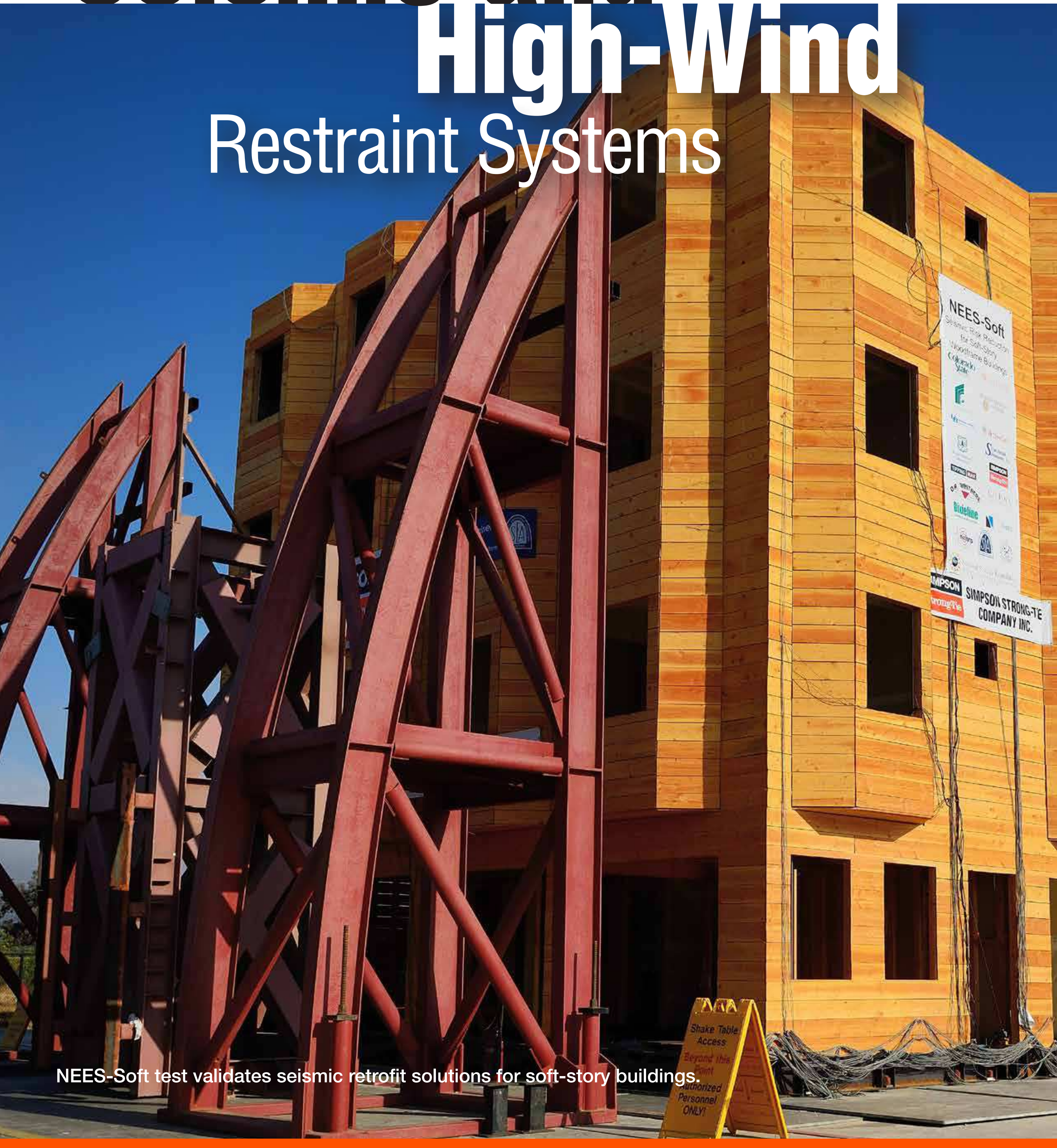
Strong-Rod™ Systems

SEISMIC AND WIND RESTRAINT SYSTEMS GUIDE

800-999-5099 | www.strongtie.com

Seismic and High-Wind Restraint Systems



NEES-Soft test validates seismic retrofit solutions for soft-story buildings.

Your Full-Solution Partner

Simpson Strong-Tie introduces the Strong-Rod™ continuous rod tiedown system for light-frame, multi-story wood construction. Our Strong-Rod Anchor Tiedown System for shearwall overturning restraint and Strong-Rod Uplift Restraint System for roofs address many of the design challenges specifically associated with multi-story buildings that must withstand seismic activity or wind events.

Multi-story structures require a variety of special design considerations, and having a reliable, highly knowledgeable design partner is critical to keeping projects on time and within budget. No company knows light-frame wood construction better than Simpson Strong-Tie, and we have everything you need to design your building. Code-listed components and systems that come with unmatched testing and design expertise are your formula for success.

Let Simpson Strong-Tie be your partner in designing the safest building possible with materials suited specifically for the application, making installation easier and costs lower. To find out how we can help you, visit us at **www.strongtie.com/srscontact** or call 800-999-5099.

Company Profile

For nearly 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 ***www.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
- Most thoroughly tested and evaluated products in the industry
- Strategically located manufacturing and warehouse facilities
- National code agency listings
- 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 9001-2008 Registered

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

Table of Contents

Seismic and wind events are serious threats to structural integrity and 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 multi-story wood-framed structures, however, rod systems have become an increasingly popular load restraint solution.

Multi-story structures present complicated design challenges. Frequently, the structures have larger windows and entrances, 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.

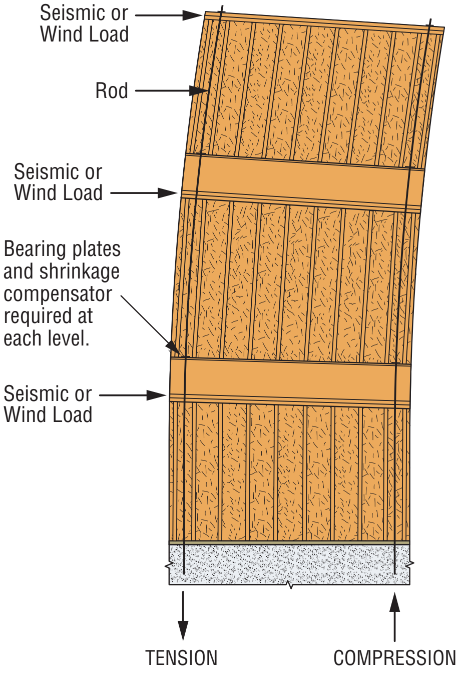
To contact a Simpson Strong-Tie representative for help designing your Strong-Rod™ continuous rod tiedown solution, call 800-999-5099 or visit **www.strongtie.com/srscontact**.

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.

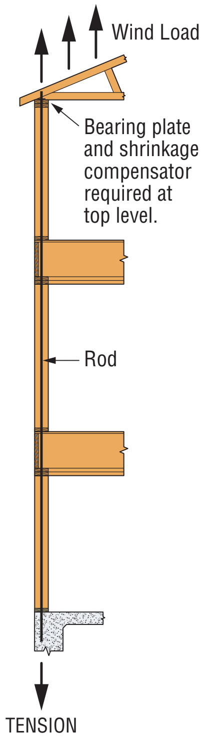
Shearwall Overturning Restraint System

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 multi-story 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, construction settling, shrinkage compensating device deflection, incremental loads, 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

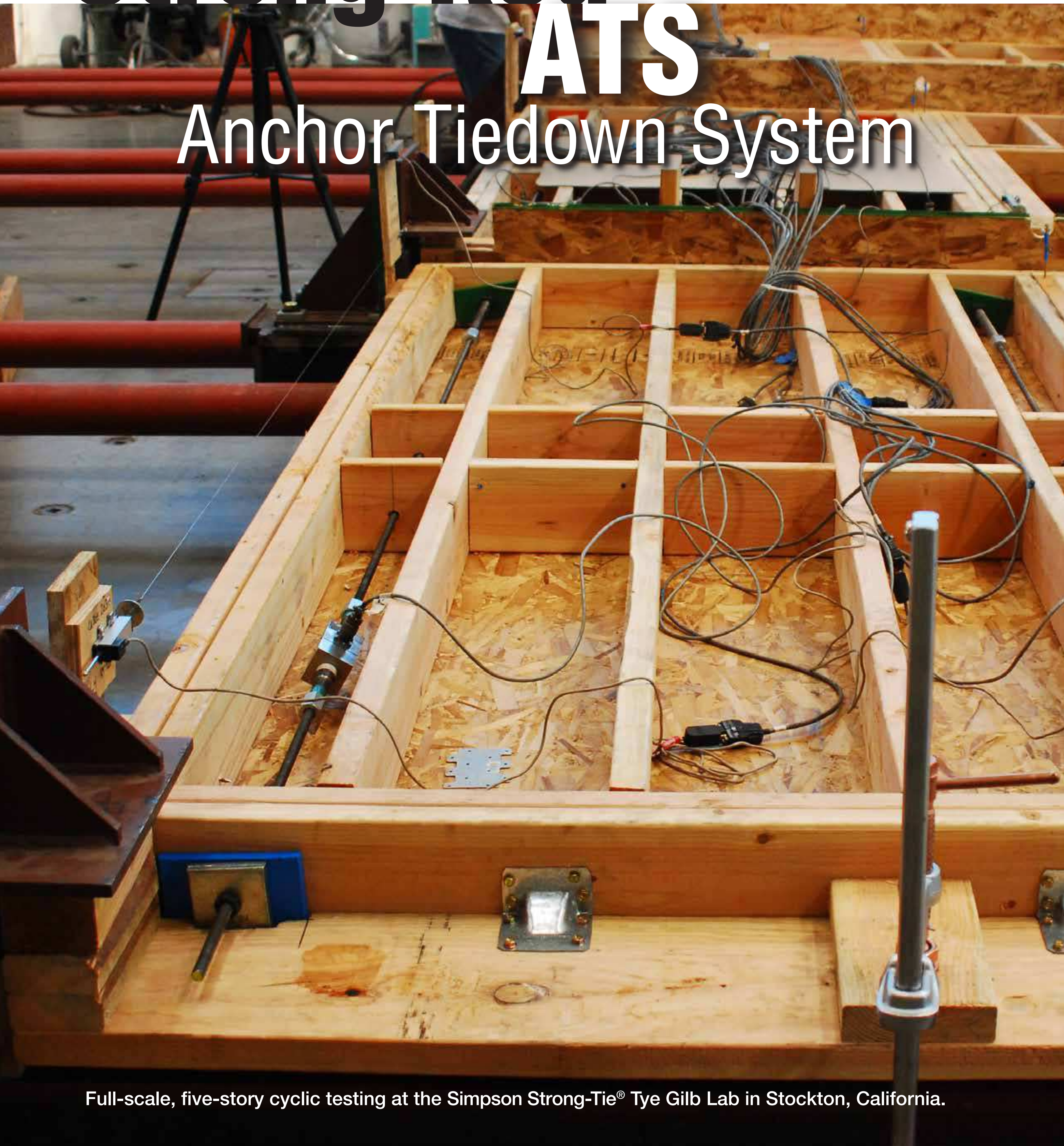
A large number of factors need to be considered when specifying a rod system:

- Wood shrinkage
- Initial and equilibrium moisture content of wood members
- Rod elongation
- Take-up device deflection
- Construction settling
- Regional code limitations
- Local requirements

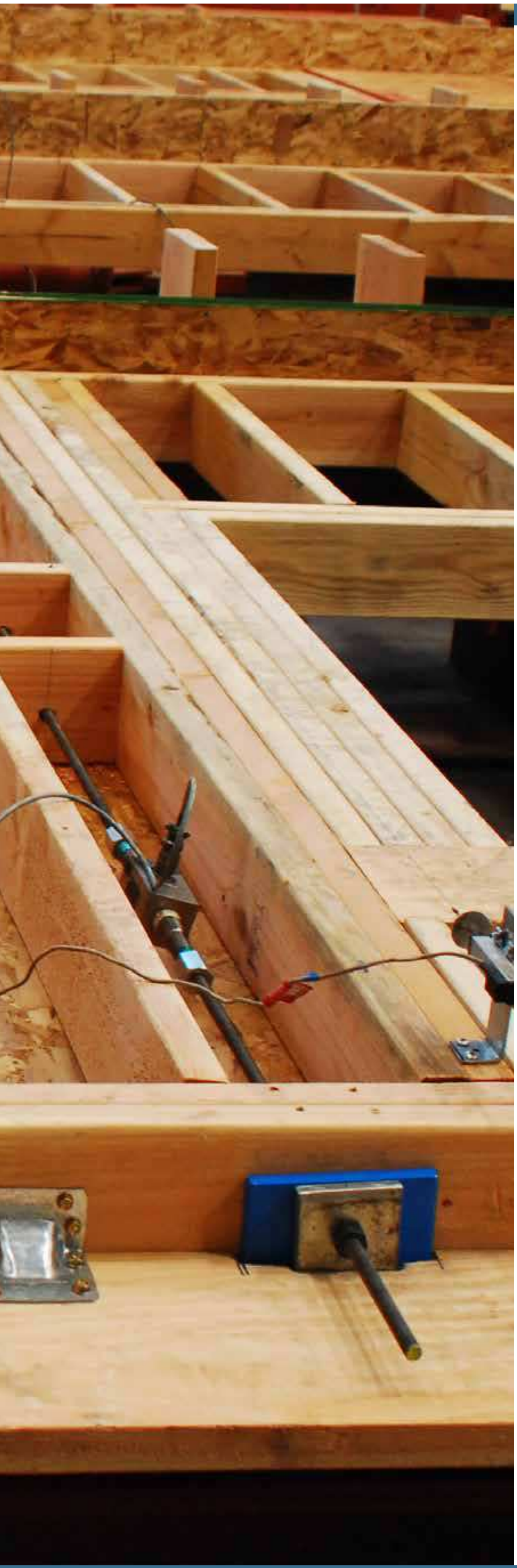
Simpson Strong-Tie is here to help you. We provide highly skilled and complimentary design services to help engineers with their continuous rod design. Since no two buildings are alike, each project is optimally designed to the Designer's individual specifications. Run-assembly elevation drawings and 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 **www.strongtie.com/srscontact**.

Strong-Rod™ ATS

Anchor Tiedown System



Full-scale, five-story cyclic testing at the Simpson Strong-Tie® Tye Gilb Lab in Stockton, California.



Strong-Rod™ Anchor Tiedown System for Shearwall Overturning Restraint

To complement its research and design expertise, Simpson Strong-Tie has all the components needed to build a continuous rod tiedown system optimal 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.

Anchor Tiedown System for Shearwall Overturning Restraint

A continuous load path is integral 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 (3- to 6-story) construction. Specifying a Strong-Rod™ Anchor Tiedown System (ATS) for shearwall overturning restraint from Simpson Strong-Tie offers several other advantages for Specifiers and installers alike:

- An ATS restraint provides the high load capacities required for mid-rise construction
- System components provide low deflection to help limit shearwall drift
- Steel tension elements of your 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
- 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). 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 at each level to mitigate any gap creation and therefore ensure optimum system performance.

SIMPSON Strong-Tie®

What is the Load Path?

Traditional vs. Continuous Rod Tiedown System

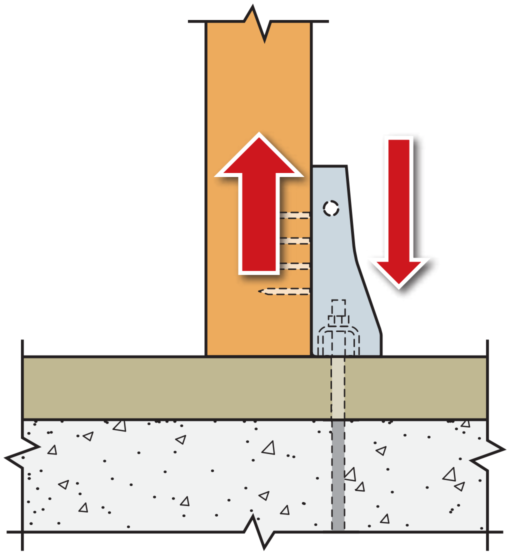
A traditional shearwall relies either on holdowns or straps attached to posts to transfer the net shearwall overturning forces to the foundation.

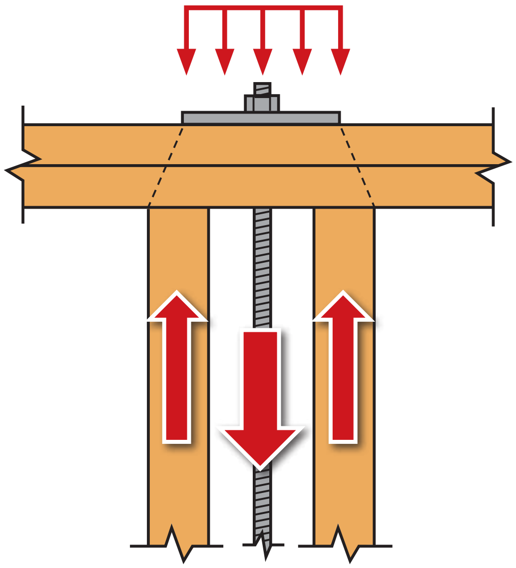
Lateral forces are transferred from the floor/roof to the plywood sheathing. The following steps describe the traditional load path:

1. Nails are typically used to transfer loads from the sheathing to the wall framing.
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.
3. The holdown system then transfers the load in tension to a threaded rod that is embedded into a concrete foundation.

A continuous rod tiedown system utilizes coupled-together 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.

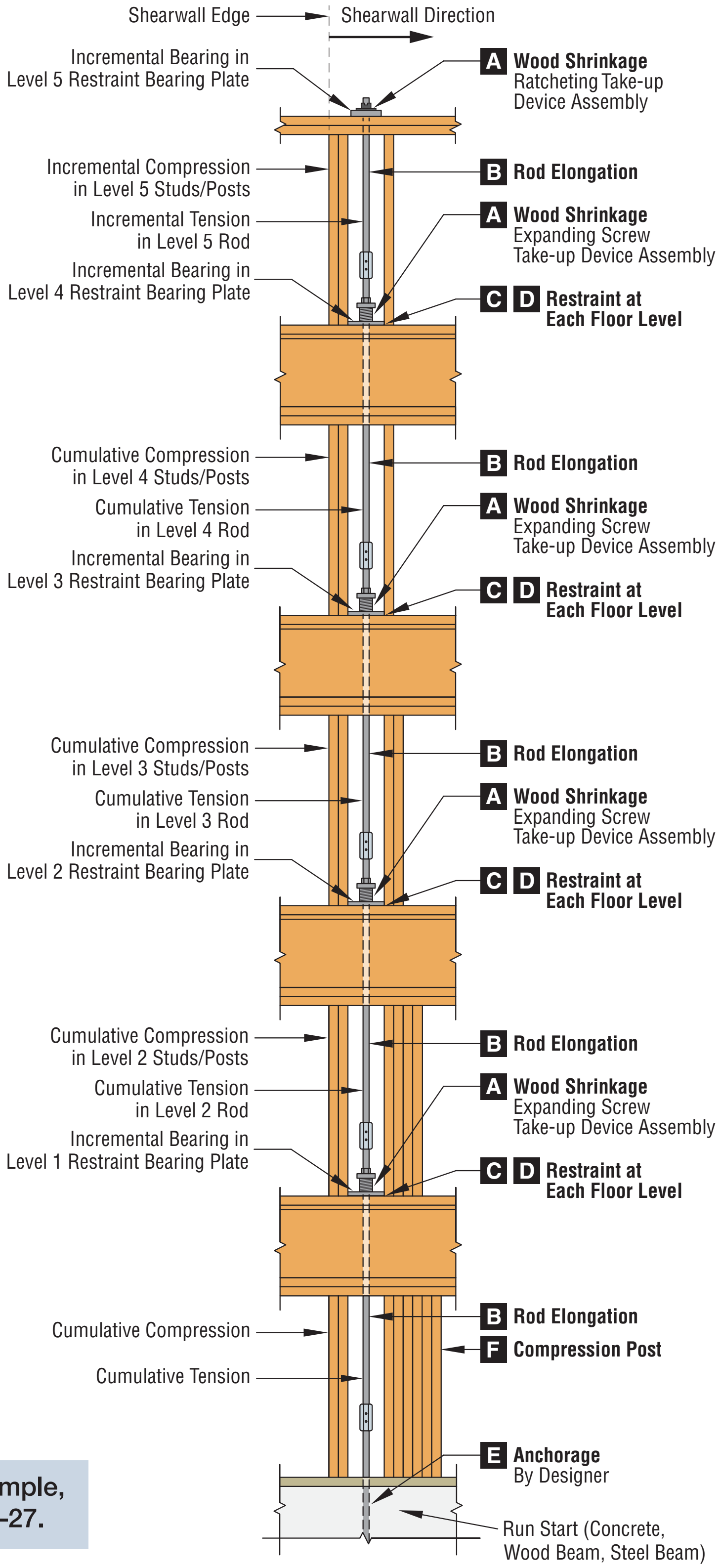




New Strong-Rod System Components to Achieve This Load Path

- New aluminum take-up device (ATUD) sizes enable greater flexibility and fewer overall system components.
- New ratcheting take-up devices (RTUD) fit ½", ⅝" and ¾" diameter rods.
- New optimized bearing plates accommodate the new ATUD and RTUD sizes.
- New options for compression post configurations that standardize anchor layout reduce extra lumber in the upper stories and have simpler sheathing nailing.
- Shallow anchors provide test-proven solutions for anchoring high loads to relatively shallow podium slabs at interior and edge conditions in conformity with ACI 318, Anchor Provisions.

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



For Design Example, see pages 26–27.

A Wood Shrinkage

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.

See **www.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 **www.strongtie.com/software**.

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:

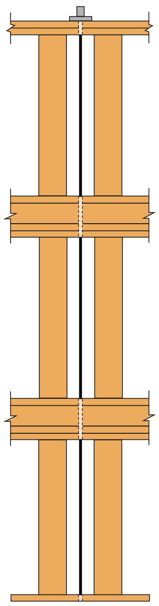
- Quantity, location and length of shearwalls provided to support the structure.
- Choice of rod diameter

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) and aluminum TUDs (ATUDs) have very little deflection ($\Delta_A + \Delta_R$) and therefore minimize the contribution of device displacement to the 0.20" deflection limit, which allows for smaller rod diameters.

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

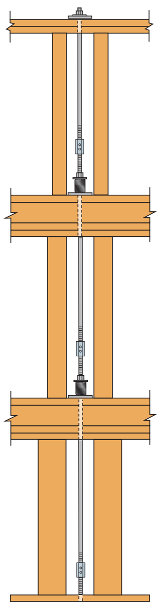
C Restrain Each Floor

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.



Skipped Floor System

- ✗ Increased cost for posts and rods
- ✗ Increased drift
- ✗ Lack of vertical redundancy
- ✗ Inefficient load path
- ✗ Shrinkage not accommodated at each floor
- ✗ Lack of construction stability



All Floors Tied-Off System

- ✓ Cost savings on posts and rods
- ✓ Reduced drift
- ✓ System redundancy
- ✓ Efficient load path
- ✓ Shrinkage accommodated at each floor
- ✓ Construction stability

See **www.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. 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 **www.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 reference design standard. Anchor products, including the Pre-Assembled Anchor Bolt (PAB), are also available to simplify specification.

An elevated concrete slab, commonly referred to as a podium slab, is a common foundation 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, Anchorage Provisions, will greatly increase the tensile capacities of the anchors.

Concrete podium slab anchorage was a multi-year test program that commenced with grant funding from the Structural Engineers Associations of Northern California, which was applied toward the initial concept testing at Scientific Construction Laboratories Inc. Following that, full-scale, detailed testing was completed at the Simpson Strong-Tie® Tye Gilb Laboratory. The concept follows code calculation procedures supported by testing of adequately designed anchor reinforcement specimens. The breakout areas in these tests were increased and spread out in a manner that is most similar to the ACI 318 concept of overlapping breakout areas for anchor groups. These increased breakout areas in the testing resulted in a significantly larger nominal concrete capacity that allows for larger capacities in wind-governed areas and development of larger-diameter anchors that meet the seismic anchor ductility requirements.

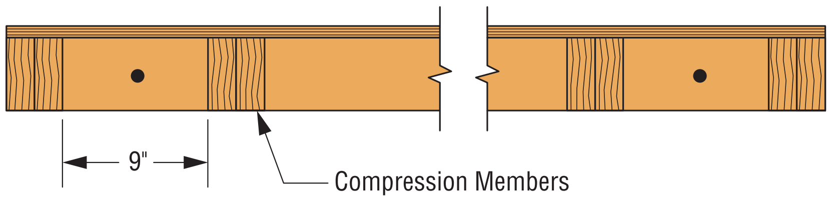
For assistance with your design, visit **www.strongtie.com/srs** for suggested anchorage-to-podium slab details, slab design requirements and Shallow Podium Slab Anchor Kit product information.

