

The e-Proceedings of the

1st Invitational Workshop on Performance-Based Design of Woodframe Structures

July 28-29, 2005
Colorado State University
Fort Collins, CO
U.S.A.

This workshop was made possible through a grant from the Structural Engineering Institute of the American Society of Civil Engineers for a Special Project entitled “The Next Step for ASCE 16: Performance-Based Design of Woodframe Structures”. This project is being executed by the Committee on the Reliability-Based Design of Wood Structures.

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Meeting Minutes

(Original minutes recorded by M. Criswell, summarized by J. van de Lindt)

The 1st Invitational Workshop on Performance-Based Design of Woodframe Structures was called to order at 8:35 a.m., July 28th 2005. From 8:35 to 8:50 a.m. the workshop participants introduced themselves. Appendix A contains a list of invitees and indicates those that were able to attend as well as those that were unable.

John van de Lindt, serving as meeting chair, gave an overview at 8:50 which was a brief explanation of the SEI special project entitled “The Next Step for ASCE 16: Performance-Based Design of Woodframe Structures.” The original proposal to SEI/ASCE is attached as Appendix B.

Appendix C shows the original agenda which was approximately followed.

B. Ellingwood (Georgia Tech) provided a review of load and resistance statistics and presented the basics of performance-based design (PBD). He defined PBD as an engineering approach based on:

- Specific performance objectives and safety goals of building occupants, owners, and the public.
 - Probabilistic or deterministic evaluation of hazards.
 - Quantitative evaluation of design alternatives against performance objectives.
- ...but does *not* prescribe a specific technical solution.

Regarding statistics of loads he discussed wind loads which are relatively stable and that computational challenges are now less that behavioral (and other) issues.

Ellingwood also stated that current reliability-based design (RBD) is reasonably accurate for members but for system behavior, it is not reflected explicitly except in seismic codes. Supporting databases for load statistics are relatively complete.

Ellingwood also stated that it was unlikely that a building owner would feel different if told that the designer was 90% confident of a performance level versus 95% confident. However, they would feel differently if asked to compare 50% and 90% levels of confidence by a design engineer. Some of the PBD research issues are:

- Selection of performance goals such as life safety, economic loss, and impact on social fabric.
- Relation of performance objectives to limit states
- Identification of hazards and hazard levels.

D. Rosowsky discussed the differences between woodframe structures versus other types. These included:

- Construction quality cannot be ignored, it can have a significant effect.
- Non-structural elements, finishes, etc. is all quasi-structural. Should it be accounted for, if so, how.
- Durability, broad issue.

There was some discussion by numerous participants on the basis of design such as deformation versus other performance measures. A. Filiatrault indicated that for seismic design, results from the CUREE-Caltech Woodframe project indicate that displacement is more important than velocity and acceleration in woodframe structures. First story of a multi-story structure tend to go very nonlinear, almost become a soft story. Some more general info – FEMA vision document is now considered a 1st generation PBD. PEER is looking at a more refined/detailed performance-based measure.

There was some discussion on the evolution of wood LRFD. Ellingwood commented that code officials are often engineers now unlike 30 years ago and therefore may be more receptive to PBD. S. Pryor stated that this would be good to sell homeowners a structural upgrade package, similar to other quality upgrades in homes. D. Gromala discussed the fact that upgrades are sold on floor system performance. Also mentioned were 10 yr versus 25 yr roofs. Several people discussed that the target audience of PBD might be the larger homebuilders. There was a discussion that the insurance industry does not refine their rate setting enough to warrant upgrade packages on homes, etc. D. Rosowsky said in South Carolina wind loss rates are not a function of distance from the coast. B.J. cited another example – if a house has sprinklers insurance may be higher because of the increased danger of water damage.

J. van de Lindt gave an overview of the rest of the mornings tasks and called for a short coffee break at 10:08.

The meeting resumed at 10:31 and J. van de Lindt gave an overview of the NEESWood project entitled “Development of a Performance-Based Seismic Design Philosophy for Mid-Rise Woodframe Construction”. This project essentially takes off where the CUREE Caltech Woodframe Project ended. Testing in year 1 will be at Buffalo, one of the CUREE index buildings and in year 4 a six story woodframe apartment building on the E-Defense shake table in Miki City, Japan. It was suggested that we could propose a

session on the project at the 2008 World Conference on Timber Engineering to be held in Japan. It was stated that the project is good news for the ASCE 16 community. Payload project are small projects that “piggyback” onto the larger project. J. van de Lindt stated that if they are under \$50K they are not externally reviewed (J. van de Lindt checked following the workshop and this number is actually \$100K for NEES, normally \$50K for CMS-NSF projects).

