Environmental Product Declaration

Environmental Product Declaration for cement products produced by Holcim Argentina at their Campana facility in Buenos Aires, Argentina

TABLE OF CONTENTS

ADMINISTRATIVE INFORMATION

International Certified Environmental Product Declaration

Declared Product:	This Environmental Product Declaration (EPD) covers cement products produced by Holcim Argentina Declared unit: 1 tonne of cement
Declaration Owner:	Holcim Argentina 680 Humberto Primo, Complejo Capitalinas, Edificio Suquia, Piso 4, Oficina 47 Córdoba, Argentina holcim.com.ar
Program Operator:	Labeling Sustainability Address, 11670 W Sunset Blvd. City, State, Los Angeles, CA http://labelinsustainability.com/
Product Category Rule:	Core PCR: ISO 21930:2017 Sustainability in buildings and civil engineering works – Core rules for environmental product declarations of construction products and services SubPCR: Product Category Rules (PCR) for ISO 14025 Type III Environmental Product Declarations (EPD) of Portland, Blended, Mansory, Mortar and Plastic (stucco) Cements, Valid through March 31, 2025. Sub PCR Program Operator: NSF International Sub-category PCR review was conducted by: Thomas P. Gloria, Ph. D. of Industrial Ecology Consultants: 35 Bracebridge, Rd., Newton, MA 02459-1728, t.gloria@industrial-ecology.com. Mr. Bill Stough, Sustainable Research Group: PO Box 1684, Grand Rapids, MI 49501-1684, bstough@sustainableresearchgroup.com. Mr. Jack Geilbig, EcoForm: 2624 Abelia War, Suite 611, Knoxville, TN 37931, jgeilbig@ecoform.com
Independent LCA Reviewer and EPD Verifier:	This EPD was independently verified in accordance with ISO 14025. The life cycle assessment was independently reviewed in accordance ISO 14044 and the referenced PCR. Independent verification of the declaration, according to ISO 14025:2006 Internal ☐ ; External X Third Party Verifier Geoffrey Guest, Certified 3rd Party Verifier under the CSA group (www.csaregistries.ca), Labeling Sustainability (www.labelingsustainability.com), P3Optima (www.P3Optima.com)
Date of Issue:	02 January 2023
Period of Validity:	5 years; valid until 02 January 2028
EPD Number:	d206e47c-5644-4196-8181-176b6ad07f44

COMPANY DESCRIPTION

Holcim Argentina belongs to the Holcim Group and is a world leader in innovative and sustainable solutions for construction. With more than 90 years of experience in Argentina, it employs more than 1,000 collaborators and has extensive coverage of the national territory. It has four cement plants located in the provinces of Córdoba, Mendoza, Jujuy and Buenos Aires. Likewise, it has permanent and mobile plants of elaborated concrete; a plant of stone aggregates; and another for industrial waste co-processing, called Geocycle.

At Holcim, we work for the cities of the future. The world population is estimated to reach 10 billion by 2050, with 70% of people living in cities by then. With 1.6 billion people lacking adequate housing and sanitation, we need to build livable cities that work for everyone. At Holcim, we are part of the solution.

United in our vision to be the global leader in innovative and sustainable building solutions, we play an essential role in accelerating our world's transition to a more inclusive, net-zero emissions future. Driven by our purpose to create progress for people and the planet, we are at the forefront of sustainable building solutions.

STUDY GOAL

The intended application of this life cycle assessment (LCA) is to comply with the procedures for creating a Type III environmental product declaration (EPD) and publish the EPD for public review on the website, http://labelingsustainability.com/ . This level of study is in accordance with EPD Product Category Rule (PCR) for Cement published by NSF (2020) and is a PCR in accordance with ISO 21930 for Preparing an Environmental Product Declaration for Portland, Blended Hydraulic, Masonry, Mortar, and Plastic (Stucco) Cements. EPDs for cements that follow other PCRs may not be comparable.; International Standards Organization (ISO) 14025:2006 Environmental labels and declarations, Type III environmental declarations-Principles and procedures; ISO 14044:2006 Environmental management, Life cycle assessment- Requirements and guidelines; and ISO 14040:2006 Environmental management, Life cycle assessment-Principles and framework. The performance of this study and its subsequent publishing is in alignment with the business-to-business (B2B) communication requirements for the environmental assessment of building products. The study does not intend to support comparative assertions and is intended to be disclosed to the public.