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

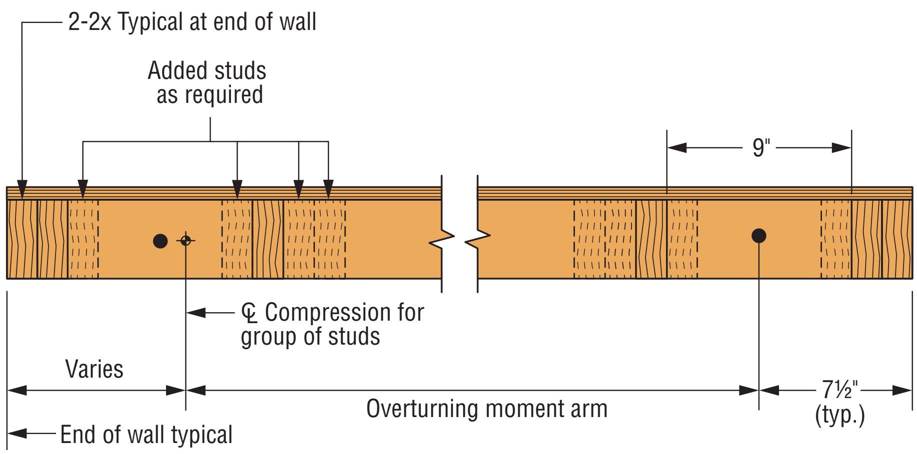
F Compression Posts

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 Strong-Rod ATS, 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. These elements are specified by the Designer. Simpson Strong-Tie offers guidance by providing standard tables for compression elements. See **www.strongtie.com/srs** for more information.

Symmetrical Posts

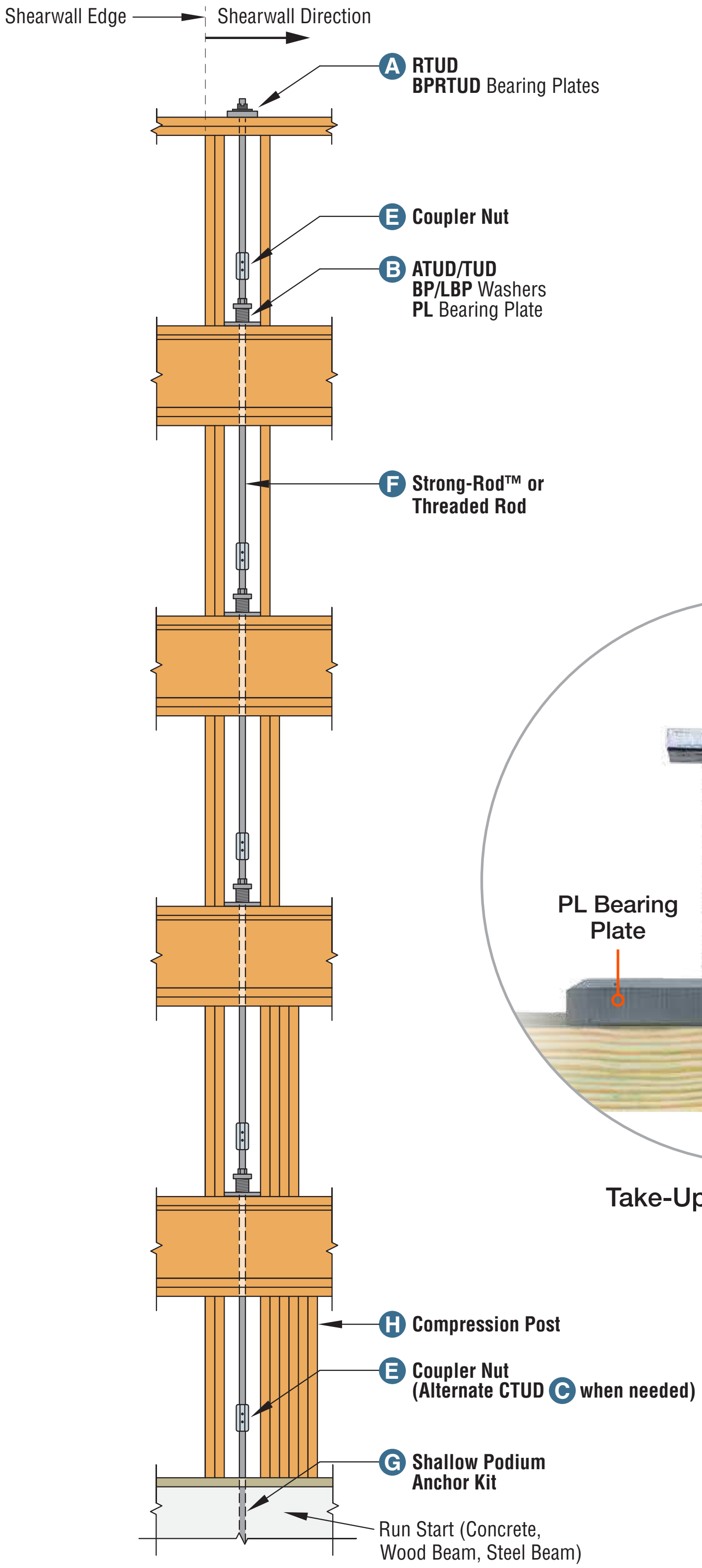


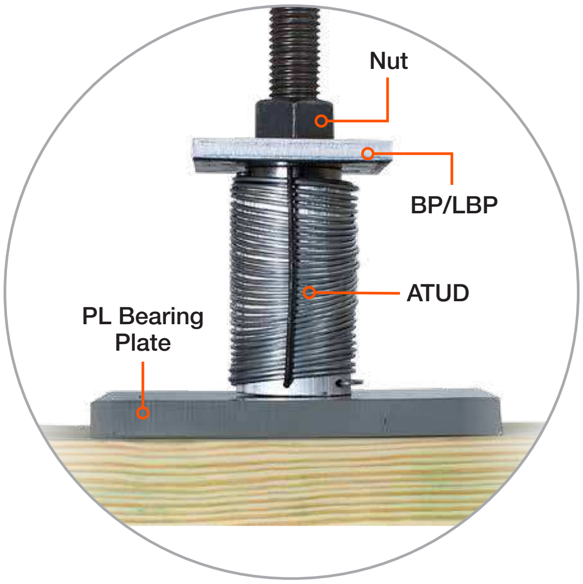
Asymmetrical Posts



From the Roof to the Foundation Anchorage

Components for Anchor Tiedown System for Shearwall Overturning Restraint





Take-Up Device Assembly

A RTUD Ratcheting Take-Up Device

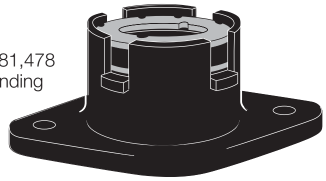
The RTUD ratcheting take-up device is a cost-effective shrinkage compensation solution for continuous rod systems. The RTUD is code-listed for use with rod systems to ensure highly reliable performance in a device that allows for unlimited shrinkage. Once the RTUD is installed, a series of internal threaded wedges enable the device to ratchet down the rod as the wood structure shrinks, but engage the rod in the reverse direction 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.

Naming Legend

RTUD4

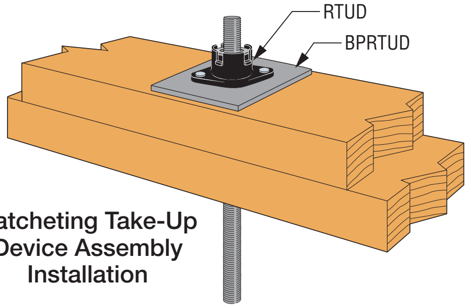
- RTUD = Type of Take-Up Device
- 4 = Rod Diameter in ⅛" Increments (Ex: 4 = 4⁄8" or ½")

RTUD
U.S. Patent 8,881,478
and patent pending

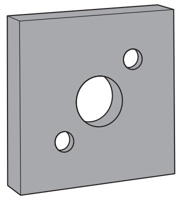


RTUD Models

Model No.	Rod Diameter (in.)	Max. Shrinkage Capacity (in.)
RTUD4	½	Unlimited
RTUD5	⅝	Unlimited
RTUD6	¾	Unlimited



Ratcheting Take-Up Device Assembly Installation



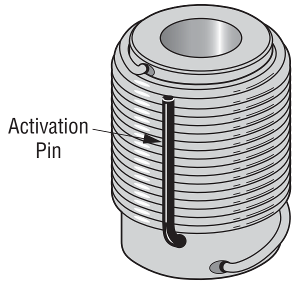
BPRTUD

B ATUD/TUD Take-Up Device

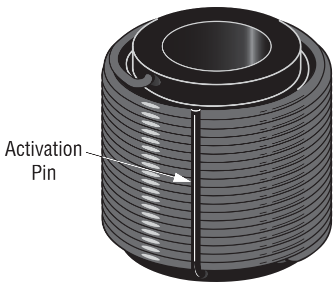
The ATUD and TUD expanding take-up devices are suitable for rod diameters from ½" up to 1¾". Expanding screw-style take-up devices provide the lowest device displacements.

ATUD Models

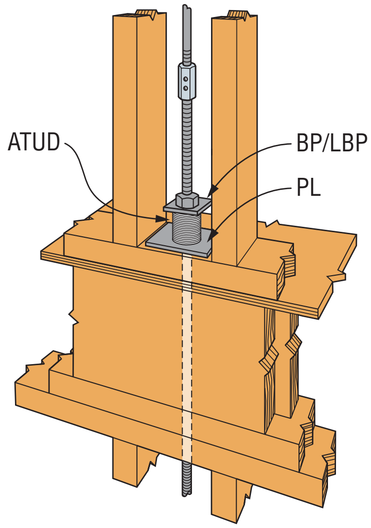
Model No.	Max. Rod Diameter (in.)	Max. Shrinkage Capacity (in.)
ATUD5	⅝	¾
ATUD6-2	¾	2
ATUD9	1⅛	1
ATUD9-2	1⅛	2
ATUD14	1¾	¾
TUD10	1¼	1



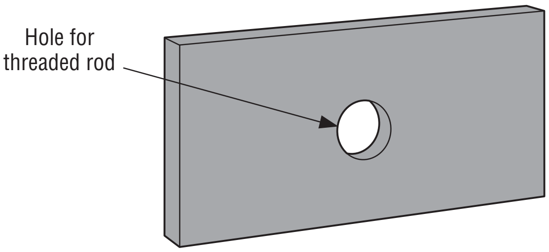
ATUD9



TUD10



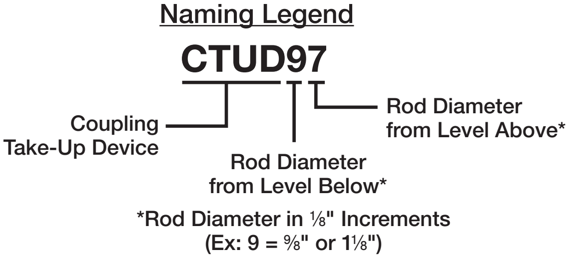
Typical Take-Up Device Assembly Installation

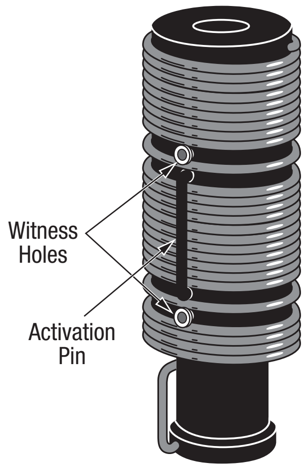


PL Bearing Plate

C CTUD Coupling Take-Up Device

The CTUD is a combination coupler nut and take-up device. The device compensates for the slack that develops in the system due to the shrinkage of wood members. It will accommodate up to 1" of movement and is available in standard and reducing sizes for ⅝", ¾", ⅞", 1" and 1⅛" diameter Strong-Rod™ threaded rod or other threaded rod.

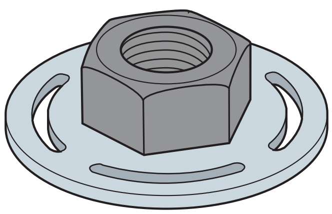




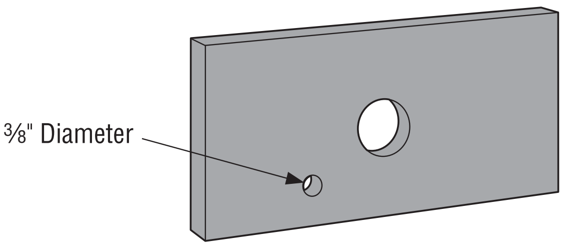
CTUD
U.S. Patent 7,905,066

D Isolator Nut

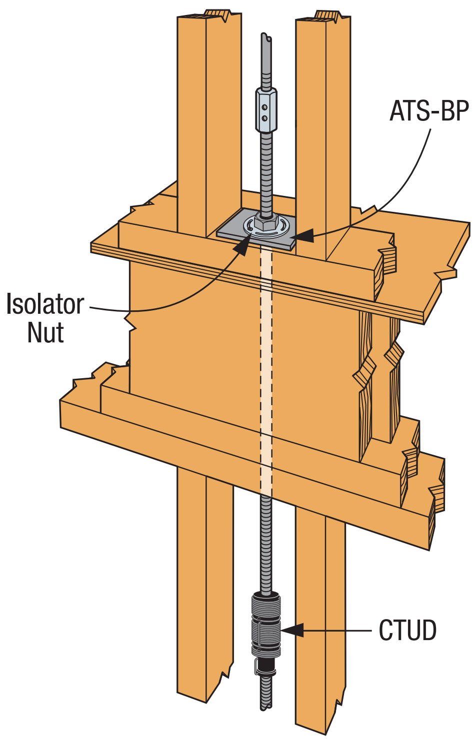
Isolator nuts isolate the wood shrinkage to the level where a CTUD is located. Isolator nuts are required on the bottom plate of the floor(s) above a level where a CTUD is used. This forces the CTUD to shrink the same amount as the wood framing. The isolator nut consists of a heavy hex nut connected to a slotted washer, and is fastened with one screw driven through the slotted washer and bearing plate into the bottom plate.



Isolator Nut



ATS-BP Bearing Plate

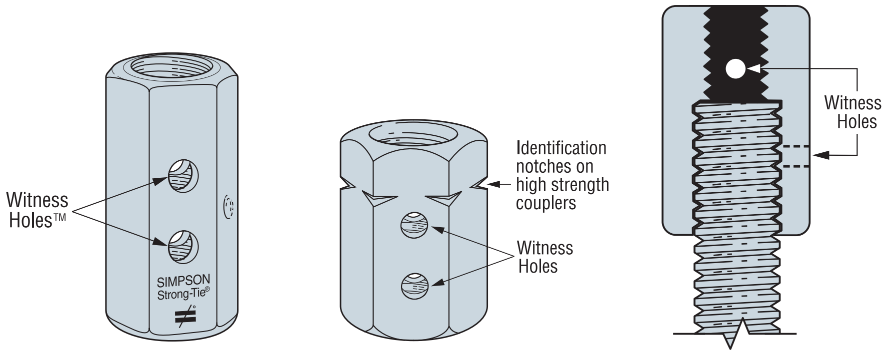


Isolator Nut Installation

SIMPSON Strong-Tie®

E 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 couplers have a testing protocol to ensure that the proper loads are achieved.



CNW or ATS-C

High-Strength Coupler ATS-HSC or ATS-HSSC

Transition Coupler Nut

F Steel Threaded Rods

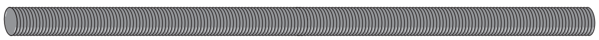
Strong-Rod™ threaded rods are the tension transfer element within the Anchor Tiedown System for shearwall overturning restraint. Strong-Rod threaded rods are threaded on both ends, with the top end having 48" of thread to allow for the distance that the rod sticks through the device, which can vary from a couple inches up to 48". Information clearly etched on the shank allows easy identification in the field.

Fully threaded rod (all-thread rod) is also available in standard-strength, high-strength and higher-strength rod material in diameters up to 2".

Naming Legend

ATS-HSR9

- **ATS** – Anchor Tiedown System
- **HS** – High Strength
- **R** – Rod
- **9** – Rod Diameter in ⅛" Increments (Ex: 9 = 9⁄8" or 1⅛")

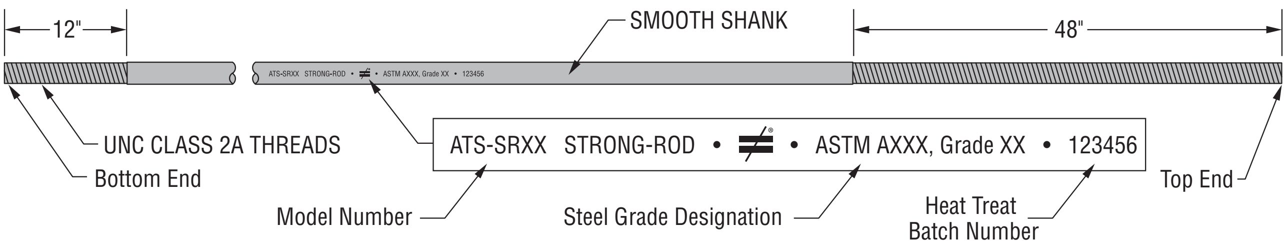


Fully Threaded Rod

Naming Legend

ATS-SR9H

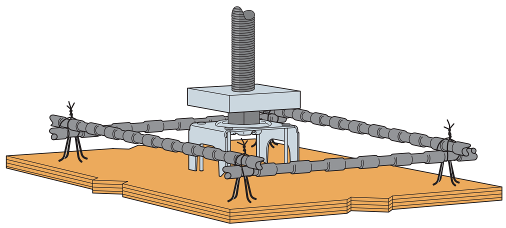
- **ATS** – Anchor Tiedown System
- **SR** – Strong-Rod
- **9** – Rod Diameter in ⅛" Increments (Ex: 9 = 9⁄8" or 1⅛")
- **H** – High Strength



Strong-Rod

G 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.



Shallow Podium Slab Anchor Kit

Naming Legend

SA1OST-8H-18KT

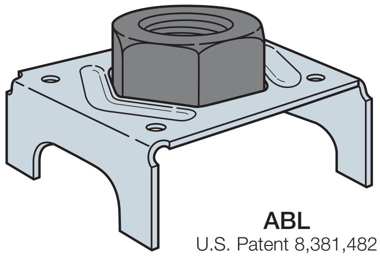
- **Shallow Anchor**
- **Standoff (1 for 1" cover)**
- **Oversize Threads (When hot-dip galvanized anchors are specified)**
- **Rod Diameter in ⅛" Increments (Ex: 8 = ⅝" or 1")**
- **High Strength**
- **Length (18", 24", 30", 36")**
- **Kit (includes ABL and SAR)**

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



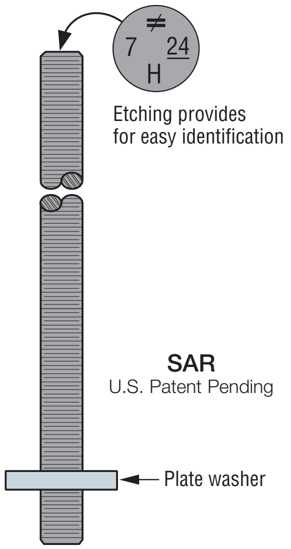
ABL
U.S. Patent 8,381,482

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, 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



SAR
U.S. Patent Pending

H Compression Post Recommendations

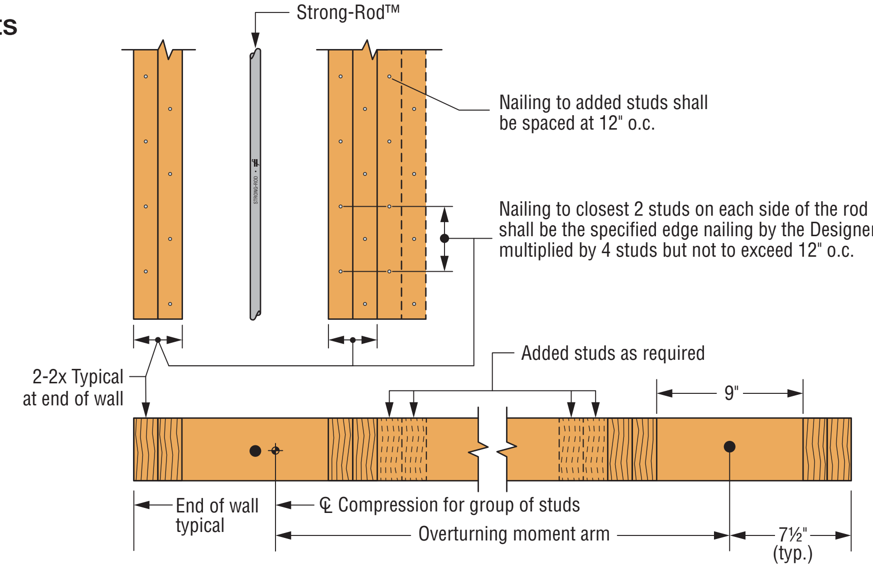
As the Strong-Rod™ Anchor Tiedown System (ATS) for shearwall overturning restraint undergoes tension loads, it is important to specify adequate compression elements to resist the compression loads. They comprise a pair of posts or built-up studs at each side of the Strong-Rod ATS system. Simpson Strong-Tie has provided two options for posts configurations. The configuration is determined by the Designer based on design and construction preference.

Asymmetrical Posts: This traditional 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.

Symmetrical Posts: An equal number of posts or studs on each side of the Strong-Rod.

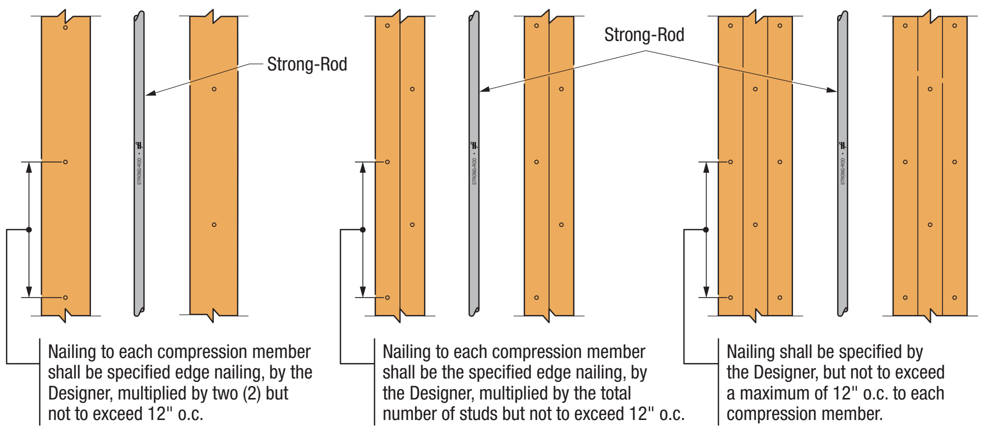
Specifications of studs and posts are the responsibility of the Designer. Simpson Strong-Tie has provided recommendations of post configurations which can be found at **www.strongtie.com/srs**. The distribution of edge nailing is important to transfer the loads appropriately. The following are some examples of recommended nail distribution between posts.

Asymmetrical Posts



Estimate of Moment Arm = Wall length – Total no. of studs at the end of wall – rod space (9" max) – 3"
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.

Symmetrical Posts



Moment Arm = Center of Rod to Center of Rod
Nailing Example: (4) total compression members: 2" o.c. edge nailing x 4 = 8" o.c. nailing at each compression member.

Top-Story Termination Types

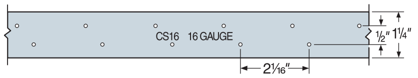
Three top-story run termination options are provided to tailor the solution to the project's specific needs. The option chosen will depend on construction preference or structure conditions, such as sloped top plates, truss/rafter locations that may conflict with top-plate termination and available space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

The traditional termination is the top-plate termination. However, run stops below the top plate using the bridge block or strap detail are often necessary or preferred. The bridge block detail accommodates high loads with installation from the inside of the structure. Where loads are lower and straps are preferred, the strap detail can be used. 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.

