



# Technical Evaluation Report

Dow Continuously Insulated Sheathing Series "Portal Frame with Hold-Down" Evaluation (DOW 12" to 24" CI PFH)

TER No. 1101-01

The Dow Chemical Company

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## Division: 06 – WOOD AND PLASTICS

Section: 06120 – Structural Panels  
Section: 06121 – Shear Wall Panels  
Section: 06160 – Sheathing

## Division: 07 – THERMAL AND MOISTURE PROTECTION

Section: 07210 – Building Insulation  
Section: 07270 – Air Barriers  
Section: 07280 – Water Resistive Barriers



### 1. Product Evaluated:

- 1.1. **DOW 12" CI PFH:** A DOW Continuously Insulated (CI) Sheathing Portal Frame with Hold-Down (PFH) Double Portal Frame with a pier width of 12" constructed with  $\frac{7}{16}$ " OSB Wood Structural Panel Sheathing (WSP-sheathing) fastened between four flatwise SPF stud grade 2"x4"s.
- 1.2. **DOW 24" CI PFH:** A DOW Continuously Insulated (CI) Sheathing Portal Frame with Hold-Down (PFH) Double Portal Frame with a pier width of 24" constructed with  $\frac{7}{16}$ " OSB WSP Sheathing fastened between four flatwise SPF stud grade 2"x4"s.

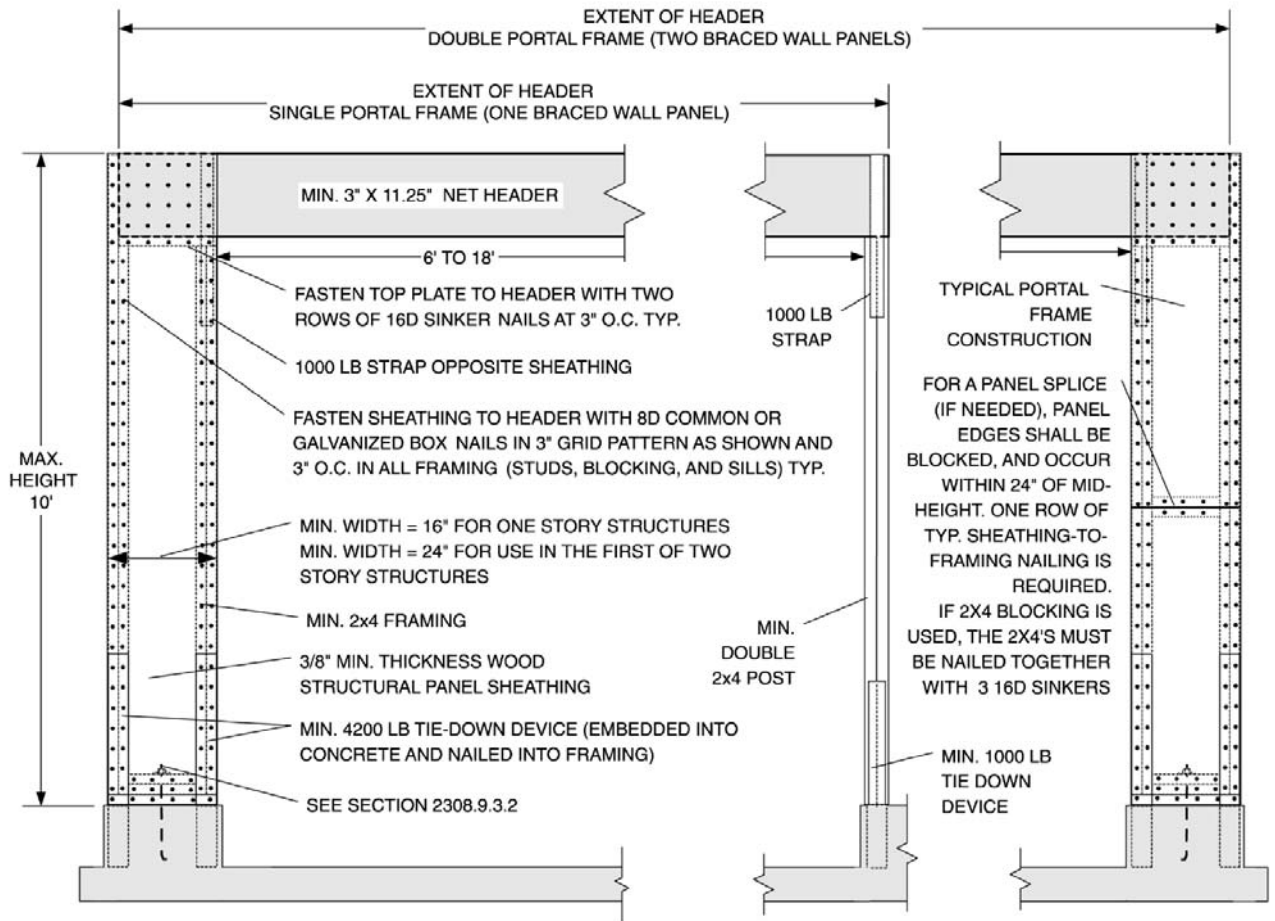
### 2. Performance Evaluation:

- 2.1. The "DOW 12" CI PFH" and "DOW 24" CI PFH" were tested and evaluated with a pier width between 12" and 24" for equivalency to the following *International Building Code (IBC)* requirement:

2009 IBC Section 2308.9.3.2 Alternate bracing wall panel adjacent to a door or window opening. Any bracing required by Section 2308.9.3 [e.g., 3. Wood structural panel sheathing with a thickness not less than  $\frac{3}{8}$  inch (9.5 mm) for 16-inch (406 mm) or 24-inch (610 mm) stud spacing in accordance with Tables 2308.9.3(2) and 2308.9.3(3).] is permitted to be replaced by the following (see [Figure 1](#)) when used adjacent to a door or window opening with a full-length header....
- 2.2. In addition to *IBC* (Section 2308.9.3.2), the *International Residential Code (IRC)* defines the PFH detail in Figure R602.10.3.3 as an equivalent replacement to the capacity of a 4x8 sheet of  $\frac{3}{8}$ " wood structural panel (WSP) sheathing through the use of the following language:

2009 IRC Section R602.10.3.3 Method PFH: Portal frame with hold-downs. Method PFH braced wall panels constructed in accordance with the following provisions (see the [Figure 1](#)) are also permitted to replace each 4 feet (1219 mm) of braced wall panel as required by Section R602.10.3 for use adjacent to a window or door opening with a full-length header: ...

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For SI: 1 foot = 304.8 mm; 1 inch = 25.4 mm; 1 pound = 4.448 N.

