Day 3

Good Morning

SelectSIPs Expo

A Better Way to Build

MARCH 2 - 4 / PHOENIX, ARIZONA
SIPA Annual Meeting & Conference
Phoenix, AZ
March 2-4, 2020

Technical Committee Chair: Tom Williamson, Timber Engineering, LLC

Presenters: Corey Nigh, ICC NTA and Todd Bergstrom, AFM Corporation
Administrative

- Call to Order and Welcome
- Restraint of Trade Statement
1. Recently Completed Projects  
   a) Review joint SIPA/FPL SIP research programs  
   b) Florida High Velocity Hurricane Zone (HVHZ) Testing

2. In-Process Projects  
   a) SIPA Design Guide for SIPs  
   b) Inclusion of SIPs in AWC Design Standards and the IBC  
   c) Revision of PRS 610 to add roofs

3. New Projects Ideas  
   a) LCA and EPD for SIPs  
   b) SIPA Technical Bulletins

4. Other business

5. Adjournment
Joint SIPA/FPL Research Projects

Seven Years - $600,000

- Creep testing projects
  - Phase I Pilot Study (SIPA/FPL/APA)
  - Phase II Study (SIPA/FPL)

- SIPA/FPL/APA lateral load testing
  - Phase I SIP shear wall performance
  - Phase II SIP diaphragm performance

- SIPA/FPL/HIRL shear wall testing

- SIPA/FPL shear wall testing (aspect ratio)
Creep Testing – Phase I Pilot Study

FPL: $40,000   APA: $5,000
SIPA: Test panels + technical support

Results published as
FPL Research Note FPL–RN–0332

- Study evaluated both shear critical and moment critical test specimens
- No significant strength loss (Pmax) was observed after 90 days of creep loading and 30 days of unloading
- Results led to Phase II creep study
Creep Testing – Phase II Study

Overall Test Setup

- 90-day testing of twenty-eight 12-1/4” deep specimens
- twenty-eight 6-1/2” deep specimens under creep load completed
- + 30 days with load removed
Creep Testing – Phase II Study

Key results:

• All test specimens essentially reached a stable asymptotic deflection profile after 90 days of testing like other wood products.

• Creep deflection was in the range of approximately 30% to 40% of the value of the load’s initial elastic deflection. There was significant recovery of total deflection (92-94%) when the applied load was removed, and the specimens rested for 30 days (with no load).

• A comparison of average static test results before and after creep loading showed a minimal loss of performance. The static bending strength of post-creep tested specimens as a percentage of control specimen strength was 90% for the 12-1/4” deep specimens and 101% for the 6-1/2” deep specimens.

Results Published in FPL-RP-697
SIPA/FPL/APA Lateral Load Testing Phase I - SIP Shear Wall Performance

Project co-funded by:

FPL : $50,000
APA : $10,000
SIPA : $10,000 in test panels and technical support

• Project involved cyclic testing of twenty-six 8x8 wall assemblies and monotonic testing of three 8x8 wall assemblies
• Results published in test report FPL-GTR-251 in January 2018
Background Information

• Historically SIPs have been tested for lateral load performance using ASTM E72 test procedures similar to conventional wood framed walls which allow the bottom of the wall to rotate (i.e. unrestrained)

• SIP walls typically installed with both the bottom and top of the walls restrained against movement

• APA pilot study showed a significant increase in the performance of SIP shear walls with restrained vs. unrestrained boundary conditions

• Industry wide test program needed to evaluate SIP shear walls with restrained boundary conditions to provide design professionals with representative design values
Test Variables

- Test protocol (monotonic and cyclic)
- Nail size for panel connection (8d Box vs. 8d Common)
- Nail spacing (6 inches, 4 inches, and 3 inches)
- Wall bearing type (wood vs. steel bearing)
- Spline type (block spline vs. 2-2x lumber spline)
- Number of panel joints (no joint, 1 joints, 2 joints, and 3 joints)
- SIP thickness (4-1/2 inches vs. 6-1/2 inches)
- Orientation of OSB facers (strength axis horizontal vs. vertical)
- Bottom plate washer geometry (square, large round, and small round)
Basic wall, 2 panels, 0.113-inch-diameter (8d box) nails spaced at 6 inches on center on wall perimeter.
Key Test Results

- **Test protocol (monotonic and cyclic):** Testing based on monotonic and cyclic protocols resulted in similar deflection profiles, but the ultimate load from monotonic tests was approximately 12% lower than the cyclic tests.