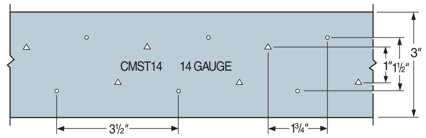
Run Stop Options

Rod runs can terminate at:

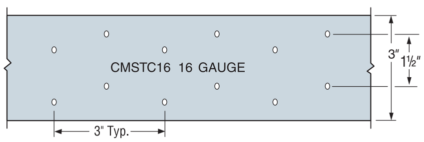
- The top plates
- A bridge block
- A floor-level with straps



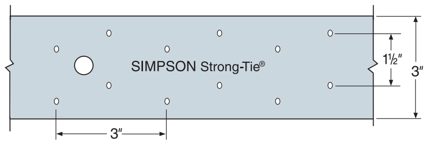
CS16 Hole Pattern
(All other CS straps similar)



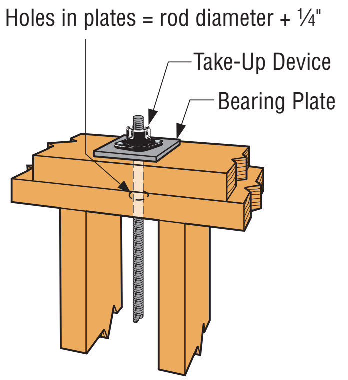
CMST14 & CMST12 Hole Pattern



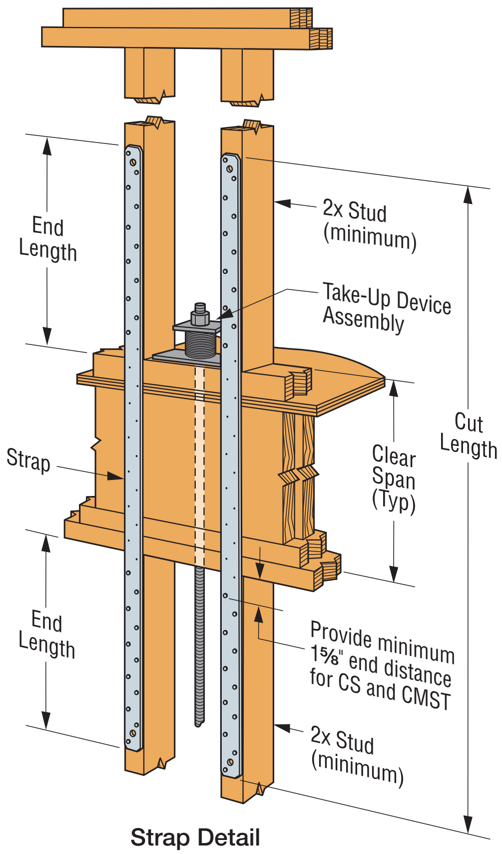
CMSTC16 Hole Pattern



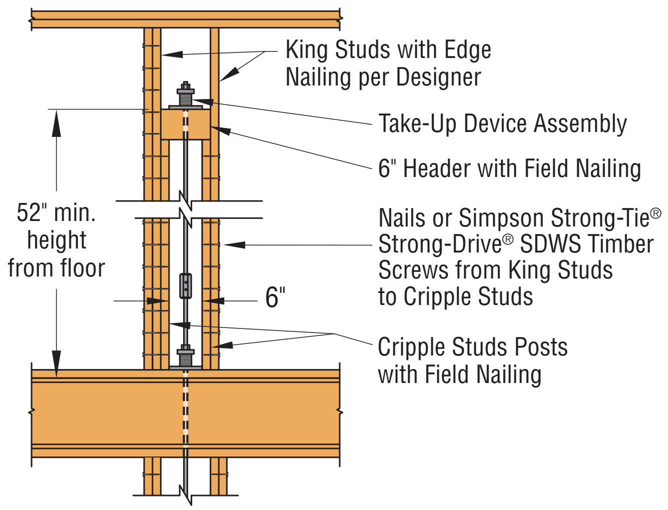
MSTC52 Hole Pattern
(MSTC 40 similar)



Top Plate Detail Example



Strap Detail



Bridge Block Detail Example

Rod System Design Considerations for Shearwall Overturning Restraint

When specifying Simpson Strong-Tie® Strong-Rod™ Systems for shearwall overturning restraint, one should weigh 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 diaphragm (roof and floor) 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

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
- 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. (Per ICC-ES AC316)

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 specification
  a. Standard threaded rod based on 36/58 ksi (F_y/F_u)
  b. High-strength Strong-Rod based on 92/120 ksi (F_y/F_u)
  c. 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 NDS to provide proper bearing capacity and limit wood crushing
- Bearing plate thickness has been sized to limit plate bending in order to provide full bearing on 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
- 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 limited to a maximum of 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.

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
- Anchorage design tools are available
- Anchorage design information conforms to AC 318 anchorage provisions and Simpson Strong-Tie testing

Three Methods for 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 **www. strongtie.com**. We currently offer the following three methods of specifying:

METHOD 1 – 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 Design engineer 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 **www.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.

METHOD 2 – Specify Run ID Callouts

The design guide provides Designers with the tools and tables to design their own ATS system by specifying predesigned run IDs. 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 within this guide based on the number of floors and the necessary capacity.

METHOD 3 – 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 **www.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:

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

Method 1 – 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 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 **www.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 a few days, 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
     - Anchorage to concrete podium slab options to aid your anchorage specification

Method 2 – Specify Run ID Callouts

In this guide, Designers are provided with the tools and tables in order to design their own Anchor Tiedown System for shearwall overturning restraint by specifying pre-designed Run IDs. These Run IDs can be specified on 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 within this guide based on the number of floors and the capacity.

The following design example illustrates the procedure for using the Run ID tables. The Designer will need to determine the overturning loads required at each floor. Use the Run ID load tables provided to pick the appropriate Strong-Rod™ ATS based on the number of floors and the capacity. The continuous rod tiedown system provides the tension restraint for the shearwall. The Designer will need to determine the compression posts, sheathing thickness and grade, nailing schedule, horizontal drift, and all other requirements in accordance with the applicable building code.

Design Example

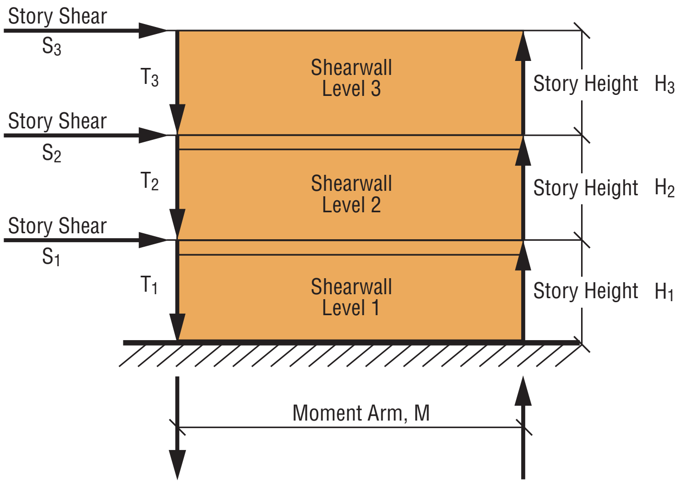
For simplicity during installation, the Designer may want to designate and group similar runs.

Given:
- 2012 IBC
- 8' plate height
- 4" nominal wall thickness
- Douglas Fir-Larch studs and wall plates

Given Overturning (OT) Forces

Level	ASD Incremental Bearing[2] (lbs.)	ASD Cumulative Tension[3] (lbs.)	ASD Cumulative Compression[4] (lbs.)
3	4,000	4,000	5,000
2	7,000	11,000	13,500
1	9,000	20,000	24,000

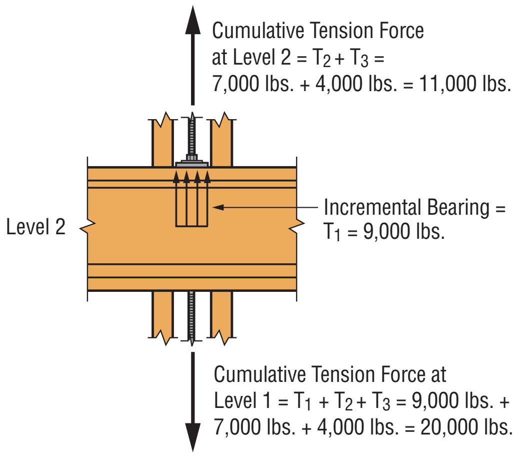
1. The structural design overturning forces listed above are intended only for this design example. Simpson Strong-Tie is not responsible for structural design of the building or determination of the design forces.
2. ASD Incremental Bearing is the bearing force at each restraint point bearing plate and is calculated as the difference between the cumulative tension force at the level considered and the level above. Used to design the bearing plates and take-up devices.
3. ASD Cumulative Tension is the cumulative rod tension force calculated as story shear times height from point of application to bottom of level considered, divided by moment arm. Used to design the tension rods.
4. ASD Cumulative Compression is the cumulative compression force used to design the compression posts at each end of the shearwall.



Shearwall Free Body Diagram Example

Example for Derivation of Forces at Level 1

1. Note that moment arm (M), in the shearwall free body diagram example at right, is the distance between the centerline of compression members to centerline of tension rod. Story shear is the total shear at the level considered.
2. ASD Incremental Bearing = $T_1 = \frac{S_1\,(H_1)}{M}$ = 9,000 lbs.
   The incremental bearing is calculated at each level.
   T_2 = 7,000 lbs. T_3 = 4,000 lbs.
3. Cumulative Tension Force at level 1 = $T_1 + T_2 + T_3$ = 9,000 lbs. + 7,000 lbs. + 4,000 lbs = 20,000 lbs.
4. See sketch at right for additional information.
5. Cumulative compression forces are higher than cumulative tension forces due to the additional contribution of gravity load when evaluating the controlling load combination.



Bearing Plate Free Body Diagram Example

Method 2 – Specify Run ID Callouts (cont.)

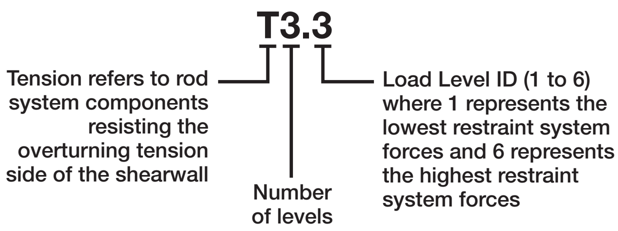
Specifying Shearwall Overturning Restraint Systems – Example

Step 1

Use Run Identification Load tables on pages 28–29 to determine run type based on (a) cumulative tension and (b) incremental bearing. Recommended Run ID will be determined by selecting the highest-capacity run type from any level.

Level	Overturning Forces		Required Run ID to Meet Design Load
	ASD Incremental Bearing (lbs.)	ASD Cumulative Tension (lbs.)	
3	4,000	4,000	T3.2
2	7,000	11,000	T3.3
1	9,000	20,000	T3.3
Result	Recommended Run ID: T3.3		

Naming Legend



Using the Run Identification Load tables on pages 28–29, compare the run cumulative tension and incremental bearing forces to the forces in the table for each level. For this example, the given loads correspond to Run ID T3.2 for the top level and T3.3 for the first and second level (see portion of Run ID table highlighted below). Specify the Run ID that corresponds to the highest-capacity run type for any of the levels, T3.3 in this example. Contact Simpson Strong-Tie for conditions not covered by the table Run IDs.

Run Identification Load Table for DF/SP Lumber (3-Story Run, See page 28 for full table)

Number of Levels in Run	3-Story	T3.1		T3.2		T3.3		T3.4		T3.5		T3.6	
		Cumulative Tension (lbs.)	Incremental Bearing (lbs.)	Cumulative Tension (lbs.)	Incremental Bearing (lbs.)	Cumulative Tension (lbs.)	Incremental Bearing (lbs.)	Cumulative Tension (lbs.)	Incremental Bearing (lbs.)	Cumulative Tension (lbs.)	Incremental Bearing (lbs.)	Cumulative Tension (lbs.)	Incremental Bearing (lbs.)
3	Level 3	4,200	4,200	4,200	4,200	6,500	6,500	9,000	9,000	14,000	14,000	14,000	14,000
	Level 2	4,200	4,200	6,500	6,000	13,000	9,000	20,000	14,000	24,000	14,000	28,000	14,000
	Level 1	6,500	6,000	9,000	9,000	20,000	9,000	30,000	14,000	35,000	14,000	38,000	14,000

Step 2

Determine deformation limits required to meet building drift limits.

Specify total deformation criteria to be used when designing the rod system run.

Step 3

a. Determine the required anchor size, material and embedment per applicable codes.

b. For anchorage to foundation, visit **www.strongtie.com/srs** to select appropriate anchor model.

Step 4

Use Compression Member Selection tables at **www.strongtie.com/srs** to select compression members.

Step 5

Specify solution on plan.

The following is the minimum information required:

- Run ID = T3.3
- Rod elongation and take-up device displacement ≤ 0.2" between restraints
- PAB7H with 14½" embedment
- Compression members as shown in table at **www.strongtie.com/srs**
- For run termination requirements, see page 32.

Level	Cumulative Overturning Compression Forces (lbs.)		8' D.Fir-L Post Compression Capacity (lbs.)	Compression Members Each Side of ATS Rod
3	5,000	<	6,565	(1) 2x4
2	13,500	<	15,315	(1) 4x4
1	24,000	<	24,065	(1) 4x6

1. Visit **www.strongtie.com/srs** for 8-foot D.Fir-L compression capacity.
2. 8'–0" plate height and 4" wall
3. Calculations based on 2012 NDS.
4. Example only reviews compression case for the lumber species, plate height, and loads provided. Designer must review compression post and size for any additional loads, load combinations, variation in species, variation in lumber grade, or unsupported heights as specified in the code.

Method 2 – Specify Run ID Callouts (cont.)

The following tables provide run identifications for easy specification of shearwall overturning restraint runs on the plans. Simply compare the cumulative rod tension and incremental bearing forces for the run at each level to the values in the table. Specify the Run ID shown in the table heading that corresponds to the highest capacity Run ID needed for any of the levels. Refer to page 26 for an example.

ATS Run Identification Load Table for DF/SP Lumber

Number of Levels in Run	5-Story	T5.1		T5.2		T5.3		T5.4		T5.5		T5.6	
		Cumulative Tension (lbs.)	Incremental Bearing (lbs.)	Cumulative Tension (lbs.)	Incremental Bearing (lbs.)	Cumulative Tension (lbs.)	Incremental Bearing (lbs.)	Cumulative Tension (lbs.)	Incremental Bearing (lbs.)	Cumulative Tension (lbs.)	Incremental Bearing (lbs.)	Cumulative Tension (lbs.)	Incremental Bearing (lbs.)
5	Level 5	4,200	4,200	4,200	4,200	6,500	6,500	6,500	6,500	9,000	9,000	9,000	9,000
	Level 4	4,200	4,200	6,500	6,500	9,000	9,000	13,000	9,000	17,000	9,000	18,000	9,000
	Level 3	6,500	6,000	6,500	6,000	13,000	9,000	17,000	9,000	22,000	9,000	27,000	9,000
	Level 2	6,500	6,000	9,000	9,000	17,000	9,000	20,000	9,000	30,000	9,000	37,000	14,000
	Level 1	6,500	6,000	9,000	9,000	20,000	9,000	30,000	14,000	36,000	9,000	50,000	14,000

Number of Levels in Run	4-Story	T4.1		T4.2		T4.3		T4.4		T4.5		T4.6	
		Cumulative Tension (lbs.)	Incremental Bearing (lbs.)	Cumulative Tension (lbs.)	Incremental Bearing (lbs.)	Cumulative Tension (lbs.)	Incremental Bearing (lbs.)	Cumulative Tension (lbs.)	Incremental Bearing (lbs.)	Cumulative Tension (lbs.)	Incremental Bearing (lbs.)	Cumulative Tension (lbs.)	Incremental Bearing (lbs.)
4	Level 4	4,200	4,200	4,200	4,200	6,500	6,500	9,000	9,000	14,000	14,000	14,000	14,000
	Level 3	4,200	4,200	6,500	6,000	13,000	9,000	13,000	9,000	20,000	9,000	26,000	14,000
	Level 2	6,500	6,000	9,000	9,000	17,000	9,000	20,000	9,000	25,000	9,000	37,000	14,000
	Level 1	6,500	6,000	9,000	9,000	20,000	9,000	30,000	14,000	35,000	14,000	50,000	14,000

Number of Levels in Run	3-Story	T3.1		T3.2		T3.3		T3.4		T3.5		T3.6	
		Cumulative Tension (lbs.)	Incremental Bearing (lbs.)	Cumulative Tension (lbs.)	Incremental Bearing (lbs.)	Cumulative Tension (lbs.)	Incremental Bearing (lbs.)	Cumulative Tension (lbs.)	Incremental Bearing (lbs.)	Cumulative Tension (lbs.)	Incremental Bearing (lbs.)	Cumulative Tension (lbs.)	Incremental Bearing (lbs.)
3	Level 3	4,200	4,200	4,200	4,200	6,500	6,500	9,000	9,000	14,000	14,000	14,000	14,000
	Level 2	4,200	4,200	6,500	6,000	13,000	9,000	20,000	14,000	24,000	14,000	28,000	14,000
	Level 1	6,500	6,000	9,000	9,000	20,000	9,000	30,000	14,000	35,000	14,000	38,000	14,000

Number of Levels in Run	2-Story	T2.1		T2.2		T2.3		T2.4		T2.5		T2.6	
		Cumulative Tension (lbs.)	Incremental Bearing (lbs.)	Cumulative Tension (lbs.)	Incremental Bearing (lbs.)	Cumulative Tension (lbs.)	Incremental Bearing (lbs.)	Cumulative Tension (lbs.)	Incremental Bearing (lbs.)	Cumulative Tension (lbs.)	Incremental Bearing (lbs.)	Cumulative Tension (lbs.)	Incremental Bearing (lbs.)
2	Level 2	4,200	4,200	4,200	4,200	6,500	6,500	6,500	6,500	9,000	9,000	14,000	14,000
	Level 1	4,200	4,200	6,500	6,000	9,000	9,000	13,000	9,000	22,000	14,000	28,000	14,000

Number of Levels in Run	1-Story	T1.1		T1.2		T1.3		T1.4		T1.5	
		Cumulative Tension (lbs.)	Incremental Bearing (lbs.)	Cumulative Tension (lbs.)	Incremental Bearing (lbs.)	Cumulative Tension (lbs.)	Incremental Bearing (lbs.)	Cumulative Tension (lbs.)	Incremental Bearing (lbs.)	Cumulative Tension (lbs.)	Incremental Bearing (lbs.)
1	Level 1	4,200	4,200	6,500	6,500	9,000	9,000	12,000	12,000	19,000	19,000

1. Cumulative Tension is the ASD design tension force in the rod at each level. It is the cumulative tension force and increases from the top level to the bottom level as each level introduces additional tension into the rod system run.
2. Incremental Bearing is the ASD design bearing force resisted by the bearing plate restraint at each level. It is the additional uplift (tension) force that is introduced into the rod system run.

Method 2 – Specify Run ID Callouts (cont.)

ATS Run Identification Load Table for SPF/HF Lumber

Number of Levels in Run	5-Story	T5.1		T5.2		T5.3		T5.4		T5.5		T5.6	
		Cumulative Tension (lbs.)	Incremental Bearing (lbs.)	Cumulative Tension (lbs.)	Incremental Bearing (lbs.)	Cumulative Tension (lbs.)	Incremental Bearing (lbs.)	Cumulative Tension (lbs.)	Incremental Bearing (lbs.)	Cumulative Tension (lbs.)	Incremental Bearing (lbs.)	Cumulative Tension (lbs.)	Incremental Bearing (lbs.)
5	Level 5	4,200	4,200	4,200	4,200	6,500	6,500	6,500	6,500	9,000	9,000	9,000	9,000
	Level 4	4,200	4,200	6,500	4,000	9,000	6,000	13,000	6,000	17,000	9,000	18,000	9,000
	Level 3	6,500	4,000	6,500	4,000	13,000	6,000	17,000	6,000	22,000	6,000	27,000	9,000
	Level 2	6,500	4,000	9,000	6,000	17,000	6,000	20,000	6,000	30,000	9,000	37,000	10,000
	Level 1	6,500	4,000	9,000	6,000	20,000	6,000	30,000	10,000	36,000	6,000	50,000	13,000

Number of Levels in Run	4-Story	T4.1		T4.2		T4.3		T4.4		T4.5		T4.6	
		Cumulative Tension (lbs.)	Incremental Bearing (lbs.)	Cumulative Tension (lbs.)	Incremental Bearing (lbs.)	Cumulative Tension (lbs.)	Incremental Bearing (lbs.)	Cumulative Tension (lbs.)	Incremental Bearing (lbs.)	Cumulative Tension (lbs.)	Incremental Bearing (lbs.)	Cumulative Tension (lbs.)	Incremental Bearing (lbs.)
4	Level 4	4,200	4,200	4,200	4,200	6,500	6,500	9,000	9,000	14,000	14,000	14,000	14,000
	Level 3	4,200	4,200	6,500	4,000	13,000	6,000	13,000	6,000	20,000	9,000	26,000	13,000
	Level 2	6,500	4,000	9,000	6,000	17,000	6,000	20,000	9,000	25,000	9,000	37,000	13,000
	Level 1	6,500	4,000	9,000	6,000	20,000	6,000	30,000	10,000	35,000	14,000	50,000	13,000

Number of Levels in Run	3-Story	T3.1		T3.2		T3.3		T3.4		T3.5		T3.6	
		Cumulative Tension (lbs.)	Incremental Bearing (lbs.)	Cumulative Tension (lbs.)	Incremental Bearing (lbs.)	Cumulative Tension (lbs.)	Incremental Bearing (lbs.)	Cumulative Tension (lbs.)	Incremental Bearing (lbs.)	Cumulative Tension (lbs.)	Incremental Bearing (lbs.)	Cumulative Tension (lbs.)	Incremental Bearing (lbs.)
3	Level 3	4,200	4,200	4,200	4,200	6,500	6,500	9,000	9,000	14,000	14,000	14,000	14,000
	Level 2	4,200	4,200	6,500	4,000	13,000	6,000	20,000	13,000	24,000	10,000	28,000	14,000
	Level 1	6,500	4,000	9,000	6,000	20,000	9,000	30,000	10,000	35,000	13,000	38,000	10,000

Number of Levels in Run	2-Story	T2.1		T2.2		T2.3		T2.4		T2.5		T2.6	
		Cumulative Tension (lbs.)	Incremental Bearing (lbs.)	Cumulative Tension (lbs.)	Incremental Bearing (lbs.)	Cumulative Tension (lbs.)	Incremental Bearing (lbs.)	Cumulative Tension (lbs.)	Incremental Bearing (lbs.)	Cumulative Tension (lbs.)	Incremental Bearing (lbs.)	Cumulative Tension (lbs.)	Incremental Bearing (lbs.)
2	Level 2	4,200	4,200	4,200	4,200	6,500	6,500	6,500	6,500	9,000	9,000	14,000	14,000
	Level 1	4,200	4,200	6,500	4,000	9,000	6,000	13,000	6,000	22,000	13,000	28,000	14,000

Number of Levels in Run	1-Story	T1.1		T1.2		T1.3		T1.4		T1.5	
		Cumulative Tension (lbs.)	Incremental Bearing (lbs.)	Cumulative Tension (lbs.)	Incremental Bearing (lbs.)	Cumulative Tension (lbs.)	Incremental Bearing (lbs.)	Cumulative Tension (lbs.)	Incremental Bearing (lbs.)	Cumulative Tension (lbs.)	Incremental Bearing (lbs.)
1	Level 1	4,200	4,200	6,500	6,500	9,000	9,000	12,000	12,000	17,000	17,000

1. Cumulative Tension is the ASD design tension force in the rod at each level. It is the cumulative tension force and increases from the top level to the bottom level as each level introduces additional tension into the rod system run.
2. Incremental Bearing is the ASD design bearing force resisted by the bearing plate restraint at each level. It is the additional uplift (tension) force that is introduced into the rod system run.

Method 3 – Handling Deferred Submittals

A continuous rod tiedown system is an ideal shearwall restraint system for multi-story light-frame wood construction. If your firm prefers these systems to be included in a deferred submittal process, there are some elements to your specification that merit consideration to ensure the proper performance of the structure being designed.

These Documents Should Include:

1. Floor heights and depths need to be clearly shown on the construction documents.
2. Wall heights from bottom of sill/sole plates to top of double top plates need to be clearly indicated.
3. A summary of cumulative tensile and compressive forces for each wall that will be utilizing the continuous rod tiedown system.
4. Maximum total deflection of each continuous rod tiedown system at each level needs to be specified on the construction document.
5. Bearing plates shall be designed for bending.
6. General Notes for continuous rod tiedown system design similar to the following.

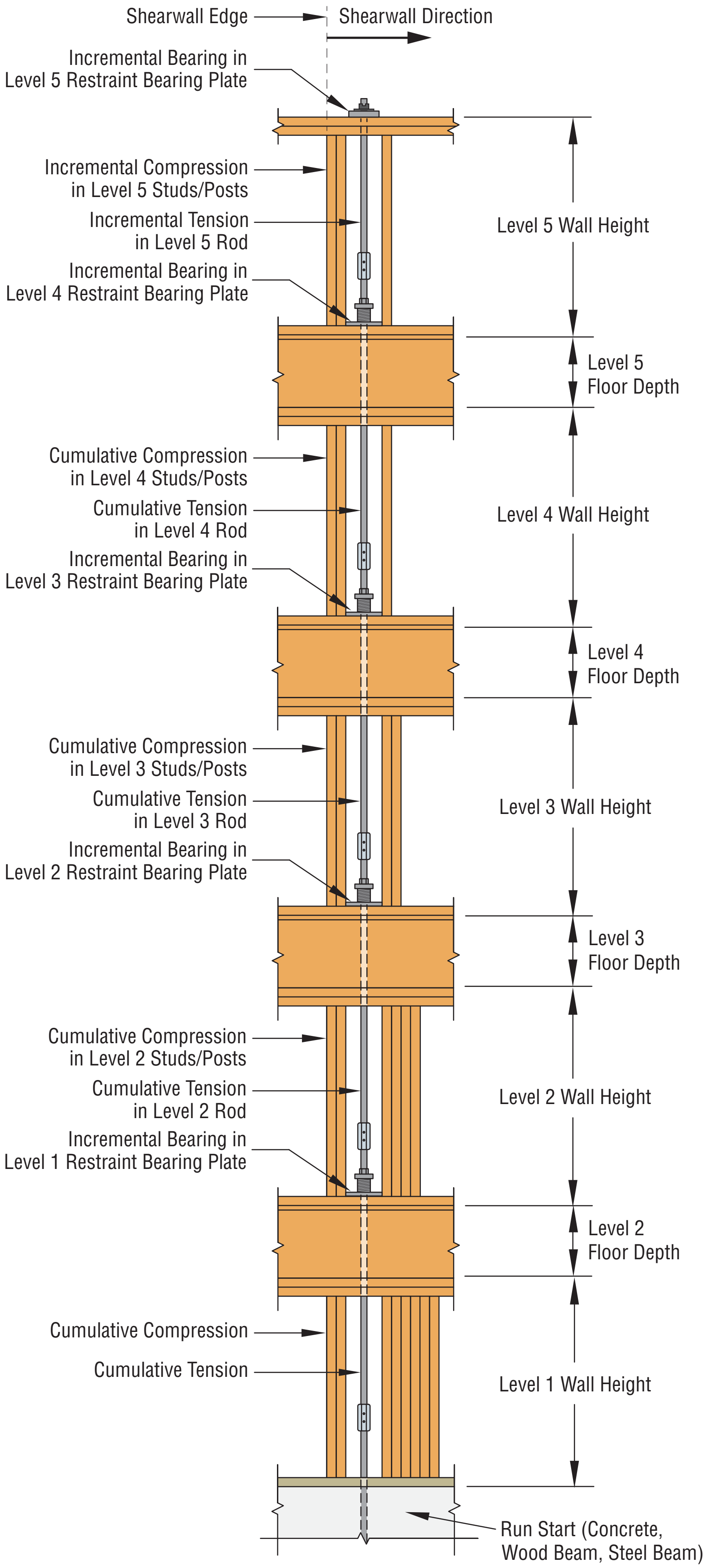
Sample Specification

The following represents some General Notes that should be added to your construction documents in a deferred submittal.