**FIGURE 2308.9.3.2**  
**ALTERNATE BRACED WALL PANEL ADJACENT TO A DOOR OR WINDOW OPENING**

Figure 1: *IBC / IRC* detail of Method PFH

- 2.3.** The testing conducted by the Structural Building Components Research Institute (SBCRI) and the supporting data meets the intent of the *IBC* and *IRC*, through the use of accepted engineering procedures, experience and good technical judgment.<sup>1</sup> The "DOW 12" CI PFH" and "DOW 24" CI PFH" assemblies have been found to be an alternative material, design or method of construction that is at least the equivalent of that prescribed in the code in quality, strength, effectiveness, durability and safety, and can be approved as such.<sup>2,3</sup>

<sup>1</sup> As stated in the 2009 *IBC* section after the Preface on top of page "x" in the overall section entitled "Effective Use of the International Building Code".

<sup>2</sup> 2009 *IBC* Section 104.11 (Alternative materials, design and methods of construction and equipment) and 2009 *IRC* Section R104.11 (Alternative materials, design and methods of construction and equipment) "An alternative material, design or method of construction shall be approved where the building official finds that the proposed design is satisfactory and complies with the intent of the provisions of this code, and that the material, method or work offered is, for the purpose intended, at least the equivalent of that prescribed in this code..."

<sup>3</sup> 2009 *IBC* Section 202 (Definitions) APPROVED. Acceptable to the code official or authority having jurisdiction.

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### 3. Applications:

3.1. A "DOW 12" to 24" CI PFH" was built and tested to determine if equivalency could be achieved (see [Figure 2](#)).

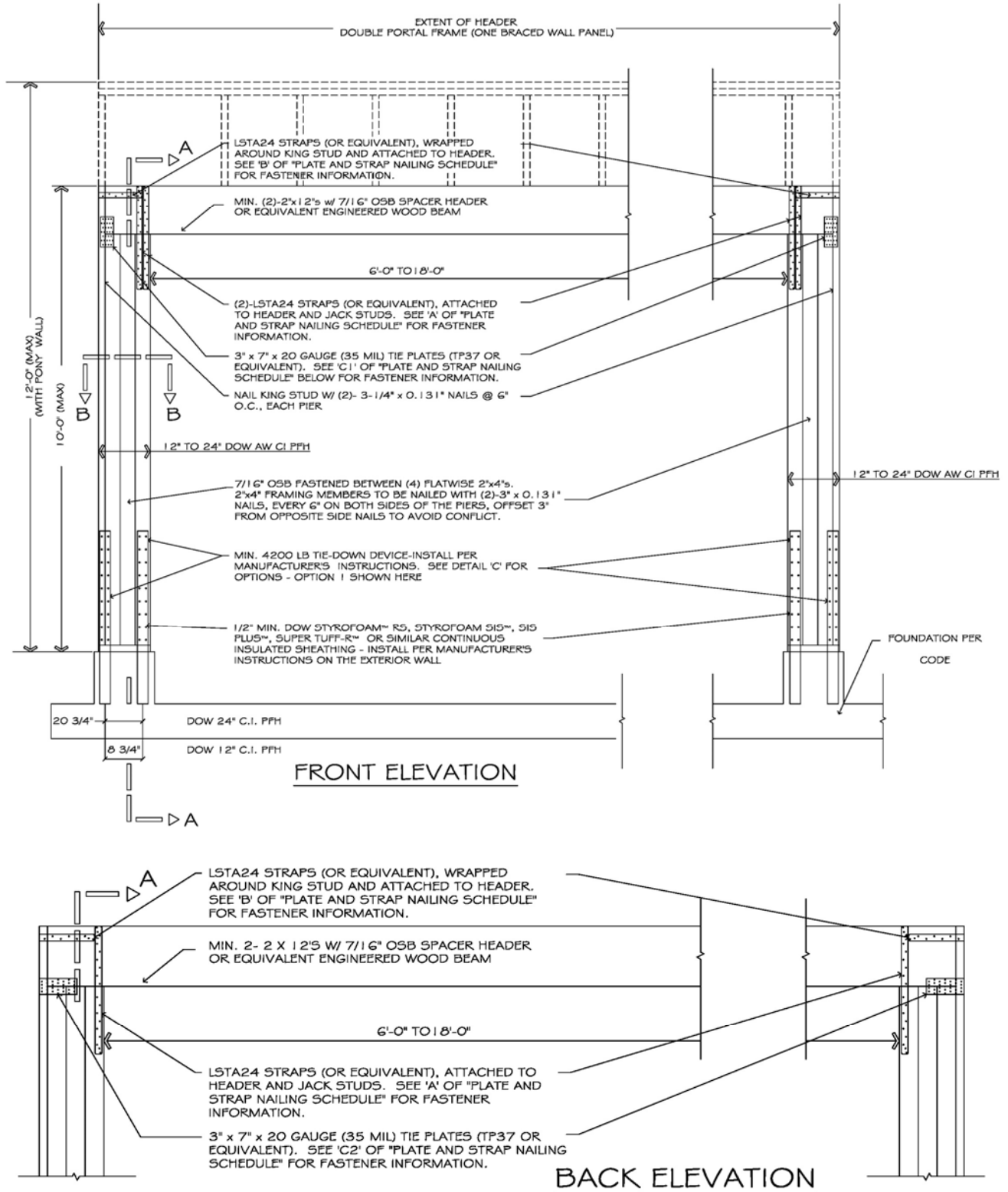
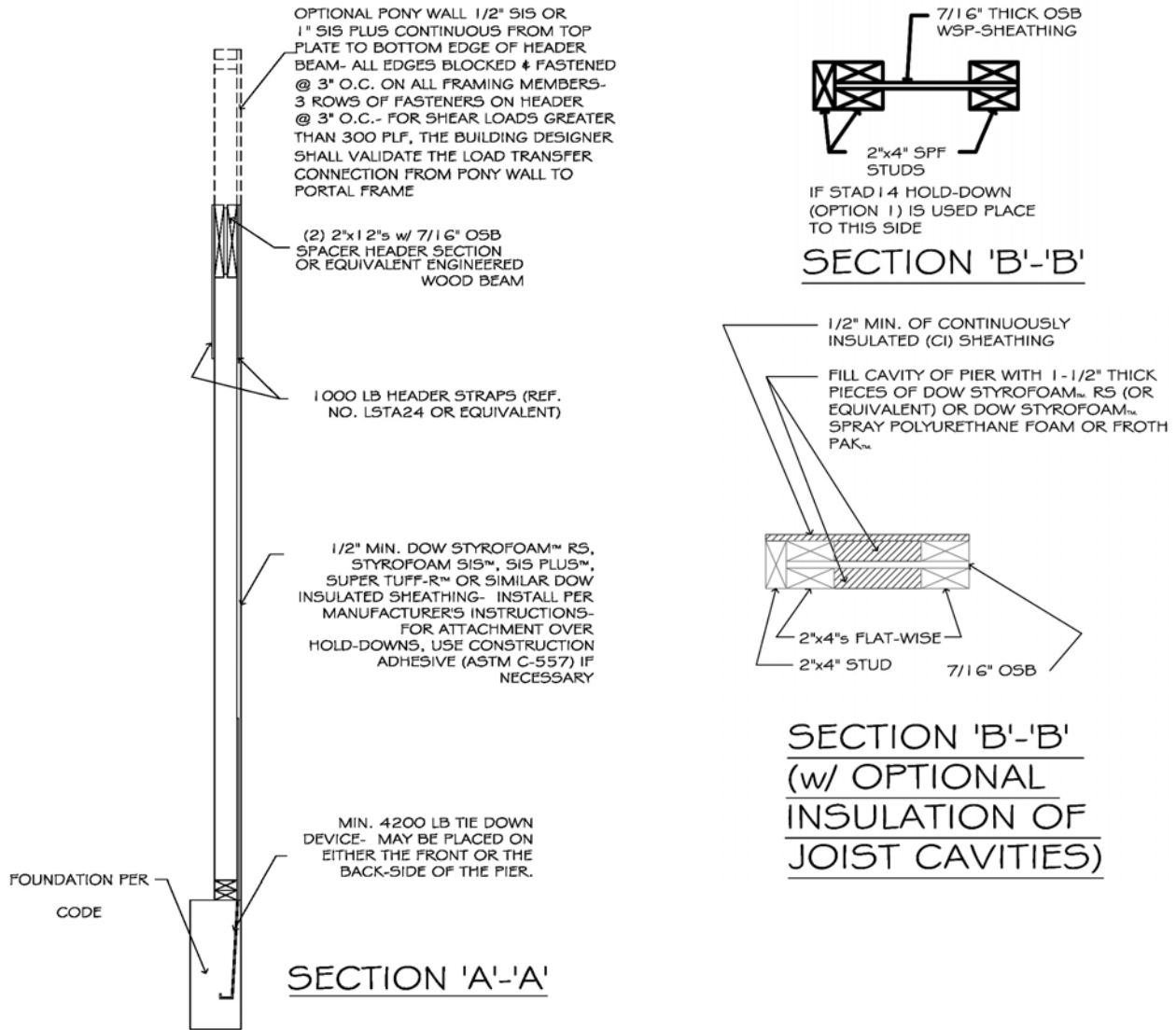


