Meeting 8 of the BSSC PUC Issue Team on Shear Walls
At KPFF Consulting Engineers, 1601 Fifth Avenue, Suite 1600, Seattle, WA 98101

January 23 and 24, 2018

Meeting Notes

Attendance:

John Wallace (remote), Bonnie Manley (remote)


1) 8:30 AM – The meeting was convened by Chair Ghosh

Item 6) John Wallace – Update on P695 study on coupled wall systems. [Attachment 1].

Presentation

Overview

November advisory meeting

Summary of test programs

Next steps

Input on test programs

Cobeen:  Q: About drift – does calculated drift exceed allowable ACI limits? And IBC limits?

A: No, ACI and IBC drift limits are met. Adjusted design is to meet drift limits.

Ghosh:  318-H is considering a drift limit ratio.

Bruneau:  Q: On archetypes - at what height does drift start to control design?

A: Not a clear answer at this point. Will know after more investigation.

Q: If design is driven by drift, that means R factor is no longer valid?

A: When drift limit is reached, often design is modified so that it becomes strength limited.
Berman: Q: Test Database load histories. Are they typical increasing cyclic loads?
A: Yes, most are many cycles.
Q: But not a long duration simulation?
A: That’s right.
Q: Seattle issue is long-duration events.
A: Has looked at many cycles at low demand followed by a few long cycles. Generally found a higher drift capacity, compared to a few large cycles initially.
Q: ACI multiplier on \( I_g \) is 0.5 for walls. This study recommends 0.75. MKA often uses 0.75 for both moderate and tall buildings. DCI as well.
A: Advisory group allowed study to use design parameters that make sense. Have found that 0.75\( I_g \) gives better results when compared to tests.

Ferzli: Q: Maffei has recommended \( I_{\text{eff}} < 0.5 I_g \), based on shake table test results.
A: Wall in those tests were intentionally designed to produce more cracking.

Varma: Q: What is range of reinforcement ratio, and what shear amplification is observed?
A: Often design calls for minimum reinforcement in C-shaped walls. Shear amplification is tracked in analysis, but no specific range is observed.

Lehman: Q: Are there flanged walls?
A: Taller walls are flanged
Q: Higher shear strength for flanged walls?
A: Yes, this shows up in analysis.

(Following item (6) on agenda, above, returned to top of agenda).

2) Self introductions

3) Opening remarks by Ghosh

Wallace will present again at 4:00

Tomorrow @ 10:00 Two UW Presentations:

a) Compare U.S. and N.Z. approaches to wall design

b) Solid and coupled wall behavior
4) At 10:00 Steel group will have its own break-out meeting

Cobeen: Q: Does a compiled draft of our committee document exist?
A: Ghosh: Not yet, but possibly by end of meeting.

Bruneau: Q: Should perhaps reiterate purpose of resource paper.
A: Ghosh replied that we are working towards the next edition of the NEHRP Provisions – we are working on the 2020 edition

The 2020 NEHRP Provisions will consist of 3 parts:

1) Proposed modifications to ASCE 7-16 – these will be considered automatically for inclusion in ASCE 7-22

2) Commentary to Part 1

3) New material – resource papers covering topics not yet ready to be codified.

Bruneau: Q: P-695 studies do not fall under Part 3, do they?
A: Ghosh: Results of P-695 studies may justify changes proposed in parts 1 and explained in Part 2; and further background may be provided in Part 3.

Lehman: Q: Will ACI Sub-H recognize this as a reference publication?
A: Taylor: Yes, this should serve as an ACI resource. Generally material published in Part 3 may be published elsewhere as well.

Ghosh: There will likely be 2 code change proposals for Part 1:

1) ductile coupled reinforced concrete shear walls

2) coupled composite steel plate shear walls

7) (skipped to agenda Item 7) – Definition of ductile coupled RC shear walls

Ghosh: This is being addressed in sub-H. Referred to Taylor & Fields

Fields reviewed current definition and background on how it was developed (Attachment 2).

Definition focuses on aspect ratios of coupling beams.

Trend: Total energy dissipation vs. aspect ratio.

When 80% of energy is dissipated by coupling beams, coupling beam aspect ratio range is 2 to 5.

Fields reviewed possible “loopholes” in this definition (Attachment 3).
Reviewed possible range of definitions from highly analytical to qualitative.

Would like a definition that can be applied early in design.

