STRUCTURAL REPORT®
STRUCTURAL SYSTEMS AND BUILDING SAFETY NEWS

SIMPSON Strong-Tie®

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## CODE UPDATE

# SIMPSON STRONG-TIE APPLIES FOR WIND UPLIFT RESTRAINT ROD SYSTEM EVALUATION REPORT

In June 2010, ICC Evaluation Services (ICC-ES) passed Acceptance Criteria 391. AC391 provides industry guidance for the design of continuous rod tie-down systems resisting wind uplift in light-frame wood construction.

For manufacturers, AC391 established guidelines for running proper calculations and/or tests in order to receive a product Evaluation Report for either:

- Steel components comprising continuous rod tie-down runs (CRTR) only
- Entire continuous rod tie-down *system* (CRTS), which includes CRTR and the light-frame wood structure used to resist wind uplift

What does this mean for engineers and architects designing projects that use rod tie-down systems for wind uplift restraint? Until manufacturers receive Evaluation Reports from ICC-ES, project designers can use the guidelines in AC391 when evaluating the use of rod tie-down systems for wind uplift restraint in their structures. Illustrated in *Figure 1* on the right and *Table 1* below, AC391 basically creates a checklist of design requirements for this type of uplift restraint system.

*(continued on page 4)*

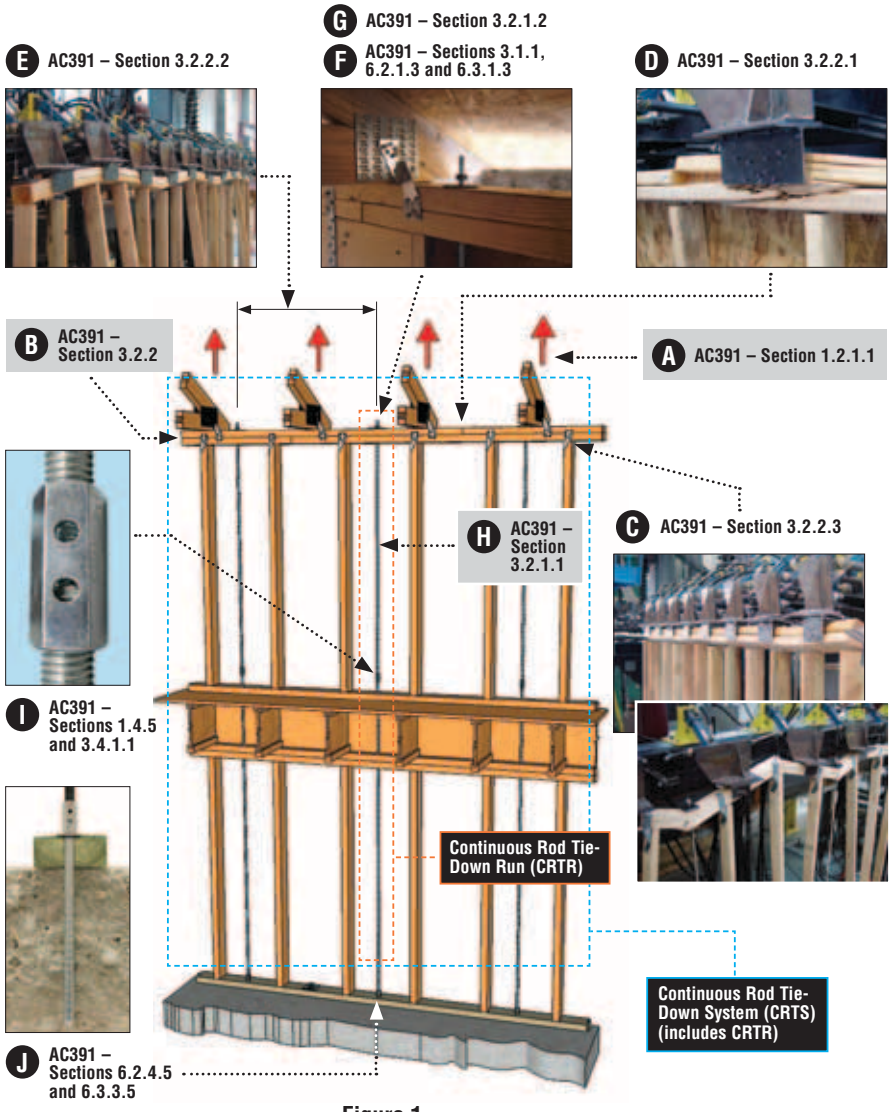


**Figure 1**

**Table 1**

| Connection Location | Requirement | Section |
|---|---|---|
| A | Use of Continuous Rod Tie-down Runs (CRTR) and Continuous Rod Tie-down Systems (CRTS) evaluated under AC391 is limited to resisting roof wind uplift in wood light-framed construction. Specifically excluded from AC391 is the use of rod tie-down runs to resist shear wall overturning forces or use in cold-formed steel framing. | 1.2 |
| B | CRTS allowable loads shall be evaluated and be limited by • Tie-down 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 *(e.g. hurricane ties at the sides of the top plates)* and load resistance *(e.g. rods at the center of the top plate)*. 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 tie-down runs. Additionally, the sum of the rod elongation and the deflection of the top plates between tie-down 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. | 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. | 3.2.1.1 |
| I | Proof of positive connection between threaded rod and threaded rod couplers shall be provided *(e.g. sight 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 |

# BUILDING NEWS

## SEISMIC SYMPOSIUM FOCUSES ON BUILDING SAFETY

On October 25-26th, Simpson Strong-Tie hosted a Seismic Symposium in Stockton, CA, for more than 120 engineers and building officials throughout North America. The event included nationally recognized experts on seismic risk, seismic design and retrofit, and tests at the Simpson Strong-Tie® Tye Gilb Research Lab. The purpose of the symposium was to provide structural engineers with the latest and greatest seismic engineering information to assist them in their design work.

