SIPA Technical Committee Update

SIPA Annual Meeting & Conference
Jacksonville, FL
February 26-28, 2018

Technical Committee Chair: Tom Williamson, Timber Engineering, LLC
Presenter: Corey Nigh, NTA
Agenda

1) Call to Order and Welcome
2) Restraint of Trade Statement
3) Review and Approval of minutes of last TAC meeting (November 30, 2018)
4) Overview of joint FPL/SIPA test programs
5) NTA/SIPA Design Guide for SIPs
6) ASTM D07.02.08 Standard development
7) SIP changes to the 2018 IRC
8) Revision of PRS 610-2013
9) Revision of APA/SIPA SIP Product Guide
10) Mississippi State University study on lignin-based polyurethane core material for SIPs
11) Canadian SIP Research
12) Adjournment and next meeting
Call to Order and Welcome

Restraint of Trade Statement

Review and Approval of minutes of last TAC meeting (November 30, 2017)
Review of Joint FPL/SIPA Research Projects

- FPL/SIPA creep testing project
  - Phase I Pilot Study
  - Phase II Study
- FPL/SIPA lateral load testing
  - Phase I testing of SIP shear wall performance
  - Phase II testing of SIP diaphragm performance
- FPL/SIPA aspect ratio and walls with openings testing
Creep Testing – APA/FPL/SIPA Pilot Study

FPL: $40,000  
APA: $5,000  
SIPA: Test panels

Results published as  
FPL Research Note FPL–RN–0332

No significant strength loss (Pmax) was observed after 90 days of creep loading and 30 days of unloading.
Phase I Pilot Study Creep Testing Results

Specimens tested under both shear critical (APA) and moment critical loading (FPL) configurations using 3 load levels as shown:

- Low load - no blocks: 11% of Pmax
- Medium load - no blocks: 22% of Pmax
- High load - no blocks: 33% of Pmax

Recovered approximately 95% of the creep deflection after 30 days relaxation.

Results led to Phase II test program.
## Test Matrix

<table>
<thead>
<tr>
<th>Test #</th>
<th>Sample Depths</th>
<th>Sample Width(a)</th>
<th>Span(a)</th>
<th>Load Level</th>
<th># of Samples</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>6-1/2 in.</td>
<td>12 in.</td>
<td>118.5”</td>
<td>To failure</td>
<td>28</td>
<td>1 min.</td>
</tr>
<tr>
<td>1a</td>
<td>6-1/2 in.</td>
<td>12 in.</td>
<td>118.5”</td>
<td>350 lbs.</td>
<td>28</td>
<td>90 days</td>
</tr>
<tr>
<td>2</td>
<td>12-1/4 in.</td>
<td>12 in.</td>
<td>226.5”</td>
<td>To failure</td>
<td>28</td>
<td>1 min.</td>
</tr>
<tr>
<td>2a</td>
<td>12-1/4 in.</td>
<td>12 in.</td>
<td>226.5”</td>
<td>350 lbs.</td>
<td>28</td>
<td>90 days</td>
</tr>
</tbody>
</table>

FPL: $100,000  
SIPA: Test Panels
Phase II FPL/SIPA Creep Testing of SIPs
Short Term Bending Tests

Short term bending testing of twenty-eight 12-1/4” deep specimens and twenty-eight 6-1/2” deep specimens completed to determine test loads for creep testing.
Phase II FPL/SIPA Creep Testing of SIPs  
Failure Modes - Short Term Bending Tests

The static bending tests typically failed in shear at the manufactured discontinuities in the EPS web. The industry published design values for both depths and spans evaluated are controlled by shear and this supports the validity of the test data.
# Phase II FPL Creep Testing of SIPs

