Dear Timothy,

Re: Canadian Building Code Compliance Alternative Report for USG Structural Concrete Panel
In Compliance with the National Building Code of Canada

A. BACKGROUND
United States Gypsum Company (USG) have developed a Structural Concrete Panel which can be used in a variety of building applications.

Progressive Engineering Inc. (PEI), an American Engineering Firm and ISO certified agency, have tested the product in accordance with the applicable design standards, and have approved the product for use in the United States. The USG Structural Concrete Panel has been widely used in the building industry in the United States, and the company is now receiving interest from the Canadian market.

PEI was approached by USG to provide assistance with obtaining Canadian approval for their product. PEI then retained Steenhof Building Services Group (SBSG), an engineering firm licensed to practice across Canada, to complete a compliance review in accordance with Canadian National Building Code (NBC) and applicable Standards.

The NBC is an “objective based” code, which allows alternative materials and solutions to be acceptable for use in buildings if they meet or exceed the associated functional and objective statements of the applicable building codes, pertaining to the intended use.

SBSG has prepared the following Compliance Alternative Report for the USG Structural Concrete Panel to permit the panel to be used for concrete subfloors for buildings in Canada. The Compliance Alternative Report will confirm that the USG Structural Concrete Panel meets the associated functional and objective National Building Code requirements for the following:
- non-combustible construction
- structural floor sheathing
- 1 & 2 hour fire-rated floor assemblies when combined with other noncombustible materials
B. PRODUCT DESCRIPTION: USG Structural Concrete Panel

The USG Structural Concrete Panel is a non-combustible concrete sheathing panel used in conjunction with cold-formed steel, wood, or hot rolled steel framing to form a load bearing structural floor or wall system.

The USG Structural Concrete Panel is approximately ¾” x 4’ x 8’ in size and weighs in the order of 170lbs. The floor panels have a Tongue and Grove edge along the 8’ side of the panel and the wall panels have a square edge.

It is a strong, durable and dimensionally stable product, and will not buckle or warp like wood sheathing. The Panel may be installed in most weather conditions including temperatures from -18°C to 52°C. The USG Structural Concrete Panel can be mechanically fastened to cold-formed steel joists, trusses or framing members.

The panel installs similar to wood sheathing, utilizing a circular saw for cutting and typical screws for fastening. Lighter than precast or poured concrete, USG Structural panels provide a new, easier and more efficient way to build walls and floors.

The USG Structural Panels can be applied in a variety of building projects, including Mid-Rise Buildings, Auditoriums & Theatres, Modular Building Construction, Custom Homes, Concrete Subfloors and Mezzanines, and more. Figures 1 through 4 below provide visual examples of how the panel may be utilized in building projects.
Refer to table below for references to testing completed by USG.

<table>
<thead>
<tr>
<th>Test Description</th>
<th>Test Standard</th>
<th>Approx. Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lap-Joint Shear Test Report</td>
<td>AISI S905</td>
<td></td>
</tr>
<tr>
<td>Fastener Lateral Load Test Report</td>
<td>AISI TS-5-02</td>
<td></td>
</tr>
<tr>
<td>Cantilever Test Reports</td>
<td>AISI TS-7</td>
<td></td>
</tr>
<tr>
<td>Compression Perpendicular to Grain Test Report</td>
<td>ASTM D143</td>
<td></td>
</tr>
<tr>
<td>Fastener Pull-Through Test Reports</td>
<td>ASTM D1037</td>
<td>5.3 lb./ft2 (26 kg/m2 )</td>
</tr>
<tr>
<td>Thickness Swell</td>
<td>ASTM D1037.B</td>
<td>Max 3.0%</td>
</tr>
<tr>
<td>Fastener Lateral Resistance* Screw Slip Test Report</td>
<td>ASTM D1761</td>
<td>&gt; 210 lbf (0.93 kN) dry</td>
</tr>
<tr>
<td>Standard Test Method for Resistance of Grown of Mold on the Surface off Interior Coatings in an Environmental Chamber</td>
<td>ASTM D3273-12</td>
<td>&gt; 160 lbf (0.71 kN) wet</td>
</tr>
<tr>
<td>Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi</td>
<td>ASTM G-21-09</td>
<td>0</td>
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<tr>
<td>Termite Evaluation Test Report</td>
<td>ASTM D3345-08</td>
<td>9.8</td>
</tr>
<tr>
<td>AWPA Standard E1-13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wall Racking Test Reports</td>
<td>ASTM E72</td>
<td></td>
</tr>
<tr>
<td>Standard Method of Test for Determination of Non-Combustibility in Building Materials</td>
<td>CAN/ULC S114-05</td>
<td>Passed</td>
</tr>
<tr>
<td>Standard for Test for Surface Burning Characteristics of Building Materials and Assemblies</td>
<td>UL 723</td>
<td></td>
</tr>
<tr>
<td>Surface Burning Characteristics (Flame Spread/Spoke Development)</td>
<td>ASTM E84 CAN/ULC S102</td>
<td>0/0</td>
</tr>
<tr>
<td>Behavior of Materials in a vertical Tube Furnace at 750 Degrees C</td>
<td>ASTM E136</td>
<td>Passed</td>
</tr>
<tr>
<td>Uniform Load Test Reports</td>
<td>ASTM E330</td>
<td></td>
</tr>
<tr>
<td>Test Description</td>
<td>Test Standard</td>
<td>Approx. Values Standard (Metric)</td>
</tr>
<tr>
<td>----------------------------------------</td>
<td>-------------------------------</td>
<td>---------------------------------</td>
</tr>
<tr>
<td>Concentrated Load Test Reports</td>
<td>ASTM E661</td>
<td>550 lb. (2.45 kN) static</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.108” (2.7 mm) max. deflection @</td>
</tr>
<tr>
<td></td>
<td></td>
<td>200 lb. (0.89 kN)</td>
</tr>
<tr>
<td>Design Load Creep-Recovery Test Report</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>ICC-ES AC318 Test Reports</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Density b</td>
<td>ASTM C1185 (Section 10.2)</td>
<td>75 lb./ft3 (1,201 kg/m3)</td>
</tr>
<tr>
<td>Linear Variation with Change in moisture (25-90% relative humidity)</td>
<td>ASTM C1185 (Section 8)</td>
<td>&lt;0.10 %</td>
</tr>
<tr>
<td>Freeze / thaw resistance</td>
<td>ASTM C1185</td>
<td>Passed (50 cycles)</td>
</tr>
<tr>
<td>Water Absorption c</td>
<td>ASTM C1185 (Section 5.2.3 1)</td>
<td>&lt;15.0 %</td>
</tr>
<tr>
<td>Long Term Durability</td>
<td>ASTM C1185 (Section 13)</td>
<td>min. 75% retention of physical properties</td>
</tr>
<tr>
<td>Water Durability</td>
<td>ASTM C1185 (Section 15)</td>
<td>min. 70% retention of physical properties</td>
</tr>
<tr>
<td>pH Value</td>
<td>ASTM D1293</td>
<td>10.5</td>
</tr>
<tr>
<td>Low VOC Emissions</td>
<td>CDPH/EHLB/Standard Method V1.1-2010 d</td>
<td>Compliant</td>
</tr>
</tbody>
</table>

C. COMPLIANCE ALTERNATIVE – Use of USG Structural Concrete Panel for Floor Sheathing

The National Building Code of Canada (NBC) was developed by the Canadian Commission on Building and Fire Codes, and sets out technical provisions for the design and construction of new buildings. The NBC is utilized by the following Canadian Provinces/Territories: Saskatchewan, Manitoba, Newfoundland & Labrador, Nova Scotia, New Brunswick, Prince Edward Island, Nunavut, Yukon, Northwest Territories, and Quebec (Including all applicable amendments from the 2010 National Building Code)

The following Compliance Alternative Report for the USG Structural Concrete Panel which will address the material evaluation, functional and objective statements of the NBC to permit the panel to be acceptable for use in the following applications:

1. Combustibility – For implementation as a Non-combustible floor sheathing
2. Structural – For implementation as a structural floor sheathing
3. Fire Resistance Rating: For approval of previously approved UL rated floor assemblies and fire rated characteristics
## 1 - NON-COMBUSTIBILITY

### National Building Code Requirements:
The NBC states the following requirements for non-combustibility:

#### Section 3.1.12.1. (2):
*The flame-spread rating and smoke developed classification of a material or assembly shall be determined on the basis of not less than three tests conducted in conformance with CAN/ULC-S102.2 “Test for Surface Burning Characteristics of Flooring, Floor Coverings, and Miscellaneous materials and Assemblies”, if the material or assembly*
  - a) Is designed for use in a relatively horizontal position with only its top surface exposed to air,
  - b) Cannot be tested in conformance with Sentence (1) without the use of supporting material that is not representative of the intended installation or
  - c) Is thermoplastic

#### Section 1.4.1.2 (1) [4]:
*Noncombustible means that a material meets the acceptance criteria of CAN/ULC-S114, “Test for Determination of Non-Combustibility in Building Materials.”*

### CAN/ULC Standards:
As noted above, the CAN/ULC Standards for Non-Combustibility are the following:
- CAN/ULC-S114-05 “Test for Determination of Non-Combustibility in Building Materials”
- CAN/ULC-S102.2-10 “Test for Surface Burning Characteristics of Flooring, Floor Coverings and Miscellaneous Materials and Assemblies.

### Testing Data:
The Table below is an excerpt from the USG Structural Panel Concrete Subfloor Submittal Sheet (Full testing data and results can be provided upon request)

As noted in the test data, The USG Structural Panel Concrete Subfloor passed both the CAN/ULC-S114 and CAN/ULC-S102 testing standards. For additional back-up documentation, please contact engineer for additional data.
- Test Record No. 23 – dated September 27th, 2013
### Table #1: Test Data from USG Structural Panel Concrete Subfloor Submittal Sheet

**Conclusions:**
The NBC clearly identified the non-combustible testing standards. As noted above, the Structural Concrete Panel passed all required testing, therefore, this product is suitable for non-combustible applications in Canada, and does not required a compliance alternative assessment.

<table>
<thead>
<tr>
<th>Physical and Mechanical Properties</th>
<th>Test Standard</th>
<th>Approximate Values Standard (Metric)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concentrated load</td>
<td>ASTM E661</td>
<td>550 lb. (2.45 kN) static 0.108&quot; (2.7 mm) max. deflection @ 200 lb. (0.89 kN)</td>
</tr>
<tr>
<td>Fastener lateral resistance*</td>
<td>ASTM D1761, Sec. 10.2</td>
<td>&gt; 210 lbf (0.93 kN) dry &lt; 160 lbf (0.71 kN) wet</td>
</tr>
<tr>
<td>Density*</td>
<td>ASTM C1185</td>
<td>75 lb./ft³ (1.201 kg/m³)</td>
</tr>
<tr>
<td>Weight at 3/4&quot; (19 mm) thickness</td>
<td>ASTM D1037</td>
<td>5.3 lb./ft³ (26 kg/m³)</td>
</tr>
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<td>Thickness swell</td>
<td>ASTM D1037, B</td>
<td>max. 3.0 %</td>
</tr>
<tr>
<td>Freeze / thaw resistance</td>
<td>ASTM C1185</td>
<td>Passed (50 cycles)</td>
</tr>
<tr>
<td>Mold resistance</td>
<td>ASTM D2273; ASTM G21</td>
<td>10</td>
</tr>
<tr>
<td>Water absorption c</td>
<td>ASTM C1185, Sec 5.2.3.1</td>
<td>&lt;15.0 %</td>
</tr>
<tr>
<td>Noncombustibility</td>
<td>ASTM E136-12 (unmodified) CAN/ULC-S114</td>
<td>Passed</td>
</tr>
<tr>
<td>Surface-burning characteristics (flame spread/smoke developed)</td>
<td>ASTM E84; CAN/ULC-S102</td>
<td>0/0</td>
</tr>
<tr>
<td>Long-term durability</td>
<td>ASTM C1185, Sec 13</td>
<td>min. 75% retention of physical properties</td>
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<td>Compliant</td>
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2 - STRUCTURAL

National Building Code Requirements (Part 4 Structural Design):

The NBC states the following requirements for structural performance of materials:

Section 4.3. DESIGN REQUIREMENTS for STRUCTURAL MATERIALS

4.3.3. Plain, Reinforced and Pre-Stressed Concrete

4.3.3.1 Design Basis for Plain, Reinforced and Pre-stressed Concrete

1) Buildings and their structural members made of plain, reinforced and pre-stressed concrete shall conform to CSA A23.3, “Design of Concrete Structures.”

CAN/ULC Standards:

As noted above, the CAN/ULC Standards for plain, reinforced and pre-stressed concrete is the following:

- CSA A23.3, “Design of Concrete Structures”

Testing Data & Compliance:

Full testing data and results can be provided upon request

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<td>Water Absorption c</td>
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<tr>
<td>Long Term Durability</td>
<td>ASTM C1185 (Section 13)</td>
<td>min. 75% retention of physical properties</td>
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</table>
Alternative Compliance Review

USG Structural Panel Concrete Subfloor is used as either a single floor or as the subfloor (concrete subfloor) when used in conjunction with an underlayment to form a structural floor system to resist gravity loading, floor diaphragm loading, and concentrated loading as typically found in residential and commercial Type I or Type II Construction.

The subject concrete panel is a composite material consisting of an alkali-resistant fiberglass and a Cementous binder. The requirements and testing as listed under the CSA A23.3, “Design of Concrete Structures” does not include the parameters and requirements for the USG Structural Panel Concrete Panel Subfloor. As listed below the functional and objective statements of the 2015 National Building Code have been reviewed to meet the code intent.

**Functional & Objective Statements for 4.3.3.3. (1) Plain, Reinforced and Pre-Stressed Concrete**

- F20-OS 2.1
- F80, F81-OS 2.3
- F20 – OP2.1
- F21, F22 – OP2.4
- F80, F81 – OP2.3, OP2.4
- F21, F22, F80, F81 – OH4

Refer to Section D for Engineering responses to all functional & objective statements.

**Conclusions:**

Based on the review of the objective and function statements, Steenhof Building Services Group confirms that the use of the USG Structural Concrete Sheathing is an approved alternative for structural floor sheathing.
3 - FIRE SEPERATIONS


The NBC states the following requirements for fire resistance ratings of materials:

3.1.7 Determination of Ratings

3.1.7.1 Determination of Ratings

1) Except as permitted by sentence (2) and articles 3.1.7.2 and 3.6.3.5, the rating of a material, assembly of materials or a structural member that is required to have a fire resistance rating, shall be determined on the bases of the results of tests conducted in conformance with CAN/ULC-S101 “Fire Endurance Testing of Building Construction and Materials”

2) A material, assembly of materials or a structural member is permitted to be assigned a fire resistance rating on the basis of Appendix D of the National Building Code of Canada

Code References not Applicable:

3.1.7.2 “Exposure for Exterior Walls” – Not Applicable
3.6.3.5 “Grease Duct Enclosures” – Not Applicable

CAN/ULC Standards:

As noted above, the CAN/ULC Standards for Determination of Ratings is as follows:


UL Approved Floor assemblies

- Floor Substrate: Concrete Structural Panel Subfloor
- Structural Members: Min 10” (254mm) deep 16 ga steel C-Joist max 24” (610mm) o.c.
- Ceiling Support: Resilient Channels spaced max 12” (305mm) oc or suspension system.
- Finished Ceiling: 5/8” (16mm) thick gypsum board on ½” (12mm) deep resilient
- FRR: Unrestrained 2 Hr.
ULC I535

- Floor Substrate - Concrete structural panel subfloor
- Structural Members - Min. 9-1/4in. (235 mm) deep 16 ga. steel C-Joists max. 24 in. (610 mm) OC
- Ceiling Support - Resilient channels spaced max. 12 in. (305 mm) OC or suspension system
- Finished Ceiling - Two layers of 5/8 in. (16 mm) thick gypsum board on ½” (12mm) deep resilient
- FRR: Unrestrained 2 Hr.

