USG Structural Solutions

USG STRUCTURAL PANEL CONCRETE SUBFLOOR

DELAVAN, WI

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TRACI v2.1 Environmental Impacts (Cradle-to-Gate)	
Declared Unit – 1 panel	
	USG Structural Panel Concrete Subfloor Panel
Global Warming Potential (kg CO_2 eq.)	**9.24E+01**
Ozone Depletion Potential (kg CFC-11 eq.)	**1.13E-07**
Acidification Potential (kg SO_2 eq.)	**3.65E-01**
Eutrophication Potential (kg N eq.)	**1.67E-02**
Photochemical Ozone Creation Potential (kg O_3 eq.)	**4.68E+00**
Abiotic Resource Depletion Potential Fossil Fuels (MJ, LHV)	**7.07E+01**

USG Structural Panel Concrete Subfloor, also known as USG Structo-Crete™ Panel, is a mechanically attached concrete subfloor that can be combined with other noncombustible materials to create 1-, 2- and 3-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 for use in all types of noncombustible construction

USG Structural Panel Concrete Subfloor is mechanically fastened to cold-formed steel joists, trusses or other framing members. A noncombustible ceiling assembly is attached to the bottom of the floor joists to complete the construction.

USG Structural Panel Concrete Subfloor can carry a total load, live and dead, of 120 psf (5.8 kPa) when support framing is spaced 24" (610 mm) o.c. Floor diaphragm design capacities 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.

For over a century, sustainable practices have naturally been an inherent part of our business at USG. Today, they help shape the innovative products that become the homes where we live, the buildings where we work and the arenas where we play. From the product formulations we choose, to the processes we employ, USG is committed to designing, manufacturing, and distributing products that minimize overall environmental impacts and contribute toward a healthier living space. We believe that transparency of product information is essential for our stakeholders and EPDs are the next step toward an even more transparent USG. For additional information, visit usg.com, cgcinc.com and usgdesignstudio.com

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This declaration is an environmental product declaration (EPD) in accordance with ISO 14025 and ISO 21930: 2017. EPDs rely on Life Cycle Assessment (LCA) to provide information on a number of environmental impacts of products over their life cycle. Exclusions: EPDs do not indicate that any environmental or social performance benchmarks are met, and there may be impacts that they do not encompass. LCAs do not typically address the site-specific environmental impacts of raw material extraction, nor are they meant to assess human health toxicity. EPDs can complement but cannot replace tools and certifications that are designed to address these impacts and/or set performance thresholds – e.g. Type 1 certifications, health assessments and declarations, environmental impact assessments, etc. Accuracy of Results: EPDs regularly rely on estimations of impacts, and the level of accuracy in estimation of effect differs for any particular product line and reported impact. Comparability: EPDs are not comparative assertions and are either not comparable or have limited comparability when they cover different life cycle stages, are based on different product category rules or are missing relevant environmental impacts. EPDs from different programs may not be comparable.

DECLARATION NUMBER	EPD 136
PROGRAM OPERATOR	ASTM International – 100 Barr Harbor Drive, West Conshohocken, PA USA www.astm.org
DECLARATION HOLDER	USG Corporation - 550 W. Adams St., Chicago, IL USA
DECLARED PRODUCT	USG Structural Panel Concrete Subfloor
REFERENCE PCR	Universal Cement Co., Ltd. and Taiwan Green Building Material Council, "Product-Category Rules (PCR) for Preparing an Environmental Product Declaration (EPD) for Flame Retardant Building Materials of Fiber Cement / Fiber Reinforced Cement and Gypsum Board", v1.0, 2015
DATE OF ISSUE PERIOD OF VALIDITY	4/17/20 5 Years
CONTENTS OF THE DECLARATION	This EPD is complete and contains the following: • Product System Documentation • Life cycle Calculation Rules • Life Cycle Assessment Results • Further Information • References
This declaration was independently verified in accordance with ISO 14025 and ISO 21930:2017 ☐ INTERNAL ☒ EXTERNAL	Tim Brooke, ASTM International
This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by:	Thomas P. Gloria, Industrial Ecology Consultants

1. Product System Documentation

1.1 Product Description and Product Identification

USG Structural Panel Concrete Subfloor, also known as USG Structo-Crete™ Panel, is formed from a composite consisting of glass fibers, cementitious materials and aggregate. USG Structural Panel Concrete Subfloor is nominally ¾" (19.1 mm) thick, 4 feet (1219 mm) wide, and 8 feet (2428 mm) long with tongue-and-groove edges along the length of the panel. Other sizes and square edge panels are also available via special request.