## Short Term Bending Tests – Control Specimens

<table>
<thead>
<tr>
<th>Pre-Creep 6-1/2”</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Quantity</strong></td>
<td>28</td>
</tr>
<tr>
<td><strong>PMax (lbf)</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Mean</strong></td>
<td>1031.8</td>
</tr>
<tr>
<td><strong>Standard Deviation</strong></td>
<td>85.9</td>
</tr>
<tr>
<td>5% PE = mean - 1.645 * std. dev.</td>
<td>890.5</td>
</tr>
<tr>
<td>5% PTL with 75% confidence = mean – 1.878 * std. dev.</td>
<td>870.5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pre-Creep 12-1/4”</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Quantity</strong></td>
<td>28</td>
</tr>
<tr>
<td><strong>Mean</strong></td>
<td>1013.6</td>
</tr>
<tr>
<td><strong>Standard Deviation</strong></td>
<td>68.2</td>
</tr>
<tr>
<td>5% PE = mean - 1.645 * std. dev.</td>
<td>901.5</td>
</tr>
<tr>
<td>5% PTL with 75% confidence = mean – 1.878 * std. dev.</td>
<td>885.6</td>
</tr>
</tbody>
</table>

**Creep Test Load = Pmax/3 ~ 350 lbs**
Phase II FPL Creep Testing of SIPs

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

CREEP DEFLECTION OVER TIME,
12-1/4” DEEP SPECIMENS

TEST TIME, DAYS
0 10 20 30 40 50 60 70 80 90

DEFLECTION, INCHES
-0.300 -0.250 -0.200 -0.150 -0.100 -0.050 0.000 0.050
Phase II FPL Creep Testing of SIPs 12-1/4” Creep Recovery Curves

DEFLECTION RECOVERY AFTER REMOVAL OF LOAD, 12-1/4" DEEP SPECIMENS

TEST TIME, DAYS

0 5 10 15 20 25 30

DEFLECTION INCHES

0 0.02 0.04 0.06 0.08 0.1 0.12 0.14 0.16

1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28
Phase II FPL Creep Testing of SIPs
6-1/2” Creep Deflection Curves
Phase II FPL Creep Testing of SIPs
6-1/2” Creep Recovery Curves
### Table 2. Results summary of SIPS testing

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Specimen Depth</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>12.25&quot;</td>
</tr>
<tr>
<td>Static failure load of control specimens (lb)</td>
<td>1013.6</td>
</tr>
<tr>
<td>Deflection of control specimens at failure (in)</td>
<td>1.251</td>
</tr>
<tr>
<td>Initial elastic deflection at start of creep test (in)</td>
<td>-0.469</td>
</tr>
<tr>
<td>Additional deflection due to creep behavior (in)</td>
<td>-0.190</td>
</tr>
<tr>
<td>Total deflection (in)</td>
<td>-0.659</td>
</tr>
<tr>
<td>Initial elastic recovery at removal of long-term load</td>
<td>0.439</td>
</tr>
<tr>
<td>Additional recovery due to creep behavior (in)</td>
<td>0.094</td>
</tr>
<tr>
<td>Total deflection recovered (in)</td>
<td>0.533</td>
</tr>
</tbody>
</table>
### Table 3. Average test results as a comparison of deflection states

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Specimen Depth</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>12.25&quot;</td>
</tr>
<tr>
<td>Creep deflection, as a percentage of initial elastic deflection</td>
<td>40%</td>
</tr>
<tr>
<td>Creep deflection, as a percentage of failure deflection</td>
<td>15%</td>
</tr>
<tr>
<td>30-day creep deflection recovery, as a percentage of 90-day creep deflection</td>
<td>50%</td>
</tr>
<tr>
<td>Total deflection recovery, as a percentage of total creep test deflection</td>
<td>81%</td>
</tr>
<tr>
<td>Static bending strength of post-creep tested specimens as a percentage of control specimen strength</td>
<td>90%</td>
</tr>
<tr>
<td>Static deflection of post-creep tested specimens as a percentage of control specimen deflection</td>
<td>84%</td>
</tr>
</tbody>
</table>
Creep behavior for structural insulated panels (SIP) under flexural loading with respect to time was modeled by Taylor, et al. (1997 ASCE Journal of Structural Engineering)

Taylor examined four distinct models for creep behavior: a three, four, and five element visco-elastic model, and a power model.

$$\Delta(t) = \Delta_0 + A_1 t^{(A_2)}$$
Modeling of Creep Behavior of SIPS

Solid line is test data from 12-1/4” deep specimen
Dotted line is power model

Final report in process – to be published 1st quarter of 2018
SIPA/FPL/APA test program on effects of boundary conditions on SIP shear wall performance