Lehman, who has been looking at this topic: ETABS or other analytical model is basis of design. But tension piers don’t carry any moment. This drives failure of the compression piers, possibly before yielding of coupling beams.

Ghosh: Not sure this effect needs to be part of the definition.

Lehman: Suggest a limit on axial load that is carried by compression piers.

Ferzli: With limits on wall slenderness (thickness) it is difficult to fail compression pier in compression.

Fields: But should compression pier limits be part of the definition of a coupled wall?

Lehman: This is an important effect that should likely be included in the definition.

Ghosh: 318H – definition of a coupled concrete shear wall system including restrictions on configuration. For R = 8 definition, perhaps need to define a compression limit.

Fields: Make sure that the work of John Wallace is consistent with this discussion.

Ghosh: Wallace will rejoin the meeting later today.

Lehman: Determining a single value of “c” (neutral axis depth) is difficult, and process is unclear.

Ferzli: Presented a proposal that at least 90 percent of levels should be coupled, and related provision if levels are not clearly defined. (Attachment 4).

Fields: This appears to close one loophole but not the other.

S.K.: This is a simple method that has merit.

Cobeen: Good that Ferzli’s definition describes the intent of the provision.

Ferzli: Presented a case where wall piers are unequal. Is it a coupled wall?

Fields: Suggested specifying that all coupling beams be configured to develop plastic moment at both ends.

Ferzli: Presented proposal for energy dissipation factor.

Ghosh: Returned to proposal that walls be linked at 90% of levels. Fields supports this proposal, as does Xia. Perhaps second part of provision could go in commentary.

Berman: Like the 90% proposal. But damage tends to occur at discontinuities, e.q. missing coupling beams.
Ghosh: Suggested this be covered in a commentary.

Collins: What if a coupling beam is entirely “missing” at a level (i.e. no wall opening at that level). Discussion: This would not be allowed by coupling beam aspect ratio restrictions.

11:00 – Break

S.K.: Discussed dates for proposal submittal to 318-H

Feb 12 – Need proposal from David Fields

April 20 – Last 318 Main ballot is due (ballot must have passed Sub-H already)

Ghosh, Fields, Ferzli, Taylor will be a subgroup to review the definition of ductile coupled shear wall system proposal.

(8) Discuss progress of each section of resource paper.

Section 1 (Introduction)

1a – Scope S.K. is working on this.


1c – Concrete shear walls – (Cast-in-place)

   Non PT – Ghosh Lehman

   PT – Kurama section needs additional work

   Precast – Kurama section needs additional work

1d – Masonry shear walls – Bennet is working on it

1e – Discussed format for write-ups. Used Berman’s writeup on steel plate shear walls as an example – (Attachment 5).

1f – Design of composite steel plate shear walls. Have a preliminary draft by Bruneau (Attachment 6). Needs some expansion. Berman will assist with next draft.

There was a question about the related Section 4, Steel Plate Shear Walls. Ghosh said that Section 4 should summarize research and basic findings.

1g – Cold-formed steel shear walls – Allen/Zeydel. S.K. will follow-up.

1h – Design of wood shear walls – Cobeen/Line will produce.

Ghosh: A big item that is missing is coupled shear walls. Does it mean the same thing for steel and concrete? Need to explain basic behavior for both types.
Berman: The mechanism for coupled steel plate shear walls is completely different from that for coupled concrete shear walls.

Types of coupling beams used with CIP concrete shear walls:

- CIP coupling beams – Ghosh (covered by 318)
- Fiber reinforced concrete coupling beams – Ferzli
- Steel coupling beams – B. Shahrooz/Fields
- PT coupling beams – Kurama
- Precast coupling beams – Lehman/Stanton

Coupled wood shear walls:

- Coupling is not often counted on for wood shear walls.
- Cobeen noted that perforated shear walls contain coupling beams although they are not called that.

Coupled steel plate shear walls.

- Always steel coupling beams – Berman

Composite steel plate shear walls.

- Concrete filled steel shell composite coupling beams – Berman/Bruneau
- Steel coupling beams

Coupled masonry shear walls – Bennett

Summary of general approach to each wall type; Current standing of each wall type, most important research, current issues, and some references.

Section 2 (Concrete Shear Walls)

2a) i) Ferzli – Core Walls. Showed core wall examples (Attachment 7). Shows span/depth ratios.