Working Session A: Defining Performance for Woodframe Structures

D. Rosowsky stated that there are several approaches for the discussion. For example, what hazards are of interest? Performance objective, tied to what types of limit states?

- Seismic – inter-story drift may be best descriptor
- Wind – component failure
- Flood – damage
- Durability/fire – is fire part of durability, the issue was not finished.

Some discussion on damage levels followed such as immediate occupancy, repairability, life safety. FEMA 273 drift limits were also discussed. What do the values 1%, 2%, and 3% mean? 1% causes considerable damage to finishes and is too much for gypsum wallboard. Is there any structural question for flood or is it simply interior finish damage, e.g. slow water level rise, not waves as in a coastal/hurricane situation. The three “D” were discussed – dollars, death, and downtime. A. Filiatrault mentioned that there are some good structural damage measures in subtask 4.1 of the ATC 58 report draft. 3% transient drift for seismic was discussed. CUREE test structures didn’t reach this. J. van de Lindt said that 2% was reached in the CSU shake table for a test structure and, based on that, 3% might be loss of resistance/structural limit. B. Ellingwood said that ATC 58 is focused on primary concern of stakeholders. It was assumed that building codes overall would address life safety. The life safety issue is difficult to define, it is not the same as collapse/overall stability. For example, if an earthquake in the S.F. Hyatt drops a large chandelier and kills people, this is a life safety issue even if there was no structural distress. B. Ellingwood also stated that most structures will start coming apart well before collapse, dropping of structural and non-structural elements. Falling debris and local collapse (life safety issues) well before loss of stability.

The “working” Powerpoint slide from the session is presented in Figure 1.


It was suggested that a grid of performance levels might work well. M. Criswell suggested looking more in depth at ATC 58 and it was agreed that van de Lindt would request a working draft. J. van de Lindt stated that there was quite a bit of background on performance-based design related to offshore oil platforms, in Norway and in the U.S.

Working Session B: Numerical tool deficiencies and software availability

There is nothing for wind currently, however D. Rosowsky discussed the “Three Little Pigs” project in Canada. B. Ellingwood stated that the failure sequence is critical, i.e. a local sheathing failure changes the pressure. The first failure is about as far as reasonable analysis can go. Current wind pressure models are from rigid body models in wind tunnels. Airborne debris should also be considered. Primary wind damage model is

roofs lifting off, not failure of overall lateral load resisting system. K. Fridley stated that the FEMA rating, i.e. the evaluation of damage, a “red card” usually significant to total structural damage, “amber card” the damage is not usually structural but tree damage, debris, water, windows out.

10:30-12:00
Working Session A



- Occupant comfort / serviceability
 - Building vibration
 - Building deformations, e.g. differential settlement, lateral drift, floor deflection
 - Others, e.g. noise, mold, lighting, air quality, energy
- Continued occupancy
 - Access/egress, maintain shelter, minimal/core utilities
- Manageable loss / acceptable damage / limited damage
- Injury/Life safety
 - Occupants can evacuate building
- General structural integrity/collapse (ASCE 7)
 - Start w/ ASCE 7 definition

FIG. 1: Slide from working session A

At 1:55 a discussion began on seismic state-of-the-art modeling. Must look at compression side as well as uplift side. How are loads transferred in compression? Should diaphragms be modeled as rigid or flexible? When should one assume one or the other? Other things that should be considered – uplift model, frame effects, user friendliness. The viscous damping value is not terribly critical if a reasonable hysteretic behavior is modeled. The interaction of two perpendicular walls when the motion is not parallel to either? What is the role of vertical accelerations?


A. Filiatrault discussed the existing models including the SAWS model. These are used by very few practicing engineers, sometime used to verify designs of notable structures. One goal of the CUREE project was to make the model more user-friendly, but ran out of time and money. Torsional effects were also discussed and the effect of transverse walls acting as tie downs. For woodframe structures, i.e. general analysis, “woodworks” program, others like it are being used. It is a more computerized version of what would be hand analysis, but not more refined computer modeling.

An analysis tool which uses subassembly properties, not nail/connector properties and component properties is needed. The working slide is shown in Figure 2.