Project co-funded by:
- FPL: $40,000
- APA: $8,000
- SIPA: $5,000 in test panels

Cyclic testing of twenty-six 8x8 wall assemblies and monotonic testing of three 8x8 wall assemblies completed in July, 2016

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Gage A: Measure the horizontal movement of the inserted top plate (not the facing) of the SIP
Gage B: Measure the sliding movement of the inserted bottom plate (not the facing) of the SIP
Gage C: Measure the downward movement of the end stud (not the facing) of the SIP
Gage D: Measure the upward movement of the end stud (not the facing) of the SIP
SIPA/ FPL/APA test program on effects of boundary conditions on SIP shear wall performance

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)
SIPA/ FPL/APA test program on effects of boundary conditions on SIP shear wall performance

<table>
<thead>
<tr>
<th>Test Series</th>
<th>Purpose (Compared to Basic Wall)</th>
<th>Test Assembly Size</th>
<th>Test Protocol</th>
<th>Replicates</th>
<th>SIP Segment</th>
<th>Deviation from Basic Wall</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Effect of test protocol</td>
<td>8’ x 8’</td>
<td>ASTM E72</td>
<td>3</td>
<td>4’ x 8’</td>
<td>Monotonic test protocol</td>
</tr>
<tr>
<td>2</td>
<td>Basic wall</td>
<td></td>
<td></td>
<td>3</td>
<td></td>
<td>Basic wall configuration</td>
</tr>
<tr>
<td>3</td>
<td>Effect of nail size</td>
<td></td>
<td></td>
<td>2</td>
<td></td>
<td>8d Common (0.131” X 2-1/2”)</td>
</tr>
<tr>
<td>4a</td>
<td>Effect of nail spacing</td>
<td></td>
<td></td>
<td>2</td>
<td></td>
<td>3” nail spacing</td>
</tr>
<tr>
<td>4b</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td></td>
<td>4” nail spacing</td>
</tr>
<tr>
<td>5</td>
<td>Effect of spline nailing</td>
<td>8’ x 8’</td>
<td>ASTM E2126</td>
<td>2</td>
<td></td>
<td>Modified basic wall</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(Method 3, CUREE)</td>
<td></td>
<td></td>
<td>configuration (12” nail spacing at spline)</td>
</tr>
<tr>
<td>6</td>
<td>Effect of spline type</td>
<td></td>
<td></td>
<td>2</td>
<td></td>
<td>(2) 2x Lumber spline</td>
</tr>
<tr>
<td>7a</td>
<td>Effect of number of panel joints</td>
<td></td>
<td></td>
<td>2</td>
<td>8’ x 8’</td>
<td>1 SIP segment (no panel joints)</td>
</tr>
<tr>
<td>7b</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>32” x 8’</td>
<td>3 SIP segments (2 panel joints)</td>
</tr>
<tr>
<td>7c</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>24” x 8’</td>
<td>4 SIP segments (3 panel joints)</td>
</tr>
<tr>
<td>8</td>
<td>Effect of SIP thickness</td>
<td></td>
<td></td>
<td>2</td>
<td>4’ x 8’</td>
<td>6-1/2” SIP thickness</td>
</tr>
<tr>
<td>9</td>
<td>Effect of sheathing orientation</td>
<td></td>
<td></td>
<td>2</td>
<td></td>
<td>Modified basic wall</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>configuration with horizontal sheathing</td>
</tr>
</tbody>
</table>

Total number of tests 26

*Monotonic Test to be conducted using ASTM E72 and ASTM E564*
Basic wall, 2 panels, 0.113-inch-diameter (8d box) nails spaced at 6 inches on center on wall perimeter.
Wall fabricated with four SIP pieces, 24 inches wide per piece. Perimeter nails of 0.113-inch-diameter nails spaced at 6 inches on center.
Example Cyclic Data

Backbone curves comparing 8d Box nails (Wall 2a) with 8d Common nails (Wall 3a).
SIPA/ FPL/APA test program on effects of boundary conditions on SIP shear wall performance

Test Results

- **Test protocol (monotonic and cyclic):** Testing based on ASTM E72 and ASTM E2126 resulted in similar ultimate loads. Testing based on ASTM E564 and ASTM E2126 resulted in similar deflection profiles, but the ultimate load from monotonic (ASTM E564) tests was approximately 12% lower than the cyclic (ASTM E2126) tests. There is not enough evidence to conclude that ASTM E564 will result in a significantly lower ultimate load than the other test methods.