Continuous Rod Tiedown System

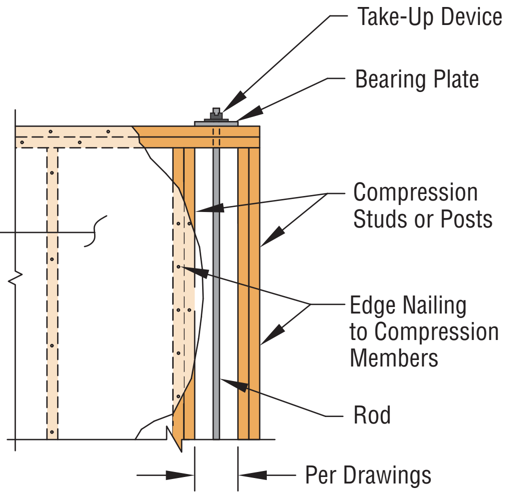
1. The continuous rod tiedown system shall be Simpson Strong-Tie® Strong-Rod™ Anchor Tiedown System for shearwall overturning restraint.
2. In a multi-story shearwall installation, the continuous rod tiedown system shall be restrained by bearing plates at each story of the multi-story shearwall. Shrinkage compensating devices shall be provided at each restraint location.
3. Skipping stories, where bearing plates are omitted at intermediate floors that result in multiple stories being tied together, is prohibited.
4. The computed rod elongation or stretch between restraint locations, together with computed deformations of shrinkage compensating device in compliance with ICC-ES AC 316, within any story under working stress level (Allowable Stress Design) short-term duration loading, such as wind or earthquake loads, shall not exceed 0.20 inch or as specified. Rod elongation or stretch shall be computed as the product PL/AE, where P is the axial load (lbs.), L is the initial rod length between restraints at the story under consideration (inches), E is 29,000,000 (psi) and A is the net tensile area of the rod (in^2). Device displacement shall be as specified in the evaluation report including $\Delta_R + \Delta_A (P_D/P_A)$.
5. Calculations and shop drawings meeting all the above requirements shall be submitted and provided by the manufacturer of the continuous rod tiedown system for review and approval prior to installation.
6. Drawings provided by the manufacturer shall specify the proprietary components or systems.
7. Simpson Strong-Tie wood connectors are specifically required to meet the structural calculations of the plan. Before substituting another brand, confirm load capacity based on reliable published testing data or calculations. The Engineer/Designer of Record should evaluate and give written approval for substitution prior to installation.

Go to **www.strongtie.com/srs** to download master specifications, general notes and typical details to be placed within your construction documents or specifications.

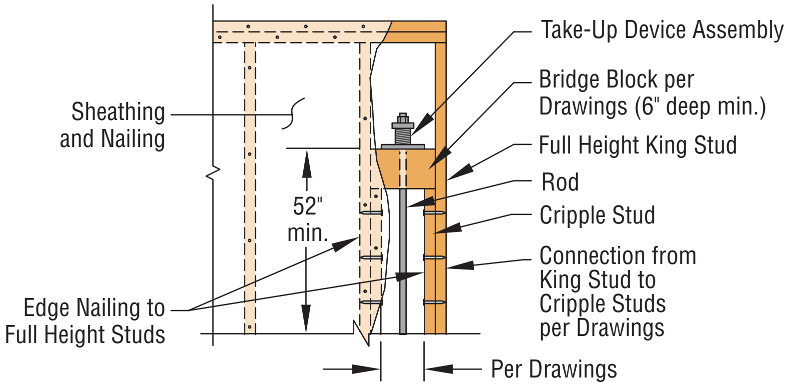


Shearwall Edge
Shearwall Direction
Incremental Bearing in Level 5 Restraint Bearing Plate
Incremental Compression in Level 5 Studs/Posts
Incremental Tension in Level 5 Rod
Incremental Bearing in Level 4 Restraint Bearing Plate
Level 5 Wall Height
Level 5 Floor Depth
Cumulative Compression in Level 4 Studs/Posts
Cumulative Tension in Level 4 Rod
Incremental Bearing in Level 3 Restraint Bearing Plate
Level 4 Wall Height
Level 4 Floor Depth
Cumulative Compression in Level 3 Studs/Posts
Cumulative Tension in Level 3 Rod
Incremental Bearing in Level 2 Restraint Bearing Plate
Level 3 Wall Height
Level 3 Floor Depth
Cumulative Compression in Level 2 Studs/Posts
Cumulative Tension in Level 2 Rod
Incremental Bearing in Level 1 Restraint Bearing Plate
Level 2 Wall Height
Level 2 Floor Depth
Cumulative Compression
Cumulative Tension
Level 1 Wall Height
Run Start (Concrete, Wood Beam, Steel Beam)

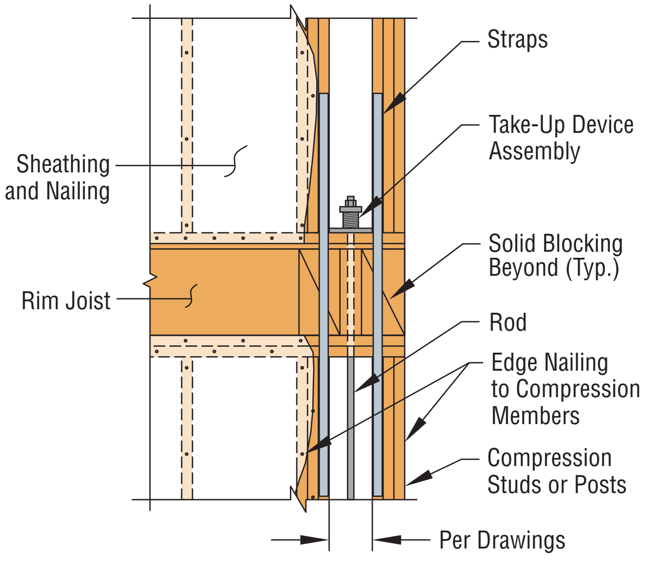
Strong-Rod™ ATS Run Termination Details



Top Plate Detail

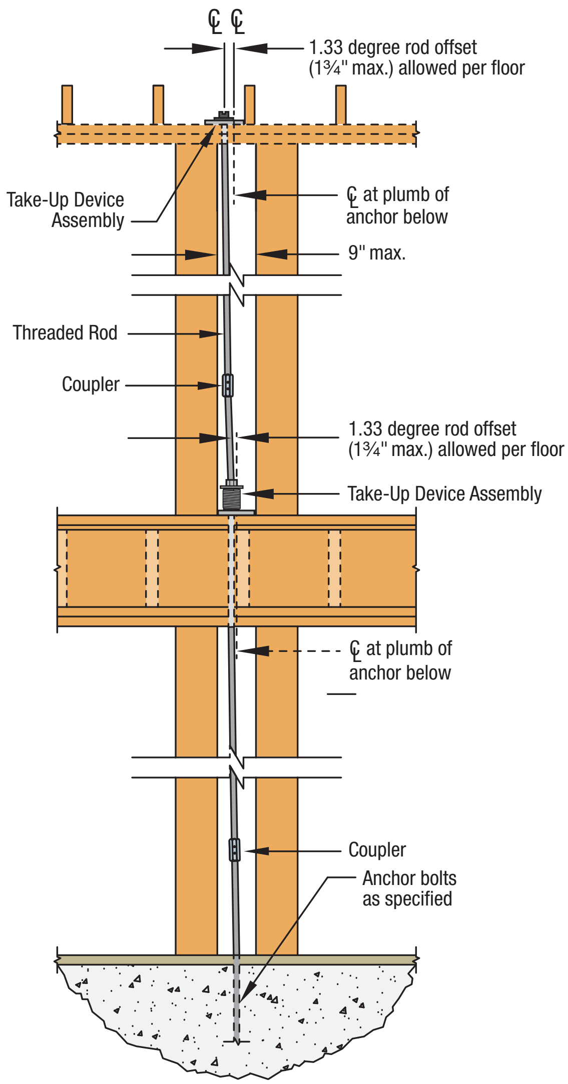


Bridge Block Detail

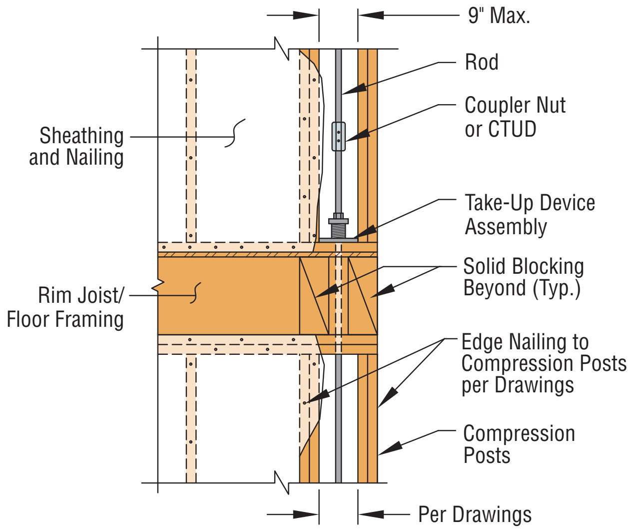


Strap Detail

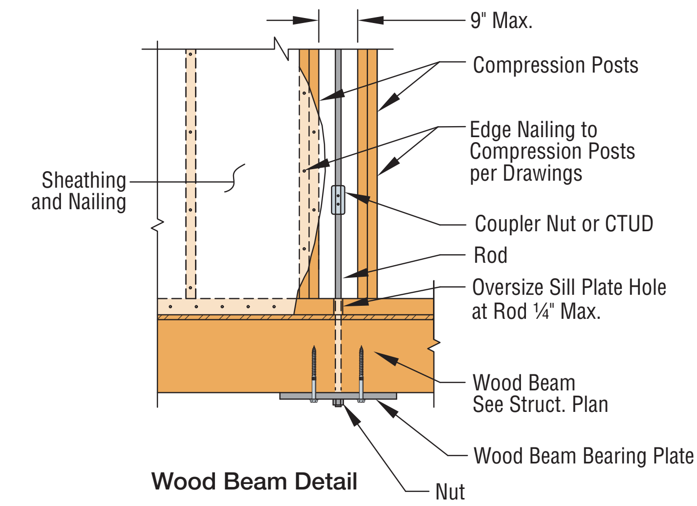
Strong-Rod™ ATS Run Start Details



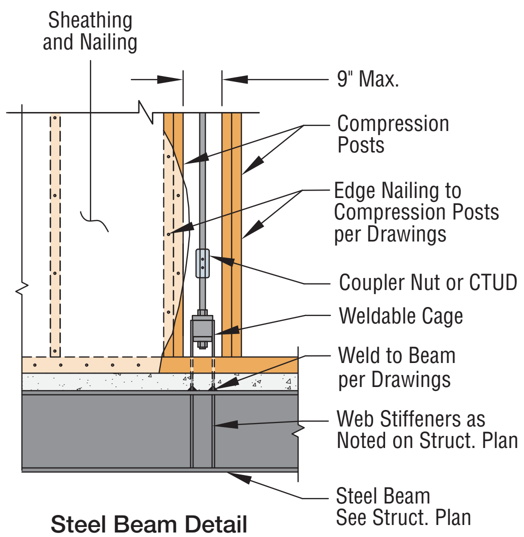
Rod Offset Detail



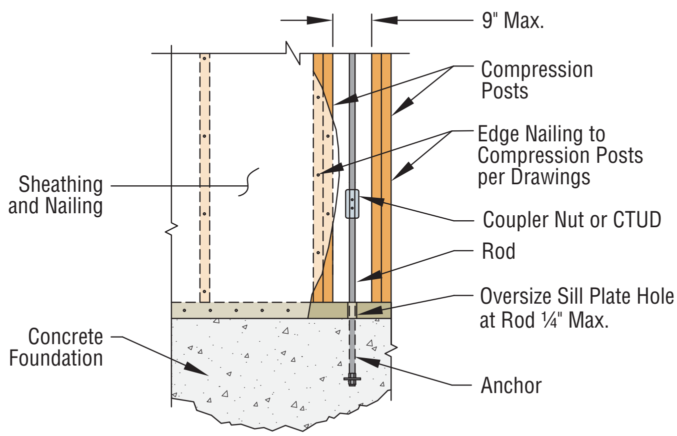
Mid Floor Detail



Wood Beam Detail



Steel Beam Detail



Concrete Detail

Strong-Rod™ URS

Uplift Restraint System

Top-plate rotation testing being conducted at the Simpson Strong-Tie® Tye Gilb Lab in Stockton, California

Introducing the Strong-Rod™ Uplift Restraint System for Roofs

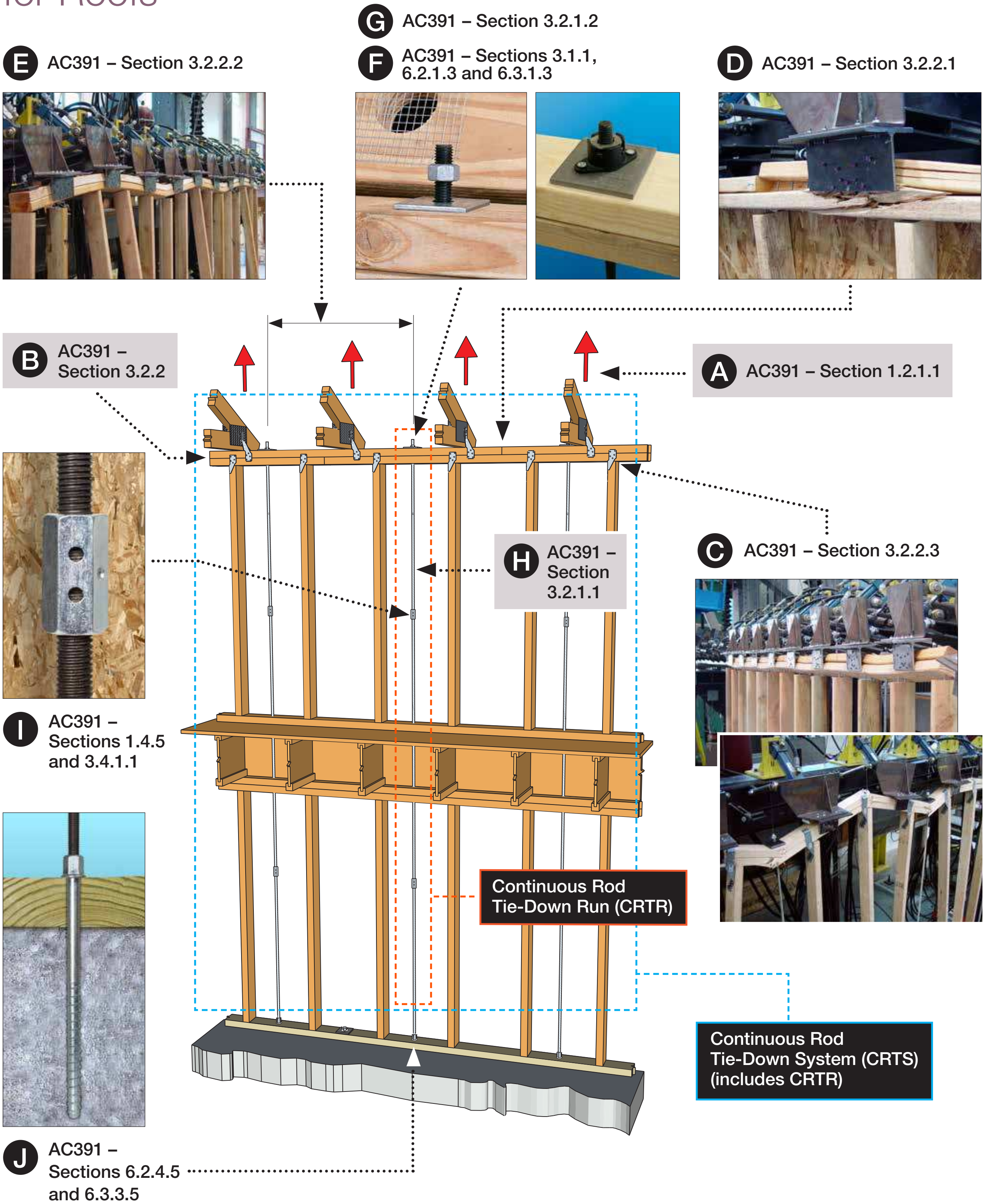
The Simpson Strong-Tie® Strong-Rod™ Uplift Restraint System for roofs (Strong-Rod URS) is a continuous rod tiedown solution designed to provide a complete load path to resist suction (uplift) pressure on the roof.

After hurricane ties transfer roof uplift forces into the uppermost top plates in a wood-frame structure, a Strong-Rod URS continues that resistance down to the foundation or final termination point. The design parameters for this specific type of continuous rod system were developed in June 2010 through a consensus process managed by ICC-ES. These requirements are provided in ICC-ES acceptance criteria AC391. Following those acceptance criteria requirements, the Strong-Rod URS has obtained an ICC-ES ESR-1161 code report and is designed and detailed to:

- Transfer wind uplift loads efficiently from wood framing to steel components in 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
- Address deflection caused by wood shrinkage

Through years of testing at our state-of-the-art facilities, Simpson Strong-Tie is unmatched in its design knowledge of continuous rod tiedown systems. Visit **www.strongtie.com/srscontact** to learn how you can leverage our experience to help design and specify code-listed uplift restraint systems for roofs.

Key Design Considerations for Uplift Restraint Systems for Roofs

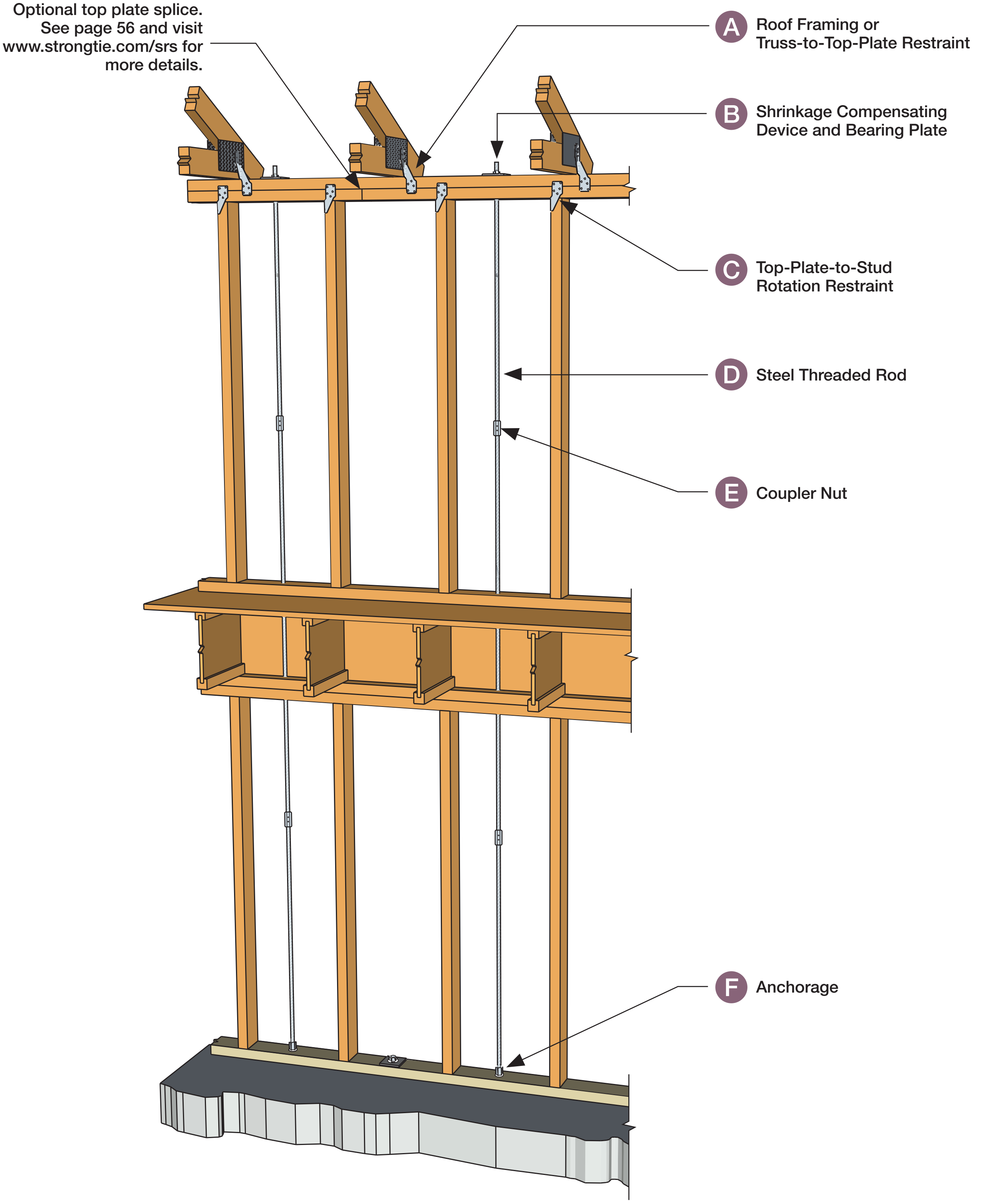


Key Design Considerations for Uplift Restraint Systems for Roofs (cont.)

Connection Location	AC391 Requirement	Criteria Section
A	• 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.	1.2.1.1
B	CRTS allowable loads shall be evaluated and be limited by • Tiedown run steel component capacities per 3.1.1, or • 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	3.1.1 and 3.2.2
C	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.	3.2.2.3
D	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.	3.2.2.1
E	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.	3.2.2.2
F	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 **www.strongtie.com/software** for more information on the Simpson Strong-Tie® Wood Shrinkage Calculator.	3.1.1, 6.2.1.3, and 6.3.1.3
G	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.	3.2.1.2 and Figure 1
H	Rod elongation is limited to 0.18 inches for total rod length at the applied (ASD) load. Visit **www.strongtie.com/software** to access our Rod Elongation Calculator.	3.2.1.1
I	• 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.	1.4.5 and 3.4.1.1
J	Design of the anchorage is the responsibility of the design professional and must be performed in accordance with the applicable code.	6.2.4.5 and 6.3.3.5

From the Roof to the Foundation

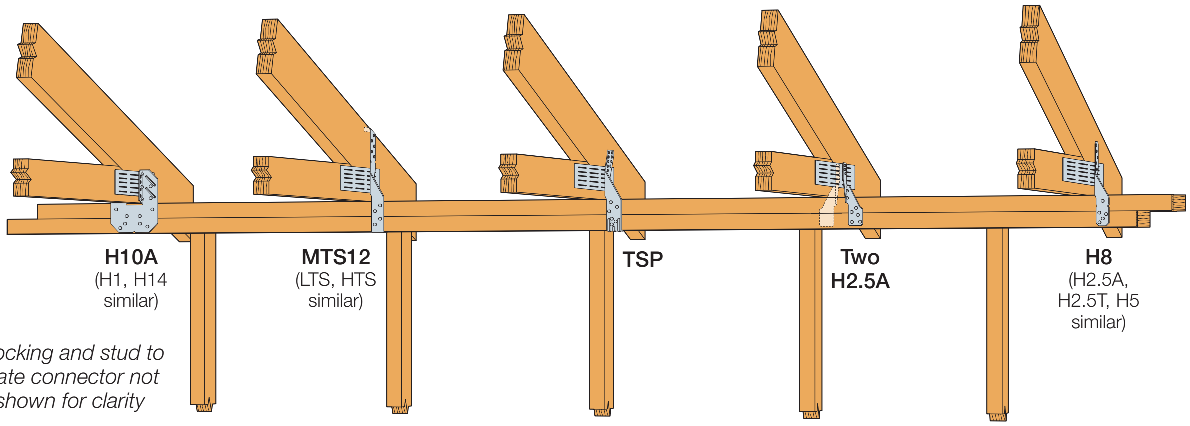
Strong-Rod™ Uplift Restraint System Components



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 typically with a hurricane tie connecting the roof framing to the top plates.

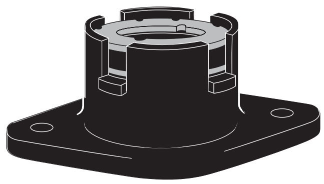
For additional information, the Simpson Strong-Tie® *High Wind-Resistant Construction* catalog offers a variety of options to resist roof uplift forces.



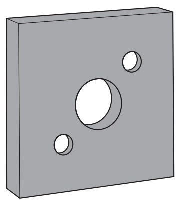
B Shrinkage Compensating Device and Bearing Plate

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 all-thread rod diameter specific and allows for unlimited shrinkage. 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.



