DIVISION: 06 00 00—WOOD, PLASTICS AND COMPOSITES
SECTION: 06 12 13—CEMENTITIOUS REINFORCED PANELS

REPORT HOLDER:

UNITED STATES GYPSUM COMPANY

EVALUATION SUBJECT:

USG STRUCTURAL PANEL CONCRETE SUBFLOOR

“2014 Recipient of Prestigious Western States Seismic Policy Council (WSSPC) Award in Excellence”
DIVISION: 06 00 00—WOOD, PLASTICS AND COMPOSITES
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1.0 EVALUATION SCOPE

Compliance with the following codes:

- 2013 Abu Dhabi International Building Code (ADIBC)†

†The ADIBC is based on the 2009 IBC. 2009 IBC code sections referenced in this report are the same sections in the ADIBC.

For evaluation for compliance with codes adopted by Los Angeles Department of Building and Safety (LADBS), see ESR-1792 LABC and LARC Supplement. For evaluation for compliance with codes adopted by California Office of Statewide Health Planning and Development (OSHPD) and Division of the State Architect (DSA), see ESR-1792 CBC and CRC Supplement.

Properties evaluated:
- Structural
- Combustibility
- Fire propagation

2.0 USES

USG Structural Panel Concrete Subfloor is a noncombustible, cementitious floor sheathing panel used as combination subfloor and underlayment or as subfloor only. Installation must be limited to weather-protected, interior locations.

USG Structural Panel Concrete Subfloor is fastened to cold-formed steel floor framing to form a structural floor system. The floor system is capable of resisting gravity loads and acting as a horizontal shear diaphragm, resisting wind and seismic loads.

When used in structures regulated under the IRC, floor systems using USG Structural Panel Concrete Subfloor must be designed in accordance with IRC Section R301.1.3.

3.0 DESCRIPTION

3.1 USG Structural Panel Concrete Subfloor:

USG Structural Panel Concrete Subfloor is formed from a composite consisting of glass fibers and cementitious materials. USG Structural Panel Concrete Subfloor is nominally 3/4 inch (19.1 mm) thick, 4 feet (1219 mm) wide, and 8 feet (2428 mm) long with tongue-and-groove edges along the length of the panel. Based on tests in accordance with ASTM E136, the panels are noncombustible. The panels yield a flame-spread index of 0 and a smoke-developed index of 5 or less when tested in accordance with ASTM E84.

3.2 Floor Framing:

Floor framing, web stiffeners, and blocking must be cold-formed from steel complying with AISI S100 (AISI-General for the 2006 IBC), with a minimum base-metal thickness of 54 mils [0.0538 inch (1.37 mm)], a minimum yield strength of 50 ksi (345 MPa), and a minimum G60 galvanized coating. The supporting flange of the framing member must be at least 1.625 inches (41 mm) wide.

3.3 Blocking:

When blocking is required, as shown in Tables 2 and 3, it must consist of minimum Grade 33 cold-formed steel straps which are 4 inches (102 mm) wide with a minimum base steel thickness of 54 mils [0.0538 inch (1.37 mm)], and a minimum G60 galvanized coating.

3.4 Fasteners:

The panels must be fastened to the steel floor framing and blocking with Grabber Construction Products, Inc., #8 x 1 5/8" winged self-drilling screws, Part No. CGH18158LG.

4.0 DESIGN AND INSTALLATION

4.1 Design:

4.1.1 General: The floor joists and other floor framing components must be designed to comply with the strength and deflection requirements of the IBC and the project specifications. The design of the floor system must address the selection of the framing members, the connections of the framing members to the supporting structure, the layout of the floor sheathing, and the fastening schedule for attaching the floor sheathing to the framing members.

4.1.2 Allowable Uniform Gravity Loads: The allowable uniform gravity loads for the USG Structural Panel Concrete Subfloor are shown in Table 1.
4.1.3 Diaphragm Loads:

4.1.3.1 General:

For horizontal diaphragms constructed with the USG Structural Panel Concrete Subfloor, the length-to-width aspect ratio of the diaphragm must be no greater than 3:1 for unblocked diaphragms and 4:1 for blocked diaphragms. Diaphragm classification as flexible or rigid must be determined in accordance with Section 12.3.1 of ASCE 7.