- **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.
Test Results

- **Wall bearing type (wood and rigid steel bearing):** Data showed that when SIPs bear on steel, as compared to SPF bottom plates, the ultimate load was reduced by approximately 15%. However, the effect of bearing plate types on cyclic performance parameters was not significant.

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

- **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 more number of joints, the higher the ductility capacity of the SIP walls. As compared to 1 panel joint, zero joint resulted in an increase of around 10% in ultimate load, while 2 and 3 joints resulted in a reduction of ultimate load of 11% and 17% respectively.
SIPA/ FPL/APA test program on effects of boundary conditions on SIP shear wall performance

Test Results

• **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. However, since the failure modes were often associated with the top plate, but virtually never associated with the bottom plate, the difference in the ultimate load between squared and round washers is recommended to be further studied.
SIPA/ FPL/APA test program on effects of boundary conditions on SIP shear wall performance

Test Report  FPL-GTR-251 published January 2018
SIP Shear Walls: Cyclic Performance of High Aspect Ratio Segments and Perforated Walls

Forest Product Laboratory Forest Service U.S. Department of Agriculture $100,000

Structural Insulated Panel Association
Provided all SIP test panels

HIRL Report published October 1, 2013
Report 3339-10012013
1. The measured unit shear capacity for fully-anchored SIP shear wall segments ranged from 1,400 lb/ft to over 2,100 lb/ft depending on the segment’s aspect ratio.

2. The unit shear wall capacity and stiffness of SIP shear wall segments decreased with an increased number of panels jointed with a spline connection. A 25 percent decrease in unit shear was observed for a 20-foot wall with four spline joints compared to an 8-foot wall with one spline joint.

3. The unit shear wall capacity of SIP shear wall segments decreases with an increased segment’s aspect ratio with a 16 percent decrease for a 2-foot segment as compared to a 4-foot segment.

4. The test results indicated that perforated SIP shear walls closely follow the overall PSW method trend for both strength and stiffness and led to joint SIPA/FPL follow-up study.
FPL/SIPA Aspect Ratio and Walls with Opening Testing

- 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

- Testing completed in June 2017

- FPL: $200,000      SIPA: All SIP Test Panels
## FPL/SIPA Aspect Ratio and Walls with Opening Testing

### Summary of Structural Insulated Panel Lateral Wall Tests

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item Description</th>
<th>No of Tests</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Aspect Ratio Tests With Anchor Bolts Only</strong></td>
<td></td>
</tr>
<tr>
<td>SP128A</td>
<td>2 by 8 SIP Panel Wall Test - Anchor Bolts Only</td>
<td>3</td>
</tr>
<tr>
<td>SP138A</td>
<td>2½ by 8 SIP Panel Wall Test - Anchor Bolts Only</td>
<td>3</td>
</tr>
<tr>
<td>SP148A</td>
<td>4 by 8 SIP Panel Wall Test - Anchor Bolts Only</td>
<td>3</td>
</tr>
<tr>
<td>SP188A</td>
<td>8 by 8 SIP Panel Wall Test - Anchor Bolts Only</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td><strong>Aspect Ratio Tests With Hold Downs</strong></td>
<td></td>
</tr>
<tr>
<td>SP128H</td>
<td>2 by 8 SIP Panel Wall Test - Hold downs</td>
<td>3</td>
</tr>
<tr>
<td>SP138H</td>
<td>2½ by 8 SIP Panel Wall Test - Hold downs</td>
<td>3</td>
</tr>
<tr>
<td>SP148H</td>
<td>4 by 8 SIP Panel Wall Test - Hold downs</td>
<td>3</td>
</tr>
<tr>
<td>SP188H</td>
<td>8 by 8 SIP Panel Wall Test - Hold downs</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td><strong>Multiple SIP Panel Wall Tests Without Openings</strong></td>
<td></td>
</tr>
<tr>
<td>SP248A</td>
<td>8 by 8 SIP Wall constructed with 2 - 4 by 8 Panels (Anchored)</td>
<td>3</td>
</tr>
<tr>
<td>SP348A</td>
<td>8 by 12 SIP Wall constructed with 3 - 4 by 8 Panels (Anchored)</td>
<td>3</td>
</tr>
<tr>
<td>SP548A</td>
<td>8 by 20 SIP Wall constructed with 2 - 4 by 8 Panels (Anchored)</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td><strong>Multiple SIP Panel Wall Tests With Various Openings Sizes</strong></td>
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</tr>
<tr>
<td>SP5201</td>
<td>8 by 20 SIP Wall with openings - Configuration 1</td>
<td>3</td>
</tr>
<tr>
<td>SP5202</td>
<td>8 by 20 SIP Wall with openings - Configuration 2</td>
<td>3</td>
</tr>
<tr>
<td>SP5203</td>
<td>8 by 20 SIP Wall with openings - Configuration 3</td>
<td>3</td>
</tr>
<tr>
<td>SP5204</td>
<td>8 by 20 SIP Wall with openings - Configuration 4</td>
<td>3</td>
</tr>
<tr>
<td>SP5205</td>
<td>8 by 20 SIP Wall with openings - Configuration 5</td>
<td>3</td>
</tr>
<tr>
<td>SP5206</td>
<td>8 by 20 SIP Wall with openings - Configuration 6</td>
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</tr>
<tr>
<td>SP5207</td>
<td>8 by 20 SIP Wall with openings - Configuration 7</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td><strong>Maximum Number of Lateral Shear Wall Tests:</strong></td>
<td>54</td>
</tr>
</tbody>
</table>
# FPL/SIPA Aspect Ratio Testing