Planning of the Wood Research Needs Workshop to be held in Long Beach, CA 2007

This discussion was led by the chair of the Wood Research Committee, Vijay Gopu. The workshop was originally discussed during the NYC wood committee meeting. It was decided that 2007 would provide enough time to get sponsors in line, 2006 is much too early. Both of the previous workshops were very well attended. In Portland, there was a reporter from each working group. V. Gopu posed the question – what basic structure/organization would people like to see for the workshop?

Partial workshop funding will be sought from NSF and USDA.



1:30-3:00

**Working Session B: Numerical tool deficiencies
and software availability**

J. van de Lindt

- Wind
 - Nothing for wind currently / three little pigs in progress
 - Current wind pressure models from rigid body models in wind tunnels
 - What happens to roof system under pressure/suction?
 - Directionality, progressive failure.
 - Windows, load path contin.
- Earthquake
 - Include axial – comp or tens.
 - Diaphragm behavior needs to be included –
 - including roof
 - Uplift model
 - Corner effects
 - User friendliness
- General
 - Need modular input of sub-assemblies
 - CSIRO working on durability

FIG 2: Slide from working session B

K. Fridley said that when he was preparing for the 1997 workshop, he approached NSF and USDA and asked what product they wanted to come out of the workshop. They wanted a “higher up/more general” look at what are the larger topics/areas of critical need. Stay away from specific projects, i.e. laundry list of details. Five major areas were identified. The 1984 workshop in Milwaukee was more specific and project oriented. The proceedings of the 1997 conference have been repeatedly referenced in proposals as “high level” justification of project need.

D. Rosowsky suggested it would be of interest in the 10 years since the 1997 workshop to see what has happened? What was the effect of the workshop? Are there new issues/products? What progress has been made? One challenge is to convince NSF and USDA that they are the primary funding sources for wood research and not HUD.

V. Gopu said quite a bit is dependent on agency personnel/staff.

A. Filiatrault said that the image for wood research is that it is not likely to lead to new discoveries. It is often viewed as product oriented. The counter argument is that the largest purchase most people ever make is their house, almost always a woodframe structure.

K. Fridley stated that research and development “for the country”, i.e. arm of the general public and to meet their needs, makes wood very appropriate for research funding. One question that often arises is why is there a Forest Products Lab, but no government steel or concrete lab.

The distribution of federal funding by material/product was discussed. Canada does not have a significant “material specific” bias.

V. Gopu brought the discussion back to our need to show the impact of the previous workshop, as Dick Schmidt did for the previous workshop. A. Filiatrault stated also relevant are loss data for woodframe structures versus other types of structures. V. Gopu asked where improvements in the workshop topics/coverage can be made?

D. Rosowsky suggested “one page” summary sheets for discussion purposes, i.e. with program officers at various funding agencies. Maybe one page on losses, another on each research focus topic. The proceedings from the last workshop had five position papers by scribes, then position papers were prepared based on those. They did not have executive summaries.

K. Fridley said we should do something on resources needed, perhaps similar to ASCE’s infrastructure report card. D. Rosowsky suggested a session on “break through” brainstorming – potential opportunities for new technology. There was some discussion on the international perspective and it was suggested to bring others onto the steering committee. Last time it was Dave Barrett (Canada) and Bob Liescher (Australia).

At 3:15 a discussion on educational needs in wood and how research and education interact began. New and emerging materials were discussed and the need for affordable housing rounded out the after-lunch session.