Diaphragm design must consider diaphragm loading parallel and perpendicular to the floor framing. For select configurations, the results of testing of simple beam assemblies, are shown in Table 2. These values are applicable when the diaphragm load is parallel to the floor framing members. Results of testing of cantilever assemblies are shown in Table 3. These values apply to diaphragm loads which are parallel and perpendicular to the floor framing, except where loading parallel to framing is addressed in Table 2. The values in Tables 2 and 3 are nominal diaphragm shear values, which must be adjusted for use in ASD or LRFD in accordance with the footnotes to the tables.

4.1.3.2 Deflections: Diaphragm deflection must be calculated as follows:

$$\Delta = \frac{5VL^3}{8EAb} + \frac{VL}{4Gt} + XL\epsilon_n$$

where:
- $\Delta$ = Diaphragm deflection, inch
- $V$ = Unit shear in the direction under consideration, plf
- $L$ = Diaphragm length, feet
- $E$ = Elastic modulus of steel rim members designed as diaphragm chords, 29,500,000 psi
- $A$ = Net area of steel rim chord cross section, in$^2$
- $b$ = Diaphragm width, feet
- $G$ = Shear modulus of sheathing, 285,714 psi
- $t$ = Effective thickness of sheathing, 0.73 inch
- $X$ = Slip coefficient from Table 2 or 3, as applicable
- $\epsilon_n$ = Fastener slip, which is based on the ratio of $V/S_u$ as follows:
  - $\epsilon_n = 0.011$ inch at 0.20$S_u$
  - $\epsilon_n = 0.019$ inch at 0.33$S_u$
  - $\epsilon_n = 0.032$ inch at 0.60$S_u$
  - $\epsilon_n = 0.084$ inch at $S_u$
- $S_u$ = Nominal shear strength given in Table 2 or 3, as applicable

Other values of $\epsilon_n$ are permitted to be determined by interpolation.

4.2 Installation:

4.2.1 General: Installation of USG Structural Panel Concrete Subfloor and framing must be in accordance with the IBC, this report, USG’s published installation instructions and the approved plans. Copies of this report, USG’s published installation instructions and the approved plans must be available at the jobsite at all times during installation of the panels.

4.2.2 Framing: The floor joists must be supported on a foundation that is uniform and level, or directly by bearing studs or headers installed at the top of the bearing wall to distribute the load.

Web stiffeners must be provided at reaction points and/or concentrated loads as specified in the approved plans, based on the joist manufacturer’s requirements and the applicable ICC-ES evaluation report on the joists. End blocking must be provided where joists ends are not otherwise restrained from rotation.

Joists must be provided at a maximum spacing of 24 inches (610 mm) on center, as indicated in the tables in this report. Additional joists must be provided under parallel partitions and around all floor openings that interrupt one or more spanning members. Floor joists must be fastened to the supporting walls or structure in accordance with the approved plans.

All blocking or bridging for the steel framing must be installed prior to the installation of the USG Structural Panel Concrete Subfloor.

Framing must comply with the manufacturing tolerances specified in Section A5.4 of AISI S200-12, which is referenced in Section 2211.1 of the 2015 IBC.

When strap blocking is required at the abutting edges of the panels, it must be centered under the tongue-and-groove joints between sheathing panels, and installed prior to installation of the sheathing panels.

4.2.3 USG Structural Panel Concrete Subfloor Application:

4.2.3.1 General: The temperature during panel installation must be a minimum of 0°F (18°C).

4.2.3.2 Panel Layout: USG Structural Panel Concrete Subfloor must be installed with the long edges perpendicular to the framing. Panels may be installed with either surface against the framing. However, because the panel markings that facilitate fastening are on one side only, the panels should preferably be applied with the markings toward the installer.

Panel installation must commence by marking a line across the joists parallel to the rim joist at a distance equal to the width of the first panel being placed. The floor layout must be planned so the first and last panel row width is a minimum of 24 inches (610 mm).

The cut edge or tongue must be placed along the rim joist. Each panel must be supported across three or more framing members. Panels must be trimmed to ensure that the butted ends of each panel are centered on the framing member flanges.