Based on tests in accordance with ASTM E136, the panels are noncombustible. The panels yield a flame-spread index of 0 and a smoke-developed index of 5 or less when tested in accordance with ASTM E84.

1.2 Application

The products covered by this EPD are designed to be mechanically fastened to cold-formed steel joists, trusses or other framing members. A noncombustible ceiling assembly is attached to the bottom of the floor joists to complete the construction. See usg.com for additional installation specifications. Cutting the concrete subfloor requires a standard framing, 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, corrosion resistant, fasteners. Refer to USG Structural Recommended Fasteners (SCP95) for details. 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).

1.3 Product Technical Data

The following technical construction data is relevant for the products covered by this EPD.

Table 1: Technical Specifications

Physical and Mechanical Properties	Test Standard	Approximate Values Standard (Metric)
Concentrated load	ASTM E661 (550 lb., .108")	804 lb. (3.58 kN) static 0.066" (1.7 mm) max. deflection @ 200 lb. (0.89 kN)
Fastener lateral resistance[A]	ASTM D1761, Sec. 10.2 (dry >210 lbf, wet >160 lbf)	776 lbf (3.45 kN) dry 800 lbf (3.56 kN) wet
Density[B]	ASTM C1185 (75 lb./ft3)	78.6 lb./ft3 (1,258 kg/m3)
pH value	ASTM D1293	10.5
Linear variation with change in moisture (25% to 90% relative humidity)	ASTM C1185, Sec. 8 (<.10%)	0.06 %
Thickness swell	ASTM D1037, B (≤3.0%)	0.04 %
Mold resistance	ASTM D3273 (10) ASTM G21 (≤ 1)	10 0
Water absorption[C]	ASTM C1185, Sec. 5.2.3.1 (<15%)	9.0 %
Noncombustibility	ASTM E136 (unmodified) CAN/ULC-S114	Passed Passed
Surface-burning characteristics ASTM E84 (0/0) 0/0	ASTM E84 (0/0) 0/0 CAN/ULC-S102 (0/0)	0/0 0/0
Long-term durability	ASTM C1185, Sec. 13 (75%)	100% properties retention
Water durability	ASTM C1185, Sec. 5 (70%)	83% properties retention
Termite resistance	AWPA Standard E1-13	9.8
Low VOC emissions	CDPH/EHLB/Standard Method v1.1-2010[D]	Compliant

(A) Fastener lateral resistance measured with #8, 1-5/8" (41 mm) Hi-Low screw.
(B) Density measured at equilibrium conditioning per Section 5.2.3.1, 28 days after manufacturing.
(C) Absorption measured from equilibrium conditioning followed by immersion in water for 48 hours.
(D) Reference Standard: California Department of Public Health CDPH/EHLB/Standard Method Version 1.1, 2010 (Emission testing method for CA Specification 01350).

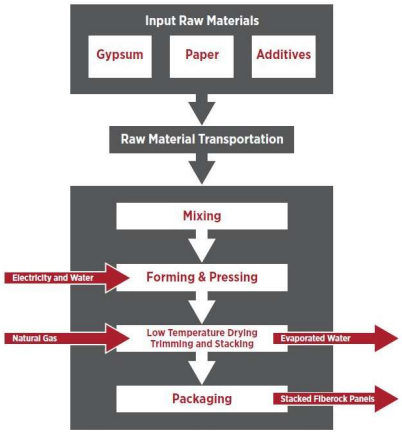
1.4 Product Composition

Table 2: Material Composition

Chemical Name	USG Structural Panel Concrete Subfloor
Cementitious binder	>65%
Glass fiber	<10%
Trade secret	<10%

1.5 Product Manufacture

The manufacture of USG Structural Panel Concrete Subfloor starts with the dry blending of the dry ingredients in a screw conveyor, feeding of this dry ingredient mixture into a mixer where these dry ingredients are mixed with water and wet additives. The resulting slurry is formed into a wet panel. The wet board is allowed to hydrate after which the hard board is trimmed. The finished product is then banded with plastic straps and stacked for shipment-filled.



1.6 Environment and Health During Manufacturing

USG has led the building sector's effort in developing and supplying sustainable construction materials. Today, sustainability is integrated into the design and manufacture of every wall, ceiling, and flooring product. As both a producer and a buyer of raw materials, we have a responsibility to extensively review and select each material we use. Each decision we make is based on careful consideration of environmental and safety effects over time. Raw materials used in our products are carefully selected and go through a screening procedure. Incoming raw materials are tested for contaminants by an internal lab and third-party labs for consideration of use and worker, environmental, and end-user exposure. This due diligence helps to ensure our products are safe to handle in our manufacturing plants and on job sites while having minimal impact on occupant health and indoor and outdoor environments.