Figure 2: Construction Details of DOW 12" to 24" CI PFH<sup>4</sup> (continued on next page)

<sup>4</sup> For downloadable construction details in DWG and PDF formats, refer to <http://building.dow.com/na/en/sis/support/cad>.

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## PLATE AND STRAP NAILING SCHEDULE

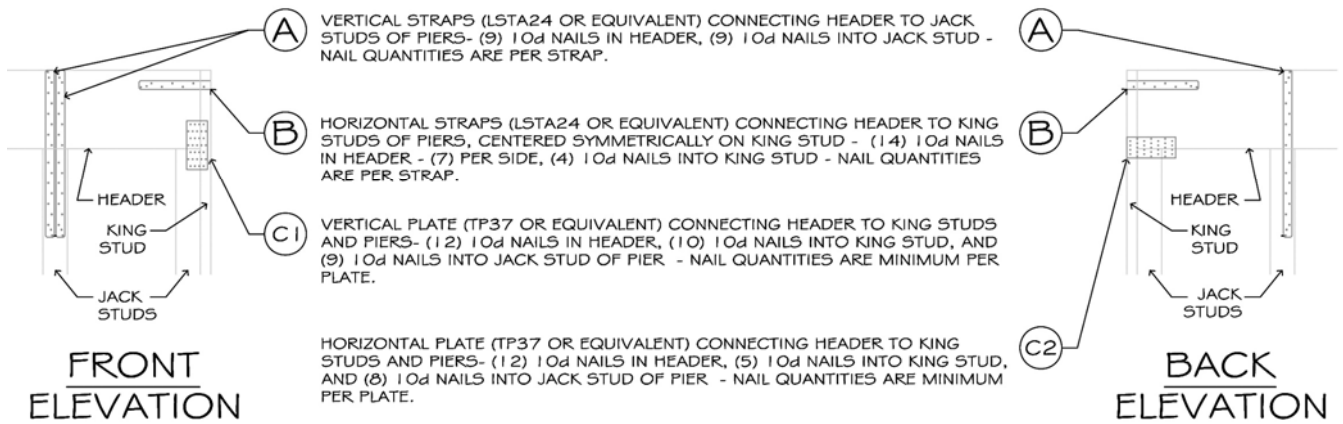


Figure 2: Construction Details of DOW 12" to 24" CI PFH<sup>5</sup> (continued on next page)

<sup>5</sup> For downloadable construction details in DWG and PDF formats, refer to <http://building.dow.com/na/en/sis/support/cad>.

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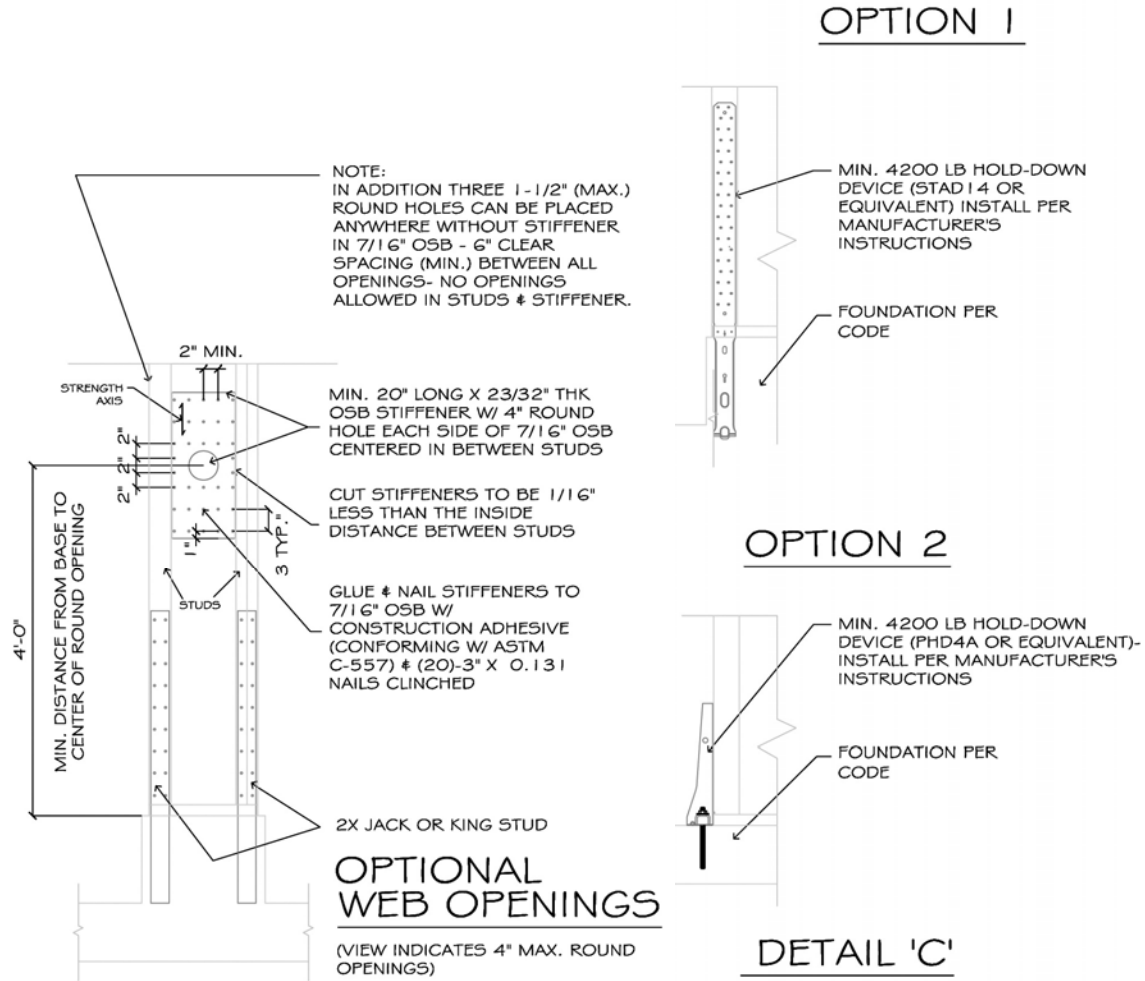