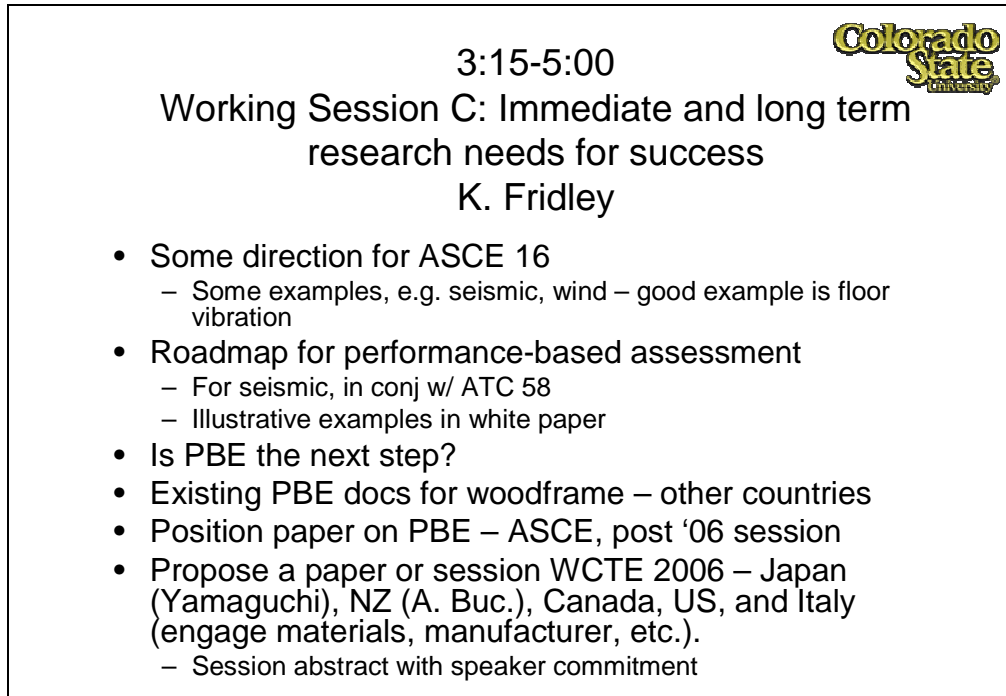
Working Session C: Immediate and Long Term Research Needs for Success

This session was quite short and can be summarized with the following tasks:

- Review seismic PB literature – what is out there and what has been done.
- Review non-seismic PB literature, e.g. fire, etc.
- Develop a wind parallel similar to the flowchart for seismic PBD in FEMA 356.

Figure 3 shows the working slide from session C.

The first day of the workshop ended at approximately 5:00 p.m.



3:15-5:00

Colorado State University

Working Session C: Immediate and long term research needs for success

K. Fridley

- Some direction for ASCE 16
 - Some examples, e.g. seismic, wind – good example is floor vibration
- Roadmap for performance-based assessment
 - For seismic, in conj w/ ATC 58
 - Illustrative examples in white paper
- Is PBE the next step?
- Existing PBE docs for woodframe – other countries
- Position paper on PBE – ASCE, post '06 session
- Propose a paper or session WCTE 2006 – Japan (Yamaguchi), NZ (A. Buc.), Canada, US, and Italy (engage materials, manufacturer, etc.).
 - Session abstract with speaker commitment

FIG. 3: Working slide from session C

Morning Session – July 29th, 2005

It was suggested by J. van de Lindt that we revisit working session A to finish the discussion on performance of woodframe structures. The slide shown in Figure 1 was put back up and discussed.

R. Gupta asked if there was any need to clarify the type of structure. Not bridges, woodframe residential or commercial structures.

K. Fridley asked what we mean exactly by “performance-based design” for wood structures – and not necessarily seismic and strength. B. Ellingwood suggested putting up the ASCE 7 work he and J. Harris are working on, which was shown bulleted earlier and is their current definition of performance-based engineering.

The overall objective is to give the design team the freedom to seek the best solution in the best way.

How does the “average” engineer deal with the additional freedom/uncertainty of a performance-based code? B. Ellingwood suggested that perhaps a prescriptive option which many would follow for routine work is feasible. Design and evaluation procedure


based on rules should be an option, but if an approach is “rules based”, you have lost the ability to do alternatives, which is a primary characteristic of PBD.

There was some discussion on component-based versus system-based design. PBD can easily address system-based design while prescriptive may work best for the component level.

At 9:50 the discussion turned back to working session C with the intent on refining and finishing the task list.

D. Rosowsky stated that it seemed that we were missing a step between us and the design engineer. B. Ellingwood said that it is clearer that PBD applies for seismic structures but in many parts of the country most occupants are concerned with occupant comfort and serviceability.

The working slides from the remainder of the morning session are presented in Figures 4 and 5.



Tasks

Tasks List A– pls finish by Oct 1

- Definition for PBD – expand for woodframe
 - Van de Lindt will draft and send for comment- begin with B. Ellingwood slide(s) from discussion.
- Opportunities and challenges of PBE for woodframe
 - Start w/ existing literature of PBE – send docs to everyone (J. van de Lindt, R. Gupta, D. Gromala)
 - Review seismic PB literature – what’s out there, what has been done (J. van de Lindt, A. Filiatrault, N. Luco, C. Ni, B. Folz)
 - Non-seismic PB literature – fire, etc. (R. Gupta, B.J.)
 - Wind parallel to FEMA 356, flowchart, etc. (D Rosowsky, J. van de Lindt, B. Ellingwood)
 - Broader impact of PB of wood (N. Luco, S. Pryor, T. Williamson, D. Gromala)

Task List Product: Session for 2006 WCTE by end Aug.