- **Nail size for panel connection (8d Box and 8d Common):** Data showed that there was no practical difference in the ultimate load between SIP walls constructed with these two nail sizes.

- **Nail spacing (6 inches, 4 inches, and 3 inches):** Data showed that a decrease in nail spacing from 6 to 4 inches and from 6 to 3 inches on center resulted in an ultimate load increase of 27% and 58%, respectively as expected.

- **Spline type (Block spline and 2-2x lumber spline):** Data showed that the difference in the ultimate load is insignificant (less than 5%).
Key Test Results

- **Number of panel joints (no joint, 1 joint, 2 joints, and 3 joints):** Data showed that the number of panel joints and the aspect ratio of the individual SIP segments clearly had an effect on the cyclic performance. The greater the number of joints, the higher the ductility capacity of the SIP walls.

- **SIP thickness (4-1/2 inches and 6-1/2 inches):** Data showed that the ultimate load is similar between SIP wall thicknesses of 4-1/2 and 6-1/2 inches (less than 7%).

- **Orientation of OSB facers (strength axis horizontal and vertical):** Data showed that cross-oriented (horizontally oriented) facers resulted in a marginal (approximately 10%) reduction in the ultimate load, as compared to vertically oriented OSB facers.

- **Bottom plate washer geometry (square and round):** Data showed no difference between large and standard round washers. However, the squared washers showed a 13% higher ultimate load.
• **Goal:** Establish baseline design capacities for both SIPs with and without perimeter support framing for a wide range of panel joint configurations

• Final Report published as FPL-RP-700 in May 2019
SIPA/FPL/APA Lateral Load Testing
Phase II - SIP Roof Diaphragm Performance

- Effect of longitudinal SIP joint (no joint vs. 1 joint)
- Effect of transverse SIP joint (no joint, 1 joint vs. 2 joints)
- Inclusion of framing connections (with and without connection to framing)
- SIP screw spacing (6 in. vs. 3 in. o.c.) between and within Series 1B6, 1B3, 5B6 and 5B3

FPL $50,000  APA $10,000  SIPA $10,000
Test Variables – Panel Splice Configurations for Parts A & B

Series 2
- Longitudinal SIP joint
- Dimensions: 24' x 4'

Series 3
- Longitudinal SIP joint
- Transverse SIP joint
- Dimensions: 12' x 8'

Series 4
- Longitudinal SIP joint
- Transverse SIP joint
- Dimensions: 12' x 4'

Series 5
- Longitudinal SIP joint
- Transverse SIP joint
- Dimensions: 8' x 4'
SIPA/FPL/APA Lateral Load Testing
Phase II - SIP Roof Diaphragm Performance

Test 5B-3
4x8 segments
3” oc screw spacing
Conclusions:

1. The shear strength of SIP diaphragms alone can be reasonably estimated using the single fastener lateral strength and the principle of engineering mechanics.

2. A difference between SIP diaphragms constructed with 1 segment and 2 segments could not be detected with the limited tests conducted in this study.

3. There is a positive correlation between ultimate deflection and number of SIP segments. While the difference between 1 segment and 2 segments was not discernible, a significant increase in the ultimate deflection was noted when the segment number was increased to 4 and 6.

4. There does not appear to be an apparent impact on the diaphragm shear strength with a change in the number of SIP segments.
Conclusions cont.:

5. The shear strength of SIP diaphragms connected to framing is under-predicted by 16% to 33% using the single SIP screw lateral strength and the principle of engineering mechanics for the screw spacing of 6 in. on center. However, these values are well-predicted on average for the screw spacing of 3 in. on center.

