi = 0.75$	For anchor reinforced per ACI 318-14, Chapter 21	*Reference: [17.4.2.9]*
$S_F = 0.75$	Seismic factor, $S_F = 0.75$, (for use with concrete limit only)	*Reference: [17.2.3.4.4]*

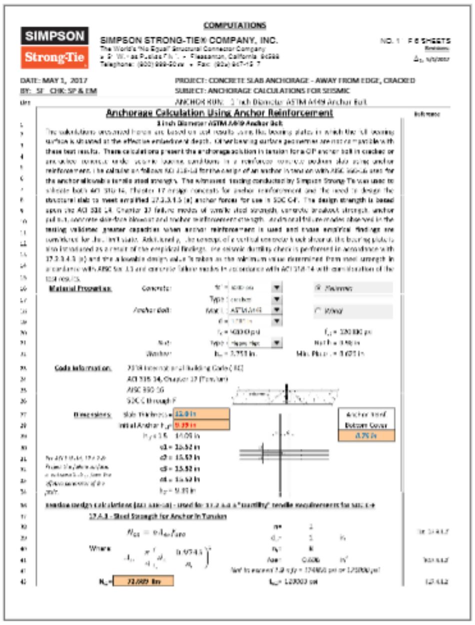
LRFD Limit

1. ACI 318 anchor steel strength in tension, ϕN_{sa} = 54,517 lb. — *Reference: [17.4.1]*
2. Sum of empirical concrete breakout + empirical anchor reinforcement, $\phi N_{cb\ empirical} \times S_F + \phi N_{n\ rebar\ empirical}$ = 91,647 lb.
   a. Concrete breakout strength of anchor reinforced system per empirical findings, Seismic), $\phi N_{cb\ empirical} \times S_F$
   b. Anchor reinforcement contribution of system per empirical findings, Seismic), $\phi N_{n\ rebar\ empirical}$ — *Reference: based on empirical data*
3. Pull-out strength, $\phi N_{pn} S_F$ = 108,238 lb. — *Reference: [17.4.3.3]*
4. Side-face blowout strength, $\phi N_{sb} S_F$ = No close edge — *Reference: [17.4.4]*
5. Block shear strength, $\phi N_{block\ shear}$ = 154,945 lb. — *Reference: based on empirical data*

LRFD limits 1–5 consider ACI 318 strength level values

Governing LRFD capacity = 54,517 lb. 1. Anchor tension controls at LRFD

For complete design example calculations of solutions shown in the Simpson Strong-Tie anchorage design tables, go to **strongtie.com/srs**.



Shallow Podium Anchorage Design Example (cont.)

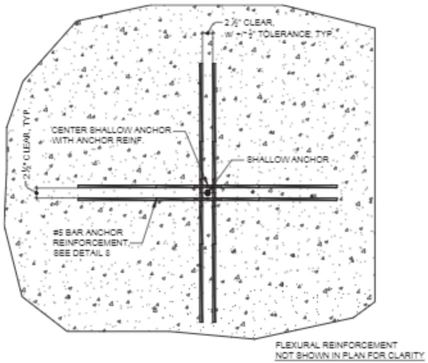
Anchorage Calculation Using Anchor Reinforcement

Anchor Reinforcement Layout Summary

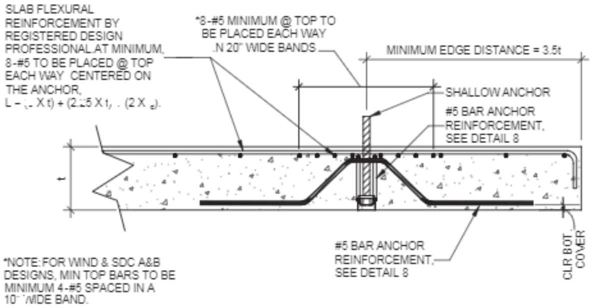
Anchor reinforcement bar: #5 — A.R. legs

Full bars: 4 bars

Min. bottom clear cover: 0.75 in. — Shallow anchor assembly kit: SA1-8H-XXKT



AWAY FROM EDGE 4-BAR PLAN



AWAY FROM EDGE 4-BAR SECTION

Anchor Reinforcement Detail: 2/SA1

SDC C-F Away From Edge Anchor Tension Capacity (lb.)

12" Thick 5,000 Psi Concrete Slab - Cracked Concrete				
Bolt Dia (in.)	Shallow Anchor	Anchor Tension Capacity, Asd (Lrfd)	Detail On Sheet Sa1	1.2 x N_{sa} Slab Design Load
High Strength Anchor Bolt				
½	SA1-4H-XXKT	8,835 (12,770)	1	2 ,435
⅝	SA1-5H-XXKT	13,805 (20,340)	1	32,545
¾	SA1-6H-XXKT	19,880 (30,100)	1	48,160
⅞	SA1-7H-XXKT	27,060 (41,555)	2	66,490
1	SA1-8H-XXKT	35,345 (54.515)	2	87,225
1⅛	SA1-9H-XXKT	46,595 (71,555)	3	114,490
1¼	SA1-10H-XXKT	57,525 (87,425)	3	145,365

For specifying a Shallow Podium Anchor solution, go to strongtie/srs and follow the below:

1. The designer should determine:
   a. Uplift demand loads from the light frame superstructure
   b. Project concrete strength
   c. Slab thickness
   d. Anticipated anchor diameter and strength
   e. Anchor load locations shown on a key plan
   f. Is it wind or seismic restraint?
2. Select the calculation that matches the variables that have been established in Step 1
   a. On the strongtie/srs, ATS Shallow Podium Anchor landing page, scroll to "Anchorage Calculations"
   b. Choose either Seismic or Wind Calculations
   c. Based on the designer variables noted in Step 1, choose the appropriate calculation
   d. Print the pdf of the calculation for your use
3. Select the Proper Anchor Solution
   a. On the strongtie/srs, ATS Shallow Podium Anchor landing page, scroll to the "Design Tables"
   b. Based on Wind or Seismic and concrete thickness, choose the necessary design table
   c. Select the table that resembles the design condition (i.e., midslab, near edge or 13" near edge)
4. For Seismic Designs
   a. Within the Design Tables, the ductile anchor steel element must govern the design, so base solutions on anchor diameter and strength, then match the project anchor diameter to the proper detail under the load table column "DETAIL ON SHEET SA1"
   b. Go to detail sheet SA1 and find the proper anchor reinforcement detail as called out in the table
5. For Wind Designs
   a. Match the project demand loads with the tabulated Anchor Tension Capacity to select the appropriate Shallow Podium Anchor callout, then choose the proper detail under the load table column "DETAIL ON SHEET SA1"
6. Details on Sheet SA1
   a. Download the details to then include in the construction documents
   b. Coordinate then specify the Shallow Podium Anchor callout on the construction documents

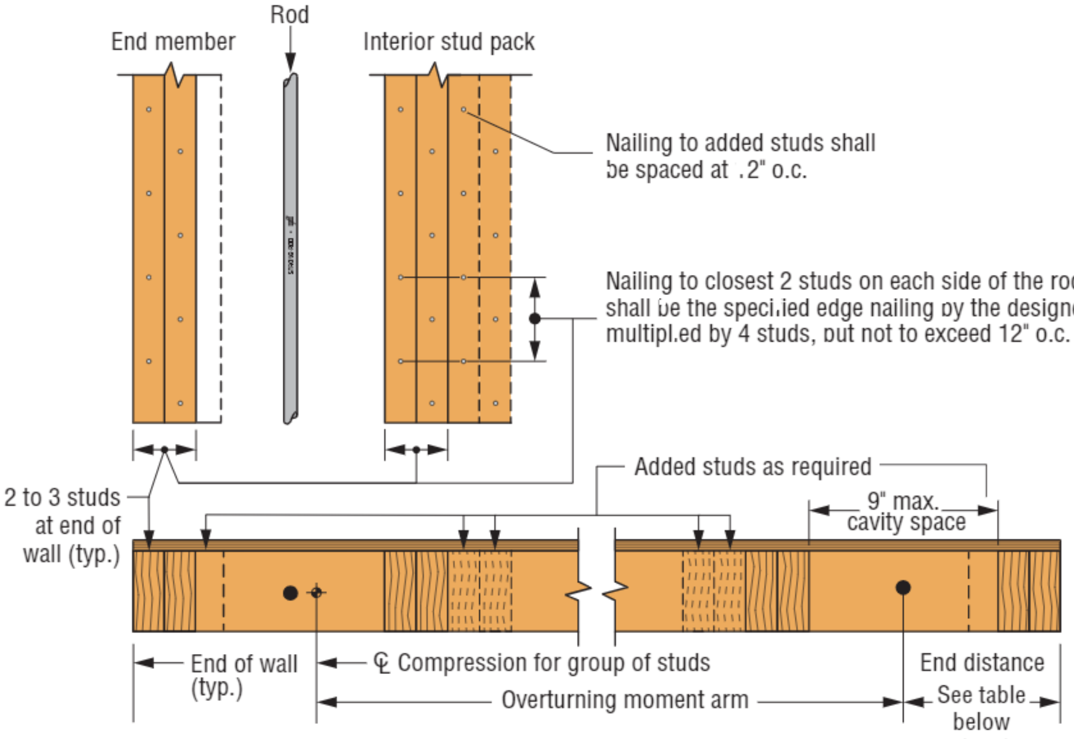
F Compression Posts

Compression posts play an integral role in designing a Strong-Rod Anchor Tiedown System for shearwall overturning restraint. As tension loads are resisted by the ATS steel rods, adequate compression elements are crucial in the opposite end of the shearwall. Compression posts are either single members or multiple members.

A designer may use either a symmetrical or an asymmetrical post configuration. Simpson Strong-Tie offers guidance by providing standard tables for compression elements. See **strongtie.com/srs** for more information.

Asymmetrical Posts

This arrangement means that a maximum of three built-up studs at the end of the wall and multiple number of studs at the opposite side of the Strong-Rod. This provides uniform anchor placement and consistent end-of-wall placement location at upper floor levels.



Anchor End Distance

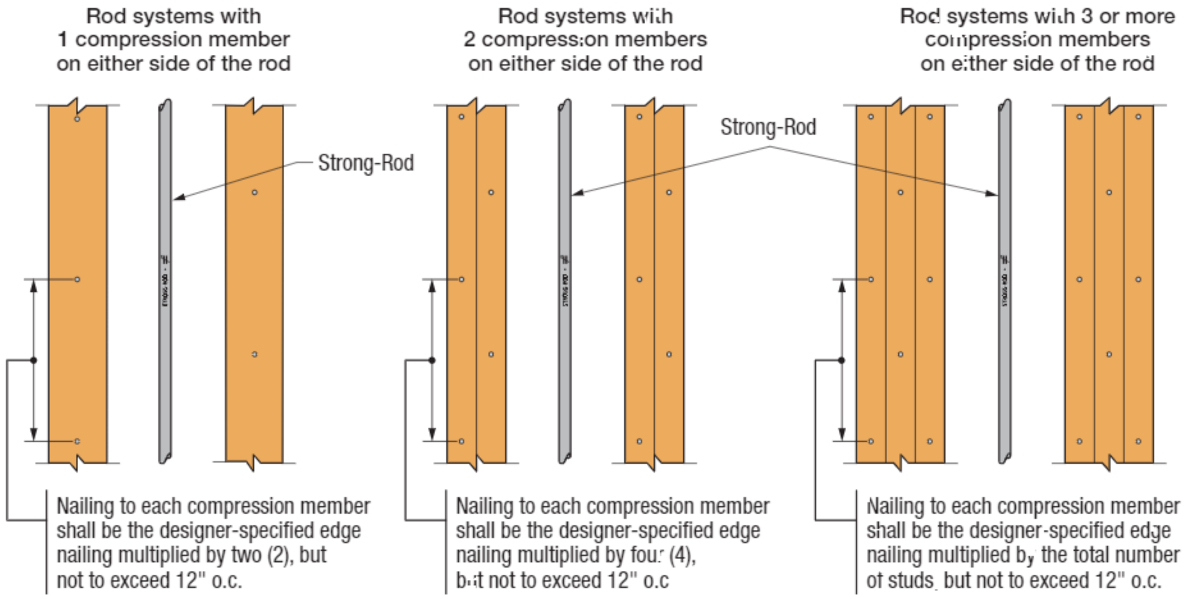
Cavity Space (in.)	End Distance (in.)			
	(2) 2x End Member	(3) 2x End Member	4x End Member	6x End Member
6	6	7.5	6.5	8.5
9	7.5	9	8	10

Nailing Example: (4) total closest compression members adjacent to rod: 2" o.c. edge nailing x 4 = 8" o.c. nailing to two closest studs, each side of rod.

F Compression Posts (cont.)

Symmetrical Posts

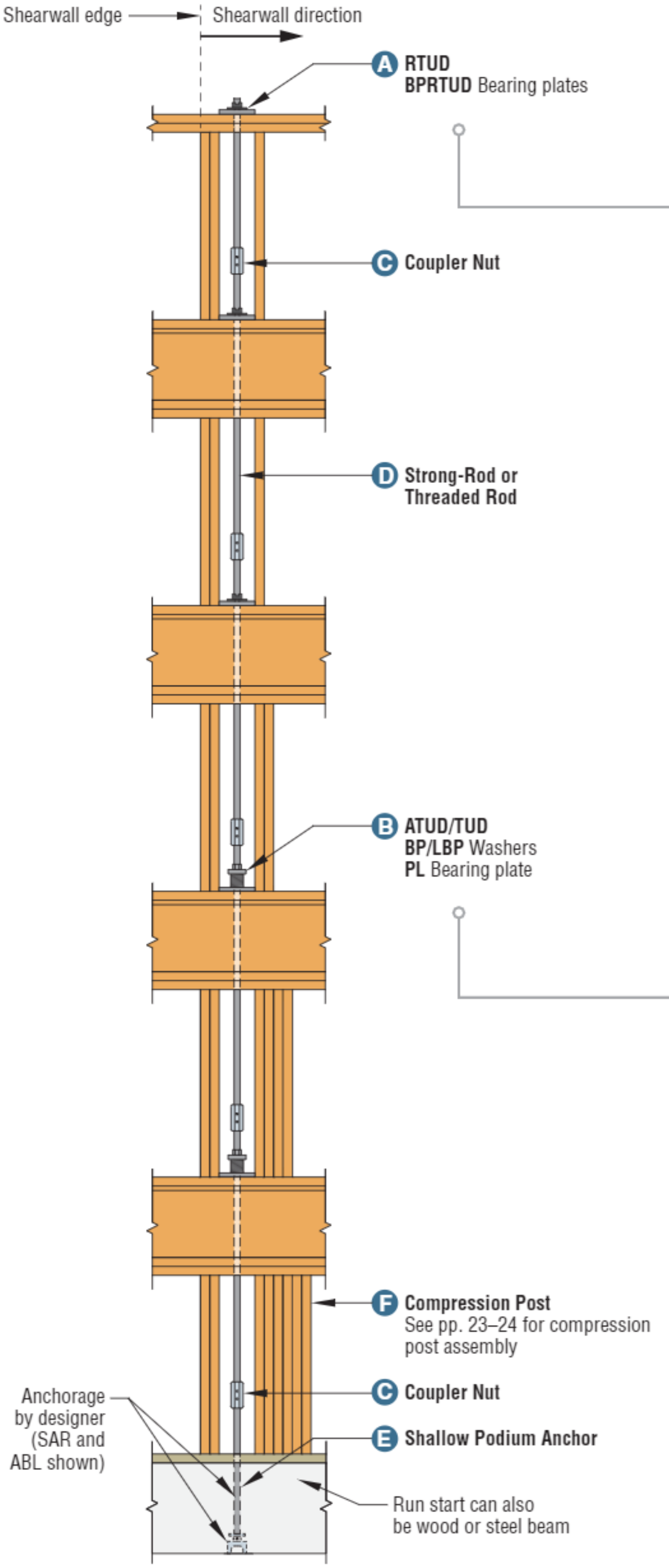
An equal number of posts or studs on each side of the Strong-Rod. End of the shearwall requires extra framing to maintain edge-of-wall line.

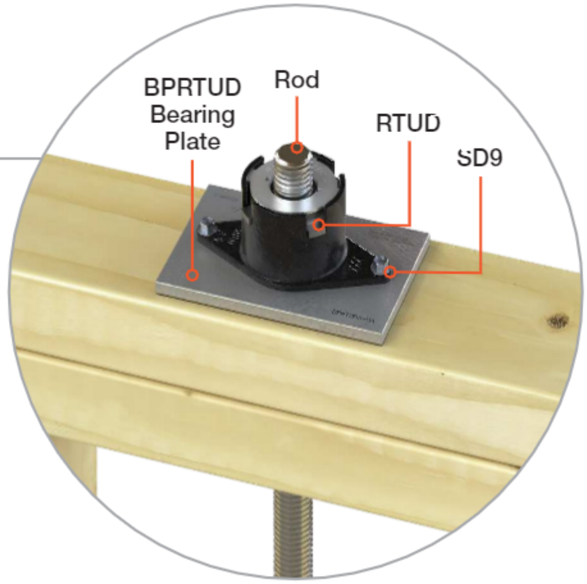


Nailing Example: (4) total compression members: 2" o.c. edge nailing x 4 = 8" o.c. nailing at each compression member.

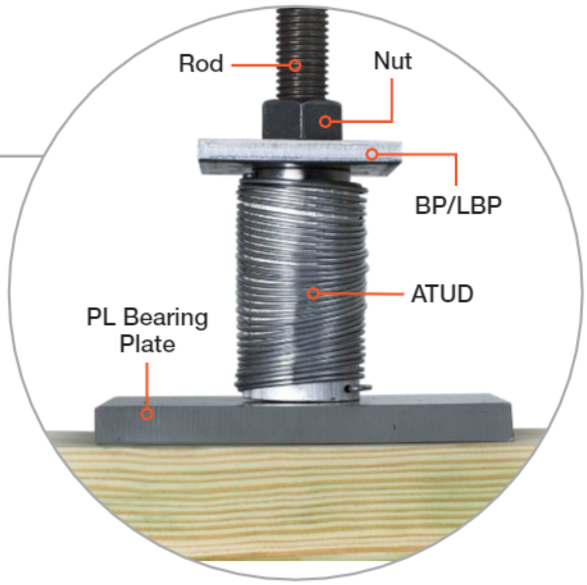
From the Roof to the Foundation Anchorage

Components for Anchor Tiedown System for Shearwall Overturning Restraint





Ratcheting Take-Up Device Assembly



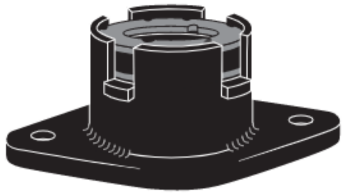
Take-Up Device Assembly

Note: For Asymmetrical Post layout, third stud may be required at shearwall edge.

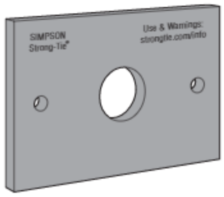
SIMPSON Strong-Tie

A RTUD Ratcheting Take-Up Device

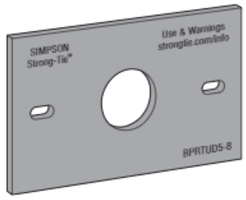
The RTUD ratcheting take-up device is a cost-effective shrinkage compensating solution for continuous rod systems. The RTUD is code-listed to use with rod systems to ensure highly reliable performance in a device that allows for unlimited shrinkage. The RTUD should be hand installed by pushing down on the device until its base firmly bears on top of the BPRTUD bearing plate — a zipper sound can be heard as it is installed. Once the RTUD is flush with the bearing plate, align the fastener holes of the device with the holes of the bearing plate, and then install the Strong-Drive fasteners through the RTUD fastener holes. After installed, a series of internal threaded wedges enable the device to ratchet down the rod as the wood structure shrinks, but engage the rod in the reverse direction under tensile loading. Engagement is maintained on the rod by the take-up device, enabling the rod system to perform as designed from the time of installation. See installation animations for further description at **strongtie.com/srs**.



RTUD
US Patents 8,881,478 and 9,394,706



BPRTUD Bearing Plate



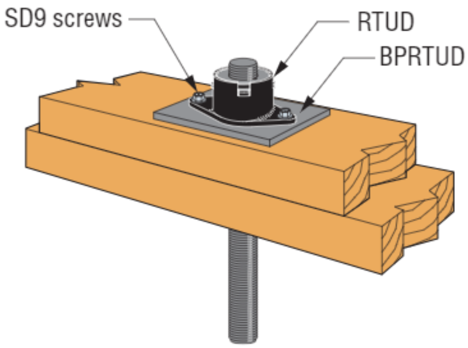
BPRTUD5-8 Bearing Plate

RTUD Models

Model No.	Threaded Rod Diameter (in.)	Dimensions (in.)			Allowable Load (lb.)	Seating Increment, Δ_R (in.)	Deflection at Allowable Load, Δ_A (in.)	Average Ratcheting Force (lb.)	Compatible Bearing Plates
		Length	Width	Height					
RTUD3B	⅜	2¾	1½	1	5,180	0.044	0.010	20	BPRTUD3-4B
RTUD4B	½	2¾	1½	1	9,210	0.045	0.003	20	BPRTUD3-4B
RTUD5	⅝	3⅞	2	1⅜	14,495	0.056	0.007	20	BPRTUD5-6, 5-8
RTUD6	¾	3⅞	2	1⅜	20,830	0.057	0.010	15	BPRTUD5-6, 5-8
NEW RTUD7	⅞	4½	2¼	2	28,185	0.059	0.012	30	BPRTUD7-8, 5-8
NEW RTUD8	1	4½	2¼	2	36,815	0.066	0.031	30	BPRTUD7-8, 5-8

1. Allowable loads for the RTUD only. The attached components must be designed to resist design loads in accordance with the applicable code.
2. Thread specification for threaded rod used with the RTUD must be UNC Class 2A, in accordance with ANSE/ASME B1.1, unless where ASTM A307 Grade A threaded rod is specified, then UNC Class 1A thread may be accepted per ASME B18.
3. No further increase in allowable load is permitted.
4. The RTUD compensates for an unlimited amount of wood shrinkage, provided there are no obstructions to the travel of the RTUD along the length of the threaded rod.
5. The RTUD fastens to the wood plate with the BPRTUD bearing plate and (2) #9 x 2½" Strong-Drive SD Connector screws.
6. The specified minimum tensile strength, F_u, of the threaded rod must not exceed 125 ksi.

*Refer to BPRTUD table below.



Ratcheting Take-Up Device Assembly Installation

BPRTUD Models

Model No.	Length (in.)	Width (in.)	Thickness	Hole Diameter (in.)	Allowable Loads (lb.)			
					DF	SP	HF	SPF
BPRTUD3-4B	3½	3	3 ga.	⅝	5,415	5,975	4,475	4,700
BPRTUD5-6B	5½	3	½ in.	[illegible]	10,295	9,305	6,670	7,[illegible]
BPRTUD5-6C	7½	3	¾ in.	1	13,335	12,100	8,675	9,105
NEW BPRTUD5-8	5	3	3 ga.	1 3/16	7,195	6,675	5,245	5,430
NEW BPRTUD7-8A	5½	3	½ in.	1 3/16	10,055	9,0[illegible]0	6,515	6,835
NEW BPRTUD7-8B	8½	3	¾ in.	1 3/16	14,990	13,595	9,745	10,225
NEW BPRTUD7-8C	5½	5	½ in.	1 3/16	17,400	15,730	11,275	11,830

1. No further increase in allowable load permitted.
2. Plate bearing area based on rod diameter plus ¼" drilled hole through wood plate below steel bearing plate. Reduce allowable load per code for larger holes.
3. Recommend drilled holes through sole plates and flooring systems be completed as one continuous drill to help prevent misalignment of holes that can be created when drilled by different trades at different stages of construction.
4. Bearing plate load capacity is based on the steel plate bearing on the wood sole plate perpendicular to the grain and steel plate bending in cantilever action.

Naming Legend

RTUD5

Type of Take-Up Device — RTUD

Rod Diameter in ⅛" Increments (Ex: 5 = ⅝")

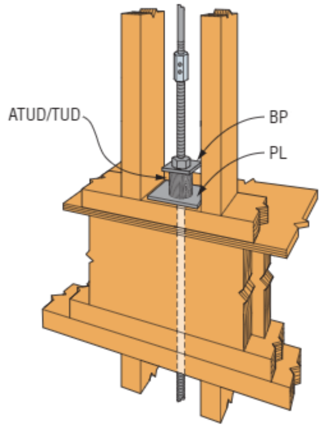
B ATUD/TUD Take-Up Device

ATUD9

TUD10

The ATUD and TUD expanding take-up devices are suitable for rod diameters from ½" up to 1¾" and shrinkage up to 3". Expanding screw-style take-up devices provide the lowest device displacements. For installation, the PL bearing plate resting on the wood sole plate should first be placed over the threaded rod. Next, the ATUD/TUD should be installed such that it bears on the PL plate, ensuring that the activation pin is pointing up and facing toward the inside of the building space. A BP bearing plate is then slid over the threaded rod to bear on top of the device and finally a nut is threaded onto the rod to be finger tightened in contact with the top BP bearing plate. The pin can be pulled any time after the nut has been tightened and must be pulled by the time the building is fully loaded. Shrinkwrap should remain on the device until the pin is ready to be pulled and devices on lower floors should be activated first in a sequence that would begin with the first elevated floor ascending up to the uppermost floor. Note that the device will be ineffective if the pin has not been pulled. See installation animations for further description at **strongtie.com/srs**.

Additionally, the project-specific effects of wood shrinkage should be considered to assure that the device rated compensation capacity has been properly accounted for. See p. 6, note 5 for more information.



Typical Take-Up Device Assembly Installation

ATUD/TUD Models

Model No.	Compatible Threaded Rod Dia. (in.)	Dimensions Width	Dimensions Length	Rated Compensation Capacity, (in.)	Allowable Load (lb.)[1,2]	Seating Increment, Δ_R (in.)[3]	Deflection at Allowable Load, Δ_A (in.)[3]	Bearing Plate Below ATUD/TUD
TUD10	¾ to 1¼	2⅜	2¼	1	45,400	0.001	0.033	PL10
ATUD6-2	½ to ¾	1¾	3⅛	2	11,430	0.004	0.022	PL6
ATUD9	¾ to 1⅛	2⅛	2¼	1	15,560	0.002	0.013	PL9
ATUD9-2	¾ to 1⅛	2[illegible]	3⅞	2	12,790	0.002	0.037	PL9
ATUD9-3	¾ to 1⅛	2[illegible]	5	3	11,830	0.002	0.034	PL9
ATUD14	1 to 1¾	2⅞	2¼	¾	24,395	0.005	0.015	PL14
ATUD14-1	1¼ to 1¾	3¼	2⅞	1	36,665	0.005	0.039	PL16, PL14
NEW ATUD14-2	1 to 1¾	3	3⅞	2	28,310	0.002	0.013	PL14
NEW ATUD16-1.5	1½ to 2	3⅜	3¾	1½	35,425	0.006	0.024	PL16

1. Allowable compression capacities are for TUD or ATUD only and are based on ICC-ES ESR-2320.
2. No further increase in allowable load is permitted.
3. Total device deflection = $\Delta_T = \Delta_R + \Delta_A(P_D/P_A)$, where P_D = Demand Load; P_A = Allowable Load.
4. For cases where the ATUD14-1 bears on a PL16, the smallest diameter threaded rod that should be used with this device is a 1¼". If bearing on a PL14, use the ATUD14-2 compatibility.