- Paper in session on U.S. PB Wood
- Follow up synthesis paper on multi-country positions, progress, etc.

FIG. 4: Slide from July 29 morning session

Task List B

Definition of performance objectives specific to woodframe construction

- Occupant comfort / serviceability
 - Building vibration
 - Building deformations, e.g. differential settlement, lateral drift, floor deflection
 - Others, e.g. noise, mold, lighting, air quality, energy
- Continued occupancy
 - Access/egress, maintain shelter, minimal/core utilities
- Manageable loss / acceptable damage / limited damage
- Injury/Life safety
 - Occupants can evacuate building
- General structural integrity/collapse (ASCE 7)
 - Start w/ ASCE 7 definition

Evaluation procedures based on performance objectives

- Snow
- Wind
- Seismic
- Normal occupancy
- Others, e.g. flood, fire, earth pressure, moisture, ...

Task Product: Concept paper(s) or notes

FIG. 5: Slide from July 29 morning session

It was decided that J. van de Lindt will serve as the collector of information, papers, etc. The post-workshop action items are presented on a separate document, and a copy is shown in Appendix D.

Appendix A: Workshop participant invitation/attendee list

Invitation/Attendance List for 1st Workshop on PBD of Woodframe Structures			
No.	Name	E-mail	Attended
1	John van de Lindt	jwv@enr.colostate.edu	Y
2	Dave Rosowsky	rosowsky@tamu.edu	Y
3	Ken Fridley	Kfridley@coe.eng.ua.edu	Y
4	Andre Filiatrault	af36@buffalo.edu	Y
5	Mike Symans	symans@rpi.edu	N
6	Dan Dolan	iddolan@wsu.edu	N
7	Phil line	Philip_Line@afandpa.org	N
8	Tom Williamson	tom.williamson@apawood.org	N
9	Dave Dinehart	David.Dinehart@villanova.edu	N
10	Bryan Folz	Bryan_Folz@bcit.ca	N
11	Steve Pryor	Spryor@strongtie.com	Y
12	Bruce Ellingwood	bruce.ellingwood@ce.gatech.edu	Y
13	Rakesh Gupta	rakesh.gupta@oregonstate.edu	Y
14	Marvin Criswell	marvin.criswell@colostate.edu	Y
15	Bill Bulleit	wmbullei@mtu.edu	N
16	Vijay Gopu	vgopu@tulane.edu	Y
17	Dave Gromala	dave.gromala@weyerhaeuser.com	Y
18	Erol Karacabeyli	erolk@van.forintek.ca	N
19	Ricardo Foschi	rowfa1@civil.ubc.ca	N
20	Chun Ni	chun@van.forintek.ca	Y
21	Bogusz Bienkiewicz	bogusz@enr.colostate.edu	N
22	Borjen ("B.J.") Yeh	borjen.yeh@apawood.org	Y
23	Nicolas Luco	nluco@usgs.gov	Y

Appendix B: Proposal to SEI for Special Project Special Project Proposal to ASCE/SEI

The Next Step for ASCE 16: Performance-Based Design of Woodframe Structures

Submitted by ASCE/SEI Committee on Reliability-Based Design of Wood Structures

Chair: John van de Lindt, *Colorado State University*

Member (and TAC Wood Chair): Ken Fridley, *The University of Alabama*

Member (and Past Chair): David Rosowsky, *Texas A&M University*

Summary: Recently Completed ASCE/SEI Special Project

The committee recently completed an SEI Special Project (2002-2004) led by former Chair David Rosowsky. That project entitled “Re-evaluation of LRFD for Engineered Wood Products: Keeping pace with Changes in ASCE 7” was very successful and resulted in four journal papers in the *Journal of Structural Engineering* and one *SEI Structures Congress* conference session with four papers that included six committee members. Presentation of the results of that project were also given at the *World Conference on Timber Engineering*, the *58th Annual Meeting of the Forest Products Society*, and *Wood-framed Housing Durability and Disaster Issues Conference*.