This project report was commissioned to differentiate Holcim Argentina from their competition for the following reasons: generate an advantage for the organization; offer customers information to help them make informed product decisions; improve the environmental performance of Holcim Argentina by continuously measuring, controlling and reducing the environmental impacts of their products; help project facilitators working on Leadership in Energy and Environmental Design (LEED) projects achieve their credit goal; and to strengthen Holcim Argentina's license to operate in the community. The intended audience for this LCA report is Holcim Argentina's employees, their suppliers, project specifiers of their products, architects, and engineers. The EPD report is also available for policy makers, government officials interested in sustainability, academic professors, and LCA professionals. This LCA report does not include product comparisons from other facilities.

DESCRIPTION OF PRODUCT AND SCOPE

This EPD is prepared for products classified as UN CPC Group 3744-Cement or CSI MasterFormat Division 03 30 00 Cast-in-Place Concrete .

This EPD is primary reported Holcim data from the reference year 2021. It reports on the ten cement mixes produced at the Campana cement plant, made from primarily limestone. These ten cement mixes make up 100% of yearly production at the Campana cement plant. Cement from the Campana cement plant is used in the EPDs for concrete mixes in Argentina concrete plants. This is a grinding facility only and does not house a kiln.

This LCA assumes the impacts from products manufactured in accordance with the standards outlined in this report. This LCA is a cradle-to-gate study , and therefore, stages extending beyond the plant gate are not included in this LCA. Excluded stages include transportation of the manufactured material to the construction site; on-site construction processes and components; building (infrastructure) use and maintenance; and “end-of-life” effects.

CEMENT DESIGN SUMMARY

The following tables provide a list of the cement products considered in this EPD along with key performance parameters.

Table 1: **Declared products with All declared products considered in this environmental product declaration**

Mix#	Unique name/ID	Short description	Product Type	Resistance @3 Days (MPa)	Resistance @28 Days (MPa)
1	CPC40 (Bulk)	Versatile cement specially formulated for concrete mixers.	Ordinary Portland	NA	40
2	CAH40ARS	ARS certified very high durability cement with low heat of hydration.	Ordinary Portland	NA	40
3	CAH40 (Bag)	Highly versatile product for finished concrete and masonry applications..	Ordinary Portland	NA	40
4	CAH30	Cement with high durability and low heat of hydration resistance 30	Ordinary Portland	NA	30
5	CPC 40 (Bag)	Highly versatile product for finished concrete and masonry applications.	Ordinary Portland	NA	40
6	CPC40 PLUS (Bag)	Highly versatile product for finished concrete and masonry applications.	Ordinary Portland	NA	40
7	CPC50 (Bulk)	Cement for high performance precasters and concretes.	Ordinary Portland	NA	50

CEMENT DESIGN COMPOSITION

The following figures provide mass breakdown (kg per functional unit) of the material composition of each cement design considered. Please note that the presented breakdown has been randomly altered by +/-10% and is therefore only an approximation; this manipulation is to ensure confidentiality.