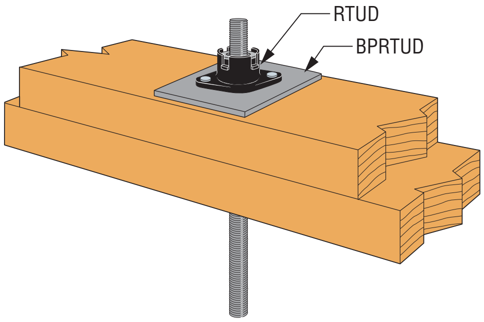
RTUD4
(RTUD3, RTUD5 and RTUD6 similar)
U.S. Patent 8,881,478 and patent pending



BPRTUD3-4
(BPRTUD5-6 similar)

RTUD Models

Model No.	Rod Diameter (in.)	Max. Shrinkage Capacity (in.)
RTUD3	⅜	Unlimited
RTUD4	½	Unlimited
RTUD5	⅝	Unlimited
RTUD6	¾	Unlimited

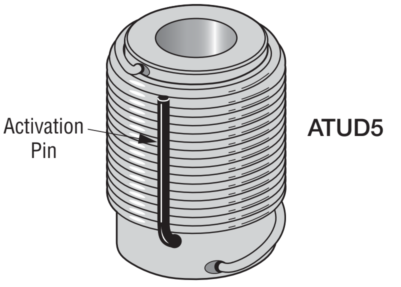


Typical Ratcheting Take-Up Device Assembly Installation

B 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.



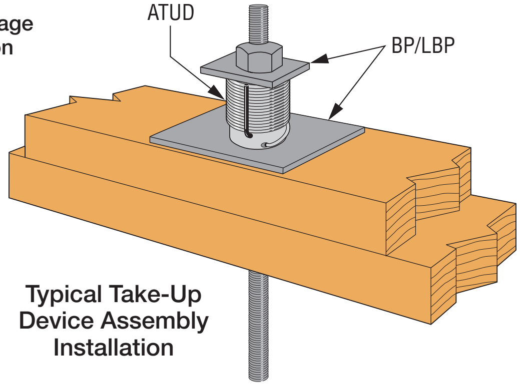
ATUD Models

Model No.	Max. Rod Diameter (in.)	Max. Shrinkage Capacity (in.)
ATUD5	⅝	¾
ATUD6-2	¾	2

Naming Legend

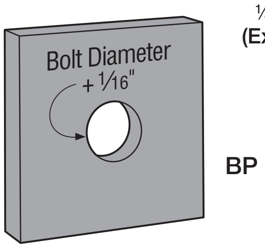
ATUD6-2

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



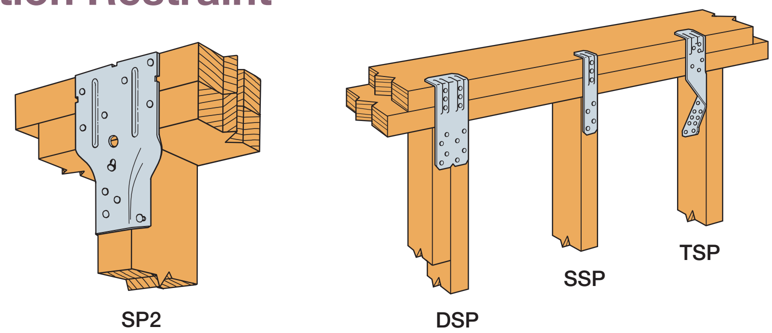
Bearing Plates

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.

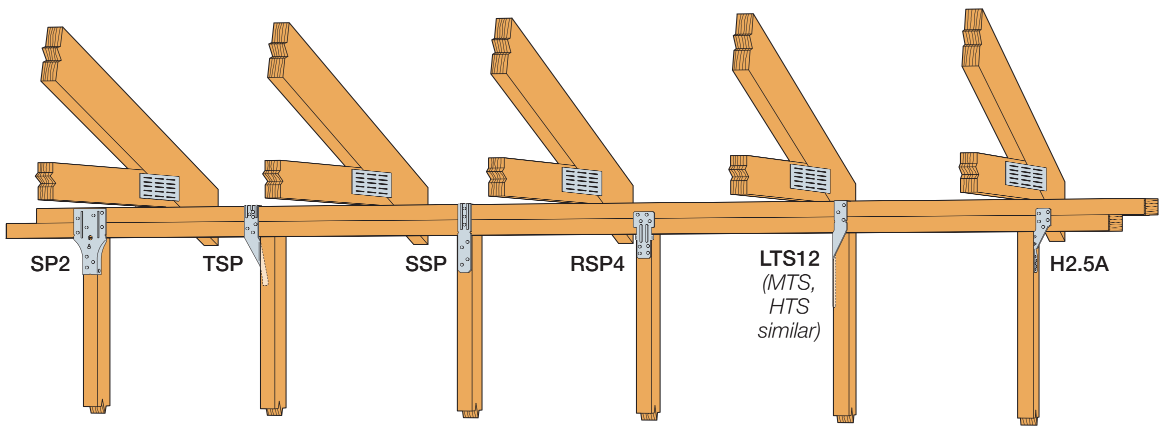


C Top-Plate-to-Stud Rotation Restraint

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.



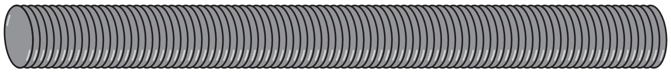
Truss-to-plate connections not shown for clarity. However, they need to be installed on the same side of the wall as plate-to-stud connectors.



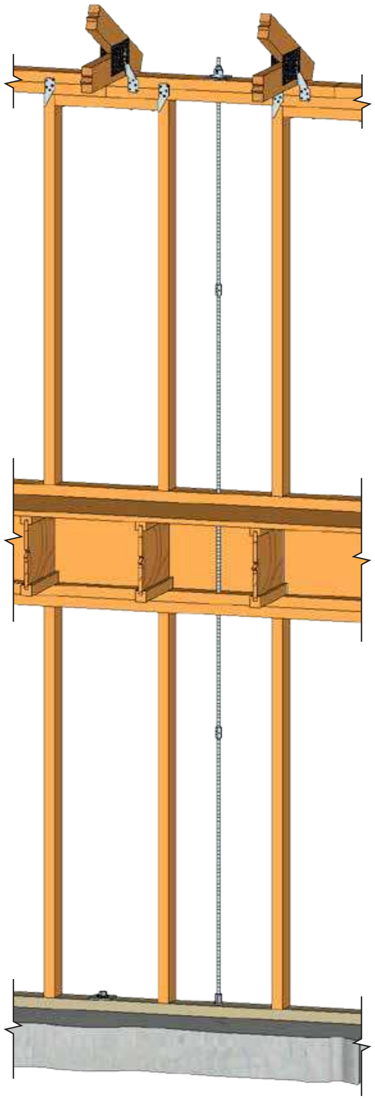
D Steel Threaded Rod

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

Fully threaded rod (all-thread rod) is standard-strength material (ASTM F1554 Grade 36) and is available in multiple lengths to suit your structure's wall height(s).

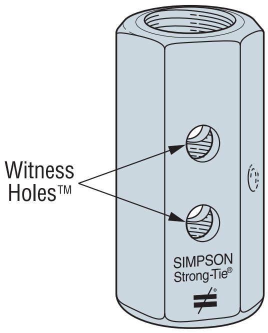


Fully Threaded Rod

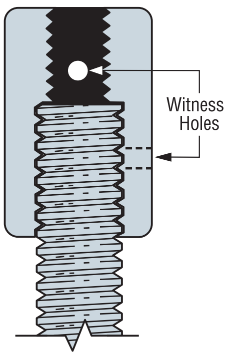


E **Coupler** Nut

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.



CNW



Transition Coupler Nut

F Anchorage

SET-XP® and SET® High-Strength Structural Anchoring Adhesives

SET-XP® is a two-component, 1:1 ratio, high-solids, epoxy-based anchoring adhesive formulated for optimum performance in both cracked and uncracked concrete. SET-XP® adhesive has been rigorously tested in accordance with ICC-ES AC308, ACC355.4 and 2012 IBC requirements and has proven to offer increased reliability in the most adverse conditions, including performance in cracked concrete under static and seismic loading.

SET® is a two-component, 1:1 ratio, high-solids, epoxy-based adhesive for use as a high-strength, non-shrink anchor-grouting material. Resin and hardener are mixed and dispensed simultaneously through the mixing nozzle. SET meets or exceeds the requirements of ASTM C-881 specification for Type I, II, IV and V, Grade 3, Class B and C. Both SET and SET-XP are made in the U.S.A.

AT-XP® and AT 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, ACC355.4 and IBC 2012 requirements for cracked and uncracked concrete in static or seismic conditions, AT-XP anchoring adhesive has demonstrated superior performance in reduced-temperature testing (14°F (-10°C)).

AT is a two-component, high-solids, 10:1 ratio, acrylic-based adhesive for use as a high-strength, anchor-grouting material. Formulated for use in all types of weather, AT is designed to dispense easily and cure at temperatures down to 0°F. AT and AT-XP are both made in the U.S.A.

Titen HD® Rod Coupler Threaded-Rod 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.

Titen HD® Rod Coupler Screw Anchor
U.S. Patent 5,674,035 and 6,623,228

Uplift Restraint System for Roofs Design Checklist

Simpson Strong-Tie is the first rod system manufacturer to complete the rigorous testing and calculation requirements within ICC-ES acceptance criteria AC391 in order to receive an Evaluation Report (ESR-1161) rod tiedown system for roof uplift restraint. This means Simpson Strong-Tie has relieved the Designer of a cumbersome amount of time and work in order to specify these types of systems.

Which rod system manufacturer do I specify?

Strong-Rod™ System for Roof Uplift Restraint (ICC-ES ESR 1161)

1. Designer Responsibilities:

- ☐ Determine project wind uplift loads
- ☐ Specify Uplift Restraint System details from this guide
- ☐ Design shearwall overturning restraint system (See Shearwall Overturning Restraint section on page 24)

2. Manufacturer Responsibilities:

- ☑ Provide rod run steel component properties
- ☑ Test coupler nuts and other proprietary components
- ☑ Calculate steel rod strength and elongation (limited to 0.18")
- ☑ Calculate bearing plate capacities (based on wood bearing and steel bending limits) and deflection based on wood plate crushing
- ☑ Calculate or test top plate deflection between rod runs (limited to spacing/240)
- ☑ Calculate or test top-plate flexural stress
- ☑ Check combined axial and flexural stress when top plate is a drag strut or chord member
- ☑ Provide approved top plate splice detail where both plates are used in flat bending
- ☑ Calculate the sum of deflection from steel rod elongation, wood top-plate bending between tie-down runs, take-up device deflection and wood plate crushing under bearing plates (limited to 0.25")
- ☑ Calculate top-plate rotation force and provide method to restrain torsion forces
- ☑ Ensure cross-grain tension is not a system failure mode
- ☑ Account for wood shrinkage (include take-up device)
- ☑ Create a simple method for Designer to specify a wind uplift restraint rod system

Design Checklist for Specifying Manufacturers Without AC391-Based Continuous Rod Tiedown System Report

1. Designer Responsibilities:

- ☐ Determine project wind uplift loads
- ☐ Design top plate splice detail to utilize both plates in flat bending when required
- ☐ Calculate top-plate deflection between rod runs
- ☐ Calculate top plate flexural stress
- ☐ Check combined axial and flexural stress when top plate is a drag strut or chord member
- ☐ Calculate steel rod elongation (limited to 0.18")
- ☐ Calculate the sum of deflection from steel rod elongation, wood top-plate bending between tiedown runs, take-up device deflection or wood shrinkage and wood plate crushing under bearing plates (limited to 0.25")
- ☐ Calculate top-plate rotation force and provide method to restrain torsion forces
- ☐ Ensure cross-grain tension is not a system failure mode
- ☐ Calculate wood shrinkage and provide a means to account for shrinkage effects
- ☐ Calculate bearing plate deformation and crushing and add to overall deflection
- ☐ Define rod tiedown system layout based on wind uplift loads and system capacities calculated
- ☐ Define all wood detailing requirements for roof uplift system
- ☐ Design shearwall overturning restraint system (It is outside the scope of AC391)

2. Manufacturer Responsibilities:

- ☑ Provide rod run steel component properties
- ☑ Provide capacity of coupler nuts and other proprietary components
- ☑ Calculate steel rod strength; provide capacities
- ☑ Calculate bearing plate capacities (based on wood bearing and steel bending limit)

Three Methods for Specifying

We recognize that, when designing midrise, residential structures, you must first address several design considerations to determine the best-quality and most appropriate wind uplift restraint solution. The Simpson Strong-Tie® Strong-Rod™ Uplift Restraint System for roofs (URS) is the result of years of development and testing of continuous rod tiedown systems and their components. When you choose the URS, you will have the piece of mind that comes with specifying the only continuous rod tiedown system on the market that meets the life-safety design parameters of ICC-ES Acceptance Criteria 391. For more information on AC391, please visit **www.strongtie.com/srs**. To make your design work easier, we currently offer the following three methods of specifying our Strong-Rod URS:

METHOD 1 – Designer Selects System and Specifies on Building Plans

Designers may choose to design the Uplift Restraint System (Strong-Rod™ URS) for roofs by utilizing the cataloged load tables. Designers will have to perform the following:

- Determine the net uplift at truss/roof framing members and bearing wall lines
- Pick connectors (hurricane ties) to transfer uplift from truss or rafter to wood top plates
- Determine the top plate rotation restraint connection
- Choose the appropriate URS to transfer uplift from top plates to point of restraint. This choice includes:
  - URS rod diameter and on-center spacing
  - Determining shrinkage compensators required
  - Establish URS run anchorage; visit **www.strongtie.com/srs** for anchorage design options

METHOD 2 – Handling Deferred Submittals

The Designer may also choose to provide a performance specification as part of their construction documents and require the contractor to submit deferred design calculations and shop drawings. Designer can download performance specifications and notes to place onto the Designer's construction documents at **www.strongtie.com/srs**. Generic typical details can also be obtained to insert into the Designer's construction documents.

Designers' construction documents should include:

- URS performance specifications, notes and typical details from **www.strongtie.com/srs**
- Wind load requirements for the project
- Uplift restraint system shall have an ICC-ES Evaluation system report per AC391
- Provide foundation type and size
- Foundation details and specifications
- Dead load at each uplift restraint wall line

METHOD 3 – Design Services from Simpson Strong-Tie

During the Designer's preparation of their construction documents, Simpson Strong-Tie Engineering Services provides design services that can be called upon to create the most cost-effective customized runs. These runs include detailed design calculations for each roof uplift restraint requirement and comprehensive design drawings with all the necessary details to install the URS system. The Design engineer will work closely with Simpson Strong-Tie design team to provide all the necessary information required to design the system.

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

- Design code for project
- Net uplift loads at each bearing wall lines (truss layout and design cut sheets are acceptable if available)
- Type of floor joist and depth and dead load
- Wall heights and dead load
- Foundation details at bearing wall locations

Simpson Strong-Tie has provided an easy-to-use worksheet to assist the Designer in providing all the necessary information. The worksheet can be downloaded at **www.strongtie.com/srs**, completed and then 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 construction documents for the Designer to submit to the building department.

Method 1 – Designer Selects System and Specifies on Building Plans

Selection and Specification Procedure

Designers may specify the Simpson Strong-Tie® Strong-Rod™ Uplift Restraint System for roofs (Strong-Rod™ URS) by utilizing the Strong-Rod URS rod run tables provided after the layout and net uplift of the roof framing members is calculated by the designer. A complete load path can be achieved by first picking the roof framing/truss connections to the top plate with hurricane ties. Then, to achieve torsional restraint of the top plate, connectors can be chosen to attach the top plate to the studs. A Strong-Rod URS and anchorage system can be chosen based on the net uplift calculated. The following are steps in properly choosing a URS and anchorage system.

Selecting the Appropriate Product

Strong-Rod URS is available in four assemblies: URS3 = ⅜", URS4 = ½", URS5 = ⅝" and URS6 = ¾" rod diameters. Below are steps for selecting and specifying the appropriate rod run solution to resist the demand wind uplift loads for a given wall line.

STEP 1 – Determine the wind uplift loads for the roof framing members along each bearing wall line, as outlined below.

- Calculate roof uplift per the current building code.
- If trusses are used for roof framing, reactions are listed on the truss shop drawings.
- Loads should be converted to pounds per lineal feet at allowable stress levels.

STEP 2 – Choose the appropriate shrinkage compensating device.

- Choose an RTUD or ATUD take-up device based on expected shrinkage and on rod diameters used in step 3.

STEP 3 – Choose the appropriate Strong-Rod™ URS table for roof uplift restraint, narrowing down the table choice by selecting from the following sections:

- Choose Strong-Rod™ URS based on the top plate lumber species SYP per Tables A-D on pages 49-52. Other species can be found at **www.strongtie.com/srs**.
- Based on the demand uplift forces calculated in Step 1, choose a row from the left-most column.
- Choose the widest on-center spacing in the second column that provides solutions for the required length of the rod run (typically, length is from foundation to roof top plate).
- Pick the smallest rod diameter URS model that satisfies the design requirements and rod length.
- Increased rod spacing may be achieved by choosing to reinforce the splices of the roof-level double top plate (see page 56).
- Verify sufficient axial capacity in top plates for drag load and chord forces.

STEP 4 – Choose the Strong-Rod URS rod run anchorage.

- Choose the appropriate anchorage required for the project at each URS wall line. Post-installed concrete foundation anchors can be chosen based on pages 53-54.
- Rods can terminate below the top plate of a wall as long as there are no net uplift forces at anchorage point. Details on options to terminate below the top plate or beam can be found at **www.strongtie.com/srs**.

STEP 5 – Choose the appropriate hurricane tie connector to resist the roof member uplift.

STEP 6 – Choose a connection to prevent top plate rotation.

Based on the uplift demand calculated in Step 1, choose a hurricane tie connection from the current Simpson Strong-Tie® *Wood Construction Connectors* catalog to attach the top plate to the stud. The connector will be placed on the same side as the roof-framing-to-top-plate connector.

Specification of the chosen URS model in a given wall line can be as noted in a sample shown:

URS4 w/RTUD4 x 30'-0" @ 40" o.c.

- URS4: URS Model based on choices listed above
- w/RTUD4: Ratcheting take-up device
- 30'-0": Total rod length in feet and inches based on overall structure height
- 40" o.c.: URS Spacing

STEP 7 – Get your documents.

Typical details can be chosen from **www.strongtie.com/srs** and inserted into the construction documents. Options for detailing around window and door openings and holdowns for uplift at girder trusses are available.

Design Example for Method 1

Specify a roof uplift restraint system (URS) assembly to resist the wind uplift demands along the main exterior walls of a three-story wood-framed structure.

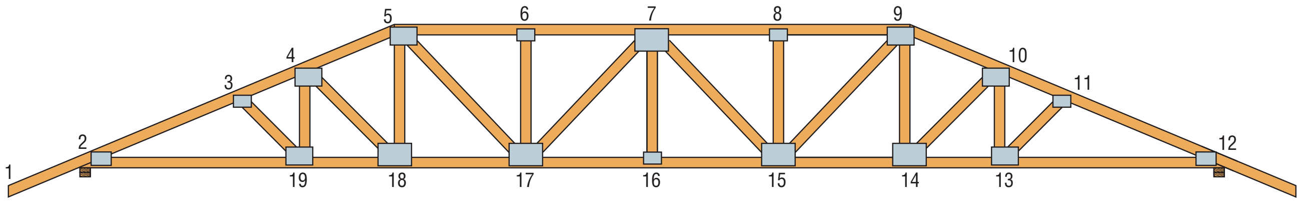
Given:

- 2012 IBC, Allowable Stress Design
- Engineered roof trusses
- 8'-1" plate height each level, 10 psf wall dead load
- ¾" floor sheathing
- 16"-deep floor joists spaced 24" o.c.
- Floor joists are running parallel to bearing wall at each level, 20 psf floor dead load
- 6" nominal width bearing walls
- Southern Yellow Pine lumber, top plates No. 2 grade
- Drag load between shearwalls = 2,000 pounds; chord force = 1,500 pounds
- Slab-on-grade foundation with turned down edge around building perimeter

1. Determine the wind uplift loads for the roof framing members along each bearing wall line, as outlined below.

Roof uplift can be determined by using the procedures found in the IBC, ASCE 7, AWC WFCM, or ICC 600 (if applicable). ASCE 7-10 calculates the wind pressure in strength design levels. It is important to include the necessary factors for allowable stress design per ASCE 7-10 Section 2.4.1. Alternatively, where trusses are used for roof framing, uplift reactions are listed on the truss cut sheets. Verify with truss calculations to confirm that the reactions shown on the cut-sheets are within allowable stress level.

In this example, engineered truss drawings show uplift reaction of 600 pounds per truss (ASD) and trusses are spaced 24" o.c. Therefore, uplift along the wall is 300 plf.



Loading		General		CSI Summary		Deflection		L/	(loc)	Allowed
Load	(psf)	Bldg Code :	IBC 2012/ TPI 1-2007	TC :	0.31 (1-2)	Vert TL:	0.42 in	L / 999	(14-15)	L / 180
TCLL :	20			BC :	0.51 (18-1)	Vert LL:	0.22 in	L / 999	15	L / 240
TCDL :	7	Rep Mbr Increase :	Yes	Web :	0.16 (6-14)	Horz TL:	0.14 in		11	
BCLL :	0	D.O.L. :	115 %			Creep Factor, Kcr = 1.5				
BCDL :	5									

Reaction Summary

JT	Type	Brg Combo	Brg Width	Material	Rqd Brg Width	Max React	Max Grav Uplift	Max Wind Uplift	Max Uplift	Max Horiz
1	Pin (Wall)	1	3.5 in	Steel	1.50 in	960 lbs	-	-600 lbs	-600 lbs	-16 lbs
11	H Roll (Wall)	1	3.5 in	Steel	1.50 in	960 lbs	-	-600 lbs	-600 lbs	0 lbs

Material Summary

TC	DFL #2 2x4
BC	DFL #2 2x4
Webs	DFL #3 2x4

Bracing Summary

TC Bracing:	Sheathed or Purlins at 3-9-0, Purlin design by Others.
BC Bracing:	Sheathed or Purlins at 5-3-0, Purlin design by Others.

2. Choose the appropriate take-up device.

Wood shrinkage, construction gaps and settlement can all create looseness in the continuous rod tiedown system, reducing the overall performance. A shrinkage compensator (or take-up device) maintains the performance of the rod system by taking up slack in the rod run. The building designer must review the overall effects of a possible loose rod system and specify a method for addressing this issue. The Simpson Strong-Tie® Strong-Rod™ URS typically includes a shrinkage compensator (RTUD or ATUD) when specifying these types of uplift restraint systems because the internal deflection of these devices under load is much less than the building shrinkage. If no shrinkage compensating device is used, the 0.25" total rod run deflection limit in ICC-ES Acceptance Criteria 391 (AC391) may be exceeded by shrinkage alone in many structures.

The expected amount of wood shrinkage can be calculated easily using the Simpson Strong-Tie Wood Shrinkage Calculator by visiting: **www.strongtie.com/software**.

⇨ **In this example, based on output from the Wood Shrinkage Calculator, the expected shrinkage is 0.570". Therefore, specify RTUD-type shrinkage take-up device to mitigate the shrinkage of 0.570".**

Design Example for Method 1 (cont.)

The specific RTUD model number is based on the rod size chosen. RTUDs are the most cost-effective shrinkage compensator on the market for rod runs, but they have slightly more internal deflection than ATUDs (see ICC-ES ESR-2320 for comparison), and this deflection is included in the 0.25" maximum rod run deflection requirement of AC391. After finding the Strong-Rod URS model and on-center spacing using an RTUD, the Designer may want to compare the spacing required if ATUDs are specified to see if wider spacing is possible and fewer rod runs are required.

3. Choose the appropriate Strong-Rod™ System table for roof uplift restraint, narrowing the table choice by selecting from the following sections:

Based on the given information of Southern Yellow Pine (SYP) and 6" nominal wall width, 2x6 No. 2 top plates narrow the choice to URS Table B on page 50 or URS Table D on page 52. However, the choice of the RTUD shrinkage compensator reduces our table choice to one, Table B.

Determine the length of the URS rod runs along this exterior bearing wall:

The length of the rod assembly will depend on the building height and available dead load on the bearing walls resisting wind uplift. Generally, the rod assembly will start at the foundation and terminate at the roof-level wood top plates. However, if a building code allows for a portion of the building dead load to resist wind uplift, it could allow the rod to terminate beneath upper top plates. Designing under the Allowable Stress Method allows for 60% of the building dead load to be used to resist wind uplift (IBC 2012 Equation 16-15).