The proposed SEI Special Project that follows is intended to begin where the previous project left off. That is, performance-based design is felt to be a super-set of the seismic portion of current design philosophies. ASCE 16 (1996), the LRFD manual for woodframe construction, was the focus of the recently completed special project. Reliability levels were computed and were felt by the committees to align with the levels originally intended. The National Design Standard (NDS) [AF&PA] will adopt a dual ASD/LRFD format in its next update. So, ASCE 16 was successful in leading the way for adoption into the NDS. ASCE 16 can once again lead the way by developing a performance-based format. Thus, that is the objective of the SEI Special Project proposed herein (please see letter of collaboration/endorsement from the Chair of the *ASCE/SEI Design of Engineered Wood Construction Standards Committee*, Tom Williamson).

Executive Summary

Woodframe construction typically has performed well with regard to life safety in regions of moderate to high seismicity primarily because (1) wood has a high strength-to-weight ratio, and (2) well designed low-rise wood structures are capable of dissipating a large amount of energy through nonlinear deformations. Both of these engineering characteristics make woodframe construction an optimal choice for construction in regions of the U.S. with moderate to high seismic demands. Although woodframe construction has performed well with regard to life safety, these types of structures have sustained significant structural and non-structural damage in recent earthquakes. Current building code requirements for engineered wood construction in the U.S. (and around the world) are not based on any unified seismic design philosophy. Rather, wood elements, e.g. walls and members, are designed independently of each other without consideration of the influence that their stiffness and strength may have on the performance of the complete structural system.

Purpose of Project

Although the intent of the performance-based format is general and for all types of loading, earthquake engineering has paved the way for heavier materials such as steel and concrete. A recent important development in earthquake engineering has been the elaboration of performance-based concepts for the seismic design of structures (e.g. SEAOC, 1996). This approach, based on the coupling of multiple performance limit states and seismic hazard levels,

overcomes several of the shortcomings of the traditional force-based seismic design procedure, which has been the cornerstone of building code requirements to date. Although the performance-based seismic design approach has advanced for some types of structures to the point where it may be ready for incorporation into future generations of building and bridge codes, its application to woodframe buildings has only been recently proposed (Filiatrault and Folz, 2002; Rosowsky and Ellingwood, 2002). **The objective of this Special Project is to systematically outline the steps needed and begin formulation of a performance-based format for ASCE 16.** This will be accomplished through two invitational workshops with key researchers from around the U.S.

Significance of Project

Many of the details in current design specifications are, in effect, performance-based in that they expect a certain level of structural performance to be achieved provided the design is carried out to the specifications dictated. However, performance-based seismic design leaves the designer or analyst the ability to use virtually any (recognized) means of design to achieve the specified performance level(s). Further, in performance-based seismic design the burden of proof through numerical analysis or testing is placed on the designer, thus ensuring that the design meets the performance requirements. Development of a new design approach is, at best, a daunting task and brings with it many questions. Many of these questions will be addressed in the proposed Special Project during the two invitational workshops proposed..

Methods and Procedures

The following tasks will be performed in order to accomplish the objective outlined earlier:

Task 1: Invitational Workshop No. 1

This task will consist of a two day invitational workshop with the researchers divided into three working groups. Working Group A will focus on defining performance for woodframe structures, and addressing how to identify those performance levels for assemblies and structures. This will include determining the relevance of FEMA 283, FEMA 349, and SEAOC documents to woodframe construction. Working Group B will focus on outlining what types of numerical tools are needed including identifying deficiencies in current tools and availability of software. Working Group C will determine what the immediate (short term) and long-term research needs are if ASCE 16 is to successfully adopt a performance-based design format. The Working Groups will receive task assignments to be presented approximately 9 to 12 months later at the second meeting.

Task 2: Year 1 Deliverables

This task will synthesize the results of the workshop described in Task 1 as well as the first half of the Special Project. Specifically, a *Structures Congress* session consisting of four papers: One overview paper and three papers (one from each Working Group) will summarize the outcome of the first portion of the project.

Task 3: Invitational Workshop No. 2

A second Working Group meeting will be held approximately 9 to 12 months after the first. Each Working Group will give a progress presentation and task assignments will be refined for completion.

Task 4: Final Deliverables

The final deliverables for the project will be a series of technical and position papers (2 to 5) in the *Journal of Structural Engineering* summarizing the method and results for the Special Project. A report to funding agencies (i.e. USDA and NSF) detailing funding needs for performance-

based design of woodframe structures will also be prepared and submitted to ASCE/SEI. The previous special project resulted in four journal publication based directly on work from the project, thus it is expected that the same deliverable will result. A second *Structures Congress* session focusing on the results of the Special Project will be a deliverable.