ULC I536

- Floor Substrate – Concrete structural panel subfloor
- Structural members (upper frame) – Min. 6 in. (152mm) min. W6x9 beams and min. 6 in. (152mm) deep 14ga. Steel C-joists max. 24 in. (610mm) OC
- Batts and Blankets – 3-1/2” (89mm) thick fiberglass insulation and support system
- Frame spacer – 4 in. by 4 in. (102mm by 102mm) ¾” (19mm) thick steel spacer
- Structural members (lower frame) – Min. 4 in. (102mm) min. W4x13 wide flange beams and min. 4 in. (102mm) deep 16ga. Steel C-joists max. 24 in. (610mm) OC
- Finished ceiling – 5/8 in. (16mm) thick gypsum board on ½” (12mm) deep resilient channels
- FRR: Unrestrained 2 Hr.

ULC I529

- Floor Substrate - Concrete structural panel subfloor
- Structural Members - Min. 10 in. (254 mm) deep 16 ga. steel C-Joists max. 24 in. (610 mm) OC
- Ceiling Support - Resilient channels spaced max. 12 in. (305 mm) OC or suspension system
- Finished Ceiling - Two layers of 5/8 in. (16 mm) thick gypsum board on ½” (12mm) deep resilient
- FRR: Unrestrained 2 Hr.
Testing Data:

<table>
<thead>
<tr>
<th>Description</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Code Reports</td>
<td>ICCESR-1792; PER-13067</td>
</tr>
<tr>
<td>City Code Approvals</td>
<td>Los Angeles: LARR # 25682</td>
</tr>
<tr>
<td>Ultimate Uniform Load* (total DL and LL)</td>
<td>Seetablebelow</td>
</tr>
<tr>
<td>Shear Diaphragm Ratings</td>
<td>1.468 plf (21.4 km/h)</td>
</tr>
<tr>
<td>UL-1, 1.5-, 2-Hour Fire Resistance Designs*</td>
<td>IS26, IS27, IS28, IS29, M520, M521</td>
</tr>
<tr>
<td>UL-2, 3-Hour Load-Bearing Walls*</td>
<td>V465, V471</td>
</tr>
<tr>
<td>UL/ULC Metal and Plastic Through-Penetration Firestop Systems*</td>
<td>F-E-1023, F-E-1032, F-E-2045,</td>
</tr>
<tr>
<td>Acoustical Ratings</td>
<td>&gt;65ILC</td>
</tr>
<tr>
<td>(a) On steel framing.</td>
<td></td>
</tr>
<tr>
<td>(b) Joints spaced 24&quot; (610 mm) o.c. and fasteners spaced 6&quot; (153 mm) o.c. at the perimeter and 12&quot; (305 mm) o.c. in field, blocked. See the Progressive Engineering Inc. Product Evaluation Report PER-13067</td>
<td></td>
</tr>
<tr>
<td>(c) Carpet and pad over USG Structural Panel Concrete Subfloor attached to cold-formed steel framing with a ceiling consisting of resilient channels spaced 12&quot; (305 mm) o.c., 3/1/2&quot; (89 mm) of fiberglass insulation in the joist cavity and a single layer of 1/2&quot; (16 mm) USG Sheetrock® Brand Firecode® C Gypsum Panel gypsum panel.</td>
<td></td>
</tr>
</tbody>
</table>

Alternative Compliance Review

USG Structural Panel Concrete Subfloor is used as either a single floor or as the subfloor (concrete subfloor) when used in conjunction with an underlayment to form a structural floor system.

The subject concrete panel is a fiber reinforced product is currently approved under the above mentioned UL and ULC Listed Floor assemblies as an approved fire rated assembly. As listed below the functional and objective statements of the 2015 National Building Code have been reviewed to meet the code intent for fire resistance in the listed assemblies.

Functional & Objective Statements for 3.1.7.1 Determination of Ratings

- F03-OS 2.1,
- F04-OS 1.3
- F03-OP 1.2
- F04-OP 1.3

Refer to Section D for Engineering responses to all functional & objective statements.

Conclusions:

Based on the review of the objective and function statements, Steenhof Building Services Group confirms that the use of the USG Structural Concrete Sheathing is an approved alternative in coordination with approved UL Floor assemblies.
### D. COMPLIANCE ALTERNATIVE – Alternative Solution – Functional & Objective Statements

<table>
<thead>
<tr>
<th>Functional Statements &amp; Objectives</th>
<th>Proposed Solution to meets Functional &amp; Objective Statements</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>F03</strong> To retard the effects of fire on areas beyond its point of origin.</td>
<td>The USG Structural Panel Concrete Subfloor is non-combustible and is in conformance with test standard CAN/ULC-S114 for non-combustibility. Also the USG panel has been test to CAN/ULC-S102 for both flame spread and smoke developed and achieved 0 for both values. The USG Structural Panel Concrete Subfloor will retard the effects of fire on areas beyond its point of origin. In addition when the USG Structural Panel Concrete Subfloor is combined with other set noncombustible materials a 1 to 2 hour fire-rated floor ceiling assembly can be achieved. ULC has tested and approved assemblies as per CAN/ULC-S101 (Refer to appendix)</td>
</tr>
<tr>
<td><strong>F04</strong> To retard failure or collapse due to the effects of fire.</td>
<td>The USG Structural Panel Concrete Subfloor is non-combustible and has been tested to CAN/ULC-S102 and In addition when the USG Structural Panel Concrete Subfloor is combined with other set noncombustible materials a 1 to 2 hour fire-rated floor ceiling assembly can be achieved. Testing for the fire-rated assemblies is to CAN/ULC-S101 “Fire Endurance Testing of Building Construction and Materials”. With these material attributes the USG Structural Panel Concrete Subfloor retards failure or collapse due to the effects of fire.</td>
</tr>
<tr>
<td><strong>F20</strong> To support and withstand expected loads and forces.</td>
<td>Engineering analysis confirms that the panel can be used as either a single floor or as the subfloor (Concrete Subfloor) when used in conjunction with an underlayment to form a structural floor. The Concrete Subfloor can be combined with other materials to create a structural diaphragm appropriate for the intended application, and is sufficient in moment, shear, and deflection criteria under the prescribed loads set out in Part 4 of the 2015 National Building Code.</td>
</tr>
<tr>
<td><strong>F21</strong> To limit or accommodate dimensional change</td>
<td>The USG Structural Concrete Subfloor panel has less than .10% dimensional change when relative humidity is between 25% and 90%. (Tested to ASTM C1185) In addition long term durability when tested to ASTM C1185, Sec 13 is greater than 75% retention of physical properties. For water durability when tested to ASTM C1185,Sec. 5 the retention of physical properties is greater than 70%. Thickness swell is maximum 3% when test to ASTM D1037B and Linear variation with change in moisture (25% to 90% relative humidity) is less than 0.10% when tested to ASTM C1185,Sec.8. The USG Structural Concrete Floor panel limits or accommodates dimensional change.</td>
</tr>
<tr>
<td>Code</td>
<td>Description</td>
</tr>
<tr>
<td>------</td>
<td>-------------</td>
</tr>
<tr>
<td>F22</td>
<td>To support and withstand expected loads and forces.</td>
</tr>
<tr>
<td>F80</td>
<td>To resist deterioration resulting from expected service conditions</td>
</tr>
<tr>
<td>F81</td>
<td>To minimize the risk of malfunction, interference, damage, tampering, lack of use or misuse.</td>
</tr>
<tr>
<td>OH 4</td>
<td>An objective of this Code is to limit the probability that, as a result of the design or construction of a building, a person in the building will be exposed to an unacceptable risk of injury due to the building’s low level of resistance to unwanted entry.</td>
</tr>
<tr>
<td>OS 1.3</td>
<td>An objective of this Code is to limit the probability that, as a result of the design or construction of a building, a person in or adjacent to the building will be exposed to an unacceptable risk of injury due to fire caused by the collapse of physical elements due to a fire or explosion.</td>
</tr>
<tr>
<td>OS 2.1</td>
<td>Structural Safety: An objective of this Code is to limit the probability that, as a result of the design or construction of the building, a person in or adjacent to the building will be exposed to an unacceptable risk of injury due to structural failure. The risks of injury due to the structural failure addressed in this Code are those</td>
</tr>
</tbody>
</table>
caused by - loads bearing on the building elements that exceed their loadbearing capacity | structural failure, as the design loads do not exceed the load bearing capacity of the member

| OS 2.3 | An objective of this Code is to limit the probability that, as a result of the design or construction of a building, a person in or adjacent to the building will be exposed to an unacceptable risk of injury due to structural failure caused by damage to or deterioration of building elements. | Engineering analysis confirms that the panel is can be used as either a single floor or as the subfloor (Concrete Subfloor) when used in conjunction with an underlayment to form a structural floor. The panel can also be designed and constructed as a structural diaphragm appropriate for the intended application, and is sufficient in moment, shear, and deflection criteria under Part 4 of the 2015 National Building Code. A person in or adjacent to the building is not exposed to unacceptable risk of injury due to structural failure, as the design loads do not exceed the load bearing capacity of the member. |

| OP 1.2 | An objective of this Code is to limit the probability that, as a result of its design or construction, a building will be exposed to an unacceptable risk of damage due to fire caused by fire or explosion impacting areas beyond its point of origin. | The USG Structural Concrete Floor panel is structural and when installed with other noncombustible materials can create 1 and 2 hour fire rated floor-ceiling assemblies. This panel when installed on floor assemblies with ratings required for the occupancy served and in accordance with the fire separations set out in the National Building code, will limit the probability as a result of design or construction, a building will be exposed to an unacceptable risk of damage due to fire caused by fire or explosion impacting areas beyond its point of origin. |

| OP 1.3 | An objective of this Code is to limit the probability that, as a result of its design or construction, a building will be exposed to an unacceptable risk of damage due to fire caused by collapse of physical elements due to a fire or explosion. | The USG Structural Concrete Floor panel is structural and when installed with other noncombustible materials can create 1 and 2 hour fire rated floor-ceiling assemblies. This panel when installed on floor assemblies with ratings required for the occupancy served and in accordance with the fire separations set out in the National Building code, will limit the probability as a result of design or construction, a building will be exposed to an unacceptable risk of damage due to fire caused by collapse of physical elements due to a fire or explosion. |

| OP 2.1 | An objective of this Code is to limit the probability that, as a result of its design or construction, a building or part of it will be exposed to an unacceptable risk of damage or loss of use due to structural failure or lack of structural serviceability caused by loads bearing on the building elements that exceed their loadbearing capacity. | Engineering analysis confirms that the panel is can be used as a single floor or as the subfloor (Concrete Subfloor) in conjunction with an underlayment to form a structural floor. The panel can also be designed as a structural diaphragm appropriate for the intended application, and is sufficient in moment, shear, and deflection criteria under Part 4 of the 2015 National Building Code and the load resistances set out in PER-13067 (copy attached). This objective is met if the USG Structural Panel Concrete Subfloor is structural designed to resists the loads set out in Part 4 of the National Building Code. |

<p>| OP 2.3 | An objective of this Code is to limit the probability that, as a result of Engineering review of the proposed product confirms that the USG Structural Panel Concrete Subfloor would resist |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>its design or construction, a building or part of it will be exposed to an unacceptable risk of damage or loss of use due to structural failure or lack of structural serviceability caused by damage to or deterioration of building elements.</strong></td>
<td><strong>deterioration from typical service conditions in conformance with the 2015 National Building Code.</strong> Mold resistance is 10 when tested to ASTM D3273 and 0 when tested to ASTM G21. Freeze/thaw resistance passed (50 cycles) when tested to ASTM C1185. Water absorption is less than 15% when tested to ASTM C1185, Sec. 5.2.3.1. This objective (OP 2.3) is fulfilled when protected from construction abrasive wear and impact after panel installation until the floor has its final finish applied. (Refer to the USG Installation Instructions)</td>
</tr>
<tr>
<td><strong>OP 2.4</strong></td>
<td><strong>An objective of this Code is to limit the probability that, as a result of its design or construction, a building or part of it will be exposed to an unacceptable risk of damage or loss of use due to structural failure or lack of structural serviceability caused by vibration or deflection of building elements.</strong> Engineering analysis confirms that the panel is can be used as either a single floor or as the subfloor (Concrete Subfloor) when used in conjunction with an underlayment to form a structural floor. The panel can also act as a structural diaphragm appropriate for the intended application, and is sufficient in moment, shear, and deflection criteria under Part 4 of the 2015 National Building Code and the load resistances set out in PER-13067. (Copy attached). This objective is met if the USG Structural Panel Concrete Subfloor is structural designed to resists the loads set out in Part 4 of the National Building Code.</td>
</tr>
</tbody>
</table>
E. COMPLIANCE ALTERNATIVE – Conclusion

The proposed solution offers a compliance alternative that fulfills the functional statements and objectives of the 2015 National Building Code of Canada. Based on the above research and review, we certify that this material meets the intention of the 2015 National Building Code of Canada for the following applications:

1. Combustibility – For implementation as a Non-combustible floor sheathing
2. Structural – For implementation as a structural floor sheathing
3. Fire Resistance Rating: For approval of previously approved UL rated floor assemblies and fire rated characteristics.

Based on the above parameters, Steenhof Building Services Group confirms that the use of the USG Structural Concrete Subfloor panel meets the intent as an “alternative solution” for use in residential and commercial subfloor and overall floor assemblies. If there are any additional concerns or questions, please do not hesitate to contact the undersigned engineer.

Sincerely,

Jack Steenhof P.Eng.
Steenhof Building Service Group
Canadian Building Code Compliance Alternative Report for USG Structural Concrete Panel

APPENDIX

Full testing data and results for testing listed in report can be provided upon request

<table>
<thead>
<tr>
<th>References</th>
<th>Appendix Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>USG Installation Guidelines – Concrete Subfloor</td>
<td>A1</td>
</tr>
<tr>
<td>USG Structural Panels</td>
<td></td>
</tr>
<tr>
<td>Statement of no combustibility of Cementitious Panels</td>
<td>A2</td>
</tr>
<tr>
<td>USG Technical Data</td>
<td></td>
</tr>
<tr>
<td>USG Structural Panel – Concrete Subfloor</td>
<td>A3</td>
</tr>
<tr>
<td>Progressive Engineering Evaluation PER-13067</td>
<td>A4</td>
</tr>
<tr>
<td>USG Panel Concrete Subfloor</td>
<td></td>
</tr>
<tr>
<td>ULC Assembly - ULC I528 (UL G556)</td>
<td>A5</td>
</tr>
<tr>
<td>ULC Assembly - ULC I535 (UL G557)</td>
<td>A6</td>
</tr>
<tr>
<td>ULC Assembly - ULC I536 (UL G536)</td>
<td>A7</td>
</tr>
<tr>
<td>ULC Assembly - ULC I529 (UL H505)</td>
<td>A8</td>
</tr>
</tbody>
</table>
USG STRUCTURAL PANEL 
CONCRETE SUBFLOOR 
FIELD INSTALLATION GUIDE
USG STRUCTURAL PANEL CONCRETE SUBFLOOR
CONTACT INFORMATION

PRODUCT INFORMATION
See usg.com for the most up-to-date product information.

CUSTOMER SERVICE
800 621-9523

TECHNICAL SERVICE
800 USG.4YOU (874-4968)

SAMPLES, LITERATURE AND PRODUCT INFORMATION
usg.com/structural

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Product Manager
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312 436-4260

usgstructural@usg.com
USG STRUCTURAL PANEL
CONCRETE SUBFLOOR
PANEL FASTENING

- Proper fall restraint equipment required
- Use only #8 screw with 1-5/8” (41 mm) joist flange
- Apply screws with a stand-up gun to reduce fatigue
- Follow fastening schedule in contract documents

Note: *Fastener schedule is to be specified by designer of record.

* Typical fastener spacing

Screw distance must be 1/2” from panel edge

USG recommends the following screws for fastening of USG Structural Panels:

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Part #</th>
<th>Fastener Pull-Through¹</th>
<th>16ga Cold-Formed Steel (5/8” (16 mm) Min. Edge Distance)</th>
<th>SPF Lumber (5/8” (16 mm) Min. Edge Distance)</th>
<th>1/4” (6.3 mm) A36 Hot Rolled Steel (3/4” (19 mm) Min. Edge Distance)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grabber Construction Products, Inc.</td>
<td>CGH8158LG</td>
<td>581 lbs. (264 kg)</td>
<td>CGH8158LG</td>
<td>581 lbs. (264 kg)</td>
<td>CGH8158LG</td>
</tr>
<tr>
<td>Simpson Strong-Tie Company Inc.</td>
<td>CBSQ1585S</td>
<td>581 lbs. (264 kg)</td>
<td>CBSQ1585S</td>
<td>581 lbs. (264 kg)</td>
<td>CBSQ1585S</td>
</tr>
</tbody>
</table>

Note: 1. Fastener pull-through capacities are based upon the minimum average ultimate tested capacity for all tabulated fasteners. The engineer or designer of record shall apply an appropriate safety factor (ASD) or resistance factor (LRFD).