Table 2 **Cement composition**

Product Components	Raw Material, weight%
Clinker	Proprietary
Mineral Additions (limestone and Pozzolana)	30-60.00
Others	0.01-5.00
Total	100.00

SYSTEM BOUNDARIES

The following figure depicts the cradle-to-gate system boundary considered in this study (ND= Not Defined)

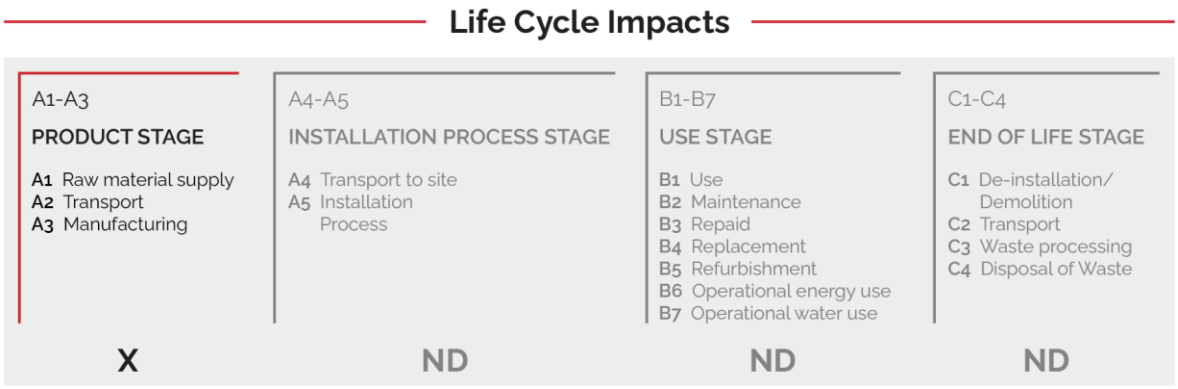

Figure 1: **General life cycle phases for consideration in a construction works system**

This is a Cradle-to-gate life cycle assessment and the following life cycle stages are included in the study:

- A1: Raw material supply (upstream processes) - Extraction, handling, and processing of the materials used in manufacturing the declared products in this LCA.
- A2: Transportation - Transportation of A1 materials from the supplier to the "gate" of the manufacturing facility (i.e. A3).
- A3: Manufacturing (core processes)- The energy and other utility inputs used to store, move, and manufacturer the declared products and to operate the facility.

As according to the PCR, the following figure illustrates the general activities and input requirements for producing cement products and is not necessarily exhaustive.

