Environmental Product Declaration

Environmental Product Declaration for various ready mix concrete products produced by Holcim México Operaciones S.A. de C.V. at their Tlaxcalancingo facility in San Andrés Cholula, Puebla

ADMINISTRATIVE INFORMATION

International Certified Environmental Product Declaration

Declared Product:	This Environmental Product Declaration (EPD) covers concrete products produced by Holcim México Operaciones S.A. de C.V.. Declared unit: 1 m3 of concrete
Declaration Owner:	Holcim México Operaciones S.A. de C.V. Av. Prolongación Vasco de Quiroga #4800 Torre II Ofic. 101 Piso 1, Santa Fe Cuajimalpa de Morelos Ciudad de México, México www.holcim.com.mx
Program Operator:	Labeling Sustainability 11670 W Sunset Blvd. Los Angeles, CA www.labelingsustainability.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: NSF International (March 2020). Product Category Rul (PCR) for Environmental Product Declarations (EPD) PCR for Concrete, v2.1 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. Dr. Michael Overcash of Environmental Clarity: 2908 Chipmunk Lane, Raleigh, NC 27607-3117, mrovercash@earthlink.net. Mr. Bill Stough of Sustainable Research Group: PO Box 1684, Grand Rapids, MI 49501-1684, bstough@sustainableresearchgroup.com. Mr. Jack Geilbig, EcoForm: 2624 Abelia Way, Suite 611, Knoxville, TN 37931, jgeilbig@ecoform.com.
Independent LCA Reviewer and EPD Verifier:	This EPD was independently verified in accordance with ISO 14025 and ISO 21930. 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 International EPD Program (www.environdec.com), CSA Group (www.csaregistries.ca)
Date of Issue:	13 July 2023
Period of Validity:	5 years; valid until 12 July 2028
EPD Number:	58a32ba3-100c-4da5-8edb-8de1bf38e1eb

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COMPANY DESCRIPTION

Holcim Mexico produces and markets cement, ready-mix concrete, and other products and services for construction. The company has a nationwide presence through 7 cement plants with a current installed capacity to produce 12.6 million tons per year, 23 cement distribution centers, two maritime terminals, 1 Corporate Office, plus 35 ready-mix concrete plants, seven platforms, and a Geocycle transfer center, 26 commercial partners with more than 90 ready-mix concrete plants, more than 500 mixing pots, one aggregates plant and a Technological Innovation Center for Construction (CITEC).

Sustainable Development is an integral part of Lafarge Holcim's strategy around the world. Holcim Mexico has a clear vision of the future it wants for our country, which contributes to its development. Holcim Mexico's main objective is to create value. Creating value ensures long-term business success in covering the triple bottom line (i.e., social, economic, environmental values). Finally, good operating performance and a solid return on invested capital go hand in hand with sustainable development.

Holcim continues to invest in research and development. They have the Innovation and Development Center, located in Lyon (France), with satellite locations in various regions developing a comprehensive portfolio of innovators and sustainable solutions. These include different categories: inclusive business models, water management solutions, urban mining solutions (recycled aggregates), waste treatment services, energy-efficient solutions (insulating building materials), resource-efficient solutions (high recycled content, bags soluble cement), and low CO2 building materials.

Holcim operates with the belief that they can gain an advantage by developing knowledge and brand equity in the green building segment.

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 Ready Mix Concrete published by NSF International (2019) and is a sub-PCR of International Standards Organization (ISO) 21930:2017 Sustainability in buildings and civil works - Core rules for EPDs of construction products and services; 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 México Operaciones S.A. de C.V. 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 México Operaciones S.A. de C.V. 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 México Operaciones S.A. de C.V.'s license to operate in the community. The intended audience for this LCA report is Holcim México Operaciones S.A. de C.V.'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 reports on 38 concrete mixes manufactured at the Holcim Mexico Operaciones S.A. de C.V. Tlaxcalancingo concrete facility in San Andrés Cholula, México.

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.

READY MIX CONCRETE DESIGN SUMMARY

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

Mix designs: 0 to 15 MPa

Table 1: **Declared products with Mix designs: 0 to 15MPa considered in this environmental product declaration**

Mix#	Unique name/ID	Short description	Product type	28 day strength, MPa	H2O to cement ratio
3	24005NB0520	3.6 MPa 28d strength mortars and fillers	Mortars and fillers	3.6	4.10
4	24007NB0520	3.8 MPa 28d strength mortars and fillers	Mortars and fillers	3.8	3.62
5	24010NB0520	4.1 MPa 28d strength mortars and fillers	Mortars and fillers	4.1	3.24
6	24015NB0520	4.6 MPa 28d strength mortars and fillers	Mortars and fillers	4.6	2.94
7	24020NB0520	5.2 MPa 28d strength mortars and fillers	Mortars and fillers	5.2	2.68
8	24025NB0520	5.6 MPa 28d strength mortars and fillers	Mortars and fillers	5.6	2.35
9	24030NB0520	6.2 MPa 28d strength mortars and fillers	Mortars and fillers	6.2	2.05
10	24035NB0520	6.7 MPa 28d strength mortars and fillers	Mortars and fillers	6.7	1.82
11	39035ND4010	3.6 MPa 28d strength Ready mix concrete	Ready mix concrete	3.6	0.72
12	77036ND4014	3.7 MPa 28d strength Ready mix concrete	Ready mix concrete	3.7	0.84