General Notes: In accordance with PER-13067, the minimum screw pattern is 6 inches (153 mm) o.c. along the perimeter of the panels and 12 inches (305 mm) o.c. in the field of the panels. Do not use a larger sizescrew unless specifically specified by the structural engineer. A qualified architect or engineer should review and approve calculations, framing and fastener spacing for all projects.
When connecting the tongue and groove, the tongue from the loose panel should be engaged into the groove of the already affixed panel.

To ensure proper panel application, be sure to:
1. Lay board down
2. Engage tongue and groove (T & G)
3. Fasten one corner
4. Fan out over the panel
USG STRUCTURAL PANEL
CONCRETE SUBFLOOR
FRAMING DIRECTION CHANGE

- Always lay panels perpendicular to supporting joists.
USG STRUCTURAL PANEL
CONCRETE SUBFLOOR
PANEL LAYOUT:
TWO-SPAN CONDITION

Two spans minimum
24" wide or larger
Less than 24"
Single span
CORRECT
T&G always perpendicular to joists
INCORRECT

See Panel Blocking—Page 6
USG STRUCTURAL PANEL
CONCRETE SUBFLOOR
PANEL BLOCKING

- Block edges that are less than 24” (610 mm) wide
- Field welding to cold-formed framing members must be performed by certified welder and approved by structural engineer of record

Note:
*Panel Blocking must be specified by designer of record.
**Panels must bear at least 3/4” (19 mm) over joist flange

* Apply blocking before panel application

Less than 24”

Alternate Screw Attachment Option

Spot weld

** Panel end bearing minimum 3/4” each side

End bearing < 3/4” requires blocking

Cold-formed steel cripple min. 18 ga. to support panel ends
USG STRUCTURAL PANEL
CONCRETE SUBFLOOR
PANEL PENETRATION

Unreinforced Penetrations
• Unreinforced penetrations are limited to a maximum dimension of 6” (153 mm) and do not require supplemental framing or engineer analysis.
• Unreinforced penetrations are generally small openings through decks to accommodate lightly loaded plumbing/electrical runs.

Reinforced Penetrations
• An opening with a dimension greater than 6” (153 mm) requires reinforcement at the perimeter of the opening.
• The framing at reinforced penetrations, as a minimum, must have an equal profile and capacity as the adjacent primary framing (joists) members.
• The maximum penetration dimension is not limited to a single opening, but also includes group effect of multiple, closely spaced openings.
USG STRUCTURAL PANEL
CONCRETE SUBFLOOR

PANEL LAYOUT:
OVER FLUTED DECK

- The concrete subfloor on fluted deck is always considered an underlayment
- The concrete subfloor is not considered a structural component
- There is no composite action between fluted deck and the concrete subfloor

T&G always perpendicular to flutes

INCORRECT
INCORRECT
CORRECT

3/4" min.
USG STRUCTURAL PANEL
CONCRETE SUBFLOOR
PANEL CUTTING

• Use a dust vacuum
• Wear appropriate respiratory protection
• Wear safety glasses
• Wear gloves
• Proper fall restraint equipment required
• Review the Safety Data Sheet (SDS) for use of proper Personal Protective Equipment (PPE).
**USG STRUCTURAL PANEL CONCRETE SUBFLOOR**

**EQUIPMENT LOADING**

**Typical Construction Equipment**

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Load capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drywall Carts</td>
<td>10 Sheets of 5/8&quot; x 4' x 12' (16 mm x 1220 mm x 3660 mm) Gypsum Panels max. 1,200 lbs. (544 kg)</td>
</tr>
<tr>
<td></td>
<td>7 Sheets of 3/4&quot; x 4' x 8' (19 mm x 1220 mm x 2440 mm) USG Structural Panels max. 1,200 lbs. (544 kg)</td>
</tr>
<tr>
<td>Rolling Trash Carts</td>
<td>1,000 lbs. max. (453 kg)</td>
</tr>
<tr>
<td>Rolling Scaffolds</td>
<td>750 lbs. max. (340 kg)</td>
</tr>
</tbody>
</table>

**Note:** Secure the cart. *Loads applicable to 24" (610 mm) o.c. maximum framing spacing.

See Panel Protection—Page 11
To protect installed panels during construction:

• Place load spreader planks perpendicular to joists for fixed scaffolding.
• Place additional USG Structural Panels on the floor in high-traffic construction pathways for rolling gang boxes, two-wheel mason carts and trash boxes.
• Avoid rolling carts near protector panel edges.
• Do not use a pallet jack on the floor.
• Consult with designer of record for load limits and proper support for all construction loads.
• Proper fall restraint equipment required.
USG STRUCTURAL PANEL CONCRETE SUBFLOOR PALLET PLACEMENT

Note: *Loading must be verified by a structural engineer

CORRECT
Over Load-Bearing Wall

INCORRECT
Load Needs Support
USG STRUCTURAL PANEL
CONCRETE SUBFLOOR
PROPER PALLET STORAGE

• Ensure unit covers are secure
• Use plastic edge shovel for snow removal
• Freezing may result in panels sticking together
• Allow panels to thaw naturally if frozen
• Only use sand when iced over. Do not use salt, fertilizer or ice melt.

CORRECT

INCORRECT INCORRECT

CORRECT
PRODUCT INFORMATION
See usg.com for the most up-to-date product information.

CUSTOMER SERVICE
800 USG.4YOU (874-4968)

EMAIL
usgstructural@usg.com

WEBSITE
usg.com/structural

MANUFACTURED BY
United States Gypsum Company
550 West Adams Street
Chicago, IL 60661

DANGER
Causes skin irritation. Causes serious eye damage. May cause an allergic skin reaction. May cause respiratory irritation. May cause cancer by inhalation of respirable crystalline silica. Do not handle until all safety precautions have been read and understood. Avoid breathing dust. Use only in a well-ventilated area and wear a NIOSH/MSHA approved respirator. Wear protective gloves/protective clothing/eye protection. If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses and continue rinsing. Immediately call a poison center/doctor if on skin: Wash with plenty of water. Take off contaminated clothing and wash before reuse. Contaminated work clothing should not be allowed out of the workplace. If skin irritation or rash occurs, or otherwise exposed or concerned: Get medical attention. Store locked up. Dispose of in accordance with local, state and federal regulations.

For more information call Product Safety: 800 507-8899 or see the SDS at usg.com.

KEEP OUT OF REACH OF CHILDREN.

NOTICE
We shall not be liable for incidental and consequential damages, directly or indirectly sustained, nor for any loss caused by applications of these goods not in accordance with current printed instructions or for other than the intended use. Our liability is expressly limited to replacement of defective goods. Any claim shall be deemed waived unless made in writing to us within 30 days from date it was or reasonably should have been discovered.

SAFETY FIRST!
Follow good safety/industrial hygiene practices during installation. Wear appropriate personal protective equipment. Read SDS and literature before specification and installation.
USG STRUCTURAL PANELS

STATEMENT OF NONCOMBUSTIBILITY OF CEMENTITIOUS PANELS

The only structural, noncombustible panel both manufactured and available in the U.S.A. is USG Structural Panel, manufactured by USG.

USG Structural Panels are considered as structural cementitious panels per the requirements of ICC-ES Acceptance Criteria for Structural Cementitious Floor and Roof Sheathing Panels (AC318) rev. October 2015. This criteria contains a requirement to have passed ASTM E136, “Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C,” and a requirement that the primary reinforcing component in the panel shall not be wood or cellulose fibers.

Products that are cementitious but do not meet the standard for noncombustibility include, but are not limited to, cement bonded particle board panels. The reason is that these panels have not shown that they meet the duration requirement of ASTM E136. This standard requires the duration of the test to be 30 minutes. The State of Florida Building Commission ruled on this issue in 2007. (Please contact your USG Structural Panel representative for a copy of the State of Florida Building Commission’s ruling.)

In its ruling, the State of Florida Building Commission confirmed the duration of the ASTM E136 test to be 30 minutes. The commission ruled that the duration cannot be reduced (modified) to 10 minutes. Its conclusion was that cement bonded particle board is considered combustible until it can pass an unmodified ASTM E136 test.

Note that some manufacturers and vendors use the phrases “non-combustibility,” “noncombustibility,” “non-combustible” or “noncombustible” in describing their structural panels. However, the manufacturers claim only that these panels meet a modified ASTM E136 test. As noted above, a panel is considered combustible until it can pass an unmodified ASTM E136.

Below are links to various competitive products stating 10-minute modifications/durations for the ASTM E136:

- Versaroc® (Scroll down to “Key Advantages”)
- Armoroc® (Click “Armoroc” and scroll down to “Key Benefits”)

Plycem® CemDeck™ is listed as the structural product in commercial thickness of 3/4” (19 mm). When paying close attention to the reports listed online for ICC-ES Evaluation Report ESR-1219, it only covers siding boards 0.43” (11 mm) and 0.55” (14 mm); no mention of the report covering a structural panel of 3/4” (19 mm) thickness. Then again, a test report is listed on Plycem’s website for ASTM E136, but when looking at the report only thicknesses from 4 mm to 10 mm were tested. Finally, the manufacturer lists Underwriters Laboratories UL Certificate where ASTM E136-12 isn’t a standard listed.

Previously another manufacturer, Viroc®, had enter the U.S. with a product for floor sheathing, meeting German Standards DIN 4102, and even pursuing and obtaining a legacy report from ICC-ES. However since their introduction, it was found the product did not meet ASTM E136, and as such the company now only markets their product as an interior wall cladding and molding/trim product for the U.S. by way of their distributor VirocNY. However, the manufacturer a Portugal-based still promotes and markets the structural panel for floor sheathings. See link below:

Viroc®

This topic was covered by an independent code consultant who warns decision makers in the U.S. about cement bonded particle board products that are being promoted as noncombustible in the U.S. when the products are manufactured outside the U.S. and the countries where they are used often have different standards than the current U.S. standard. The code consultant’s comments can be found at this link:

Vandergriff Code Consulting Services
Underwriters Laboratories Certification Directory is widely known as the most reliable source for validation and certification of building materials for many life-safety, health and welfare characteristics. Within the directory, “Structural Cement-fiber Units” are contained in UL Category Code CIYT. However, this category only covers structural cement-fiber units investigated for use in fire-resistance designs as detailed in Fire-resistance Ratings. Whereas, UL Category Code BICW covers various noncombustible building materials certified in accordance with ANSI/ASTM E136, “Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C.”

The ongoing certification by UL for Category BICW ensures that every panel manufactured meets the requirements for noncombustibility in accordance with ASTM E136.

USG Structural Panels are the only structural, noncombustible panels manufactured and available in the U.S.A.

Manufactured by USG, USG Structural Panels meet the U.S. standard for noncombustibility in accordance with ASTM E136. See the following UL link for our Noncombustible Building Materials certification:

USG Structural Panels UL Noncombustible Building Materials certification

Always verify a product’s noncombustibility claims by ensuring that a certification agency like UL has a program of continued validation.

For more information on USG Structural Panels, or for a copy of USG Structural Panel’s ASTM E136-12 Certificate from UL, please contact the USG Structural Solutions team.

<table>
<thead>
<tr>
<th>USG Structural Solutions</th>
<th>Name</th>
<th>Phone</th>
<th>Email</th>
</tr>
</thead>
<tbody>
<tr>
<td>National Sales Manager</td>
<td>Mike Inman</td>
<td>312 436-4270</td>
<td><a href="mailto:minman@usg.com">minman@usg.com</a></td>
</tr>
<tr>
<td>Technical Sales Manager</td>
<td>Frank Pospisil</td>
<td>312 436-7618</td>
<td><a href="mailto:fpospisil@usg.com">fpospisil@usg.com</a></td>
</tr>
<tr>
<td>Product Manager</td>
<td>Jose Estrada</td>
<td>312 436-4260</td>
<td><a href="mailto:jmestrada@usg.com">jmestrada@usg.com</a></td>
</tr>
</tbody>
</table>
USG STRUCTURAL PANEL
CONCRETE SUBFLOOR

A concrete subfloor that can be combined with other noncombustible materials to create 1- and 2-hour fire-rated floor-ceiling assemblies.

- Strong, durable concrete panel
- Dimensionally stable; panel will not buckle or warp like wood sheathing
- Installs like wood sheathing; circular saw for cutting, screws for fastening
- Meets the criteria of ASTM E136-12 for use in all types of noncombustible construction

USG Structural Panel Concrete Subfloors are mechanically fastened to cold-formed steel joists, trusses or framing members. A noncombustible ceiling assembly is attached to the bottom of the floor joists to complete the construction. This floor system is designed to carry gravity and lateral loads. Finished floor materials, such as residential carpet and pad, may be applied directly over USG Structural Panel Concrete Subfloors. For retrofit or renovation projects, USG Structural Panel Concrete Subfloors can also be installed on wood joists and hot-rolled steel framing. See recommended fasteners within this submittal sheet.

USG Structural Panel Concrete Subfloors can carry a total load, live and dead, of 330 psf (15.8 kPa) when cold-formed steel framing is spaced 24" (610 mm) o.c. Shear diaphragm design ratings up to 1,468 plf (21.4 kNm) allow this panel to be used as a shear diaphragm in the structural design of the building.

When applied over steel framing, covered with carpet and pad, with a double-layer drywall ceiling attached to resilient channels below the framing, a floor system using USG Structural Panel Concrete Subfloors can achieve a 56 STC and a 65 IIC sound performance rating. Additional acoustically rated systems for various floor and ceiling finishes are available.

USG Structural Panel Concrete Subfloors have a linear variation with change in moisture content of less than 0.10%. This means that the panels will not buckle or warp like wood sheathing. Do not gap USG Structural Panel Concrete Subfloors.

Cutting the concrete subfloor requires a carbide-tipped saw blade and a circular saw equipped with dust collection or suppression to control airborne dust. Fastening is also conventional, using a screw gun and self-drilling No. 8-gauge screws. Because these panels are so durable, they may be installed in most weather conditions including mild precipitation (rain or snow) and temperatures from 0°F to 125°F (-18°C to 52°C).

USG Structural Panel Concrete Subfloors should not be left in service without an appropriate finish floor covering such as ceramic tile, vinyl, wood, carpet or other approved materials. Without an underlayment, future removal of these floor coverings may damage the structural subfloor. The only floor coverings that do not require an underlayment are residential carpet and pad. Do not gap USG Structural Panel Concrete Subfloors.

To perform in the expected manner, USG Structural Panel Concrete Subfloors must be installed according to USG specifications, using only the listed materials and components. For a complete set of specifications, email usgstructural@usg.com

As with all types of construction, appropriate safety procedures must be followed to protect installers from personal injuries resulting from lifting incorrectly, falling, and eye, hand and lung irritation from dust.

Care must be taken when placing pallets of USG Structural Panel Concrete Subfloors on floor framing. A pallet of USG Structural Panel Concrete Subfloors, 20 sheets, 3/4" x 4' x 8' (19 mm x 1,220 mm x 2,440 mm) weighs approximately 3,400 lb. (1,542 kg). Do not exceed floor limits when loading pallets or panels on open framing or completed floor assemblies. Store units next to structural walls where the joists meet the wall. See USG Structural Panel Concrete Subfloor Field Installation Guideline (SCP14) for additional information.
The steel floor framing must be designed to meet the strength and deflection criteria specified in the contract documents. The attachment flange or bearing edge must be a minimum 1-5/8" (41 mm) wide with at least 3/4" (19 mm) of the panel bearing on the supporting flange. Metal framing must be a minimum 16 gauge and spaced no greater than 24" (610 mm) o.c. Follow the contract documents and the steel framing manufacturer’s recommendations for the proper installation and bracing of the framing.