1.7 Packaging

USG Structural Panel Concrete Subfloor comes as 3/4" panels in various sizes. USG Structural Panel Concrete Subfloor are packaged in 20 piece units. Both the production and disposal of these packaging materials was modeled in this study.

1.8 Reference Service Life

The Reference Service Life is considered not to be relevant for this cradle-to-gate study.

1.9 Extraordinary Effects

DESCRIPTION	REFERENCE
Code Reports	PER-13067
Code Approvals	ICC-ES Evaluation Report – ESR-1792
Ultimate Uniform Load (total DL and LL)	Refer to PER-13067
Shear Diaphragm Ratings[A]	1,468 plf (21.4 kNm)[A]
UL 1-, 1.5-, 2-Hour Fire Resistance Designs[C]	G535, G536, G556, G557, G558, G562, G588, L521, L541, L550, L569, L570, M502, M506, M515, M521, M527, H505, H501™
ULC 1-,1.5-, 2-Hour Fire Resistance Designs[C]	I526, I527, I528, I529, M520, M521
UL 2-, 3-Hour Load-Bearing Walls[C]	V465, V471
UL/ULC Metal and Plastic Through-Penetration Firestop Systems[C]	F-E-1023, F-E-1032, F-E-2045,
Acoustical Ratings	>65 IIC[B] >56 STC [B]

(A) 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.

(B) 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.

(C) For the most up-to-date UL/ULC Designations, visit USGStructuralUL.com.com

2. LCA Calculation Rules

2.1 Declared Unit

The functional unit for this LCA study is one 3/4" (19.05 mm) 4 ft. (1220 mm) by 8 ft. (2440 mm) sheet of USG Structural Panel Concrete Subfloor as dictated by the PCR. The results are also presented per 1,000 square feet.

Table 3: Declared Unit

NAME	USG STRUCTURAL PANEL CONCRETE SUBFLOOR	USG STRUCTURAL PANEL CONCRETE SUBFLOOR
Declared Unit	1 panel	1,000 sf
Declared Unit (sf)	32.0	1,000
Declared Unit (m^2)	2.97	92.9
Declared Thickness (inches)	0.75	0.75
Declared Thickness (cm)	1.90	1.90
Surface weight per declared unit (lbs.)	150	4,688
Surface weight per declared unit (kg)	68.0	2,126

2.2 System Boundary

This EPD represents a "cradle-to-gate" LCA analysis for USG Structural Panel Concrete Subfloor. It covers all production steps from raw material extraction (i.e., the cradle) to packaged panels ready for shipment (gate).

2.3 Estimates and Assumptions

In the case of USG Structural Panel Concrete Subfloor production, no significant assumptions were required. All material and energy inputs were accounted for as were all raw material transportation inputs. Additional data limitations include the use of proxy processes rather than actual supplier generated primary data. This would include such processes as Portland cement, which is representative of US-produced Portland cement but may not necessarily be representative of USG's particular Portland cement supplier. In addition, the data is limited in that the primary data was collected during the 2016 year and changes in operations may increase/decrease impacts in the future. Other data limitations include the use of secondary data sets instead of primary data for upstream and downstream processes, local impacts vs. global impacts, possible impacts vs. actual impacts, inherent uncertainty in the data sets, accuracy and precision of impact assessment methodology, etc.

2.4 Cut-off Criteria

All inputs and outputs to a (unit) process were included in the calculation for which data is available.

In case of insufficient input data or data gaps for a unit process, the cut-off criteria was 1% of renewable and non-renewable primary energy usage and 1% of the total mass of that unit process. The total neglected input flows did not exceed 5% of energy usage and mass.

As such, some minor additives fell well below the cut-off criteria and were therefore not included in this study.

2.5 Background Data

All background was sourced from critically reviewed GaBi databases.

2.6 Data Quality

The LCA model was created using the GaBi ts software. Specific comments related to data quality requirements cited in ISO 14025 Section 4.2.3.6.2 include the following.

Temporal: In the case of USG Structural Panel Concrete Subfloor production, the LCI data was collected from the Delevan, WI plant for the 2016 production year.

Geographical: Where possible, all processes were chosen as being representative of US manufacturing processes. Specifically, this would include electricity generation. The specific process selected for electricity generation was chosen to be specific to the specific region in the US using the updated eGRID system.

Technical: The data selected for this study is specific to the technology used in the preparation of the various raw materials.

Precision: The raw material usage amounts for panel were derived from plant data. They are representative of actual usage for the 2016 calendar year.