Figure 2: Construction Details of DOW 12" to 24" CI PFH<sup>6</sup> (continued from previous page)

#### 4. SBCRI Testing Performed:

- 4.1. **3/8" Braced Wall Panel<sup>7</sup>:** To define braced wall panel equivalency in accordance with the 2009 *IBC* Section 104.11 and the 2009 *IRC* Section R104.11, SBCRI tested a 12'x30' single-story building, framed and assembled precisely to the 2009 *IRC* prescriptive requirements<sup>8</sup>. The building was constructed using the WSP (wood structural panel) braced wall panel (BWP) construction method where a BWP is defined by the *IBC* and *IRC* as follows:

**2009 IBC Section 2302.1 Definitions. BRACED WALL PANEL.** A section of wall braced in accordance with Section 2308.9.3 or 2308.12.4.

**2009 IRC Chapter 2. BRACED WALL PANEL.** A full-height section of wall constructed to resist in-plane shear loads through interaction of framing members, sheathing material and anchors. The panel's length meets the requirements of its particular bracing method, and contributes toward the total amount of bracing required along its *braced wall line*.

<sup>6</sup> For downloadable construction details in DWG and PDF formats, refer to <http://building.dow.com/na/en/sis/support/cad>.

<sup>7</sup> Test Report # SBCRI-09-0104.1

<sup>8</sup> See the SBCA website location: [www.sbcra.info/common/kb/techIRCnotes.php](http://www.sbcra.info/common/kb/techIRCnotes.php)

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4.2. A BWP is defined by the ANSI/AF&PA *Special Design Provisions for Wind and Seismic standard with Commentary (SDPWS)* as follows:

ANSI / AF&PA SDPWS-2008 Section 4.3.7 Shear Wall Systems. 4.3.7.1 Wood Structural Panel Shear Walls: Shearwalls sheathed with wood structural panel sheathing shall be permitted to be used to resist seismic and wind forces. The size and spacing of fasteners at shear wall boundaries and panel edges shall be as provided in Table 4.3A. The shear wall shall be constructed as follows: 1. Panels shall not be less than 4' x 8', except at boundaries and changes in framing. All edges of all panels shall be supported by and fastened to framing members or blocking.

4.3. The *IBC*, *IRC*, and *SDPWS* all provide the ability to use a  $\frac{3}{8}$ "-thick WSP, which is the minimum BWP specification in the conventional light-frame construction section of the *IBC* and *IRC* as shown in [Figure 3](#).

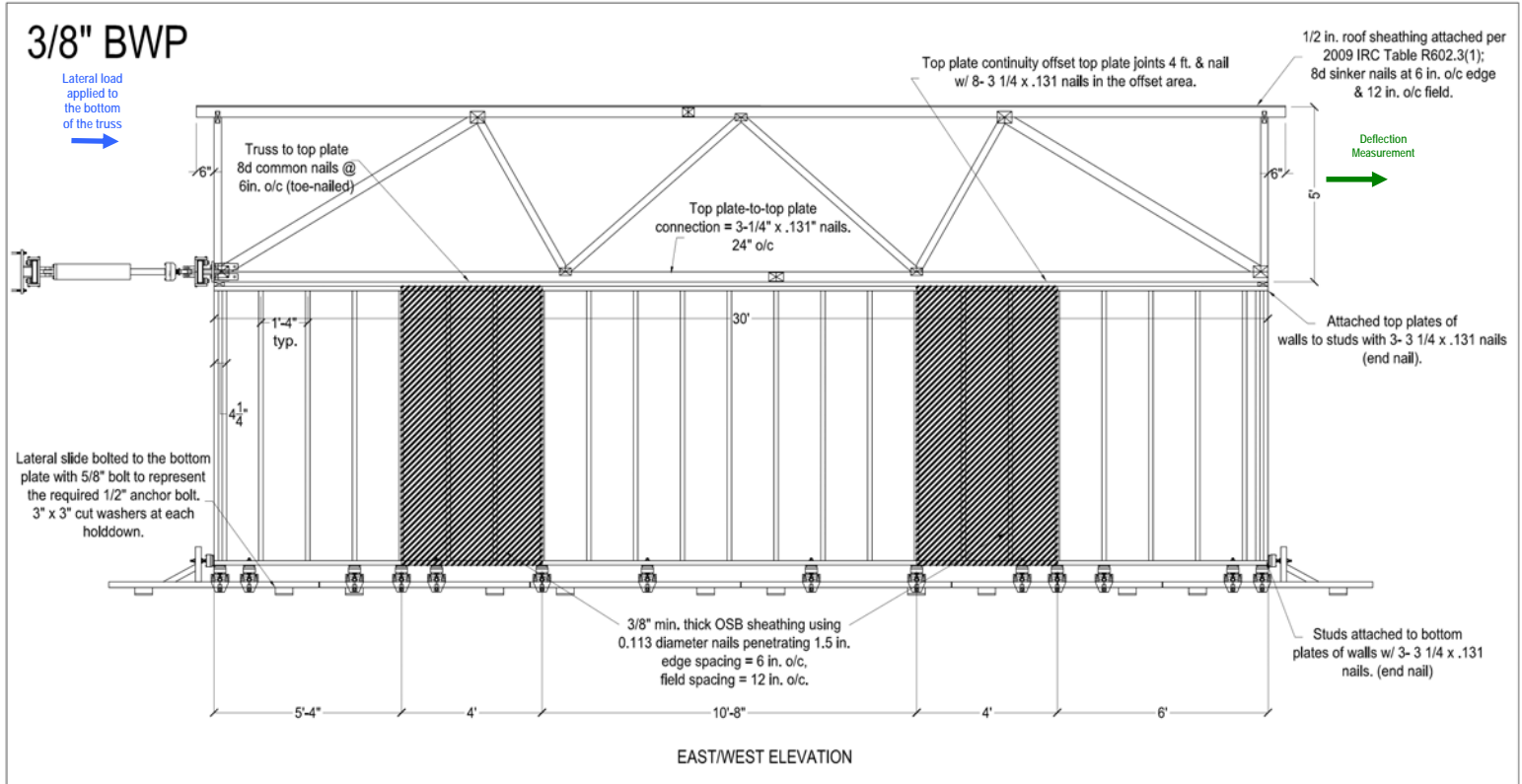


Figure 3: Test Assembly's 30' Braced Wall Line Illustrating Locations of Lateral Load Application & Deflection Measurements

