SHEATHING BRACED DESIGN OF WALL STUDS

Year 1 (of 3) Report
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OVERVIEW

This report summarizes the first year of the JHU project on Sheathing Braced Design of Wall Studs. The overall goal of this research project is to provide new provisions for the AISI-COFS Standards that cover sheathing braced design of wall studs, with particular attention paid to similar and dis-similar sheathing.

Research in this first year has focused on 3 areas: (1) understanding existing design methods and available test data and putting in place a plan for development of a new design method, (2) employing computational tools to supplement understanding of the behavior of sheathed walls, and (3) developing a testing rig and executing tests on axially loaded sheathed walls. Item (1) was originally scheduled to be completed in the first year and is complete. Item (2) is ongoing, with excellent progress to date. Item (3) was originally scheduled to be complete half-way through year 1 and is approximately 1 to 3 months behind. However, sufficient progress has been made to provide confidence that the axially loaded sheathed wall tests (item 3) will be complete in the Fall and post-processed and shared by the next (Spring 2009) AISI-COFS meetings.

All of the project materials are available at a project web site maintained by the PI: www.ce.jhu.edu/bschafer/sheathedwalls.

PHASE 1 WORK PRODUCTS

A number of written work products have been developed in the first year of the project and include:

- Notes on AISI Design Methods for
  Sheathing Braced Design of Wall Studs in Compression
- Supplement on reliability when fastener is assumed missing (2a rule)
- Supplement on fastener stiffness
- Supplement on initial FE modeling of elastic buckling of walls

Notes on AISI Design Methods for Sheathing Braced Design of Wall Studs in Compression provides a comprehensive review of the 1962, 1980, and 2004 AISI design methods for wall studs in compression. The theoretical assumptions behind these methods are delineated and the advantages and disadvantages of the available approaches detailed. In addition, a comprehensive summary of the limit states for sheathing braced design of wall studs are provided. From a practical standpoint the newly developed design method is likely to be a hybrid of the existing methods. The intent is to use the fastener stiffness tests of the 1962 (Winter) tests, in the theoretical framework of the 1980 (Simaan and Peköz) method, with the simplicity of the 2004/7 Wall Stud standard (developed by LaBoube).

Supplement on reliability when fastener is assumed missing (2a rule) provides a first examination of the assumption that a single fastener should be assumed ineffective in the design method. This preliminary work shows that such an assumption can be remarkably conservative and is inconsistent with expected buckling strength, even when such a fastener is missed.

Supplement on fastener stiffness provides a compilation of all available data related to stud-sheathing or track-sheathing stiffness values; including translational and rotational stiffnesses. Such stiffness values were at the heart of the 1962 AISI Specification and are necessary for accurately predicting the behavior of sheathed walls. The importance of these stiffness (and strength) values have lead the project towards performing these tests as a part of this project. Such tests were demonstrated at the October AISI-COFS meetings and are a supplement to the original project work plan.

Supplement on initial FE modeling of elastic buckling of walls provides an initial examination of the role of fastener spacing on elastic buckling of sheathed walls. These models provide (a) a useful comparison between FE models with discrete fastener spacing and FSM models, as might be used in conventional design, with smeared/continuous fastener stiffness values, and (b) initial FE modeling that can later be used for collapse modeling, including collapse modeling with axial + bending loads to explore fastener demands and make corrections for torsional demands on fasteners, or other details unique to a sheathed wall in compression + bending.

In addition to the written work products a number of presentations, related to the research have been provided to the AISI-COFS. Including, a 30 minute presentation at the April 2008 AISI-COFS meetings on AISI design methods, and a ~1 hour presentation at the October 2008 AISI-COFS field trip covering the available written work products.

Along with the written reports and presentations a number of additional work products, primarily in the lab, have been completed in this first year:

- specimen design and initial test matrix for axially loaded sheathed walls,
- materials procurement and building of initial specimens for shakedown testing,
- testing rig for axial and axial+bending tests[1],
- testing rig for fastener stiffness tests, and
- testing rig for ancillary single column tests.

It is anticipated that the written work products will become peer-reviewed papers, Technical Notes for the CFSEI, and form the basis for AISI-COFS standards as the work progresses.

REVIEW OF SCHEDULE AND WORK PLAN

Given that one year of the project is complete it is appropriate at this time to review the proposed work plan for the project and assess progress. The original work plan is provided in Table 1, along with vertical lines denoting the current progress on the given work item.

The four areas covered in the work plan are:

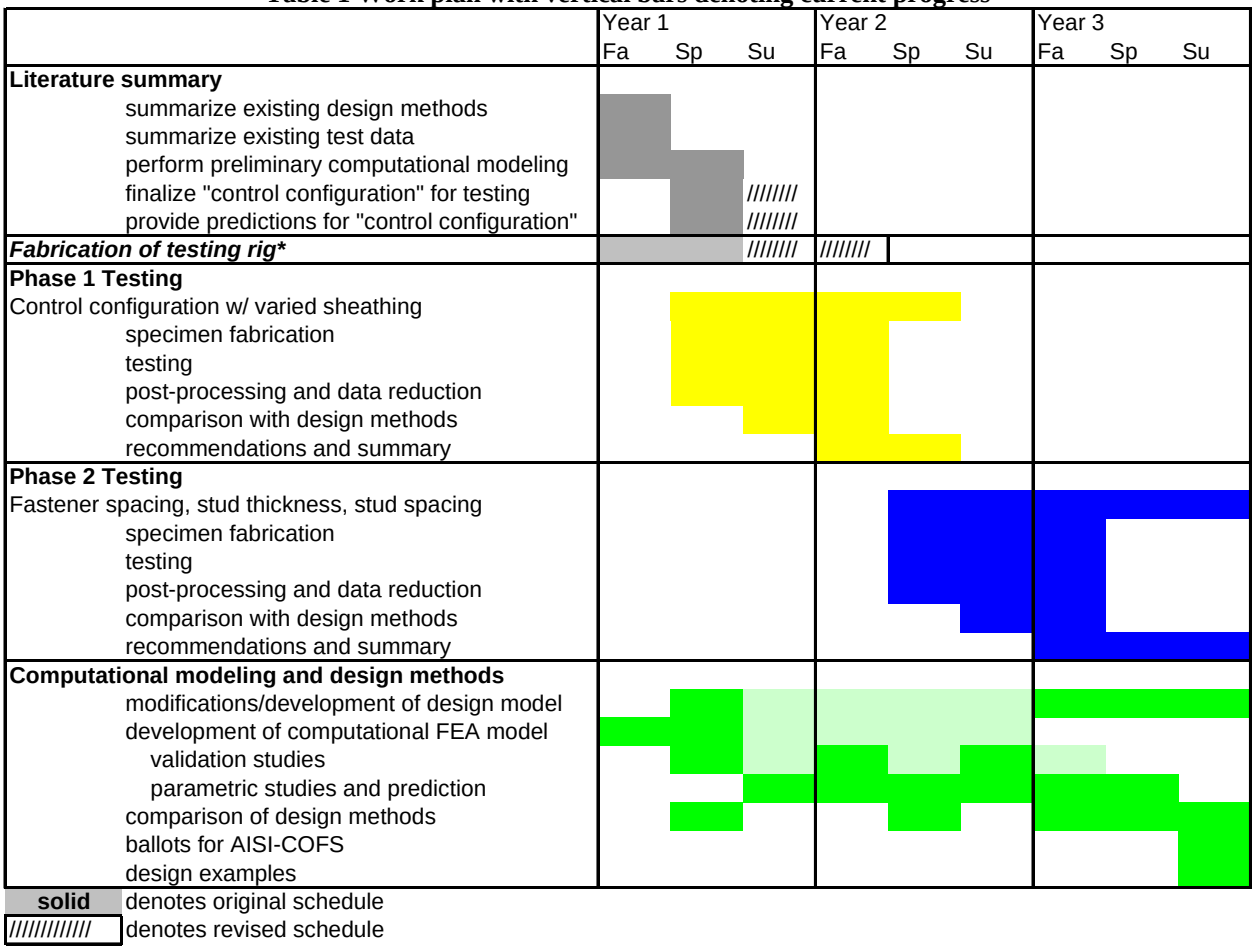
- literature Summary,
- phase 1 Testing,
- phase 2 Testing, and
- computational modeling and design methods.

As shown in Table 1, the work related to the Literature Summary is complete. The phase 1 testing was proposed to be complete in the Fall of year 2 of the project, with summary and recommendations by the Spring of year 2. Though work on the testing rig has delayed matters somewhat, the original plan remains without change. Phase 1 testing will be complete this Fall and post-processing conducted and completed in the Spring. Phase 2 testing is scheduled to begin in the Spring of year 2 (Spring 2009), and the ongoing computational modeling efforts are currently in-line with the original schedule.

The originally established work plan remains the expectation for the project. However, it is worth noting that some additional testing has been planned as part of this project. First, translational fastener stiffness and strength tests are being conducted on the fastener and sheathing details in use for the Phase 1 testing. Second, a series of ancillary single column tests are being conducted using similar fastener and sheathing details as real walls. The student performing the ancillary single column tests is funded from another project and is at no cost to this project. However, these additional tests provide another means to better understand the behavior of the sheathed walls. These additional tests will not compromise the planned schedule.

[1] As was discussed at the AISI-COFS 6 October 2008 field trip the large testing rig for this project was damaged during shakedown testing. Rehabilitation of the rig is underway, but this damage has delayed the axial load testing for at least 4-8 weeks. A retrofit/rehabilitation plan is in place and testing should be back underway later this Fall.

Table 1 Work plan with vertical bars denoting current progress



CONCLUSIONS

Year 1of the JHU project: Sheathing Braced Design of Wall Studs is complete. Progress on the project has resulted in a number of work products, including: Notes on AISI Design Methods for Sheathing Braced Design of Wall Studs in Compression, Supplement on reliability when fastener is assumed missing (2a rule), Supplement on fastener stiffness, and Supplement on initial FE modeling of elastic buckling of walls. In addition, planning, procurement, and initial specimen preparation are complete for the Phase 1 testing on axially loaded walls. Testing will be complete this Fall as originally proposed in the work plan. Additional ancillary testing is also underway which will provide needed information on fastener-sheathing-stud stiffness, strength, and overall behavior. Ongoing information including all work products and test results will continue to be provided at the project web site: www.ce.jhu.edu/bschafer/sheathedwalls.