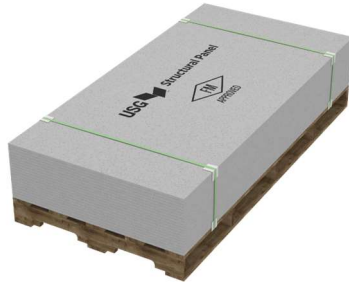


USG STRUCTURAL PANEL CONCRETE ROOF DECK

DELANAN, WI



USG Structural Panel Concrete Roof Deck, also known as USG Structo-Crete™ Panel, is a concrete roof deck that can be combined with other noncombustible materials to create 1- and 2-hour fire-rated roof-ceiling assemblies.

- The only cementitious structural panel approved by Factory Mutual (FM) — FM Approval Standard 4472

- Strong, durable concrete panel; great uplift ratings

- Dimensionally stable; panel will not buckle or warp like wood sheathing; no moisture issues

- like structural concrete

- Installs fast and easy with appropriate dust collection

- Meets the criteria of ASTM E136 for use in all types of noncombustible construction

- Made in the US

USG Structural Panel Concrete Roof Deck is mechanically fastened to cold-formed steel joists, trusses or wood framing members to create a structural substrate for ideal as low- and steep slope roof systems, canopies and/or balconies. This roof system is designed to carry gravity and lateral loads. Roof membranes may be applied directly over USG Structural Panel Concrete Roof Deck.

TRACI v2.1 ENVIRONMENTAL IMPACTS (CRADLE-TO-GATE)

Declared Unit – 1 panel

	USG Structural Panel Concrete Roof Deck
Global Warming Potential (kg CO₂ eq.)	9.24E+01
Ozone Depletion Potential (kg CFC-11 eq.)	1.13E-07
Acidification Potential (kg SO₂ eq.)	3.65E-01
Eutrophication Potential (kg N eq.)	1.67E-02
Photochemical Ozone Creation Potential (kg O₃ eq.)	4.68E+00
Abiotic Resource Depletion Potential Fossil Fuels (MJ, LHV)	7.07E+01

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

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 135	
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 Roof Deck	
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	4/17/20	
PERIOD OF VALIDITY	5 Years	
CONTENTS OF THE DECLARATION	This EPD is complete and contains the following: <ul style="list-style-type: none"> • 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 <input type="checkbox"/> INTERNAL <input checked="" type="checkbox"/> 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 Roof Deck is a concrete roof deck that can be combined with other noncombustible materials to create 1- and 2-hour fire-rated roof-ceiling assemblies.

- The only cementitious structural panel approved by Factory Mutual (FM) — FM Approval Standard 4472
- Strong, durable concrete panel; great uplift ratings
- Dimensionally stable; panel will not buckle or warp like wood sheathing; no moisture issues like structural concrete
- Installs fast and easy with appropriate dust collection
- Meets the criteria of ASTM E136 for use in all types of noncombustible construction
- Made in the US

1.2 Application

USG Structural Panel Concrete Roof Deck is mechanically fastened to cold-formed steel joists, trusses or wood framing members to create a structural substrate for ideal as low- and steep slope roof systems, canopies and/or balconies. This roof system is designed to carry gravity and lateral loads. Roof membranes may be applied directly over USG Structural Panel Concrete Roof Deck. For retrofit or renovation projects, Concrete Roof Deck can also be installed on wood-joists, trusses or bar joists.

Cutting the concrete roof deck 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	TYPICAL VALUE STANDARD (METRIC)
Non-combustibility	ASTM E136 (unmodified)	Non-combustibility
Surface-burning characteristics (flame spread/smoke developed)	ASTM E84 CAN/ULC-S102	0/0
Weight at ¾" (19 mm) thickness	ASTM D1037	5.3 lbs./ft ² (26 kg/m ²)
Density ^a	ASTM C1185	75 lb./ft ³ (1,201 kg/m ³)
Mold resistance	ASTM D3273 ASTM G21	10 0
Termite resistance	AWPA Standard E1-13	9.8
Low VOC emissions	CDPH/EHLB/Standard Method V1.1-2010 ^b	Compliant
Concentrated load	ASTM E661	550 lbs. (2.45 kN) static 0.108 in. (2.7mm) max. deflection @ 200 lbs. (0.89 kN)
Fastener lateral resistance ^c	ASTM D1761, Sec. 10.2	>210 lbs. (0.93 kN) dry >160 lbs. (0.71 kN) wet
pH value	ASTM C1185, Sec. 8	10.5
Linear variation with change in moisture (25% to 90% relative humidity)	E84 and CAN/ULC S102	<0.10 %
Thickness swell	ASTM D1037, B	max. 3.0 %
Freeze / thaw resistance	ASTM C1185	Passed (50 cycles)
Water absorption ^d	ASTM C1185, Sec. 5.2.3.1	<15.0 %
Long-term durability	ASTM C1185, Sec. 13	min. 75% retention of physical properties
Water durability	ASTM C1185, Sec. 5	min. 70% retention of physical properties