Project Personnel

It is proposed that this project be coordinated under the leadership of the ASCE/SEI Committee on Reliability-Based Design of Wood Structures. Interested committee members will be encouraged to participate in all phases of the roadmap development and at least the following personnel are expected to participate: John van de Lindt, *Colorado State University*, David Rosowsky, *Texas A&M University*, Kenneth Fridley, *University of Alabama*, Andre Filiatrault, *University at Buffalo*, Daniel Dolan, *Washington State University*, Philip Line, *AF&PA*, David Dinehart, *Villanova University*. In addition to SEI committee member participation, efforts will be made to include international researchers such as Bryan Folz, *British Columbia Institute of Technology* and Isao Sakamoto, *University of Tokyo*.

Project Outcome

The final product of this project is anticipated to be a series of technical/position papers under the authorship of the committee and committee members. This will likely include one paper that will outline, in detail, the steps to be taken to ensure that a performance-based format is eminent for ASCE 16.

Benefits to the Profession and SEI/ASCE

The direct benefit to SEI/ASCE is that they will remain at the forefront of cutting-edge design code development through committee work and Special Projects like the one proposed herein. The direct benefit to the civil/structural engineering profession is that woodframe construction in the U.S. will sustain less damage. The end result will be an increase in the quality and integrity of the U.S. woodframe infrastructure over time.

Budget

A budget of \$6,000 is requested for a period of 18-24 months to complete this project. The funds will be used entirely to offset travel expenses of participating committee members to attend the two invitational workshops described above. The first meeting will be held in Fort Collins, CO and the second meeting will be arranged to maximize convenience for those participating.

References

- [1] Filiatrault, A. and Folz, B. (2002). "Performance-Based Seismic Design of Wood Framed Buildings." *J. Struct. Engrg.*, 128(1), 39-47.
- [2] Rosowsky, D. and Ellingwood, B., 2002, "Performance-Based Engineering of Wood Frame Housing: A Fragility Analysis Methodology," *ASCE Journal of Structural Engineering*, 128(1):32-38.
- [3] SEAOC (1996). "Recommended Lateral Force Requirements and Commentary, Appendix B: Vision 2000 – Conceptual Framework for Performance-Based Seismic Design," *Structural Engineers Association of California*.
- [4] Seible, F., Filiatrault, A., and Uang, C-M. Editors (1999). "Proceedings of the Invitational Workshop on Seismic Testing, Analysis and Design of Woodframe Construction", *CUREE Publication No. W-01, CUREE-Caltech Woodframe Project, Department of Structural Engineering*, University of California, San Diego.

February 24, 2005

Professor John W. van de Lindt
Department of Civil Engineering
Colorado State University
Fort Collins, Colorado 80523-1372; USA

SUBJ: ASCE/SEI Special Project Proposal for the Committee on Wood

Dear John:

I was very pleased to hear about your interest in submitting an ASCE/SEI Special Project proposal entitled "The Next Step for ASCE 16: Performance-Based Design of Woodframe Structures" with Ken Fridley and Dave Rosowsky. As Chair of the ASCE Standards Committee on Design of Engineered Wood Construction which developed ASCE 16, I would like to offer my full endorsement and cooperation on the project, should it be awarded funding by SEI. The previous Special Project completed by the Committee on Wood was very successful and provided valuable information for consideration by the Standards Committee for the development of ASCE 16.

As you know from attending the Committee on Design of Engineered Wood Construction meeting held in Nashville at the 2004 SEI Structures Congress, the National Design Specification for Wood Construction (NDS) promulgated by AF&PA has traditionally been an ASD specification only. However the 2004 NDS, to be published this year, will be a dual format specification with both ASD and LRFD design provisions included. ASCE 16 successfully led the way for adoption of the LRFD provisions into the 2004 NDS and I hope that through your proposed project it will provide the same basis for developing a Performance-Based Design format.

Both LRFD and ASD approaches are strength-based and enable designers to achieve desired design levels at the component and/or assembly level such as for a connection or shearwall. I strongly agree that the next step is to begin development of a design method that can provide desired performance at the system level.

Again, on behalf of the ASCE 16 Standards committee, I look forward to working with you on this very timely and challenging problem. I envision this project as a first step toward a new standard for design of wood structures in the U.S.

Sincerely yours,

A handwritten signature in black ink that reads "Tom Williamson". The signature is written in a cursive, flowing style.