<table>
<thead>
<tr>
<th>Configuration</th>
<th>Aspect Ratio</th>
<th>Width</th>
<th>Height</th>
<th>Anchor Bolts Only</th>
<th>Anchors and Holddowns</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1:1</td>
<td>96</td>
<td>96</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>2:1</td>
<td>48</td>
<td>96</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>3:1</td>
<td>32</td>
<td>96</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>4:1</td>
<td>24</td>
<td>96</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>
FPL/SIPA Aspect Ratio Testing

General Notes:
- Wall Heights: 8'
- Wall Thickness: 6 1/2 in.
- 8d box nails (0.113-in by 2 1/4 in.)
- All framing No. 2 or better SPF
  - 2 - 2 by 6 End Studs
  - 2 by 6 Top and Bottom Plates
  - 2 by 8 Cap Plate (Trimmed)
  - 2 by 8 Sill Plate (Trimmed)
- 1/4" diameter anchor bolts with round washers attached only to sill plate
- 8d common nail (0.131-in by 2 1/2 in.) fasten sill and bottom plate
- Simpson strong-tie hold downs sized for test

Detail of SIP Wall Test Fabrication
FPL/SIPA Aspect Ratio Testing

General Notes:
- Wall Heights: 8'
- Wall Thickness: 6 1/2 in.
- 8d box nails (0.113-in by 2 1/2 in.)
- All framing No. 2 or better SPF
  - 2 - 2 by 6 End Studs
  - 2 by 6 Top and Bottom Plates
  - 2 by 8 Cap Plate (Trimmed)
  - 2 by 8 Sill Plate (Trimmed)
- 1/2"diameter anchor bolts with round washers attached only to sill plate
- 8d common nail (0.131-in by 2 1/2 in) fasten sill and bottom plate
- Simpson strong-tie hold downs sized for test
FPL/SIPA Aspect Ratio Testing

8x8 wall test with hold downs

8x8 wall test with anchor bolts
# FPL/SIPA Aspect Ratio Testing

<table>
<thead>
<tr>
<th>Panel Width</th>
<th>Replicate No.</th>
<th>Peak Deformation (in)</th>
<th>Peak Load (lbf)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Positive</td>
<td>Negative</td>
</tr>
<tr>
<td>24</td>
<td>01</td>
<td>5.50</td>
<td>5.53</td>
</tr>
<tr>
<td></td>
<td>02</td>
<td>5.56</td>
<td>6.16</td>
</tr>
<tr>
<td></td>
<td>03</td>
<td>5.92</td>
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<td><strong>2.96</strong></td>
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<td><strong>1.89</strong></td>
<td><strong>1.97</strong></td>
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FPL/SIPA Aspect Ratio Testing