(a) Density measured at equilibrium conditioning per Section 5.2.3.1., 28 days after manufacturing.

(b) Reference Standard: California Department of Public Health CDPH/EHLB/Standard Method Version 1.1, 2010 (Emission testing method for CA Specification 01350).

(c) Fastener lateral resistance measured with #8, 1-5/8 in. (41mm), winged, self-drilling screw.

(d) Absorption measured from equilibrium conditioning followed by immersion in water for 48 hours.

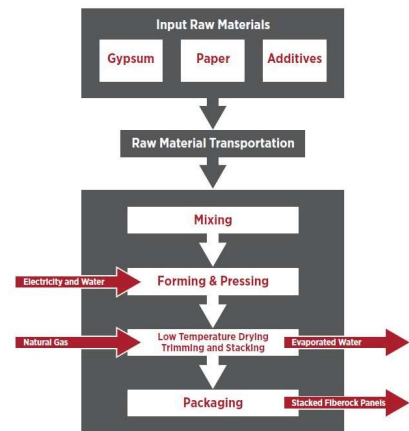
1.4 Product Composition

Table 2: Material Composition

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

1.5 Product Manufacture

The manufacture of USG Structural Panel Concrete Roof Deck 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 Roof Deck comes as 3/4" panels in various sizes. USG Structural Panel Concrete Roof Deck 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

Ultimate Load Capacity for USG Structural Panel Concrete Roof Deck

Joist Spacing – Inches (mm)	Uniform Load – psf (kPa) ^{1,2,3}	Uplift Capacity – psf (kPa) ^{1,2,3}			
		8/12	8/8	6/6	4/4
12 inch (304.8 mm)	1320 (63.2)	513 (24.6)	770 (36.9)	1026 (49.1)	1320 (63.2)
16 inch (406.4 mm)	744 (35.6)	385 (18.4)	557 (27.6)	744 (35.6)	744 (35.6)
24 inch (609.6 mm)	330 (15.8)	257 (12.3)	330 (15.8)	330 (15.8)	330 (15.8)
32 inch (812.8 mm)	240 (11.5)	192 (9.19)	240 (11.5)	240 (11.5)	240 (11.5)
48 inch (1219 mm) ⁴	150 (7.2)	128 (6.1)	150 (7.2)	150 (7.2)	150 (7.2)

(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.

For complete load capacities, consult Progressive Engineering Inc. Product Evaluation Report PER-14076

(4) Blocking at all joints perpendicular to framing to be a minimum of 16 gauge (54 mils, or 0.0538 inch [1.37 mm]), 3-5/8 in (92 mm)

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 Roof Deck as dictated by the PCR. The results are also presented per 1,000 square feet.

Table 3: Declared Unit

NAME	USG STRUCTURAL PANEL CONCRETE ROOF DECK	USG STRUCTURAL PANEL CONCRETE ROOF DECK
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 Roof Deck. 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 Roof Deck 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 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 Roof Deck 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 Roof Deck 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	m ³
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 Roof Deck 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 Roof Deck 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 Roof Deck Panel

PARAMETER	UNITS	1 USG STRUCTURAL PANEL CONCRETE ROOF DECK 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 Roof Deck Panels

PARAMETER	UNITS	1,000 SF OF USG STRUCTURAL PANEL CONCRETE ROOF DECK 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 Roof Deck Panel

PARAMETER	UNITS	1 USG STRUCTURAL PANEL CONCRETE ROOF DECK 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 Roof Deck Panels

PARAMETER	UNITS	1,000 SF OF USG STRUCTURAL PANEL CONCRETE ROOF DECK 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 Roof Deck were dominated by raw material contributions particularly 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 Roof Deck is 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