- Discussion of coupling beam span/depth ratios. Possibly commentary in ACI 318 on this topic.

ii) Wall penetrations

Important effects on wall behavior

What are the issues?
Lowes – discussed effects of wall openings Lehman & Lowes have summarized past research on this topic. They will send to Ghosh (Attachment 8).

Further discussion of openings in shear walls. There is a wide variety of conditions and configurations.

Lunch Break – 12:35

Fields: Discussed cores illustration by Ferzli. What about walls in the same direction of loading that are different e.g. one coupled wall, and one non-coupled wall.

Ghosh: Suggests Ferzli give us a brief write-up on figure. This may be included in commentary.

2b – Deformation – demand in slender shear wall buildings. – Fields

Ghosh suggested illustrations with commentary e.g. the finding that there is very little nonlinearity in tall slender walls. Wall axial strains are lower than expected. Story drifts in plastic hinge zones are smaller than expected.

Ferzli: There are differences between analyzed response for mid-rise and high-rise buildings.

2c – Classification of RC shear walls – in progress

Section 3 (Masonry Shear Walls)

Ghosh: Dick Bennett has written two summaries which now require review.

Partially grouted shear walls.

No benefit to considering coupling in masonry shear walls.

Reviewer: John Hochwalt, KPFF, Seattle

Section 4 (Steel Sher Walls)

Bruneau – Will discuss in terms of NEHRP Provisions Part 1, 2, and 3

Part 1 – Research started last fall.

Span/depth ratios in range 2.5-5

Steel plate sections filled with concrete.

Peer review panel – discussion of archetypes

Currently developing the elements of the analysis process. Will present at the next meeting.

Intention is to place new provisions in Part I.
Part 2 – Commentary on Part I.

Part 3 – Maybe rolled into the resource paper, or will be written as a stand-alone document.

Cobeen: Has the PUC assigned a review panel for this research? Yes: Sabelli, Deierlein, Klemencic plus others are involved, including members of the PUC.

Manley: Independent Peer Review panel has already been appointed for this study.

Ghosh: Wants to make sure PUC considers both P695 studies to be on the same level of review.

Bruneau continued:

Ongoing discussion with peer review panel to develop archetypes. Also discussions of drift limits and building heights. Plan is to write a procedure for design related to the proposed R-factor.

There are likely requirements that are common to R/C shear walls and steel plate composite shear walls e.g. how is axial compression shared between the two wall piers in a planar wall. Will Test T- and C-shaped walls. Then they will test coupled planar walls.

Ghosh: Question about composite construction committee – Developed design guide (Attachment 9).

Varma: This was developed 10 years ago for concrete walls with steel coupling beams. Published as a paper and a book.

Ghosh: Information on mechanics of this type of wall could be included in the IT4 resource paper.

Varma: See also AISC 341-16, Chapter H for discussion.

Ghosh: Basics will be spelled out in Ch.1, then state-of-the-art in Ch. 4. The line item for coupled shear walls in ASCE 7 will come with conditions on the configuration of the wall.

Break 2:45

Back to 2f – Shear Design of RC Shear Walls

Ghosh: This is a big topic. We have divided it into subtopics.

i) ACI determination of required shear strength – Ghosh – in progress

ii) \( \phi \) factor used in shear design of shear walls. \( \Phi \) is relatively low

iii) Flexural overstrength – Lowes

iv) Dynamic amplification – Lowes, Kurama

Lowes gave a presentation on “Capacity Design for Concrete Shear Walls” (Attachment 10).
Lowes asked for direction for writing section of Resource Paper on concrete shear walls.

Ghosh: Let’s hear Wallace’s report at 4:00 and then discuss

Discussion of shear amplification

Varma: Are we satisfied with our estimations of shear wall strength? So far we have focused the discussion on shear demand.

Ghosh: Three things that help create a strength reserve are the rate of loading, overstrength of materials, and improved shear capacity in compression zones.

Lowes: Shear failures in walls may be disguised as flexural failures.

Ghosh: These are critically important issues. We have not a very clear understanding of the effects and interactions between these issues.

Lowes gave presentation on “Detailing to Achieve Expected Flexural Ductility.” (Attachment 11)

Lowes suggests changing design rules to include amplification of shear, and then improved detailing in walls to prevent shear failures. Showed FEM analyses that illustrate high compression at toes of walls. To prevent this behavior, confine a longer length of wall, e.g., all the way from the toe to the neutral axis.

Varma: Pointed out the difference in behavior of slender walls and squat walls. Squat walls can carry higher shear loads.