4.3.1. To be typical and consistent in approach, braced wall lines were built in compliance with the maximum end distances defined in *IRC* Figure R602.10.1.4(1) and as allowed by *IBC* Section 2308.9.3 (see [Figure 4](#)).

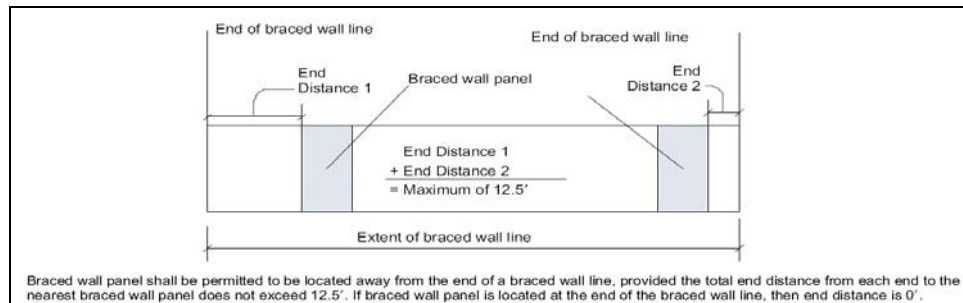


Figure 4: Braced Wall Panel End Distance Requirements per *IRC* Figure 602.10.1.4(2)

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**4.4. IBC/IRC 16" PFH:** This portal frame was constructed as shown in [Figure 1](#) and tested<sup>9</sup> in accordance with *ASTM E564* testing procedures. Testing determined its lateral resistance within an identical braced wall line so that a direct performance comparison could be made with respect to the tests performed on the "DOW 12" to 24" CI PFH" assemblies.

**4.4.1.** Two 30' braced wall lines were framed using standard code-complying framing techniques with SPF top plate, sill plate and studs from stud grade lumber. The braced wall lines were then tested simultaneously.

**4.4.2.** The assembly was constructed with  $\frac{3}{8}$ "-thick OSB WSP sheathing as detailed in *IRC* Section R602.10.3.3 and *IBC* Section 2308.9.3.2 and fastened with 0.113-diameter nails<sup>10</sup> penetrating 1- $\frac{1}{2}$ ", 3" o/c spacing at the edges and to all framing members per the detail (see [Figure 5](#)).

**4.4.3.** Interior GWB was not applied.

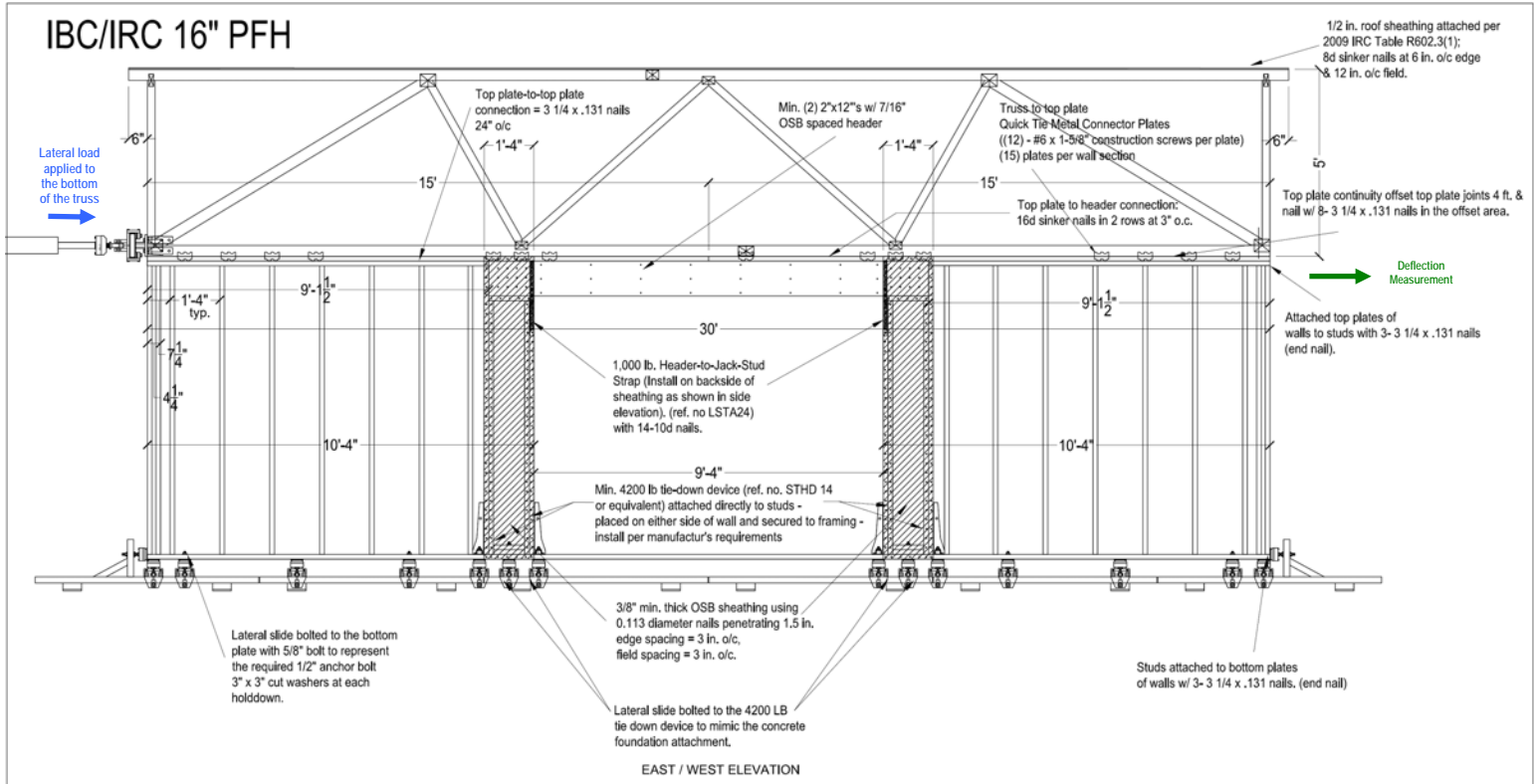


Figure 5: Test Assembly's 30' Braced Wall Line Illustrating Locations of Lateral Load Application & Deflection Measurements

**4.5. "DOW 12" to 24" CI PFH":** These portal frames were constructed as shown in [Figure 2](#) and tested<sup>11</sup> in accordance with *ASTM E564* testing procedures. Testing determined their lateral resistance within an identical braced wall line so that a direct performance comparison could be made with respect to the tests performed on the  $\frac{3}{8}$ " BWP and the *IBC/IRC* 16" PFH assemblies.