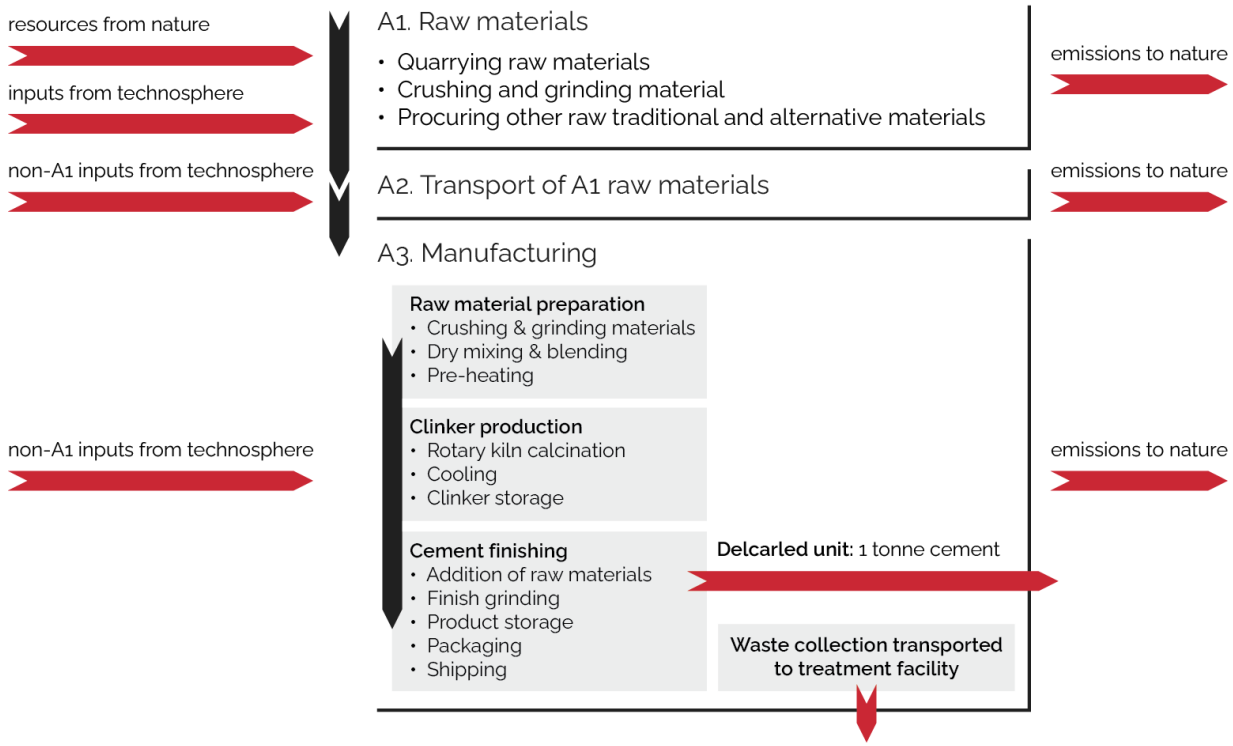

Figure 2: **General system inputs considered in the product system and categorized by modules in scope**

In addition, as according to the relevant PCR, the following requirements are excluded from this study:

- Production, manufacture and construction of A3 building/capital goods and infrastructure.
- Production and manufacture of steel production equipment, steel delivery vehicles, earthmoving equipment, and laboratory equipment.
- Personnel-related activities (travel, furniture, office supplies);
- Energy use related to company management and sales activities.

For this LCA the manufacturing plant, owned and operated by Holcim Argentina, is located at their Planta Campana facility in Argentina. All operating data is formulated using the actual data from Holcim Argentina plant at the above location, including water, energy consumption and waste generation. All inputs for this system boundary are calculated for the plant.

This life cycle inventory was organized in a spreadsheet and was then input into an RStudio environment where pre-calculated LCIA results for relevant products/activities stemming from the ecoinvent v3.8 database and a local EPD database in combination with primary data from Holcim Argentina were utilized. Explanations of the contribution of each data source to this study are outlined in the section 'Data Sources and Quality'. Further LCI details for each declared product are provided in the sections 'Detailed LCI tables' and 'Transport tables' of the detailed LCA report. A parameter uncertainty analysis was also performed where key statistical results (e.g. min/mean/max etc.) are provided in the detailed LCA report.

CUT-OFF CRITERIA

ISO 14044:2006 and the focus PCR requires the LCA model to contain a minimum of 95% of the total inflows (mass and energy) to the upstream and core modules be included in this study. The cut-off criteria were applied to all other processes unless otherwise noted above as follows. A 1% cut-off is considered for all renewable and non-renewable primary energy consumption and the total mass of inputs within a unit process where the total of the neglected inputs does not exceed 5%.

DATA SOURCES AND DATA QUALITY ASSESSMENT

Raw material transport: A combination of actual mode/distance combinations were assumed for key bulk materials whereas ecoinvent default multi-modal market mix distances were assumed for other inputs where no original data could be provided.

Electricity: Electrcity values entered were from primary Holcim Argentina reporting for the reference year 2021. The ecoinvent unit process "market for electricity, medium voltage/electricity, medium voltage/AR/kWh" was used.

Process/space heating: Natural gas is used for drying the clinker at this facility. Campana is a grinding facility only. It does not have a kiln..

Fuel required for machinery: There is no additional fuel used for machinery at this plant.

Waste generation: Waste generation values are directly reported from Holcim operations for the reference year 2021.

Recovered energy: Not Applicable.

Recycled/reused material/components: Not applicable.

Module A1 material losses: Due to lack of data, default loss factors were assumed.

Direct A3 emissions accounting: All emission data are based on primary fuel reporting from Holcim Argentina. This is a grinding facility only therefore it does not have a kiln. Only natural gas in burned at this location for which an ecoinvent unit process was used.

Waste transport requirements: Transportation distances are using estimated values. The waste hauler cannot guarantee the exact distances traveled due to the variation of route and actual location of disposal. Most hazardous waste disposal sites are near the plant therefore the 25 km distance is a representative estimate.