6. Increasing the number of SIP screws from a spacing of 6 inches to 3 in. o.c. resulted in a 60 percent increase in the diaphragm shear strength. It is unclear why doubling the number of SIP screws did not double the diaphragm shear strength.

7. There does not appear to be an apparent impact on the diaphragm shear strength with a change in the number of SIP segments when SIPS are connected to framing.

8. SIP stiffness diaphragms correlate to the number of SIP segments used in the diaphragm. As the number of SIP segments increases, the SIP diaphragm stiffness decreases.
SIPA/FPL/HIRL Shear Wall Testing

SIP Shear Walls:
Cyclic Performance of High Aspect Ratio Segments and Perforated Walls

USDA Forest Product Laboratory contributed $100,000

Structural Insulated Panel Association Provided all SIP test panels

HIRL conducted all testing

HIRL Report published October 1, 2013
Report 3339-10012013
SIPA/FPL Shear Wall Testing (Aspect Ratio)

FPL: $200,000      SIPA: All SIP Test Panels

• Extension of HIRL Study in 2013: *SIP Shear Walls: Cyclic Performance of High Aspect Ratio Segments and Perforated Walls*

• HIRL study demonstrated that a SIP perforated shear wall performs like a traditional perforated shear-wall but more testing needed.

• FPL staff and SIPA member representatives developed study plan to incorporate testing of 54 SIP wall assemblies
## SIPA/FPL Shear Wall Testing (Aspect Ratio)

### Test Plan

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<th>Configuration</th>
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<th>Height</th>
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<th>With Hold-downs</th>
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<td>96</td>
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</table>
SIPA/FPL Shear Wall Testing (Aspect Ratio)

8x8 wall test with hold downs

8x8 wall test with anchor bolts
Comparison of use of hold downs vs. anchor bolts only for 8x8 walls

Significant increase in unit shear strength (more than 3x) with hold downs as expected
Comparison of Test Results with and without hold downs
SIPA/FPL Shear Wall Testing
(Aspect Ratio)

Seven wall opening configurations tested to simulate real world construction situations.
SIPA/FPL Shear Wall Testing (Aspect Ratio)

8x20 wall with single opening
SIPA/FPL Shear Wall Testing (Aspect Ratio)

8x20 wall with two openings
Key Test Results - I

• Lateral load resistance of SIP walls made of a single panel with low aspect ratios (1:1 and 2:1) and SIP wall configurations made of multiple panels without openings satisfied the cyclic performance parameters of over-strength, drift, and ductility capacities.

• Equivalent to light-frame walls as defined in International Code Council Evaluation Service (ICC-ES) Acceptance Criteria AC04 and ASTM D7989.
Key Test Results – II

• SIP walls made of multiple panels with openings were compared with the SDPWS perforated shear wall design approach for various baseline configurations.

• For all baselines, the perforated shear wall design method adequately or conservatively predicted the strength and stiffness of the SIP walls.
Next Steps?

• Archive test reports in SIPA files

• Identify and complete additional testing to fill in the “blanks”

• Create series of Technical Bulletins to share with design community
Florida High Velocity Hurricane Zone (HVHZ) Approval Testing

- Four SIPA member companies joined with SIPA to gain HVHZ approval for SIPs in Florida’s Building Code (FBC).

- Florida Product Approvals issued for 6-1/2” SIPs with 7/16” OSB facers used in walls and roofs in accordance with the Florida Building Code (2019).

- Norbord completed wet & dry pull-out testing of both plywood & OSB to show fastening schedules for equivalent performance to 19/32”.

- Next steps might be to have APA or FPL conduct similar tests to confirm the Norbord data as independent 3rd-party lab?

