SIPA Annual Meeting & Conference
Phoenix, AZ
March 4-6, 2019

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

Call to Order and Welcome

Restraint of Trade Statement

Review and Approval of minutes of last TAC meeting (December 18, 2018)
Technical Agenda

1) Overview of joint FPL/SIPA test programs
2) NTA/SIPA Design Guide for SIPs
3) ASTM D07.02.08 Standard development
4) Revision of PRS 610-2013
5) Revision of APA/SIPA SIP Product Guide
6) Mississippi State University study on lignin-based polyurethane core material for SIPs
7) Canadian SIP Research
8) Florida High Velocity Hurricane Zone (HVHZ) Testing
9) SIPA Technical Bulletins
10) Ongoing Technical Support
11) Other business
12) Adjournment and next meeting
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 \((P_{\text{max}})\) was observed after 90 days of creep loading and 30 days of unloading.
# Phase II - Joint FPL/SIPA Creep Testing of SIPs

## 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
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.
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>Quantity</td>
<td>28</td>
</tr>
<tr>
<td>PMax (lbf)</td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>1031.8</td>
</tr>
<tr>
<td>Standard Deviation</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>Quantity</td>
<td>28</td>
</tr>
<tr>
<td>Mean</td>
<td>1013.6</td>
</tr>
<tr>
<td>Standard Deviation</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
Phase II FPL Creep Testing of SIPs 12-1/4” Creep Recovery Curves

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

DEFLECTION INCHES

TEST TIME, DAYS

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

CREEP DEFLECTION OVER TIME,
6-1/2" DEEP SPECIMENS

TEST TIME, DAYS
DEFLECTION, INCHES
Phase II FPL Creep Testing of SIPs
6-1/2” Creep Recovery Curves

DEFLECTION RECOVERY AFTER REMOVAL OF LOAD,
6-1/2" DEEP SPECIMENS

DEFLECTION, INCHES

TEST TIME, DAYS

SIPA Structural Insulated Panel Association
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 (82%–90%) when the applied load was removed and the specimens were allowed to rest for 30 days (with no load), implying that the creep behavior was at least partially elastic.

A comparison of average static test results before and after creep loading shows that the creep loading resulted in a loss of strength in the 12.25-in.-deep panels of 10% with a 16% lower deflection at failure. For the 6.5-in.-deep panels, creep loading resulted in a 3% increase in strength values and a 12% increase in deflection at failure.
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
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 Test Setup

Load Head
>10 x SDS Screws evenly spaced

4x Block Spline (provided)

6" o.c. nail spacing
(3/8" from edge)
Both Sides
8d Box nails

6" o.c. nail spacing
(3/8" from edge)
Both Sides
8d Box nails

1/8" gap between panels

2x6 Treated SPF (or equiv.) Sill Plate (No.2 or Better)

3/4" Bolt bore 1" deep hole in foam

2x6 Untreated SPF Cap Plate
(No.2 or Better)

6" o.c. nail spacing
(3/8" from edge)
Both Sides
8d Box nails

6" o.c. nail spacing
(3/8" from edge)
Both Sides
8d Box nails

Two 2x4 end-post
12 x SDS Screws
~6.5" spacing staggered in both directions

HDQ-8 Hold-down
12 x SDS Screws evenly spaced

3/4" Bolt
Basic wall, 2 panels, 0.113-inch-diameter (8d box) nails spaced at 6 inches on center on wall perimeter.
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
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

• FPL: $200,000  SIPA: All SIP Test Panels
# 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><strong>Aspect Ratio Tests With Anchor Bolts Only</strong></td>
<td></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>2 ½ 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><strong>Aspect Ratio Tests With Hold Downs</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SP128H</td>
<td>2 by 8 SIP Panel Wall Test - Holddowns</td>
<td>3</td>
</tr>
<tr>
<td>SP138H</td>
<td>2 ½ by 8 SIP Panel Wall Test - Holddowns</td>
<td>3</td>
</tr>
<tr>
<td>SP148H</td>
<td>4 by 8 SIP Panel Wall Test - Holddowns</td>
<td>3</td>
</tr>
<tr>
<td>SP188H</td>
<td>8 by 8 SIP Panel Wall Test - Holddowns</td>
<td>3</td>
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<tr>
<td><strong>Multiple SIP Panel Wall Tests Without Openings</strong></td>
<td></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>
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<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><strong>Multiple SIP Panel Wall Tests With Various Openings Sizes</strong></td>
<td></td>
<td></td>
</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 2</td>
<td>3</td>
</tr>
<tr>
<td>SP5204</td>
<td>8 by 20 SIP Wall with openings - Configuration 4</td>
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<tr>
<td>SP5205</td>
<td>8 by 20 SIP Wall with openings - Configuration 5</td>
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<td>SP5206</td>
<td>8 by 20 SIP Wall with openings - Configuration 6</td>
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<td>SP5207</td>
<td>8 by 20 SIP Wall with openings - Configuration 7</td>
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**Maximum Number of Lateral Shear Wall Tests:** 54
## 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>
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<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>
General Notes:
- Wall Heights: 8'
- Wall Thickness: 6 1/2 in.
- 8d box nails (0.113-in by 2 3/4 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 Stile 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

