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ICC-ES Los Angeles

26451 Ambia
Mission Viejo
CA 92692

April 2, 2008

Peter Bahlo, C.E.
ICC Evaluation Service, Inc
5360 Workman Mill Rd.
Whittier, CA 90601

Subject: Acceptance Criteria for Light-Frame Elements

Dear Sir:

This letter is independent of all ICC industry proponents. It is written with respect to the interests of the Ultimate Stakeholders, the persons who buy, own, rent or enter buildings using products covered by ICC-ES reports.

The writer is aware of issues with respect to various Acceptance Criteria related to Light-Frame construction. There are several issues. This letter is concerned only with the testing of specimens.

In a recent letter to the Los Angeles Department of Building and Safety, Borjen Yeh, APA wrote:

"The SEAOSC-SPD protocol has not received wide acceptance due to the predominant nail fatigue failure mechanism observed in the tests being significantly different from the types of failure observed in buildings following a seismic or high wind event."

David Gromala, Weyerhaeuser, in a letter to Kurt Stochli, ICC-ES with respect to AC322 wrote:

"It should be noted that it was decided NOT to establish wood wall benchmarks using data collected with the previous SPD protocol for two reasons. First, it was a general consensus that the CUREE protocol could be used to establish performance targets that would be conservative for both test protocols. Second, it is well-documented that the SPD protocol induces failure modes in wood-frame walls that are inconsistent with failure modes observed in seismic events."

Both of these statements, plus many other similar statements from similar sources, and the "well-documented" status claimed are a **single source opinion** that has been repeated over and over again without critical review.

Please be aware of the following.

- 1 The referenced "failure modes observed in seismic events" were **unwanted premature failures due to inadequate hold-down stiffness.**
- 2 A SEAOSC Committee concluded the unwanted premature "failure modes observed in seismic events" **should be discouraged in future design and construction.**
- 3 The SEAOSC Committee specified testing boundary conditions that included hold-down devices sufficiently stiff to prevent the premature "failure modes observed in seismic events." **As expected, this resulted in a different final failure mode presenting itself.**
- 4 Shake table testing by CUREE in 2002 reported (at page 220 of 269 pages of Ref. 6) failure modes the same as those first demonstrated by the SEAOSC COLA-UCI testing using the SPD protocol. The CUREE cyclic test protocol has not demonstrated similar failure modes.

Further, please also be aware of the following documentation.

The CUREE Protocol was developed with the following significant **restrictions**.

First CUREE restriction:

Quote from Ref. 2 "**For all cases** it is assumed that the structure is located at a site with NEHRP soil type D. **Soft soil ground motions are not considered.**" (Emphasis added.)

Reiterated in Ref. 3. "Thus, there is no simple answer to representative loading protocols for structures located at soft soil sites, but it is **not fair** to base general loading protocols on the worst of soft soil conditions." (Emphasis added.)

Comment: The ICC Code does not preclude constructing Light-Frame buildings on soft soil sites. The ICC Code has no "fairness" requirement.

Second CUREE restriction:

Quote from Ref. 3 "CUREE protocols are based on a statistical evaluation of inelastic time history analyses performed with SDOF systems, and using "ordinary" ground motions (distance from fault rupture greater than about 13 km to avoid near-fault effects) from **earthquakes of magnitudes 7.0 or smaller. Ground motions from earthquakes greater than magnitude 7.0 are not considered** (because of a lack of records)." (Emphasis added.)

Comment: The ICC Code does not preclude the construction of Light-Frame buildings in locations subjected to earthquakes greater than magnitude 7.0

Third CUREE restriction:

Quote from Ref. 2 "No documentation is requested for elastic stiffness and yield force because for timber structures such quantities are not well defined and numerical values depend strongly on the definition used."

These restrictions in the CUREE test protocol are very significant.