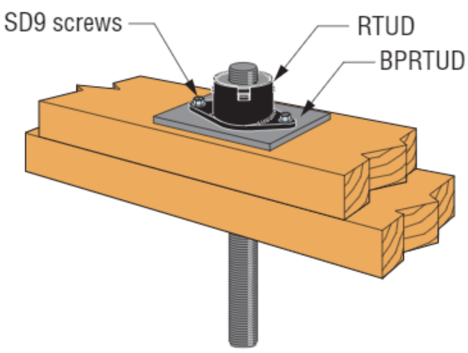
Bearing Plate Models

Model No.	Dimensions (in.) Width	Length	Thickness	Hole Dia.	Allowable Load (lb.) DF	SP	HF	SPF
PL6-3x3.5	3	3½	⅜	13/16	6,720	6,075	4,355	4,570
PL6-3x5.5	3	5½	½	13/16	10,275	9,485	6,800	7,135
PL9-3x5.5	3	5½	½	1 3/16	10,025	9,060	6,495	6,815
PL9-3x8.5	3	8½	⅞	1 3/16	15,010	13,570	9,725	10,205
PL14-3x8.5	3	8½	⅞	1 13/16	13,975	12,635	9,055	9,500
PL9-3x12	3	12	1¼	1 3/16	21,570	19,500	13,980	14,670
PL14-3x12	3	12	1¼	1 13/16	20,535	18,565	13,310	13,965
PL9-3x15	3	15	1½	1 3/16	25,690	24,315	17,625	18,495
PL10-3x15	3	15	1½	1 [illegible]/16	25,985	24,425	17,510	18,375
PL14-3x15	3	15	1½	1 13/16	26,060	23,650	16,955	17,790
PL9-5x5.5	5	5½	½	1 3/16	17,370	15,700	11,255	11,810
PL14-5x5.5	5	5½	½	1 13/16	16,260	14,700	10,540	11,060
PL9-5x8.5	5	8½	⅞	1 3/16	25,635	23,175	16,610	17,430
PL14-5x8.5	5	8½	⅞	1 13/16	24,600	22,240	15,940	16,725
PL9-5x12	5	12	1¼	1 3/16	36,570	33,060	23,700	24,870
PL10-5x12	5	12	1¼	1 5/16	36,395	32,900	23,585	24,750
NEW PL16-5x8.5	5	8½	¾	2 1/16	24,075	21,765	15,600	16,375
NEW PL16-5x12	5	12	1¼	2 1/16	35,015	31,655	22,690	23,810
NEW PL16-7x8.5	7	8½	¾	2 1/16	34,700	31,370	22,485	23,600

1. Secure PL bearing plates to framing with washer and ATS-N nut over ATUD or TUD.
2. Plate bearing area based on rod diameter plus ¼" drilled hole through wood plate below steel bearing plate. Reduce allowable load per code for larger holes.
3. Bearing plate load capacity is based on the steel plate bearing on the wood sole plate perpendicular to the grain and steel plate bending in cantilever action.

RTUD and ATUD Now UL Listed As a Through-Penetration Firestop System

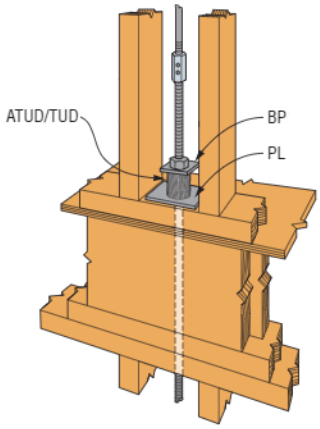
The Simpson Strong-Tie® take-up devices (RTUD and ATUD) are now rated as UL-qualified through-penetration firestop systems. The devices received F (flame) and T (temperature) ratings per ASTM E814 when they are installed in conjunction with the Simpson Strong-Tie BPRTUD steel bearing plate (RTUD) or the PL steel bearing plate with top plate and nut (ATUD and TUD), eliminating the need for additional fire resistance material at the hole in the plate.



Ratcheting Take-Up Device Assembly Installation

Use Description

- The Simpson Strong-Tie continuous rod system consists of RTUD and TUD/ATUD take-up devices and bearing plates that provide a full-building-height shrinkage-compensating and tension-force-resisting system.
- To make the system continuous, holes must be drilled through the wall plates and floor sheathing. Reference BPRTUD and PL bearing plate footnotes pp. 26 and 27 for detailed installation instructions.
- These penetrations, if not properly sealed, can be propagation points for flame and smoke during a fire.
- Many building jurisdictions require the application of UL-listed fire caulking to be applied to the penetrations, particularly at locations where rods pass through sill plates and double top plates.
- The new UL rating for the Simpson Strong-Tie continuous rod system provides a tested substitute at these floor penetrations, and when the devices are installed per manufacturers' specifications, they will attain the F and T ratings shown in the table below.



Expanding Take-Up Device Assembly Installation

NEW Fire Rating

Product	F-Rating[1]	T-Rating[1]	L-Rating[1]	Testing Standard
RTUD3B	2-hour	1¾-hour	Less Than 1 CFM/sq. ft.	ASTM E814
RTUD4B				
RTUD5				
RTUD6				
RTUD7				
RTUD8				
TUD10		2-hour		
ATUD6-2				
ATUD9				
ATUD9-2				
ATUD9-3				
ATUD14				
ATUD14-1				
ATUD14-2				

1. The F-rating criteria prohibits flame passage through the system and requires acceptable hose-stream test performance.
2. The T-rating criteria prohibits flame passage through the system and requires the maximum temperature rise on the unexposed surface of the wall or floor assembly, on the penetrating item and on the fill material not to exceed 325°F above ambient, and requires acceptable hose-stream test performance.
3. The L-rating criteria determines the amount of air leakage in cubic feet per minute per square foot of opening (CFM/sq.ft.) or in cubic feet per minute per unit (CFM/unit) for fixed-size opening units, through the firestop system at ambient and /or 400°F air temperatures at an air-pressure differential of 0.011 psi. L-rating listed is for both ambient temperature and at 400°F.

Strong-Rod® ATS Components

C UL US CLASSIFIED
FIRESTOP DEVICE
FOR USE IN THROUGH-PENETRATION
FIRESTOP SYSTEMS
SEE UL FIRE RESISTANCE DIRECTORY
R40313

Application

- RTUDs are to be installed with the Simpson Strong-Tie bearing plate and fastened to the wood plate with Strong-Drive® SD Connector screws
- TUD/ATUD are to be installed with the appropriate Simpson Strong-Tie bearing plate and secured in place with a heavy hex nut
- No further application of fire caulking or additional procedures needed when drilled through hole is no greater than rod diameter plus ¼"
- The F rating of the firestop system provided by the take-up device assembly is equal to the hourly fire rating of the floor-ceiling assembly in which it is installed

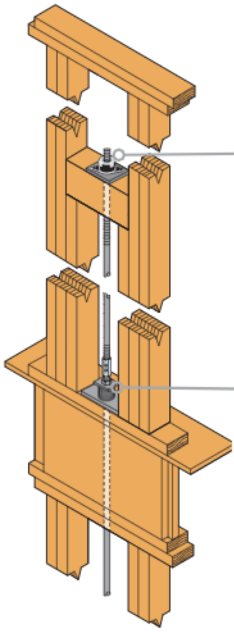
Advantages of the System

- The take-up device assembly with bearing plates provides UL-listed fire protection for F and T ratings without the need to install costly and time-consuming fire caulking after installation of the take-up device
- The assembly eliminates concerns about traditional fire caulk adhering to the rods and affecting the mechanics of the device, which could restrict rod travel and device functionality
- The assembly has been tested to the same ASTM and UL standards as typical building fire caulk and attains an equivalent fire rating

Description of UL Fire Testing

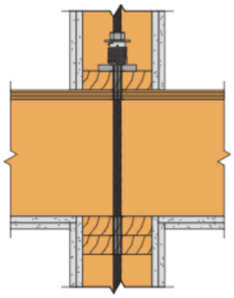
- Agencies such as the Underwriters Laboratories (UL) define tests and standards to determine an hour rating for how long a building system can adequately resist flame propagation and smoke generation, as well as resist providing additional fuel for combustion.
- **Floor-Ceiling Assembly:** The one-hour and two-hour assemblies were constructed in a manner and with materials specified in the UL Fire Resistance Directories.
- **Flooring System:** Lumber or plywood subfloor with finish floor of lumber, plywood or floor-topping mixture as specified in the individual floor-ceiling design.
- **Wood Joists:** The tested assembly for two-hour fire-rated floor-ceiling assemblies is equivalent to a system with nominal 2x10 lumber joists spaced at 16" o.c. with nominal 1x3 lumber bridging and with ends fireblocked.
- **Gypsum Board:** Nominal 4' wide by ⅝" thick as specified in the individual floor-ceiling design. Gypsum board secured to wood joists as specified in the individual floor-ceiling design.

RTUD Installation

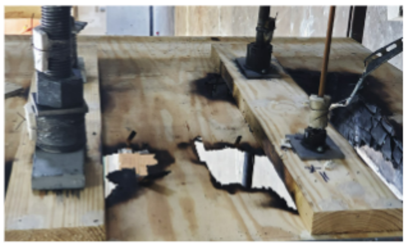


ATUD Installation

Assemblies During Fire Testing



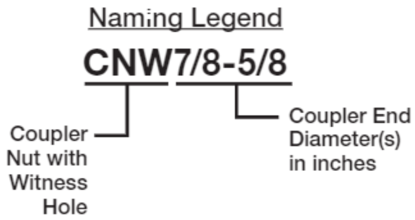
Take-Up Device Through Flooring

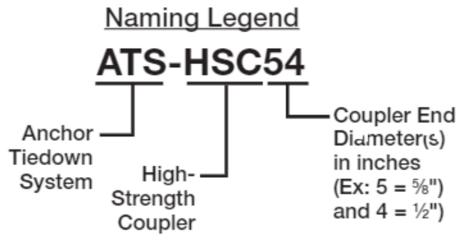


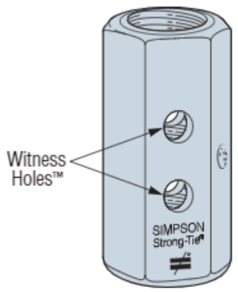
Assemblies After Fire Test

C Coupler Nuts

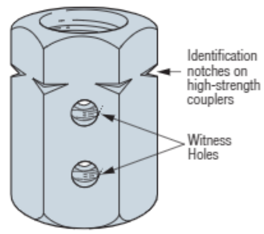
CNW and ATS-C coupler nuts are used to connect one threaded rod to another and connect to anchor bolts within the Strong-Rod Anchor Tiedown System for shearwall overturning restraint. CNWs and ATS-C coupler nuts exceed the tensile capacity of the corresponding standard-strength threaded rod. ATS-HSC coupler nuts exceed the tension capacity of the corresponding high-strength threaded rod. All coupler nuts exceed 100% of the tensile capacity and 125% of the yield capacity of the corresponding standard-strength threaded rod. All coupler nuts are lot tested to ensure quality.



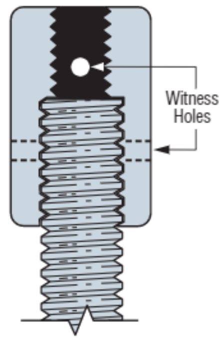




CNW or ATS-C



High-Strength Coupler ATS-HSC or ATS-HSSC



Transition Coupler Nut

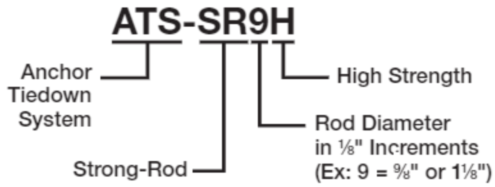
Coupler Nuts

Rod Dia. (in.)	⅜	½	⅝	¾	⅞	1	1⅛	1¼	1⅜	1½	1¾	2
⅜	CNW⅜	—	—	—	—	—	—	—	—	—	—	—
½	—	CNW½	ATS-HSC54	ATS-HSC64	ATS-HSC74	ATS-HSC84	ATS-HSC94	ATS-HSC104	ATS-HSC114	ATS-HSC124	ATS-HSC144	ATS-HSC164
⅝	—	CNW⅝–½	CNW⅝ ATS-HSC55	ATS-HSC65	ATS-HSC75	ATS-HSC85	ATS-HSC95	ATS-HSC105	ATS-HSC115	ATS-HSC125	ATS-HSC145	ATS-HSC165
¾	—	ATS-C64	CNW¾–⅝	CNW¾ HSCNW¾	ATS-HSC76	ATS-HSC86	ATS-HSC96	ATS-HSC106	ATS-HSC116	ATS-HSC126	ATS-HSC126	ATS-HSC166
⅞	—	ATS-C74	CNW⅞–⅝	ATS-C76	CNW⅞ ATS-HSC77	ATS-HSC87	ATS-HSC97	ATS-HSC107	ATS-HSC117	ATS-HSC127	ATS-HSC147	ATS-HSC167
1	—	ATS-C84	ATS-C85	ATS-C86	CNW1-⅞	CNW1 HSCNW1	ATS-HSC98	ATS-HSC108	ATS-HSC118	ATS-HSC128	ATS-HSC148	ATS-HSC168
1⅛	—	ATS-C94	ATS-C95	ATS-C96	ATS-C97	ATS-C98	ATS-C99 ATS-HSC99	ATS-HSC109	ATS-HSC119	ATS-HSC129	ATS-HSC149	ATS-HSC169
1¼	—	ATS-C104	ATS-C105	ATS-C106	ATS-C107	ATS-C108	ATS-C109	CNW1¼ ATS-HSC1010	ATS-HSC1110	ATS-HSC1210	ATS-HSC1410	ATS-HSC1610
1⅜	—	ATS-C114	ATS-C115	ATS-C116	ATS-C117	ATS-C118	ATS-C119	ATS-C1110	ATS-C1111 ATS-HSC1111	ATS-HSC1211	ATS-HSC1411	ATS-HSC1611
1½	—	—	—	—	—	—	—	—	—	ATS-HSC1212	ATS-HSC1412	ATS-HSC1612
1¾	—	—	—	—	—	—	—	—	—	—	ATS-HSC1414	ATS-HSC1614
2	—	—	—	—	—	—	—	—	—	—	—	ATS-HSC1616

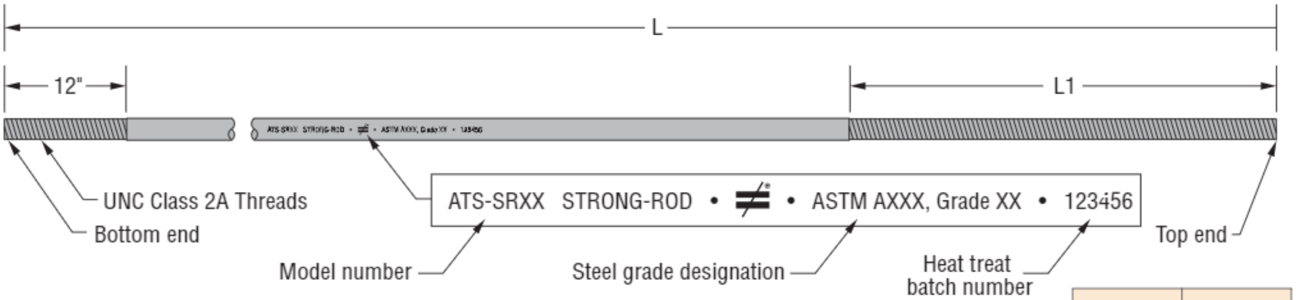
1. All ATS couplers available with one side with over-sized threads for use with HDG rod, ATS-Cxx-OST, ATS-HSCxx-OST, ATS-HSSCxx-OST.
2. All CNW and HSCNW couplers are zinc plated.
3. Couplers in the 1¾" and 2" series may be cylindrical.
4. ATS-HSC couplers are used for both standard-strength and high-strength rods in 1½", 1¾" and 2" diameters.

D Steel Strong-Rod

Naming Legend



Strong-Rod threaded rods are the tension transfer element with the Anchor Tiedown System for shearwall overturning restraint. Strong-Rod threaded rods are threaded on both ends, with the top end having 12" or 48" of thread to allow for the distance that the rod sticks through the device, which can vary. Information clearly etched on the shank allows easy identification in the field. When placing the rod, the most commonly used procedure involves dropping in (or pushing up) the rod through the drilled holes in the flooring system after framing has been completed. Drilled holes through the sill plate and flooring system should be completed with one continuous drilling action. See installation animations for further description at **strongtie.com/srs**.



Strong-Rod

L (ft.)	L1 (ft.)
3 to 5	1
6 to 12	4

High-Strength, Strong-Rod Product Data

Allowable Tension Capacity for ATS Strong-Rod				
Rod Model No.	Rod Diameter (in.)	Material		Allowable Tension Capacity (lb.)[2]
		F_y (ksi)	F_u (ksi)	
ATS-SR5H	⅝	92	120	13,805
ATS-SR6H	¾	92	120	19,880
ATS-SR7H	⅞	92	120	27,060
ATS-SR8H	1	92	120	35,345
ATS-SR9H	1⅛	92	120	44,730
ATS-SR10H	1¼	92	120	55,225

1. Allowable tension capacities are based on AISC 360-16.
2. No further increase in allowable load is permitted.
3. For standard strength ATS-SRx product information, see Canadian Guide C-L-SRSCAN18. For ASD load values, refer to ATR-X for equivalent Allowable Tension Capacities.
4. Note that rod strength and allowable tension capacity, if using Steel Strong-Rods (ATS-SRxH) for 1⅛" and 1¼" rod diameters, are associated with 120 ksi rod steel. When ATS-SRxH and ATS-HSRx are used in the same ATS run or calculation set between restraints, the 120 ksi ATS-SRxH will govern.

Super High-Strength, Strong-Rod Product Data

Allowable Tension Capacity for ATS Strong-Rod				
Rod Model No.	Rod Diameter (in.)	Material		Allowable Tension Capacity (lb.)
		F_y (ksi)	F_u (ksi)	
ATS-SR9H150	1⅛	130	150	55,915
ATS-SR10H150	1¼	130	150	69,030

1. Allowable tension capacities are based on AISC 360-16.
2. No further increase in allowable load is permitted.

D Steel Threaded Rod

Fully threaded rods (all-thread rod) are also available in standard-strength, high-strength rod material in diameters up to 2". When placing the rod, the most commonly used procedure involves dropping in (or pushing up) the rod through the drilled holes in the flooring system after framing has been completed. Drilled holes through the sill plate and flooring system should be completed with one continuous drilling action. See installation animations for further description at **strongtie.com/srs.**

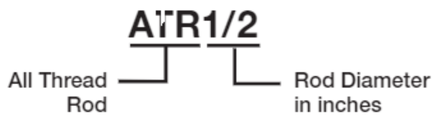
Fully Threaded Rod

Standard-Strength, Fully Threaded Rod

Model No.	Rod Diameter (in.)	Allowable Tension Capacity (lb.) [2]	F_y (ksi)	F_u (ksi)
ATR3/8	⅜	2,400	36	58
ATR1/2	½	4,270	36	58
ATR5/8	⅝	6,675	36	58
ATR3/4	¾	9,610	36	58
ATR7/8	⅞	13,080	36	58
ATR1	1	17,080	36	58
ATR1-1/8	1⅛	21,620	36	58
ATR1-1/4	1¼	26,690	36	58
ATR1-3/8	1⅜	32,295	36	58
ATR1-1/2	1½	38,435	36	58
ATR1-3/4	1¾	52,315	36	58
ATR2	2	68,330	36	58

1. Allowable tension capacities are based on AISC 360-16.
2. No further increase in allowable load is permitted.
3. In accordance with ANSI/ASME B1.1, thread specification for threaded rod must be UNC Class 2A for high-strength rod and may be either Class 2A or Class 1A for standard-strength rod.

Naming Legend

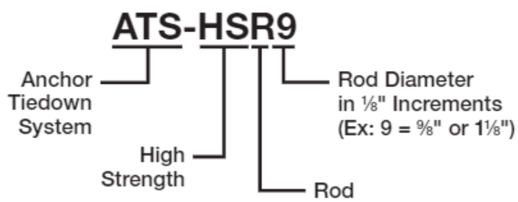


High-Strength, Fully Threaded Rod

Model No.	Rod Diameter (in.)	F_y (ksi)	F_u (ksi)	Allowable Tension Capacity (lb.)[2]
ATS-HSR5	⅝	92	120	13,805
ATS-HSR6	¾	92	120	19,880
ATS-HSR7	⅞	92	120	27,060
ATS-HSR8	1	92	120	35,345
ATS-HSR9	1⅛	105	125	46,595
ATS-HSR10	1¼	105	125	57,525
ATS-HSR11	1⅜	105	125	69,605
ATS-HSR12	1½	105	125	82,835
ATS-HSR14	1¾	105	125	112,745
ATS-HSR16	2	105	125	147,260

1. Allowable tension capacites are based on AISC 360-16.
2. No further increase in allowable load is permitted.
3. Available in one foot increments up to 12 feet.
4. Note that rod strength and allowable tension capacity, if using Steel Strong-Rods (ATS-SRxH) for 1⅛" and 1¼" rod diameters, are associated with 120 ksi rod steel. When ATS-SRxH and ATS-HSRx are used in the same ATS run or calculation set between restraints, the 120 ksi ATS-SRxH will govern.

Naming Legend



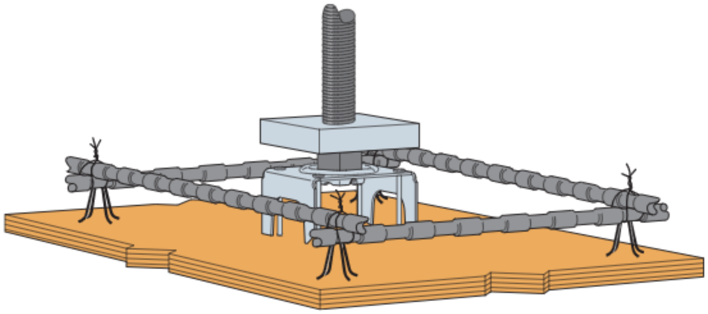
Fully Threaded Rod Material

Standard Strength Steel, ATR:
ASTM F1554 Grade 36 or
ASTM A307 Grade A; F_u = 58 ksi

High-Strength Steel, ATS-HSRx:
(up to 1" dia.) — ASTM A449; F_u = 120 ksi
(1⅛" and larger dia.) — ASTM A193 Grade B7 or F1554 Grade 105; F_u = 125 ksi

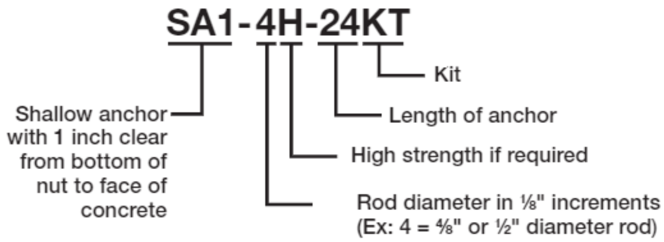
E Shallow Podium Slab Anchor Kit

The Shallow Podium Slab anchor kit includes the patented Anchor Bolt Locator (ABL) and patent-pending Shallow Anchor Rod (SAR). Uniquely suited for installation to concrete-deck forms, the ABL enables accurate and secure placement of anchor bolts. The structural heavy hex nut is attached to a pre-formed steel "chair" and becomes the bottom nut of the anchor assembly. The shallow anchor is provided with a plate washer fixed in place that attaches on the ABL nut when assembled and increases the anchor breakout and pullout capacity. The shallow anchor is easily installed before or after placement of the slab reinforcing steel or tendons. Where higher anchor capacities are needed such as at edge conditions or to meet seismic ductility requirements, the anchor kit is combined with anchor reinforcement as shown in Simpson Strong-Tie SAR drawing detail sheets.



Shallow Podium Slab Anchor Kit

Naming Legend

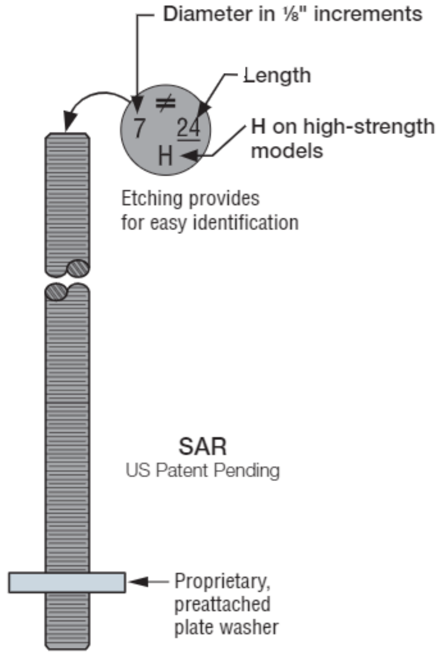


SAR Shallow Anchor Rod

SAR anchor rods are for use with the ABL anchor bolt locator. They combine to make an economical podium-deck anchorage solution. Anchorage specification is per designer.

Features:

- Proprietary and patent pending, pre-attached plate washer
- Available in standard or high strength
- Anchor rod diameters from ½" to 1¼"
- Standard lengths available 18", 24", 30" or 36"
- Specify "HDG" for hot-dip galvanized



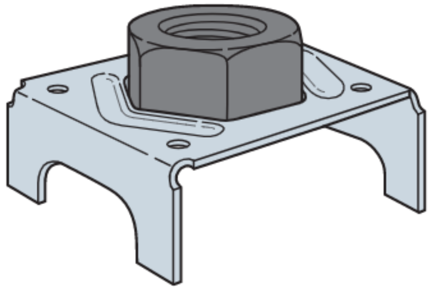
Shallow Podium Slab Anchor Kit (cont.)

ABL Anchor Bolt Locator

The ABL enables the accurate and secure placement of anchor bolts on concrete-deck forms prior to concrete placement. The structural heavy hex nut is attached to a pre-formed steel "chair," which eliminates the need for an additional nut on the bottom of the anchor bolt.