Tom Williamson, P.E.
Chair, ASCE Standards Committee on Design of Engineered Wood Construction

Appendix C: Original Workshop Agenda

The 1st Invitational Workshop on Performance-Based Design of Woodframe Structures

Fort Collins, Colorado, U.S.A.

Sponsored by the Structural Engineering Institute of ASCE as part of a Special Project awarded to the Committee on the Reliability-Based Design of Wood Structures

The Next Step for ASCE 16: Performance-Based Design of Woodframe Structures

Workshop Location: Colorado State University, Engineering Building, Room B3.

AGENDA

Thursday, July 28

Approximate Time	Topic/Activity
8:30-8:45	Welcome and workshop overview <i>J. van de Lindt, Colorado State University</i>
8:45-9:15	Existing load and resistance statistics for woodframe structures <i>D. Rosowsky, Texas A&M University</i> <i>B. Ellingwood, Georgia Institute of Technology</i>
9:15-9:45	Current Status of PBSB of woodframe structures including NEESWood <i>A. Filiatrault, SUNY-Buffalo</i> <i>J. van de Lindt, Colorado State University</i> <i>D. Rosowsky, Texas A&M University</i>
9:45-10:15	Refine working session charges <i>J. van de Lindt, Colorado State University</i>
10:15-10:30	Coffee Break
10:30-12:00	Working Session A: Defining performance for woodframe structures <i>D. Rosowsky, Texas A&M University</i>
12:00-1:30	Working lunch/discussion: Planning of the "Research Needs Workshop" to be held at the 2007 Structures Congress, Long Beach, CA. <i>V. Gopu, Tulane University</i>
1:30-3:00	Working Session B: Numerical tool

	deficiencies and software availability <i>J. van de Lindt, Colorado State University</i>
3:00-3:15	Coffee Break
3:15-5:00	Working Session C: Immediate and long term research needs for success <i>K. Fridley, University of Alabama</i>
6:15-???	Fajita dinner at the van de Lindt's. Please bring your family, etc. We are located approximately 15 minutes south of campus (I will give you a map at the workshop).

Friday, July 29

8:30-9:00	Continental breakfast in meeting room
9:00-9:30	Summary of working sessions from Day 1 <i>J. van de Lindt, Colorado State University</i>
9:30-12:00	Define special project tasks, working groups, and request volunteers, etc. <i>J. van de Lindt, Colorado State University</i> <i>K. Fridley, University of Alabama</i> <i>D. Rosowsky, Texas A&M University</i>
12:00	Adjourn

Appendix D: Post-Workshop Action Items

1st Invitational Workshop on Performance-Based Design of Woodframe Structures

This short document summarizes the post-workshop action items that were discussed during the 1st Invitational Workshop on Performance-Based Design of Woodframe Structures. Thank you for volunteering for these tasks and please e-mail me if you have any questions.

Color Code:

Working Group 1

Working Group 2

Working Group 3

Working Group 4

Period of August 10 – October 1, 2005

J. van de Lindt will develop a draft of the definition for PBD, beginning with the Ellingwood and Harris definition, expanding it for woodframe and send it out to the workshop list before October 1, 2005. J. van de Lindt will also develop and submit an abstract to the 2006 WCTE for a session on PBE with speaker commitments. This session will present progress from 4 or 5 different countries in this PB-wood area including materials and manufacturing.

Group 1: A. Filiatrault, J. van de Lindt, N. Luco, C. Ni, and B. Folz will review seismic PBE literature and van de Lindt will compile the papers and send them to the workshop list by October 1.

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chun@van.forintek.ca

bryan_folz@bcit.ca

Group 2: R. Gupta and B.J. will review the non-seismic PBE literature and send it to J. van de Lindt by Sept. 29 to be included in the packets.

Rakesh.gupta@oregonstate.edu

Borjen.yeh@apawood.org

Group 3: D. Rosowsky, J. van de Lindt, and B. Ellingwood will develop a wind parallel to the FEMA 356 flowchart for PBSB and distribute it by Oct. 1 to the e-mail list.

rosowsky@tamu.edu

jwv@engr.colostate.edu

bruce.ellingwood@ce.gatech.edu

Group 4: N. Luco, S. Pryor, T. Williamson, and D. Gromala will summarize the broader impact of PBE of wood, e.g two page write up, and distribute it by October 1 to the e-mail list.

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spryor@strongtie.com

tom.williamson@apawood.com

dave.gromala@weyerhaeuser.com