USG recommends the following fasteners for the installation of USG Structural Panels to structural framing:

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>16 ga. Cold-Formed Steel (1/2 in. [13 mm] Min. Edge Distance)</th>
<th>SPF Lumber (5/8 in. [16 mm] Min. Edge Distance)</th>
<th>1/4 in. (6.5 mm) A36 Hot-Rolled Steel (3/4 in. [19 mm] Min. Edge Distance)</th>
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<td>Part #</td>
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<td>Part #</td>
<td>Fastener Pull-Through¹</td>
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<tr>
<td>Grabber Construction</td>
<td>CGH8158LG 581 lb. (264 kg)</td>
<td>CB200L2M 581 lb. (264 kg)</td>
<td>—</td>
</tr>
<tr>
<td>Products, Inc.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Simpson Strong-Tie</td>
<td>CB120158S 581 lb. (264 kg)</td>
<td>WSNTLG2S 581 lb. (264 kg)</td>
<td>FBG2605 581lb. (264 kg)</td>
</tr>
<tr>
<td>Company Inc.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SENCO²</td>
<td>—</td>
<td>GL24AABF¹ 581 lb (264 kg)</td>
<td>—</td>
</tr>
</tbody>
</table>

**Notes:**
1. Fastener pull-through capacities are based upon the minimum average ultimate tested capacity for all tabulated fasteners. The engineer or designer of record shall apply an appropriate safety factor (ASD) or resistance factor (LRFD).
2. SENCO 8d ring shank nails are manufactured with a length of 2-3/8 in., head diameter of 0.266 in. and a shank diameter of 0.113 in. Equivalent 8d ring shank nails meeting these dimensional requirements may be utilized when approved by the engineer or designer of record.
3. Minimum edge distance for nails is 1/2 in.

General Notes: In accordance with PER-13067, the minimum screw pattern is 6 in. (153 mm) o.c. along the perimeter of the panels and 12 in. (305 mm) o.c. in the field of the panels. Do not use a larger size screw unless specified by the structural engineer. A qualified architect or engineer should review and approve calculations, framing and fastener spacing for all projects.

Place sheathing materials (i.e. additional layer of USG Structural Panel or plywood) on the floor in high traffic areas to protect newly installed concrete subfloors. See USG Structural Panel Concrete Subfloor Field Installation Guideline (SCP14) for additional information.

Cut panels to size with a circular saw equipped with carbide-tipped blade and a dry dust collection device or a water-dispensing device that controls the amount of airborne dust. Wear safety glasses and a NIOSH-approved N95 dust mask when cutting this panel. Dispose of collected dust in a safe manner and in compliance with local, state and federal ordinances.

Install USG Structural Panel Concrete Subfloors with the long edges perpendicular to the framing. Apply the panel with the print markings facing up toward the installer. Fasten each panel after it has been placed following the fastening schedule listed in the contract documents. **The use of adhesives in addition to screw-attachment is not required, nor recommended.** Install panels in a running bond pattern so that end joints fall over the center of the framing members and are staggered by at least two supports from where the end joints fall in the adjacent rows. **Tongue and groove joints should be free of debris and fitted tightly without any gapping.** For all panels less than 24" (610 mm) wide, all edges must be supported by blocking. Blocking must be cold-formed from steel complying with AISI-General, with a minimum 54 mils (0.0538 inch or 1.37 mm) base metal thickness (No.16 gauge) and a minimum G60 galvanized coating. The attachment flange or bearing edge must be at least 1-5/8" (41 mm) wide and at least 3/4" (19 mm) of the panel must bear on the supporting flange or edge. See USG Structural Panel Concrete Subfloor Field Installation Guideline (SCP14) for additional information.

Installed panels shall not be exposed to weather for more than 90 days. Care must be taken to avoid accumulation of snow and/or ice on installed panels. Brooms should be used for snow removal whenever possible. Excessive shoveling or scraping may damage installed panel surface. In the event of significant accumulations of snow and/or ice, use indirect heat from temporary space heaters to melt the affected areas. To prevent damage to USG Structural Panel Concrete Subfloors, never expose the panels to direct flame for the purpose of snow removal and/or de-icing efforts. At no time should salts, fertilizers or other chemicals be used on the panels for anti-icing and/or de-icing purposes.

Follow the contract documents and the floor finish manufacturer’s recommendations for the application of finished flooring. Note that most floor finishes will require an underlayment. Before the application of floor finish materials, ensure that all panels are properly fastened, with the fastener head driven flush or slightly below the surface of the panels.
For fire- and sound-rated assemblies, the installed ceiling must comply with the UL-listed Design and USG recommendations. Follow the contract documents and the ceiling manufacturer’s instructions for the ceiling installations. A USG Sheetrock® Brand Firecode® C Core gypsum panel or a plaster ceiling should be applied to resilient channels that are fastened to the joists. A drywall or acoustical suspended ceiling system may also be used to enhance sound performance. For a complete list of UL designs visit usgstructuralul.com

Sizes and Packaging: 3/4” x 4’ x 8’ (19 mm x 1,220 mm x 2,440 mm) panels. Each panel weighs approximately 170 lb. (77 kg) and is intended to be handled by two people. USG Structural Panel Concrete Subfloors are packaged in 20 piece units.

Availability: USG Structural Panel Concrete Subfloors are sold through any USG distributor. Email usgstructural@usg.com for information on availability and a dealer in your area.

Storage: USG Structural Panel Concrete Subfloors are shipped in 20 piece units. Panels should be stored in a horizontal position and uniformly supported. Panels must be covered when stored in unprotected areas.

Excessive moisture and freezing temperatures may result in panels sticking together within the units. Therefore, care should be taken to ensure units of USG Structural Panel Concrete Subfloors are not exposed to excessive moisture, ice and snow. In the event that panels do become frozen together within a unit, the unit needs to be brought to a temperature above 32°F (0°C) to allow the ice to melt naturally. Salt, fertilizer or other de-icing agents should not be used at any time. Covering the units completely with tarps or similar coverings is an easy way to avoid panels freezing together.

Maintenance: USG Structural Panel Concrete Subfloors do not require any regular maintenance except to remove standing water and repair damage from abuse. Any cracked or broken panels should be replaced with sound USG Structural Panel Concrete Subfloor that are secured following the fastening schedule prescribed in the original installation documents. The replacement panels must be a minimum of 24” (610 mm) wide and must span a minimum of two supports. If not, the replacement panel must be fully blocked on all sides. See USG Structural Panel Concrete Subfloor Installation Guideline (SCP14) for additional information

<table>
<thead>
<tr>
<th>Physical and Mechanical Properties</th>
<th>Test Standard</th>
<th>Approximate Values Standard (Metric)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concentrated load</td>
<td>ASTM E661</td>
<td>550 lb. (2.45 kN) static 0.108” (2.7 mm) max. deflection @ 200 lb. (0.89 kN)</td>
</tr>
<tr>
<td>Fastener lateral resistancea</td>
<td>ASTM D1761, Sec. 10.2</td>
<td>&gt; 210 lbf (0.93 kN) dry</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt; 160 lbf (0.71kN) wet</td>
</tr>
<tr>
<td>Densityb</td>
<td>ASTM C1185</td>
<td>75 lb./ft³ (1,201 kg/m³)</td>
</tr>
<tr>
<td>Weight at 3/4” (19 mm) thickness</td>
<td>ASTM D1037</td>
<td>5.3 lb./ft² (26 kg/m²)</td>
</tr>
<tr>
<td>pH value</td>
<td>ASTM D1293</td>
<td>10.5</td>
</tr>
<tr>
<td>Linear variation with change in moisture (25% to 90% relative humidity)</td>
<td>ASTM C1185, Sec. 8</td>
<td>&lt;0.10 %</td>
</tr>
<tr>
<td>Thickness swell</td>
<td>ASTM D1037, B</td>
<td>max. 3.0 %</td>
</tr>
<tr>
<td>Freeze / thaw resistance</td>
<td>ASTM C1185</td>
<td>Passed (50 cycles)</td>
</tr>
<tr>
<td>Mold resistance</td>
<td>ASTM D3273, ASTM G21</td>
<td>10</td>
</tr>
<tr>
<td>Water absorption</td>
<td>ASTM C1185, Sec. 5.2.3.1</td>
<td>&lt;15.0 %</td>
</tr>
<tr>
<td>Noncombustibility</td>
<td>ASTM E136-12 (unmodified) CAN/ULC-STI4</td>
<td>Passed</td>
</tr>
<tr>
<td>Surface-burning characteristics (flame spread/smoke developed)</td>
<td>ASTM E84 CAN/ULC-S102</td>
<td>0/0</td>
</tr>
<tr>
<td>Long-term durability</td>
<td>ASTM C1185, Sec. 13</td>
<td>min. 75% retention of physical properties</td>
</tr>
<tr>
<td>Water durability</td>
<td>ASTM C1185, Sec. 5</td>
<td>min. 70% retention of physical properties</td>
</tr>
<tr>
<td>Termite resistance</td>
<td>AWPA Standard E1-13</td>
<td>9.8</td>
</tr>
<tr>
<td>Low VOC emissions</td>
<td>CDPH/EHLB/Standard Method V1.1-2010 (Emission testing method for CA Specification 01350)</td>
<td>Compliant</td>
</tr>
</tbody>
</table>
**Description**

<table>
<thead>
<tr>
<th>Description</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Code Reports</td>
<td>ICC ESR-1792; PER-13067</td>
</tr>
<tr>
<td>City Code Approvals</td>
<td>Los Angeles: LARR # 25682</td>
</tr>
<tr>
<td>Ultimate Uniform Load (total DL and LL)</td>
<td>See table below</td>
</tr>
<tr>
<td>Shear Diaphragm Ratings</td>
<td>1,468 psf (21.4 kN/m)</td>
</tr>
<tr>
<td>UL 1-, 1.5-, 2-Hour Fire Resistance Designs(^a)</td>
<td>G355, G536, G556, G557, G558, G562, G588, L521, L541, L550, L569, L570, M502, M506, M515, M521, M527, HS01</td>
</tr>
<tr>
<td>ULC 1-, 1.5-, 2-Hour Fire Resistance Designs(^b)</td>
<td>I526, I527, I528, I529, M520, M521</td>
</tr>
<tr>
<td>UL 2-, 3-Hour Load-Bearing Walls(^c)</td>
<td>V465, V471</td>
</tr>
<tr>
<td>UL/ULC Metal and Plastic Through-Penetration Firestop Systems(^d)</td>
<td>F-E-1023, F-E-1032, F-E-2045,</td>
</tr>
<tr>
<td>Acoustical Ratings</td>
<td>&gt;65 RC(^e), &gt;56 STC(^g)</td>
</tr>
</tbody>
</table>

\(^a\) On steel framing.

\(^b\) Joists spaced 24" (610 mm) o.c. and fasteners spaced 6" (153 mm) o.c. at the perimeter and 12" (305 mm) o.c. in field, blocked. See the Progressive Engineering Inc. Product Evaluation Report PER-13067.

\(^c\) Carpet and pad over USG Structural Panel Concrete Subfloor attached to cold-formed steel framing with a ceiling consisting of resilient channels spaced 12" (305 mm) o.c., 3-1/2" (89 mm) of fiberglass insulation in the joist cavity and a single layer of 5/8" (16 mm) USG Sheetrock® Brand Firecode® C Gypsum Panel gypsum panel.

\(^d\) For the most up-to-date UL/ULC Designations, visit usg.com/structural.

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**LOAD TABLE**

The following table represents the load carrying capacity of USG Structural Panel Concrete Subfloors. For the most up-to-date load tables, see the Progressive Engineering Inc. Product Evaluation Report PER-13067, or for technical questions, email usgstructural@usg.com.

A qualified architect or engineer should review and approve calculations, framing and fastener spacing for all projects.

### Ultimate Uniform Load for USG Structural Panel Concrete Subfloor

<table>
<thead>
<tr>
<th>Joist Spacing - inches (millimeters)</th>
<th>12&quot; (305 mm)</th>
<th>16&quot; (406 mm)</th>
<th>24&quot; (610 mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity - psf (kPa)</td>
<td>1,320 psf (63.2 kPa)</td>
<td>744 psf (35.6 kPa)</td>
<td>330 psf (15.8 kPa)</td>
</tr>
</tbody>
</table>

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

1. Ultimate Load Values have no safety factor included.
2. Two framing spans minimum per panel piece.
3. Ultimate Uniform Load Table for general reference only.
5. Ultimate Uniform Load Values are given by engineer analysis.

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**NOTICE**

We shall not be liable for incidental and consequential damages, directly or indirectly sustained, nor for any loss caused by applications of these goods not in accordance with current printed instructions or for other than the intended use. Our liability is expressly limited to replacement of defective goods. Any claim shall be deemed waived unless made in writing to us within 30 days from date it was or reasonably should have been discovered.

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**SAFETY FIRST!**

Follow good safety/industrial hygiene practices during installation. Wear appropriate personal protective equipment. Read SDS and literature before specification and installation.
PER-13067

Initial Approval: October, 2013
Re-Approved: July, 2016

See all Pei ES Reports at: www.p-e-i.com

Report Owner
United States Gypsum Company
700 North Highway 45
Libertyville, IL 60048

Approved Manufacturing Locations
USG Structural Technologies, LLC
309 Hallberg Street
Delavan, WI 53115

Product
USG Structural Panel Concrete Subfloor
(a.k.a. 3/4" STRUCTO-CRETE™ Structural Concrete Panels)

For Evaluation Report Questions
USG Contact: Manny Hurtado, Building Codes Manager
Phone: 847-970-5179
Email: mhurtado@usg.com

General Details
The approved manufacturing plant has an approved Q.C. Manual to manufacture USG Structural Panel Concrete Subfloor and is audited quarterly by Progressive Engineering Inc. USG Structural Panel Concrete Subfloor is also known as 3/4" STRUCTO-CRETE Structural Concrete Panels, and the contents of this PER are applicable to both product names.

Product Description
USG Structural Panel Concrete Subfloor is a noncombustible concrete sheathing panel used in conjunction with cold-formed steel, wood, or hot-rolled steel framing to form a load bearing structural floor system. USG Structural Panel Concrete Subfloor is a nominal 3/4" [19mm] thick x 4' [1220mm] wide x 8' [2440mm] long. The floor panels have a Tongue and Groove edge along the 8' [2440mm] sides and the wall panels are square edged. The panels have a maximum weight of 5.3psf [25.9 kg/m²] from the manufacturing plant. The panels are a composite material consisting of alkali-resistant fiberglass and a cementitious binder.

USG Structural Panel Concrete Subfloor are noncombustible per ASTM E136 (CAN CSA S114) and have a mold resistance value of no less than 10 per ASTM D3273 and a rating of 1 or less per ASTM G21. These panel products have also been shown to be termite resistant when tested in accordance with AWPA Standard E1-13 exposure C, and comply with the VOC emission requirements of the California Department of Public Health CDPH/EHLB/Standard Method Version 1.1 (Emission testing method for CA Specification 01350).

Product Application
USG Structural Panel Concrete Subfloor is used as a single floor or as the subfloor (Concrete Subfloor) in conjunction with an underlayment to form a structural floor system to resist gravity loading, floor diaphragm loading and concentrated loading as typically found in Residential and Commercial Type I or Type II Construction.

Framing
Cold-formed steel framing shall comply with AISI and have minimum yield strength of 50 ksi, minimum 16 ga. [54mil] or 0.0538" [1.366mm] thickness, and minimum G60 galvanized coating. Member flanges must have a minimum width of 1-5/8" [41.27mm]. As an alternative, SPF lumber or 1/4" A36 steel framing may also be used in conjunction with the fasteners and edge distance listed in Table 2. Typical frame spacing ranges from 12" o.c. [304.8mm] to 24" o.c. [406.4mm] for floors. See Table 4 and Table 5 for floor diaphragm shear design values.