Writer's Conclusion 1

Consistent engineering and scientific practice requires that parameters developed using the CUREE protocol be used **with the same restrictions** as the protocol. A large percentage of buildings constructed under the ICC Code fall outside these restrictions. This leads the writer to the following conclusion:

"Elements tested using the CUREE protocol shall not be qualified for use in buildings on sites with soil type E and F, or at sites that may be influenced by earthquakes greater than magnitude 7.0."

ICC-ES must recognize this restriction if the CUREE test protocol is recommended.

Writer's Conclusion 2

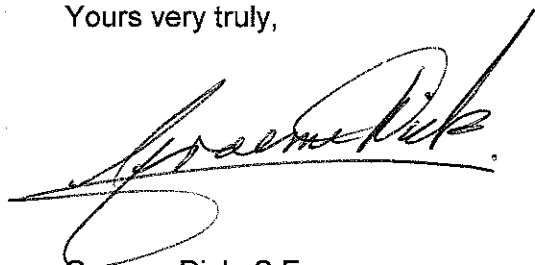
The third CUREE restriction is equally important. It precludes understanding and assessing the actual *element* Initial Stiffness, Overstrength and Mu because it does not accommodate the determination of YLS **independently** from SLS. The SPD protocol deliberately addresses this by accommodating the collection of data for use in applying the only definition for YLS contained in ASTM E2126 that is independent of the SLS.

In the writer's opinion, the basis of AC322 cannot be realized without the independent measurement of YLS and SLS. It is only with the independent measurement of YLS and SLS that *element* Initial Stiffness, Overstrength and Mu can be assessed. This *may* lead to an assessment and comparison of element R-Factors - which then *may* lead to a consideration of "equivalence "

Reference1 demonstrates the importance of the requirement for understanding the effects of testing protocols. ICC-ES should not proceed with the various AC considerations without insisting the effects of seismicity on light-frame elements be known. The writer is not an advocate of the SPD protocol or any other test protocol. The protocol issue must be properly addressed by experts independent of AC proponents. **There is the risk of wasting a lot of time and money if testing proceeds based on AC's that rely on a protocol that is clearly NOT state-of-the-art.**

It is in the best interests of all proponents, and all Ultimate Stakeholders, that these issues be fully researched. Development, revision and application of all AC's pertaining to the above should be suspended pending a full unbiased critical review by a disinterested expert panel.

Yours very truly,



Graeme Dick, S.E.

References:

- (1) Cyclic Response of Woodframe Shearwalls: Loading Protocol and Rate Of Loading Effects. CUREE Task 1 3 1, Kip Gatto, Chia-Ming Uang
- (2) Development of a Testing Protocol for Wood Frame Structures. CUREE, Helmut Krawinkler, Francisco Parisi, Luis Ibarra, Ashraf Ayoub, Ricardo Medina
- (3) Proposed SEAOC "Blue Book" paper by Helmut Krawinkler. First submitted 2003 and resubmitted in 2007.
- (4) ASTM E2126 Standard Test Methods for Cyclic (Reversed) Load Test for Shear Resistance of Walls For Buildings
- (5) Recommendations for earthquake Resistance in Design and Construction of Woodframe Buildings: Codes, Standards and Guidelines. CUREE, Kelly Cobeen, James Russell, J. Daniel Dolan, Seminar, 2003.
- (6) Seismic Evaluation of an Asymmetric Three-Story Woodframe Building CUREE Publication W-19, 2002, Mosalam, Machado, Gliniorz, Naito, Kunkel, Mahin

From: Graeme Dick [mailto:gd@kspeng.com]
Sent: Monday, April 28, 2008 9:55 AM
To: Brian Gerber; Kurt Stochlia; Nick Horeczko; Peter Bahlo
Subject: ICC-ES Staff: April 1 & 3, 2008 Memos, Acceptance Criteria

Kurt Stochlia, C.E., Brian Gerber, S.E., Nick Horeczko, C.E., Peter Bahlo, C.E.

The attached letter is in response to ICC-ES staff memos of April 1 and April 3, 2008.

This letter addresses testing boundary conditions.