Comparison of APA and FPL tests for 8x8 walls

Diagram showing the relationship between applied load and displacement (in.) for different tests.
FPL/SIPA Aspect Ratio Testing

Comparison of use of hold downs vs. anchor bolts only for 8x8 walls
FPL/SIPA Walls with Openings Testing

General Notes:
- Wall Heights: 8'
- Wall Thickness: 6\frac{1}{2} in.
- 1\# box nails (0.133-in by 2 1/2 in.)
- All framing No. 2 or better SPF
  - 2 - 2 by 8 End Studs
  - 2 by 6 Top and Bottom Plates
  - 2 by 8 Cap Plate (Trimmed)
  - 2 by 8 Sill Plate (Trimmed)
- 3/16\# diameter anchor bolts with round washers attached only to sill plate
- 1\# common nail (0.133-in by 2 1/2 in) fastens sill and bottom plate
- Simpson strong-tie hold downs sized for test
- Box spline with 1\# box nails at 6 in. oc

5 - 4 by 8 SIP Blocked Spline Wall Test

Detail of SIP Wall Block Spline

Detail of SIP Wall Test Fabrication
FPL/SIPA Walls with Openings Testing

5 - 4 by 8 SIP Multiple Opening Shear Wall Test - Configuration 1

5 - 4 by 8 SIP Multiple Opening Shear Wall Test - Configuration 2

Framing Detail Above Opening
FPL/SIPA Walls with Openings Testing

8x20 wall with five 4x8 panels
FPL/SIPA Walls with Openings Testing

8x20 wall with single opening
FPL/SIPA Walls with Openings Testing

8x20 wall with two openings
Current Status

All testing completed in 2017
Initial aspect ratio testing results reported
Preliminary analysis of walls with openings testing underway
Final report anticipated in 3rd quarter of 2018
SIPA/FPL/APA test program on SIP diaphragm performance

12 full-size SIP diaphragms of various configurations that will cover a range of variables as follows:

1. Effect of longitudinal SIP joint (no joint vs. 1 joint)
2. Effect of transverse SIP joint (no joint, 1 joint vs. 2 joints)
3. Inclusion of framing connections (with and without SIP screws)
4. SIP screw spacing (6” o.c. vs. 3” o.c.) between and within Series 1A and 5A

FPL $40,000   APA $8,000   SIPA $8,000
SIPA/ FPL/APA test program on SIP diaphragm performance

Test Variables

Part I: SIP diaphragms without framing

Objective: The purpose of this part is to evaluate the SIP diaphragm capacities without SIP screw connections to framing.

• Commonality for all test series in Part I:

  • Assembly size: 8’ x 24’
  • SIP thickness: 8-1/4”
  • Fastener spacing to SIP plates: 8d cooler (2-5/16” x 0.113”) nails at 6” o.c.
  • Test protocol: ASTM E455 (Monotonic)
Test Variables

Part I: SIP diaphragms without framing

Series 1 (Base configuration)

1) SIP segment size: 8’ x 24’
2) Spline type: None
3) Number of tests: 1
SIPA/ FPL/APA test program on SIP diaphragm performance

Test Variables

Part I: SIP diaphragms without framing
SIPA/ FPL/APA test program on SIP diaphragm performance

Test Variables

Part II: SIP diaphragms with framing

Objective: The purpose of this part is to evaluate the SIP diaphragm capacities with framing and framing screws.

Commonality for all test series in Part II

1. Assembly size: 8’ x 24’
2. SIP thickness: 8-1/4”
3. Fastener spacing to SIP plates: 8d cooler (2-5/16” x 0.113”) nails at 6” o.c.
4. Framing materials: 4x6 No. 2 or Better SPF
5. SIP screws: 3” o.c and 6” o.c.
6. Test protocol: ASTM E455 (Monotonic)
SIPA/ FPL/APA test program on SIP diaphragm performance

Test Variables

Part II: SIP diaphragms with framing

Series 1A (Base configuration)

• SIP segment size: 8’ x 24’
• Spline type: None
• SIP screws: 6” o.c. and 3” o.c. (1 test each)
• Number of tests: 2
Test Variables