General Notes:
- Wall Heights: 8'0"
- Wall Thickness: 6 ½ in.
- 8d box nails (0.113-in by 2 ½ in.)
- All framing No. 2 or better SPF
  - 2 by 6 End Studs
  - 2 by 6 Top and Bottom Plates
  - 2 by 8 Cap Plate (Trimmed)
  - 2 by 8 Sill Plate (Trimmed)
- ⅝" diameter anchor bolts with round washers attached only to sill plate
- 8d common nail (0.131-in by 2 ½ in) fasten sill and bottom plate
- Simpson strong-tie hold downs sized for test

4 by 8 SIP Wall Test

8 by 8 SIP Wall Test

Detail of SIP Wall Test Fabrication
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>
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<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>
<td>5.96</td>
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<tr>
<td>Average:</td>
<td></td>
<td>5.66</td>
<td>5.88</td>
</tr>
<tr>
<td>32</td>
<td>01</td>
<td>3.62</td>
<td>4.14</td>
</tr>
<tr>
<td></td>
<td>02</td>
<td>5.67</td>
<td>4.65</td>
</tr>
<tr>
<td></td>
<td>03</td>
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<td></td>
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<tr>
<td>Average:</td>
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<td></td>
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<tr>
<td>48</td>
<td>01</td>
<td>2.79</td>
<td>2.74</td>
</tr>
<tr>
<td></td>
<td>02</td>
<td>3.62</td>
<td>2.61</td>
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<tr>
<td></td>
<td>03</td>
<td>2.76</td>
<td>3.55</td>
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<tr>
<td>Average:</td>
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<td>3.06</td>
<td>2.96</td>
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<tr>
<td>96</td>
<td>01</td>
<td>1.57</td>
<td>1.05</td>
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<tr>
<td></td>
<td>02</td>
<td>2.11</td>
<td>2.15</td>
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<tr>
<td></td>
<td>03</td>
<td>2.00</td>
<td>2.72</td>
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<tr>
<td>Average:</td>
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<td>1.89</td>
<td>1.97</td>
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</table>
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 1/2 in.
- 8d box nails (0.113-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 Nailing Plate (Trimmed)
- 1" 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
- Box spline with 8d box nails at 6-in. oc

5 - 4 by 8 SIP Blocked Spline Wall Test

Detail of SIP Wall Block Spline
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

General Notes:
- Wall Heights: 8'
- Wall Thickness: 6 3/4 in.
- 8d box nails (0.113-in by 2 3/4 in)
- All Framing No. 2 or better SPF
  - 2 by 2 by 6 End Studs
  - 2 by 6 Top and Bottom Plates
  - 2 by 6 Cap Plate (trimmed)
  - 2 by 6 Stiff Plate (trimmed)
- 1/4 inch anchor bolts with round washers attached only to sill plate
- 8d common nails (0.130-in by 2 1/2 in) fasten sill and bottom plate
- Simpson strong tie hold downs sized for test
- Box spline with 8d box nails at 6-in. oc

Framing Detail Above Opening

Structural Insulated Panel Association
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 by the FPL
- Initial aspect ratio testing results reported
- Preliminary analysis of walls with openings underway but completion delayed due to a number of unanticipated circumstances
- Final report anticipated in 3rd quarter of 2019
SIPA/FPL/APA test program on SIP diaphragm performance

FPL $40,000  APA $8,000  SIPA $8,000

• 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
## SIPA/FPL/APA Diaphragm Performance Testing