Compliance

<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>Section R301.1.3</td>
<td>Section 703.5.1</td>
</tr>
<tr>
<td>Section R301.1.3</td>
<td>Section 703.5.2</td>
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<tr>
<td>Section R302.6</td>
<td>Section 1607.4</td>
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</table>

<table>
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</thead>
<tbody>
<tr>
<td>Section R301.1.3</td>
<td>Section 703.5.1</td>
</tr>
<tr>
<td>Section R302.6</td>
<td>Section 703.5.2</td>
</tr>
<tr>
<td></td>
<td>Section 1607.3 &amp; 1607.4</td>
</tr>
</tbody>
</table>

* Meets or exceeds the requirements of ICC-ES AC 318 Structural Cementitious Floor Sheathing Panels, Effective July 1, 2009.
* Meets or exceeds the requirements of ICC-ES AC 319 Horizontal Diaphragms Consisting of Structural Cementitious Floor Sheathing Panels Attached to Cold-formed Steel Framing—Approved June 2005, Editorially Revised January.
Compliance Continued

- Meets the requirements of Table R301.7 Allowable Deflection of Structural Members for Joist Spacing of 24" [610mm] o.c. per the 2012 & 2015 IRC.
- Meets or exceeds the requirements for noncombustible core in accordance with Section 703.5.1 of the 2012 & 2015 IBC.
- Meets or exceeds the requirements for materials having a structural base of noncombustible material when tested in accordance with ASTM E 136 as defined in 2012 & 2015 IBC Section 703.5.2 and CAN CSA S114.
- Meets the requirements of Section R301.1.3 Engineered Design for otherwise conventional construction for buildings per the 2012 & 2015 IRC.
- For Canadian applications suitability needs to be reviewed by Architect or Engineer of record prior to use.
- Meets or Exceeds the requirements of the 2012 & 2015 IBC Table 1607.1 Minimum Uniformly Distributed Live Loads and Minimum Concentrated Live Loads, when installed per manufacturer's instructions.
- Surface Burning Characteristics - Flame Spread Index of 0 / Smoke Development Index of 0 or less when tested in accordance with ASTM E 84.
- Meets & exceeds requirements for concentrated load per ICC AC318 when tested in accordance with ASTM E661 using a 1" [25mm] and 3" [76mm] loading diameter for Wet & Dry conditions.
- USG Structural Panel Concrete Subfloor is allowed for occupancies or uses where concentrated load resistance, as required by Section1607.1 of the IBC, is 1,000 pounds[4.45kN] or less. Actual concentrated load compliance shall be verified and approved by the engineer of record based upon the occupancy served and the expected end-use of the structure. For buildings with 2000 pound requirement over a 2.5ft by 2.5ft area, framing must be spaced a maximum of 12" o.c.

General Product Installation

1. USG Structural Panel Concrete Subfloor is to be installed and maintained during construction following this report and the USG installation instructions. Installation instructions must be made easily available to the product installer.
2. When cutting USG Structural Panel Concrete Subfloor, safety glasses and a NIOSH approved N-95 dust mask should be worn at all times due to dust produced by the cutting of this product.
3. Fasteners shall be flush or slightly below the surface and care must be taken to not strip out in the framing. No fastener shall be installed within 2" [50.8mm] of the corner of a panel and shall not be closer than the minimum distance from panel edges indicated in Table 2 of this PER.
   1. The tongue and groove joints shall be oriented perpendicular to the framing.
   2. The 3/4" [19mm] USG Structural Panel Concrete Subfloor is fastened to the cold-formed steel, hot-rolled steel, or wood floor framing with the applicable fasteners indicated in Table 2 of this report.
   3. Install panels in a running board pattern bridging a minimum of 2 framing spans. The minimum panel width, measured parallel to the framing, shall be no less than 24" [690.6mm].
4. Fasteners are applied as shown on the following Screw pattern A, B & C diagrams.
5. Up to a 6" [152.4mm] x 6" cutout through the panels is allowed without blocking. Up to a 44" [1117.8mm] x 44" cutout is allowed with sufficient blocking around the perimeter of the opening. Larger openings shall be designed by the Engineer of record and are beyond the scope of this report.
6. USG Structural Panel Concrete Subfloor must be protected from construction abrasive wear and impact after panel installation until the floor has its final finish applied. Refer to the USG Installation Instructions.

Product Storage

USG Structural Panel Concrete Subfloor shall be stored in a dry location. Placement of the palleted product must be on level firm ground or a floor capable of carrying the approximate 3,400 lb [1545kg] pallet weight. Pallets shall not be stacked more than three high and must be stacked with direct alignment on the pallet below it. If a dry location is unavailable, cover pallets with a waterproof tarp or covering. Sub-freezing temperature may cause the panels to freeze together. Should this happen, move the panels to a warmer location to thaw out. Do not use tools or chemicals to loosen the panels as this will cause damage to the panels and will void the performance ratings described in this PER.
### Table 1: Physical and Mechanical Properties

**USG Structural Panel Concrete Subfloor**

<table>
<thead>
<tr>
<th>Test Standard</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concentrated Load</td>
<td>ASTM E661, 550 lb [2.45 kN] Static</td>
</tr>
<tr>
<td></td>
<td>0.108&quot; [2.7 mm] max. deflection @ 200lb [0.89 kN]</td>
</tr>
<tr>
<td>Fastener Lateral Resistance&lt;sup&gt;1&lt;/sup&gt;</td>
<td>ASTM D1761, Dry &gt;210 lb [0.93 kN]</td>
</tr>
<tr>
<td></td>
<td>Wet &gt;160 lb [0.71 kN]</td>
</tr>
<tr>
<td>Density - Oven Dried&lt;sup&gt;2&lt;/sup&gt;</td>
<td>ASTM C1185, 75 lb/ft³ [1200 kg/m³]</td>
</tr>
<tr>
<td>Weight, 3/4&quot; [19mm]</td>
<td>ASTM D1037, 5.3 lb/ft² [25.9 kg/m²]</td>
</tr>
<tr>
<td>Thickness Delivered</td>
<td>ASTM D1293, 10.5</td>
</tr>
<tr>
<td>pH Value</td>
<td>ASTM C1185, &lt;0.10%</td>
</tr>
<tr>
<td>Linear Variation with Change in Moisture</td>
<td>ASTM D1037, max. 3.0%</td>
</tr>
<tr>
<td>25% to 90% Relative Humidity</td>
<td>ASTM D1037, Passed 50 cycles</td>
</tr>
<tr>
<td>Thickness Swell</td>
<td>ASTM D1037, 10</td>
</tr>
<tr>
<td>Freeze/Thaw resistance</td>
<td>ASTM D1037, 0</td>
</tr>
<tr>
<td>Mold Resistance</td>
<td>ASTM E136, Passed</td>
</tr>
<tr>
<td>Water Absorption&lt;sup&gt;3&lt;/sup&gt;</td>
<td>ASTM C1185, &lt;15.0%</td>
</tr>
<tr>
<td>Noncombustibility</td>
<td>ASTM E136, Permeance &lt;2 Perm</td>
</tr>
<tr>
<td>Surface burning Characteristics</td>
<td>ASTM E84, 0 Flame Spread / Smoke Developed Index 0</td>
</tr>
<tr>
<td>Long Term Durability</td>
<td>ASTM C1185, min. 75% retention of physical properties</td>
</tr>
<tr>
<td>Water Durability</td>
<td>ASTM C1185, min. 70% retention of physical properties</td>
</tr>
<tr>
<td>Water Vapor Transmission (Method B)</td>
<td>ASTM E96, Through</td>
</tr>
</tbody>
</table>

1. Fastener Lateral Resistance measured with applicable fasteners in Table 2.
2. Density Measured at Equilibrium Conditioning per Section 5.2.3.1-Tested 28 days after manufacturing.
3. Absorption Measured from Equilibrium Conditioning followed by immersion in Water for 48 hours.

### Table 2: Acceptable Diaphragm Fasteners<sup>1</sup>

**USG Structural Panel Concrete Subfloor**

<table>
<thead>
<tr>
<th>Framing Type</th>
<th>Minimum Edge Distance</th>
<th>Manufacturer</th>
<th>Part No.</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>16ga Cold-Formed Steel</td>
<td>1/2&quot; [13mm]</td>
<td>Grabber Construction Products, Inc.</td>
<td>CGH8158LG</td>
<td>#8 x 1-5/8&quot; winged self-drilling screw</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Simpson Strong-Tie Company, Inc.</td>
<td>CBSQ158S</td>
<td>#8 x 1-5/8&quot; winged self-drilling screw</td>
</tr>
<tr>
<td>SPF Lumber (Min. S.G. = 0.42)</td>
<td>5/8&quot; [16mm]</td>
<td>Grabber Construction Products, Inc.</td>
<td>C8200L2M</td>
<td>#8 x 2&quot;, Flat Head, Type 17, Nibs, GrabberGard,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Simpson Strong-Tie Company, Inc.</td>
<td>WSNTLG2S</td>
<td>#8 x 2&quot;, Flat Head, Twin threads, Nibs</td>
</tr>
<tr>
<td></td>
<td>1/2&quot; [13mm]</td>
<td>Senco&lt;sup&gt;2&lt;/sup&gt;</td>
<td>GL24AABF</td>
<td>8d Ring Shank Nails</td>
</tr>
<tr>
<td>1/4&quot; A36 Hot Rolled Steel</td>
<td>3/4&quot; [19mm]</td>
<td>Simpson Strong-Tie Company, Inc.</td>
<td>TBG1260S</td>
<td>#12 x 2-3/8&quot;, Flat Head, Strong-Drive® TB WOOD-TO-STEEL Screw</td>
</tr>
</tbody>
</table>

Note:
1. Fastener pull-through capacity of 581-lbs [2584N] may be applied to all listed fasteners. Capacity is based upon the minimum average ultimate tested capacity for all tabulated fasteners. The engineer or designer of record shall apply an appropriate safety factor (ASD) or resistance factor (LRFD).
2. Senco 8d ring shank nails are manufactured with a length of 2-3/8" [60mm], a head diameter of 0.266" [6.8mm], and a shank diameter of 0.113" [2.9mm]. Equivalent 8d ring shank nails meeting these dimensional requirements may be utilized when approved by the engineer or designer of record.
Table 3: Uniform Live Load Performance Rating$^{2,4}$

USG Structural Panel Concrete Subfloor

<table>
<thead>
<tr>
<th>Span Rating</th>
<th>Conditions</th>
<th>Live Load Rating$^1$ (PSF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>12&quot; [304.8mm]</td>
<td>Dry or Wet</td>
<td>430$^2$ [63.2 kPa]</td>
</tr>
<tr>
<td>16&quot; [406.4mm]</td>
<td>Dry or Wet</td>
<td>238$^3$ [35.6 kPa]</td>
</tr>
<tr>
<td>24&quot; [609.6mm]</td>
<td>Dry or Wet</td>
<td>100 [15.8 kPa]</td>
</tr>
</tbody>
</table>

Notes
1. Live load ratings have been determined from testing based upon a minimum 100 psf service live load for the 24" span rating and a maximum panel live load deflection = L/360.
2. Two framing spans minimum per panel piece
3. Tabulated live load ratings are valid for a service level dead load of 10 psf or less.
4. Live load rating values for 12" and 16" span ratings are by engineering analysis based upon 24" span rating results and L/360 deflection criteria.

Table 4 - Safety Factors and Resistance Factors for Diaphragms

USG Structural Panel Concrete Subfloor

<table>
<thead>
<tr>
<th>Framing Type</th>
<th>Fastener Type</th>
<th>Earthquake</th>
<th>Wind</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>$\Omega$ (ASD)</td>
<td>$\phi$ (LRFD)</td>
</tr>
<tr>
<td>Steel$^1$</td>
<td>Screws</td>
<td>2.50</td>
<td>0.65</td>
</tr>
<tr>
<td>Wood$^{2,3}$</td>
<td>Screws or Nails</td>
<td>3.30</td>
<td>0.50</td>
</tr>
</tbody>
</table>

Notes:
1. Safety factors and resistance factors for USG Structural Panel Concrete Subfloor diaphragms installed over cold-formed and hot-rolled steel framing are based upon Table D5 of AISI S100-2007.
2. Safety factors and resistance factors for USG Structural Panel Concrete Subfloor diaphragms installed over wood studs are based on the worst case of the standard factors from the American Wood Council Special Design Provisions for Wind and Seismic (AWC SDPWS-2008) and those tabulated for steel framing.
3. Earthquake factors for installations over wood construction are based upon the wind factors modified by a factor of 1.4 to match the general seismic strength reduction observed in Tables 4.2A, 4.2B, 4.2C, and 4.2D of AWC SDPWS-2008.
4. Limit States Design (LSD) shall be used in combination with the load combinations found in the National Building Code of Canada (NBCC).
Table 5: Simple Beam Diaphragm Testing

<table>
<thead>
<tr>
<th>Fastener Spacing</th>
<th>Joist Perimeter</th>
<th>Screw Pattern</th>
<th>Panel Blocking</th>
<th>S&lt;sub&gt;n&lt;/sub&gt; - Nominal Shear Strength (pfl)</th>
<th>X</th>
<th>Aspect Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>4&quot; [101.6mm]</td>
<td>12&quot; [304.8mm]</td>
<td>16&quot;</td>
<td>B</td>
<td>None</td>
<td>1462 [21.3 kN/m]</td>
<td>0.443</td>
</tr>
<tr>
<td>6&quot; [152.4mm]</td>
<td>16&quot; [406.4mm]</td>
<td></td>
<td>B</td>
<td>None</td>
<td>1395 [20.4 kN/m]</td>
<td>0.421</td>
</tr>
<tr>
<td>4&quot; [101.6mm]</td>
<td>12&quot; [304.8mm]</td>
<td>16&quot;</td>
<td>B</td>
<td>None</td>
<td>1341 [19.6 kN/m]</td>
<td>0.476</td>
</tr>
<tr>
<td>6&quot; [152.4mm]</td>
<td>16&quot; [406.4mm]</td>
<td></td>
<td>B</td>
<td>None</td>
<td>1053 [15.4 kN/m]</td>
<td>0.397</td>
</tr>
</tbody>
</table>

Refer to Table 4 of this PER for applicable diaphragm safety (Ω) and load resistance (ϕ) factors corresponding to ASD, LRFD, and/or LSD design methods.

Screw Pattern B - Panel fasteners must be inset 2" [51mm] from the corners. Fastener edge distance at all panel edges must comply with Table 2 distances with exception to the tongue and groove joints where the framing joists are perpendicular to the joint. The fasteners should be kept flush or slightly below the surface of the panel. At the T&G panel joists where the framing joists are perpendicular to the joint, one (1) panel fastener is required. One fastener should be 1" [25mm] and the other 2" [51mm] from the panel edge.

Screw Pattern C - Panels shall be fastened as described in Screw Pattern B with the addition of fasteners at 6" [152mm] o.c. along the metal Strap Blocking on both sides of seam.

**Deflection Equation for Simple Beam Diaphragm**

\[
\Delta = \frac{5VI^3}{8EAb} + \frac{VI}{4Et} + Xe_n
\]

Where:
- \( V \) = Unit shear in the direction under consideration, pfl
- \( t \) = Diaphragm length, ft.
- \( b \) = Diaphragm width, ft.
- \( E \) = Elastic modulus of steel rim chords, 29,500,000 psi
- \( A \) = Net area of steel rim chord cross section, in\(^2\)
- \( G \) = Shear modulus of USG Structural Panel Concrete Subfloor for shear, 285,714 psi
- \( t \) = Effective thickness of USG Structural Panel Concrete Subfloor for shear, 0.73 in.
- \( e_n \) = Screw joint slippage at load per screw on perimeter of interior panel
  - \( e_n @ 0.20S_n = 0.011 \)
  - \( e_n @ 0.33S_n = 0.019 \)
  - \( e_n @ 0.60S_n = 0.032 \)
  - \( e_n @ 0.8S_n = 0.064 \)
- \( X \) = Slip Co-efficient. See Table 3 above.
Table 6: Cantilever Floor Diaphragm Testing
USG Structural Panel Concrete Subfloor

<table>
<thead>
<tr>
<th>Fastener Spacing</th>
<th>Joist Spacing</th>
<th>Screw Pattern</th>
<th>Panel Blocking</th>
<th>S_n - Nominal Shear Strength (plf)*</th>
<th>X</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perimeter</td>
<td>Field</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6&quot; [152.4mm]</td>
<td>12&quot; [304.8mm]</td>
<td>24&quot; [609.6mm]</td>
<td>B</td>
<td>None</td>
<td>487 [7.1 kN/m]</td>
</tr>
<tr>
<td>8&quot; [203.2mm]</td>
<td>12&quot; [304.8mm]</td>
<td>24&quot; [609.6mm]</td>
<td>B</td>
<td>None</td>
<td>475 [6.9 kN/m]</td>
</tr>
<tr>
<td>4&quot; [101.6mm]</td>
<td>12&quot; [304.8mm]</td>
<td>24&quot; [609.6mm]</td>
<td>A</td>
<td>None</td>
<td>713 [10.4 kN/m]</td>
</tr>
<tr>
<td>6&quot; [152.4mm]</td>
<td>12&quot; [304.8mm]</td>
<td>24&quot; [609.6mm]</td>
<td>A</td>
<td>None</td>
<td>525 [7.7 kN/m]</td>
</tr>
<tr>
<td>8&quot; [203.2mm]</td>
<td>12&quot; [304.8mm]</td>
<td>16&quot; [406.4mm]</td>
<td>A</td>
<td>None</td>
<td>465 [6.8 kN/m]</td>
</tr>
<tr>
<td>4&quot; [101.6mm]</td>
<td>12&quot; [304.8mm]</td>
<td>16&quot; [406.4mm]</td>
<td>A</td>
<td>None</td>
<td>975 [14.2 kN/m]</td>
</tr>
<tr>
<td>6&quot; [152.4mm]</td>
<td>12&quot; [304.8mm]</td>
<td>16&quot; [406.4mm]</td>
<td>A</td>
<td>None</td>
<td>915 [13.4 kN/m]</td>
</tr>
<tr>
<td>8&quot; [203.2mm]</td>
<td>12&quot; [304.8mm]</td>
<td>12&quot; [304.8mm]</td>
<td>A</td>
<td>None</td>
<td>860 [12.6 kN/m]</td>
</tr>
<tr>
<td>4&quot; [101.6mm]</td>
<td>12&quot; [304.8mm]</td>
<td>12&quot; [304.8mm]</td>
<td>A</td>
<td>None</td>
<td>1121 [16.4 kN/m]</td>
</tr>
<tr>
<td>6&quot; [152.4mm]</td>
<td>12&quot; [304.8mm]</td>
<td>24&quot; [609.6mm]</td>
<td>C</td>
<td>4&quot; [101.6mm]Wide x 16ga. [1.438mm] Strap</td>
<td>1148 [19.8 kN/m]</td>
</tr>
</tbody>
</table>

Refer to Table 4 of this PER for applicable diaphragm safety (C) and load resistance (Φ) factors corresponding to ASD, LRFD, and/or LSD design methods.