- For 8' tall walls, the dead load (DL) allowed by code to reduce uplift can be calculated:
  0.6 x 10 psf of DL x 8' = 48 plf per level
- For 1' of floor width tributary to the walls, the DL allowed by code to reduce uplift can be calculated:
  0.6 x 20 psf of DL x 1' = 12 plf per level
- 300 plf uplift load at the roof (as shown in the sample table below) will reduce to 234 plf at 3rd floor and 168 plf uplift below the 2nd floor. This does not allow the rod assembly to terminate at a wood floor above the foundation level.
- Calculating the required rod-run length:
  (3 levels) x (8'-1" tall walls) + (2 floors) x (1'-4¾" floor depth) = 27½'. Determine the URS rod run to specify:

URS Table B – Maximum Lengths of URS Uplift Rod Runs and Maximum Chord/Drag Strut Loads (RTUD Deflection included)

Roof Uplift Along Top of Wall (plf)	Uplift Rod Run Spacing (in.)	Double 2x6 SYP No.2 Top Plates									
		Unreinforced Top Plate Splices					Reinforced Top Plate Splices				
		URS Model				Maximum Chord/ Drag Strut Load (lbs.)	URS Model				Maximum Chord/ Drag Strut Load (lbs.)
		URS3	URS4	URS5	URS6		URS3	URS4	URS5	URS6	
		Maximum Length of URS Uplift Rod Run (ft.) [System Deflection, Δ (in.)]					Maximum Length of URS Uplift Rod Run (ft.) [System Deflection, Δ (in.)]				
300	24	50 [0.248]	65 [0.196]	65 [0.156]	65 [0.134]	4,130	54 [0.247]	65 [0.182]	65 [0.143]	65 [0.121]	10,790
	30	30 [0.248]	58 [0.249]	65 [0.214]	65 [0.185]	2,710	38 [0.248]	65 [0.232]	65 [0.181]	65 [0.153]	9,370
	36	10 [0.248]	21 [0.248]	32 [0.248]	48 [0.249]	970	24 [0.248]	47 [0.25]	65 [0.236]	65 [0.201]	7,630
	40	NP	NP	NP	NP	—	15 [0.25]	29 [0.247]	46 [0.249]	65 [0.245]	6,300
	42	NP	NP	NP	NP	—	10 [0.249]	21 [0.25]	32 [0.249]	48 [0.249]	5,580
	48	NP	NP	NP	NP	—	NP	NP	NP	NP	—
	60	NP	NP	NP	NP	—	NP	NP	NP	NP	—
	72	NP	NP	NP	NP	—	NP	NP	NP	NP	—

The widest possible spacing in the table for a rod run that is 27.5 ft. long is 42" o.c. using a URS5 (32' > 27.5'), but the cost savings that can be achieved by using a URS4 is worth the slightly closer spacing of 40" o.c. (29' > 27.5'). Either of these choices requires the top plate to be reinforced at the splices to achieve increased bending capacity. The detail on page 56 must be specified on the plans. Without reinforcing the top plate, the maximum on-center spacing is 36" and requires a URS5. The cost-effective splice detail uses wood blocking and Simpson Strong-Tie® Strong-Drive® SDS Heavy-Duty Connector screws and is only required at the roof level.

The values shown in the table are the maximum rod length for the Strong-Rod™ URS and the total system deflection (rod elongation, top-plate bending, bearing-plate crushing and take-up device deflection). 29 [0.247] indicates a maximum rod length of 29'-0" and a total system deflection of 0.247".

Design Example for Method 1 (cont.)

- Next verify that there is still sufficient axial capacity in the top plates to drag force between shearwalls or resist diaphragm chord forces.

The Maximum Chord/Drag Strut Load column in the table above lists the available tension capacity in the top plate(s) after it is reduced based on a through hole in the wood plates and the required wood capacity used to resist bending (combined tension/bending check). Typically, the top plates are used to drag load between shearwalls and resist chord forces in the diaphragm. If more tension load is required, then a reduced rod-run spacing may be needed.

Drag-force demand governs over the chord force demand given, so 2,000 pounds of tension load is required. There is 6,300 pounds of capacity, so this is adequate.

⇨ **Specify: Strong-Rod™ URS4 27'-6" with RTUD4 at 40" o.c. with Reinforced Top Plate Splices at Roof Level.**

4. Choose the Strong-Rod URS rod run anchorage

Foundation types can vary, so the specification of anchorage is the responsibility of the Designer. Simpson Strong-Tie has several post-installed and cast-in-place anchorage solutions.

- Determine the design demand load:
  300 plf x 40 inches = 1,000 pounds of tension in (ASD)
- Try Simpson Strong-Tie® Titen HD® Rod Coupler threaded rod anchors. Table below provides a post-installed anchoring solution using these products

ASD Tension Values (Cracked Concrete)

Size (in.)	Model No.	Nom. Embed. Depth (in.)	Center of Interior Thickened Slab			Edge of Turned Down Slab or Stemwall				Edge of Elevated Slab			
			Min. End Dist. (in.)	Min. Concrete Thick. (in.)	Tension Strength (lbs.)	Min. Concrete Thick. (in.)	Min. End Dist. (in.)	Tension Strength (lbs.)		Min. Concrete Thick. (in.)	Min. End Dist. (in.)	Tension Strength (lbs.)	
								1¾ Edge Dist.	2¾ Edge Dist.			1¾ Edge Dist.	2¾ Edge Dist.
⅜ x 6¾	THD37634RC	5	1¾	10	1,055	10	6	1,055	1,055	10	5½	1,055	1,055
½ x 9¾	THD50934RC	8	10	14	1,715	14	10	1,680	1,715	14	5	1,715	1,715

- Installing a THD50934RC with an 8" embed at 1¾" edge distance yields 1,680 lbs. of allowable tension capacity.

⇨ **Specify: THD50934RC with 8" Embedment at 40" o.c. with 1¾" Min. Edge Distance.**

5. Choose the connection to resist the uplift forces from the roof framing/trusses.

In order to create a continuous load path, the roof framing/trusses will have to be connected to the double top plates in order to transfer the uplift from the roof down to the wall.

- As stated in Step 1, each truss has a 600-pound uplift demand, and a Simpson Strong-Tie® H2.5A hurricane tie can transfer this load from the truss to the top plates. Typically, these are installed on the inside of the wall in a multi-story structure for ease of installation.

6. Choose connection to prevent top plate rotation.

Top plate rotation can occur when rods are installed in the center of the top plate and the roof truss or rafter is attached to the side of the top plate. An additional load resulting from this load path offset is defined as F_{clip} (top-plate rotation restraint connection force). Follow the steps below to provide the necessary restraint for this load.

- In order to resist top plate rotation, a connection must be made from top plates to studs on the same side of the wall as the truss-to-top-plate connection. This connector must be able to resist the F_{clip} force shown in the table on page 55.
- The force for connectors spaced at 32" o.c. (every other stud) is 400 pounds. A H2.5A hurricane tie can resist this rotational force.

⇨ **Specify: Simpson Strong-Tie H2.5A at Each Truss and a H2.5A at Every Other Stud.**

Strong-Rod™ URS Load Tables

URS Table A – Maximum Lengths of URS Uplift Rod Runs and Maximum Chord/Drag Strut Loads (RTUD Deflection included)

Roof Uplift Along Top of Wall (plf)	Uplift Rod Run Spacing (in.)	Double 2x4 SYP No. 2 Top Plates									
		Unreinforced Top Plate Splices					Reinforced Top Plate Splices				
		URS Model				Maximum Chord/ Drag Strut Load (lbs.)	URS Model				Maximum Chord/ Drag Strut Load (lbs.)
		URS3	URS4	URS5	URS6		URS3	URS4	URS5	URS6	
		Maximum Length of URS Uplift Rod Run (ft.) [System Deflection, Δ (in.)]					Maximum Length of URS Uplift Rod Run (ft.) [System Deflection, Δ (in.)]				
100	24	65 [0.139]	65 [0.102]	65 [0.09]	65 [0.086]	3,445	65 [0.132]	65 [0.095]	65 [0.083]	65 [0.08]	7,700
	30	65 [0.177]	65 [0.132]	65 [0.117]	65 [0.111]	2,995	65 [0.16]	65 [0.115]	65 [0.1]	65 [0.094]	7,250
	36	65 [0.231]	65 [0.179]	65 [0.16]	65 [0.151]	2,445	65 [0.196]	65 [0.144]	65 [0.125]	65 [0.116]	6,695
	40	48 [0.25]	65 [0.222]	65 [0.201]	65 [0.191]	2,020	65 [0.226]	65 [0.169]	65 [0.147]	65 [0.138]	6,270
	42	33 [0.249]	65 [0.249]	65 [0.226]	65 [0.216]	1,790	65 [0.244]	65 [0.184]	65 [0.161]	65 [0.151]	6,045
	48	NP	NP	NP	NP	—	37 [0.248]	65 [0.24]	65 [0.214]	65 [0.201]	5,290
	60	NP	NP	NP	NP	—	NP	NP	NP	NP	—
	72	NP	NP	NP	NP	—	NP	NP	NP	NP	—
200	24	65 [0.225]	65 [0.157]	65 [0.131]	65 [0.118]	2,645	65 [0.211]	65 [0.143]	65 [0.117]	65 [0.104]	6,895
	30	45 [0.248]	65 [0.217]	65 [0.184]	65 [0.167]	1,740	58 [0.248]	65 [0.183]	65 [0.15]	65 [0.133]	5,995
	36	14 [0.247]	31 [0.25]	47 [0.25]	65 [0.248]	635	37 [0.25]	65 [0.239]	65 [0.199]	65 [0.178]	4,890
	40	NP	NP	NP	NP	—	22 [0.248]	44 [0.249]	65 [0.245]	65 [0.22]	4,040
	42	NP	NP	NP	NP	—	15 [0.249]	31 [0.25]	47 [0.249]	65 [0.246]	3,585
	48	NP	NP	NP	NP	—	NP	NP	NP	NP	—
	60	NP	NP	NP	NP	—	NP	NP	NP	NP	—
	72	NP	NP	NP	NP	—	NP	NP	NP	NP	—
300	24	45 [0.247]	65 [0.211]	65 [0.171]	65 [0.149]	1,840	52 [0.248]	65 [0.19]	65 [0.15]	65 [0.129]	6,095
	30	21 [0.249]	41 [0.249]	64 [0.249]	65 [0.222]	485	33 [0.246]	64 [0.248]	65 [0.2]	65 [0.172]	4,740
	36	NP	NP	NP	NP	—	16 [0.248]	32 [0.248]	50 [0.249]	65 [0.239]	3,080
	40	NP	NP	NP	NP	—	NP	NP	14 [0.249]	22 [0.25]	1,810
	42	NP	NP	NP	NP	—	NP	NP	NP	NP	—
	48	NP	NP	NP	NP	—	NP	NP	NP	NP	—
	60	NP	NP	NP	NP	—	NP	NP	NP	NP	—
	72	NP	NP	NP	NP	—	NP	NP	NP	NP	—
400	24	30 [0.248]	58 [0.249]	65 [0.211]	65 [0.181]	1,035	37 [0.25]	65 [0.237]	65 [0.183]	65 [0.153]	5,290
	30	NP	NP	NP	NP	—	21 [0.247]	41 [0.248]	65 [0.25]	65 [0.211]	3,480
	36	NP	NP	NP	NP	—	NP	13 [0.249]	20 [0.25]	30 [0.249]	1,275
	40	NP	NP	NP	NP	—	NP	NP	NP	NP	—
	42	NP	NP	NP	NP	—	NP	NP	NP	NP	—
	48	NP	NP	NP	NP	—	NP	NP	NP	NP	—
	60	NP	NP	NP	NP	—	NP	NP	NP	NP	—
	72	NP	NP	NP	NP	—	NP	NP	NP	NP	—
500	24	21 [0.249]	41 [0.249]	64 [0.25]	65 [0.212]	235	27 [0.246]	53 [0.25]	65 [0.217]	65 [0.178]	4,485
	30	NP	NP	NP	NP	—	14 [0.249]	27 [0.247]	43 [0.249]	65 [0.249]	2,225
	36	NP	NP	NP	NP	—	NP	NP	NP	NP	—
	40	NP	NP	NP	NP	—	NP	NP	NP	NP	—
	42	NP	NP	NP	NP	—	NP	NP	NP	NP	—
	48	NP	NP	NP	NP	—	NP	NP	NP	NP	—
	60	NP	NP	NP	NP	—	NP	NP	NP	NP	—
	72	NP	NP	NP	NP	—	NP	NP	NP	NP	—
600	24	NP	NP	NP	NP	—	21 [0.246]	41 [0.248]	64 [0.248]	65 [0.202]	3,685
	30	NP	NP	NP	NP	—	NP	18 [0.247]	28 [0.248]	44 [0.249]	970
	36	NP	NP	NP	NP	—	NP	NP	NP	NP	—
	40	NP	NP	NP	NP	—	NP	NP	NP	NP	—
	42	NP	NP	NP	NP	—	NP	NP	NP	NP	—
	48	NP	NP	NP	NP	—	NP	NP	NP	NP	—
	60	NP	NP	NP	NP	—	NP	NP	NP	NP	—
	72	NP	NP	NP	NP	—	NP	NP	NP	NP	—

For table foonotes, visit **www.strongtie.com/srs**.

URS Table B – Maximum Lengths of URS Uplift Rod Runs and Maximum Chord/Drag Strut Loads (RTUD Deflection included)

Roof Uplift Along Top of Wall (plf)	Uplift Rod Run Spacing (in.)	Double 2x6 SYP No. 2 Top Plates									
		Unreinforced Top Plate Splices					Reinforced Top Plate Splices				
		URS Model				Maximum Chord/ Drag Strut Load (lbs.)	URS Model				Maximum Chord/ Drag Strut Load (lbs.)
		URS3	URS4	URS5	URS6		URS3	URS4	URS5	URS6	
		Maximum Length of URS Uplift Rod Run (ft.) [System Deflection, Δ (in.)]					Maximum Length of URS Uplift Rod Run (ft.) [System Deflection, Δ (in.)]				
100	24	65 [0.134]	65 [0.097]	65 [0.085]	65 [0.081]	5,815	65 [0.129]	65 [0.093]	65 [0.081]	65 [0.077]	12,475
	30	65 [0.165]	65 [0.12]	65 [0.105]	65 [0.098]	5,340	65 [0.154]	65 [0.109]	65 [0.094]	65 [0.088]	12,000
	36	65 [0.206]	65 [0.153]	65 [0.134]	65 [0.126]	4,765	65 [0.183]	65 [0.131]	65 [0.112]	65 [0.104]	11,425
	40	65 [0.241]	65 [0.183]	65 [0.162]	65 [0.152]	4,320	65 [0.207]	65 [0.149]	65 [0.128]	65 [0.118]	10,980
	42	58 [0.249]	65 [0.201]	65 [0.179]	65 [0.168]	4,080	65 [0.22]	65 [0.16]	65 [0.138]	65 [0.127]	10,740
	48	23 [0.249]	48 [0.25]	65 [0.244]	65 [0.231]	3,290	56 [0.248]	65 [0.199]	65 [0.173]	65 [0.161]	9,950
	60	NP	NP	NP	NP	—	NP	16 [0.25]	23 [0.25]	31 [0.25]	8,055
	72	NP	NP	NP	NP	—	NP	NP	NP	NP	—
200	24	65 [0.215]	65 [0.146]	65 [0.121]	65 [0.108]	4,975	65 [0.206]	65 [0.138]	65 [0.112]	65 [0.099]	11,635
	30	55 [0.25]	65 [0.192]	65 [0.159]	65 [0.142]	4,025	63 [0.249]	65 [0.171]	65 [0.138]	65 [0.12]	10,685
	36	30 [0.247]	60 [0.25]	65 [0.219]	65 [0.197]	2,865	45 [0.25]	65 [0.214]	65 [0.174]	65 [0.152]	9,525
	40	14 [0.249]	29 [0.249]	45 [0.25]	65 [0.25]	1,980	33 [0.248]	64 [0.249]	65 [0.206]	65 [0.182]	8,640
	42	NP	13 [0.249]	19 [0.249]	28 [0.25]	1,500	27 [0.247]	54 [0.25]	65 [0.225]	65 [0.199]	8,160
	48	NP	NP	NP	NP	—	10 [0.249]	21 [0.248]	33 [0.25]	48 [0.249]	6,580
	60	NP	NP	NP	NP	—	NP	NP	NP	NP	—
	72	NP	NP	NP	NP	—	NP	NP	NP	NP	—
300	24	50 [0.248]	65 [0.196]	65 [0.156]	65 [0.134]	4,130	54 [0.247]	65 [0.182]	65 [0.143]	65 [0.121]	10,790
	30	30 [0.248]	58 [0.249]	65 [0.214]	65 [0.185]	2,710	38 [0.248]	65 [0.232]	65 [0.181]	65 [0.153]	9,370
	36	10 [0.248]	21 [0.248]	32 [0.248]	48 [0.249]	970	24 [0.248]	47 [0.25]	65 [0.236]	65 [0.201]	7,630
	40	NP	NP	NP	NP	—	15 [0.25]	29 [0.247]	46 [0.249]	65 [0.245]	6,300
	42	NP	NP	NP	NP	—	10 [0.249]	21 [0.25]	32 [0.249]	48 [0.249]	5,580
	48	NP	NP	NP	NP	—	NP	NP	NP	NP	—
	60	NP	NP	NP	NP	—	NP	NP	NP	NP	—
	72	NP	NP	NP	NP	—	NP	NP	NP	NP	—
400	24	35 [0.249]	65 [0.245]	65 [0.191]	65 [0.161]	3,290	39 [0.248]	65 [0.227]	65 [0.173]	65 [0.143]	9,950
	30	18 [0.25]	35 [0.249]	55 [0.25]	65 [0.229]	1,395	26 [0.249]	50 [0.249]	65 [0.225]	65 [0.186]	8,055
	36	NP	NP	NP	NP	—	14 [0.25]	27 [0.247]	43 [0.25]	65 [0.25]	5,735
	40	NP	NP	NP	NP	—	NP	12 [0.248]	19 [0.25]	29 [0.249]	3,960
	42	NP	NP	NP	NP	—	NP	NP	NP	11 [0.25]	3,000
	48	NP	NP	NP	NP	—	NP	NP	NP	NP	—
	60	NP	NP	NP	NP	—	NP	NP	NP	NP	—
	72	NP	NP	NP	NP	—	NP	NP	NP	NP	—
500	24	25 [0.245]	49 [0.248]	65 [0.226]	65 [0.187]	2,445	30 [0.249]	57 [0.249]	65 [0.204]	65 [0.165]	9,105
	30	10 [0.246]	21 [0.248]	33 [0.25]	50 [0.249]	75	18 [0.245]	36 [0.249]	56 [0.248]	65 [0.219]	6,735
	36	NP	NP	NP	NP	—	NP	16 [0.248]	24 [0.247]	38 [0.248]	3,840
	40	NP	NP	NP	NP	—	NP	NP	NP	NP	—
	42	NP	NP	NP	NP	—	NP	NP	NP	NP	—
	48	NP	NP	NP	NP	—	NP	NP	NP	NP	—
	60	NP	NP	NP	NP	—	NP	NP	NP	NP	—
	72	NP	NP	NP	NP	—	NP	NP	NP	NP	—
600	24	19 [0.245]	38 [0.249]	59 [0.248]	65 [0.213]	1,605	23 [0.244]	45 [0.247]	65 [0.235]	65 [0.187]	8,265
	30	NP	NP	NP	NP	—	13 [0.244]	27 [0.25]	42 [0.25]	64 [0.25]	5,420
	36	NP	NP	NP	NP	—	NP	NP	NP	21 [0.249]	1,945
	40	NP	NP	NP	NP	—	NP	NP	NP	NP	—
	42	NP	NP	NP	NP	—	NP	NP	NP	NP	—
	48	NP	NP	NP	NP	—	NP	NP	NP	NP	—
	60	NP	NP	NP	NP	—	NP	NP	NP	NP	—
	72	NP	NP	NP	NP	—	NP	NP	NP	NP	—

For table foonotes, visit **www.strongtie.com/srs**.

Strong-Rod™ URS Load Tables

URS Table C – Maximum Lengths of URS Uplift Rod Runs and Maximum Chord/Drag Strut Loads (ATUD Deflection included)

Roof Uplift Along Top of Wall (plf)	Uplift Rod Run Spacing (in.)	Double 2x4 SYP No. 2 Top Plates									
		Unreinforced Top Plate Splices					Reinforced Top Plate Splices				
		URS Model				Maximum Chord/ Drag Strut Load (lbs.)	URS Model				Maximum Chord/ Drag Strut Load (lbs.)
		URS3	URS4	URS5	URS6		URS3	URS4	URS5	URS6	
		Maximum Length of URS Uplift Rod Run (ft.) [System Deflection, Δ (in.)]					Maximum Length of URS Uplift Rod Run (ft.) [System Deflection, Δ (in.)]				
100	24	65 [0.086]	65 [0.055]	65 [0.041]	65 [0.036]	3,445	65 [0.079]	65 [0.048]	65 [0.034]	65 [0.029]	7,700
	30	65 [0.124]	65 [0.085]	65 [0.068]	65 [0.06]	2,995	65 [0.107]	65 [0.068]	65 [0.051]	65 [0.043]	7,250
	36	65 [0.178]	65 [0.132]	65 [0.111]	65 [0.101]	2,445	65 [0.143]	65 [0.097]	65 [0.076]	65 [0.066]	6,695
	40	65 [0.227]	65 [0.175]	65 [0.152]	65 [0.14]	2,020	65 [0.173]	65 [0.122]	65 [0.098]	65 [0.087]	6,270
	42	61 [0.248]	65 [0.201]	65 [0.177]	65 [0.165]	1,790	65 [0.191]	65 [0.137]	65 [0.112]	65 [0.1]	6,045
	48	NP	NP	NP	NP	—	62 [0.248]	65 [0.192]	65 [0.164]	65 [0.15]	5,290
	60	NP	NP	NP	NP	—	NP	NP	NP	NP	—
	72	NP	NP	NP	NP	—	NP	NP	NP	NP	—
200	24	65 [0.171]	65 [0.109]	65 [0.081]	65 [0.067]	2,645	65 [0.158]	65 [0.096]	65 [0.068]	65 [0.053]	6,895
	30	65 [0.247]	65 [0.17]	65 [0.135]	65 [0.116]	1,740	65 [0.213]	65 [0.136]	65 [0.101]	65 [0.082]	5,995
	36	31 [0.247]	57 [0.248]	65 [0.22]	65 [0.197]	635	53 [0.247]	65 [0.192]	65 [0.15]	65 [0.127]	4,890
	40	NP	NP	NP	NP	—	37 [0.247]	65 [0.242]	65 [0.196]	65 [0.17]	4,040
	42	NP	NP	NP	NP	—	29 [0.247]	54 [0.25]	65 [0.223]	65 [0.196]	3,585
	48	NP	NP	NP	NP	—	NP	NP	NP	NP	—
	60	NP	NP	NP	NP	—	NP	NP	NP	NP	—
	72	NP	NP	NP	NP	—	NP	NP	NP	NP	—
300	24	56 [0.228]	65 [0.164]	65 [0.122]	65 [0.099]	1,840	56 [0.207]	65 [0.143]	65 [0.101]	65 [0.078]	6,095
	30	34 [0.247]	63 [0.249]	65 [0.201]	65 [0.172]	485	45 [0.24]	65 [0.203]	65 [0.151]	65 [0.121]	4,740
	36	NP	NP	NP	NP	—	27 [0.246]	50 [0.248]	65 [0.225]	65 [0.189]	3,080
	40	NP	NP	NP	NP	—	14 [0.248]	26 [0.249]	41 [0.249]	62 [0.249]	1,810
	42	NP	NP	NP	NP	—	NP	NP	NP	NP	—
	48	NP	NP	NP	NP	—	NP	NP	NP	NP	—
	60	NP	NP	NP	NP	—	NP	NP	NP	NP	—
	72	NP	NP	NP	NP	—	NP	NP	NP	NP	—
400	24	42 [0.244]	65 [0.218]	65 [0.162]	65 [0.13]	1,035	42 [0.217]	65 [0.19]	65 [0.134]	65 [0.103]	5,290
	30	NP	NP	NP	NP	—	31 [0.245]	57 [0.247]	65 [0.2]	65 [0.16]	3,480
	36	NP	NP	NP	NP	—	14 [0.245]	26 [0.247]	42 [0.249]	64 [0.249]	1,275
	40	NP	NP	NP	NP	—	NP	NP	NP	NP	—
	42	NP	NP	NP	NP	—	NP	NP	NP	NP	—
	48	NP	NP	NP	NP	—	NP	NP	NP	NP	—
	60	NP	NP	NP	NP	—	NP	NP	NP	NP	—
	72	NP	NP	NP	NP	—	NP	NP	NP	NP	—
500	24	31 [0.247]	57 [0.249]	65 [0.202]	65 [0.162]	235	33 [0.223]	61 [0.226]	65 [0.167]	65 [0.127]	4,485
	30	NP	NP	NP	NP	—	22 [0.247]	40 [0.247]	64 [0.248]	65 [0.199]	2,225
	36	NP	NP	NP	NP	—	NP	NP	NP	NP	—
	40	NP	NP	NP	NP	—	NP	NP	NP	NP	—
	42	NP	NP	NP	NP	—	NP	NP	NP	NP	—
	48	NP	NP	NP	NP	—	NP	NP	NP	NP	—
	60	NP	NP	NP	NP	—	NP	NP	NP	NP	—
	72	NP	NP	NP	NP	—	NP	NP	NP	NP	—
600	24	NP	NP	NP	NP	—	28 [0.235]	51 [0.236]	65 [0.201]	65 [0.152]	3,685
	30	NP	NP	NP	NP	—	16 [0.248]	29 [0.248]	46 [0.248]	65 [0.238]	970
	36	NP	NP	NP	NP	—	NP	NP	NP	NP	—
	40	NP	NP	NP	NP	—	NP	NP	NP	NP	—
	42	NP	NP	NP	NP	—	NP	NP	NP	NP	—
	48	NP	NP	NP	NP	—	NP	NP	NP	NP	—
	60	NP	NP	NP	NP	—	NP	NP	NP	NP	—
	72	NP	NP	NP	NP	—	NP	NP	NP	NP	—

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URS Table D – Maximum Lengths of URS Uplift Rod Runs and Maximum Chord/Drag Strut Loads (ATUD Deflection included)