Part I: SIP diaphragms with framing

Series 2A

Series 3A

Series 4A
SIPA/ FPL/APA test program on SIP diaphragm performance

Part II: SIP diaphragms with framing

Series 5A

- SIP segment size: 4’ x 8’
- Spline type: Block spline for SIP joints
- SIP screws: 6” o.c. and 3” o.c.
- Number of tests: 2
Test 5A-3
4x8 segments
3” oc screw spacing
Test 5A-3
4x8 segments
3” oc screw spacing
Ultimate load 3347
# SIPA/ FPL/APA test program on SIP diaphragm performance

<table>
<thead>
<tr>
<th>Test Series</th>
<th>Purpose (Compared to Basic Wall)</th>
<th>Test Assembly Size</th>
<th>No. of tests</th>
<th>SIP Segment</th>
<th>Deviation from Basic Diaphragm</th>
<th>N</th>
<th>Size</th>
<th>Spline</th>
<th>Ultimate Load (plf)</th>
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<td>8' x 24'</td>
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<td>8' x 12'</td>
<td>2 SIP segments</td>
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<td>8' block</td>
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<td>8' x 24'</td>
<td>1</td>
<td>4' x 12'</td>
<td>4 SIP segments</td>
<td>4</td>
<td>8-1/4&quot; x 4' x 12'</td>
<td>24' + 8' block</td>
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<td>8-1/4&quot; x 4' x 8'</td>
<td>24' + (2) 8' block</td>
<td>3,347</td>
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</table>

**Preliminary results: February 2, 2018**
SIPA/ FPL/APA test program on SIP diaphragm performance

Part 1 Base diaphragm tests:
Low value of 1186 using 8x24 segment with no joints
High value of 1362 using 4x8 segments with longitudinal and vertical joints
Average of 1242 with a COV of 8.4%

Part 2 Diaphragm tests with SIP screws attached to test frame:
8x24 diaphragm with no joints
6” oc screw spacing 2332
3” oc screw spacing 3740 60% increase
8x24 diaphragm with 4x8 segments with longitudinal and vertical joints
6” oc screw spacing 2094
3” oc screw spacing 3347 60% increase
SIPA/ FPL/APA test program
on SIP diaphragm performance

Preliminary results: February 2, 2018
NTA/SIPA Design Guide for SIPs

- Design Guide development on schedule with NTA
- TAC Task Group review of Design Guide drafts completed
- Members of TAC invited to provide input to Design Guide
- TAC Task Group review of example software calculations underway
ASTM Standard on Structural Insulated Panels

- Draft document in process at ASTM D07.02.08 Section Committee level
- Standard development delayed due to other pressing industry activities
- After Section Committee level approval the standard will be balloted at the ASTM D07.02 Subcommittee level
APA submitted numerous changes to the SIP section of the 2018 IRC based on conformance with the ANSI PRS 610-2013 standard.

Changes reviewed and approved by SIPA TAC

All changes were approved and are included in the 2018 IRC
Revision and Update of ANSI PRS 610-2013

- Standards Committed reformed in 2017
- Changes submitted to Secretariat (APA)
- 1st Revision ballot issued in November 2017
- Committee resolving comments
- Goal is to have revised version ready for publication in 1st quarter of 2018
- Possible next step is to add roofs and floors
Revision and Update of APA/SIPA SIP Product Guide

- Last printed in 2007
- Changes developed by SIPA staff working with TAC Task Group
- Changes submitted to APA for review in January 2018
- Goal is to have revised version ready for publication in 1st quarter of 2018
Mississippi State University study on lignin-based polyurethane core material for SIPs.

- Submitted to the USDA as a research proposal for funding of $250,000 under the 2016 *Wood Innovations Funding Opportunity*.
- Project approved and work program initiated by MSU researchers in 2017.
- SIPA provided a letter of support for this research in the form of providing necessary SIP panels for testing and in-kind technical support.
Canadian SIP Research

- Research being conducted by NRA CAN
- Emphasis is on the study of the durability/longevity of SIP construction
- Also conducting static load tests of various SIP facers and foam cores
  

- Canadian researchers agreeable to meeting with FPL staff and SIPA representatives to share research information but no time table set
Next meeting and Adjournment