### Test Matrix

<table>
<thead>
<tr>
<th>Test series</th>
<th>Purpose (Compared to basic wall)</th>
<th>Test assembly size (ft)</th>
<th>No. of tests</th>
<th>SIP segment (ft)</th>
<th>Deviation from basic diaphragm</th>
</tr>
</thead>
<tbody>
<tr>
<td>1A</td>
<td>Basic diaphragm for Part A</td>
<td>8 by 24</td>
<td>1</td>
<td>8 by 24</td>
<td>Basic configuration</td>
</tr>
<tr>
<td>2A</td>
<td>Effect of longitudinal joint</td>
<td></td>
<td>1</td>
<td>4 by 24</td>
<td>2 SIP segments</td>
</tr>
<tr>
<td>3A</td>
<td>Effect of transverse joint</td>
<td></td>
<td>1</td>
<td>8 by 12</td>
<td>2 SIP segments</td>
</tr>
<tr>
<td>4A</td>
<td>Effect of longitudinal and transverse joints</td>
<td>8 by 24</td>
<td>1</td>
<td>4 by 12</td>
<td>4 SIP segments</td>
</tr>
<tr>
<td>5A</td>
<td></td>
<td></td>
<td>1</td>
<td>4 by 8</td>
<td>6 SIP segments</td>
</tr>
<tr>
<td>1B6</td>
<td>Basic diaphragm for Part B</td>
<td>8 by 24</td>
<td>1</td>
<td>8 by 24</td>
<td>Basic configuration with 6 in. o.c. SIP screw spacing</td>
</tr>
<tr>
<td>1B3</td>
<td></td>
<td></td>
<td>1</td>
<td>8 by 24</td>
<td>Basic configuration with 3 in. o.c. SIP screw spacing</td>
</tr>
<tr>
<td>2B6</td>
<td>Effect of longitudinal joint</td>
<td></td>
<td>1</td>
<td>4 by 24</td>
<td>2 SIP segments with 6 in. o.c. SIP screw spacing</td>
</tr>
<tr>
<td>3B6</td>
<td>Effect of transverse joint</td>
<td></td>
<td>1</td>
<td>8 by 12</td>
<td>2 SIP segments with 6 in. o.c. SIP screw spacing</td>
</tr>
<tr>
<td>4B6</td>
<td></td>
<td></td>
<td>1</td>
<td>4 by 12</td>
<td>4 SIP segments with 6 in. o.c. SIP screw spacing</td>
</tr>
<tr>
<td>5B6</td>
<td>Effect of longitudinal, transverse joints, and SIP screw spacing</td>
<td></td>
<td>1</td>
<td>4 by 8</td>
<td>6 SIP segments with 6 in. o.c. SIP screw spacing</td>
</tr>
<tr>
<td>5B3</td>
<td></td>
<td></td>
<td>1</td>
<td>4 by 8</td>
<td>6 SIP segments with 3 in. o.c. SIP screw spacing</td>
</tr>
</tbody>
</table>

**Total number of full-scale diaphragms**: 12
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 A: 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 A: SIP diaphragms without framing

Series 2
- Longitudinal SIP joint
- 24'

Series 3
- Transverse SIP joint
- 12'

Series 4
- Transverse SIP joint
- 12'
- Longitudinal SIP joint
- 12'

Series 5
- Longitudinal SIP joint
- Transverse SIP joint
- 8'
- Transverse SIP joint
- 8'
- Longitudinal SIP joint
- 8'

Series 2A
- 4'

Series 3A
- 6'

Series 4A
- 12'

Series 5A
Test Variables

Part B: 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: 6x6 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 B: SIP diaphragms with framing
Series 1B3 and 1B6 (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
SIPA/FPL/APA test program on SIP diaphragm performance

Test Variables

Part B: SIP diaphragms with framing

Series 2B6

Series 3B6

Series 4B6
SIPA/FPL/APA test program on SIP diaphragm performance

Test Variables

Part B: SIP diaphragms with framing

Series 5B3 and 5B6

- SIP segment size: 4’ x 8’
- Spline type: Block spline for SIP joints
- SIP screws: 6” o.c. and 3” o.c. (1 test each)
- Number of tests: 2
SIPA/FPL/APA test program on SIP diaphragm performance

Test 5B-3
4x8 segments
3” oc screw spacing
SIPA/FPL/APA test program on SIP diaphragm performance

Test 5B-3
4x8 segments
3” oc screw spacing
Ultimate load 3347
# SIP diaphragm performance testing