**4.5.1.** Two 30' braced wall lines were framed using standard code-complying framing techniques with SPF top plate, sill plate and studs from stud grade lumber. The braced wall lines were then tested simultaneously.

**4.5.2.** The assembly was constructed with  $\frac{7}{16}$ " thick OSB WSP-sheathing (10- $\frac{1}{2}$ " wide for the "DOW 12" CI PFH" to 22- $\frac{1}{2}$ " wide for the "DOW 24" CI PFH") fastened between four flatwise SPF 2"x4"s attached to a SPF king stud as shown in [Figure 2](#) and [Figure 6](#).

**4.5.3.** Interior GWB was not applied.

<sup>9</sup> Test Report # SBCRI-09-0104.62

<sup>10</sup> Per *IBC* Table 2306.3 and *SDPWS* Table 4.3A

<sup>11</sup> Test Report # SBCRI-11-0100.100 ("DOW 12" CI PFH") and Test Report # SBCRI-11-0100.101 ("DOW 24" CI PFH")

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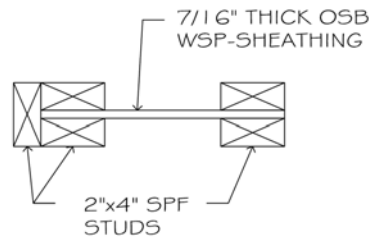


Figure 6: Cross-Section View of the Dow 12" to 24" Continuously Insulated Portal Frame Hold-Down

- 4.5.4.** Providing for thermal insulation and the code-required water-resistive barrier, 1/2"-thick Dow STYROFOAM™ RS was attached to the exterior of the PFH piers with staples (1" crown x 1-1/4" long 16 gage staples, 3/4" embedment into stud), 12" o/c spacing at the edges and 12" o/c spacing in the field (see Figure 7).

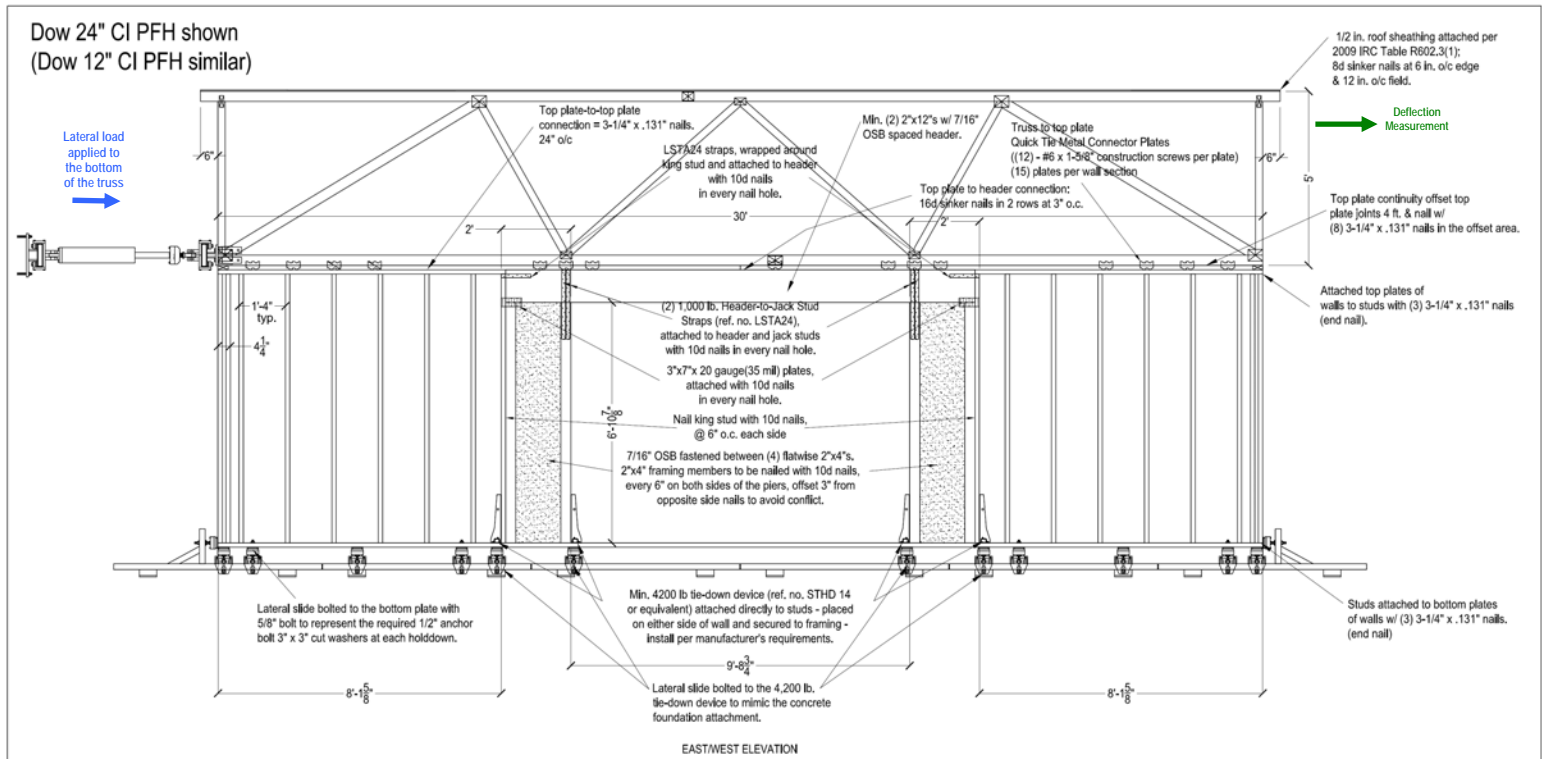


Figure 7: Test Assembly's 30' Braced Wall Line Illustrating Locations of Lateral Load Application & Deflection Measurements

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### 5. Test and Engineering Substantiating Data:

- 5.1. A comparison of the  $\frac{3}{8}$ " BWP, the *IBC/IRC* 16" PFH, the "DOW 12" CI PFH" and the "DOW 24" CI PFH" is shown in [Table 1](#).
- 5.2. The test data provides confirmation that the performance of the "DOW 12" CI PFH" and "DOW 24" CI PFH" provide comparable equivalence to the  $\frac{3}{8}$ " BWP and the *IBC/IRC* 16" PFH.