Features:

- Designed for optimum concrete flow
- Installs with (2) nails or (2) screws
- Provides 1" standoff (clear cover)
- Available for anchor rod diameter ½" to 1¼"
- For use with hot-dip galvanized anchor rods, specify "OST" for oversized threads



ABL
US Patents 8,381,482 and 8,621,816

ABL Models

Model No.	Anchor Bolt Diameter (in.)
ABL4-1	½
ABL5-1	⅝
ABL6-1	¾
ABL7-1	⅞
ABL8-1	1
ABL9-1	1⅛
ABL10-1	1¼

Rod System Design Considerations for Shearwall Overturning Restraint

When specifying Simpson Strong-Tie® Strong-Rod Anchor Tiedown System for shearwall overturning restraint, one should consider several factors to ensure that the system is configured to meet the design intent and building codes. These factors apply to each method of specification. The list on the left below delineates the general design requirements for any continuous rod tiedown system used to restrain overturning forces in stacked shearwalls. The list on the right provides a description of how our system is designed and of the services we provide in order to meet the general strength and performance requirements.

General Shearwall Overturning Restraint Rod System

Designer Responsibilities

- Calculating lateral forces in each floor and roof diaphragm (at diaphragm level) of structure
- Locating shearwalls in each level of the structure
- Calculating cumulative overturning tension and compression forces for each shearwall
- Design and specification of compression posts
- Design and specification of anchorage to foundation including anchor bolt diameter and grade of steel
- Drift Check (Seismic)

Information Required to Design Rod Tiedown System

- Building code edition
- Building jurisdiction deformation requirements, (if applicable) such as rod elongation and system deformation limits
- Cumulative overturning tension/compression forces
- Estimate of wood shrinkage per level
- Wood framing including size and species of stud, post, sill and sole plates as well as floor system type and depth
- Fire-Retardant Wood Treatment (FRT) design value adjustment factors when applicable
- Wall height (finish floor to ceiling)
- Anchor bolt size and grade at foundation
- Anchor bolt coating
- Run start above foundation such as steel or wood beam
- Run termination preference at top of run (top plate, bridge block, strap)
- Floor plan shearwall layout

Required Rod System Design Checks

- Tensile capacity of rod
- Bearing plate capacity
- Travel capacity of shrinkage take-up device
- Load capacity of shrinkage take-up device
- Rod elongation per level using net tensile area of rod
- Total system deformation per level
- Verification that rod elongation plus take-up device displacement is less than or equal to 0.2 inch or less based on jurisdictional or designer requirements. (Per ICC-ES AC316)

Anchorage Design

- Anchorage design information conforms to ACI 318-14. Designer may also consider Simpson Strong-Tie Shallow Podium Slab Anchorage. Anchorage design tools are available at **strongtie.com/software**.

Simpson Strong-Tie Strong-Rod Design Checklist

Rod Tension (Overturning) Check

- Rods at each level designed to meet the cumulative overturning tension force per level as delivered from bearing plates and transfer it to the foundation
- Standard and high-strength steel rods designed not to exceed tensile capacity as defined in AISC 360-16 specification
  a. Standard threaded rod based on 36/58 ksi (F_y/F_u)
  b. High-strength fully threaded rod for diameters up to 1" based on 92/120 ksi (F_y/F_u)
  c. High-strength fully threaded rod for diameters 1⅛" and greater based on 105/125 ksi (F_y/F_u)
  d. High-strength Strong-Rod for all diameters is based on 92/120 ksi (F_y/F_u)
  e. H150 Strong-Rod based on 130/150 ksi (F_y/F_u)
- Rod elongation limits (see below)

Bearing Plate Check

- Bearing plates designed to transfer incremental overturning force per level into the rod
- Bearing stress on wood member limited in accordance with the 2018 NDS to provide proper bearing capacity and limit wood crushing
- Bearing plate thickness is considered for bending when calculating and sizing the plate, and in some cases will govern over simplified full plate bearing on the wood member

Shrinkage Take-Up Device Check

- Shrinkage take-up device is selected to accommodate estimated wood shrinkage to eliminate gaps in the system load path. See note 5a. under *Strong-Rod Systems Assemblies,* p. 6 for lumber moisture content assumptions.
- Load capacity of the take-up device compared with incremental overturning force to ensure that load is transferred into rod

Movement/Deflection Check

- System deformation is an integral design component impacting the selection of rods, bearing plates and shrinkage take-up devices
- Rod elongation plus take-up device displacement is less than or equal to 0.2 inch per level or as further limited by the requirements of the engineer or the governing authority having jurisdiction
- Total system deformation reported for use in Δ_a term (total vertical elongation of wall anchorage system) when calculating shearwall deflection
- Both seating increment (Δ_R) and deflection at allowable load (Δ_A) are included in the overall system movement. These are listed in the evaluation report ICC-ES ESR-2320 for take-up devices, and are summarized in our job summary

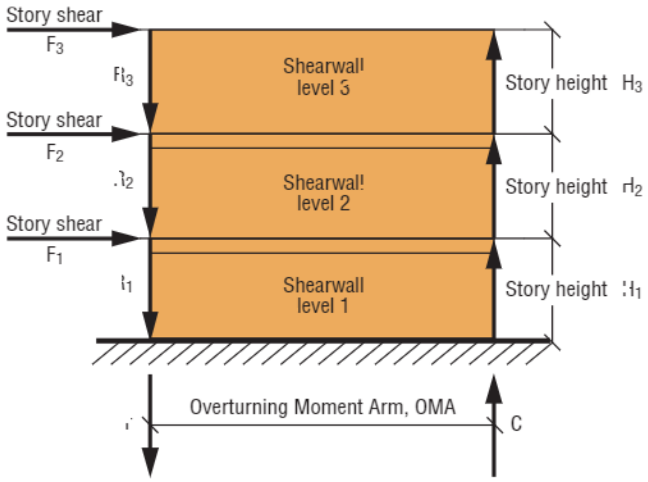
Optional Compression Post Design

- Compression post design can be performed upon request along with the Strong-Rod System
- Compression post design limited to buckling or bearing perpendicular to grain on wood plate

Anchor Tiedown System Design Example

The following design sample illustrates the steps that are used when the design professional determines lateral loads to the shearwall F_x, using proper code provisions, and then determines the resultant ASD level wall shear and overturning forces as distributed by the appropriate gravity and seismic code load combinations. These ASD loads are then provided to Simpson Strong-Tie in the form of cumulative tension (for rod design), incremental bearing (for take-up device and bearing-plate design) and cumulative compression (for when end-of-wall bearing post and stud design is requested). Simpson Strong-Tie will use this input to design the specific continuous Strong-Rod tiedown system as the tension restraint for the shearwall.

During the design process of the overall structure, the designer will have already determined the wall length, minimum wall height-to-width ratios, sheathing thickness and grade, nailing schedule, Δ_a for horizontal drift (or designer to assume $\Delta_a = 0.2$), floor-to-floor height (including floor depth to determine plate height) and all other requirements in accordance with the applicable building code.



See p. 39 for suggestions on estimating moment arm.

Figure 1

Shearwall Free Body Diagram Example

General Steps for Designing the Anchor Tiedown System

1. The designer will calculate the cumulative overturning force at each level. These forces will be used to determine the end-of-wall incremental bearing, cumulative tension and cumulative compression. As these forces will initially be at strength level, the designer must convert the loads to ASD and, for seismic, may use a 0.7 factor based on 2018 IBC load combinations.

2. Tabulate the incremental bearing, cumulative tension and cumulative compression and provide these values in the designer structural drawing set. See sample below.

Sample End-of-Wall Forces Determined by Designer

Level	ASD Incremental Bearing, B (lb.)	ASD Cumulative Tension, T (lb.)	ASD Cumulative Compression, C (lb.)	Δ_a for Horizontal Drift as Determined by Designer (in.)
3	4,000	4,000	5,000	0.20
2	7,000	11,000	13,500	0.20
1	9,000	20,000	24,000	0.20

1. Compression post design can be performed by SST upon request.
2. ASD end-of-wall values determined by designer.
3. If compression post design is performed by SST, the end-of-wall forces to be verified by designer if overturning moment arm is updated due to extent of post members.
4. Appropriate load combinations shall be considered by the designer in calculating the end of wall forces.

Anchor Tiedown System Design Example (cont.)

3. Determine the tension rod size, rod strength and rod elongation. The demand tension loads used for rod design are the ASD cumulative tension uplift loads.

   a. Rod nominal tensile capacity is based on AISC 360-16, Eq. J3-1, $R_n = R_{nAB}$

   b. Allowable capacity = R_n/Ω, where $\Omega = 2.0$

   c. For elongation, the net tensile area, A_ε, shall be used, where: $A_e = \frac{\pi}{4}\left(d_o - \frac{0.9743}{n_t}\right)^2$ and $\Delta = \frac{PL}{A_eE}$

4. The appropriate couplers should then be selected based on rod strength and diameter. These will be used to connect threaded rods to one another as well as coupling to the anchor bolts within the rod tiedown system. See Figure 2. Note that Simpson Strong-Tie® coupler nuts exceed the tensile capacity of the threaded rod.

5. Next, determine the bearing-plate sizes and capacities. These plates are designed to transfer the ASD demand incremental bearing loads from the floor below via bearing from the top plate below, then through the blocking and the sole plate and into the rod via either a nut or an attached ratcheting device. See Figure 3.

   The design is based both on:

   a. Wood bearing perpendicular to the grain of the wood sole plate, $F_{cperp} = F_{cperp} \times A_{bearing} \times C_b$. The bearing area should consider the hole diameter in the steel plate as well as the drilled hole through the wood sole plate. Simpson Strong-Tie recommends maintaining the drilled hole such that it is no more than ¼" greater in diameter than the steel rod.

   b. Steel-bearing-plate bending where the cantilever length can be taken from the face of the take-up device.

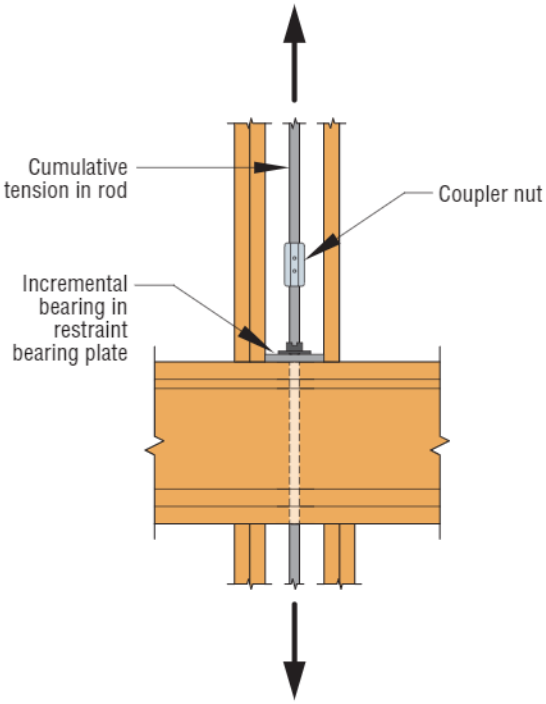


Figure 2
Rod Coupler
Detail Example

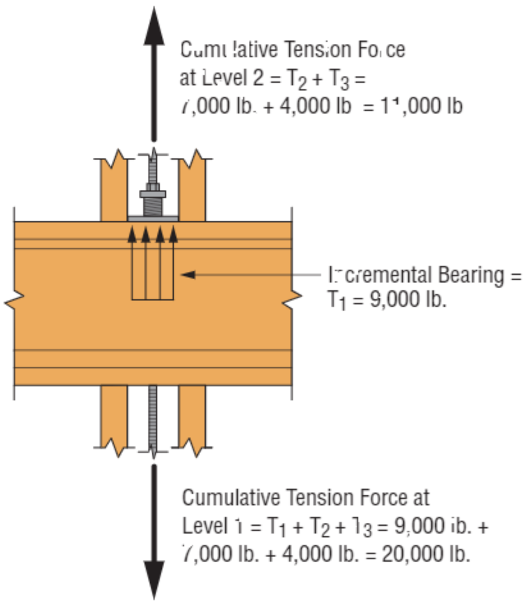


Figure 3
Bearing Plate Free
Body Diagram Sample

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Anchor Tiedown System Design Example (cont.)

6. Sole plate crushing/deformation (See Figure 4) should then be determined following the provisions of 2018 NDS Section 4.2.6. Though the standard equation of $F_{c\perp 0.02} = 0.73\ F_{c\perp}$ can be used for initially evaluating the deformation, it should be noted that the effects of wood crushing are not linear and must be evaluated based on specific loading. Refer to the NDS for the variables and conditions.

   a. Note that the initial crushing value calculated using the NDS equations will be at ASD load level and can be used for purposes of evaluating AC316 limits. For story drift per ASCE7-16, when this value is being used for wall deformation, a strength-level value would need to be computed.

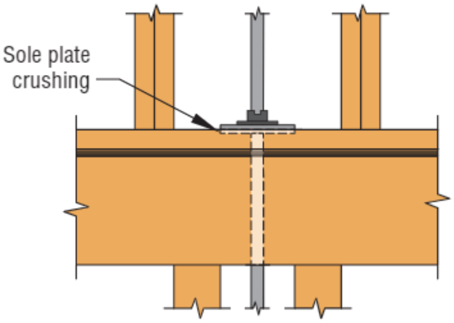

Figure 4
Sole Plate Crushing

7. Next, determine the take-up device type and size. The 2018 NDS and 2018 IBC require that consideration be given to the wood shrinkage, where the total shrinkage in wood-framed buildings can be estimated by adding up cross-grain shrinkage of the wall plates, sills and floor joists, as well as the small fraction of shrinkage that comes from the studs and posts. This calculation is important for avoiding gaps in the system as the wood shrinks while the rod doesn't. For the Simpson Strong-Tie wood shrinkage calculator, see **strongtie.com/webapps/woodshrinkage**. Also, note that shrinkage is cumulative going up the building.

   a. In order to compensate for building shrinkage and to help meet the shearwall code drift requirements, take-up devices are necessary with most wood structures greater than two stories tall. Take-up devices are either ratcheting devices that have unlimited shrinkage capacity or expanding devices that have a designated shrinkage capacity. The ASD incremental bearing load shall be used to design the strength of the device.

   b. The other variables used for selecting the take-up device are the associated rod diameter, seating increment Δ_R and deflection at the allowable load, Δ_A, where $\Delta_T = \Delta_R + \Delta_A\ (P_{-}/P_A)$.

8. Finally, a system deflection check per ICC-ES AC316, Section 6.0.

   a. This system deflection check is at ASD level, and it limits rod elongation and the shrinkage compensating device deflection to 0.20" at each level or between restraints unless the shearwall drift is determined to be within code limits. Note that while the sole plate crushing value is an option to be considered when required by the local building jurisdiction, this is not a requirement per AC316.

   b. The 0.20" vertical displacement limit may be exceeded when it can be shown that the code story drift limit is not exceeded. This check must follow the provisions of ASCE7-16, where loads and deformations are at strength level and shearwall deflection is per SDPWS, Eq. 4.3-1:

$$\delta_{SW} = \frac{8vh^3}{EAb} + \frac{vh}{1{,}000G_a} + \frac{h\Delta_a}{b}$$

9. Design of the shearwall chord boundary members, or the compression post members that are part of the shearwall associated with the continuous rod system, is an option that can be provided by Simpson Strong-Tie. These wood members are the vertical studs or posts at the end of the shearwalls that perform as the chords or boundary members of the system. The load path is such that the overturning moment is resolved into a tension/compression couple, creating equal and opposite axial tension and compression forces in each end of the wall. The designer is responsible for establishing appropriate tributaries for the dead and live loads that are resolved into the cumulative compression — as well as the proper resultant lateral load — and for then utilizing the correct code load combinations. Key aspects to the end-of-wall compression member design are:

Anchor Tiedown System Design Example (cont.)

a. Determine the proper Overturning Moment Arm (OMA). In general, this length is measured from the center line of the tension rod at one end of the wall to the center of gravity of compression end at the other end of the wall.

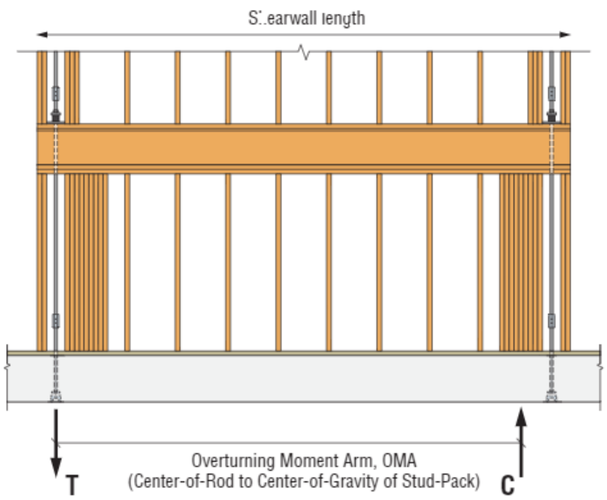

Figure 5. Overturning Moment Arm

b. Refer to 2018 NDS Supplement, Table 4A for the proper wood design variables as well as 2018 NDS Table 4.3.1 for the proper F_{cperp} perpendicular-to-wood-grain design equation. The NDS will also provide the appropriate adjustment factors to use, including the column stability factor equation, C_p, as well as the F_{cE} and C_p, C_f variables.

c. Determine the 2018 NDS Parallel-to-Grain Capacity.

d. Compute the ASD compression capacity of the end-of-wall wood members and determine the specific wood members to be called out for use in the design. See sample table below.

Sample Table for the End-of-Wall Members — Asymmetrical Layout

Level	Chord Post		l_e (in.)	C_f	C_p	Bearing Capacity (kips)	Stability Capacity (kips)	Demand (kips)	Minimum D/C Ratio
	End	Interior							
3	(1) 2x4	(1) 2x4	91.63	1.15	0.262	6.[illegible]6	6.82	5	0.73
2	(2) 2x4	(3) 2x4	91.63	1.15	0.262	16.41	17.05	13.5	0.79
1	(2) 2x4	(9) 2x4	115.63	1.15	0.169	30.09	24.24	24	0.99

e. Establish either a symmetrical compression member layout or an asymmetrical layout.

f. For the asymmetrical configuration, as a general rule when using typical platform framing, a maximum of six additional studs (or 9") may be used at the interior studs as compared to the interior stud pack above.

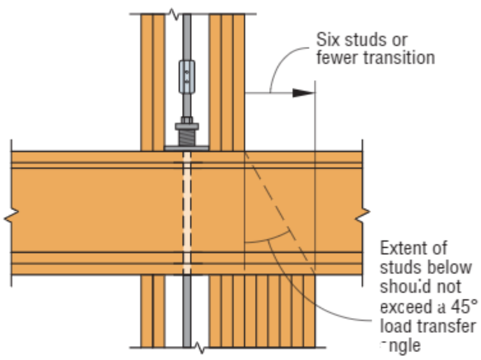

Figure 6
Compression Post Floor-to-Floor Transition

10. In summary, whenever you're designing an anchor tiedown system, it's important to understand the multiple design considerations.

  a. Know the difference between cumulative tension and incremental bearing.

  b. Estimate the vertical wood shrinkage and coordinate that with the rated travel distance of the specified take-up device.

  c. Ensure that rod elongation is being determined using net tensile area of the rod.

  d. Know the proper design checks for the steel bearing plate (bearing and bending).

  e. Understand the different take-up device options.

  f. Ensure that the system deflection is being evaluated per ICC-ES AC316 and require restraints at each floor level (don't skip floors).

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Methods of Specifying

We recognize that specifying the Simpson Strong-Tie Strong-Rod® Anchor Tiedown System (ATS) for shearwall overturning restraint is unlike choosing any other product we offer. You must first address several design questions and considerations to ensure that the system will be configured to meet the design's intent. For example, when determining whether to use Strong-Rod Systems or conventional holdowns and strapping, a designer must determine the project's incremental and cumulative loads or specification of elongation and system deflection limits. The designer will need to determine the compression posts, sheathing thickness and grade, nailing schedule, horizontal drift, and meet all other requirements in accordance with the applicable building code.

For more on these issues and many others, please visit **strongtie.com**. We currently offer the following three methods of specifying:

Your Partner During the Project Design Phase

During the designer's preparation of the construction documents, Simpson Strong-Tie can be contacted to create the most cost-effective customized runs. These runs include detailed design calculations for each shearwall overturning restraint requirement and design drawings with all the necessary details to install the ATS system. The designer or Engineer of Record will work closely with Simpson Strong-Tie Engineering Services to provide all the necessary information required to design the system.

Some of the items required by Simpson Strong-Tie to design the ATS system are:

- The design code for the project
- Sill/sole plate species and size
- System elongation limits at each level
- Type of floor system and depth
- Cumulative tension and compression loads at each level
- Wall heights
- Anchor diameter
- Type of run start and termination

Simpson Strong-Tie has provided an easy-to-use spreadsheet to assist the designer in providing all the necessary information. The spreadsheet can be downloaded at **strongtie.com/srs**. The completed spreadsheet can be emailed to *engineeringservices@strongtie.com*. The completed design calculations, drawings, notes and specifications prepared by Simpson Strong-Tie Engineering Services can then be incorporated into the design documents that the designer will be submitting to the building official.

Handling Deferred Submittals

The designer may also choose to provide general specifications and loads in the construction documents and require the contractor to submit deferred design calculations and shop drawings. The designer can download generic specifications and notes to place in the construction documents at **strongtie.com/srs**. Generic details can also be obtained to insert into the designer's construction documents

Some of the items required to be included in the designer's construction document are:

- General Notes for rod system design
- System elongation limits at each level
- Cumulative tension and compression loads at each level
- Anchor diameter
- Details of system run start and termination

Specify Run ID Callouts

An option for designers who prefer to specify their own ATS system is to specify run IDs predesigned by Simpson Strong-Tie. These run IDs can be specified in the designer's construction documents with associated details. The designer will be required to determine the overturning tension force required at each level and choose the run ID from the tables. The steps to follow as well as the tables are available on our website at **strongtie.com/srs**, based on the number of floors and the necessary capacity.

Your Partner During the Project Design Phase

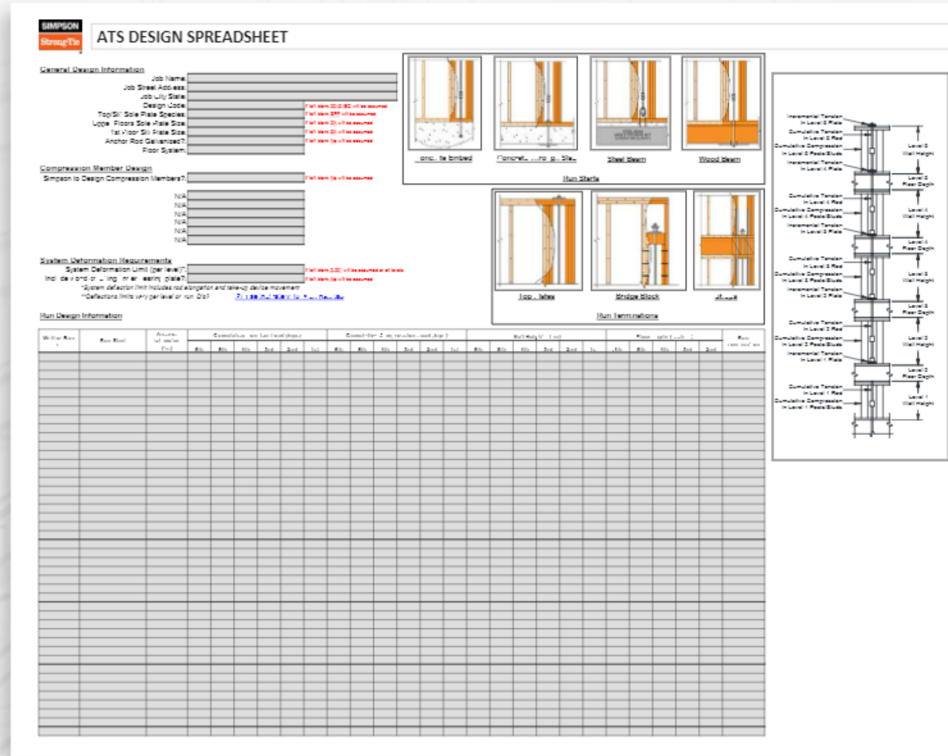
Simpson Strong-Tie offers complimentary design services to assist those specifiers considering the inclusion of the Strong-Rod Anchor Tiedown System (ATS) for shearwall overturning restraint. For years, Simpson Strong-Tie has leveraged its testing and overall industry experience to provide world-class, customized design services for designers of multi-story wood structures.

Why Use Our Engineering Design Services?