Adjacent panels must be butted together so that the tongue of one panel being installed fits into the groove of the installed panel. No gaps are required between panels. Panel rows must be placed in a running bond pattern so that end joints fall over the center of the framing members and are staggered by at least two framing members from where the end joints fall in the adjacent rows, except when panels less than 8 feet (2440 mm) long are used, in which case an offset of one framing member is allowed.

4.2.3.3 Panel Fastening: Each panel must be fastened to the framing members in accordance with the requirements for the applicable screw pattern shown in Tables 2 and 3, and in accordance with the fastening schedule specified in the approved plans. Fastening must commence at one end and fan out across the panel, and corners must not be fastened initially. Fasteners must be placed sequentially one row at a time. Screws must be installed using tools recommended by the screw manufacturer. Screw fasteners must be installed so the heads are flush with the panel surface. Panels must be fastened in accordance with one of the following patterns, as required by Tables 2 and 3:
The USG Structural Panel Concrete Subfloor described in this report complies with, or is a suitable alternative to what is specified in, the code indicated in Section 1.0 of this report, subject to the following conditions:

5.0 CONDITIONS OF USE

5.1 The product must be installed in accordance with this report, the manufacturer's published instructions, the approved plans and the applicable code. In the event of a conflict amongst these documents, the most restrictive requirements govern.

5.2 Calculations and details showing that the applied gravity loads do not exceed the uniform load capacity, and that the applied diaphragm loads do not exceed the diaphragm strengths specified in this report, must be submitted to the code official for approval. The calculations must be prepared by a registered design professional where required by the statutes of the jurisdiction in which the project is to be constructed.

5.3 Design of the building foundation system, walls or roof is outside the scope of this report.

5.4 The USG Structural Panel Concrete Subfloor is manufactured under a quality control program with inspections by ICC-ES.

6.0 EVIDENCE SUBMITTED

6.1 Data in accordance with the ICC-ES Acceptance Criteria for Structural Cementitious Floor Sheathing Panels (AC318), dated October 2015.

6.2 Data in accordance with the ICC-ES Acceptance Criteria for Horizontal Diaphragms Consisting of Structural Cementitious Floor Sheathing Panels Attached to Cold-formed Steel Framing (AC319), dated June 2005 (editorially revised October 2015).

7.0 IDENTIFICATION

7.1 Each panel is labeled with the USG Structural Panel Concrete Subfloor brand name; the United States Gypsum Company name and address; the panel thickness; the maximum joist spacing for the panel (referred to as the maximum span); the maximum allowable load (live and dead gravity load); the ICC-ES report number (ESR-1792); and the date of manufacture.

7.2 The report holder's contact information is the following:

UNITED STATES GYPSUM COMPANY
550 WEST ADAMS STREET
CHICAGO, ILLINOIS 60661
(312) 436-6139
www.usg.com
### TABLE 1—ALLOWABLE UNIFORM GRAVITY LOADS FOR USG STRUCTURAL PANEL CONCRETE SUBFLOOR

<table>
<thead>
<tr>
<th>JOIST SPAN (inches)</th>
<th>ALLOWABLE UNIFORM LOAD^1 (psf)</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>440</td>
</tr>
<tr>
<td>16</td>
<td>248</td>
</tr>
<tr>
<td>19.2</td>
<td>172</td>
</tr>
<tr>
<td>24</td>
<td>110</td>
</tr>
</tbody>
</table>

^1These loads represent the load-carrying capacity of the panels spanning between the floor joists. A minimum of two spans is required. This table does not consider the influence of joist deflection.

For SI: 1 inch = 25.4 mm, 1 psf = 47.88 Pa.