Roof Uplift Along Top of Wall (plf)	Uplift Rod Run Spacing (in.)	Double 2x6 SYP No. 2 Top Plates									
		Unreinforced Top Plate Splices					Reinforced Top Plate Splices				
		URS Model				Maximum Chord/ Drag Strut Load (lbs.)	URS Model				Maximum Chord/ Drag Strut Load (lbs.)
		URS3	URS4	URS5	URS6		URS3	URS4	URS5	URS6	
		Maximum Length of URS Uplift Rod Run (ft.) [System Deflection, Δ (in.)]					Maximum Length of URS Uplift Rod Run (ft.) [System Deflection, Δ (in.)]				
100	24	65 [0.081]	65 [0.05]	65 [0.036]	65 [0.031]	5,815	65 [0.077]	65 [0.046]	65 [0.032]	65 [0.026]	12,475
	30	65 [0.112]	65 [0.073]	65 [0.055]	65 [0.048]	5,340	65 [0.101]	65 [0.062]	65 [0.045]	65 [0.037]	12,000
	36	65 [0.153]	65 [0.106]	65 [0.085]	65 [0.075]	4,765	65 [0.13]	65 [0.084]	65 [0.063]	65 [0.053]	11,425
	40	65 [0.188]	65 [0.136]	65 [0.113]	65 [0.101]	4,320	65 [0.154]	65 [0.102]	65 [0.079]	65 [0.068]	10,980
	42	65 [0.209]	65 [0.154]	65 [0.13]	65 [0.118]	4,080	65 [0.167]	65 [0.113]	65 [0.088]	65 [0.076]	10,740
	48	48 [0.249]	65 [0.223]	65 [0.195]	65 [0.18]	3,290	65 [0.214]	65 [0.152]	65 [0.124]	65 [0.11]	9,950
	60	NP	NP	NP	NP	—	26 [0.248]	48 [0.249]	65 [0.239]	65 [0.22]	8,055
	72	NP	NP	NP	NP	—	NP	NP	NP	NP	—
200	24	65 [0.161]	65 [0.099]	65 [0.071]	65 [0.057]	4,975	65 [0.153]	65 [0.091]	65 [0.063]	65 [0.048]	11,635
	30	65 [0.222]	65 [0.145]	65 [0.11]	65 [0.091]	4,025	65 [0.201]	65 [0.123]	65 [0.088]	65 [0.07]	10,685
	36	47 [0.247]	65 [0.211]	65 [0.169]	65 [0.146]	2,865	56 [0.231]	65 [0.167]	65 [0.125]	65 [0.102]	9,525
	40	29 [0.248]	53 [0.248]	65 [0.225]	65 [0.199]	1,980	48 [0.247]	65 [0.204]	65 [0.157]	65 [0.131]	8,640
	42	20 [0.249]	36 [0.248]	58 [0.25]	65 [0.231]	1,500	42 [0.248]	65 [0.225]	65 [0.176]	65 [0.149]	8,160
	48	NP	NP	NP	NP	—	23 [0.249]	42 [0.25]	65 [0.247]	65 [0.216]	6,580
	60	NP	NP	NP	NP	—	NP	NP	NP	NP	—
	72	NP	NP	NP	NP	—	NP	NP	NP	NP	—
300	24	56 [0.213]	65 [0.149]	65 [0.107]	65 [0.084]	4,130	56 [0.2]	65 [0.135]	65 [0.093]	65 [0.07]	10,790
	30	44 [0.25]	65 [0.217]	65 [0.164]	65 [0.135]	2,710	45 [0.221]	65 [0.185]	65 [0.132]	65 [0.103]	9,370
	36	21 [0.246]	39 [0.248]	62 [0.249]	65 [0.218]	970	35 [0.246]	65 [0.25]	65 [0.187]	65 [0.151]	7,630
	40	NP	NP	NP	NP	—	25 [0.248]	46 [0.249]	65 [0.235]	65 [0.195]	6,300
	42	NP	NP	NP	NP	—	20 [0.249]	36 [0.248]	58 [0.25]	65 [0.221]	5,580
	48	NP	NP	NP	NP	—	NP	NP	NP	NP	—
	60	NP	NP	NP	NP	—	NP	NP	NP	NP	—
	72	NP	NP	NP	NP	—	NP	NP	NP	NP	—
400	24	42 [0.224]	65 [0.198]	65 [0.142]	65 [0.11]	3,290	42 [0.207]	65 [0.18]	65 [0.124]	65 [0.092]	9,950
	30	28 [0.248]	51 [0.248]	65 [0.219]	65 [0.179]	1,395	33 [0.231]	61 [0.234]	65 [0.176]	65 [0.136]	8,055
	36	NP	NP	NP	NP	—	22 [0.245]	41 [0.248]	65 [0.248]	65 [0.199]	5,735
	40	NP	NP	NP	NP	—	13 [0.245]	24 [0.247]	39 [0.249]	60 [0.25]	3,960
	42	NP	NP	NP	NP	—	NP	16 [0.249]	25 [0.248]	40 [0.25]	3,000
	48	NP	NP	NP	NP	—	NP	NP	NP	NP	—
	60	NP	NP	NP	NP	—	NP	NP	NP	NP	—
	72	NP	NP	NP	NP	—	NP	NP	NP	NP	—
500	24	33 [0.232]	61 [0.235]	65 [0.177]	65 [0.137]	2,445	33 [0.21]	61 [0.213]	65 [0.155]	65 [0.115]	9,105
	30	19 [0.25]	34 [0.248]	54 [0.248]	65 [0.222]	75	27 [0.249]	49 [0.249]	65 [0.22]	65 [0.168]	6,735
	36	NP	NP	NP	NP	—	14 [0.242]	27 [0.249]	43 [0.25]	65 [0.248]	3,840
	40	NP	NP	NP	NP	—	NP	NP	NP	NP	—
	42	NP	NP	NP	NP	—	NP	NP	NP	NP	—
	48	NP	NP	NP	NP	—	NP	NP	NP	NP	—
	60	NP	NP	NP	NP	—	NP	NP	NP	NP	—
	72	NP	NP	NP	NP	—	NP	NP	NP	NP	—
600	24	28 [0.247]	51 [0.247]	65 [0.212]	65 [0.163]	1,605	28 [0.22]	51 [0.221]	65 [0.186]	65 [0.137]	8,265
	30	NP	NP	NP	NP	—	20 [0.243]	37 [0.246]	60 [0.25]	65 [0.201]	5,420
	36	NP	NP	NP	NP	—	NP	17 [0.246]	23 [0.248]	43 [0.248]	1,945
	40	NP	NP	NP	NP	—	NP	NP	NP	NP	—
	42	NP	NP	NP	NP	—	NP	NP	NP	NP	—
	48	NP	NP	NP	NP	—	NP	NP	NP	NP	—
	60	NP	NP	NP	NP	—	NP	NP	NP	NP	—
	72	NP	NP	NP	NP	—	NP	NP	NP	NP	—

For table foonotes, visit **www.strongtie.com/srs**.

Strong-Rod™ URS Load Tables for Titen HD® Rod Coupler Anchor

SD Tension Values (Cracked Concrete)

Size (in.)	Model No.	Nom. Embed. Depth (in.)	Center of Interior Thickened Slab			Edge of Turned Down Slab or Stemwall				Edge of Elevated Slab			
			Min. End Dist. (in.)	Min. Concrete Thick. (in.)	Tension Strength (lbs.)	Min. Concrete Thick. (in.)	Min. End Dist. (in.)	Tension Strength (lbs.)		Min. Concrete Thick. (in.)	Min. End Dist. (in.)	Tension Strength (lbs.)	
								1¾ Edge Dist.	2¾ Edge Dist.			1¾ Edge Dist.	2¾ Edge Dist.
⅜ x 6¾	THD37634RC	5	1¾	10	1,755	10	6	1,755	1,755	10	5½	1,755	1,755
½ x 9¾	THD50934RC	8	10	14	2,855	14	10	2,800	2,855	14	5	2,855	2,855

SD Shear Values (Cracked Concrete)

Size (in.)	Model No.	Nom. Embed. Depth (in.)	Center of Interior Thickened Slab			Edge of Turned Down Slab or Stemwall				Edge of Elevated Slab			
			Min. End Dist. (in.)	Min. Concrete Thick. (in.)	Shear Strength (lbs.)	Min. Concrete Thick. (in.)	Min. End Dist. (in.)	Shear Strength (lbs.)		Min. Concrete Thick. (in.)	Min. End Dist. (in.)	Shear Strength (lbs.)	
								1¾ Edge Dist.	2¾ Edge Dist.			1¾ Edge Dist.	2¾ Edge Dist.
Shear Load Perpendicular to Edge													
⅜ x 6¾	THD37634RC	5	1¾	10	525	10	6	525	1,035	10	5½	525	1,035
½ x 9¾	THD50934RC	8	10	14	610	14	10	610	1,195	14	5	610	1,195
Shear Load Parallel to Edge													
⅜ x 6¾	THD37634RC	5	1¾	10	1,050	10	6	1,050	2,070	10	5½	1,050	2,070
½ x 9¾	THD50934RC	8	10	14	1,220	14	10	1,220	2,390	14	5	1,220	2,390

ASD Tension Values (Cracked Concrete)

Size (in.)	Model No.	Nom. Embed. Depth (in.)	Center of Interior Thickened Slab			Edge of Turned Down Slab or Stemwall				Edge of Elevated Slab			
			Min. End Dist. (in.)	Min. Concrete Thick. (in.)	Tension Strength (lbs.)	Min. Concrete Thick. (in.)	Min. End Dist. (in.)	Tension Strength (lbs.)		Min. Concrete Thick. (in.)	Min. End Dist. (in.)	Tension Strength (lbs.)	
								1¾ Edge Dist.	2¾ Edge Dist.			1¾ Edge Dist.	2¾ Edge Dist.
⅜ x 6¾	THD37634RC	5	1¾	10	1,055	10	6	1,055	1,055	10	5½	1,055	1,055
½ x 9¾	THD50934RC	8	10	14	1,715	14	10	1,680	1,715	14	5	1,715	1,715

ASD Shear Values (Cracked Concrete)

Size (in.)	Model No.	Nom. Embed. Depth (in.)	Center of Interior Thickened Slab			Edge of Turned Down Slab or Stemwall				Edge of Elevated Slab			
			Min. End Dist. (in.)	Min. Concrete Thick. (in.)	Shear Strength (lbs.)	Min. Concrete Thick. (in.)	Min. End Dist. (in.)	Shear Strength (lbs.)		Min. Concrete Thick. (in.)	Min. End Dist. (in.)	Shear Strength (lbs.)	
								1¾ Edge Dist.	2¾ Edge Dist.			1¾ Edge Dist.	2¾ Edge Dist.
Shear Load Perpendicular to Edge													
⅜ x 6¾	THD37634RC	5	1¾	10	315	10	6	315	620	10	5½	315	620
½ x 9¾	THD50934RC	8	10	14	365	14	10	365	715	14	5	365	715
Shear Load Parallel to Edge													
⅜ x 6¾	THD37634RC	5	1¾	10	630	10	6	630	1,240	10	5½	630	1,240
½ x 9¾	THD50934RC	8	10	14	730	14	10	730	1,435	14	5	730	1,435

1. SD tabled values are strength level values. ASD values are allowable level values.
2. Anchor lengths 6¾" and 9¾" are measured from underside of coupler.
3. Capacities have been developed using the anchorage provisions of ICC-ES AC193 and are not published in a current evaluation report.
4. Tabled values are based on 2,500 psi concrete strength.
5. The Designer is responsible for checking the interaction between shear and tension loads per the anchorage provisions of ICC-ES AC193.

$$\frac{N_{ua}}{\phi N_n} + \frac{V_{ua}}{\phi V_n} \leq 1.2$$

Where N_{ua} = Factored tensile force applied to anchor
V_{ua} = Factored shear forces applied to anchor
ϕN_n = Factored nominal strength in tension
ϕV_n = Factored nominal strength in shear

6. Cracked concrete capacities have been developed assuming no supplemental reinforcement.
7. Capacities have been based on loads governed by wind.
8. The Designer is responsible for foundation design.

Strong-Rod™ URS Load Tables for Titen HD® Rod Coupler Anchor

SIMPSON Strong-Tie®

SD Tension Values (Uncracked Concrete)

Size (in.)	Model No.	Nom. Embed. Depth (in.)	Center of Interior Thickened Slab			Edge of Turned Down Slab or Stemwall				Edge of Elevated Slab			
			Min. End Dist. (in.)	Min. Concrete Thick. (in.)	Tension Strength (lbs.)	Min. Concrete Thick. (in.)	Min. End Dist. (in.)	Tension Strength (lbs.)		Min. Concrete Thick. (in.)	Min. End Dist. (in.)	Tension Strength (lbs.)	
								1¾ Edge Dist.	2¾ Edge Dist.			1¾ Edge Dist.	2¾ Edge Dist.
⅜ x 6¾	THD37634RC	5	1¾	10	2,900	10	6	2,900	2,900	10	5½	2,900	2,900
½ x 9¾	THD50934RC	8	10	14	4,035	14	10	3,955	4,035	14	5	4,035	4,035

SD Shear Values (Uncracked Concrete)

Size (in.)	Model No.	Nom. Embed. Depth (in.)	Center of Interior Thickened Slab			Edge of Turned Down Slab or Stemwall				Edge of Elevated Slab			
			Min. End Dist. (in.)	Min. Concrete Thick. (in.)	Shear Strength (lbs.)	Min. Concrete Thick. (in.)	Min. End Dist. (in.)	Shear Strength (lbs.)		Min. Concrete Thick. (in.)	Min. End Dist. (in.)	Shear Strength (lbs.)	
								1¾ Edge Dist.	2¾ Edge Dist.			1¾ Edge Dist.	2¾ Edge Dist.
Shear Load Perpendicular to Edge													
⅜ x 6¾	THD37634RC	5	1¾	10	735	10	6	735	1,450	10	5½	735	1,450
½ x 9¾	THD50934RC	8	10	14	850	14	10	850	1,675	14	5	850	1,675
Shear Load Parallel to Edge													
⅜ x 6¾	THD37634RC	5	1¾	10	1,470	10	6	1,470	2,900	10	5½	1,470	2,900
½ x 9¾	THD50934RC	8	10	14	1,700	14	10	1,700	3,350	14	5	1,700	3,350

ASD Tension Values (Uncracked Concrete)

Size (in.)	Model No.	Nom. Embed. Depth (in.)	Center of Interior Thickened Slab			Edge of Turned Down Slab or Stemwall				Edge of Elevated Slab			
			Min. End Dist. (in.)	Min. Concrete Thick. (in.)	Tension Strength (lbs.)	Min. Concrete Thick. (in.)	Min. End Dist. (in.)	Tension Strength (lbs.)		Min. Concrete Thick. (in.)	Min. End Dist. (in.)	Tension Strength (lbs.)	
								1¾ Edge Dist.	2¾ Edge Dist.			1¾ Edge Dist.	2¾ Edge Dist.
⅜ x 6¾	THD37634RC	5	1¾	10	1,740	10	6	1,740	1,740	10	5½	1,740	1,740
½ x 9¾	THD50934RC	8	10	14	2,420	14	10	2,375	2,420	14	5	2,420	2,420

ASD Shear Values (Uncracked Concrete)

Size (in.)	Model No.	Nom. Embed. Depth (in.)	Center of Interior Thickened Slab			Edge of Turned Down Slab or Stemwall				Edge of Elevated Slab			
			Min. End Dist. (in.)	Min. Concrete Thick. (in.)	Shear Strength (lbs.)	Min. Concrete Thick. (in.)	Min. End Dist. (in.)	Shear Strength (lbs.)		Min. Concrete Thick. (in.)	Min. End Dist. (in.)	Shear Strength (lbs.)	
								1¾ Edge Dist.	2¾ Edge Dist.			1¾ Edge Dist.	2¾ Edge Dist.
Shear Load Perpendicular to Edge													
⅜ x 6¾	THD37634RC	5	1¾	10	440	10	6	440	870	10	5½	440	870
½ x 9¾	THD50934RC	8	10	14	510	14	10	510	1,005	14	5	510	1,005
Shear Load Parallel to Edge													
⅜ x 6¾	THD37634RC	5	1¾	10	880	10	6	880	1,740	10	5½	880	1,740
½ x 9¾	THD50934RC	8	10	14	1,020	14	10	1,020	2,010	14	5	1,020	2,010

1. SD tabled values are strength level values. ASD values are allowable level values.
2. Anchor lengths 6¾" and 9¾" are measured from underside of coupler.
3. Capacities have been developed using the anchorage provisions of ICC-ES AC193 and are not published in a current evaluation report.
4. Tabled values are based on 2500 psi concrete strength.
5. The Designer is responsible for checking the interaction between shear and tension loads per the anchorage provisions of ICC-ES AC193.

$$\frac{N_{ua}}{\phi N_n} + \frac{V_{ua}}{\phi V_n} \le 1.2$$

Where N_{ua} = Factored tensile force applied to anchor
V_{ua} = Factored shear forces applied to anchor
ϕN_n = Factored nominal strength in tension
ϕV_n = Factored nominal strength in shear

6. Cracked concrete capacities have been developed assuming no supplemental reinforcement.
7. Capacities have been based on loads governed by wind.
8. The Designer is responsible for foundation design.

SIMPSON Strong-Tie®

Top-Plate-to-Stud Connectors Play Critical Role in Preventing Top Plate Rotation

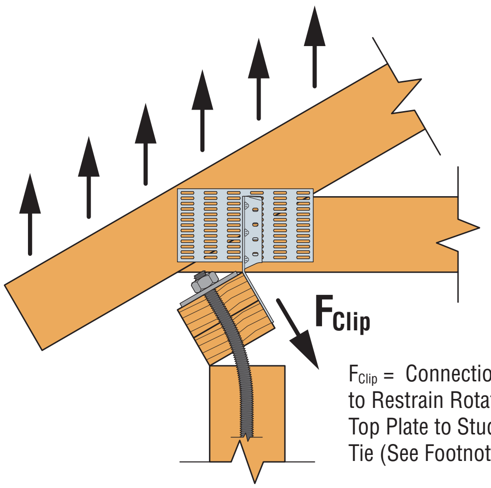
When connection hardware between the roof framing members and the wall top plate induces eccentric loading about the centerline of the top plate, Simpson Strong-Tie® top-plate-to-stud connectors are the optimum installation solution to prevent top-plate rotation as shown in illustration below, as well as to comply with ICC-ES ESR-2613. As described in the code report, 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)	Received Connector Capacity (plf)		
	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 = 25.4mm

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.



Top Plate Rotation Restraint Connection Force

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.

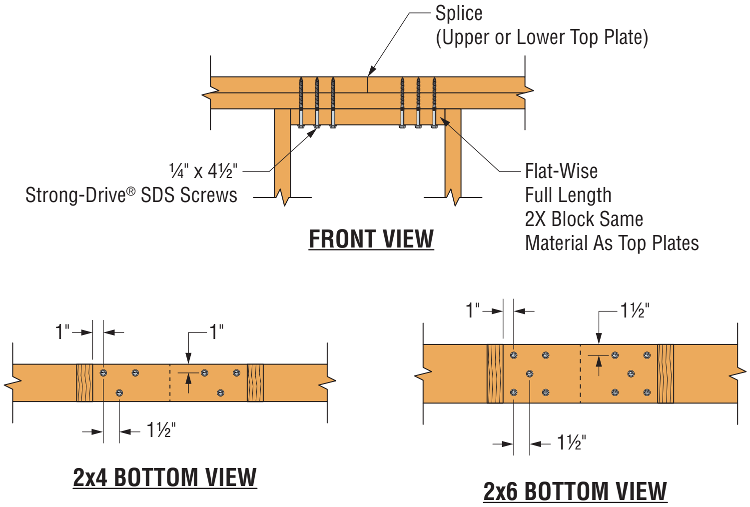
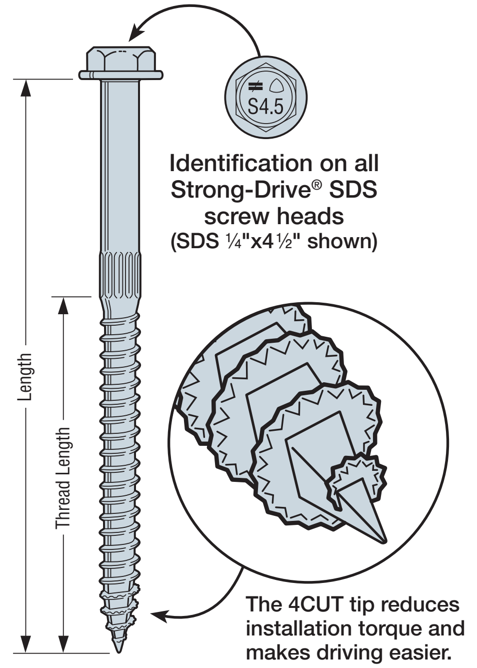


Figure 1
Top Plate Splice: Bending Reinforcement
(Splice Between Studs)



Strong-Drive®
¼"x4½" SDS HEAVY-DUTY CONNECTOR Screw
U.S. Patent 6,109,850;
5,897,280; 7,101,133

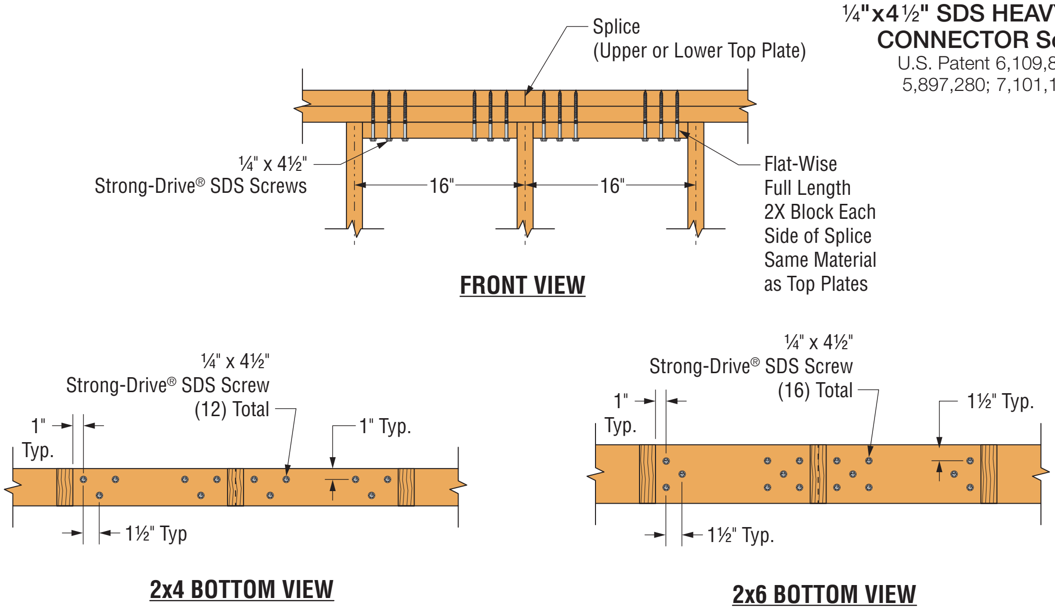


Figure 2
Top Plate Splice: Bending Reinforcement
(Splice Centered Over Studs)

Method 2 – Handling Deferred Submittals

For Designers who prefer their Simpson Strong-Tie® Strong-Rod™ Uplift Restraint System for roofs (Strong-Rod URS) to be part of the deferred submittal process, a design in accordance with ICC-ES AC391 will be provided upon request that is compliant with ICC-ES Evaluation Report ESR-1161. Following the acceptance criteria requirements, the Strong-Rod URS is designed and detailed to:

- Transfer wind uplift loads efficiently from wood framing to steel components in the rod run
- Keep wood top-plate bending within acceptable limits
- Control wood top-plate rotation
- Limit steel rod elongation
- Restrict crushing of wood top plates through the use of bearing plates
- Address deflection caused by wood shrinkage

In order to provide a design, the following is needed:

- Full set of structural and architectural drawings
- An approved roof truss design package clearly indicating uplift demand loads must be available if the uplift is not specified in the construction documents

Specification of a continuous rod tiedown system in accordance with AC391 is needed to ensure proper performance of the Strong-Rod URS. The following note should be placed within your construction documents or specification:

Continuous Rod Tie-Down System for Roof Uplift Restraint

Contractor shall provide a continuous rod tiedown system (CRTS) to resist wind uplift possessing an ICC-ES evaluation report in accordance with ICC-ES AC391 (Acceptance Criteria #391 ICC-ES) recognizing the entire CRTS (including the wood framing elements), as opposed to recognizing only the steel components that comprise continuous rod tiedown runs (CRTR). The entire CRTS shall be designed by a professional engineer registered in the state of the project. URS uplift rod run layout, component and detail drawings shall be submitted to the engineer of record (EOR) for review prior to construction.