Completeness: All raw material flows used in the production of USG Structural Panel Concrete Subfloor have been modeled.

Representative: Where possible all the data sets were selected to be representative of US-based production, are less than 10 years in age and are representative of the technology being employed.

Consistency: All the manufacturing processes were modeled in a consistent manner throughout this study in accordance with the goal and scope definitions.

Reproducibility: The information contained in this study, including raw material, energy and transportation distance inputs, have been fully documented in the LCA report.

Sources of Data: The sources for the processes used in this study have been fully provided in the LCA report and are representative of the material and energy sources used in actual production.

Uncertainty: The relative uncertainty associated with this study has been minimized. No significant assumptions have been made.

2.7 Period under Review

All raw material and energy inputs are for the 2016 calendar year.

2.8 Allocation

No allocations were required for this LCA study.

2.9 Comparability

A comparison or evaluation of EPD data is only possible if all data sets to be compared are 1) created according to EN 15804 and 2) are considered in a whole building context or utilize identical defined use stage scenarios. Comparisons are only allowable when EPDs report cradle-to-grave information using a functional unit. Refer to section 5.3 of EN 15804 for further information. Comparison of the environmental performance of panels using EPD information shall be based on the product's use and impacts at the building level, and therefore EPDs may not be used for comparability purposes when not considering the building energy use phase as instructed under this PCR. Full conformance with the PCR for Gypsum Panel Products allows EPD comparability only when all stages of a panel life cycle have been considered. However, variations and deviations are possible.

3. Life Cycle Assessment Results

Table 4: Description of the system boundary modules

PRODUCT STAGE			CONSTRUCTION PROCESS STAGE		USE STAGE							END OF LIFE STAGE				BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARIES
Raw Material Supply	Transport	Manufacturing	Transport From Gate to Site	Assembly/Install	Use Stage	Maintenance	Repair	Replacement	Refurbishment	Operational Energy Use	Operational Water Use	Deconstruction	Transport	Waste Processing	Disposal	Reuse, Recovery, Recycling Potential
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
X	X	X	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND

Table 5: Acronym Key

ABBREVIATION	PARAMETER	UNIT
	Life Cycle Impact Assessment Indicators	
GWP	Global Warming Potential	kg CO_2 eq.
ODP	Ozone Depletion Potential	kg CFC-11 eq.
AP	Acidification Potential	kg SO_2 eq.
EP	Eutrophication Potential	kg N eq.
POCP	Photochemical ozone creation potential	kg O_3 eq.
ADP	Abiotic resource depletion potential – fossil fuels	MJ, LHV
	Resource Use Parameters	
PERE	Use of renewable primary energy excluding renewable primary energy resources used as raw materials	MJ, LHV
PERM	Use of renewable primary energy resources used as raw materials	MJ, LHV
PERT	Total use of renewable primary energy resources (primary energy and primary energy resources used as raw materials)	MJ, LHV
PENRE	Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials	MJ, LHV
PENRM	Use of non-renewable primary energy resources used as raw materials	MJ, LHV
PENRT	Total use of non-renewable primary energy resources (primary energy and primary energy resources used as raw materials)	MJ, LHV
SM	Use of secondary materials	kg
RSF	Use of renewable secondary fuels	MJ, LHV
NRSF	Use of non-renewable secondary fuels	MJ, LHV
FW	Net use of fresh water	m3
	Waste Parameters	
HWD	Disposed-of-hazardous waste	kg
NHWD	Disposed-of non-hazardous waste	kg
RWD	Radioactive Waste Disposed	kg
	Output Flow Parameters	
CRU	Components for reuse	kg
MFR	Materials for recycling	kg
MER	Materials for energy recovery	kg
EE	Exported energy	MJ

3.1 Life Cycle Impact Assessment Results

Table 6: North American Impact Assessment Results for 1 USG Structural Panel Concrete Subfloor Panel

TRACI V2.1	UNITS	A1-A3
GWP 100	kg CO_2 eq.	9.24E+01
ODP	kg CFC-11 eq.	1.13E-07
AP	kg SO_2 eq.	3.65E-01
EP	kg N eq.	1.67E-02
POCP	kg O_3 eq.	4.68E+00
ADP	MJ, LHV	7.07E+01

Table 7: North American Impact Assessment Results for 1,000 SF of USG Structural Panel Concrete Subfloor Panels

TRACI V2.1	UNITS	A1-A3
GWP 100	kg CO_2 eq.	2.89E+03
ODP	kg CFC-11 eq.	3.52E-06
AP	kg SO_2 eq.	1.14E+01
EP	kg N eq.	5.21E-01
POCP	kg O_3 eq.	1.46E+02
ADP	MJ, LHV	2.21E+03