- Data package available for purchase for interested manufacturers.
**Project Goal:** Promote/expand the use of SIPs with professional designers by developing an engineering design guide for SIPs

**Status:**
- Draft Guide reviewed by TAC Task Group
- Design Examples currently do not always compare to existing Code Reports
- Task Group suggested development of industry-minimum design values; three design examples completed so far
- Task Group suggested limiting the Design Guide to use only the industry-minimum values until further research is completed on how SIP design properties are derived consistently

**Further Research:** Develop industry-minimum values for remaining Design Examples prior to publishing Design Guide
Adoption of SIPs into AWC Design Standards and the IBC

- AWC publishes 2 ANSI consensus standards that are essentially the basis for all wood design in the U.S.
  
  (1) National Design Specification (NDS)
  
  (2) Special Design Provisions for Wind and Seismic (SDPWS)

- Both are cross-referenced in the IBC
- Both are governed and approved by the AWC Wood Design Standards Committee (WDSC)
- The WDSC consists of 57 members and very few have any experience with SIPs
Adoption of SIPs in AWC Design Standards and the IBC

- SIPA TAC chair, Tom Williamson, is a long-standing member of the WDSC
- He has submitted numerous changes to the WDSC to incorporate SIPs in the SDPWS
- All changes have been rejected by the WDSC due to
  (a) the lack of an industry consensus standard for determining design properties for SIPs and
  (b) the lack of an industry data base on the performance of SIPs as shear walls and diaphragms
- Recent SIPA/FPL research on SIP shear walls and diaphragms will help address the second issue
- But what about an industry consensus standard?
Adoption of SIPs in AWC Design Standards and the IBC

- All wood products referenced in the AWC Design Standards and the IBC are based on consensus standards for determining design properties.

<table>
<thead>
<tr>
<th>Product</th>
<th>Reference Standard</th>
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<tbody>
<tr>
<td>Lumber</td>
<td>PS20</td>
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<tr>
<td>Plywood/OSB</td>
<td>PS1/PS2</td>
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<tr>
<td>Glulam</td>
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<tr>
<td>I-Joists</td>
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<td>CLT</td>
<td>ANSI/APA PRG 320</td>
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<tr>
<td>SIPs</td>
<td>???</td>
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</table>

- SIP industry must develop a consensus standard for determining structural design properties for SIPs (ASTM or ANSI) to have any opportunity of gaining acceptance in the AWC design standards or the IBC.
Originally published as PRS 610-2013
- Standards Committed reformed in 2017
- Changes submitted to Secretariat (APA)
- Revision ballot issued
- Committee resolved all comments
- Re-published as PRS 610-2018
Revision and Update of ANSI/APA PRS 610 Needed

- Next step is to add provisions for SIPs used as roofs to develop a broad consensus standard that can be submitted to AWC and the ICC for code adoption.

- SIPA TAC Task Group formed to draft revisions.

- Task Group has prepared the initial draft but has identified numerous challenges to complete the draft such as developing Performance Requirements for Table 4 which may require research.

- Task Group meetings need to be scheduled to move this project forward and determine what research might be needed and what funding options might be available.

- Proposed changes will then be submitted to the ANSI Secretariat (APA) as the basis for reforming the ANSI Standards Committee.

- Anticipated as a 2-4 year project
The world of promoting low embodied carbon products is picking up a lot of speed both commercially and residentially.

SIPA does not have the data to make the necessary claims on the SIP carbon position.

SIPA has approached the FPL to update the industry LCA position and to develop an EPD for SIPs.

But this has met with some resistance by the FPL until an industry Product Category Rule (PCR) is created.

What is SIPA’s desire to proceed?
SIPA Technical Bulletins

- Currently have 10 Technical Bulletins on the SIPA web site
- Interest expressed by SIPA members to add new technical bulletins (Consider Best Practices’ Task Group as LEED?)
- Some topics suggested have been:
  - Moisture and wood: tar paper vs. plastic wrap
  - Summary of APA diaphragm testing
  - Summary of other SIPA/FPL test programs
  - Use of tape in SIP roof installations
  - Many more as tracked by Manufacturer’s Committee
- Members will be surveyed for input on topics and prioritization after Annual Meeting
Other Business
Adjournment – Thank you