## Part A Results

<table>
<thead>
<tr>
<th>Test series</th>
<th>Purpose (Compared to basic diaphragm)</th>
<th>SIP segment (ft)</th>
<th>Deviation from basic diaphragm</th>
<th>Peak load (lbf/ft) $^a$</th>
<th>Ultimate deflection $^b$ (in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1A</td>
<td>Basic diaphragm for Part A</td>
<td>8 by 24</td>
<td>Basic configuration</td>
<td>1,186</td>
<td>1.16</td>
</tr>
<tr>
<td>2A</td>
<td>Effect of longitudinal joint</td>
<td>4 by 24</td>
<td>2 SIP segments</td>
<td>1,220 (+2.9%)</td>
<td>1.09 (-6.0%)</td>
</tr>
<tr>
<td>3A</td>
<td>Effect of transverse joint</td>
<td>8 by 12</td>
<td>2 SIP segments</td>
<td>1,110 (-6.4%)</td>
<td>1.12 (-3.4%)</td>
</tr>
<tr>
<td>4A</td>
<td>Effect of longitudinal and transverse joints</td>
<td>4 by 12</td>
<td>4 SIP segments</td>
<td>1,325 (+11.7%)</td>
<td>1.74 (+50%)</td>
</tr>
<tr>
<td>5A</td>
<td></td>
<td>4 by 8</td>
<td>6 SIP segments</td>
<td>1,362 (+14.8%)</td>
<td>2.63 (+126.7%)</td>
</tr>
</tbody>
</table>

$^a$ Measured as compared to basic diaphragm configuration.

$^b$ Measured as compared to basic deflection.
# SIP diaphragm performance testing

## Part B Results

<table>
<thead>
<tr>
<th>Test series</th>
<th>Purpose (Compared to basic wall)</th>
<th>SIP segment (ft)</th>
<th>Deviation from basic diaphragm</th>
<th>Peak load (lbf/ft)</th>
<th>Ultimate deflection (in)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1B6</td>
<td>Basic diaphragm for Part B</td>
<td>8 by 24</td>
<td>Basic configuration with 6 in. SIP screw spacing</td>
<td>2,332</td>
<td>1.91</td>
</tr>
<tr>
<td>1B3</td>
<td></td>
<td></td>
<td>Basic configuration with 3 in. SIP screw spacing</td>
<td>3,740</td>
<td>2.01</td>
</tr>
<tr>
<td>2B6</td>
<td>Effect of longitudinal joint</td>
<td>4 by 24</td>
<td>2 SIP segments with 6 in. o.c. SIP screw spacing</td>
<td>2,346 (+0.6%)</td>
<td>1.71 (-10.5%)</td>
</tr>
<tr>
<td>3B6</td>
<td>Effect of transverse joint</td>
<td>8 by 12</td>
<td>2 SIP segments with 6 in. o.c. SIP screw spacing</td>
<td>2,041 (-12.5%)</td>
<td>2.04 (+6.8%)</td>
</tr>
<tr>
<td>4B6</td>
<td></td>
<td>4 by 12</td>
<td>4 SIP segments with 6 in. o.c. SIP screw spacing</td>
<td>2,290 (-1.8%)</td>
<td>2.08 (+8.9%)</td>
</tr>
<tr>
<td>5B6</td>
<td>Effect of longitudinal, transverse joints, and SIP screw spacing</td>
<td>4 by 8</td>
<td>6 SIP segments with 6 in. o.c. SIP screw spacing</td>
<td>2,094 (-10.2%)</td>
<td>2.51 (+31.4%)</td>
</tr>
<tr>
<td>5B3</td>
<td></td>
<td></td>
<td>6 SIP segments with 3 in. o.c. SIP screw spacing</td>
<td>3,347 (-10.5%)</td>
<td>2.72 (+35.3%)</td>
</tr>
</tbody>
</table>
## General Observations

### Comparison of Peak Load from Part A and Part B with 6” screw spacing

<table>
<thead>
<tr>
<th>Part A</th>
<th>Part B</th>
<th>Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>1186</td>
<td>2332</td>
<td>1.97</td>
</tr>
<tr>
<td>1220</td>
<td>2346</td>
<td>1.92</td>
</tr>
<tr>
<td>1110</td>
<td>2041</td>
<td>1.84</td>
</tr>
<tr>
<td>1325</td>
<td>2290</td>
<td>1.73</td>
</tr>
<tr>
<td>1362</td>
<td>2094</td>
<td>1.54</td>
</tr>
</tbody>
</table>