Thank you,

Graeme Dick, S.E.

<<MISC-HD-Displ.pdf>>

26451 Ambia
Mission Viejo
CA 92692

April 27, 2008

Kurt Stochlia, C.E.
ICC Evaluation Service, Inc.
5360 Workman Mill Rd.
Whittier, CA 90601

Subject: Status of Seismic Issues Relating to Lateral-force-resisting Products Covered in ICC-ES Evaluation Service Reports

Category: Testing Methods: Boundary Conditions (Hold-Down Displacement)

Dear Sir:

This letter is in response to ICC-ES staff memos of April 1 and April 3, 2008. It is written with respect to the interests of the "ultimate stakeholders," the persons who buy, own, rent or enter buildings using products covered by ICC-ES reports. The writer is independent of all industry proponents.

I note some piecemeal alterations to testing methods that must not be adopted.

An AC adopts the *Standard Method of Cyclic (Reversed) Load Test for Shear Resistance of Framed Walls for Buildings*, by SEAOSC.

The AC then modifies the Standard by

"Section 5.2 of SEAOSC is deleted."

Section 5.2 must not be deleted. Section 5.2 must be referenced as follows:

"Section 5.2 of SEAOSC is noted. The strength limit state referred to in 5.2 of the Standard shall be the peak strength limit state. This section controlling boundary conditions shall be satisfied for all testing, including testing using protocols other than the SEAOSC protocol.

If the requirements of this section are not met, the end post displacements at all maxima throughout the test shall be reported. The data shall be reviewed by ICC-ES Staff (and a panel of Disinterested Structural Engineers as ICC-ES Staff determine is necessary) to determine compliance or noncompliance with the AC."

Compliance with the boundary conditions is necessary for the following reasons:

The conditions are set to ensure the specimen is tested as intended. The specimens being tested are shear walls subject to shear displacements. Shear displacements are distinct from overturning displacements.

Shear displacements take place primarily within the fasteners connecting the sheathing to the framing. It is the testing of this system that tests for the majority of the items named in Section 1629.9.2 of the 1997 UBC. In particular, this utilizes many fasteners working in parallel which is an element with *Redundancy*. The failure of a few nails does not jeopardize the entire wall. The system also relies on fasteners displacing back and forth and producing resistance in both directions throughout the complete cycles, which give the system its *Energy Dissipation Characteristics*. The independent assessment of YLS, SLS and negative slope of the load-displacement curve beyond the SLS for the shear wall specimen, provide data for assessing the other items named in Sec. 1629.9.2.

Overturning displacements due to end post displacements (due to the hold-down connector displacements) do not have the same characteristics. Hold-down or end post displacements have poor Energy Dissipation Characteristics. No resistance is offered during the return of the up-lifted post to the original position, and no resistance is offered on the next cycle until the displacement of the previous cycle is reached. No *Redundancy* is present. The failure or poor performance of one hold-down makes the wall ineffective.

End post displacements modify the primary backbone curve. They can, for example exaggerate the displacement at the SLS and suggest an enhanced ductility. This is not an enhanced ductility because the *Energy Dissipation Characteristics* are not the same.

If end post or hold-down displacements are significant then the specimen is behaving as a cantilevered column rather than a shear wall.

In summary *Section 5.2 of SEAOSC* is necessary in combination with the independent measurement of YLS and SLS in order to assess elements per Section 1629.9.2 of the 1997 UBC, the section in effect when the SEAOSC test methodology was adopted.

1629.9.2 Undefined structural systems. For undefined structural systems not listed in Table 16-N, the coefficient *R* shall be substantiated by approved cyclic test data and analysis. The following items shall be addressed when establishing *R*:

- 1 Dynamic response characteristics,
- 2 Lateral force resistance,
- 3 Overstrength and strain hardening or softening,
- 4 Strength and stiffness degradation,
- 5 Energy dissipation characteristics,
- 6 System ductility, and
- 7 Redundancy.