3.2 Life Cycle Inventory Results

Table 8: Resource Use for 1 USG Structural Panel Concrete Subfloor Panel (A1-A3)

PARAMETER	UNITS	1 USG STRUCTURAL PANEL CONCRETE SUBFLOOR PANEL
PERE	MJ, LHV	1.09E+02
PERM	MJ, LHV	0.00E+00
PERT	MJ, LHV	1.09E+02
PENRE	MJ, LHV	1.11E+03
PENRM	MJ, LHV	0.00E+00
PENRT	MJ, LHV	1.11E+03
SM	MJ, LHV	0.00E+00
RSF	MJ, LHV	0.00E+00
NRSF	MJ, LHV	0.00E+00
FW	m^3	3.36E-01

Table 9: Resource Use for 1,000 SF of USG Structural Panel Concrete Subfloor Panels (A1-A3)

PARAMETER	UNITS	1,000 SF OF USG STRUCTURAL PANEL CONCRETE SUBFLOOR PANELS
PERE	MJ, LHV	3.39E+03
PERM	MJ, LHV	0.00E+00
PERT	MJ, LHV	3.39E+03
PENRE	MJ, LHV	3.46E+04
PENRM	MJ, LHV	0.00E+00
PENRT	MJ, LHV	3.46E+04
SM	MJ, LHV	0.00E+00
RSF	MJ, LHV	0.00E+00
NRSF	MJ, LHV	0.00E+00
FW	m^3	1.05E+01

Table 10: Output Flows and Waste Categories for 1 USG Structural Panel Concrete Subfloor Panel

PARAMETER	UNITS	1 USG STRUCTURAL PANEL CONCRETE SUBFLOOR PANEL
HWD	kg	3.90E-04
NHWD	kg	1.18E+02
RWD	kg	4.69E-02
CRU	kg	0.00E+00
MFR	kg	0.00E+00
MER	kg	0.00E+00
EE	MJ, LHV	0.00E+00

Table 11: Output Flows and Waste Categories for 1,000 SF of USG Structural Panel Concrete Subfloor Panels

PARAMETER	UNITS	1,000 SF OF USG STRUCTURAL PANEL CONCRETE SUBFLOOR PANELS
HWD	kg	1.22E-02
NHWD	kg	3.70E+03
RWD	kg	1.47E+00
CRU	kg	0.00E+00
MFR	kg	0.00E+00
MER	kg	0.00E+00
EE	MJ, LHV	0.00E+00

3.3 LCA Interpretation

The LCA results for the production of USG Structural Panel Concrete Subfloor were dominated by raw material contributions particulary cement and glass fiber. For example, total cement usage was responsible for 62% of the global warming impact in a cradle-to-gate analysis.

4. Further Information

4.1 VOC Emissions

USG certifies that USG Structural Panel Concrete Subfloors are certified as GreenGuard Gold (certificate number 127750-420). Additional information can be obtained at USG.com and CGCINC.com.

5. References

LCA Report

A Cradle-to-Gate (A1-A3) and Cradle-to-Grave (A1-C4) Life Cycle Assessment of USG Structural Panels; March 6th, 2018. USG.

PCR

Universal Cement Co., Ltd. and Taiwan Green Building Material Council, "Product-Category Rules (PCR) for Preparing an Environmental Product Declaration (EPD) for Flame Retardant Building Materials of Fiber Cement / Fiber Reinforced Cement and Gypsum Board", v1.0, 2015

SUSTAINABILITY REPORTING STANDARDS

EN 15804: 2012-04 - Sustainability of construction works — Environmental Product Declarations — Core rules for the product category of construction product.

ISO 14025: 2006 - Environmental labels and declarations — Type III environmental declarations — Principles and procedures

ISO 14040: 2006 - Environmental management – Life cycle assessment – Principles and framework

ISO 14044:2006 - Environmental management – Life cycle assessment – Requirements and guidelines

ISO 14046:2013 - Environmental management- Water footprint- Principles, requirements and guidelines

ISO 15392:2008 - Sustainability in building construction- General principles

ISO 15686-1:2011 - Buildings and constructed assets- Service life planning- Part 1: General principles

ISO 15686-2:2008 - Buildings and constructed assets- Service life planning Part 2: Service life prediction procedures

ISO 15686-7:2008 - Buildings and constructed assets- Service life planning Part 7: Performance evaluation for feedback of service life data from practice

ISO 15686-8:2008 - Buildings and constructed assets- Service life planning Part 8: Reference service life and service life estimation

ISO 21930: 2017 - Sustainability in building construction -- Environmental declaration of building products