**Ave.**: 1242   2220   1.80
Part A  Base diaphragm shear strength:
- Low value of 1186 using 8x24 segment with no joints
- High value of 1362 using 4x8 segments with both longitudinal and vertical joints
- Average of 1242 with a COV of 8.3%

Part B  Diaphragm shear strength with SIP screws attached to test frame at 6 inches on center:
- Low value of 2041 using 8x12 segments with transverse joint
- High value of 2346 using 4x24 segments with longitudinal joint
- Average of 2220 with a COV of 4.9%
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.
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.
1. 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.

2. 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.

3. 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.

4. The stiffness of SIP diaphragms can be correlated to the number of SIP segments used in the diaphragm. As the number of SIP segments increases, the SIP diaphragm stiffness decreases.
Lateral Load Performance of Structural Insulated Panel (SIP) Diaphragms

External and internal peer review of report completed

Final report submitted to the FPL for formal editing in December 2018

Editing delayed due to government shut down of the USDA

Report scheduled for publication in 2nd quarter of 2019
NTA/SIPA Design Guide for SIPs

- Design Guide and software development completed by NTA
- TAC Task Group review of Design Guide drafts completed
- TFEC Committee formed to review the Design Guide
- TFEC Committee has recommended that the Design Guide be released to the public but only if it includes a supplement that contains design values (allowable stresses) and section properties based on manufacturers code or listing reports.
- TFEC Committee discovered numerous glitches in the software and has advised NTA that the software should not be released until these have all been resolved.
- SIPA TAC and the Manufacturers Committee will need to take action on these recommendations.
“Standard Specification for Establishing and Monitoring Structural Capacities of SIPs”

- Draft document in process at ASTM D07.02.08 Section Committee level
- Standard development delayed for 2 years due to other pressing industry activities
- Standard effort renewed under Chairmanship of Corey Nigh of NTA
- Needs involvement and commitment of SIP industry to proceed
- Standard needed to support the development of ASD values for use with the SIPA Design Guide
- After Section Committee level approval the standard will be balloted at the ASTM D07.02 Subcommittee level
- Expected to take 2-3 years before approval by ASTM
Revision and Update of ANSI PRS 610

- Originally published as PRG 610-2013
- Standards Committed reformed in 2017
- Changes submitted to Secretariat (APA)
- 1st Revision ballot issued in November 2017
- Committee resolved all comments
- Re-published as PRG 610-2018
Revision and Update of ANSI PRS 610

- Next step is to add provisions for SIPs used as Roofs
- 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 will 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.
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
- Published in June 2018 as H650A
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.
- Initial results were very positive. Next step is to scale research up to commercial production level.
- Submitted a 2\textsuperscript{nd} proposal to the USDA as a research proposal for additional funding of $250,000 under the 2019 Wood Innovations Funding Opportunity.
- 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

- Ongoing 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
- Report “Behavior of Structural Insulated Panels (SIPs) Subjected to Short-term Axial Loads” to be published in the ASCE Journal of Structural Engineering
Florida High Velocity Hurricane Zone (HVHZ) Testing

- Four SIPA member companies are pursuing HVHZ approval for SIPs in Florida.
- SIP roofs with 19/32” exterior OSB as required in Florida are being evaluated.
- Preliminary information will be shared with SIPA members when it is available.
- Testing can then be expanded to other interested manufacturers.
Currently have 10 Technical Bulletins on the SIPA web site

Interest expressed by SIPA members to add new technical bulletins

Topics suggested have been:
- Moisture and wood / tar paper vs. plastic wrap
- Summary of APA diaphragm testing
- Use of tape in SIP roof installations

Members will be surveyed for input on topics and prioritization
Gaining recognition of SIPs in such industry standards as the AWC Special Design Provisions for Wind and Seismic (SPDWS), the AWC National Design Specification (NDS) and the IBC will require significant engineering support which SIPA does not have available through its volunteer efforts for resolving technical issues.

NTA has made a proposal to get additional staff working on SIPA’s technical progress (to support but not to replace volunteer efforts). NTA proposes setting up a retainer based on target dedicated hours per month.

The SIPA Board needs to evaluate this proposal and other alternatives if SIPA is going to achieve mainstream engineering recognition with competing products.
Other Business
Next meeting and Adjournment