The following tables depict a list of assumed life cycle inventory utilized in the LCA modeling to generate the impact results across the life cycle modules in scope. An assessment of the quality of each LCI activities utilized from various sources is also provided.

Table 3: **LCI inputs assumed for module A1 (i.e. raw material supply)**

Input	LCI.activity	Data.source	Geo	Year	Technology	Time	Geography	Reliability	Completeness
CLINKER Local	clinker production/clinker/RoW/kg	ecoinvent v3.8	Buenos Aires	v3.8 in 2021	3	3	3	3	3
Limestone	limestone production, crushed, for mill/limestone, crushed, for mill/RoW/kg	ecoinvent v3.8	Mendoza	v3.8 in 2021	2	3	2	3	3
Puzzlano	market for cement, pozzolana and fly ash 36-55%/cement, pozzolana and fly ash 36-55%/RoW/kg	ecoinvent v3.8	Mendoza	v3.8 in 2021	2	3	2	3	3
CLINKER CA	Clinker CA	Progam Operator: Labeling Sustainability- EPD ID: fa8b3271-b31f-4e88-a727-cfdc4fd2e73f	Mendoza,	19-Jan-23	3	3	3	3	3
CLINKER MG	Clinker MG	Progam Operator: Labeling Sustainability- EPD ID: f2621473-b677-4e9d-9047-0a38323ea4ee	Córdoba	24-Jan-23	3	3	3	3	3
CLINKER PV	CLINKER PV	Progam Operator: Labeling Sustainability- EPD ID: d0c13d31-83f9-4490-8b4b-6a36c139e8e0	Jujuy	20-Jan-23	3	3	3	3	3

Bag	market for packing, cement/packing, cement/GLO/kg	ecoinvent v3.8	Provincia de Buenos Aires	v3.8 in 2021	2	3	2	3	3
Gypsum	gypsum quarry operation/gypsum, mineral/RoW/kg	ecoinvent v3.8	Aires	v3.8 in 2021	2	3	2	3	3
Slag	Waste input produced off-site	See A3 inputs	Buenos Aires	See A3 inputs	2	A3	2	A3	A3

DATA QUALITY ASSESSMENT

Data quality/variability requirements, as specified in the PCR, are applied. This section describes the achieved data quality relative to the ISO 14044:2006 requirements. Data quality is judged based on its precision (measured, calculated, or estimated), completeness (e.g., unreported emissions), consistency (degree of uniformity of the methodology applied within a study serving as a data source) and representativeness (geographical, temporal, and technological).

Precision: Through measurement and calculation, the manufacturers collected and provided primary data on their annual production. For accuracy, the LCA practitioner and 3rd Party Verifier validated the plant gate-to-gate data.

Completeness: All relevant specific processes, including inputs (raw materials, energy, and ancillary materials) and outputs (emissions and production volume) were considered and modeled to represent the specified and declared products. Most relevant background materials and processes were taken from ecoinvent v3.6 LCI datasets where relatively recent region-specific electricity inputs were utilized. The most relevant EPDs requiring key A1 inputs were also utilized where readily available.

Consistency: To ensure consistency, the same modeling structure across the respective product systems was utilized for all inputs, which consisted of raw material inputs and ancillary material, energy flows, water resource inputs, product, and co-products outputs, returned and recovered Cement materials, emissions to air, water and soil, and waste recycling and treatment. The same background LCI datasets from the ecoinvent v3.6 database were used across all product systems. Crosschecks concerning the plausibility of mass and energy flows were continuously conducted. The LCA team conducted mass and energy balances at the plant and selected process level to maintain a high level of consistency.

Reproducibility: Internal reproducibility is possible since the data and the models are stored and available in a machine-readable project file for all foreground and background processes, and in Eco-Purpose's proprietary Cement LCA calculator* for all production facility and product-specific calculations. A considerable level of transparency is provided throughout the detailed LCA report as the specifications and material quantity make-up for the declared products are presented and key primary and secondary LCI data sources are summarized. The provision of more detailed publicly accessible data to allow full external reproducibility was not possible due to reasons of confidentiality.