Test Name	Sheathing Material	Fastener Size & Spacing	Total Bracing Width (in)	Tested Ultimate Capacity (lbs)
$\frac{3}{8}$ " BWP <sup>12</sup>	$\frac{3}{8}$ " OSB	0.113Ø nails penetrating 1-1/2"; 6:12	48"	1,468
<i>IBC/IRC</i> 16" PFH <sup>13</sup>	$\frac{3}{8}$ " OSB	0.113Ø nails penetrating 1-1/2"; 3:3	16"	2,093
DOW 12" CI PFH <sup>14</sup>	1/2" STYROFOAM™ RS or Dow Sheathing Equivalent	see <a href="#">Figure 2</a>	12"	2,124
DOW 24" CI PFH <sup>15</sup>	1/2" STYROFOAM™ RS or Dow Sheathing Equivalent	see <a href="#">Figure 2</a>	24"	3,851

Table 1: SBCRI Test Results Based on SPF Framing

- 5.3. Based on the SBCRI Test Results using the equivalency principle as defined in *IBC* Section 104.11 and *IRC* Section R104.11, the "DOW 12" to 24" CI PFH" are assigned the recommended design values for designs controlled by wind or gravity loading conditions as provided in [Table 2](#).
- 5.4. The design values for the "DOW 12" to 24" CI PFH" are based on SBCRI testing and the evaluation of the test data compared to the *IBC/IRC* 16" PFH test data. The evaluation considered the following two design conditions found in the *IBC/IRC*, and the ASD Allowable Design Value per Pier listed in [Table 2](#) is based on the lower of these two limits:
- 5.4.1. The allowable seismic design story drift for typical residential and conventional light-frame construction as found in *ASCE 7*.<sup>16</sup>
- 5.4.2. The tested or nominal unit shear capacity divided by a safety factor of 2.0.<sup>17</sup>

Test Name	Tested Ultimate Capacity / 2 (lbs)	Maximum Wall Height <sup>18</sup>	ASD Allowable Design Value per Pier (lbs)
<i>IBC/IRC</i> 16" PFH (16" Wide Pier)	1,047	8'	1,047
		10'	785
DOW 12" CI PFH (12" Wide Pier)	1,062	8'	1,062
		10'	797
DOW 24" CI PFH (24" Wide Pier)	1,926	8'	1,926
		10'	1,445

Table 2: Recommended Allowable Wind Design Values for DOW 12" to 24" CI PFH

\* Interpolation between the wall heights and pier widths for the DOW 12" CI PFH & DOW 24" CI PFH is permitted.

- 5.5. A comparison of the load deformation graphs for the tests listed in [Table 1](#) is shown in [Figure 8](#). Deformation values are not reflective of actual story drifts anticipated in service, but are specific to the test assembly boundary conditions and shown for comparison purposes.

<sup>12</sup> BWP  $\frac{3}{8}$ " 6' from Corner Test 1 (Test Report # SBCRI-09-0104.1)

<sup>13</sup> 16" PFH Portal @ Center Test 62 (Test Report #SBCRI-09-0104.62)

<sup>14</sup> DOW 12" CI PFH Portal @ Center Test 101 (Test Report # SBCRI-11-0100.101)

<sup>15</sup> DOW 24" CI PFH Portal @ Center Test 100 (Test Report # SBCRI-11-0100.100)

<sup>16</sup> Although the *ASCE 7* criterion is specifically for seismic design and does not apply to wind design, it does provide a reasonable deformation point of reference. The ASD allowable unit shear capacity is determined per *SDPWS* Section 4.3.3. *SDPWS* also references the allowable story drift limits according to *ASCE 7* Section 12.12.1 and Table 12.12-1.

<sup>17</sup> *SDPWS* Section 4.3.3 Unit Shear Capacities states "The ASD allowable unit shear capacity shall be determined by dividing the tabulated nominal unit shear capacity, modified by applicable footnotes, by the ASD reduction factor of 2.0..."

<sup>18</sup> In APA Technical Topics Form No. TT-100, the 10'-high portals have 77-78% of the 8'-high portal capacity. Since SBCRI testing provides conservative equivalency to the APA TT-100 test data, 10'-high wall design values are provided that use a 75% factor to reduce the 8'-high wall design values generated by the SBCRI test data.

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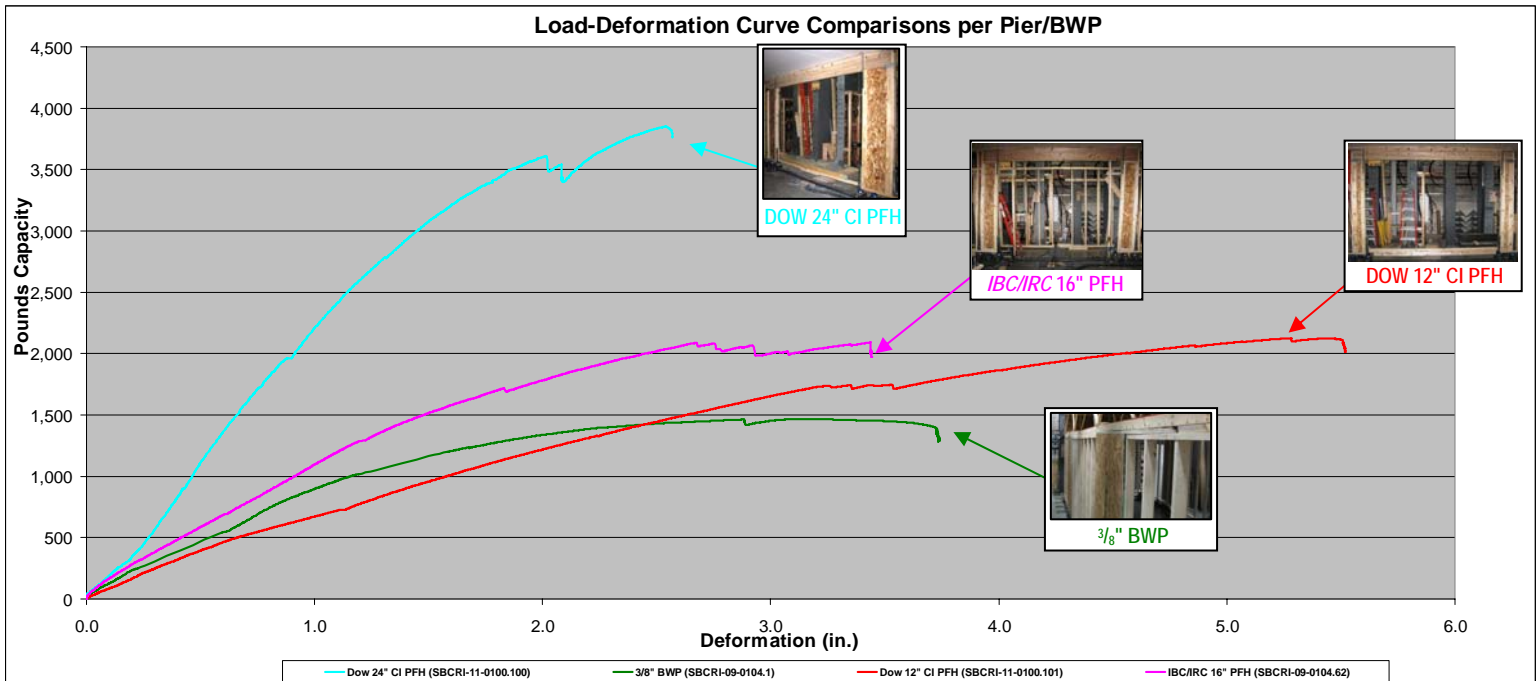