Ghosh: For squat walls, ultimate failure is a sliding shear failure at high shear stress. For slender walls, compression and shear are concentrated at the compression toe.

Berman: Could one test just the compression zone?

Lowes: This has been investigated. Some tests have been conducted at Illinois in cyclic tension and compression.

Lowes gave presentation summarizing boundary element tests by various researchers. Attachment?

4:05

Wallace re-joined meeting by phone.

Ghosh mentioned the two ongoing P695 studies.

Bruneau: Noted that some studies have proposed $R$-factors that have been questioned as being too high. Bruneau believes the most important consideration is the relative magnitude of $R$ compared to other established systems.
Ghosh: This would be a major change in the scope of Wallace’s work. Perhaps keep this for a future consideration.

Wallace: Could perhaps work with a subset of previous analyses to make a comparative study.

Wallace: Suggested that if drift capacity check is introduced, then compression capacity and shear capacity deficiencies may be taken care of.

Wallace gave presentation: “Shear Amplification in Reinforced Concrete Structural Walls” Safdari & Wallace (Attachment 12). Wallace plans to repeat this study for coupled walls.

Further Discussion

Taylor: There is some urgency to get a proposal to ACI 318 Subcommittee H. What is the simplest proposal that could be made?

Wallace: Possibly use an expression like the Eurocode 8 amplification factor with a cap of \( R \) on the amplification factor.

Ghosh: Suggested we discuss this further tomorrow.

Cobeen: Does Wallace’s study include soil springs?

Wallace: No, it does not.

Ferzli: Soil springs may reduce the amplification factor.

Tomorrow we will start with wood shear walls.

Reviewed Item 5 from notes of previous IT4 conference call on 11/6/17. Item 5 was a discussion of wood shear walls.

Ghosh discussed this section, particularly the section on combined shear/compression failure of wood shear walls. Cobeen said she has seen the formation of a compression strut in plywood in analytical models. Lowes thought that formation of a compression strut in wood shear walls is possible, but there are other behavioral differences between wood and concrete shear walls. That would have to be considered. Line thought the mechanisms of the two shear wall types are completely different. With wood shear walls, bottom plates tend to crush in tests because the plates are cut off at the edge of the compression element.

Ghosh – will continue discussion tomorrow.

Next in-person meeting will be September 5 and 6, in Seattle

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January 24, 2018
Ghosh called the meeting to order at 8:10 AM

Agenda review

Item 12

**Section 5 (Wood Shear Walls)**

5a - Methods for computing deflections in stacked shear walls.

5b - Combined compression and shear failure

5c - Capacity-based design

5a – Cobeen discussed – 3 components of drift

1) Cord elongations

2) Tension-compression elongation at base compression components

   - Crushing of end grain
   - Crushing of sill plate

3) Shear deformation of panel, including nail slip

Some of the shear walls with high-density nailing can have deformations. Nails can have deformations large enough to merit re-configuration of wall, to reduce drift.

Cobeen reviewed the Canadian approach

Rotation of 1st floor panel results in rigid body rotation of next higher panel. This is in Canadian code. The SEAOC design example does not include this. This approach requires detailed modeling, which is not common in practice.

Lehman asked about characteristics of nail deformations.

Line showed a side-by-side example

   i) Level floor plate at each floor

   ii) Rotation of a panel causes rotation of panels above.

Ghosh: What was the state of practice until the idea of panel rotations was introduced?

Cobeen: Four-term equation in the NDS.

Line: Recently the Canadian approach has been discussed. The NDS approach results in about half the deflection of the Canadian approach.
NDS does not really address deformations of stacked walls.

Ghosh: Were Canadian drift limits adjusted?

Line: The Canadian drift limits have remained the same, but stiffness for calculating drift has been adjusted. There is not complete clarity on this procedure. Longer periods have led to reduction in base shear.

Cobeen: This is not a good idea. U.S. research has shown that base shears should not be reduced.

   The two approaches should be compared to full-scale shake table test data.

   Vertical flexibility of diaphragms would result in uneven floor deflections.

Lowes: Commented on difference in behavior of concrete shear panels and wood shear panels.

Ghosh: Biggest unknown with concrete shear walls is the cracked moment of inertia.

Ferzli: Shear panel rotation for concrete shear walls is only a concern for very tall shear walls.

Xia: For wood walls, current practice is to calculate drift on a story by story basis.