- Receive customized shearwall overturning restraint solutions
- Collaborate during the project design phase
- Receive a full set of drawings and calculations to add to your submittal
- Maintain the flexibility to provide the most cost-effective solution for your project
- Gain trusted technical expertise in critical rod tiedown system design considerations

Typical Engagement Process

1. Determine the shearwall layout and establish the shearwall overturning demand loads.
2. Visit **strongtie.com/srs** to download the ATS spreadsheet. Fill out the requested information and email it to *engineeringservices@strongtie.com*. We'll review your submittal and contact you if we have any questions. In 24–48 hours, you will receive a complete ATS design package to include with your project submittal. The package will include:
   - Calculations for each unique rod run
   - Elevation drawings for each unique run identifying each component in the rod run
   - Typical detail sheet showing installation details
   - General notes to include in the plans
   - Upon request
     - Compression post design and specification
     - For podium slab anchor reinforcement solution options, visit **strongtie.com/srs** for calculations, load tables and detail options



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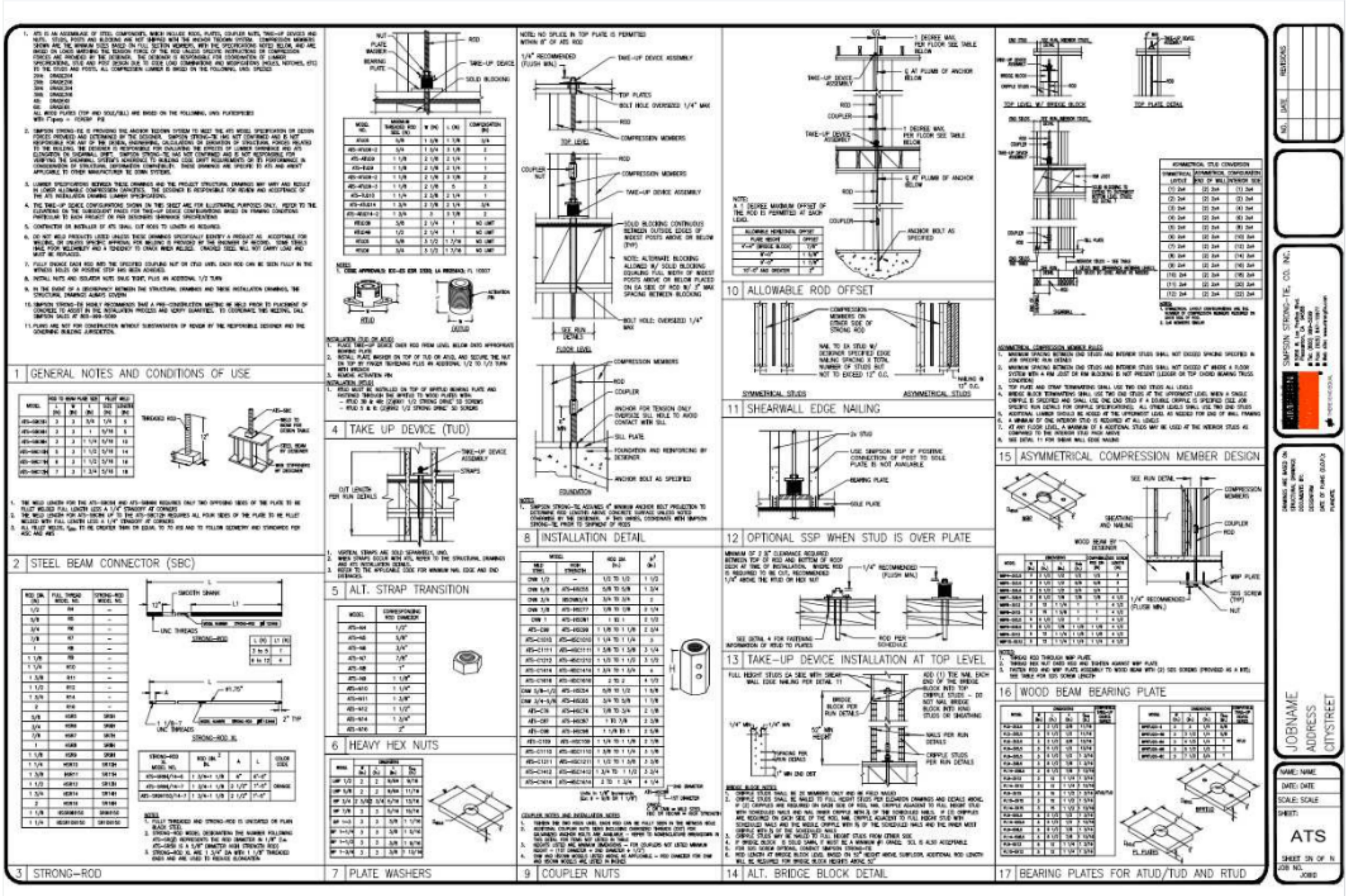
Handling Deferred Submittals

The following represents some General Notes that should be added to the construction documents in a deferred submittal. A printable PDF version of these notes can be downloaded at **strongtie.com/srs**.

General Notes for Simpson Strong-Tie® Strong-Rod Anchor Tiedown System

1. The continuous rod tiedown system for this project shall be the Simpson Strong-Tie Strong-Rod Anchor Tiedown System (ATS) for shearwall overturning restraint.
2. Simpson Strong-Tie shall provide the ATS to meet the design forces, total vertical displacement limit, and shrinkage requirements as set forth in the structural drawings. ATS calculations and installation details shall be provided to the designer or Engineer of Record for review and approval.
   a. Allowable rod capacities shall be calculated per American Institute of Steel Construction (AISC) Specification for Structural Steel Buildings.
   b. AISC 360 — 14th Edition for 2012 and 2015 International Building Code
   c. AISC 360 — 16th Edition for the 2018 International Building Code
3. Bearing plate, wood stud and fastener capacities shall be calculated per the National Design Specification (NDS) for Wood Construction.
   a. NDS — 12 for 2012 International Building Code
   b. NDS — 15 for 2015 International Building Code
   c. NDS — 18 for 2018 International Building Code
4. Shrinkage compensating devices shall be provided at each restraint location and account for the shrinkage amount at each story as set forth on the structural drawings.



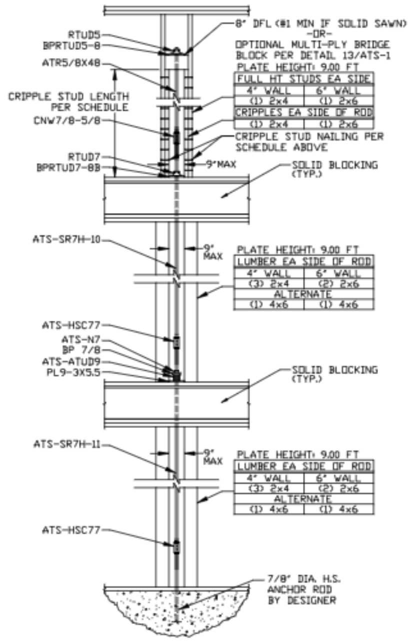
Handling Deferred Submittals (cont.)

5. The total vertical displacement between restraint locations, including steel rod elongation and shrinkage compensating device deflection, shall be less than 0.20 inches or as set forth in the structural drawings, using allowable stress design (ASD). Steel rod elongation shall be computed as the product PL/AE, where P is the axial load (lb.), L is the initial rod length between restraint locations at the story under consideration (inches), E is 29,000,000 (psi) and A is the net tensile area of the rod (in.[2]). Shrinkage compensating device deflection shall be as specified in ICC-ES ESR-2320 including $\Delta_R + \Delta_A\ (P_D/P_A)$.
6. The ATS shall be restrained by a bearing plate and take-up device assembly at each story of the multi-story shearwalls. **Note:** Skipping stories, where bearing plates are omitted at intermediate floors that result in multiple stories being tied together, is prohibited.
7. Do not weld products unless the ATS installation details specifically identify a product as acceptable for welding. Some steels have poor weldability and a tendency to crack when welded. Rods, nuts, and coupler nuts shall not be welded.
8. In the event of a discrepancy between the structural drawings and the ATS installation details, the structural drawings shall govern.
9. The structural drawings are specific to the Simpson Strong-Tie Strong-Rod Anchor Tiedown System (ATS) and are not applicable to other manufacturers' continuous rod tiedown systems. Proposed substitutions of other manufacturers' continuous rod tiedown systems shall be submitted to the designer or Engineer of Record for review and approval at the contractor's expense. Submittal shall include evaluation reports indicating compliance with governing building codes and test data performed in accordance with ICC-ES Acceptance Criteria for Shrinkage Compensating Devices (AC316). In addition, submittal shall include installation details and instructions, calculations in accordance with the governing building codes, and certification by the manufacturer of compliance with these ATS specifications and the structural drawings.
10. ATS run start/terminations shall be as set forth on the structural drawings. Alternate run start/terminations shall be submitted to the designer or Engineer of Record for review and approval prior to placement of the concrete and at the contractor's expense. Submittal shall include calculations in compliance with the governing building code, including concrete anchorage in accordance with ACI 318 provisions for Strength Design and conversion to ASD load levels.
11. The ATS is designed to be installed floor by floor as the structure is built. Installation in this manner, with shearwalls, will provide a lateral-force-resisting system during construction. The design and expense of alternative methods of temporary-lateral-force resisting systems are the responsibility of the contractor.
12. A pre-construction meeting is recommended with Simpson Strong-Tie prior to placement of the concrete. The purpose of this meeting is to assist in verifying quantities and understanding the installation process. To coordinate this meeting, call Simpson Strong-Tie at (800) 999-5099.

LEVEL	CUMULATIVE TENSION (kips)		INCREMENTAL TENSION (kips)	
	DEMAND	CAPACITY	DEMAND	CAPACITY
Level 3:	4.59	5.29	4.59	5.29
Level 2:	15.70	20.28	11.11	14.99
Level 1:	15.70	27.06	0.00	10.03

CRIPPLE STUD NAILING SCHEDULE							
CRIPPLE EA SIDE OF ROD	CRIPPLE PLY 1		CRIPPLE PLY 2		CRIPPLE PLY 3		CRIPPLE STUD LENGTH
	QTY OF FASTENERS PER ROW	TOTAL ROWS OF FASTENERS	QTY OF FASTENERS PER ROW	TOTAL ROWS OF FASTENERS	QTY OF FASTENERS PER ROW	TOTAL ROWS OF FASTENERS	
(1) 2x4	2	[illegible]	-	-			[illegible]
(1) 2x6	2	[illegible]	-		-	-	[illegible]

[illegible]

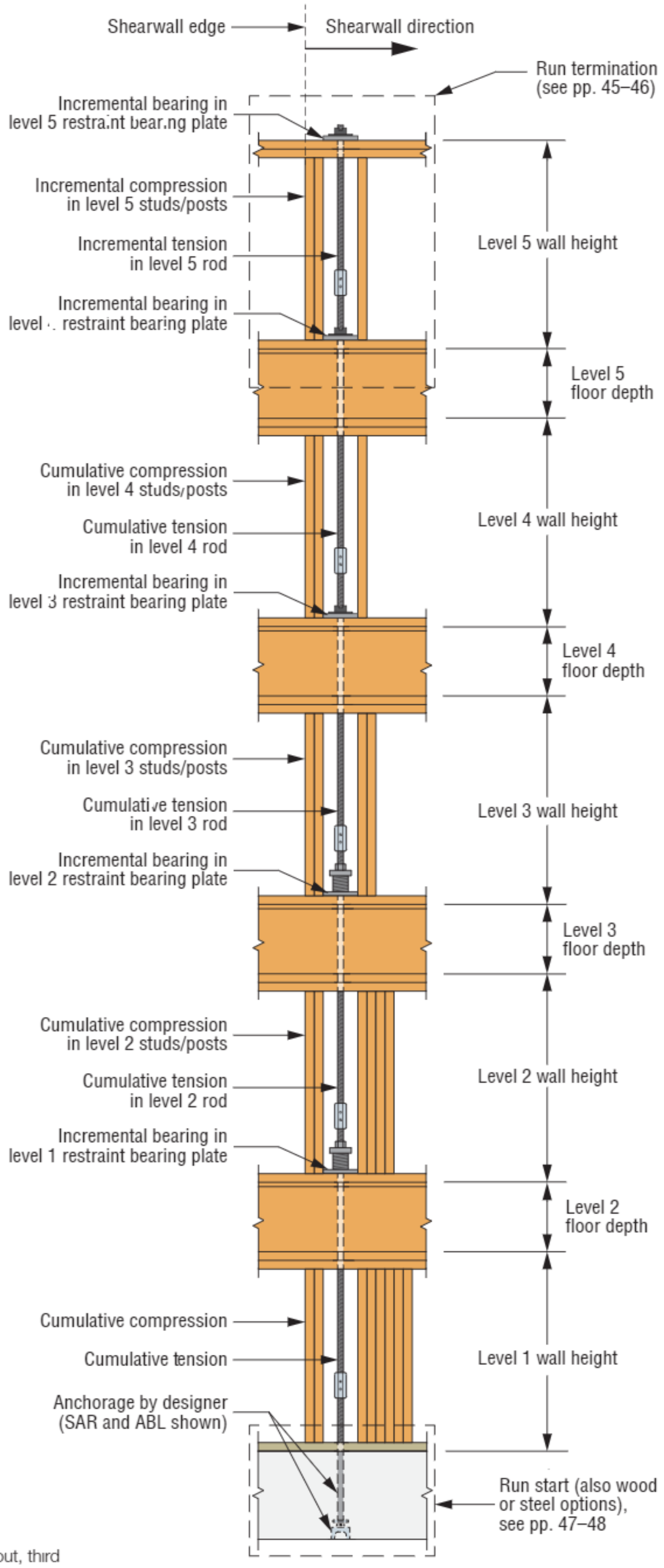


SEE ALTERNATE BRIDGE BLOCK DETAIL ON ATS-1 FOR ADDITIONAL INFORMATION

3.1

Strong-Rod® ATS System Details

SIMPSON Strong-Tie



Note: For Asymmetrical Post layout, third stud may be required at shearwall edge.

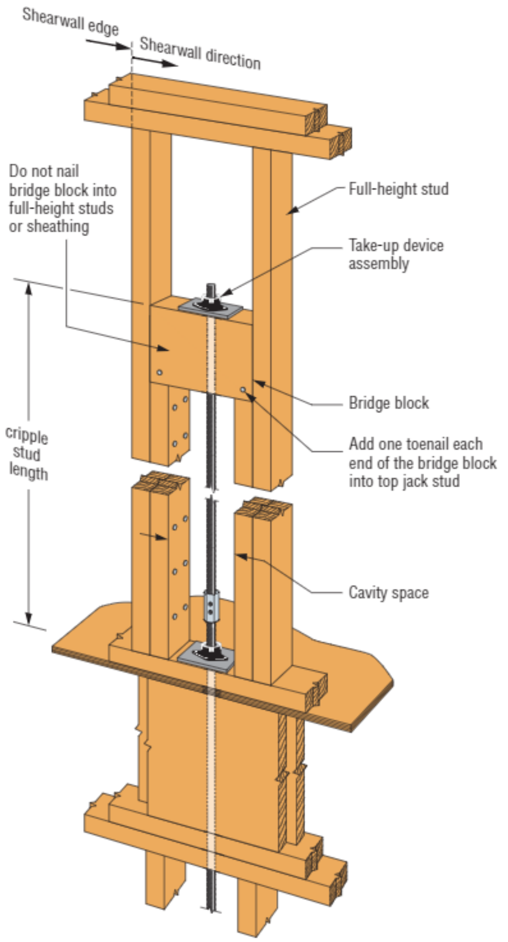
Top-Story Termination Types

Three top-story run termination options are provided to tailor the solution to the project's specific needs. The option chosen will depend on construction preference or structure conditions, such as sloped top plates, truss/rafter locations that may conflict with top-plate termination and available space above top plates for the take-up device assembly. The bridge block or strap termination are often necessary or preferred when the run stops below the top plate.

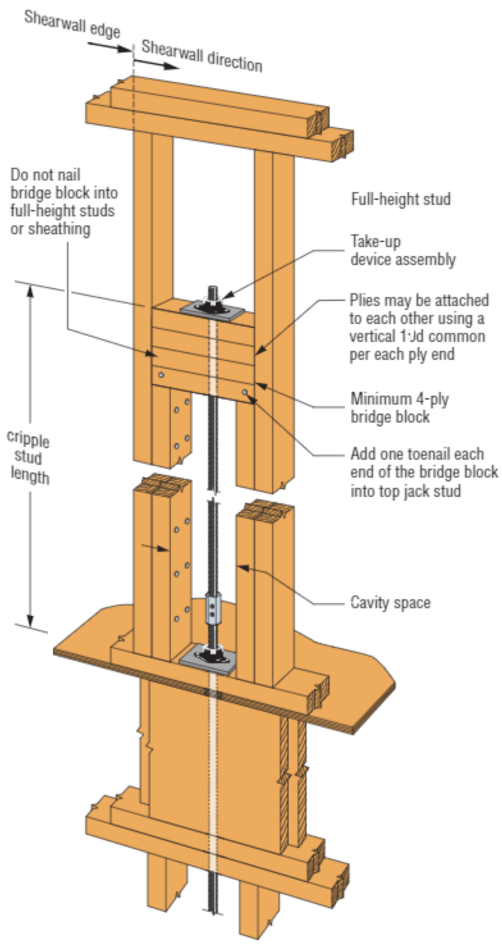
With the design support services we offer, Simpson Strong-Tie will also verify each specified run application and recommend the best termination method for the given project. Consider these variables when specifying run terminations.

Bridge Block Connection

The bridge block connection is an acceptable method to terminate the rod-run at the uppermost floor level. Most bridge block heights will allow the installer to tie off the rod run without working from a ladder. There is no need to worry about interference with the roof trusses or having enough room in the roof space to allow for accumulated shrinkage. One 16d toe nail to each jack stud is all that is required to keep the bridge block tight against the jack studs when shrinkage occurs in the members. Do not nail bridge block into full-height studs or sheathing to avoid gaps between the bridge block and jack studs. Check the structural plans for the required fasteners from the jack to the full-height stud below the bridge block.



Bridge Block
Detail Example



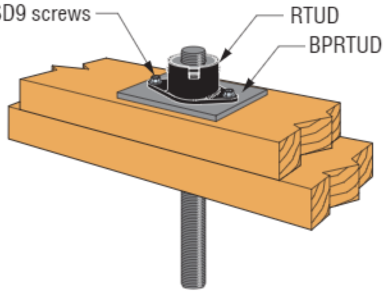
Multi-Ply Bridge Block
Detail Example

SIMPSON Strong-Tie

Top-Story Termination Types (cont.)

Top-Plate Termination

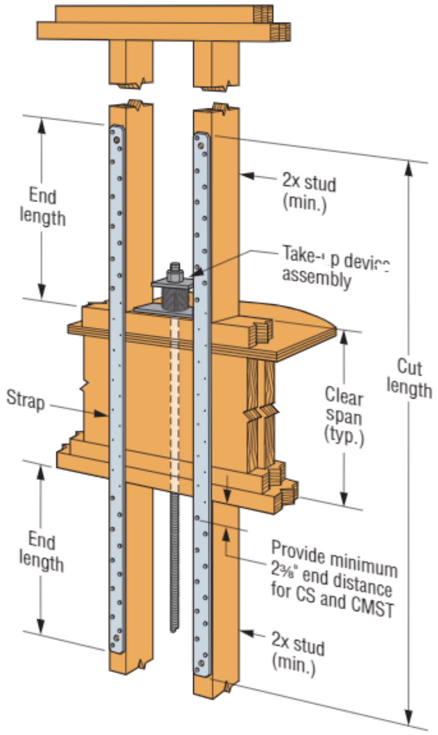
Top-plate termination can be used where there is no interference with the roof trusses or where there is enough room in the roof space to allow for accumulated shrinkage.



Top Plate Detail Example

Strap Detail Termination

Straps can be used where loads are lower and framing conditions don't require a bridge block or top-plate termination.



Strap Detail Example

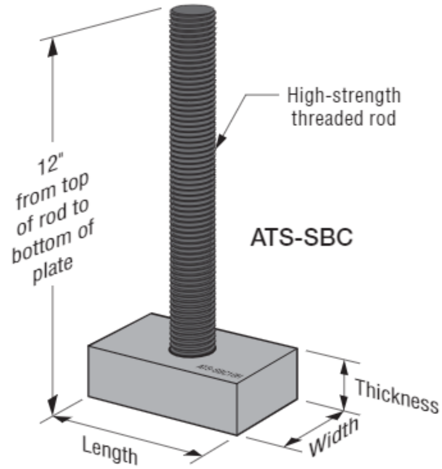
 (800) 999-5099 | strongtie.com

Rod-to-Steel-Beam Connector (ATS-SBC)

The rod-to-steel-beam connector (ATS-SBC) features a preattached high-strength steel threaded rod and weldable plate for use on projects where the run is to be anchored to steel beams. The SBC is pre-assembled as a single unit, saving contractors installation time and cost. The design of the steel beam and the stiffeners are the responsibility of the designer.

Material: Plate — ASTM A572 Grade 50

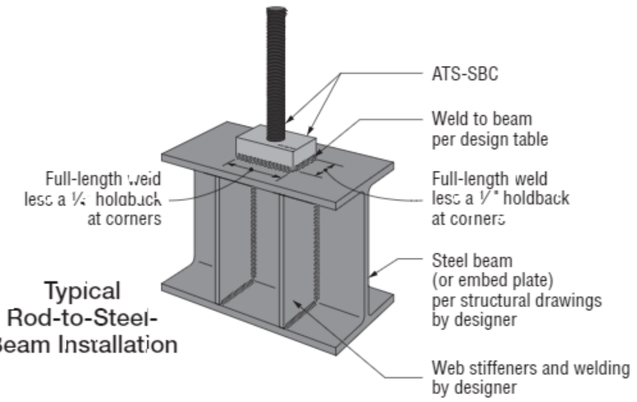
Threaded Rod: High-Strength (ATS-HSR).
Up to 1" diameter — ASTM A449
Greater than 1" diameter — ASTM A193 B7 or F1554 Grade 105



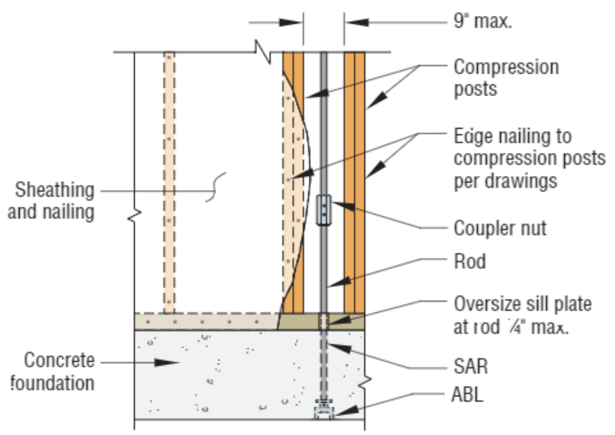
Rod-to-Steel-Beam Connector (SBC)

Model No.	Rod Diameter (in.)[3, 4]	Rod Height (in.)	Rod-to-Beam Plate Size (in.)			Fillet Weld Size (in.)	Total Weld Length (in.)	Allowable Tension Load (lb.)[1, 2]
			Width	Length	Thickness			
ATS-SBC5H	⅝	12 (top of rod to bottom of plate)	3	3	¾	¼	5	13,805
ATS-SBC6H	¾			3	1	5⁄16	5	19,880
ATS-SBC8H	1			3	1¼	5⁄16	10	35,345
ATS-SBC10H	1¼			5	1½	5⁄16	14	57,525
ATS-SBC11H	1⅜			6	1½	5⁄16	16	63,605
ATS-SBC12H	1½			7	1¾	5⁄16	18	82,835

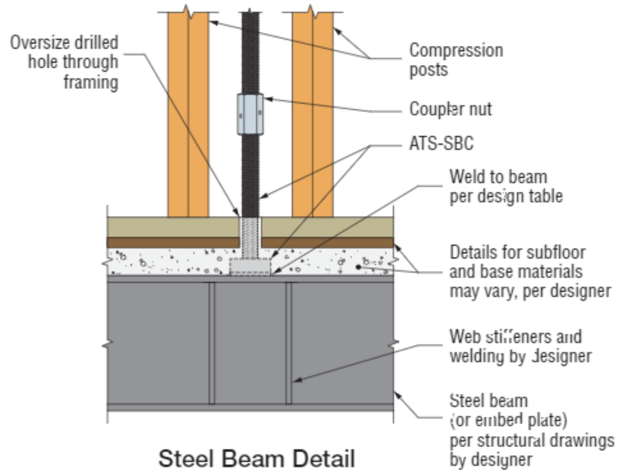
1. Allowable loads are for ATS-SBC only. No further increase in allowable load is permitted.
2. The weld length for the ATS-SBC5H and ATS-SBC6H requires only two opposing sides of the plate to be fillet welded full length less a ¼" holdback from each of the edges. For the ATS-SBC8H up to the ATS-SBC12H, all four sides must be fillet welded full length less a ¼" holdback from each of the edges. All fillet welds, F_{EXX}, to be greater than or equal to 70 ksi and to follow geometry and standards per AISC 360-16 and AWS 2017. Prepare base materials in accordance with AWS D1.1.
3. For purposes of coupling on to the rod above, the ATS-SBC threaded rod specification is UNC Class 2A, in accordance with ANSE/ASME B1.1.
4. The minimum tensile strength, F_u, of the threaded rod for the ATS-SBC5H, ATS-SBC6H and ATS-SBC8H is 120 ksi, and for the ATS-SBC10H, ATS-SBC11H and ATS-SBC12H it is 125 ksi. For rod steel ASTM specifications, see reference above.
5. A minimum flange thickness of 0.258" is required for the structural steel beam.



Typical Rod-to-Steel-Beam Installation



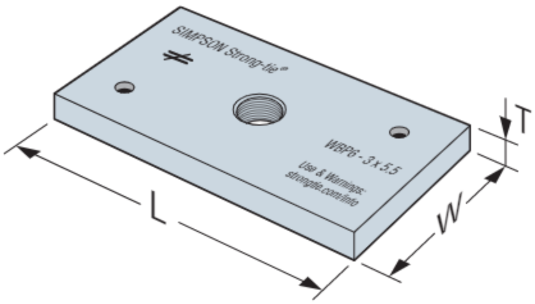
Concrete Detail



Steel Beam Detail

Wood-Beam Plate (WBP)

The WBP wood-beam plate is for projects where the rod run attaches to wood beams. The center hole of the bearing plate has internal threads to receive the threaded rod from above, and the plate spreads the load across the underside of the wood beam. Two SDS Heavy-Duty Connector screws (provided with the kit) are to be installed through the WBP fastener holes and into the wood beam to support the weight of the bearing plate and rod above. This eliminates the need for an additional smaller bearing plate and nut on the top side of the beam. This unique connection also provides a fixed point at the very bottom of the rod run, allowing the take-up devices above to address shrinkage of all the wood framing including any from the wood beam itself. The heavy hex nut provided with the WBP is required to fully engage the tensile capacity of the rod above.