The *R* of a system cannot be assessed without considering the corresponding items of the elements comprising the system.

Thank you for the opportunity to comment.

Signed by Graeme Dick, S.E.

Copy: Brian Gerber, S.E., Peter Bahlo, C.E., Nick Horeczko, C.E.

References:

- (1) Standard Method of Cyclic (Reversed) Load Test of Structural Connector or Sub-assembly, August 1, 1996, revised September 9, 1997 and Commentary.
- (2) Standard Method of Cyclic (Reversed) Load Test for Anchors in Concrete or Grouted Masonry Structural Connector or Sub-assembly, August 1, 1996, revised September 9, 1997, and Commentary.
- (3) Standard Method of Cyclic (Reversed) Load Test for Shear Resistance of Framed Walls for Buildings, August 1, 1996, revised January 20, 1997.

From: Graeme Dick [mailto:gd@kspeng.com]
Sent: Monday, April 28, 2008 12:13 PM
To: Brian Gerber; Kurt Stochlia; Nick Horeczko; Peter Bahlo
Subject: ICC-ES Staff: April 1 & 3, 2008 Memos, Acceptance Criteria

Kurt Stochlia, C.E., Brian Gerber, S.E., Nick Horeczko, C.E., Peter Bahlo, C.E.

The attached letter is in response to ICC-ES staff memos of April 1 and April 3, 2008.

This letter addresses the required independent determination of "yield."

Thank you,

Graeme Dick, S.E.

<<MISC-YLS.pdf>>

26451 Ambia
Mission Viejo
CA 92692

April 28, 2008

Kurt Stochlia, C.E.
ICC Evaluation Service, Inc.
5360 Workman Mill Rd.
Whittier, CA 90601

Subject: Status of Seismic Issues Relating to Lateral-force-resisting Products Covered in
ICC-ES Evaluation Service Reports

Category: Testing Methods: Independent Measurement of YLS

Dear Sir:

This letter is in response to ICC-ES staff memos of April 1 and April 3, 2008. It is written with respect to the interests of the "ultimate stakeholders," the persons who buy, own, rent or enter buildings using products covered by ICC-ES reports. The writer is independent of all industry proponents.

I note some piecemeal alterations to testing methods that must not be adopted.

An AC adopts the *Standard Method of Cyclic (Reversed) Load Test for Shear Resistance of Framed Walls for Buildings*, by SEAOSC.

The AC then modifies the Standard by

"Section 8 of SEAOSC is nonmandatory."

Section 8 must not be deleted. Section 8 must be referenced as follows:

"Section 8 of SEAOSC is mandatory".

Compliance with this section is necessary for the following reasons:

Section 8 requires the YLS to be established independently from the SLS in accordance with the definition of YLS in SEAOSC and adopted into ASTM E2126. Section 8 requires the bilinear force-displacement response through the independently established YLS and the SLS to be determined.

Element Mu ($\Delta_{SLS}/\Delta_{YLS}$) and element overstrength can only be assessed after the YLS and SLS are independently measured.

No attempt can be made to compare or establish the R of building systems, unless the Mu and overstrength values of the elements in the building systems are known. We know, even then, it is by no means easy.

Thus Section 8 of SEAOSC is necessary before any attempt at "equivalence" can be made. AC322, for example does not require the YLS be established independently from the SLS.

We do not make progress by deleting sections from standards unless we replace them with equal or better sections. I find no requirements in any AC that can replace SEAOSC Section 8.

Thank you for the opportunity to comment.

Signed by Graeme Dick, S.E.

Copy: Brian Gerber, S.E., Peter Bahlo, C.E., Nick Horeczko, C.E.

References:

- (1) Standard Method of Cyclic (Reversed) Load Test for Shear Resistance of Framed Walls for Buildings, August 1, 1996, revised January 20, 1997.
- (2) ASTM E2126 Standard Test Methods for Cyclic (Reversed) Load Test for Shear Resistance of Walls for Buildings.