Kicking off the event, DHS/FEMA geophysicist Mike Mahoney covered lessons learned from the major seismic events occurring in the last two years in Haiti, Chile, New Zealand, Japan and Turkey. Under the National Earthquake Hazards Reduction Program, FEMA is responsible for turning research results into practice, such as providing guidance and input on national consensus standards. FEMA P-750 (2009) is one example, serving as the primary seismic resource for ASCE7-10.

*Attendees gathered at the Tye Gilb Lab in Stockton to witness a three-story seismic shake table test.*

### Western U.S.

Geophysicist Dr. Ross Stein of USGS discussed recent large international earthquakes and potential implications to the western United States. He presented a theory known as "stress triggering" which is the understanding that faults are responsive to stresses produced when adjacent faults or fault segments rupture. He noted this could be a way to identify higher hazard areas to better focus retrofit resources. For more information go to ***www.earthquake.usgs.gov*** **and search for Ross Stein**.

### Central and Eastern U.S.

Gary Patterson, a geologist from CERI at the University of Memphis *(www.ceri.memphis.edu)*, focused on the differences between plate boundary earthquakes, such as in California, and those away from plate boundaries, such as in the New Madrid Seismic Zone. He stated that there are failed historic geologic rifts creating weak spots in the plate, indicating where future seismic events can occur. He also mentioned that earthquakes are felt across a much larger area in the Midwest and East Coast *(compared to the western U.S.)* due to differences in geology. A recent FEMA-funded report, *Impact of New Madrid Seismic Zone Earthquakes on the Central USA*, describes damage to the built environment, impact on transportation and utility networks as well as social and economic consequences. Download this report at ***http://mae.cee.illinois.edu.***

Brian Pietras, M.S., P.E., of Rickborn & Associates discussed the importance of seismic detailing in wind country. He presented damage photos of Charleston after Hurricane Hugo in 1989 and after the estimated 7.3M seismic event in 1886, demonstrating the unique high wind and high seismic risk in South Carolina. Had the 1886 earthquake happened today, it is estimated that there would be 45,000 injured, 900 deaths, 200,000 displaced, $14 billion in damage and 220 schools with significant damage. He stressed the importance of designing and detailing not only for the governing lateral load, but for both wind and seismic.