Method 3 – Design Services from Simpson Strong-Tie

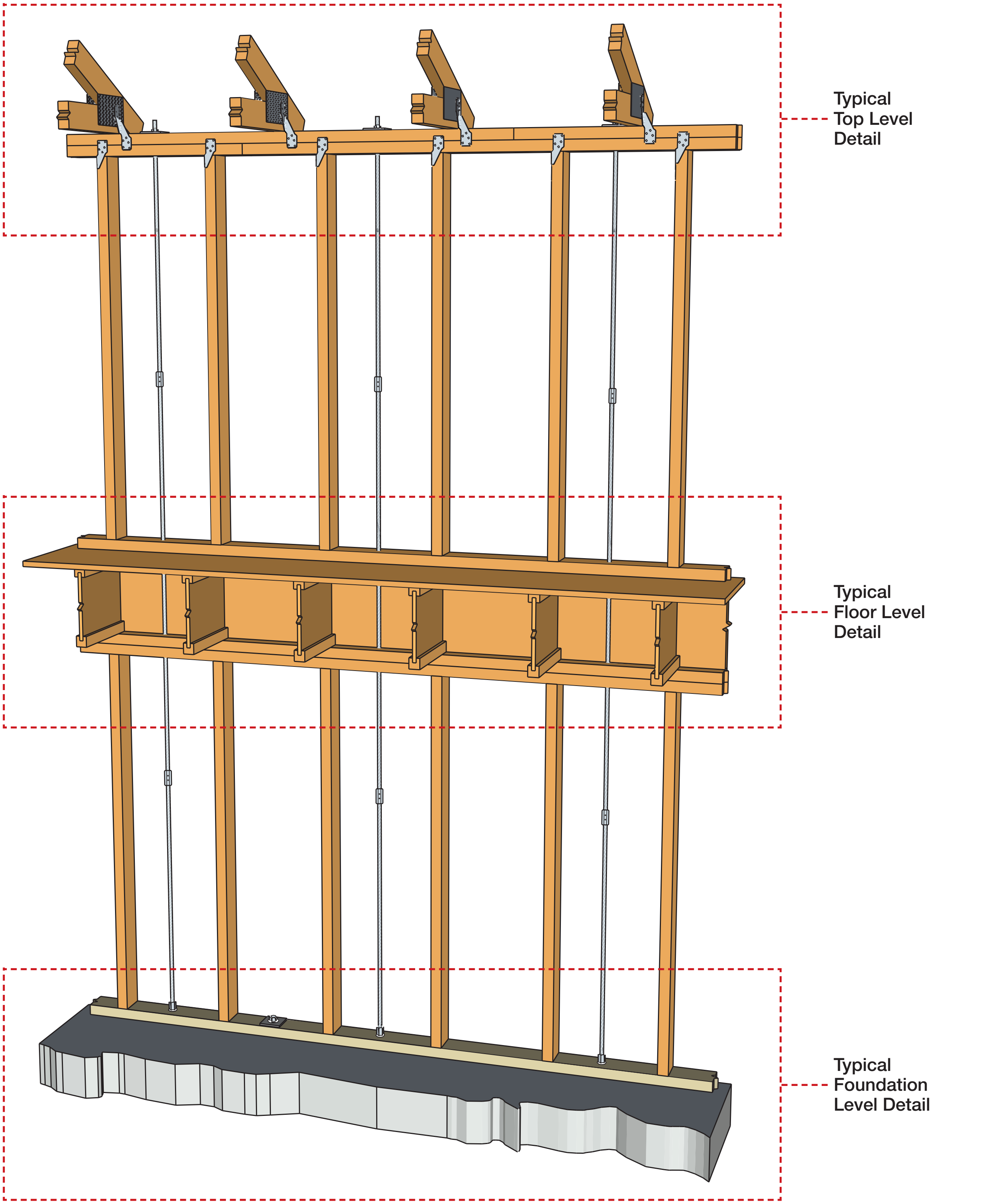
Simpson Strong-Tie offers complimentary design services for its Strong-Rod™ Uplift Restraint System for roofs (Strong-Rod URS) to help you meet the rigorous demands of ICC-ES AC391. Designers can leverage our unmatched continuous rod tiedown system expertise and collaborate during the project design phase to identify any potential issues.

When working with Simpson Strong-Tie, Designers not only enjoy the benefits of having the only continuous rod system with an evaluation report (ESR-1161) proven to meet the requirements of ICC-ES AC391, they also receive a full design package of set of AutoCAD drawings and calculations to add to submittals.

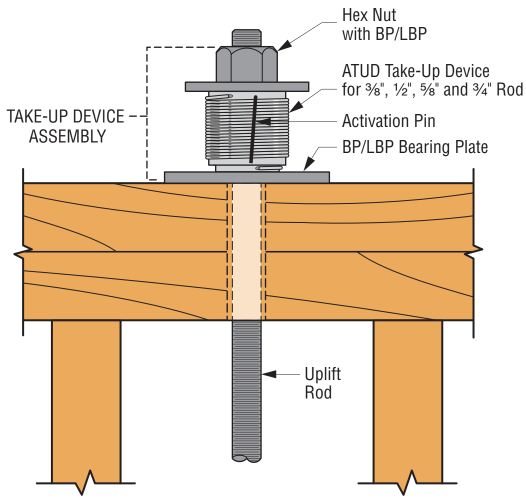
How it Works

1. Determine the bearing wall layout that will resist the roof uplift loads. Indicate the wind design requirements for the project.
2. Visit **www.strongtie.com/srs** to download the Strong-Rod URS worksheet. 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. Within a few days, the Designer will receive a complete Simpson Strong-Tie® Strong-Rod URS design package to include with your project submittal. The package will include:
   - Preliminary wind uplift forces determination and consultation
   - Calculation package for each unique rod run with anchorage solutions
   - 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
   - Suggested anchorage solutions to aid the Designer in this specification area

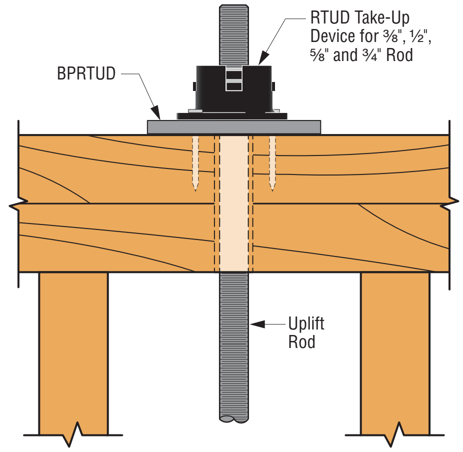
SIMPSON Strong-Tie®



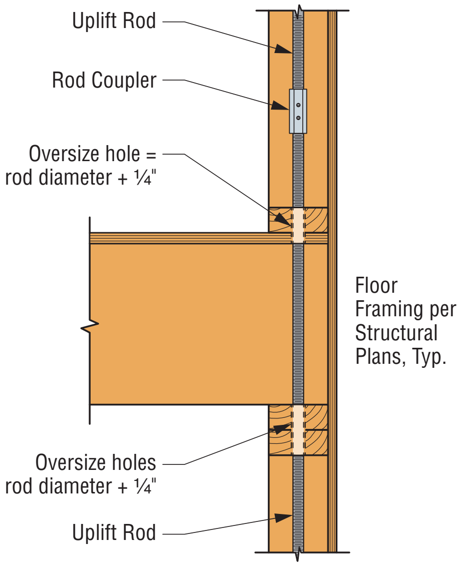
Strong-Rod™ URS Installation Details



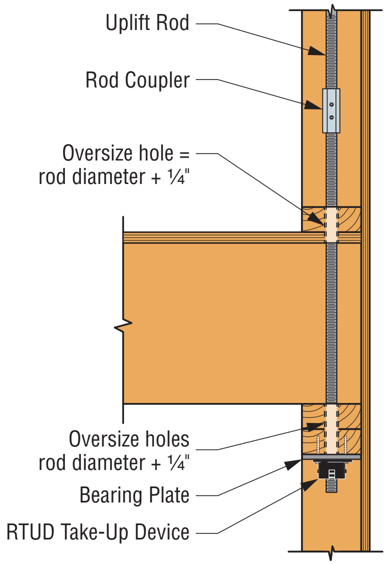
Top Level Installed with ATUD Take-Up Device



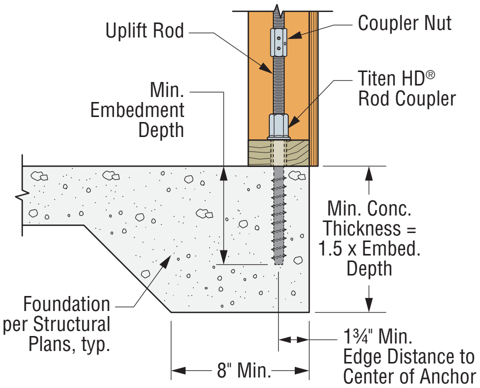
Top Level Installed with RTUD Take-Up Device



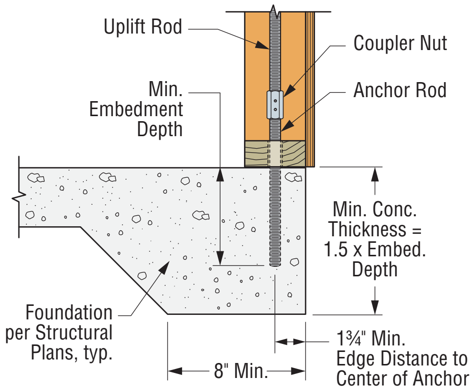
Floor Level



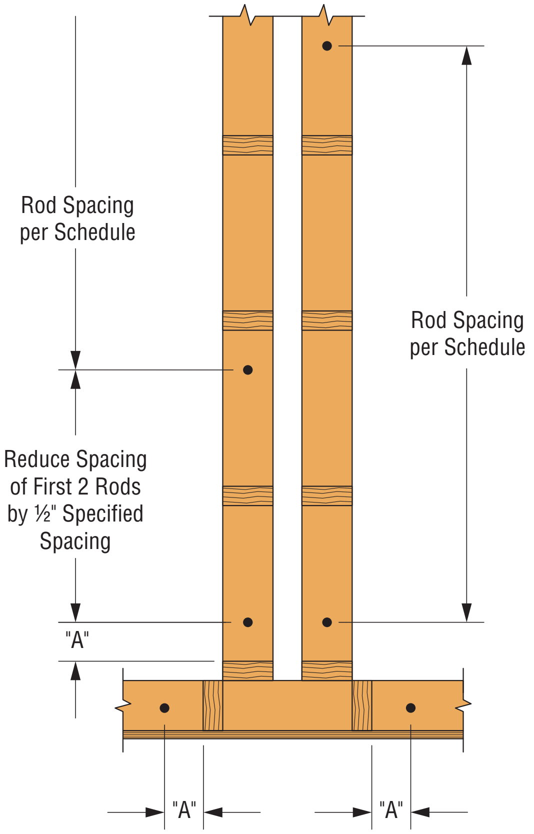
Termination at Floor Level



Typical Simpson Strong-Tie® Titen HD® Rod Coupler Installation

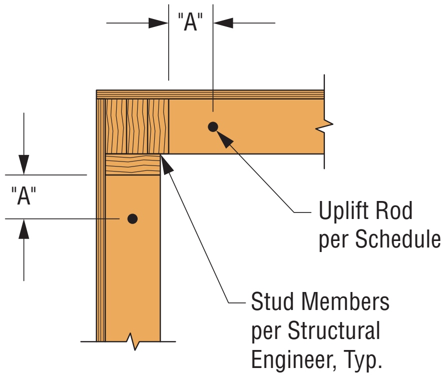


Typical Simpson Strong-Tie® Adhesive Installation

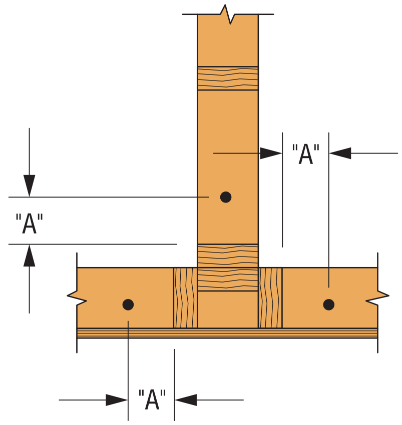


Typical Rod Location Guidelines – Party Wall, Staggered Rod Runs

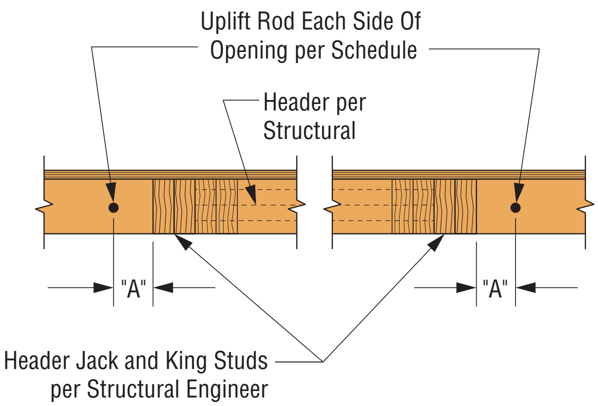
Note: "A" = Layout per Designer.



Typical Rod Location Guidelines – Corner



Typical Rod Location Guidelines – Perpendicular to Wall



Typical Rod Location Guidelines – Window and Door Opening

Strong-Rod™ Systems Assemblies

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 factory for steel information on specific products.
3. Unless otherwise noted, dimensions are in inches, loads are in pounds.
4. Do not overload. Do not exceed published allowable loads that would jeopardize the connections.
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 2012 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 **www.strongtie.com/software** for more information. See ICC-ES ESR-2320 for additional information on Simpson Strong-Tie take-up devices.
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.
8. 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.
9. 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.
10. All installations should be designed only in accordance with the published allowable load values.
11. The Designer is responsible for verifying that all design loads do not exceed the allowable loads listed for each component in the restraint system.
12. Corrosion information may be found at **www.strongtie.com/corrosion**.
13. Components should be kept in a dry environment to limit exposure to moisture and corrosion.

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. 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 **www.strongtie.com** 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.
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. The Designer should evaluate and give written approval for substitution prior to installation."
7. The allowable loads published in this catalog 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-2012. 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.
10. Available Strong-Rods, fully threaded rod sizes and material grades are listed at **www.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. Continuous rod systems for uplift restraint include, but are not limited to, top-plate rotation restraint connections, bearing, rod tension, concrete anchorage and wood framing members.
4. 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.
5. Spacing tables for uplift restraint runs shall be found at **www.strongtie.com/srs**. The Designer may establish specific detailing and provide calculations approved by the local jurisdiction to allow for increased spacing.
6. 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, 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.
7. 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 page 55 for more information.
8. The top-plate splice details shown on page 56 apply to the "reinforced" top-plate tables available at **www.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.
9. 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 Class 2A or A307 Grade A, steel.
10. 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™.
11. Tabulated values given for the roof uplift restraint runs available at **www.strongtie.com/srs** 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").

Limited Warranty

Simpson Strong-Tie Company Inc. warrants catalog products to be free from defects in material or manufacturing. Simpson Strong-Tie Company Inc. products are further warranted for adequacy of design when used in accordance with design limits in this catalog and when properly specified, installed and maintained. This warranty does not apply to uses not in compliance with specific applications and installations set forth in this catalog, or to non-catalog or modified products, or to deterioration due to environmental conditions.

Simpson Strong-Tie® connectors are designed to enable structures to resist the movement, stress and loading that results from impact events such as earthquakes and high-velocity winds. Other Simpson Strong-Tie products are designed to the load capacities and uses listed in this catalog. Properly-installed Simpson Strong-Tie products will perform in accordance with the specifications set forth in the applicable Simpson Strong-Tie catalog. Additional performance limitations for specific products may be listed on the applicable catalog pages.

Due to the particular characteristics of potential impact events, the specific design and location of the structure, the building materials used, the quality of construction, and the condition of the soils 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 catalog specifications and Simpson Strong-Tie connectors are properly installed in accordance with applicable building codes.

All warranty obligations of Simpson Strong-Tie Company Inc. shall be limited, at the discretion of Simpson Strong-Tie Company Inc., to repair or replacement of the defective part. These remedies shall constitute Simpson Strong-Tie Company Inc.'s sole obligation and sole remedy of purchaser under this warranty. In no event will Simpson Strong-Tie Company Inc. be responsible for incidental, consequential, or special loss or damage, however caused.

This warranty is expressly in lieu of all other warranties, expressed or implied, including warranties of merchantability or fitness for a particular purpose, all such other warranties being hereby expressly excluded. This warranty may change periodically – consult our website **www.strongtie.com** for current information.

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.

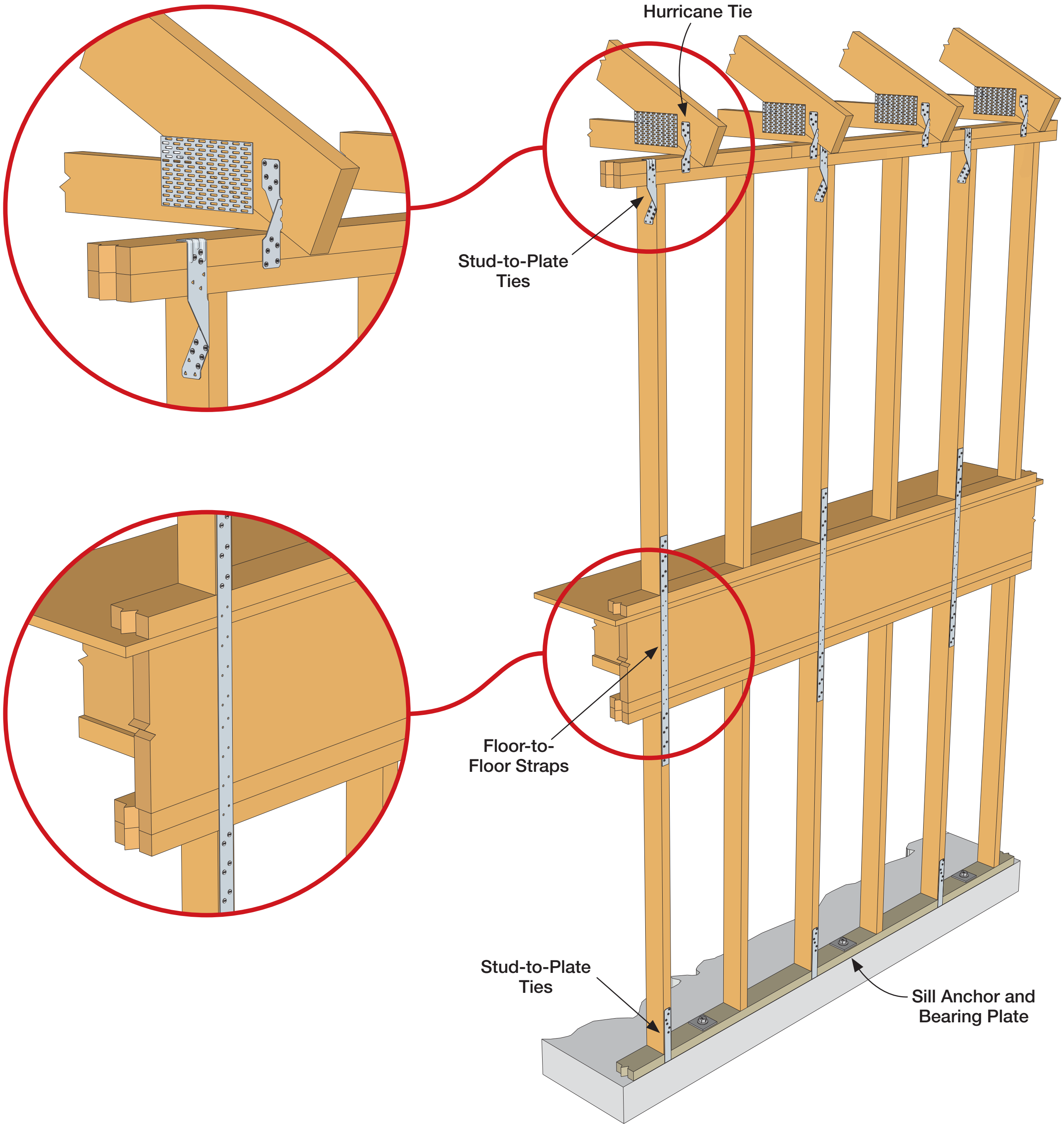
Simpson Strong-Tie cannot and does not make any representations regarding the suitability of use or load-carrying capacities of non-catalog products. Simpson Strong-Tie provides no warranty, express or implied, on non-catalog products. F.O.B. Shipping Point unless otherwise specified.

SIMPSON Strong-Tie®

Simpson Strong-Tie understands that Designers need economic 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.

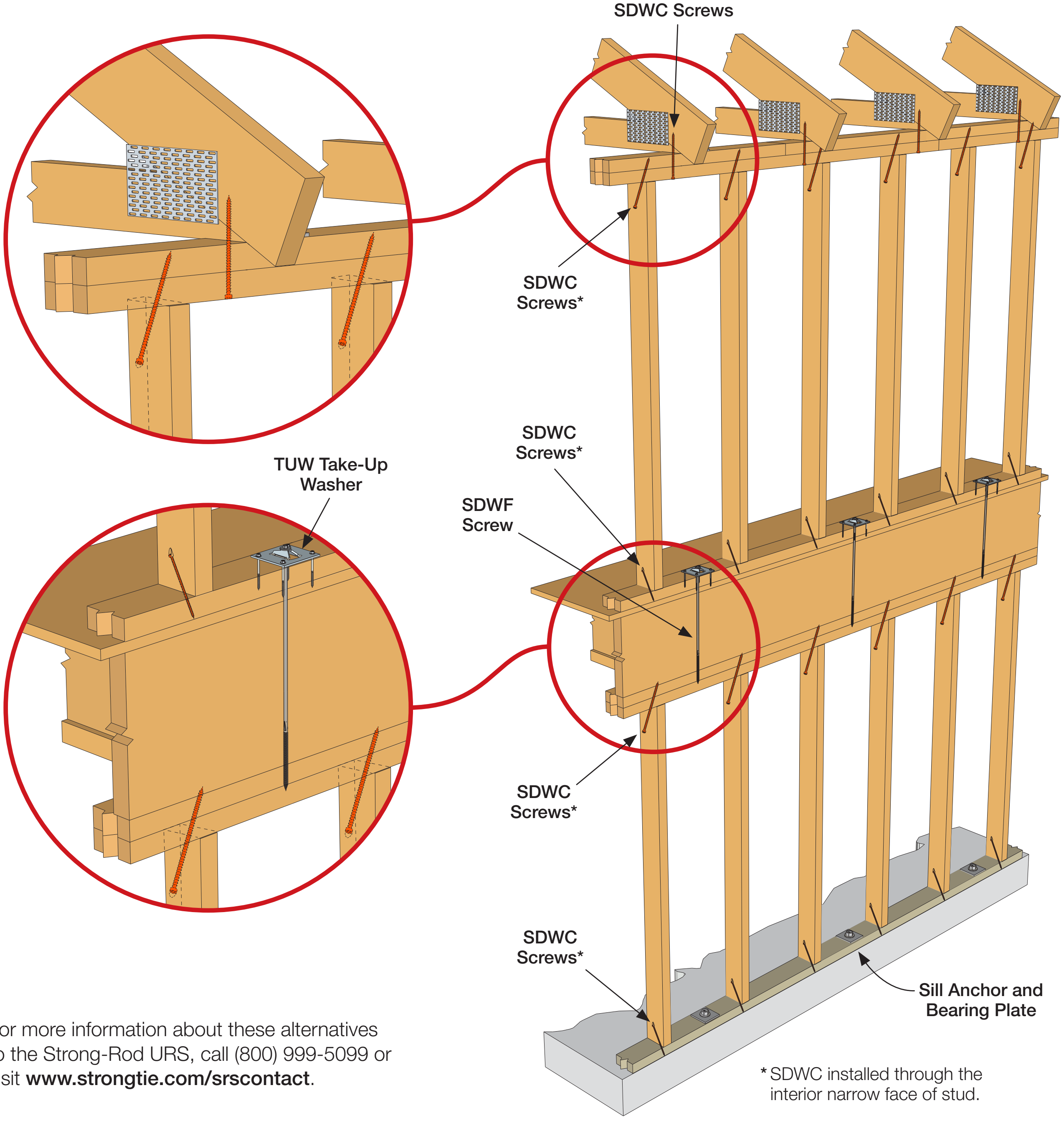
Simpson Strong-Tie® Connectors for Roof Uplift

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.



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 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 **www.strongtie.com/srscontact**.

Your Electronic Resource for More Strong-Rod™ Information

In addition to our engineering and design services, Simpson Strong-Tie offers a comprehensive volume of information to help you determine the best continuous rod tiedown system solution for your project. By visiting **www.strongtie.com/srs**, you will find:

- Updated load values based on recent research and testing for new Strong-Rod™ System components
- General notes, specifications and details available for the Designer to reference and use
- Code requirements for AC316 and AC391 for Strong-Rod Systems for both shearwall overturning restraint and wind uplift restraint for roofs

WE'RE HERE TO HELP!

Visit www.strongtie.com/srscontact or call (800) 999-5099.

Notes

SIMPSON Strong-Tie®

The Research and Design Experts

At Simpson Strong-Tie, our extensive research has given us a deep understanding of the performance of our Strong-Rod™ Systems and of design and installation efficiencies for both the Uplift Restraint System for roofs (URS) and the Anchor Tiedown System for shearwall overturning restraint (ATS).

In 2003, Simpson Strong-Tie opened our state-of-the-art Tyrell Gilb Research Laboratory in Stockton, California. Considering that a good number of taller mid-rise wood structures were being built in seismically active regions, we recognized the need to test continuous rod systems to the proper specifications to ensure life safety. In response, we constructed a static, five-story test rig and a three-story shake table that has since provided great insight into the importance of rod elongation in continuous rod systems design.

In 2009, Simpson Strong-Tie was the primary industry sponsor for the NEESWood Capstone test in Miki, Hyogo, Japan. Performed at E-Defense, the world's largest multi-axial shake table, the test involved a first story made up of Strong Frame® special moment frames with six stories of mid-rise wood construction above. The wooden structure contained the Strong-Rod™ Anchor Tiedown System for shearwall overturning restraint. This full-scale, seven-story apartment building was subjected to several severe earthquake motions. Some rods experienced more than 120,000 pounds of tension force during the largest of the tests, giving our engineers thorough understanding of rod system design and of the versatility of the components.

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