2 to 1 maximum Aspect Ratio

Screw Pattern A & B - Panel fasteners must be inset 2" [51mm] from the corners. Fastener edge distance at all panel edges must comply with Table 2 distances with exception to the tongue and groove joints where the framing joists are perpendicular to the joint. The fasteners should be kept flush or slightly below the surface of the panel. At the T&G panel joists where the framing joists are perpendicular to the joint, two (2) panel fasteners are required for Pattern A and one (1) fastener for Pattern B. One fastener should be 1" [25mm] and the other 2" [51mm] from the panel edge.

Screw Pattern C - Panels shall be fastened as described in Screw Pattern B with the addition of fasteners at 6" [152mm] o.c. along the metal Strap Blocking on both sides of seam.

Deflection Equation for Cantilever Diaphragm

\[
\Delta = \frac{5V(2)}{8EAb} + \frac{V(2)}{4Gt} + X(2)\epsilon_n
\]

Where:
- \( V \) = Unit shear in the direction under consideration, plf
- \( t \) = Diaphragm length, ft.
- \( b \) = Diaphragm width, ft.
- \( E \) = Elastic modulus of steel rim chords, 29,500,000psi
- \( A \) = Net area of steel rim chord cross section, in²
- \( G \) = Shear modulus of USG Structural Panel Concrete Subfloor for shear, 285,714 psi
- \( \epsilon_n \) = Screw joint slippage at load per screw on perimeter of interior panel
- \( \epsilon_n = 0.20S_n \) = 0.011
- \( \epsilon_n = 0.33S_n \) = 0.019
- \( \epsilon_n = 0.60S_n \) = 0.032
- \( \epsilon_n = S_n \) = 0.084
- \( X \) = Slip Co-efficient. See Table 4 above.
1. Two Span offset of Seams w/o Blocking, One Span w/ Blocking

Screw Pattern A

Figure 1 - Screw Pattern "A" Details
1. Two Span Minimum offset of Seams w/o Blocking, One Span offset w/ Blocking.

Screw Pattern B

DETAIL -B

MIN. EDGE DIST. (SEE TABLE 2)

4", 6" or 8" o.c.

1"

2"

Strap Block Detail for Screw Pattern C

Figure 2 - Screw Pattern "B" & "C" Details
Table 8: Floor Anchorage Options - USG Structural Panel Concrete Subfloor

Nominal Withdrawal Capacities per Anchor

<table>
<thead>
<tr>
<th>Anchor Type</th>
<th>ASTM D 1037 Value (1 Layer)</th>
<th>Subfloor Layers</th>
<th>Distance Between Bolts, d</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2&quot;</td>
<td>4&quot;</td>
<td>6&quot;</td>
</tr>
<tr>
<td>3/8&quot; SnapToggles®</td>
<td>1481 lb [6588 N]</td>
<td>1</td>
<td>927 lb</td>
</tr>
<tr>
<td>1/2&quot; SnapToggles®</td>
<td>1616 lb [7188 N]</td>
<td>2</td>
<td>1719 lb*</td>
</tr>
<tr>
<td>1/4&quot;x3&quot; Peel Rivet®</td>
<td>758 lb [3372 N]</td>
<td>1</td>
<td>636 lb</td>
</tr>
</tbody>
</table>

*For ASD designs use minimum Ω = 4.0; For LRFD designs use maximum φ = 0.40

Notes:

1. TOGGLER Anchor System and peel rivet capacity is based on random anchors purchased from a distributor and have not been evaluated for installations other than that described in Table 8 and Figure 3. This PER verifies the USG Structural Panel Concrete Subfloor capacity only, and actual toggler anchor capacity without panel failure shall be verified by the engineer or designer of record through the SnapToggle anchor or peel rivet manufacturer.
2. TOGGLER Anchor System shall be installed with a maximum torque setting of 200 in-lb [23 N-m].
3. Anchors have been evaluated for use general component connections to the USG Structural Panel Concrete Subfloor (i.e. auditorium seating, lightweight equipment, etc.). Final application must be reviewed and approved by the engineer or designer of record.
4. TOGGLER Anchor System 3/8" SnapToggles® (Item No. BC) w/ a Grade 8 Hex Head Bolt. Ultimate withdrawal occurred at a maximum tested shear per pair of 232 lb [1032 N] for one-layer and 430 lb [1913 N] for two layers.
5. TOGGLER Anchor System 1/2" SnapToggles® (Item No. BD) w/ a Grade 5 Hex Head Bolt. Ultimate withdrawal occurred at a maximum tested shear per pair of 294 lb [1308 N] for one-layer and 600 lb [2669 N] for two layers.
6. Peel Rivets manufactured by SFS Intec (Part No. TPR-L-6, 3x76). Ultimate withdrawal occurred at a maximum tested shear per pair of 167 lb [743 N] for a single layer of USG Structural Panel Concrete Subfloor.

* Denotes Toggler Failure by Strip out.

Figure 3 - Typical Toggler Bolt Application

Product Labeling
Each bundle shipped of USG Structural Panel Concrete Subfloor that are covered by this PER, must have a label attached with at least the following information:
1. USG Name and Location / Plant Number
2. Date of manufacture
3. This PER Number & Pei ES Logo

Acceptable Evaluation Marks
Quickly find, specify, or verify UL Certified products for your projects.

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FIRE-RESISTANCE DESIGN

Assembly Usage Disclaimer

BXUVC - Fire-resistance Ratings

See General Information for Fire-resistance Ratings

Design No. I528

May 05, 2017

Unrestrained Assembly Rating — 1-1/2 h or 2 h (See Item 1)

Load Restriction - (See Item 2, 2A and 2B)
1. Flooring System —

1-1/2 h Rating

*1A. Structural Cement-Fibre Units — (CIYTC) — Nominal 19 mm thick, with long edges tongue and grooved. Long dimension of panels to be perpendicular to joists with end joints staggered a minimum of 610 mm and centred over the joists. Panels secured to steel joists with 41 mm long No. 8 self-drilling, self-countersinking steel screws spaced a maximum of 305 mm OC in the field with a screw located 25 mm and 50 mm from each edge, and 200 mm OC on the
perimeter with a screw located 50 mm from each edge, located 12.7 mm from the side edges of the panel.

**UNITED STATES GYPSUM CO** — Types STRUCTO-CRETE, USGSP

### 2 h Rating

**System A**

*1A. **Structural Cement-Fibre Units** — (CIYTC) — Nominal 19 mm thick, with long edges tongue and grooved. Long dimension of panels to be perpendicular to joists with end joints staggered a minimum of 610 mm and centred over the joists. Panels secured to steel joists with 41 mm long No. 8 self-drilling, self-countersinking steel screws spaced a maximum of 305 mm OC in the field with a screw located 25 mm and 50 mm from each edge, and 200 mm OC on the perimeter with a screw located 50 mm from each edge, located 12.7 mm from the side edges of the panel.

**UNITED STATES GYPSUM CO** — Types STRUCTO-CRETE, USGSP

*1B. **Wallboard (Not Shown)** — (CKNXC) — Minimum 12.7 mm thick, 1220 mm by 1220 mm Classified gypsum board underlayment. Bonded and attached to Structural Cement Fibre Units (Item 1A) with a mortar applied with a 6 mm. by 6 mm notched trowel, and 31 mm long coarse thread screws spaced maximum 610 mm OC. Joints between Structural Cement Fibre Units and of Wallboard staggered a minimum of 150 mm.

**UNITED STATES GYPSUM CO** — Fiberock Type FRX-G

### System B

*1A. **Structural Cement-Fibre Units** — (CIYTC) — Nominal 19 mm thick, with long edges tongue and grooved. Long dimension of panels to be perpendicular to joists with end joints staggered a minimum of 610 mm and centred over the joists. Panels secured to steel joists with 41 mm long No. 8 self-drilling, self-countersinking steel screws spaced a maximum of 305 mm OC in the field with a screw located 25 mm and 50 mm from each edge, and 200 mm OC on the perimeter with a screw located 50 mm from each edge, located 12.7 mm from the side edges of the panel.

**UNITED STATES GYPSUM CO** — Types STRUCTO-CRETE, USGSP

*1B. **Floor Topping Mixture** — (CCOXC) — Applied at a minimum thickness of 19 mm, having a minimum compressive strength of 10 MPa. Refer to manufacturer's instructions accompanying the material for specific mix design.

**UNITED STATES GYPSUM CO** — Levelrock 2500.
1C. Vapor Barrier — (Optional) — Nominal 0.76 mm thick commercial asphalt saturated felt.

1D. Floor Mat Materials — (CCUC) — (Optional) - One of the following: Minimum 10 mm to maximum 19 mm thick floor mat material loosely laid over the Structural Cement Fibre Units.

UNITED STATES GYPSUM CO — LEVELROCK® Brand Sound Reduction Board.

Nominal 6 mm thick floor mat material loosely laid over the Structural Cement FibreUnits.

UNITED STATES GYPSUM CO — LEVELROCK® Brand Floor Underlayment SRM-25.

2. Steel Joists — Channel-shaped, minimum 254 mm deep with minimum 41 mm wide flanges and 12.7 mm long stiffening flanges. Fabricated from minimum 1.6 mm thick (16 GA) galvanized steel of yield strength 345 MPa. Joists spaced maximum 610 mm OC. The effect of factored loading shall not exceed a maximum of 96% of the factored strength calculated in accordance with limit states design principles outlined in the joist manufacturer's load tables.

2A. Steel Joists — (Not Shown) - As an alternate to Item 2 - For maximum clear spans not exceeded 2.44 m. Channel-shaped, minimum 152 mm deep with minimum 40 mm wide flanges and 9.5 mm long stiffening flanges. Fabricated from minimum 1.2 mm thick (18 GA) galvanized steel of yield strength 230 MPa. Joists spaced maximum 610 mm OC. Supplied with appropriate rim tracks of same size and gauge. The effect of factored loading shall not exceed a maximum of 96% of the factored strength calculated in accordance with limit states design principles outlined in the joist manufacturer's load tables.

2B. Steel Joists — (Not Shown) - As an alternate to Item 2 - Channel-shaped, minimum 203 mm deep with minimum 40 mm wide flanges and 9.5 mm long stiffening flanges. Fabricated from minimum 1.6 mm thick (16 GA) galvanized steel of yield strength 230 MPa.. Joists spaced maximum 610 mm Supplied with appropriate rim tracks of same size and gauge. The effect of factored loading shall not exceed a maximum of 96% of the factored strength calculated in accordance with limit states design principles outlined in the joist manufacturer's load tables.

2C. Angle Clips — (Not Shown) - For use with 254 mm. deep joists (Item 2). Connect joists to header. Steel angles 1.9 mm thick (14 GA), 200 mm long with 50 mm legs and four 3 mm diameter holes spaced 50 mm OC and located 25
mm from the ends and 19 mm from long edge. Secured to header and joists with eight 12.7 mm long S12 pan head screws.

2D. **Angle Clips** — (Not Shown) - For use with 152 mm or 203 mm deep joists (Item 2A or 2B). Steel angles 1.6 mm thick (16 GA), 140 mm long with 38 mm legs for the 152 mm deep joists and 1.2 mm thick (18 GA), 184 mm long with 38 mm legs for the 203 mm deep joists. Secured to track and joist with six No. 10, 19 mm long, self drilling, hex head screws, located 25 mm from each end of the clip angle and at the centerline. Only one clip angle per joist end.

3. **Blocking & Bridging** — Installed before construction loads are applied. The blocking consists of joist sections placed between joists spaced maximum 2440 mm OC perpendicular to the joists. In addition, bridging consists of 50 mm wide cold-rolled flat strap, minimum No. 16 GA, attached to the bottom of each joist and at four points along the blocking with 16 mm long No. 10 low profile steel screws.

*4. **Batts and Blankets** — Glass fibre batt insulation of nominal thickness 92 mm, ULC labelled, nominal density 10 kg/m³ draped over the resilient channels (Item 5) or suspension system grid (Item 5A). Insulation supplied in 610 mm by 1220 mm blankets.

5. **Resilient Channels** — Formed of 0.53 mm thick (25 GA) galvanized steel, 12.7 mm deep, spaced maximum 305 mm OC, perpendicular to joists. Channel splices located beneath joists and overlapped 100 mm. Channels secured to each joist with one 12.7 mm long Type S-12 low profile steel screw. Two channels, spaced 150 mm OC, oriented opposite each gypsum board end joint as shown on the illustration above. Additional channels shall extend minimum 150 mm beyond each side edge of board.

*5A. **Steel Framing Members** — (Optional, Not Shown) — (CIKVC) — When it is desired to drop the ceiling below the bottom plane of the structural steel members (Item 2), a suspension system may be used in lieu of the resilient channels. Main runners, cross tees, cross channels and wall angle as specified below:

(a). **Main Runners** — Nominal 3050 or 3660 mm long, 24 or 38 mm wide face, inverted "T" shape, spaced 1220 mm OC. Main runners suspended by minimum 2.7 mm diameter (12 SWG) galvanized steel hanger wires spaced 601 mm OC a minimum of 100 mm below bottom flange of joists, twist tied to #10 - 19 mm long screws installed in the web, 12.7 mm from the bottom flange of the steel joists. Hanger wires to be located adjacent to main runner/cross tee intersections.

(b). **Cross Tees** — Nominal 1220 mm long, 38 mm wide face, installed perpendicular to the main runners, spaced 406 mm OC. Additional cross tees or cross channels used at 200 mm from each side of butted gypsum panel end joints. The cross tees or cross channels may be riveted or screw attached to the wall angle or channel to facilitate the ceiling installation.
(c) **Cross Channels** — Alternate to cross tees. Nominal 1220 mm or 3660 mm long, installed perpendicular to main runners, spaced 406 mm OC.

(d) **Wall Angle or Channel** — Painted or galvanized steel angle with 25 mm legs or channel with 25 mm legs, 40 mm deep attached to walls at perimeter of ceiling with fasteners 406 mm OC, to support steel framing member ends and for screw-attachment of the gypsum panel.