### Research and Testing

Principal of Tipping Mar in Northern California, David Mar, S.E., presented work about the ATC 71-1 simplified guidelines project for multi-unit, multi-story weak-story buildings and apartment buildings with tuck-under parking. The recommended approach is to strengthen the weak first story enough to prevent collapse while not making it so strong that it pushes too much load to the unretrofitted upper stories and causes failure. Retrofitting the first story saves up to three times the expense of retrofitting the upper stories. Mr. Mar also demonstrated the Weak Story Tool, a software program developed as part of the project that uses structural plan and materials graphics to determine the best retrofit solution based on the owner and/or local jurisdictions or future codes or standards and the required probability of collapse margin. For more information visit ***www.atcouncil.org.***

Attendees also visited the Tye Gilb lab and witnessed three tests, including a shake table test with two stories of site-built segmented wood-framed shear walls over a Simpson Strong-Tie® Strong Frame™ special moment frame. The test featured five ground motions: 50% and 100% of the 1994 Northridge Canoga Park record and 80%, 100% and 110% of the 1995 Kobe Takatori record. The other tests performed included a single-story segmented wood-framed shear wall designed for force transfer around its opening on a cyclic test rig and a steel anchor rod with a plate washer cast-in-place into concrete and tested in tension.

Dr. Tom Skaggs of the APA presented a recent joint research study by the APA, the University of British Columbia, and the USDA Forest Products Laboratory on force transfer around openings in segmented wood framed shear walls. He reviewed the specimens used in the test program, which included walls with different size openings as well as different types of openings *(e.g. window and garage door)*, and compared those to tests of segmented walls on either side of the opening. The testing indicated that of the Drag Strut, Cantilever Beam, Diekmann and SEAOC/Thompson force transfer around openings calculation methodologies, the Diekmann and SEAOC/Thompson methods appeared to best match the test results. To obtain a copy of the research study visit ***www.apawood.org.***

### Building Materials Update

Providing an update on the revisions to the

*(continued on page 3)*

# WORKSHOPS & TRAINING

## NORTHWEST

***Connections for Light Framed Construction***

| | |
|---|---|
| Spokane, Washington | Thursday, March 29 |
| Bozeman, Montana | Thursday, April 5 |

***Construction Basics with a focus on Lateral, Truss and Cold Formed Steel***

| | |
|---|---|
| Idaho Falls, Idaho | Monday, January 30 |
| Stockton, California | Thursday, February 2 |
| Juneau, Alaska | Thursday, February 16 |
| Kent, Washington | Thursday, March 6 |
| Denver, Colorado | Tuesday, March 20 |
| Boise, Idaho | Tuesday, March 27 |

***Deck Framing Connection Seminar***

| | |
|---|---|
| Reno, Nevada | Thursday, April 12 |

***General Construction Review with Lateral Systems and Cold Formed Steel***

| | |
|---|---|
| Pleasanton, California | Thursday, February 9 |
| Kent, Washington | Tuesday, February 14 |
| Stockton, California | Tuesday, February 28 |
| Pleasanton, California | Thursday, March 1 |
| Reno, Nevada | Thursday, April 12 |
| Pleasanton, California | Thursday, April 19 |

***Introduction to Anchor Systems***

| | |
|---|---|
| Denver, Colorado | Tuesday, March 20 |
| Salt Lake City, Utah | Thursday, March 22 |
| Spokane, Washington | Thursday, March 29 |

***Seismic Retrofit***

| | |
|---|---|
| Denver, Colorado | Tuesday, March 20 |
| Salt Lake City, Utah | Thursday, March 22 |

## SOUTHWEST

***All Audience-All Topic Workshop***

| | |
|---|---|
| Riverside, California | Thursday, February 2 |
| Fullerton, California | Thursday, February 23 |
| Phoenix, Arizona | Thursday, March 22 |
| Waipahu, Hawaii | Tuesday, April 24 |
| Waipahu, Hawaii | Wednesday, April 25 |

***Anchor Systems Workshop for Contractors/Builders/ Inspectors/Distributors***

| | |
|---|---|
| Tamuning, Guam | Thursday, February 9 |

***Anchor Systems Workshop for Engineers, Architects, and Designers***

| | |
|---|---|
| Tamuning, Guam | Wednesday, February 8 |

WoodWorks™ and Virginia Tech University present Advanced Design Topics in Wood Construction on March 13-14. This course offers topics often faced by wood design professionals, yet background data and references on the topics are not readily accessible. Attendees will receive 15 AIA/CES CEHs and 1.5 CEUs (15 contact hours). Visit ***www.cpe.vt.edu/woodworks*** for details.