Wood-Beam Plate

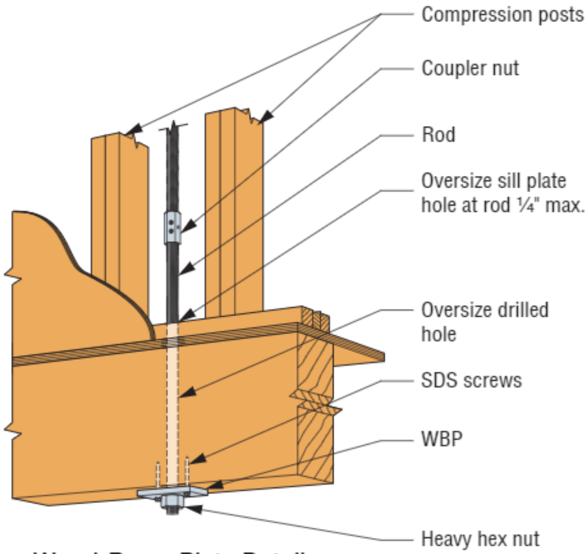
Material: ASTM A36

Finish: Gray primer

Wood-Beam Plate (WBP)

Model No.	Plate Dimensions			Compatible Rod Diameter (in.)[1,3]	SDS Screw Length (in.)[2]	Allowable Bearing Loads (lb.)[1,4,5]				
	W	L	T			DF	SP	HF	SPF	SCL
	(in.)	(in.)	(in.)							
WBP4-3X3.5	3	3½	½	½	3	6,885	6,225	4,460	4,680	8,260
WBP5-3X3.5	3	3½	½	⅝	3	6,775	6,125	4,390	4,605	8,130
WBP6-3X5.5	3	5½	½	¾	3	9,955	9,375	6,750	7,085	11,100
WBP7-3X8.5	3	8½	⅞	⅞	4½	15,245	13,785	9,880	10,370	17,335
WBP8-3X12	3	12	1¼	1	4½	21,665	19,585	14,040	14,730	23,975
WBP8-3X15	3	15	1⅝	1	4½	27,290	24,670	17,685	18,555	30,375
WBP9-5X8.5	5	8½	⅞	1⅛	4½	25,565	23,110	16,565	17,385	30,480
WBP9-5X12	5	12	1¼	1⅛	4½	36,505	33,000	23,655	24,820	41,140
WBP10-5X12	5	12	1¼	1¼	4½	36,325	32,840	23,540	24,700	41,630

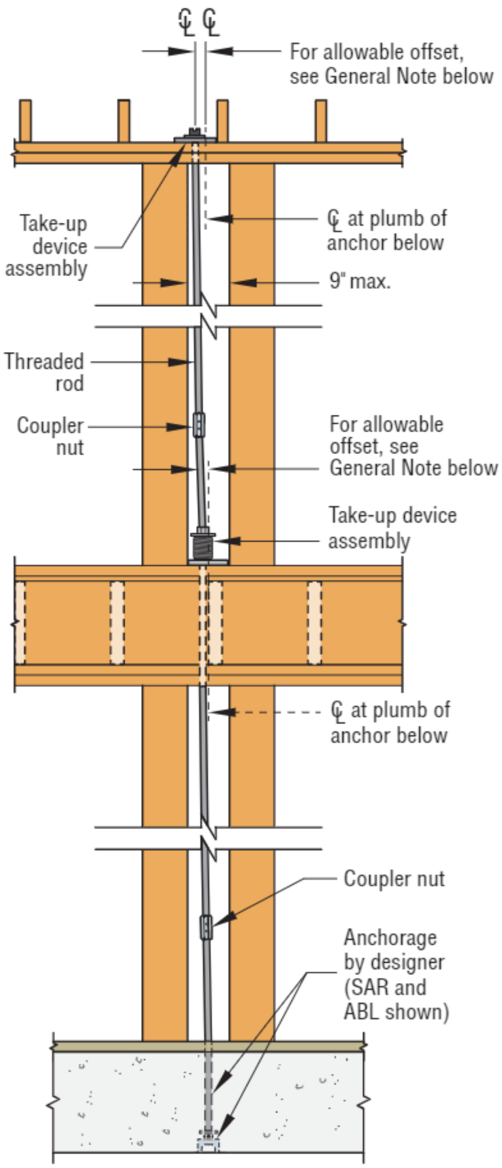
1. No further increase in allowable load is permitted. For installation, thread rod through WBP plate, then thread the provided heavy hex nut to the threaded rod. Table loads are based on the rod threading through the plate and attaching to the heavy hex nut with a recommended one thread showing past the heavy hex nut. Heavy hex nut to be snug tight.
2. SDS screws are needed to fasten the rod and WBP assembly to the wood beam (SDS screws provided).
3. Center hole is a UNC-2B tapped hole.
4. In accordance with the 2018 NDS, the following perpendicular to grain design variables were used to calculate allowable bearing loads: DF = 625 psi, SP = 565 psi, HF = 405 psi and SPF = 425 psi.
5. For structural composite lumber (SCL), manufacturers' specifications were referenced and a minimum design value adjustment factor ($F_{c\perp}$) of 750 psi was used. For $F_{c\perp}$ values when specifying SCL other than this, a linear adjustment may be applied. Designer to account for drilled hole in beam where occurs.



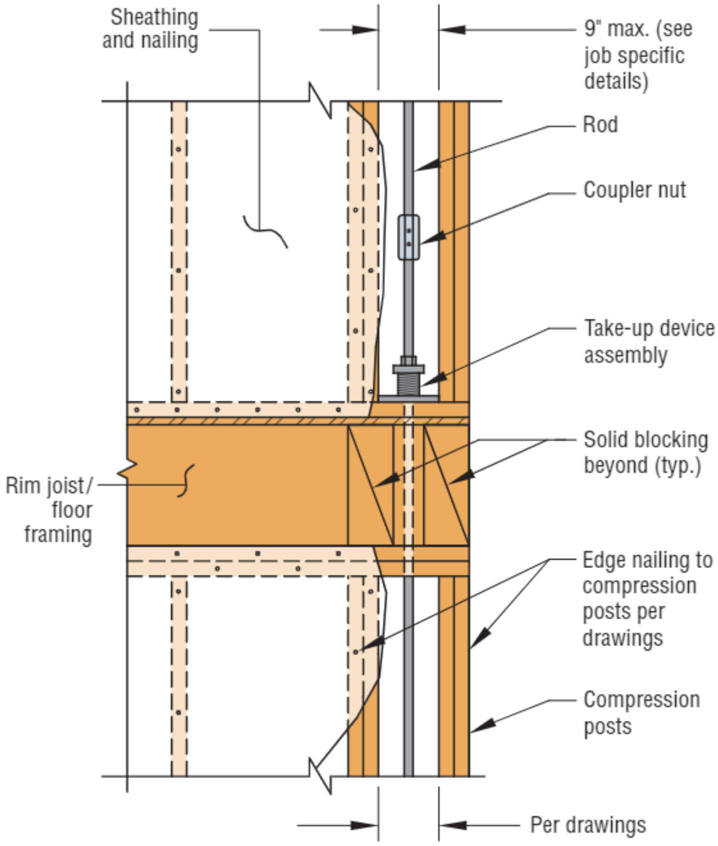
Wood-Beam Plate Detail

Strong-Rod® ATS Run Details

Our Anchor Tiedown System (ATS) for shearwall overturning restraint addresses many of the design challenges specifically associated with multi-story buildings that must withstand seismic and high wind activity. For your project, you will want to implement drawing details that will assist you during design and construction. In addition to the run start and run termination details shown on pp. 44–48, Simpson Strong-Tie offers general details that can be found at **strongtie.com/srs** as well as our general detail sheets that are provided with our complete ATS design package. Below are two common run details; the rod offset detail and the mid-floor blocking detail.



Rod Offset Detail



Mid-Floor Detail

General Note: In order for the take-up device assembly to function properly, rods must be installed at less than 1 degree from vertical but not to exceed measured horizontal offset dimensions shown in the table to the right.

Rod Offset Table

Plate Height	Offset
4' – 4" (bridge block)	⅞"
8' – 0"	1⅝"
9' – 0"	1⅞"
10' – 0" and greater	2"

Strong-Rod® URS Uplift Restraint System for Roofs

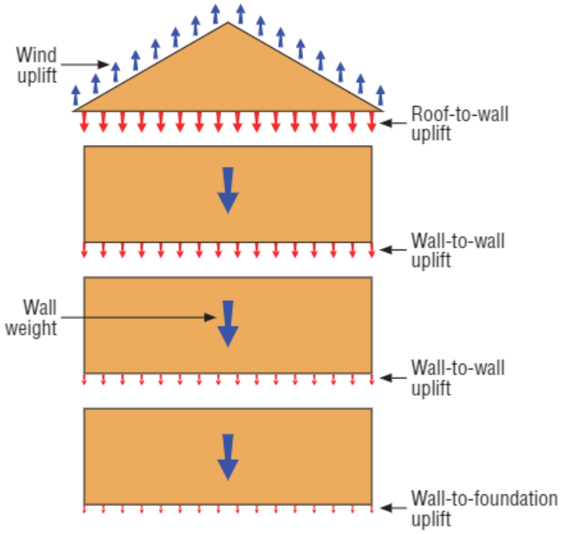
The Simpson Strong-Tie® Strong-Rod uplift restraint system for roofs (Strong-Rod URS) is a continuous rod tiedown solution designed to provide a complete load path to resist uplift (suction) pressure on the roof by transferring these forces through the structure to the resisting elements (typically the foundation).

Strong-Rod Uplift Restraint System for Roofs

The Simpson Strong-Tie® Strong-Rod uplift restraint system for roofs (Strong-Rod URS) is a continuous rod tiedown solution designed to provide a complete load path to resist uplift (suction) pressure on the roof by transferring these forces through the structure to the resisting elements (typically the foundation).

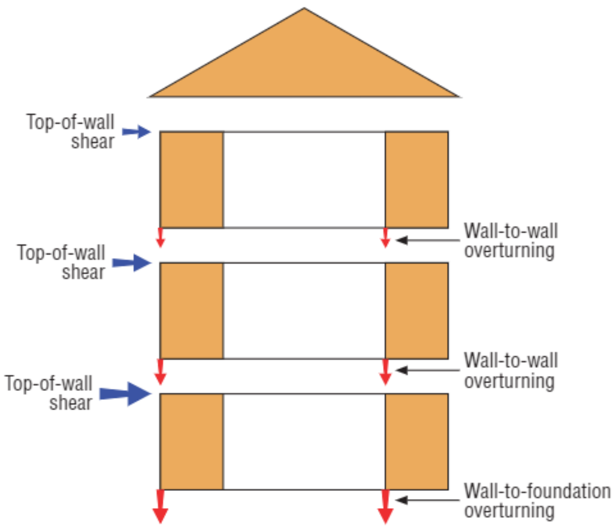
Designing rod systems to resist wind uplift (URS) is very different from designing rod systems used to resist shearwall overturning caused by lateral wind pressure or seismic forces (ATS) (see pp. 12–49). This is due to where each type of force originates in a building. For wind uplift, this is only at the roof and can be reduced by dead load at each level of the building. Lateral forces are applied at each level (each horizontal diaphragm, both roof and floor) of the building, and increase at each lower level as load from the level above is added to the level below.

Forces Resisted by URS



- Uniform load applied to roof
- Load reduces when transferred down to foundation due to self weight of structure
- Connections uniformly spaced

Forces Resisted by ATS



- Shear load applied at each level
- Load increases when transferred down to foundation
- Connections must be at both ends of shearwalls to resist overturning tension force from wind or seismic applied in each direction

This section of the guide will illustrate the design methods for creating the load path using a rod system to resist wind uplift (URS), explain the key design considerations for both the wood structural elements and rod-run components, provide load capacities for components, suggest methods of specification and show typical details to assist in your design.

SIMPSON Strong-Tie

A Quick History of Wind Uplift Rod Systems

Rod tiedown systems have been used by the light-framed wood construction industry to resist wind uplift forces. Yet codes and standards have not provided detailed guidance for design of these systems. Designers, consequently, have been forced to rely entirely on engineering judgment and/or trust a rod manufacturer's literature or substitution submittals to create this load path.

This lack of guidance sometimes led to rod-restraint spacing based on rod tension and bearing plate capacities alone. This design neglects the wood components of the system and may lead to rods spaced too far apart, compromising the continuous load path, causing building damage and creating life-safety issues.

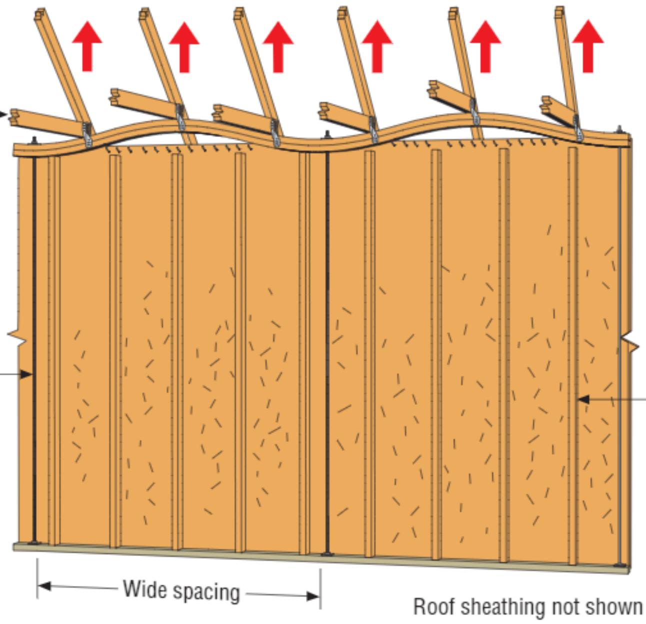


Figure 1 — Excessive Spacing of Rod Restraints to Resist Uplift Forces Causing Top Plate Failure

Industry Guidance

In June 2010, ICC-ES passed and made effective Acceptance Criteria 391 after multiple public hearings that garnered engineer, manufacturer, building official and other third-party input. AC391 established guidelines for the evaluation of either:

- The steel components making up continuous rod tiedown runs (CRTR) only. If a manufacturer has a CRTR report, the designer or Engineer of Record must take the time to evaluate how the light-framed wood members will transfer forces to the CRTR.
- The entire continuous rod tiedown system (CRTS), which includes CRTR and the light-framed wood structure used to resist wind uplift. If a manufacturer has a CRTS report, this saves the designer or Engineer of Record time.

These same guidelines in AC391 can be used by project designers themselves to lay out continuous rod tie-down systems to resist wind uplift.

Following the key design considerations, an effective uplift rod system is designed and detailed to:

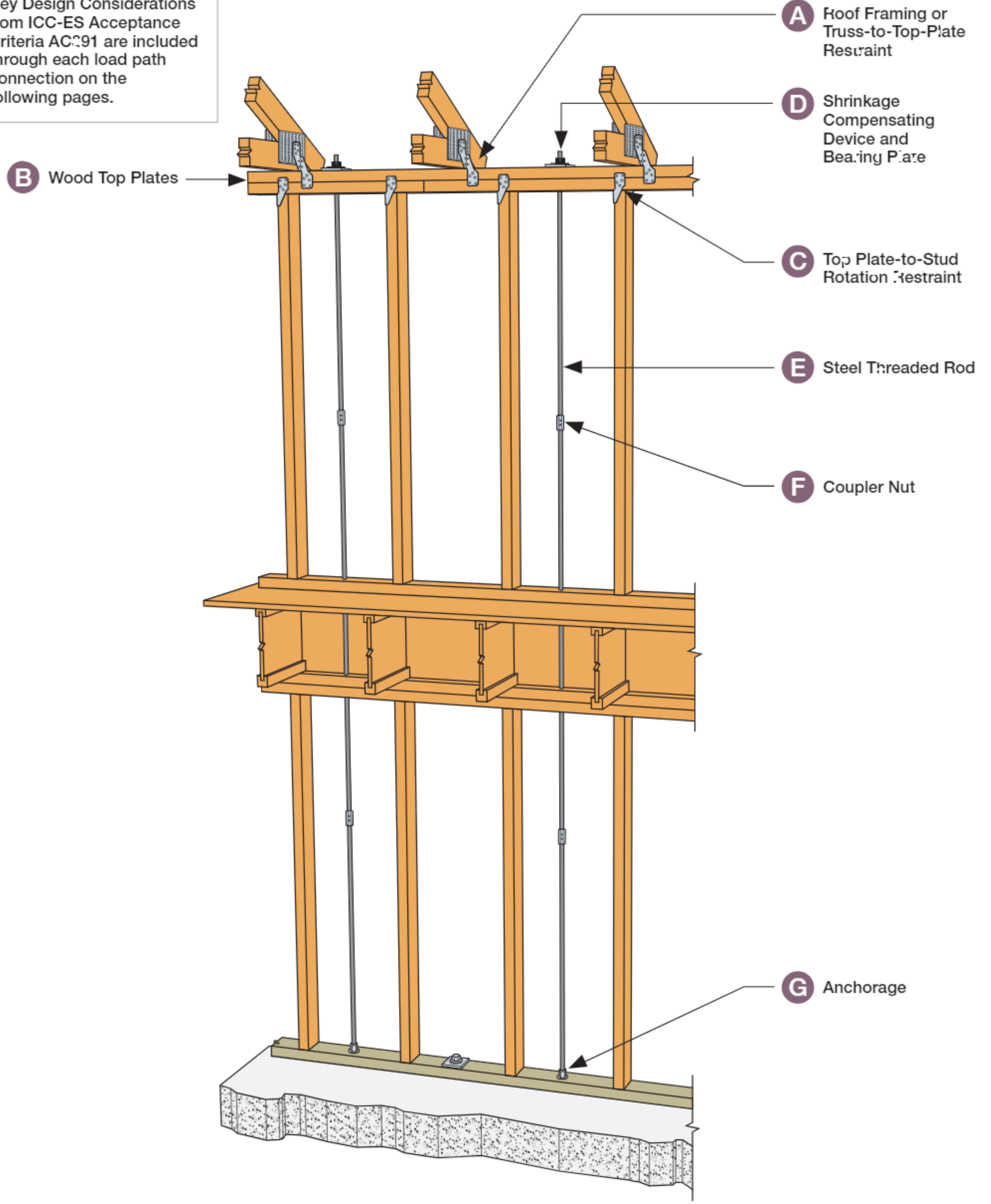
- Efficiently transfer wind uplift loads from wood components to steel components of the rod runs
- Keep wood top plate bending within acceptable limits
- Control wood top plate rotation
- Limit steel rod elongation
- Restrict crushing of wood top plate under bearing plates
- Address deflection caused by wood shrinkage

SIMPSON Strong-Tie

From the Roof to the Foundation

Strong-Rod Uplift Restraint System Components

Key Design Considerations from ICC-ES Acceptance Criteria AC391 are included through each load path connection on the following pages.

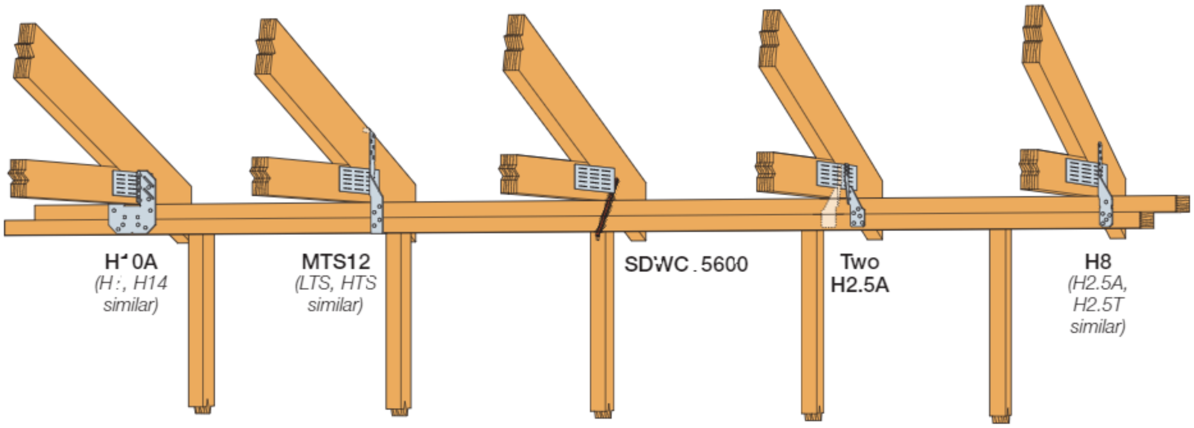


A Roof Framing or Truss-to-Top-Plate Restraint

Uplift refers to the forces that can lift a structure. The forces are generated when high winds blow over the top of the structure, creating suction that can lift the roof. These uplift forces must be transferred down to the foundation to prevent damage. Several connections are required to create a continuous load path, starting with a hurricane tie or structural fastener connecting the roof framing to the top plates.

For additional information, the Simpson Strong-Tie® *High Wind Guide* (F-C-HWG) offers a variety of options to resist roof uplift forces.

High Wind Guide
(F-C-HWG)

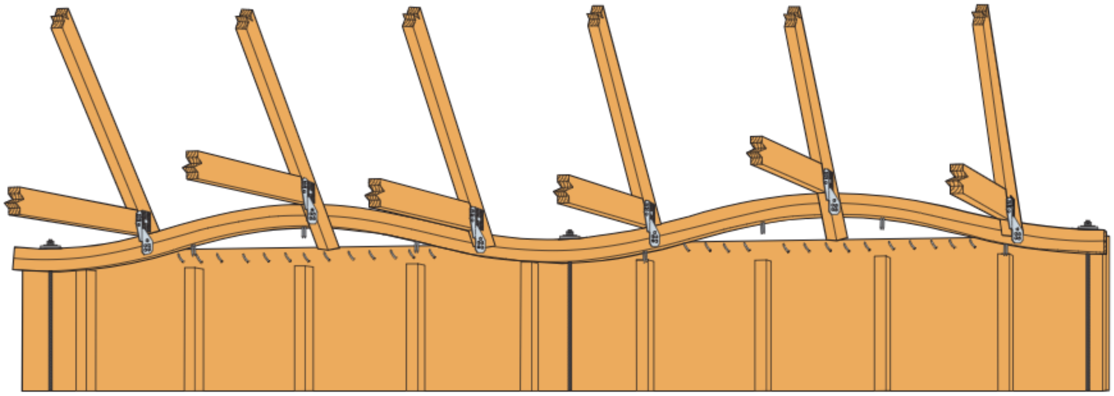


Blocking and stud to plate connector not shown for clarity

AC391 Criteria Section	AC391 Requirement
1.2.1.1	• Use of continuous rod tiedown runs (CRTR) and continuous rod tiedown systems (CRTS) is limited to resisting roof wind uplift in light-frame wood construction. • Specifically excluded from AC391 is the use of CRTR to resist shearwall overturning forces or use in cold-formed steel framing.

B Wood Top Plates

In addition to distributing the gravity loads from the roof to the studs below, the top plates in a light-frame wood structure are also the drag struts between shearwalls and the chords of the diaphragms. This means that these elements are already stressed in shear perpendicular to grain as well as tension parallel to grain. After hurricane ties transfer roof uplift forces into the top plates, the load path dictates that these wood top plates transfer uplift forces by bending along the weak axis to each rod run restraint. The designer needs to specify the on-center spacing of the rod runs with multiple design considerations in mind.



Top-Plate Bending Due to Uplift

AC391 Criteria Section	AC391 Requirement
3.2.2	CRTS allowable loads shall be evaluated and be limited by • Wood deflection limitations per 3.2.2.2, or • Flexural (bending) stress per 3.2.2.1, or • Shear stress perpendicular to grain per 3.2.2.4, or • Combined axial (chord/drag force) and flexural (bending) stresses per 3.2.2.5
3.2.2.2	The deflection of the top plates in bending occurring between CRTR is limited to L/240, where L is the length of the top plates between tiedown runs. Additionally, the sum of the rod elongation, top plate crushing under bearing plates, deflection of any take-up devices and the deflection of the top plates between tiedown runs shall not exceed 0.25 inches at the applied (ASD) load.

Top-Plate Bending Due to Uplift

Failure at Top-Plate Splice

SIMPSON Strong-Tie

B Wood Top Plates (cont.)

Top-Plate Splice Bending Reinforcement

When wind uplift restraint systems are installed in accordance with ICC-ES ESR-1161 and the designer wants to use the bending capacity of both top plates and not just one, top-plate splice reinforcement must be installed at all locations in which there is a discontinuity in one of the top-plate members, such as the top-plate splice. This is to reinforce the top plate in bending. The splice reinforcement must be attached using Simpson Strong-Tie® ¼" x 4½" Strong-Drive® SDS Heavy-Duty Connector screws. For top-plate splices that are approximately centered between two adjacent studs in the wall below, reinforcement must be installed as depicted in Figure 1 below. For top-plate splices that are not centered between two adjacent studs in the wall below, reinforcement must be installed as shown in Figure 2 below as well.

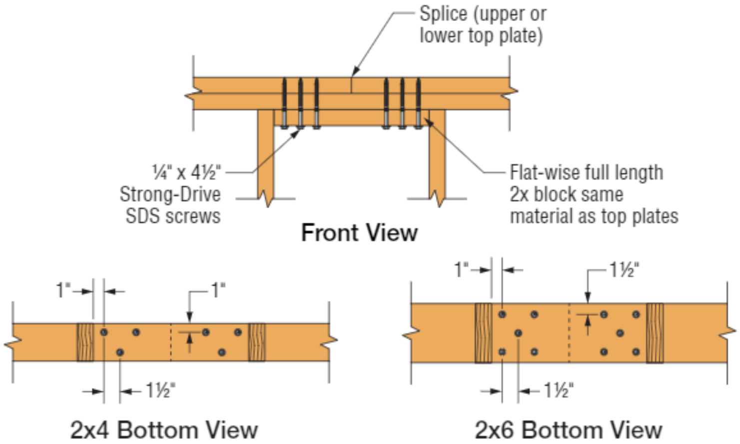
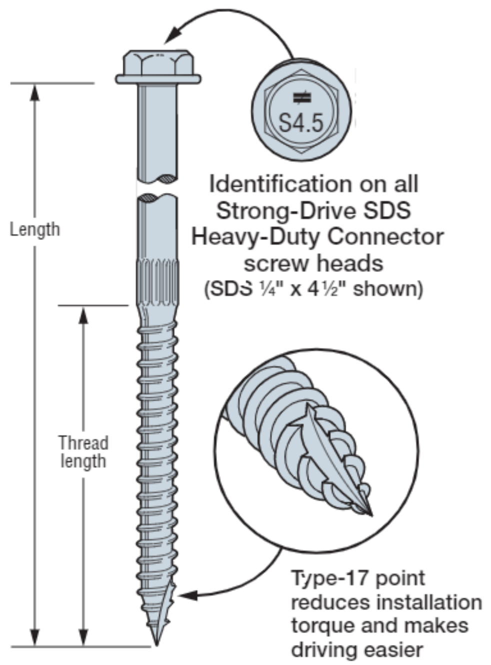


Figure 1 — Top-Plate Splice: Reinforcement (Splice Between Studs)



Strong-Drive ¼" x 4½" SDS Heavy-Duty Connector Screw

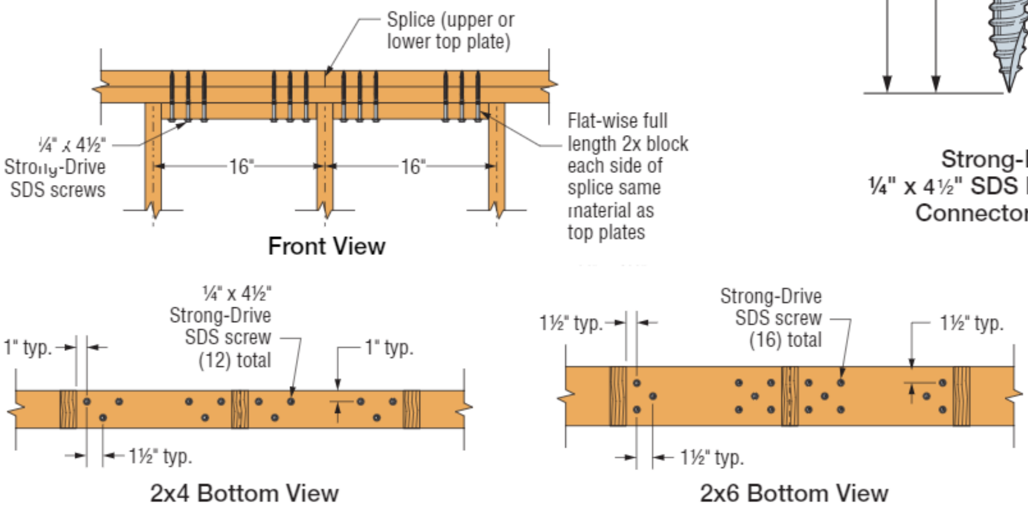
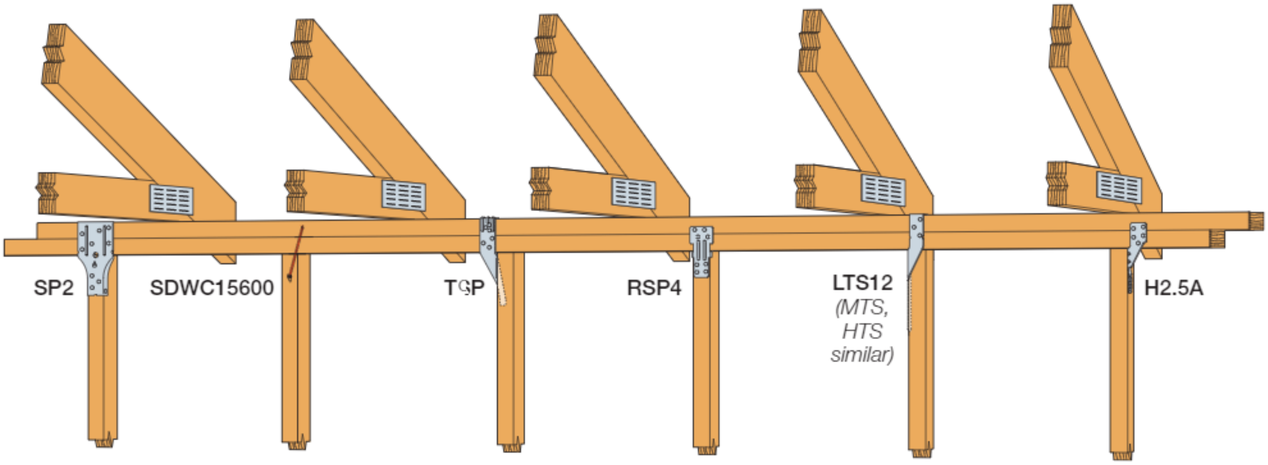


Figure 2 — Top-Plate Splice: Bending Reinforcement (Splice Centered Over Studs)

AC391 Criteria Section	AC391 Requirement
3.2.2.1	Approved top-plate splice details must be provided for the CRTS to utilize both top plates in bending, otherwise only the capacity of a single top plate may be used.