Label Sustainability has developed a proprietary tool that allows the calculation of PCR-compliant LCA results for Cement product designs. The tool auto-calculates results by scaling base-unit Technosphere inputs (i.e., 1 kg sand, 1 kWh electricity, etc.) to replicate the reference flow conversions that take place in any typical LCA software like openLCA or SimaPro. The tool was

tested against several LCAs performed in openLCA and the tool generated identical results to those realized in openLCA across every impact category and inventory metric (where comparisons could be readily made).

Representativeness: The representativeness of the data is summarized as follows.

- Time related coverage of the manufacturing processes' primary collected data from 2020-01-01 to 2020-12-31.
- Upstream (background) LCI data was either the PCR specified default (if applicable) or more appropriate LCI datasets as found in the country-adjusted ecoinvent v3.6 database.
- Geographical coverage for inputs required by the A3 facility(ies) is representative of its region of focus; other upstream and background processes are based on US, North American, or global average data and adjusted to regional electricity mixes when relevant.
- Technological coverage is typical or average and specific to the participating facilities for all primary data.

ENVIRONMENTAL INDICATORS AND INVENTORY METRICS

Per the PCR, this EPD supports the life cycle impact assessment indicators and inventory metrics as listed in the tables below. As specified in the PCR, the most recent US EPA Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts (TRACI), impact categories were utilized as they provide a North American context for the mandatory category indicators to be included in the EPD. Additionally, the PCR requires a set of inventory metrics to be reported with the LCIA indicators.

It should be noted that emerging LCA impact categories and inventory items are still under development and can have high levels of uncertainty that preclude international acceptance pending further development. Use caution when interpreting data in any of the following categories.

LIMITATIONS

This EPD is a declaration of potential environmental impact and does not support or provide definitive comparisons of the environmental performance of specific products. Only EPDs prepared from cradle-to-grave life cycle results and based on the same function and reference service life and quantified by the same functional unit can be used to assist purchasers and users in making informed comparisons between products.

LCIA results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins or risks. Further, LCA offers a wide array of environmental impact indicators, and this EPD reports a collection of those, as specified by the PCR.

In addition to the impact results, this EPD provides several metrics related to resource consumption and waste generation. While these data may be informational in other ways, they do not provide a measure of impact on the environment.

TOTAL IMPACT SUMMARY

The following table reports the total LCA results for each product produced at the given cement facility on a per 1 tonne of cement basis.

Table 4: **Total life cycle (across modules in scope) impact results for All declared products, assuming the geometric mean point values on a per 1 tonne of cement basis**

a) Midpoint Impact Categories:

Indicator/LCI Metric	AP	EP	GWP	ODP	PCOP	ADPe	ADPf
Unit	**moles of H+-Eq**	**kg N**	**kg CO2-Eq**	**kg CFC-11-Eq**	**kg NOx-Eq**	**kg Sb-Eq**	**MJ, net calorific value**
Minimum	10.7	0.0174	41	6.83e-06	0.171	0.00142	590
Maximum	122	0.134	950	4.27e-05	2.07	0.00351	6170
Mean	72.7	0.0823	539	2.63e-05	1.23	0.00277	3640
Median	79.9	0.0905	600	2.9e-05	1.35	0.00305	3760
CPC40 (Bulk)	87.1	0.0996	688	3.26e-05	1.47	0.00321	3840
CAH40ARS	78.6	0.0852	567	2.67e-05	1.33	0.00266	4290
CAH40 (Bag)	71.1	0.0841	542	2.71e-05	1.19	0.00289	3420
CAH30	50.6	0.0575	359	1.93e-05	0.845	0.00242	2820
CPC 40 (Bag)	97.8	0.108	702	3.19e-05	1.66	0.00329	5160
CPC40 PLUS (Bag)	81.3	0.0959	634	3.08e-05	1.37	0.00329	3680
CPC50 (Bulk)	116	0.123	844	3.7e-05	1.97	0.00337	6170

b) Inventory Metrics:

Indicator/LCI Metric	TPE	RE	NRE	NRR	RR	WDP	LFW	LFHW	bioC
Unit	**MJ-Eq**	**MJ-Eq**	**MJ-Eq**	**kg**	**m3**	**m3**	**kg waste**	**kg waste**	**kg**
Minimum	644	15	632	17.3	0.000383	0.0869	25.4	0.00164	-0.425
Maximum	6860	270	6710	156	0.0135	0.647	37.4	0.00699	0.802
Mean	4090	142	3940	95.6	0.00478	0.397	33.2	0.00459	0.0841
Median	4270	145	4080	102	0.00161	0.436	35.2	0.00478	-0.0734
CPC40 (Bulk)	4300	121	4170	105	0.00143	0.488	35.6	0.00474	-0.413
CAH40ARS	4780	114	4660	109	0.00125	0.4	32.3	0.00511	-0.1
CAH40 (Bag)	3940	226	3690	91.3	0.0135	0.414	35.5	0.00446	0.673
CAH30	3130	73.6	3050	72.6	0.000888	0.269	30.7	0.00369	-0.0847
CPC 40 (Bag)	5880	270	5620	132	0.0134	0.528	35.4	0.00621	0.802

CPC40 PLUS (Bag)	4240	239	3990	100	0.0128	0.458	37	0.00482	0.644
CPC50 (Bulk)	6860	169	6710	156	0.00179	0.588	35	0.00699	-0.157

REFERENCES

ASTM Standards:

- ASTM C150/C150M Standard Specification for Portland Cement
- ASTM C260/C260M Standard Specification for Air-Entraining Admixtures for Concrete
- ASTM C595 Standard Specification for Blended Hydraulic Cements
- ASTM C618 Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
- ASTM C979/C979M Standard Specification for Pigments for Integrally Colored Concrete
- ASTM C989/C989M Standard Specification for Slag Cement for Use in Concrete and Mortars
- ASTM C1017/C1017M Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete
- ASTM C1116/C1116M Standard Specification for Fiber-Reinforced Concrete
- ASTM C1157/C1157M Standard Performance Specification for Hydraulic Cement
- ASTM C1240 Standard Specification for Silica Fume Used in Cementitious Mixtures
- ASTM C1602/C1602M Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete
- ASTM G109 Standard Test Method for Determining Effects of Chemical Admixtures on Corrosion of Embedded Steel Reinforcement in Concrete Exposed to Chloride Environments

CSA Standards:

- CAN/CSA A3000 Cementitious Materials Compendium
- CAN/CSA G40.20/G40.21 General requirements for rolled or welded structural quality steel / Structural quality steel

ISO Standards:

- ISO 6707-1: 2014 Buildings and Civil Engineering Works - Vocabulary - Part 1: General Terms
- ISO 14021:1999 Environmental Labels and Declarations - Self-declared Environmental Claims (Type II Environmental Labeling)
- 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 14067:2018 Greenhouse Gases - Carbon Footprint of Products - Requirements and Guidelines for Quantification
- ISO 14050:2009 Environmental Management - Vocabulary
- ISO 21930:2017 Sustainability in Building Construction - Environmental Declaration of Building Products

EN Standards:

- EN 16757 Sustainability of construction works - Environmental product declarations - Product Category Rules for concrete and concrete elements
- EN 15804 Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction products

Other References:

- US EPA Waste Reduction Model (WARM), Fly Ash Chapter: http://epa.gov/climatechange/wycd/waste/downloads/fly-ash-chapter10-28-10.pdf
- USGBC LEED v4 for Building Design and Construction, 11 Jan 2019 available at https://www.usgbc.org/resources/pcr-committee-process-resources-part-b
- USGBC PCR Committee Process & Resources: Part B, USGBC, 7 July 2017 available at https://www.usgbc.org/resources/pcr-committee-process-resources-part-b.