***For more information regarding workshop content and for a complete schedule, visit the Workshops and Training section of our website at www.strongtie.com/workshops.***

# BUILDING NEWS *(continued from page 2)*

wood design provisions of the IBC, Phil Line, P.E., of the American Wood Council found that the demand and capacity for light-frame wood shear walls has remained fairly consistent since the 1955 building code, with some exceptions like shear wall aspect ratio reductions and building irregularities. He noted that the 2009 and 2012 IBC and ASCE7-10 now reference the 2008 AF&PA Special Design Provisions for Wind & Seismic for the entire diaphragm and shear wall design-engineered provisions for wood framing.

Rounding out the program, Bret Lizundia, S.E., Principal at Rutherford & Chekene in San Francisco, discussed retrofit of unreinforced masonry buildings. He pointed out the various vulnerabilities of a typical URM building, such as the parapet, flexural weakness of the walls in resisting out-of-plane forces and shear weakness of the walls in resisting in-plane forces. He presented solutions to strengthen these vulnerable areas, such as bracing the parapets, adding wall-to-roof and floor anchorage, adding shotcrete, carefully coring out vertical portions of the URM walls and adding reinforcement and grout, adding fiber-reinforced polymer to the walls, and adding structural steel-braced frames or moment frames.

We would like to thank all of the presenters and attendees of the 2011 Seismic Symposium for their participation. The program was well-received and provided the opportunity for continuing education, networking and research. Simpson Strong-Tie welcomes the opportunity to engage with dedicated and talented individuals and organizations to reduce seismic risk and ultimately, save lives. ■

***Jeff Ellis, P.E., S.E.***
*Code Report and Branch Engineering Manager*
*Simpson Strong-Tie*
*Riverside, California*
*jellis@strongtie.com*

*Tension test of a cast-in-place steel anchor rod with plate washer in concrete*



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## CODE UPDATE *(continued from page 1)*

Once manufacturers have obtained Evaluation Reports for their products, project designers can use the reports to help reduce their workload. However, a CRTR evaluation report leaves the bulk of the design work up to the designer because only the steel components of the run are evaluated, which means the designer must still analyze the wood structure and its ability to transfer uplift forces to the rod tie-down runs. Alternatively, a CRTS report evaluates all pertinent elements of the wind uplift system – steel components and wood structural members – and will likely provide the results in user-friendly tables that help minimize the work needed to detail the system.

Simpson Strong-Tie submitted an evaluation report to ICC-ES this past July and is anticipating a full CRTS report in the first quarter of 2012. For more information about AC391 and the specific design requirements for continuous rod tie-down systems resisting wind uplift in light-frame wood construction, please see the article "Coming up with Tie-Downs, Part II" in the November 2011 issue of *Structure* magazine or on our website, ***www.strongtie.com/articles***. ■

***Bryan Wert, M.S., P.E., SECB***
*Engineer*
*Simpson Strong-Tie*
*McKinney, Texas*
*bwert@strongtie.com*

## INDUSTRY NEWS

### SIMPSON STRONG-TIE TO OFFER CONCRETE REPAIR, PROTECTION AND STRENGTHENING PRODUCTS

Simpson Strong-Tie has recently entered the concrete repair, protection and strengthening business as part of its ongoing effort to expand its presence in the commercial, industrial and infrastructure construction. The company has acquired Baltimore-based Fox Industries Inc. and has agreed to purchase Switzerland-based S&P Clever Reinforcement Company. The market for these types of concrete products is large and continues to grow as governments and countries all over the world invest in infrastructure projects, such as roads, bridges, tunnels, buildings and water treatment plants. Simpson Strong-Tie has been in this industry for more than 15 years with its Anchor Systems product line and is excited to broaden its offering to customers both here in the U.S. and in Europe. ■

SIMPSON Strong-Tie®

P.O. Box 10789, Pleasanton, CA 94588
**800-999-5099**
**www.strongtie.com**

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*Inside this issue:*

- ***Simpson Strong-Tie Applies for Wind Uplift Restraint Rod System Evaluation Report***
- ***Seismic Symposium Focuses on Building Safety***
- ***Simpson Strong-Tie to Offer Concrete Repair, Protection and Strengthening Products***