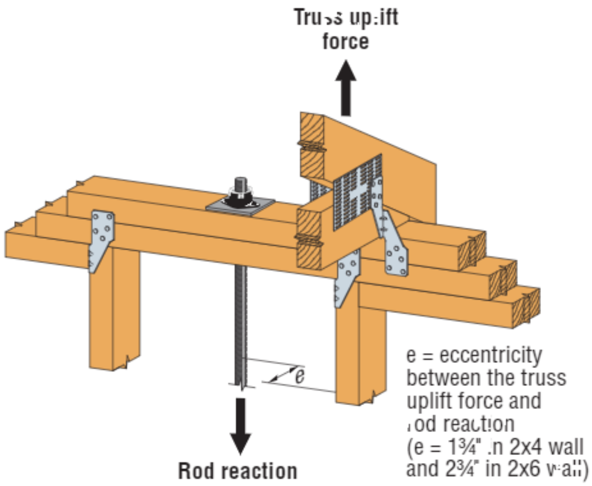
C Top Plate-to-Stud Rotation Restraint

The roof-structure-to-top-plate connection induces eccentric loads to the top plate. This will require a top-plate-to-stud connection to continue the load path and prevent torsional rotation of the top plates. Simpson Strong-Tie offers a variety of product options to resist the rotational forces from the roof structure.



Truss-to-plate connections not shown for clarity. However, they need to be installed on the same side of the wall as plate-to-stud connectors.

AC391 Criteria Section	AC391 Requirement
3.2.2.3	Top-plate torsion (rotation) must be prevented due to offsets between the point of load application, such as hurricane ties at the sides of the top plates and load resistance (rods at the center of the top plate for example). This can be accomplished by providing a positive connection from the top plate to stud on the same side of the wall as the roof framing to wall connection



Stud-to-Plate Tie Reaction

Top-Plate Rotation Failure Due to Uplift

Ultimate Failure of Top Plate in Pure Bending Due to Rotation Restraint

C Top Plate-to-Stud Rotation Restraint (cont.)

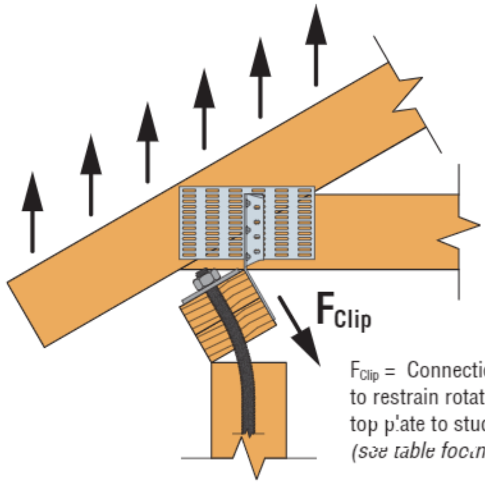
When connection hardware between the roof framing members and the wall top plate induces eccentric loading about the centerline of the top plate, Simpson Strong-Tie® top plate-to-stud connectors are the optimum installation solution to prevent top-plate rotation as shown in illustration below. The top plate-to-stud connectors must be installed on the same side of the top plate as the roof-to-wall connectors. Connector models must be selected and installed in a manner that does not induce significant tension stresses perpendicular to the grain of the wood top-plate members.

Required Top-Plate Rotation Restraint Connection Force[1]

Roof Uplift (plf)	Required Connector Capacity (lb)		
	Connection Spacing		
	16"	24"	32"
100	67	100	133
150	100	150	200
200	133	200	267
300	200	300	400
400	267	400	533
500	333	500	667
600	400	600	800

For SI: 1 inch = 25.4 mm

1. The top plate-to-stud connection used to restrain top-plate rotation must be installed on the same side of the wall as the roof-to-top plate connection.



F_{Clip} = Connection force required to restrain rotation by connecting top plate to stud with hurricane tie *(see table footnote 1 on the left)*

Top-Plate Rotation Restraint Connection Force

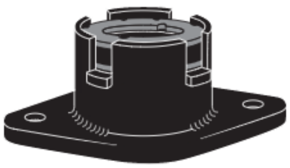
For hurricane tie components that can connect top plates to studs to resist rotation refer to the *High Wind Guide* (F-C-HWG) or the *Wood Construction Connectors* catalog.

High Wind Guide
(F-C-HWG)

D Shrinkage Compensating Device and Bearing Plate

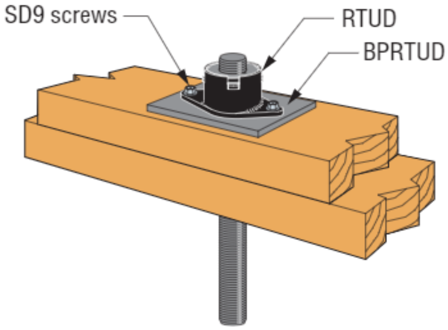
RTUD Ratcheting Take-Up Device

The RTUD ratcheting take-up device is a cost-effective shrinkage compensation solution for continuous rod systems. The RTUD is threaded rod diameter specific and allows for unlimited shrinkage. The RTUD should be hand installed until the base of the device fully bears on top of the BPRTUD. Once the fastener holes are aligned and the RTUD is flush, install the Strong-Drive® fasteners. Once the RTUD is installed, a series of internal threaded wedges enable the device to ratchet down the rod as the wood structure shrinks, but engage the rod in the reverse direction when under tensile loading. Continuous engagement is maintained on the rod at all times by the take-up device, enabling the rod system to perform as designed from the time of installation.

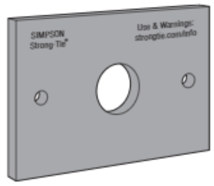


RTUD

US Patents 8,881,478 and 9,394,706



Typical Ratcheting Take-Up Device Assembly Installation



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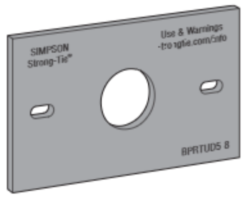


BPRTUD5-8

Note: Where take-up devices are not used, additional through-penetration firestop systems are required. At floors where take-up devices are used, alternate means to address through-penetration firestop are not required. See pp. 28–29 for more information.

RTUD

Model No.	Threaded Rod Diameter (in.)	Dimensions (in.)			Allowable Load (lb.)	Seating Increment, Δ_R (in.)	Deflection at Allowable Load, Δ_A (in.)	Compatible Bearing Plates*
		Length	Width	Height				
RTUD3B	⅜	2¾	1½	1	5,180	0.044	0.010	BPRTUD3-4B
RTUD4B	½	2¾	1½	1	9,210	0.045	0.003	BPRTUD3-4B
RTUD5	⅝	3⅞	2	1⅜	14,495	0.056	0.007	BPRTUD5-6, 5-8
RTUD6	¾	3⅞	2	1⅜	20,830	0.057	0.010	BPRTUD5-6, 5-8
RTUD7	⅞	4½	2¼	2	28,185	0.059	0.012	BPRTUD7-8, 5-8
RTUD8	1	4½	2¼	2	36,815	0.066	0.031	BPRTUD7-8, 5-8

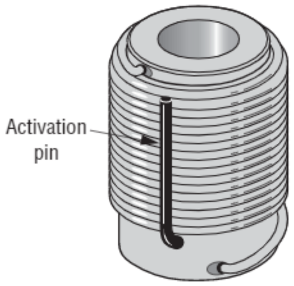
1. Allowable loads for the RTUD only. The attached components must be designed to resist design loads in accordance with the applicable code.
2. Thread specification for threaded rod used with the RTUD must be UNC Class 2A, in accordance with ANSE/ASME B1.1, unless where ASTM A307 Grade A threaded rod is specified, then UNC Class 1A thread may be accepted per ASME B18.
3. No further increase in allowable load is permitted.
4. The RTUD compensates for an unlimited amount of wood shrinkage, provided there are no obstructions to the travel of the RTUD along the length of the threaded rod.
5. The RTUD fastens to the wood plate with the BPRTUD bearing plate and (2) #9 x 2½" Strong-Drive SD Connector screws.
6. The specified minimum tensile strength, F_u, of the threaded rod must not exceed 125 ksi.

*Indicate the compatible BPRTUD on design plan. Refer to the BPRTUD table on p. 61.

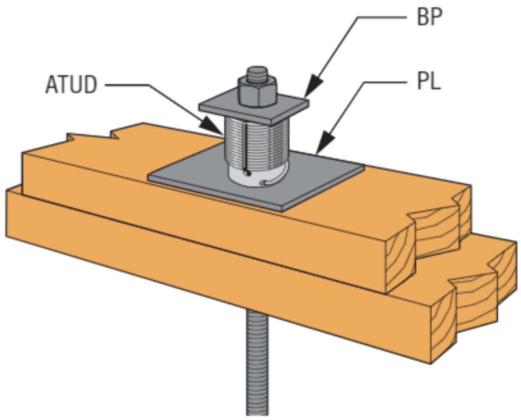
D Shrinkage Compensating Device and Bearing Plate (cont.)

ATUD Take-Up Device

The ATUD take-up devices are not specific to a single rod diameter but allow up to a maximum rod diameter clearance and then require a diameter-specific nut on top. Once activated, the spring allows the ATUD to expand to keep the bearing plate tight against the wood members as shrinkage occurs.



ATUD



Typical Take-Up Device Assembly Installation

Naming Legend

ATUD6-2

- ATUD — Aluminum Take-Up Device
- 6 — Maximum Rod Clearance in ⅛" Increments (Ex: 6 = 6⁄8" or ¾")
- 2 — Rated Shrinkage Compensation Capacity in Inches

Note: Where take-up devices are not used, additional through-penetration firestop systems are required. At floors where take-up devices are used, alternate means to address through-penetration firestop are not required. See pp. 28–29 for more information.

ATUD

Model No.	Compatible Threaded Rod Dia. (in.)	Dimensions (in.)		Rated Shrinkage Compensation Capacity (in.)	Allowable Load (lb.)[1,2]	Seating Increment, Δ_R (in.)[3]	Deflection at Allowable Load, Δ_A (in.)[3]	Bearing Plate Below ATUD, TUD
		Width	Length					
ATS-ATUD6-2	½ to ¾	1¾	3⅛	2	11,430	0.004	0.022	PL5/PL6
ATS-ATUD9	¾ to 1⅓	2⅛	2¼	1	15,560	0.002	0.013	PL9
ATS-ATUD9-2	¾ to 1⅛	2⅞	3⅞	2	12,790	0.002	0.037	PL9
ATS-ATUD9-3	¾ to 1⅛	2⅓	5	3	11,830	0.002	0.034	PL9

1. Allowable compression capacities are for TUD or ATUD only and are based on ICC-ES ESR2320.
2. No further increase in allowable load is permitted.
3. Total device deflection = $\Delta_T = \Delta_R + \Delta_A(P_D/P_A)$.

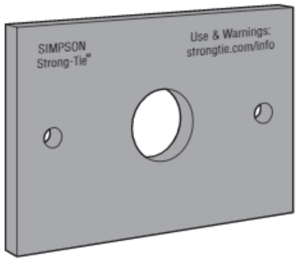
P_D = Demand Load

P_A = Allowable Load

D Shrinkage Compensating Device and Bearing Plate (cont.)

Bearing Plates

Bearing plates must be used to transfer tension load from the building structure to the rods and installed on the top of the wood double top plates.



BPRTUD

AC391 Criteria Section	AC391 Requirement
3.1.1, 6.2.1.3, and 6.3.1.3	The effects of wood shrinkage on the overall deflection of the CRTS shall be analyzed by a registered design professional, and a method of addressing wood shrinkage in the system shall be provided. If shrinkage compensating devices are used, they shall meet AC316 requirements. Visit **strongtie.com/software** for more information on the Simpson Strong-Tie® Wood Shrinkage Calculator.
3.2.1.2 and Figure 1	Steel bearing plates shall be sized for proper length, width and thickness based on steel cantilever bending action and wood bearing. Deflection from bearing compression (up to 0.04") must be included in overall deflection calculations.

Separation Between Nut and Bearing Plate Due to Wood Shrinkage

Properly Installed RTUD over BPRTUD Bearing Plate

See pp. 59–60 for take-up device models and capacities.

BPRTUD

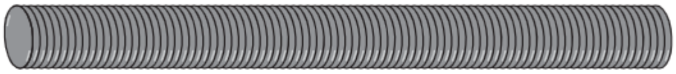
Model No.	Length (in.)	Width (in.)	Thickness	Hole Diameter (in.)	Allowable Loads (lb.)			
					DF	SP	HF	SPF
BPRTUD3-4B	3½	3	3 ga.	⅝	6,415	5,975	4,475	4,700
BPRTUD5-6A	4½	3	3 ga.	1	7,070	6,565	5,170	5,350
BPRTUD5-6B	5½	3	½ in.	1	10,295	9,305	6,670	7,000
BPRTUD5-6[illegible]	7½	3	¾ in.	1	13,385	12,100	8,675	9,105
BPRTUD5-8	5	3	3 ga.	1 1/16	7,195	6,675	5,245	5,430

1. No further increase in allowable load permitted.
2. Plate bearing area based on rod diameter plus ¼" diameter drilled hole through wood plate below steel bearing plate. Reduce allowable load per code for larger holes.
3. Bearing plate load capacity is based on the steel plate bearing on the wood sole plate perpendicular to the grain and steel plate bending in cantilever action.
4. For bearing plate models associated with ATUD/TUDs, see p. 27.

E Steel Threaded Rod

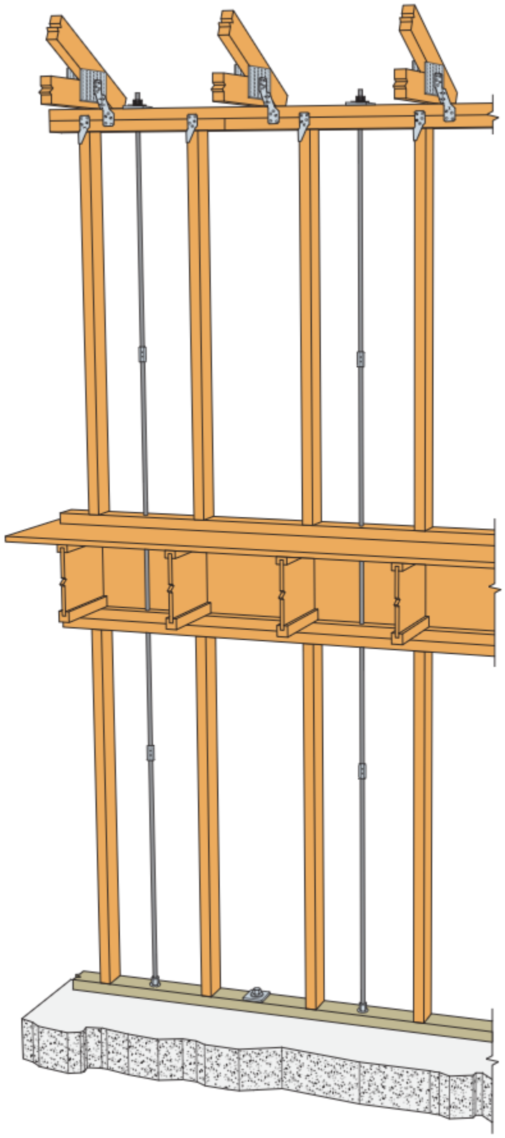
Strong-Rod threaded rods are the tension transfer element within the Uplift Restraint System.

Fully threaded rod (all-thread rod) is standard-strength material (F_y = 36 ksi, F_u = 58 ksi) and is available in multiple lengths to suit your structure's wall height(s).



Fully Threaded Rod

AC391 Criteria Section	AC391 Requirement
3.1.1	CRTS allowable loads shall be evaluated and be limited by • Tiedown run steel component capacities per 3.1.1
3.2.1.1	Rod elongation is limited to 0.18 inches for total rod length at the applied (ASD) load. Visit **strongtie.com/software** to access our Rod Elongation Calculator.



Steel Threaded Rod

Threaded Rod Model No.	Rod Dia. (in)	Gross Area A_{gross} (in.²)	Threads per Inch, *n*	Net Area A_n (in.²)	F_u (ksi)	Allowable Tension Capacity (lb.)						
						Based on Steel Stresses	Based on 0.18" Elongation Limit for Maximum Rod Length of:					
							15'	25'	35'	45'	55'	65'
ATR⅜	⅜	0.110	16	0.077	58	2,400	2,250	1,350	960	750	610	520
ATR½	½	0.196	13	0.142	58	4,270	4,120	2,470	1,760	1,370	1,120	950
ATR⅝	⅝	0.307	11	0.226	58	6,675	6,550	3,930	2,810	2,180	1,790	1,510
ATR¾	¾	0.442	10	0.334	58	9,610	9,610	5,820	4,160	3,230	2,650	2,240
ATR⅞	⅞	0.601	9	0.462	58	13,080	13,080	8,040	5,740	4,460	3,650	3,090
ATR1	1	0.785	8	0.606	58	17,080	17,080	10,540	7,530	5,850	4,790	4,050
ATR1-⅛	1⅛	0.994	7	0.763	58	21,620	12,620	13,270	9,480	7,370	6,030	5,100

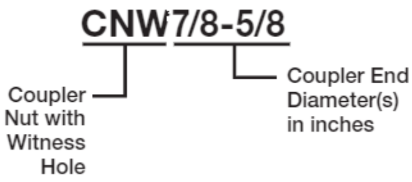
1. Allowable tension capacities are based on AISC 360-16.
2. No further increase in allowable load is permitted.
3. Available in 1', 1½', 2', 3' and 6' lengths.
4. In accordance with ANSI/ASME B1.1, threaded specification for threded rod must be UNC Class 2A for high-strength rod and may be either Class 2A or Class 1A for standard-strength rod.

SIMPSON Strong-Tie

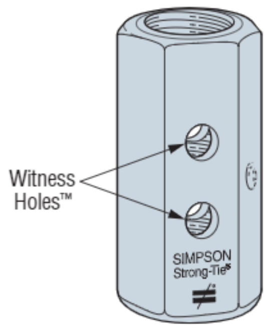
F Coupler Nut

CNW coupler nuts are used to connect one threaded rod to another, and to connect to anchor bolts within the Strong-Rod URS. CNW coupler nuts exceed 100% of the tensile capacity and 125% of the yield capacity of the corresponding standard-strength threaded rod. All coupler nuts are lot tested to ensure quality.

Naming Legend



AC391 Criteria Section	AC391 Requirement
1.4.6 and 3.4.1.1	• Proof of the positive connection between threaded rod and threaded rod couplers shall be provided, such as Witness Holes™ or other method. • Rod couplers must also be tested to prove they can develop at least 100% of the rod's tensile strength and 125% of the rod's yield strength.

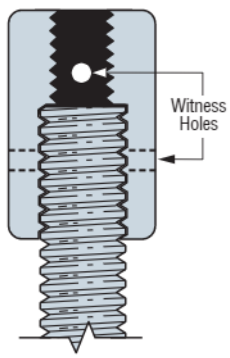


CNW

Allowable Loads for Coupler Nuts Used in the URS

Model No.	Nominal Rod Diameter (in.)	Height, H Min. (in.)	Allowable Tension (lb.)
CNW⅜	0.375	1.125	2,400
CNW½	0.500	1.500	4,270
CNW⅝	0.625	1.875	6,675
CNW¾	0.750	2.250	9,610
CNW⅝-½	0.625 and 0.500	1.500	4,270
CNW¾-⅝	0.750 and 0.625	1.750	6,675

For SI: 1 in. = 25.4 mm; 1 lb. = 4.45 N



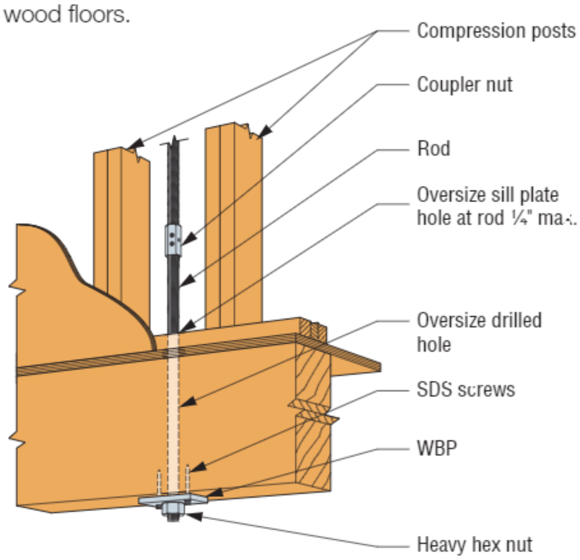
Transition Coupler Nut

Strong-Rod® URS

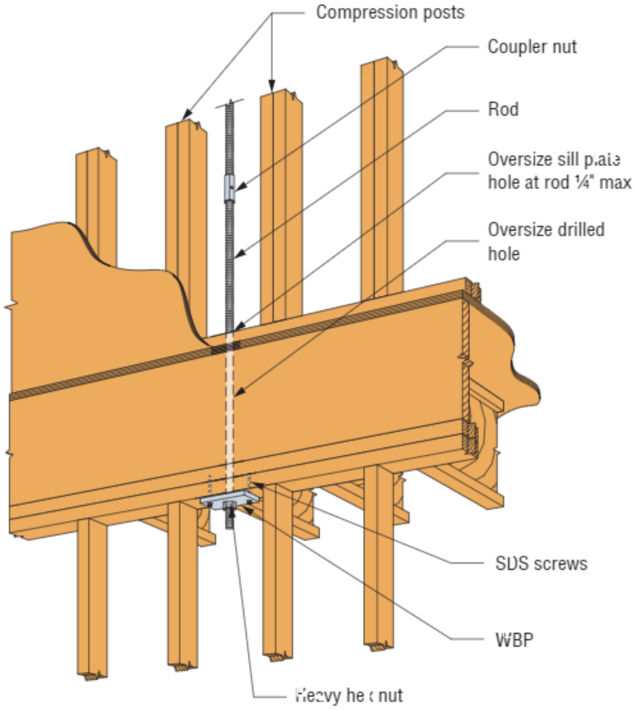
G Anchorage

Typically, rod runs will terminate at the foundation, using the dead load of the concrete to ultimately resist the uplift demands. The building code does, however, allow the designer or Engineer of Record to use a percentage of the dead load expected to exist during a wind event (with the percentage based on load combinations for either Strength or Allowable Stress Design). Consequently, if the uplift loads are low enough and dead loads are high enough, it is possible to terminate the rod runs underneath upper wood floors.

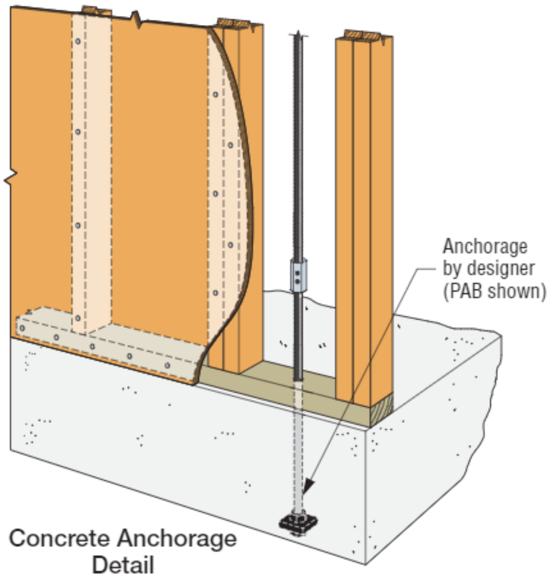
AC391 Criteria Section	AC391 Requirement
6.2.4.5 and 6.3.3.5	Design of the anchorage is the responsibility of the design professional and must be performed in accordance with the applicable code.



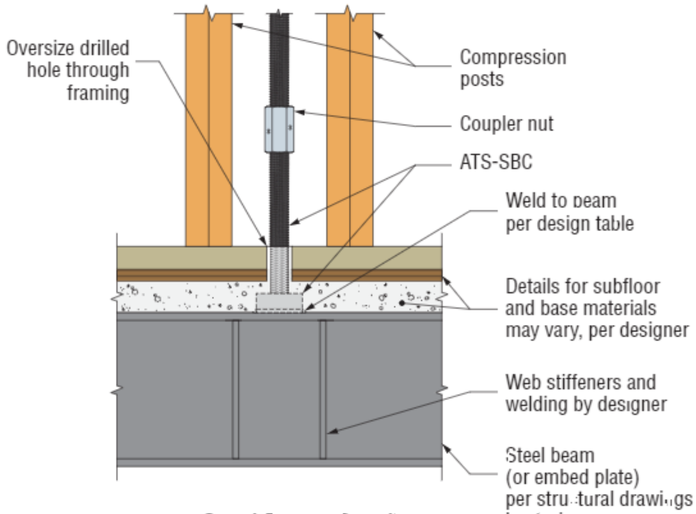
Wood Beam Detail



Wood Top Plate Detail



Concrete Anchorage Detail



Steel Beam Detail

See pp. 47–48 for more information on ATS anchorage details.