**CGC INC** — Type DGL or RX

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*6. **Wallboard** — (CKNXC) — One layer of nominal 15.9 mm thick by 1220 mm wide gypsum panels installed with long dimension perpendicular to resilient channels or cross tees of suspension system. Gypsum panels secured to resilient channels or drywall suspension system with 25 mm long Type S bugle-head screws spaced 200 mm OC, with screws located 100 mm from and on each side of the gypsum panel midspan, and 38 from side edges of the board. End joints secured to both resilient channels as shown in end joint detail.

**CGC INC** — Sheetrock Firecode C

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*6A. **Wallboard** — For use when Steel Framing Members (Item 5A) are used - One layer 15.9 mm thick, 1220 mm wide, installed with long dimension perpendicular to cross tees with side edges centred over main runners and joints centred over cross tees or channels. Fastened to cross tees or channels with 25 mm long Type S bugle-head screws spaced 200 mm OC with the screws located 100 mm from the midspan of the cross tee or channel, and 38 mm from side edges of gypsum panel. Fastened to main runners with 25 mm long Type S bugle-head screws spaced midway between cross tees or channels. End joints of gypsum panels shall be staggered not less than 1220 mm OC with adjacent gypsum panels end joints.

**CGC INC** — Sheetrock Firecode C

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7. **Finishing System** — (Not Shown) — Vinyl, dry or premixed joint compound, applied in two coats to joints and screw-heads. Nominal 50 mm wide paper tape embedded in first layer of compound over all joints. As an alternate, nominal 2.4 mm thick veneer plaster may be applied to the entire surface of gypsum panels.

*Indicates such products shall bear the UL or cUL Certification Mark for jurisdictions employing the UL or cUL Certification (such as Canada), respectively.
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FIRE-RESISTANCE DESIGN

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BXUVC - Fire-resistance Ratings

See General Information for Fire-resistance Ratings

Design No. I529

May 05, 2017

Unrestrained Assembly Rating - 2 h

Load Restriction - (See Item 2, 2A, 2B and 2C)
1A. **Structural Cement-FibreUnits** — (CIYTC) — Nominal 19 mm thick, with long edges tongue and grooved. Long dimension of panels to be perpendicular to joists with end joints staggered a minimum of 610 mm and centred over the joists. Panels secured to steel joists with 41 mm long No. 8 self-drilling, self-countersinking steel screws spaced a maximum of 305 mm OC in the field with a screw located 25 mm and 50 mm from each edge, and 200 mm OC on the perimeter with a screw located 50 mm from each edge, located 12.7 mm from the side edges of the panel.

**UNITED STATES GYPSUM CO** — Types STRUCTO-CRETE, USGSP

2. **Steel Joists** — Channel-shaped, minimum 254 mm deep with minimum 41 mm wide flanges and 12.7 mm long stiffening flanges. Fabricated from minimum 1.6 mm thick (16 GA) galvanized steel of yield strength 345 MPa. Joists spaced maximum 610 mm OC. The effect of factored loading shall not exceed 96% of the factored strength calculated in accordance with limit states design principles outlined in the joist manufacturer's load tables.

2A. **Steel Joists** — (Not Shown) - As an alternate to Item 2 - For maximum clear spans not exceeded 2.44 m. Channel-shaped, minimum 152 mm deep with minimum 40 mm wide flanges and 9.5 mm long stiffening flanges. Fabricated from minimum 1.2 mm thick (18 GA) galvanized steel of yield strength 230 MPa. Joists spaced maximum 610 mm OC. Supplied with appropriate rim tracks of same size and gauge. The effect of factored loading shall not exceed a maximum of 96% of the factored strength calculated in accordance with limit states design principles outlined in the joist manufacturer's load tables.

2B. **Steel Joists** — (Not Shown) - As an alternate to Item 2 - Channel-shaped, minimum 203 mm deep with minimum 40 mm wide flanges and 9.5 mm long stiffening flanges. Fabricated from minimum 1.6 mm thick (16 GA) galvanized steel of yield strength 230 MPa. Joists spaced maximum 610 mm. Supplied
with appropriate rim tracks of same size and gauge. The effect of factored loading shall not exceed a maximum of 96% of the factored strength calculated in accordance with limit states design principles outlined in the joist manufacturer's load tables.

*2C. Structural Components — (CIZTC) — (Not Shown) - As an alternate to Item 2 - Pre-fabricated light gauge steel truss system minimum 305 mm deep, consisting of cold-formed, galvanized steel chord and web sections. Trusses fabricated in various sizes, and various steel thickness spaced maximum of 610 mm OC. The effect of factored loading shall not exceed a maximum of 96% of the factored strength calculated in accordance with limit states design principles outlined in the joist manufacturer's load tables.

AEGIS METAL FRAMING, DIV OF MITEK — Ultra-Span, Pre-fabricated Light Gauge Steel Truss System

2D. Angle Clips — (Not Shown) - For use with 254 mm. deep joists (Item 2). Connect joists to header. Steel angles 1.9 mm thick (14 GA), 200 mm long with 50 mm legs and four 3 mm diameter holes spaced 50 mm OC and located 25 mm from the ends and 19 mm from long edge. Secured to header and joists with eight 12.7 mm long S12 pan head screws.

2E. Angle Clips — (Not Shown) - For use with 152 mm or 203 mm deep joists (Item 2A or 2B). Steel angles 1.6 mm thick (16 GA), 140 mm long with 38 mm legs for the 152 mm deep joists and 1.2 mm thick (18 GA ), 184 mm long with 38 mm legs for the 203 mm deep joists. Secured to track and joist with six No. 10, 19 mm long, self drilling, hex head screws, located 25 mm from each end of the clip angle and at the centerline. Only one clip angle per joist end.

3. Blocking & Bridging — (Not Shown) - For use with 254 mm. deep joists (Item 2, 2A and 2B). Installed before construction loads are applied. The blocking consists of joist sections placed between joists spaced maximum 2440 mm OC perpendicular to the joists. In addition, bridging consists of 50 mm wide cold-rolled flat strap, minimum 1.6 mm thick (16 GA), attached to the bottom of each joist and at four points along the blocking with 16 mm long No. 10 low profile steel screws.

3B. Bridging — (Not Shown)—For use with Item 2C - Location of lateral bracing for truss chord and web sections to be specified on truss engineering.

*4. Batts and Blankets — Glass fibreglass insulation of nominal thickness 92 mm, ULC labelled, nominal density 10 kg/m³ draped over the resilient channels (Item 5) or suspension system grid (Item 5A). Insulation supplied in 610 mm by 1220 mm blankets.

5. Resilient Channels — Formed of 0.53 mm thick (25 GA) galvanized steel, 12.7 mm deep, spaced maximum 305 mm OC, perpendicular to joists. Channel splices located beneath joists and overlapped 100 mm. Channels secured to each joist with one 12.7 mm long Type S-12 low profile steel screw. Two channels, spaced 150 mm OC, oriented opposite each gypsum board end
joint as shown on the illustration above. Additional channels shall extend minimum 150 mm beyond each side edge of board.

*5A. Steel Framing Members — (Optional, Not Shown) — (CIKVC) — When it is desired to drop the ceiling below the bottom plane of the structural steel members (Item 2), a suspension system may be used in lieu of the resilient channels.

(a.) **Main Runners** — Nominal 3050 or 3660 mm long, 24 or 38 mm wide face, inverted "T" shape, spaced 1220 mm OC. Main runners suspended by minimum 2.7 mm diameter (12 SWG) galvanized steel hanger wires spaced 601 mm OC a minimum of 100 mm below bottom flange of joists, twist tied to #10 - 19 mm long screws installed in the web, 12.7 mm from the bottom flange of the steel joists. Hanger wires to be located adjacent to main runner/cross tee intersections.

(b.) **Cross Tees** — Nominal 1220 mm long, 38 mm wide face, installed perpendicular to the main runners, spaced 406 mm OC. Additional cross tees or cross channels used at 200 mm from each side of butted gypsum panel end joints. The cross tees or cross channels may be riveted or screw attached to the wall angle or channel to facilitate the ceiling installation.

(c.) **Cross Channels** — Alternate to cross tees. Nominal 1220 mm or 3660 mm long, installed perpendicular to main runners, spaced 406 mm OC.

(d.) **Wall Angle or Channel** — Painted or galvanized steel angle with 25 mm legs or channel with 25 mm legs, 40 mm deep attached to walls at perimeter of ceiling with fasteners 406 mm OC, to support steel framing member ends and for screw-attachment of the gypsum panel.

**CGC INC** — Type DGL or RX

*6. **Gypsum Board** — Nominal 15.9 mm thick, 1220 mm wide gypsum panels. Base layer installed with long dimension perpendicular to resilient channels or cross tees, secured with 31 mm long Type S bugle-head screws spaced 305 mm OC, with screws located 150 mm from and on each side of the gypsum panel, in both the field and the perimeter, and 38 mm from side edges of the panels. Face layer installed with long dimension perpendicular to resilient channels or cross tees with joints offset 610 mm from base layer, secured with 41 mm long Type S bugle-head screws spaced 200 mm OC in both the field and the perimeter, and 38 mm from side edges of the panel. End joints of face layer panels secured to base layer with 38 mm long Type G screws spaced 200 mm OC and 38 mm from end joints, with end joints located between resilient channels. End joints of face panels staggered a minimum of 305 mm from end joints of base layer.

**CGC INC** — Sheetrock Firecode C
7. **Finishing System** — (Not Shown) — Vinyl, dry or premixed joint compound, applied in two coats to joints and screw-heads. Nominal 50 mm wide paper tape embedded in first layer of compound over all joints. As an alternate, nominal 2.4 mm thick veneer plaster may be applied to the entire surface of gypsum panels.

* Indicates such products shall bear the UL or cUL Certification Mark for jurisdictions employing the UL or cUL Certification (such as Canada), respectively.

Last Updated on 2017-05-05

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- Authorities Having Jurisdiction should be consulted before construction.
- Fire resistance assemblies and products are developed by the design submitter and have been investigated by UL for compliance with applicable requirements. The published information cannot always address every construction nuance encountered in the field.
- When field issues arise, it is recommended the first contact for assistance be the technical service staff provided by the product manufacturer noted for the design. Users of fire resistance assemblies are advised to consult the general Guide Information for each product category and each group of assemblies. The Guide Information includes specifics concerning alternate materials and alternate methods of construction.
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CANADIAN CERTIFICATIONS

1. HOW DO YOU WANT TO SEARCH?

FIRE-RESISTANCE DESIGN

Assembly Usage Disclaimer

BXUVC - Fire-resistance Ratings

See General Information for Fire-resistance Ratings

Design No. I535

May 10, 2017

Unrestrained Assembly Rating — 1, 1-1/2 and 2 h (See Items 1 and 2)
1 or 1-1/2 h Rating

*1A. Structural Cement-Fiber Units — (CIYTC) — Nom 19 mm (3/4 in.) thick, with long edges tongue and grooved. Long dimension of panels to be perpendicular to joists with end joints staggered a min of 610 mm (2 ft) and centered over the joists. Panels secured to steel joists with 41 mm (1-5/8 in.) long No. 8 self-drilling, self-countersinking steel screws spaced a max of 305 mm (12 in.) OC in the field with a screw located 25 mm (1 in.) and 51 mm (2 in.) from each edge, and 203 mm (8 in.) OC on the perimeter with a screw located 51 mm (2 in.) from each edge, located 13 mm (1/2 in.) from the side edges of the panel.

Unrestrained Assembly Rating is 1 hour when Item 2A or 2B is used.

Unrestrained Assembly Rating is 1-1/2 hour when Item 2 is used.

UNITED STATES GYPSUM CO — Types STRUCTO-CRETE, USGSP

2 h Rating

System A

*1A. Structural Cement-Fiber Units — (CIYTC) — Nom 19 mm (3/4 in.) thick, with long edges tongue and grooved. Long dimension of panels to be perpendicular to joists with end joints staggered a min of 610 mm (2 ft) and centered over the joists. Panels secured to steel joists with 41 mm (1-5/8 in.)
long No. 8 self-drilling, self-countersinking steel screws spaced a max of 305 mm (12 in.) OC in the field with a screw located 25 mm (1 in.) and 51 mm (2 in.) from each edge, and 203 mm (8 in.) OC on the perimeter with a screw located 51 mm (2 in.) from each edge, located 13 mm (1/2 in.) from the side edges of the panel.

UNITED STATES GYPSUM CO — Types STRUCTO-CRETE, USGSP

*1B. Wallboard (Not Shown) — CKNXC) — Min 12.7 mm (1/2 in.) thick, 1220 mm (4 ft) by 1220 mm (4 ft) gypsum board underlayment, Classified as to Surface Burning Characteristics. Bonded and attached to Structural Cement Fiber Units (Item 1A) with a mortar applied with a 6 mm (1/4 in.) by 6 mm (1/4 in.) notched trowel, and 32 mm (1-1/4 in.) long coarse thread screws spaced max 203 mm (8 in.) OC. Joints between Structural Cement Fiber Units and of Gypsum Board staggered a min of 152 mm (6 in.).

UNITED STATES GYPSUM CO — Type FRX-G

System B

*1A. Structural Cement-Fiber Units — (CIYTC) — Nom 19 mm (3/4 in.) thick, with long edges tongue and grooved. Long dimension of panels to be perpendicular to joists with end joints staggered a min of 610 mm (2 ft) and centered over the joists. Panels secured to steel joists with 41mm (1-5/8 in.) long No. 8 self-drilling, self-countersinking steel screws spaced a max of 305 mm (12 in.) OC in the field with a screw located 25 mm (1 in.) and 51 mm (2 in.) from each edge, and 203 mm (8 in.) OC on the perimeter with a screw located 51 mm (2 in.) from each edge, located 13 mm (1/2 in.) from the side edges of the panel.

UNITED STATES GYPSUM CO — Types STRUCTO-CRETE, USGSP

*1B. Floor Topping Mixture — (CCOXC) — Min 19 mm (3/4 in.) thickness of floor topping mixture having a minimum compressive strength of 12.4 MPa. Refer to manufacturer's instructions accompanying the material for specific mix design.

UNITED STATES GYPSUM CO — Types LRK, HSLRK, CSD

*Floor Mat Materials — (CCQUC) — (Optional) - Floor mat material loose laid over the subfloor. Refer to manufacturer's instructions regarding the minimum thickness of floor topping over each floor mat material.

UNITED STATES GYPSUM CO — Types LEVELROCK® Brand Sound Reduction Board, and LEVELROCK® Brand Floor Underlayment SRM-25
2. **Steel Joists** — Channel-shaped, min 254 mm (10 in.) deep with min 41mm (1-5/8 in.) wide flanges and 13 mm (1/2 in.) long stiffening flanges. Fabricated from min No. 16 MSG galv steel. Min yield strength of 345 MPa. Joists spaced max 610 mm (24 in.) OC. Supplied with appropriate rim tracks of same size and gauge.

2A. **Steel Joists** — (Not Shown) - As an alternate to Item 2 - For maximum clear spans not exceeded 2438 mm (8 ft.) Channel-shaped, min 152 mm (6 in.) deep with min 40 mm (1-9/16 in.) wide flanges and 10 mm (3/8 in.) long stiffening flanges. Fabricated from min No. 18 MSG galv steel. Min yield strength of 230 MPa. Joists spaced max 610 mm (24 in.) OC. Supplied with appropriate rim tracks of same size and gauge.

2B. **Steel Joists** — (Not Shown) - As an alternate to Item 2 - Channel-shaped, min 8 in. deep with min 40 mm (1-9/16 in.) wide flanges and 10 mm (3/8 in.) long stiffening flanges. Fabricated from min No. 16 MSG galv steel. Min yield strength of 230 MPa. Joists spaced max 610 mm (24 in.) OC. Supplied with appropriate rim tracks of same size and gauge.

3. **Clip Angles (Not shown)** — For use with 10 in. deep joists (Item 2). No. 16 MSG, 248 mm (9-3/4 in.) long steel angles with 51 mm (2 in.) legs. Secured to track and joist with eight No.10, 19 mm (3/4 in.) long, self drilling, hex head screws, located 25 mm (1 in.) from each end of clip angle, with the other two screws on each leg evenly spaced. Only one clip angle per joist end.