### TABLE 2—NOMINAL SHEAR STRENGTH FOR SIMPLE BEAM DIAPHRAGMS CONSTRUCTED WITH USG STRUCTURAL PANEL CONCRETE SUBFLOOR

<table>
<thead>
<tr>
<th>JOIST SPACING (inches)</th>
<th>BLOCKING REQUIRED^2</th>
<th>MAXIMUM FASTENER SPACING (inches)</th>
<th>SCREW PATTERN</th>
<th>SHEAR STRENGTH, $S_u$ (plf)</th>
<th>SLIP COEFFICIENT, $X$</th>
</tr>
</thead>
<tbody>
<tr>
<td>24</td>
<td>Yes</td>
<td>6 12</td>
<td>C</td>
<td>1,526</td>
<td>0.346</td>
</tr>
<tr>
<td>24</td>
<td>No</td>
<td>4 12</td>
<td>A or B</td>
<td>1,357</td>
<td>0.476</td>
</tr>
<tr>
<td>24</td>
<td>No</td>
<td>6 12</td>
<td>A or B</td>
<td>1,073</td>
<td>0.397</td>
</tr>
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<td>16</td>
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<td>4 12</td>
<td>B</td>
<td>1,462</td>
<td>0.443</td>
</tr>
<tr>
<td>16</td>
<td>No</td>
<td>6 12</td>
<td>B</td>
<td>1,429</td>
<td>0.421</td>
</tr>
</tbody>
</table>

^2See Section 3.2 for cold-formed steel floor framing requirements.

### TABLE 3—NOMINAL SHEAR STRENGTH FOR CANTILEVER DIAPHRAGMS CONSTRUCTED WITH USG STRUCTURAL PANEL CONCRETE SUBFLOOR

<table>
<thead>
<tr>
<th>JOIST SPACING (inches)</th>
<th>BLOCKING REQUIRED^3</th>
<th>MAXIMUM FASTENER SPACING (inches)</th>
<th>SCREW PATTERN</th>
<th>SHEAR STRENGTH, $S_u$ (plf)</th>
<th>SLIP COEFFICIENT, $X$</th>
</tr>
</thead>
<tbody>
<tr>
<td>24</td>
<td>Yes</td>
<td>6 12</td>
<td>C</td>
<td>1,148</td>
<td>0.354</td>
</tr>
<tr>
<td>24</td>
<td>No</td>
<td>4 12</td>
<td>A</td>
<td>738</td>
<td>0.732</td>
</tr>
<tr>
<td>24</td>
<td>No</td>
<td>6 12</td>
<td>A</td>
<td>566</td>
<td>0.518</td>
</tr>
<tr>
<td>24</td>
<td>No</td>
<td>8 12</td>
<td>A</td>
<td>488</td>
<td>0.511</td>
</tr>
<tr>
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<td>No</td>
<td>6 12</td>
<td>B</td>
<td>522</td>
<td>0.625</td>
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<tr>
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<td>No</td>
<td>8 12</td>
<td>B</td>
<td>487</td>
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</tr>
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<td>No</td>
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<td>A</td>
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<td>0.833</td>
</tr>
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<td>No</td>
<td>6 12</td>
<td>A</td>
<td>956</td>
<td>0.765</td>
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<td>No</td>
<td>8 12</td>
<td>A</td>
<td>860</td>
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<td>1,146</td>
<td>0.759</td>
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<td>No</td>
<td>6 12</td>
<td>A</td>
<td>956</td>
<td>0.541</td>
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<tr>
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<td>No</td>
<td>8 12</td>
<td>A</td>
<td>779</td>
<td>0.484</td>
</tr>
</tbody>
</table>

^3See Section 3.3 for blocking requirements.

For SI: 1 inch = 25.4 mm, 1 plf = 14.6 N/m.

^1See Section 3.2 for cold-formed steel floor framing requirements.

^2See Section 3.4 for fastener requirements.

^3See Section 4.2.3.3 for a description of the screw patterns.

The maximum ASD diaphragm shear strength must be determined by applying a minimum factor of safety, $\Omega$, of 2.5 to the tabulated nominal strength for seismic forces, and a minimum factor of safety, $\Omega$, of 2.35 for wind forces. The maximum LRFD diaphragm shear strength must be determined using a maximum resistance factor, $\phi$, of 0.65 applied to the tabulated nominal strength for seismic forces and a maximum resistance factor, $\phi$, of 0.70 for wind forces.

^4See Section 3.3 for blocking requirements.
FIGURE 1—SCREW PATTERN A LAYOUT

1. Two-Span offset of Beams w/o Blocking, One Span w/ Blocking

Screw Pattern A

DETAIL - A

Tongue & Groove

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Note 1

12" o.c.