Anchorage (cont.)

SET-3G™
High-Strength Epoxy Adhesive

SET-3G is the latest innovation in epoxy anchoring adhesives from Simpson Strong-Tie. Formulated to provide superior performance in cracked and uncracked concrete at elevated temperatures, SET-3G installs and performs in a variety of environmental conditions and temperature extremes. The exceptional bond strength of SET-3G results in high design strengths at shallow embedment depths. Code listed per ICC-ES-ESR-4057 in accordance with ICC-ES AC308, ACI 355.4 and IBC 2018 requirements for cracked and uncracked concrete in static and seismic conditions, SET 3G anchoring adhesive can be installed when concrete substrate temperature is as high as 100ºF (38ºC).

SET-3G Adhesive

AT-XP Adhesive

AT-XP®
Fast-Curing Anchoring Adhesives

AT-XP anchoring adhesive from Simpson Strong-Tie has been formulated for high-strength anchorage of threaded rod and rebar into concrete under a wide range of conditions, such as cold weather installations. Code listed per IAPMO UES ER-263 in accordance with ICC-ES AC308, ACI 355.4 and IBC 2018 requirements for cracked and uncracked concrete in static or seismic conditions, AT-XP anchoring adhesive has demonstrated superior performance in reduced-temperature testing (can be installed in concrete substrate temperatures as low as (14°F (–10°C)).

Titen HD®
Rod Coupler Screw Anchor for Concrete Foundations

The Titen HD rod coupler screw anchor is designed to be used in conjunction with a single or multi-story continuous rod tie-down system. This anchor provides a fast and simple way to attach threaded rod to a concrete stem wall or thickened slab footing. Unlike adhesive anchors, the installation requires no special tool, cure time or secondary setting process; just drill a hole and drive the anchor.

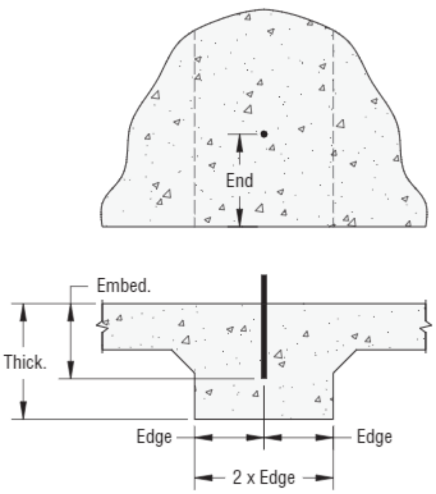
See p. 66 for load tables with possible solutions using Titen HD rod coupler anchors or adhesives.

Titen HD Rod Coupler Screw Anchor

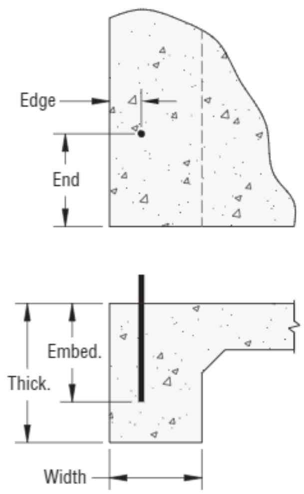
Allowable (ASD) Tension Loads for Post-Installed Anchors into Uncracked Concrete for Wind Loads

Anchorage		Interior Thickened Slab					Stem Wall or Turned-Down Slab						Elevated Slab				
Product	Size	Geometry (in.)				Allowable Tension (lb.)	Geometry (in.)				Allowable Tension (lb.)		Geometry (in.)			Allowable Tension (lb.)	
		Embed	Edge	End	Thick		Embed.	End	Thick.	Width	1¾" Edge Distance	2¾" Edge Distance	Embed.	End	Thick.	1¾" Edge Distance	2¾" Edge Distance
Titen HD® rod coupler	⅝" x 6¾"	5	6	1.75	10	1,740	5	6	10	8	1,740	1,740	5	5.5	10	1,740	1,740
	½" x 9¾"	8	6	10	14	2,420	8	10	14	8	2,3[illegible]5	2,420	8	5	14	2,420	2,420
SET-3G™ adhesive with threaded rod	⅜"-diameter rod	3	4	4	8	1,570	3	4	8	8	1,165	1,450	2½	6	8	1,055	1,365
		4	4	6	10	1,775	5	6	12	8	1,385	1,595	3¼	6	8	1,325	1,640
		4½	6	6	10	2,265	6	8	16	10	1,670	2,[illegible]	3½	6	10	1,385	1,695
	½"-diameter rod	3	4	5	8	1,425	3	6	8	8	1,370	1,450	3	6	8	1,380	1,730
		4	6	6	10	3,395	5	8	12	8	1,945	2,[illegible]45	5	8	8	1,585	1,865
		4½	8	8	12	4,115	7	8	18	10	2,065	2,430	4¼	8	10	1,870	2,225
	⅝"-diameter rod	4	4	6	8	1,940	4	6	10	8	1,905	2,025	3¼	6	8	1,505	1,865
		4	6	8	10	3,745	6	10	16	8	2,21[illegible]	2,310	6½	10	8	2,[illegible]55	2,325
		6	10	10	12	6,090	8	12	20	10	2,955	3,055	8½	12	10	2,445	2,800
	¾"-diameter rod	4	4	6	8	1,910	4	8	10	8	1,905	2,050	4	6	8	1,770	2,125
		5	6	8	10	3,495	6	10	14	8	2,305	2,4[illegible]5	6¼	10	8	2,15[illegible]	2,445
		7	10	10	18	8,015	10	16	24	10	3,360	3,450	8¼	12	10	2,810	3,1[illegible]5
AT-XP® adhesive with threaded rod	⅜"-diameter rod	3	6	8	5	1,265	3	6	8	8	870	1,105	3	6	8	870	1,105
		4	6	8	8	1,775	7	12	9	8	1,725	1,820	6	8	10	1,475	1,875
		4½	7	8	10	2,265	7½	12	10	10	1,845	2,265	7	12	12	1,725	2,185
	½"-diameter rod	3	6	6	6	2,430	4	6	10	8	1,585	1,740	3	6	8	1,255	1,505
		5	6	8	7½	2,675	8½	12	11	8	1,860	1,920	6	8	10	1,635	1,965
		7	8	10	16	3,875	10	16	14	10	2,570	2,640	7	12	12	1,910	2,290
	⅝"-diameter rod	3½	6	6	8	2,460	5	8	10	8	1,775	1,870	4	6	8	1,645	1,975
		6	6	8	10	2,725	9½	12	14	8	1,860	1,920	6	8	10	1,790	2,075
		8	8	10	20	5,355	12	18	16	10	2,790	2,855	8	12	12	2,385	2,770
	¾"-diameter rod	6	6	8	10	2,290	6	8	10	8	1,665	1,745	4	6	8	1,770	2,125
		8	6	8	12	2,835	10½	12	15	8	1,860	1,920	6	8	10	2,215	2,530
		10	8	16	24	6,290	14	22	18	10	3,000	3,055	8	12	12	2,640	2,995

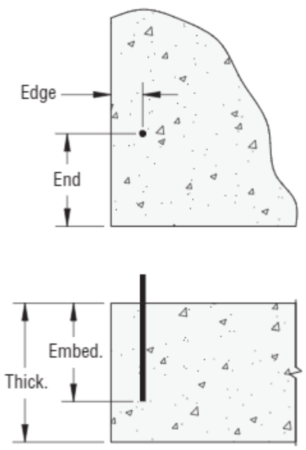
1. Allowable tension loads are based on the Strength Design provisions of ACI 318-14 and have been converted to Allowable Stress Design (ASD) levels by applying a 0.6 factor for Wind loads.
2. Tabulated values are applicable to the conditions listed below. Refer to the Simpson Strong-Tie Anchor Selector™ Design software for other conditions.
   a. Minimum concrete compressive strength = 2,500 psi
   b. Uncracked concrete
   c. Dry concrete
   d. Periodic special inspection
   e. Maximum short-term temperature = 150°F
   f. Maximum long-term temperature = 110°F
3. Tabulated values apply to design tension loads consisting of 100% wind loads.



Interior Thickened Slab



Turned-Down Slab (shown) or Stem Wall



Elevated Slab Edge

SIMPSON Strong-Tie

Specification of Uplift Restraint Systems

In the previous section of this guide, we shared wind uplift rod run component model numbers and capacities along with the design requirements published by ICC-ES in Acceptance Criteria 391. While some of these design considerations are for the rod run components, others are for the wall-framing elements that transfer load to the rod runs. Simpson Strong-Tie used these requirements to earn the only system evaluation report (ICC-ES ESR-1161) in the industry. However, AC391 also allows for reports that consider only rod run components and not the wall-framing elements. This allows the designer or Engineer of Record to specify a rod run based on the allowable load deflection values for the rod run itself, and determine for themselves an appropriate spacing of the rod runs to ensure the wall-framing elements satisfy load and deflection limits for their structure. To assist designers in the specification, we offer guidance below for two methods of specifying our Strong-Rod URS.

Designer Selects System and Specifies on Building Plans

Once designers know their wood framing species, net uplift at roof-bearing walls and length of rod run, then they can specify the following information on the plans:

- Hurricane ties to transfer uplift from roof truss/rafter to top plates
- Method (possibly hurricane ties) of restraining top-plate rotation
- URS model which includes:
  i. Rod diameter, shrinkage compensation device, length and spacing
  ii. Specification format:
  URS {3, 4, 5, 6} – {RTUD, ATUD} x {length in ft.-in.} @ {on-center spacing in inches}
  (Example: URS4-RTUD x 30'-8" @ 36")
- URS rod run termination details (anchorage at foundation or at a raised floor)

To assist in this specification, reference p. 69. Table 1 provides the allowable tension load (P_A) of each URS rod run based on model number (rod diameter and take-up device). Table 2 provides the equations to calculate the deflection of each URS model based on demand tension load, length and wood species. For simplicity, Tables 3 and 4 provide tabulated deflection values for various combinations of tension load and length.

Handling Deferred Submittals

Designers may choose to provide performance specification as part of their construction documents and require the contractor to submit deferred design calculations and shop drawings. To do so, the following performance criteria should be on the plans.

- URS rod run allowable demand tension load
- URS rod run on-center spacing
- URS rod run deflection limits
- URS rod run shrinkage compensation amount required
- URS rod run termination details (anchorage at foundation or at a floor)
- Hurricane ties to transfer uplift from roof truss/rafter to top plates
- Method (possibly hurricane ties) of restraining top plate rotation
- Any additional requirements as determined by the designer or Engineer of Record

Specification of Uplift Restraint Systems (cont.)

Design Example

Given: The exterior bearing walls of a project have a uniform roof uplift load of 250 plf, a roof bearing height of 40' above the top of the foundation, and use wall plates made of southern pine. The designer has determined that the dead load of the floors above requires anchorage to the foundation and would like to space the URS at 4' on center and limit the URS to a maximum deflection of 0.20" based on project-specific parameters.
(Tables 1–4 available on the following three pages of this guide.)

Step 1 — Determine the demand load on each URS run.

(250 lb./ft.) (4 ft.) = 1,000 lb. per URS rod run

Step 2 — Choose a shrinkage take-up device and determine the deflection for the URS rod run.

From Table 3, the URS4-RTUD has a deflection of 0.164" < 0.20"

Note: For demand loads (P_D) or rod run lengths (L) not listed in Table 3, Table 2 can be used to calculate URS deflection for any load and run length.

Step 3 — Specify the rod run: rod diameter, shrinkage compensation device, length and spacing.

URS4-RTUD — 40'–0" @ 48"

Step 4 — Specify the URS rod run anchorage.

See Allowable Tension Anchorage Loads on p. 66. Also, you may download the free Anchor Designer Software from **strongtie.com** or use the *Anchoring and Fastening Systems for Concrete and Masonry* catalog.

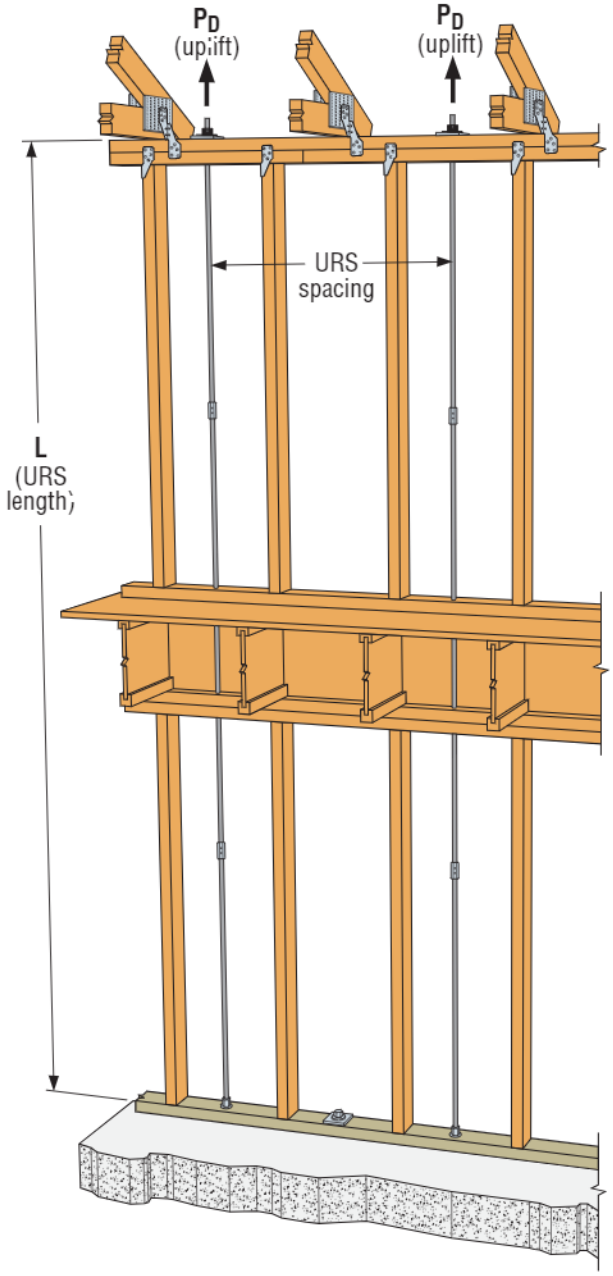
Step 5 — Specify the appropriate hurricane tie connector to resist the roof member uplift.

The H2.5A hurricane tie capacity is greater than 500 lb. (assumes trusses @ 2 ft. o.c.).

Note: For reference, see the *Wood Construction Connector* catalog or *High Wind–Resistant Construction Application Guide* (F-C-HWRCAG) for multiple hurricane tie options.

Step 6 — Specify a connection to prevent top-plate rotation.

See p. 58 to determine the required top-plate rotation restraint connection force. If a tie is specified at every other stud (32" o.c.), then this force is 333 lb. An H2.5A is a good choice since these are already being used for roof-to-top-plate connections.



Specification of Uplift Restraint Systems (cont.)

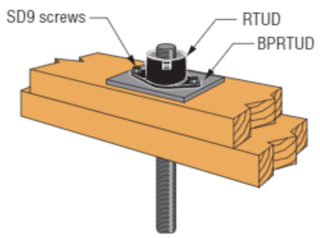
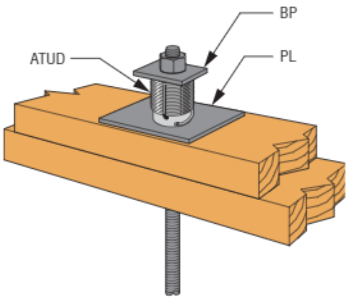
URS Run Tables:

Table 1 — Allowable Loads for URS Runs

URS Model	Allowable Load, P_A (lb.)		
	DF	SP	SPF
URS3-RTUD		2,400	
URS4-RTUD		4,270	
URS5-RTUD	6,675	6,575	5,355
URS6-RTUD	7,080	6,575	5,355
URS3-ATUD	2,310	2,085	1,570
URS4-ATUD	4,270	4,270	3,635
URS5-ATUD	5,250	4,745	3,570
URS6-ATUD	5,135	4,641	3,490

1. Tabulated allowable load is the lowest allowable load of the threaded rod, coupler nut, take-up device and bearing plate components for each URS model.

Table 2 — Deflection Equations

Shrinkage Take-Up Device	URS Model	Deflection, Δ (in.)		
		DF	SP	SPF
 Typical Ratcheting Take-Up Device Assembly Installation	URS3-RTUD	$\frac{P_D(5.3L + 10.9)}{1,000,000} + 0.044$	$\frac{P_D(5.3L + 11.5)}{1,000,000} + 0.044$	$\frac{P_D(5.3L + 13.9)}{1,000,000} + 0.044$
	URS4-RTUD	$\frac{P_D(2.9L + 6.7)}{1,000,000} + 0.040$	$\frac{P_D(2.9L + 7.4)}{1,000,000} + 0.040$	$\frac{P_D(2.9L + 9.7)}{1,000,000} + 0.040$
	URS5-RTUD	$\frac{P_D(1.8L + 5.5)}{1,000,000} + 0.056$	$\frac{P_D(1.8L + 6.1)}{1,000,000} + 0.056$	$\frac{P_D(1.8L + 7.9)}{1,000,000} + 0.056$
	URS6-RTUD	$\frac{P_D(1.2L + 5.5)}{1,000,000} + 0.057$	$\frac{P_D(1.2L + 6.0)}{1,000,000} + 0.057$	$\frac{P_D(1.2L + 7.9)}{1,000,000} + 0.057$
 Typical Take-Up Device Assembly Installation	URS3-ATUD	$\frac{P_D(5.3L + 18.7)}{1,000,000} + 0.001$	$\frac{P_D(5.3L + 20.5)}{1,000,000} + 0.001$	$\frac{P_D(5.3L + 26.9)}{1,000,000} + 0.001$
	URS4-ATUD	$\frac{P_D(2.9L + 8.8)}{1,000,000} + 0.001$	$\frac{P_D(2.9L + 9.6)}{1,000,000} + 0.001$	$\frac{P_D(2.9L + 12.4)}{1,000,000} + 0.001$
	URS5-ATUD	$\frac{P_D(1.8L + 9.0)}{1,000,000} + 0.001$	$\frac{P_D(1.8L + 9.8)}{1,000,000} + 0.001$	$\frac{P_D(1.8L + 12.6)}{1,000,000} + 0.001$
	URS6-ATUD	$\frac{P_D(1.2L + 8.6)}{1,000,000} + 0.002$	$\frac{P_D(1.2L + 9.5)}{1,000,000} + 0.002$	$\frac{P_D(1.2L + 12.3)}{1,000,000} + 0.002$

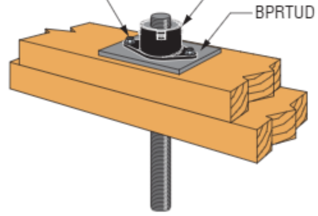
1. Tabulated deflection formulas account for rod elongation, wood bearing deformation and deflection of shrinkage compensating device. See pp. 70–71 for tabulated deflection values for various length and tension values.
2. Where P_D is the demand (or design) uplift load and L is the total length of the rod in inches between restraints (foundation level to take-up device).

Specification of Uplift Restraint Systems (cont.)

Table 3 — Tabulated Deflection Tables Using RTUD

L (ft.)	P_D (lb.)	DF Top Plates (in.)				SP Top Plates (in.)				SPF Top Plates (in.)			
		URS3-RTUD	URS4-RTUD	URS5-RTUD	URS6-RTUD	URS3-RTUD	URS4-RTUD	URS5-RTUD	URS6-RTUD	URS3-RTUD	URS4-RTUD	URS5-RTUD	URS6-RTUD
60	2,000	—[3]	—[3]	—[3]	0.216	—[3]	—[3]	—[3]	0.218	—[3]	—[3]	—[3]	0.221
	1,500	—[3]	—[3]	0.229	0.177	—[3]	—[3]	0.230	0.177	—[3]	—[3]	0.233	0.180
	1,000	—[3]	0.222	0.171	0.137	—[3]	0.222	0.172	0.137	—[3]	0.225	0.174	0.139
	750	—[3]	0.176	0.143	0.117	—[3]	0.177	0.143	0.117	—[3]	0.178	0.144	0.119
	500	0.219	0.131	0.114	0.097	0.219	0.131	0.114	0.097	0.220	0.132	0.115	0.098
	250	0.136	0.085	0.085	0.077	0.136	0.086	0.085	0.077	0.137	0.086	0.085	0.078
50	2,500	—[2]	—[3]	—[3]	0.225	—[2]	—[3]	—[3]	0.227	—[2]	—[3]	—[3]	0.231
	2,000	—[3]	—[3]	—[3]	0.192	—[3]	—[3]	—[3]	0.193	—[3]	—[3]	—[3]	0.196
	1,500	—[3]	—[3]	0.202	0.158	—[3]	—[3]	0.202	0.159	—[3]	—[3]	0.205	0.162
	1,000	—[3]	0.192	0.153	0.124	—[3]	0.193	0.154	0.125	—[3]	0.195	0.155	0.127
	750	—[3]	0.154	0.129	0.108	—[3]	0.155	0.129	0.108	—[3]	0.157	0.131	0.109
	500	0.192	0.116	0.105	0.091	0.192	0.117	0.105	0.091	0.193	0.118	0.106	0.092
40	3,000	—[2]	—[3]	—[3]	0.222	—[2]	—[3]	—[3]	0.224	—[2]	—[3]	—[3]	0.229
	2,000	—[3]	—[3]	0.214	0.167	—[3]	—[3]	0.215	0.168	—[3]	—[3]	0.218	0.172
	1,500	—[3]	0.225	0.174	0.140	—[3]	0.226	0.175	0.140	—[3]	0.229	0.178	0.143
	1,000	—[3]	0.163	0.135	0.112	—[3]	0.164	0.135	0.113	—[3]	0.166	0.137	0.114
	750	0.221	0.133	0.115	0.098	0.222	0.133	0.115	0.099	0.224	0.135	0.117	0.100
	500	0.165	0.102	0.095	0.085	0.166	0.102	0.096	0.085	0.167	0.103	0.097	0.086
30	4,000	—[2]	—[3]	—[3]	0.228	—[2]	—[3]	—[3]	0.230	—[2]	—[3]	—[3]	0.237
	3,000	—[2]	—[3]	0.237	0.185	—[2]	—[3]	0.239	0.186	—[2]	—[3]	0.244	0.192
	2,000	—[3]	0.228	0.177	0.142	—[3]	0.230	0.178	0.143	—[3]	0.234	0.182	0.147
	1,000	0.224	0.134	0.116	0.100	0.225	0.135	0.117	0.100	0.227	0.137	0.119	0.102
	500	0.139	0.087	0.086	0.078	0.139	0.087	0.086	0.079	0.140	0.089	0.087	0.079
20	5,000	—[2]	—[2]	—[3]	0.208	—[2]	—[2]	—[3]	0.211	—[2]	—[2]	—[3]	0.220
	4,000	—[2]	—[3]	0.225	0.178	—[2]	—[3]	0.227	0.180	—[2]	—[3]	0.234	0.188
	3,000	—[2]	0.235	0.182	0.148	—[2]	0.237	0.184	0.149	—[2]	0.244	0.190	0.155
	2,000	—[3]	0.170	0.140	0.118	—[3]	0.171	0.141	0.119	—[3]	0.176	0.145	0.122
	1,000	0.171	0.105	0.098	0.087	0.171	0.106	0.099	0.088	0.174	0.108	0.101	0.090
	500	0.112	0.073	0.077	0.072	0.112	0.073	0.077	0.072	0.113	0.074	0.078	0.073
10	5,000	—[2]	—[2]	0.175	0.146	—[2]	—[2]	0.178	0.149	—[2]	—[2]	0.187	0.158
	4,000	—[2]	0.183	0.151	0.129	—[2]	0.186	0.153	0.131	—[2]	0.195	0.161	0.138
	3,000	—[2]	0.148	0.127	0.111	—[2]	0.150	0.129	0.112	—[2]	0.157	0.135	0.118
	2,000	0.182	0.112	0.104	0.093	0.183	0.113	0.105	0.094	0.188	0.118	0.108	0.098
	1,000	0.117	0.076	0.080	0.075	0.118	0.077	0.080	0.075	0.120	0.079	0.082	0.077
	500	0.085	0.058	0.068	0.066	0.085	0.058	0.068	0.066	0.087	0.059	0.069	0.067

1. Tabulated deflection values include rod elongation, wood bearing deformation and deflection of shrinkage compensating device. For design loads and lengths not listed, use the deflection calculations tabulated on p. 69.
2. Noted values exceed the maximum allowable load for the URS run.
3. Noted values exceed the maximum rod elongation of 0.18" specified in Section 3.2.1.1 of ICC-ES AC391.
4. Where P_D is the demand (or design) uplift load and L is the total length of the rod between restraints (foundation level to take-up device).



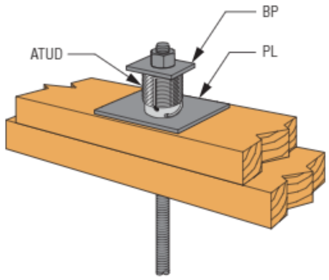
Typical Ratcheting Take-Up Device Assembly Installation

Specification of Uplift Restraint Systems (cont.)