Figure 8: Comparison of Load (in pounds) Deformation Curves for the DOW 12" CI PFH, DOW 24" CI PFH, 3/8" BWP, and the IBC/IRC 16" PFH up to Ultimate Deformation

- 5.6. [Figure 8](#) provides additional confirmation that the "DOW 12" CI PFH" and "DOW 24" CI PFH" has comparable performance to the 3/8" BWP and the IBC/IRC 16" PFH, particularly where code compliance is based on the performance of replacing 4' of the 3/8" BWP.
- 5.7. As detailed in [Figure 2](#), the maximum allowable compressive strength of the "DOW 12" to 24" CI PFH" is 11,156 lbs per pier. Additional compressive capacity may be engineered into each pier. Structurally attaching full-height framing members within the pier cavity is one possible engineered option.
- 5.8. The SBCRI Test Results in [Table 1](#) provide assurance that both the "DOW 12" CI PFH" and "DOW 24" CI PFH" provide equivalent or better shear resistance and comparable stiffness performance to code-compliant benchmarks (the 3/8" BWP and the IBC/IRC 16" PFH).
- 5.9. At this time, the testing performed on the "DOW 12" to 24" CI PFH" limits its use to replacing any bracing required by the 2009 IBC Section 2308.9.3 and 2009 IRC Table R602.10.2 in Seismic Design Categories A, B, and detached dwellings in Category C.

### 6. Equivalency:

- 6.1. The 2009 IBC Section 104.11 and 2009 IRC Section R104.11 specifically state that:

"The provisions of this code are not intended to prevent the installation of any material or to prohibit any design or method of construction not specifically prescribed by this code, provided that any such alternative has been approved. An alternative material, design or method of construction shall be approved where the building official finds that the proposed design is satisfactory and complies with the intent of the provisions of this code, and that the material, method or work offered is, for the purpose intended, at least the equivalent of that prescribed in this code....."

- 6.1.1. The testing and engineering analysis performed provides the basis for the use of the "DOW 12" to 24" CI PFH" in all locations that require the use of a 4' BWP within the IBC<sup>19</sup> or the IRC<sup>20</sup>.
- 6.1.2. The testing and engineering analysis performed provides the basis for the use of the "DOW 12" to 24" CI PFH" as a substitution for a IBC/IRC 16" PFH as defined in IBC Section 2308.9.3.2 and IRC Section R602.10.3.3, and have the relative performance as defined in [Tables 1](#) and [2](#).

<sup>19</sup> 2009 IBC Section 2308.9.3.2 Alternate bracing wall panel adjacent to a door or window opening. Any bracing required by Section 2308.9.3 [i.e., 3. Wood structural panel sheathing with a thickness not less than 3/8 inch (9.5 mm) for 16-inch (406 mm) or 24-inch (610 mm) stud spacing in accordance with Tables 2308.9.3(2) and 2308.9.3(3).] is permitted to be replaced by the following when used adjacent to a door or window opening with a full-length header:

<sup>20</sup> 2009 IRC Section R602.10.3.3 Method PFH: Portal frame with hold-downs. Method PFH braced wall panels constructed in accordance with one of the following provisions are also permitted to replace each 4 feet (1219 mm) of braced wall panel as required by Section R602.10.3 for use adjacent to a window or door opening with a full-length header:

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### 7. Background and References:

- 7.1. *A Portal Frame with Hold Downs for Wall Bracing or Engineered Applications*, APA Technical Topics, Form No. TT-100, APA – The Engineered Wood Association, Tacoma, WA, 2005.
- 7.2. ANSI/AF&PA SDPWS-2008: *Special Design Provisions for Wind and Seismic standard with Commentary*, AF&PA American Wood Council, 1111 Nineteenth St., NW, Suite 800, Washington, DC 20036: 2009.
- 7.3. ASCE/SEI 7-05: *Minimum Design Loads for Buildings and Other Structures*, American Society of Civil Engineers, 2005.
- 7.4. ASTM E564-00e1: *Standard Practice for Static Load Test for Shear Resistance of Framed Walls for Buildings*, ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959: 2000.
- 7.5. Braced Wall Panel Testing in a 12'x30' Full Scale Building  $\frac{3}{8}$ " OSB Constructed Braced Wall Panel System Located 6' from Corner of Laterally Applied Monotonic Loading (BWP  $\frac{3}{8}$ " 6' from Corner Test 1), Test Report # SBCRI-09-0104.1.
- 7.6. Braced Wall Panel Testing in a 12'x30' Full Scale Building with Method PFH Double Portal Frame Performance Under Laterally Applied Monotonic Loading (16" PFH Portal @ Center Test 62), Test Report # SBCRI-09-0104.62.
- 7.7. Braced Wall Panel Testing in a 12'x30' Full Scale Building with Dow STYROFOAM™ RS Double Portal Frame Performance Under Laterally Applied Monotonic Loading (DOW 24" PFH Portal @ Center Test 100), Test Report # SBCRI-11-0100.100.
- 7.8. Braced Wall Panel Testing in a 12'x30' Full Scale Building with Dow STYROFOAM™ RS Double Portal Frame Performance Under Laterally Applied Monotonic Loading (DOW 12" PFH Portal @ Center Test 101), Test Report # SBCRI-11-0100.101.
- 7.9. *International Residential Code 2009 and International Building Code 2009*, International Code Council, 2009.

### 8. Report Date:

- 8.1. This TER shall be re-evaluated one year from the issue date.



#### Responsibility Statement

The information contained herein is a product, engineering or building code evaluation performed in accordance with the referenced building code, testing and/or analysis using generally accepted engineering practices. Product, design and code compliance quality control is the responsibility of the referenced company. Consult the referenced company for the proper detailing and application for the intended purpose. Consult your local jurisdiction or design professional to assure compliance with the local building code. Qualtim, Inc. ([www.qualtim.com](http://www.qualtim.com)) and SBC Research Institute ([www.sbcinfo.info](http://www.sbcinfo.info)) do not make any warranty, express or implied, or assume any legal liability or responsibility for the use, application of, and/or reference to opinions, findings, conclusions, or recommendations included in this report.