4", 6", or 8"
FIGURE 2—SCREW PATTERN B LAYOUT

1. Two-Span offset of Seams w/o Blocking
1. One Span offset w/ Blocking

Screw Pattern C

DETAIL -C: Strap Block Detail

FIGURE 3—SCREW PATTERN C LAYOUT
1.0 REPORT PURPOSE AND SCOPE

Purpose:
The purpose of this evaluation report supplement is to indicate that the USG Structural Panel Concrete Subfloor, described in ICC-ES master evaluation report ESR-1792, has also been evaluated for compliance with the codes noted below as adopted by the Los Angeles Department of Building and Safety (LADBS).

Applicable code editions:
- 2017 City of Los Angeles Building Code (LABC)
- 2017 City of Los Angeles Residential Code (LARC)

2.0 CONCLUSIONS

The USG Structural Panel Concrete Subfloor, described in Sections 2.0 through 7.0 of the master evaluation report ESR-1792, complies with the LABC and the LARC and is subject to the conditions of use described in this supplement.

3.0 CONDITIONS OF USE

The USG Structural Panel Concrete Subfloor described in this evaluation report must comply with all of the following conditions:

- All applicable sections in the master evaluation report ESR-1792.
- The design, installation, conditions of use and identification of the USG Structural Panel Concrete Subfloor are in accordance with the 2015 International Building Code® (2015 IBC) provisions noted in the master evaluation report ESR-1792.
- The design, installation and inspection are in accordance with additional requirements of LABC Chapters 16 and 17, as applicable.
- Under the LARC, an engineered design in accordance with LARC Section R301.1.3 must be submitted.

This supplement expires concurrently with the master report, issued January 2019 and revised March 2019.
1.0 REPORT PURPOSE AND SCOPE

Purpose:
The purpose of this evaluation report supplement is to indicate that the USG Structural Panel Concrete Subfloor, described in ICC-ES master evaluation report ESR-1792, have also been evaluated for the codes noted below.

Applicable code edition:

- **2016 California Building Code (CBC)**  
  For evaluation of applicable chapters adopted by the California Office of Statewide Health Planning and Development (OSHPD) and Division of the State Architect (DSA), see Sections 2.1 and 2.2 below.

- **2016 California Residential Code (CRC)**

2.0 CONCLUSIONS

The USG Structural Panel Concrete Subfloor, described in Sections 2.0 through 7.0 of the master evaluation report ESR-1792, comply with CBC and CRC Section R301.1.3, provided the design and installation are in accordance with the 2015 International Building Code® (IBC) provisions noted in the master report, and the additional design and inspection requirements of the CBC Chapter 16 and Section 1705.1.1.

2.1 OSHPD:
The USG Structural Panel Concrete Subfloor, described in Sections 2.0 through 7.0 of the master evaluation report ESR-1792, satisfy CBC amended Section 104.11, provided the design and installation are in accordance with the 2015 International Building Code® (IBC) provisions noted in the master report, and the additional requirements in Sections 2.1.1 to 2.1.2 of this supplement:

- **2.1.1 Special Inspection Requirements**: Special inspection shall be required in accordance with Section 1705.1.1 [OSHPD 2] or Section 1705A.1.1 [OSHPD 1 & 4] of the CBC, as applicable.

- **2.1.2 Conditions of Use**: Framing must comply with the manufacturing tolerances specified in Section A5.4 of AISI S200-12, which is referenced in Section 2211.1 [OSPHD 2] or Section 2211.1A [OSHPD 1 & 4] of the CBC, as applicable.

2.2 DSA:
The USG Structural Panel Concrete Subfloor, described in Sections 2.0 through 7.0 of the master evaluation report ESR-1792, satisfy CBC amended Section 104.11, provided the design and installation are in accordance with the 2015 International Building Code® (IBC) provisions noted in the master report, and the additional requirements in Sections 2.2.1 to 2.2.2 of this supplement:

- **2.2.1 Special Inspection Requirements**: Special inspection shall be required in accordance with Section 1705A.1.1 [DSA-SS & SS/CC] of the CBC.

- **2.2.2 Conditions of Use**: Framing must comply with the manufacturing tolerances specified in Section A5.4 of AISI S200-12, which is referenced in Section 2211A.1 [DSA-SS] or Section 2211.1 [DSA SS/CC] of the CBC, as applicable.

This supplement expires concurrently with the master report, reissued January 2019 and revised March 2019.