Table 4 — Tabulated Deflection Tables Using ATUD

L (ft.)	P_D (lb.)	DF Top Plates (in.)				SP Top Plates (in.)				SPF Top Plates (in.)			
		URS3-ATUD	URS4-ATUD	URS5-ATUD	URS6-ATUD	URS3-ATUD	URS4-ATUD	URS5-ATUD	URS6-ATUD	URS3-ATUD	URS4-ATUD	URS5-ATUD	URS6-ATUD
60	2,000	—[3]	—[3]	—[3]	0.168	—[3]	—[3]	—[3]	0.169	—[2]	—[3]	—[3]	0.175
	1,500	—[3]	—[3]	0.179	0.126	—[3]	—[3]	0.180	0.128	—[3]	—[3]	0.185	0.132
	1,000	—[3]	0.185	0.120	0.085	—[3]	0.186	0.121	0.086	—[3]	0.188	0.123	0.089
	750	—[3]	0.139	0.090	0.064	—[3]	0.139	0.091	0.065	—[3]	0.142	0.093	0.067
	500	0.171	0.093	0.060	0.043	0.171	0.093	0.061	0.044	0.175	0.095	0.062	0.045
	250	0.086	0.047	0.031	0.023	0.086	0.047	0.031	0.023	0.088	0.048	0.032	0.024
50	2,500	—[2]	—[3]	—[3]	0.178	—[2]	—[3]	—[3]	0.180	—[2]	—[3]	—[3]	0.187
	2,000	—[3]	—[3]	—[3]	0.143	—[3]	—[3]	—[3]	0.145	—[2]	—[3]	—[3]	0.150
	1,500	—[3]	—[3]	0.152	0.108	—[3]	—[3]	0.153	0.109	—[3]	—[3]	0.157	0.113
	1,000	—[3]	0.156	0.102	0.072	—[3]	0.156	0.102	0.073	—[3]	0.159	0.105	0.076
	750	—[3]	0.117	0.076	0.055	—[3]	0.118	0.077	0.055	—[3]	0.120	0.079	0.058
	500	0.144	0.078	0.051	0.037	0.145	0.079	0.052	0.038	0.148	0.080	0.053	0.039
40	3,000	—[2]	—[3]	—[3]	0.176	—[2]	—[3]	—[3]	0.179	—[2]	—[3]	—[3]	0.187
	2,000	—[3]	—[3]	0.165	0.118	—[3]	—[3]	0.167	0.120	—[2]	—[3]	0.173	0.126
	1,500	—[3]	0.189	0.124	0.089	—[3]	0.190	0.126	0.090	—[3]	0.195	0.130	0.095
	1,000	—[3]	0.126	0.083	0.060	—[3]	0.127	0.084	0.061	—[3]	0.130	0.087	0.064
	750	0.175	0.095	0.063	0.046	0.177	0.096	0.063	0.046	0.181	0.098	0.065	0.048
	500	0.117	0.064	0.042	0.031	0.118	0.064	0.043	0.031	0.121	0.066	0.044	0.033
30	4,000	—[2]	—[3]	—[3]	0.185	—[2]	—[3]	—[3]	0.188	—[2]	—[2]	—[2]	—[2]
	3,000	—[2]	—[3]	0.193	0.139	—[2]	—[3]	0.195	0.142	—[2]	—[3]	0.204	0.150
	2,000	—[3]	0.194	0.129	0.093	—[3]	0.195	0.130	0.095	—[2]	0.201	0.136	0.101
	1,000	0.180	0.097	0.065	0.048	0.182	0.098	0.066	0.049	0.188	0.101	0.069	0.051
	500	0.090	0.049	0.033	0.025	0.091	0.050	0.033	0.025	0.095	0.051	0.035	0.027
20	5,000	—[2]	—[2]	—[3]	0.169	—[2]	—[2]	—[2]	—[2]	—[2]	—[2]	—[2]	—[2]
	4,000	—[2]	—[3]	0.183	0.135	—[2]	—[3]	0.187	0.139	—[2]	—[2]	—[2]	—[2]
	3,000	—[2]	0.203	0.138	0.102	—[2]	0.205	0.140	0.105	—[2]	0.213	0.149	0.113
	2,000	—[3]	0.135	0.092	0.069	—[3]	0.137	0.094	0.070	—[2]	0.142	0.099	0.076
	1,000	0.126	0.068	0.047	0.035	0.128	0.069	0.047	0.036	0.135	0.072	0.050	0.039
	500	0.064	0.035	0.024	0.019	0.065	0.035	0.024	0.019	0.068	0.036	0.026	0.021
10	5,000	—[2]	—[2]	0.138	0.107	—[2]	—[2]	—[2]	—[2]	—[2]	—[2]	—[2]	—[2]
	4,000	—[2]	0.153	0.110	0.086	—[2]	0.156	0.113	0.089	—[2]	—[2]	—[2]	—[2]
	3,000	—[2]	0.115	0.083	0.065	—[2]	0.117	0.085	0.067	—[2]	0.126	0.094	0.076
	2,000	0.145	0.077	0.056	0.044	0.149	0.079	0.057	0.046	—[2]	0.084	0.063	0.051
	1,000	0.073	0.039	0.028	0.023	0.075	0.040	0.029	0.024	0.081	0.043	0.032	0.027
	500	0.037	0.020	0.015	0.012	0.038	0.020	0.015	0.013	0.041	0.022	0.016	0.014

1. Tabulated deflection values include rod elongation, wood bearing deformation and deflection of shrinkage compensating device. For design loads and lengths not listed, use the deflection calculations tabulated on p. 69.
2. Noted values exceed the maximum allowable load for the URS run.
3. Noted values exceed the maximum rod elongation of 0.18" specified in Section 3.2.1.1 of ICC-ES AC391.
4. Where P_D is the demand (or design) uplift load and L is the total length of the rod between restraints (foundation level to take-up device).



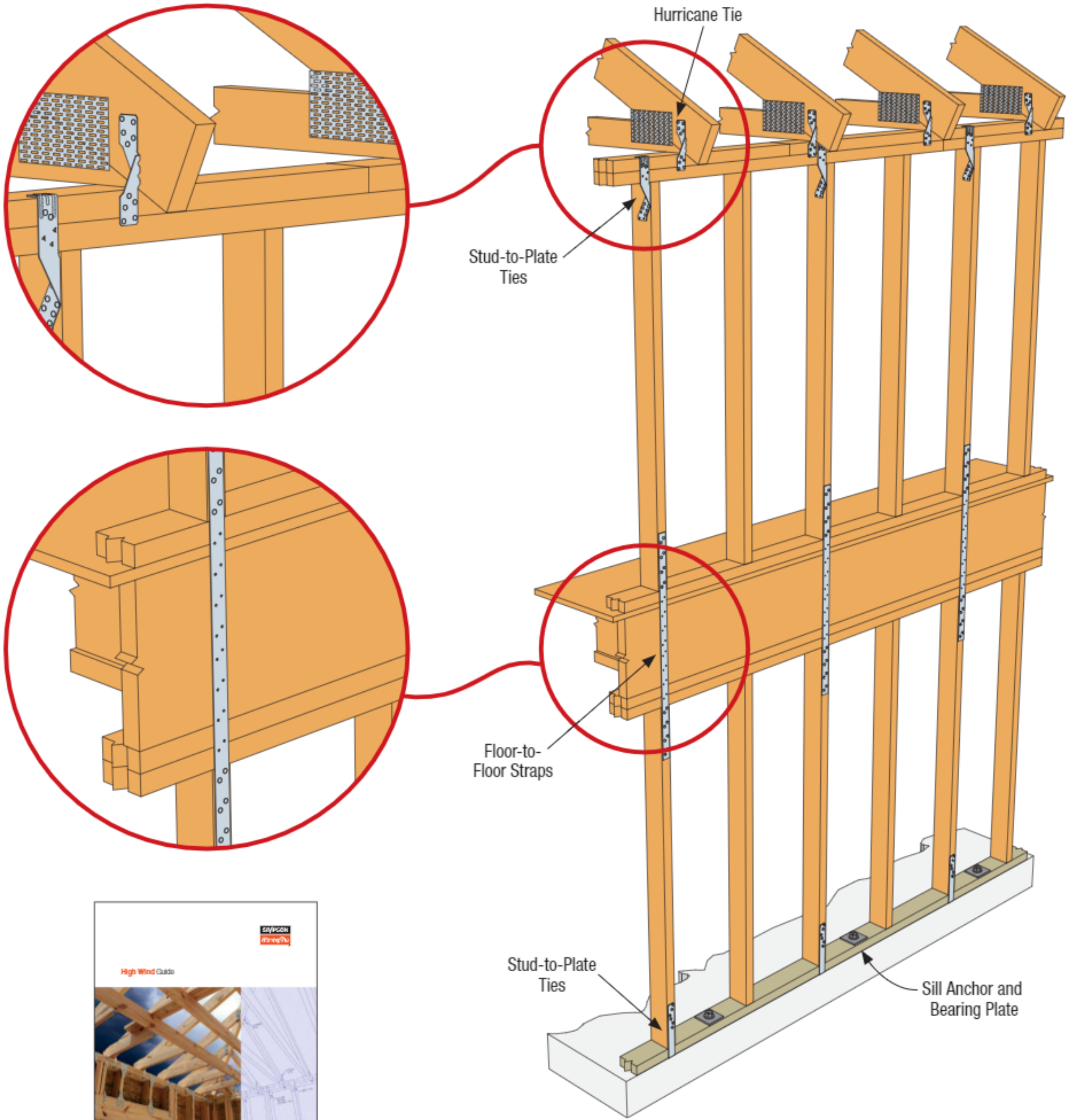
Typical Take-Up Device Assembly Installation

SIMPSON Strong-Tie

Simpson Strong-Tie understands that designers need economical solutions to establish a continuous load path from the roof to the foundation. In addition to our Strong-Rod® Uplift Restraint System for roofs, Simpson Strong-Tie has long been the industry leader in providing connector and fastening solutions to meet these specific requirements.

Simpson Strong-Tie® Connectors for Roof Uplift

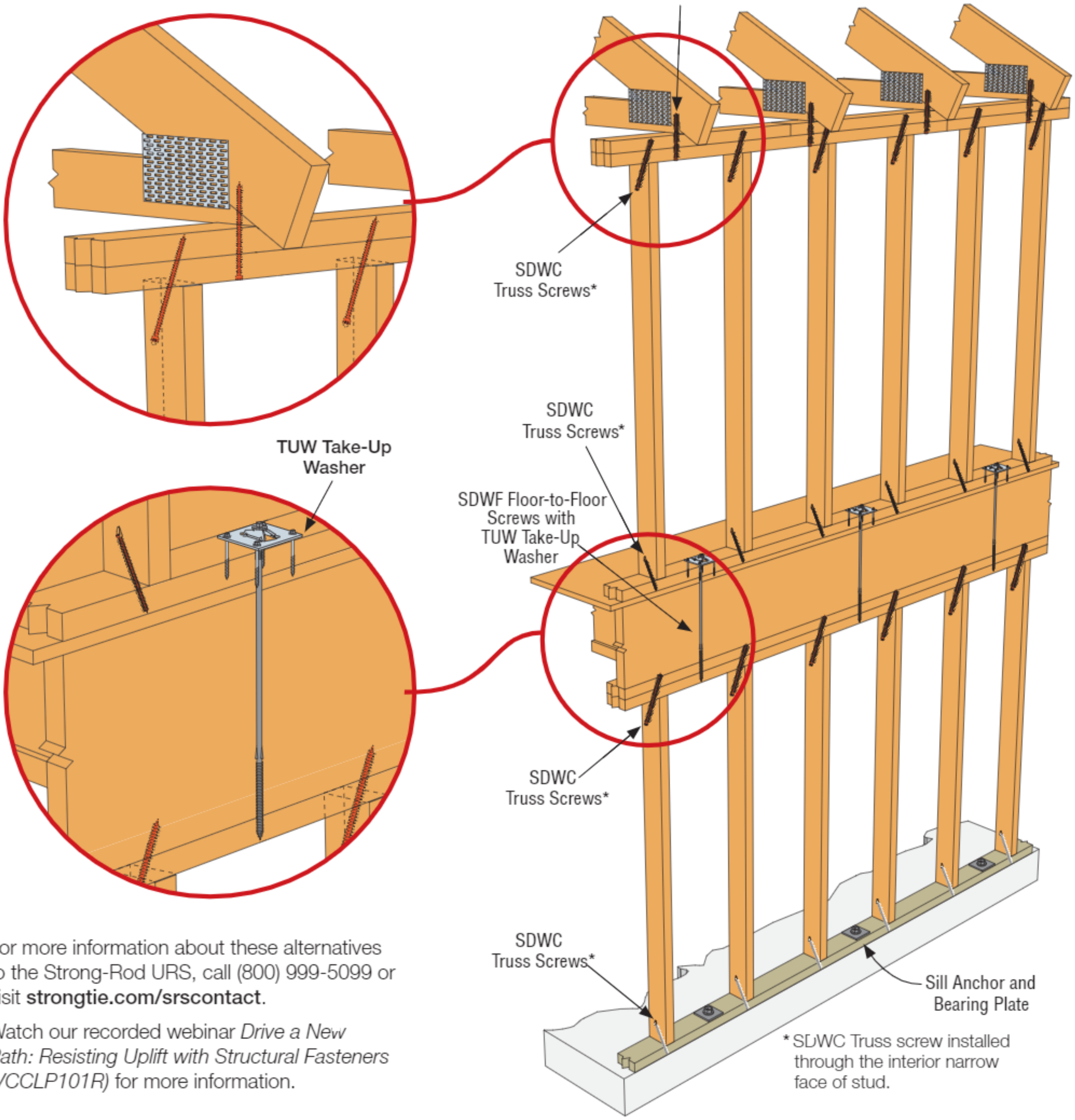
Simpson Strong-Tie offers a wealth of top plate-to-stud, top plate-to-truss and hurricane tie connectors that can be installed to resist wind uplift forces that affect roofs. Depending on the particular connection and the loads required, you can be confident that Simpson Strong-Tie has the connector you need.



High Wind Guide
(F-C-HWG)

Fastening Systems Designed for Floor-to-Floor, Stud-to-Plate and Truss-to-Top-Plate Connections

Simpson Strong-Tie provides two Strong-Drive® fastener models designed to create a continuous load path from the roof down to the foundation. The Strong-Drive SDWF Floor-to-Floor screw, when used with TUW take-up washer, is designed to simplify floor-to-floor wind-uplift restraint while providing shrinkage compensation and superior performance over the life of the structure. The Strong-Drive SDWF Floor-to-Floor screw is code listed in ICC-ES ESR-3046, and the TUW take-up washer is in ESR-2320. The unique design of the Strong-Drive SDWF Floor-to-Floor screw enables it to attach upper and lower walls together from the top, spanning the floor system and providing an easy-to-install connection within the continuous uplift load path of the structure. The Strong-Drive SDWC Truss screw is tested in accordance with ICC-ES AC233 (screw) and AC13 (wall assembly and roof-to-wall assembly) for uplift and lateral loads between wall plates and vertical wall framing and between the top plate and the roof rafters or trusses.



* SDWC Truss screw installed through the interior narrow face of stud.

For more information about these alternatives to the Strong-Rod URS, call (800) 999-5099 or visit **strongtie.com/srscontact**.

Watch our recorded webinar *Drive a New Path: Resisting Uplift with Structural Fasteners (VCCLP101R)* for more information.

Simpson Strong-Tie Limited Warranty

SIMPSON Strong-Tie

Effective Date: May 10, 2021

This Limited Warranty applies to all Simpson Strong-Tie products ("Products"), purchased after the Effective Date while this Limited Warranty remains in effect, other than those Simpson Strong-Tie products that have a separate Limited Warranty applicable to such products. For purchases after the Effective Date, please consult strongtie.com/limited-warranties, as this Limited Warranty may be updated by Simpson from time to time. All future purchases of Products are subject to the terms of the Limited Warranty in effect as of the purchase date.

This Limited Warranty must be read in conjunction with all applicable General Notes, General Instructions for the Installer, General Instructions for the Designer, Building Codes, Corrosion Information, and Terms & Conditions of Sale, along with any other information or specifications published by Simpson Strong-Tie Company Inc. ("Simpson") or available on the strongtie.com website ("Website") or on the product package, label or product manual. All of this information is referred to collectively as the "Simpson Strong-Tie Documentation." All applicable Simpson Documentation must be carefully reviewed each time any Product is used.

Simpson Strong-Tie warrants, to the original purchaser only, that each Product will be free from substantial defects in materials, manufacturing and design if properly specified, installed, and maintained, and when used in accordance with the design limits and the structural, technical, and environmental specifications in the Simpson Strong-Tie Documentation. This Limited Warranty is void and does not apply to any (a) Product purchased from an unauthorized dealer, retailer or distributor, (b) Product deterioration or damage due to environmental conditions or inadequate or improper handling, transportation, storage or maintenance, (c) cosmetic defects, including discoloration, (d) failure or damage caused by improper installation, application, mixing or preparation, (e) use of a Product in temperatures or environmental conditions outside the ranges specified for such Product in the Simpson Strong-Tie Documentation, (f) use of a Product outside of its shelf-life specifications, (g) normal wear and tear, (h) failure or damage caused by the use of a Product with any fasteners, pins, screwstrips, products or accessories other than authentic Simpson Strong-Tie products, (i) Product that was subjected to negligence or excessive or improper use, including any use not in accordance with the Simpson Strong-Tie Documentation, (j) failure or damage caused by the building site, foundation, or any third-party products, building materials or components, (k) failure or damage caused by use of a Product in a structure that has a design or other defect or that does not comply with all applicable building codes, laws, rules and regulations, (l) modified Product, or any nonstandard use or application of a Product, (m) failure or damage caused by corrosion, termites or other wood destroying organisms, animal or insect activity, wood fungal decay, rot, mold, mildew, exposure to chemicals or other hazardous substances, a corrosive environment or materials, inadequate moisture protection, or premature deterioration of building materials, (n) failure or damage caused by an act of God, including any hurricane, earthquake, tornado, lightning, ice, snow, high wind, flood or other severe weather or natural phenomena, (o) installation services or workmanship, including any failure or damage caused by installation of any Product, whether or not in accordance with the Simpson Strong-Tie Documentation, or (p) failure or damage caused by the gross negligence, willful misconduct, or other acts or omissions of the builder, general contractor, installer or any third party, including the building owner. Notwithstanding the foregoing, Simpson Strong-Tie disclaims and does not provide any warranty related to the design of any custom-order or non-design guide Product.

Although Products are designed for a wide variety of uses, Simpson Strong-Tie assumes no liability for confirming that any Product is appropriate for an intended use, and each intended use of a Product must be reviewed and approved by qualified professionals. Each Product is designed for the load capacities and uses listed in the Simpson Strong-Tie Documentation, subject to the limitations and other information set forth in the Simpson Strong-Tie Documentation. Due to the particular characteristics of potential impact events such as earthquakes and high velocity winds, the specific design and location of the structure, the building materials used, the quality of construction, or the condition of the soils or substrates involved, damage may nonetheless result to a structure and its contents even if the loads resulting from the impact event do not exceed Simpson Strong-Tie's specifications and the Products are properly installed in accordance with applicable building codes, laws, rules and regulations.

Product demonstrations, training, operator examinations, technical and customer support and other services provided by Simpson Strong-Tie are based on Simpson Strong-Tie's present knowledge and experience, are conducted for illustrative or instructive purposes only, do not constitute a warranty of Product capabilities, specifications or installation and do not modify the applicable Limited Warranty for Products set forth herein. Any services provided by Simpson Strong-Tie are provided without any representation or warranty of any kind, and Simpson Strong-Tie assumes no liability for any representations or statements made as part of such Product demonstrations, training, operator examinations or other services. In the event of any inconsistency between any information provided during any such demonstration or service, and the information in any applicable Simpson Strong-Tie Documentation, the information in the Simpson Strong-Tie Documentation shall govern. In the event of any inconsistency between any information provided on the Website, and the information in any other Simpson Strong-Tie Documentation, the information on the Website shall govern.

ALL WARRANTY OBLIGATIONS OF SIMPSON STRONG-TIE SHALL BE LIMITED, AT SIMPSON STRONG-TIE'S ABSOLUTE DISCRETION, TO EITHER REPAIRING THE DEFECTIVE PRODUCT OR PROVIDING A REPLACEMENT FOR THE DEFECTIVE PRODUCT. THIS REMEDY CONSTITUTES SIMPSON STRONG-TIE'S SOLE OBLIGATION AND LIABILITY AND THE SOLE AND EXCLUSIVE REMEDY OF PURCHASER AND, WITHOUT LIMITING THE GENERALITY OF THE FOREGOING, EXCLUDES ANY LABOR OR OTHER COSTS INCURRED IN CONNECTION WITH A WARRANTY CLAIM. PURCHASER ASSUMES ALL RISK AND LIABILITY ASSOCIATED WITH ANY USE OF THE PRODUCT, INCLUDING BUT NOT LIMITED TO SUITABILITY FOR ITS INTENDED USE.

THE LIMITED WARRANTY HEREIN IS EXPRESSLY IN LIEU OF ALL OTHER WARRANTIES, AND, WHERE LAWFUL, SIMPSON STRONG-TIE DISCLAIMS ALL OTHER WARRANTIES, INCLUDING BUT NOT LIMITED TO IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE AND WARRANTIES ARISING FROM COURSE OF PERFORMANCE, COURSE OF DEALING OR TRADE USAGE. IN NO EVENT WILL SIMPSON STRONG-TIE BE LIABLE FOR INCIDENTAL, CONSEQUENTIAL, PUNITIVE OR SPECIAL DAMAGES OR DIRECT OR INDIRECT LOSS OF ANY KIND, INCLUDING BUT NOT LIMITED TO PROPERTY DAMAGE, DEATH AND PERSONAL INJURY. SIMPSON STRONG-TIE'S ENTIRE LIABILITY IS LIMITED TO THE PURCHASE PRICE OF THE DEFECTIVE PRODUCT. SOME STATES DO NOT ALLOW LIMITATIONS ON HOW LONG AN IMPLIED WARRANTY LASTS, OR THE EXCLUSION OR LIMITATION OF INCIDENTAL OR CONSEQUENTIAL DAMAGES, SO THE ABOVE LIMITATION OR EXCLUSION MAY NOT APPLY TO YOU. THIS WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS, AND YOU MAY ALSO HAVE OTHER RIGHTS WHICH VARY FROM STATE TO STATE.

To obtain warranty service, you must contact Simpson Strong-Tie promptly at (800) 999-5099 or at Simpson Strong-Tie Company Inc., 5956 West Las Positas Boulevard, Pleasanton, CA 94588, regarding any potential claim, no later than sixty (60) days after you discover the potential claim. Upon request by Simpson Strong-Tie, you must provide Simpson Strong-Tie with: (a) proof of purchase and written records evidencing, in reasonable detail, the date and manner of installation, application, mixing and preparation of the Products, as applicable, (b) a reasonable opportunity to inspect the site where the Product was installed, and (c) samples of the Products from the actual installation in sufficient quantities in order for Simpson Strong-Tie to perform testing to determine whether or not the Product failed as set forth herein. Simpson Strong-Tie may, in its absolute discretion, request that you return the allegedly defective Products to Simpson Strong-Tie, in which case Simpson Strong-Tie will issue a Return Materials Authorization (RMA), which must be completed and returned to Simpson Strong-Tie with the Product. Simpson Strong-Tie is not responsible for any costs or expenses incurred in connection with any inspection (other than by Simpson Strong-Tie employees) or in connection with the return of Products to Simpson Strong-Tie, but Simpson Strong-Tie shall bear all costs and expenses incurred in connection with the shipment of replacement Products in the event that Simpson Strong-Tie determines that the Product should be replaced in accordance with this Limited Warranty. If Simpson Strong-Tie elects to repair or replace the Product, Simpson Strong-Tie shall have a reasonable time to do so.

No one is authorized to change or add to this Limited Warranty. If at any time Simpson Strong-Tie does not enforce any of the terms, conditions or limitations stated in this Limited Warranty, Simpson Strong-Tie shall not have waived the benefit of said term, condition or limitation and can enforce it at any time. This Limited Warranty is extended only to the original purchaser and is not transferrable. It is not intended nor shall it be construed to create rights in any third party.

Simpson Strong-Tie Brand Tools One-Year Limited Warranty

Simpson Strong-Tie Company Inc. ("Simpson") provides this Limited Warranty to original purchasers of the Simpson Strong-Tie® brand tool product ("Product"). This Limited Warranty is effective as of the date of purchase. This Product, if properly stored, maintained and used in compliance with all instructions and warnings, will be free from substantial defects in material and manufacturing for one year of purchase. This Limited Warranty does not cover normal wear and tear, as determined by Simpson in its absolute discretion, and is null and void with respect to: (a) any Product that was purchased from an unauthorized dealer, retailer or distributor, (b) any Product that was modified or altered, (c) any Product that was improperly or inadequately serviced or maintained, (d) any Product that was subject to negligence or excessive or improper use, including use in improper conditions, as determined by Simpson in its absolute discretion, (e) any failure or damage caused by the use of a Product with any accessories other than authentic Simpson products, or (f) any Product that was subject to any use not in accordance with the applicable specifications provided with the Product or on the strongtie.com website. If any Product fails to conform to this Limited Warranty, original purchaser's sole and exclusive remedy is either the replacement or repair, at Simpson's election, of the defective Product. Original purchaser must return the Product to Simpson along with satisfactory proof of purchase, with return shipping prepaid by original purchaser. To obtain warranty service, go to strongtie.com or contact Simpson promptly at (800) 999-5099. The repaired or replaced Product is warranted under the terms of this Limited Warranty.

THE LIMITED WARRANTY HEREIN IS EXPRESSLY IN LIEU OF ALL OTHER WARRANTIES, AND, WHERE LAWFUL, SIMPSON DISCLAIMS ALL OTHER WARRANTIES, INCLUDING BUT NOT LIMITED TO IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE AND WARRANTIES ARISING FROM COURSE OF PERFORMANCE, COURSE OF DEALING OR TRADE USAGE BEYOND THIS WARRANTY PERIOD. SOME STATES DO NOT ALLOW LIMITATIONS ON HOW LONG AN IMPLIED WARRANTY LASTS, SO THE ABOVE LIMITATION MAY NOT APPLY TO YOU. WHERE LAWFUL, UNDER NO CIRCUMSTANCES SHALL SIMPSON BE LIABLE FOR INCIDENTAL, CONSEQUENTIAL, PUNITIVE OR SPECIAL DAMAGES OR DIRECT OR INDIRECT LOSS OF ANY KIND, INCLUDING BUT NOT LIMITED TO BODILY INJURY, DEATH OR PROPERTY DAMAGE. SIMPSON'S ENTIRE LIABILITY IS LIMITED TO THE PURCHASE PRICE OF THE DEFECTIVE PRODUCT. SOME STATES DO NOT ALLOW THE EXCLUSION OR LIMITATION OF INCIDENTAL OR CONSEQUENTIAL DAMAGES, SO THE ABOVE LIMITATION OR EXCLUSION MAY NOT APPLY TO YOU. SIMPSON IS IN NO WAY LIABLE FOR INCIDENTS RESULTING FROM USE WITHOUT PROPER CERTIFICATION OR DISREGARD OF INSTRUCTIONS AND WARNINGS. THIS LIMITED WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS, AND YOU MAY ALSO HAVE OTHER RIGHTS WHICH VARY FROM STATE TO STATE.

Onsite for your success

Ensuring the integrity of mid-rise structures against seismic and wind forces requires many complex design considerations unique to each project. Our onsite knowledge is the perfect complement to our Strong-Rod systems. With Simpson Strong-Tie field support, you'll have highly skilled experts on the jobsite to help you manage project changes, answer product questions and supply engineering advice. We offer training, conduct preconstruction meetings and provide a project overview so that your team can build the safest structure possible while keeping material costs low and installation easy. When it comes to onsite support, we're there every step of the way.

F-L-SRS21 Effective 5/1/2021 Expires 12/31/2023