Fields: Drift limits are mainly based on non-structural performance. The 2% DBE limit is intended to maintain operable stairs, elevators, sprinkler systems, glazing, etc.

Line: Does not anticipate a U.S. adoption of the Canadian approach.

Ghosh: The Canadian approach will likely evolve further.

Line: Another topic - shear wall testing being conducted by industry. Past tests on shear walls have often not included vertical dead load simulation. Also, in about 2010, started running tests with hold-down hardware. Sole plate did not extend past end of wall. Hold-down has minimum permitted fasteners. Nails are driven into studs with only 3/8-in. edge distance.

Line showed typical test data. Boundary conditions have a significant effect on load-deflection behavior. Current practice tends to capture lower-bound behavior.

Cobeen: Current trend in ATC projects is to aim for prediction of actual behavior, not lower bound behavior.

Past tests have shown that nail edge distance significantly influences the wall ductility.

Line: Showed tested drift capacities for different configurations of perforated shear walls. There is high variability of drift capacity for the various configurations.

Ghosh: Requested a PDF copy of Line’s slides (Attachment 13). Suggested this committee monitor progress and developments in this area and wait to decide on the next step for this committee.
Cobeen: ATC 116 – Short-period buildings and probability of collapse

ATC 110 – Retrofit of one & two family dwellings – cripple walls/hillside dwellings

Both are in progress

ATC 116 may re-evaluate $R$-factors for some short-period buildings.

Inclusion of finish materials is also being investigated.

Lehman – Lowes and Lehman are studying buildings damaged by earthquakes in Taiwan. Frame infill materials have a significant effect on seismic response.

Ghosh – This is important information and we should continue to monitor. Now we will return to a discussion of shear design of concrete shear walls.

Shear design of concrete shear walls

Ghosh: Wallace has suggested implementing some form of Eurocode 8 equation, with soil adjustments.

Lehman: We should be sure that whatever methods we develop, they should be easily implemented by practicing engineers.

Ghosh: Displayed EC8 formula that Wallace referenced. Discussed the various terms in this expression.

Lowes: Suggested comparing EC8 expression with the expression proposed yesterday by Lowes.

Lowes displayed her proposed equation for discussion.

Taylor: Whatever expression is adopted, it should be possible to apply it early in the design process.

Lowes: Reviewed equation by Eibl & Keintzel (1988)

Works fairly well for short buildings. Proposed expression – apply $R$-factor to the most dominant mode.

Fields: This requires modal response spectrum analysis. Puts a large analytical burden on designers.

Lehman: Her research has indicated shear amplification occurs not only in tall structures, but also in short structures.

Ferzli: Based on Wallace’s presentation the amplification factors are between about 2 and 4. Need to develop a simple approach that produces results in that range.

Fields: Shear amplification is a real effect, so we should account for it. The main effect is thicker walls. Once wall is made thicker, demands on reinforcement in flexure are low.
Ghosh: To summarize, in practice it may be acceptable to have thicker walls as long as the $R$-factor is higher. A higher $R$-factor seems rational, but $R$-factor is set by ASCE 7.

Overstrength is $\approx 1.4$ to $1.5$

Higher mode effects $\approx 2$

Combined $1.5 \times 2 = 3$ amplification factor

Should $\phi$ factor by increased? Probably so, if we amplify shear.

Displayed Wallace’s plot of amplification factors from yesterday. Several questions arose, but Wallace was not available for discussion.

Examined N.Z. expressions.

Ghosh suggested we developed something similar, because it is simple and can be easily applied. Perhaps adopt a version of the SEAOC amplification equation.

Taylor: Can we have a sub-H proposal by Feb 12?

Ghosh: Lowes, Lehman, Ghosh will work on adapting the SEAOC expression.

Dawn Lehman stated taking notes at 10.10 am, following Andy Taylor’s departure)