3A. **Clip Angles** — (Not Shown) - As an alternate to Item 3, for use with 152 mm (6 in.) or 203 mm (8 in.) deep joists (Item 2A or 2B). No. 16 MSG, 140 mm (5-1/2 in.) long steel angles with 13 mm (1/2 in.) legs for 152 mm (6 in.) deep joists and No. 18 MSG, 184 mm (7-1/4 in.) long steel angles with 38mm (1-1/2 in.) legs for 203 mm (8 in.) deep joists. Secured to track and joist with six No.10, 19 mm (3/4 in.) long, self-drilling, hex head screws, located 25 mm (1 in.) from each end of the clip angle and at the centerline. Only one clip angle per joist end.

4. **Joist Bridging** — For use with Items 2 and 2B - Installed immediately after joists are erected and before construction loads are applied. The bridging consisting of joist sections cut to length and placed between outer supports, adjacent to openings and at mid span with 2438 mm (8 ft) OC max spacing. Bridging channels are screw-attached at each end to joist web using angle clips. V-bracing of 38mm (1-1/2 in.) by 20-ga galvanized steel is screw-attached to bottom joist flange between bridging channels.

4A. **Joist Bridging** — (Not Shown) - For use with Items 2A and 2B - 38mm (1-1/2 in.) wide strips formed from 20 MSG - The structural bridging is installed perpendicular to and on the bottom surface of the joists at mid-span with one #10 x 19 mm (3/4 in.) long hex head steel screw at each interface.

4B. **Joist Bridging** — (Not Shown) - For use with Item 2A - Installed immediately after joists are erected and before construction loads are applied. The bridging consisting of rim track sections cut to length, with two 102 mm (4 in.) long folded back flanges, and placed between outer supports, adjacent to openings and at mid span with 3048 mm (10 ft) OC max spacing. Bridging
channels are screw-attached to each of the four top and bottom joist flanges with two No. 8 by 13 mm (1/2 in.) long wafer head steel screws.

5. **Ceiling Joists** — Channel shaped sections, min 89 mm (3-1/2 in.) deep with min 40 mm (1-9/16 in.) flanges and 14 mm (9/16 in.) stiffening flanges. Joists fabricated from min No. 18 MSG painted or galv steel with a min 345 MPa yield strength. Joists designed in accordance with the North American specification for the design of Cold-Formed Steel Structural Members - CSA S136. Joists spaced max 406 mm (16 in.) OC. A separation of minimum 51 mm (2 inches) shall be maintained between the top of the ceiling joists and the bottom of the floor joists.

6. **Ceiling Joists Track** — Cold formed channels min 76 mm (3-5/8 in.) deep with min 6 mm (1/4 in.) flanges. Ceiling tracks fabricated from min No. 18 MSG painted or galv steel, to provide supporting surface between ceiling joists and at periphery structural support elements. Ends of ceiling joists secured to ceiling tracks with 25 mm (1 in.) long, 3.18 mm (1/8 in.) fillet welds at top and bottom joist flanges.

7. **Ceiling Joist Bridging** — Continuous channel shaped sections, min 64 mm (2-1/2 in.) deep with min 40 mm (1-9/16 in.) flanges and 13 mm (1/2 in.) stiffening flanges. Bridging fabricated from min No. 18 MSG painted or galv steel. Bridging provided on top of ceiling joists at mid-span. Bottom flange of bridging secured to top flange of each ceiling joist with 25 mm (1 in.) long, 3mm (1/8 in.) fillet weld.

*8. **Insulation - Batts and Blankets** — (Optional) - Glass fiber batt insulation draped over the top flanges of the 89 mm (3-1/2 in.) deep "C" ceiling joists (Item 5), or draped over the resilient channels (Item 9), or supported between the "C" channel (Item 2) floor joists, just below the structural cement fiber units (Item 1), Any glass fiber batt insulation bearing the UL/ULC Classification Marking for Surface Burning Characteristics may be used.

9. **Resilient Channels** — Formed of No. 25 MSG galv steel, 13 mm (1/2 in.) deep, spaced max 305 mm (12 in.) OC, perpendicular to ceiling joists (Item 5). Channel splices located beneath joists and overlapped 102 mm (4 in.) Channels secured to each joist with one 13 mm (1/2 in.) long Type S-12 low profile steel screw. Two channels spaced 152 mm (6 in.) OC, oriented opposite each gypsum board end joint as shown on the illustration above. Additional channels shall extend min 152 mm (6 in.) beyond each side edge of board.

*10. **Wallboard** — (CKNXC) — One layer of nom 15.9 mm (5/8 in.) thick by 1220 mm (48 in.) wide gypsum panels installed with long dimension perpendicular to resilient channels. Gypsum panels secured to resilient channels with 25mm (1 in.) long Type S bugle-head screws spaced 203 mm (8 in.) OC, with screws located 102 mm (4 in.) from and on each side of the gypsum panel midspan, and 38mm (1-1/2 in.) from side edges of the board. End joints secured to both resilient channels as shown in end joint detail.

**CGC INC** — Sheetrock Firecode C
11. Finishing System - (Not Shown) — Vinyl, dry or premixed joint compound, applied in two coats to joints and screw-heads. Nom 51 mm (2 in.) wide paper tape embedded in first layer of compound over all joints. As an alternate, nom 2.4 mm (3/32 in.) thick veneer plaster may be applied to the entire surface of gypsum panels.

*Indicates such products shall bear the UL or cUL Certification Mark for jurisdictions employing the UL or cUL Certification (such as Canada), respectively.

Last Updated on 2017-05-10

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- Fire resistance assemblies and products are developed by the design submitter and have been investigated by UL for compliance with applicable requirements. The published information cannot always address every construction nuance encountered in the field.

- When field issues arise, it is recommended the first contact for assistance be the technical service staff provided by the product manufacturer noted for the design. Users of fire resistance assemblies are advised to consult the general Guide Information for each product category and each group of assemblies. The Guide Information includes specifics concerning alternate materials and alternate methods of construction.

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CANADIAN CERTIFICATIONS

1. HOW DO YOU WANT TO SEARCH?  2. RESULTS

FIRE-RESISTANCE DESIGN

Assembly Usage Disclaimer

BXUVC - Fire-resistance Ratings

See General Information for Fire-resistance Ratings

Design No. I536

June 21, 2017

Unrestrained Assembly Ratings - 1 and 2 h. (Refer to Item 5)
Floor Construction
Beam — W150 x 14, min size, 345 MPa steel.

1. **Structural Cement-Fiber Units** — (CIYTC) — Nom 19 mm (3/4 in.) thick, with tongue and grooved on long edges. Long dimension of panels to be perpendicular to joists with end joints staggered a min of 610 mm (2 ft.) and centered over the joists. Panels secured to steel joists with 41 mm (1-5/8 in.) long No. 8 self-drilling, self-countersinking steel screws spaced a max of 305 mm (12 in.) OC in the field with a screw located 25mm (1 in.) and 51 mm (2 in.) from each edge, and 8 in. OC on the perimeter with a screw located 51 mm (2 in.) from each edge, located 13 mm (1/2 in.) from the side edges of the panel.

**UNITED STATES GYPSUM CO** — Types STRUCTO-CRETE, USGSP

2. **Steel Joists** — Min. 14 MSG (68 mil) corrosion-protected steel joist, min 152 mm (6 in.) wide, with 51 mm (2 in) wide flanges (600S200-68), min yield strength of 345 MPa, cold formed, designed in accordance with North American specification for the design of Cold-Formed Steel Structural Members - CSA S136. All design details including the flexural design load of the joist, shall be as specified by the steel designer and/or producer, and shall meet the requirements of all applicable local code agencies. Joists spaced max 610 mm (24 in.) OC. Attached to W150 x 14, beam with clip angles (Items 3, 3A) or butt weld.

3. **Clip Angles** — For use with 152 mm (6 in.) deep joists (Item 2) when joists ends are cut to beam profile. Min. 16 MSG (1.44 mm) 38mm (1-1/2 in.) x 38 mm (1-1/2 in.) x 127 mm (5 in.) high steel angles. Secured to beam with
minimum five #12 self-drilling hex head screws. Secured to joist with five #10 self-drilling hex head screws. Only one clip angle per joist end.

3A. Clip Angles (Alternate to Item 3) — For use with 152 mm (6 in.) deep joists (Item 2) when joists ends are square cut. Min. 14 MSG (1.80 mm), 48 mm (1-7/8 in.) x 203 mm (8 in.) x 124 mm (4-7/8 in.) high secured to beam with minimum four #12 self-drilling hex head screws and attached to joists with minimum six #12 self-drilling hex head screws. Only one clip angle per joist end.

4. Joist Bridging (Not Shown) — For use with Item 2 - Installed immediately after joists are erected and before construction loads are applied. The bridging consisting of 51 mm (2 in.) wide flat steel strap formed from min. 16 MSG (1.44 mm). The structural bridging is installed perpendicular to and on the bottom flange of each joist at a maximum of 991 mm (39 in.) from each end of joist with one #10 self-drilling hex head steel screw per joist. Maximum spacing of bridging shall be 2438 mm (8 ft.).

4A. Joist Solid Blocking (Not Shown) — For use with Item 2 - Installed immediately after joists are erected and before construction loads are applied. This blocking consists of joists (Item 2) cut to length to fit in between joist cavity, using clip angles (Items 3, 3A) to attach solid bridging to joists at each end. Solid joist blocking required at each perimeter joist cavity and at joist bridge strapping (Item 4) with maximum 2438 mm (8 ft.) OC spacing.

*5. Insulation — Batts and Blankets — (When Insulation is not used the rating shall be 1 hour.) Min. 89 mm (3-1/2 in.) thick glass fiber batt or mineral wool insulation installed in joist cavities and supported by hexagonal wire netting (Item 6) attached to the bottom of the joists. Any glass fiber or mineral wool batt insulation bearing the UL/ULC Classification Marking for Surface Burning Characteristics may be used.

6. Hexagonal Wire Netting — To be used with item 5. Min. 20 MSG attached to bottom of steel joists (Item 2) with min. 18 MSG hanger wire wrapped around joist at 610 mm (24 in.) OC. Alternate Attachment Method-I - Use 13 mm (1/2 in.) long, pan head, self-drilling screws with washers, spaced 610 mm (24 in.) OC to attach Hexagonal Wire Netting to bottom of the Steel Joists (Item 2). Alternate Attachment Method-II - Use 19 mm (3/4 in.) wide, min 25 MSG steel straps to attach Hexagonal Wire Netting to bottom of Steel Joists (Item 2), metal straps screw attached parallel to the bottom of the Steel Joists or perpendicular to the Steel Joists spaced 610 mm (24 in.) OC with 13 mm (1/2 in.) long, self-drilling screws spaced 610 mm (24 in.) OC.

6A. Hexagonal Wire Netting — As an alternate to Item 6 - Min 20 MSG, min 914 mm (36 in.) wide, centered over the top of the joist cavity, bending Hexagonal Wire Netting over top of two adjacent flanges of steel joists to accommodate the insulation, with insulation installed between Hexagonal Wire Netting and Type USGSP (Item 1), prior to the Type USGSP (Item 1) being screw attached to the top of the steel joists.

6B. Metal Strap — As an alternate to Item 6, 19 mm (3/4 in.) wide, min 25 MSG steel straps attached perpendicular to the bottom of the steel joists (Item
2), spaced 406 mm (16 in.) OC with 13 mm (1/2 in.) long, self-drilling screws.

Ceiling Construction
Beam — W100 x 19, min size, 345 MPa steel. Supported at a maximum 3658 mm (12 feet.) OC.

7. Steel Joists — CMin. 16 MSG (1.44 mm) corrosion-protected steel joist, min 102 mm (4 in.) deep, with 51 mm (2 in.) wide flanges (400S200-54), min yield strength of 50 ksi, cold formed, designed in accordance with North American specification for the Design of cold-formed Steel Structural Members - CSA S136. All design details, including the flexural design load of the joist, shall be as specified by the steel stud designer and/or producer, and shall meet the requirements of all applicable local code agencies. Joists spaced max 610 mm (24 in.) OC. Attached to W100 x 19 beam with clip angles (Items 8, 8A) or butt weld.

8. Clip Angles — For use with 102 mm (4 in.) deep joists (Item 7) when joists ends are cut to beam profile. Min. 16 MSG, 38mm (1-1/2 in.) x 38mm (1-1/2 in.) x 76 mm (3 in.) high steel angles. Secured to beam with minimum three #12 self-drilling hex head screws. Secured to joists with three #10 self-drilling hex head screws. Only one clip angle per joist end.

8A. Clip Angles (Alternate to Item 8) — For use with 102 mm (4 in.) deep joists (Item 7) when joist ends are square cut. Min. 16 MSG (1.44 mm), 38 mm (1-1/2 in.) x 102 mm (4 in.) x 76 mm (3 in.) high steel angles. Secured to beam with minimum three #12 self-drilling hex head screws, attached to joists with three #10 self-drilling hex head screws. Only one clip angle per joist end.

9. Joist Bridging (Not Shown) — For use with Item 7 - Installed immediately after joists are erected and before construction loads are applied. The bridging consisting of 51 mm (2 in.) wide flat steel strap formed from min. 16 MSG (54 mil). The structural bridging is installed perpendicular to and on the bottom flange of each joist at a maximum of 1067 mm (42 in.) from each end of joist with one #10 self-drilling hex head steel screw per joist. Maximum spacing of bridging shall be 2438 mm (8 ft.).

9A. Joist Solid Blocking (Not Shown) — Consisting of joists (Item 7) cut to length to fit in between joist cavities, using clip angles (Items 8, 8A) to attach solid blocking to joists at each end. Solid joist blocking required at each perimeter joist cavity and at joist bridge strapping (Item 9) with maximum 2438 mm (8 ft.) OC spacing.

10. Resilient Channels — Formed of min. 25 MSG galv. steel, 13 mm (1/2 in.) deep, spaced max 406 mm (16 in.) OC, perpendicular to ceiling joists (Item 7). Channel splices located beneath joists and overlapped 102 mm (4 in.) Channels secured to each joist with one 11mm (7/16 in.) long Type S-12 low profile steel screw. Two channels spaced 152 mm (6 in.) OC, oriented opposite each gypsum board end joint. These channels shall extend min 152 mm (6 in.) beyond each side edge of board.

*11. Wallboard — (CKNXC) — One layer of nom 15.9 mm (5/8 in.) thick by 1220 mm (48 in.) wide gypsum panels installed with long dimension
perpendicular to resilient channels. Gypsum panels secured to resilient channels with 25mm (1 in.) long Type S bugle-head screws spaced 203 mm (8 in.) OC, with screws located 102 mm (4 in.) from and on each side of the gypsum panel midspan, and 25mm (1 in.) from tapered edges of the board. End joints secured to both resilient channels.

**CGC INC — Sheetrock Firecode C**

**12. Finishing System (Not Shown) —** Vinyl, dry or premixed joint compound, applied in two coats to joints and screw-heads. Nom 51 mm (2 in.) wide paper tape embedded in first layer of compound over all joints. As an alternate, nom 2.4 mm (3/32 in.) thick veneer plaster may be applied to the entire surface of gypsum panels.

**13. Connection Between Floor and Ceiling Construction —** Steel plate, minimum 102 mm (4 in.) by 102 mm (4 in.) by 19 mm (3/4 in.) thick, welded between Floor and Ceiling Beams and at four corners of the modular assembly and at intermediate structural supports space a maximum of 3658 mm (12 ft.) OC.

*Indicates such products shall bear the UL or cUL Certification Mark for jurisdictions employing the UL or cUL Certification (such as Canada), respectively.

Last Updated on 2017-06-21

**Design/System/Construction/Assembly Usage Disclaimer**

- Authorities Having Jurisdiction should be consulted in all cases as to the particular requirements covering the installation and use of UL Certified products, equipment, system, devices, and materials.
- Authorities Having Jurisdiction should be consulted before construction.
- Fire resistance assemblies and products are developed by the design submitter and have been investigated by UL for compliance with applicable requirements. The published information cannot always address every construction nuance encountered in the field.
- When field issues arise, it is recommended the first contact for assistance be the technical service staff provided by the product manufacturer noted for the design. Users of fire resistance assemblies are advised to consult the general Guide Information for each product category and each group of assemblies. The Guide Information includes specifics concerning alternate materials and alternate methods of construction.
- Only products which bear UL's Mark are considered Certified.

The appearance of a company's name or product in this database does not in itself assure that products so identified have been manufactured under UL's Follow-Up Service. Only those products bearing the UL Mark should be considered to be Certified and covered under UL's Follow-Up Service. Always look for the Mark on the product.

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