**ACI Ballot on Shear Amplification**

- There was substantial discussion the prior day (January 23, 2018) on shear amplification in concrete wall buildings.
- Presentation by John Wallace demonstrated that the Eurocode expression for shear amplification adequately captured the impact, using a series of buildings designed for soil classification B. This expression has two components, one that accounts for flexural overstrength and one that accounts for higher-mode effects. The total amplification calculated using nonlinear analyses was compared with the equation, using different soil classifications. This was required since the Eurocode equation uses the ratio of $S_a(T_1)$ and $S_a(T_s)$ and these values depend on the soil classification. The expression is bounded by the force reduction factor, $R$.
- Work by Lowes and Lehman (presented by Lowes on January 23, 2018) demonstrated that (i) shear demands are amplified by a factor between 2 and 4 for higher-mode effects alone, (ii) the 2008 SEAOC equation does an adequate job of capturing the amplification for most buildings between 4 and 20 stories tall, and (iii) a more transparent method is to only reduce the predominant mode, but this is more complicated and can only be applied to MRSA and even that with some difficulty.
- Note that Wallace was not able to join the meeting on January 24, 2018 and therefore his feedback and input were not available. Ghosh will follow up with Wallace on these and other related topics.
- If there is consensus among Ghosh, Wallace, Lehman and Lowes, Ghosh will lead the development of an ACI 318 Sub-H ballot to define shear amplification for inclusion in the code. Lehman and Lowes agreed to help SK with the development of the ballot.
UW Presentation entitled “Comparison of Seismic Collapse Probabilities of Solid and Coupled-Wall Buildings”, presented by Nasser Marafi, PhD candidate. (Attachment 14)
  a. The presentation focused on investigation of the collapse probability of ductile reinforced concrete shear walls using nonlinear dynamic analyses of buildings at the MCE-level event. The study focused on 4-, 8- and 12-story buildings. The 4- and 8-story buildings used planar (blade) walls. The 12-story buildings used core walls.
  b. To ensure convergence of the analyses, displacement-based, distributed plasticity elements were used.
  c. The study investigated the impact of modeling and design parameters on the collapse probability in addition to investigating the fundamental difference between collapse of solid and coupled wall buildings.
  d. Buildings were designed using code-compliant, elastic, ELF methods.
  e. Collapse was defined as loss of the gravity system, assumed to be a slab-column system with a drift capacity of 5% (based on test data).
  f. All of the buildings demonstrated probability of collapse of ~10% or less.
  g. The primary finding was that coupled walls have a higher collapse probability than their solid-wall counterparts. This results from amplification of the compressive axial stress ratio. This can be counteracted by designing the wall pier such that the true axial load is taken into account and the target axial stress ratio is lower than balance.
  h. There was some discussion about the coupling beam modeling. Ferzli mentioned that he uses backbone curves and asked about the backbone curves used here. This approach used fiber-based elements, which compute the response from the stress-strain models of the concrete and steel.
  i. 2% damping was used in the analyses
  j. There was some discussion about the percentage of the LL used in the design, 20% or 25%. This is termed $L_{exp}$ in the TBI document, that portion of the live load, or related internal moments, forces, or deformations, expected to be present at the time of significant earthquake shaking, with a default value of 0.25.

UW presentation entitled: “Differences in New Zealand and U.S. Design of Concrete Coupled Walls”, presented by Alex Shegay, PhD candidate, University of Auckland (Ph.D. advisor is Ken Elwood). (Attachment 15)
  k. Primary features of NZ design that are different from those of US design are: (1) capacity-based design, rather than design based on prescriptive detailing, (2) redistribution of loads in the coupled-wall system and (3) limit on axial stress ratio.
  l. Overstrength of coupling beams is explicitly considered.
  m. Alex noted that in new design, coupled wall systems are rarely used.
  n. $R$ can vary with a maximum value of 8.5. The value of $R$ depends on the rotational demand in the plastic hinge region.

Discussion returned to Resource Paper
Section 5 (Wood Shear Walls. Kelly Cobeen lead)
  - Cobeen presented information on performance-based design, evaluation and retrofit of wood buildings.
In addition, information was presented on wood walls with continuous and staggered openings with the possibility of including this information in the resource document within the category of coupled wall systems. There is a particular interest in continuity around openings in wood walls.

Information that will be provided in the document includes:

i. Basic information about wood wall systems (likely to follow the outline that Jeff Berman used for his write-up on steel-plate shear walls.)

ii. Information on coupled wall systems to inform the designer about the design approach and its basis in tests and the behavior that they exhibit.

iii. Capacity-based design approach including design for deflection/drift limits.

New topic: Cross-laminated timber (CLT) wall systems. To be brought up as new business for discussion during the next meeting.

Refresher: significant progress was made as this meeting in particular with respect to: (1) a quantified definition for coupled wall systems and (2) shear amplification for concrete walls

Next meeting: in-person meeting scheduled for September 5-6, 2018 (please mark your calendar)

Next conference call: scheduled for March 20, 2018 (please mark your calendar)