13	77038NB4014	3.9 MPa 28d strength Ready mix concrete	Ready mix concrete	3.9	0.80
14	77040ND4014	4.2 MPa 28d strength Ready mix concrete	Ready mix concrete	4.2	0.77
15	24040NB0520	7.1 MPa 28d strength mortars and fillers	Mortars and fillers	7.1	1.63
16	77042NB4014	4.3 MPa 28d strength Ready mix concrete	Ready mix concrete	4.3	0.74
17	68042ND4010	4.3 MPa 28d strength special concrete	Special concrete	4.3	0.74
18	77045ND4014	4.6 MPa 28d strength Ready mix concrete	Ready mix concrete	4.6	0.71
19	68045ND4010	4.6 MPa 28d strength special concrete	Special concrete	4.6	0.70
20	77048ND4014	4.9 MPa 28d strength Ready mix concrete	Ready mix concrete	4.9	0.68
21	77050ND4014	5.2 MPa 28d strength Ready mix concrete	Ready mix concrete	5.2	0.66
22	24050NB0518	8 MPa 28d strength mortars and fillers	Mortars and fillers	8.0	1.56
23	60080NB0518	10.9 MPa 28d strength mortars and fillers	Mortars and fillers	10.9	1.51
24	70100NB2018	13.2 MPa 28d strength Ready mix concrete	Ready mix concrete	13.2	1.36
25	11100NB0514	13.1 MPa 28d strength mortars and fillers	Mortars and fillers	13.1	1.39
26	11125ND0514	13.8 MPa 28d strength mortars and fillers	Mortars and fillers	13.8	1.33

Mix designs: 15 to 20 MPa

Table 2: **Declared products with Mix designs: 15 to 20MPa considered in this environmental product declaration**

Mix#	Unique name/ID	Short description	Product type	28 day strength, MPa	H2O to cement ratio
27	01150NB2014	17.8 MPa 28d strength Ready mix concrete	Ready mix concrete	17.8	1.15

Mix designs: 21 to 25 MPa

Table 3: **Declared products with Mix designs: 21 to 25MPa considered in this environmental product declaration**

Mix#	Unique name/ID	Short description	Product type	28 day strength, MPa	H2O to cement ratio
28	71200NB1214	22.8 MPa 28d strength Ready mix concrete	Ready mix concrete	22.8	1.02
29	27200NB1200	22.8 MPa 28d strength special concrete	Special concrete	22.8	0.00

Mix designs: 26 to 30 MPa

Table 4: **Declared products with Mix designs: 26 to 30MPa considered in this environmental product declaration**

Mix#	Unique name/ID	Short description	Product type	28 day strength, MPa	H2O to cement ratio
30	70250NB2018	25.3 MPa 28d strength Ready mix concrete	Ready mix concrete	25.3	0.86
31	60250NB1222	28.5 MPa 28d strength special concrete	Special concrete	28.5	0.80

Mix designs: 31 to 35 MPa

Table 5: **Declared products with Mix designs: 31 to 35MPa considered in this environmental product declaration**

Mix#	Unique name/ID	Short description	Product type	28 day strength, MPa	H2O to cement ratio
32	71300NB1214	32.6 MPa 28d strength Ready mix concrete	Ready mix concrete	32.6	0.76

Mix designs: 36 to 40 MPa

Table 6: **Declared products with Mix designs: 36 to 40MPa considered in this environmental product declaration**

Mix#	Unique name/ID	Short description	Product type	28 day strength, MPa	H2O to cement ratio
2	19.55NB2014	39.2 MPa 28d strength Ready mix concrete	Ready mix concrete	39.2	0.62
33	71350NB1214	37.5 MPa 28d strength Ready mix concrete	Ready mix concrete	37.5	0.66
34	60350NB1222	38.7 MPa 28d strength special concrete	Special concrete	38.7	0.63

Mix designs: 41 to 45 MPa

Table 7: **Declared products with Mix designs: 41 to 45MPa considered in this environmental product declaration**

Mix#	Unique name/ID	Short description	Product type	28 day strength, MPa	H2O to cement ratio
1	19.50NB2014	42.5 MPa 28d strength Ready mix concrete	Ready mix concrete	42.5	0.56
35	70400ND2014	42.4 MPa 28d strength Ready mix concrete	Ready mix concrete	42.4	0.56

Mix designs: 46 to 50 MPa

Table 8: **Declared products with Mix designs: 46 to 50MPa considered in this environmental product declaration**

Mix#	Unique name/ID	Short description	Product type	28 day strength, MPa	H2O to cement ratio
37	13450NB2018	47.3 MPa 28d strength Ready mix concrete	Ready mix concrete	47.3	0.51

Mix designs: >60 MPa

Table 9: **Declared products with Mix designs: >60MPa considered in this environmental product declaration**

Mix#	Unique name/ID	Short description	Product type	28 day strength, MPa	H2O to cement ratio
36	60400NB1265	70.6 MPa 28d strength special concrete	Special concrete	70.6	0.39
38	60500NB1265	79.2 MPa 28d strength special concrete	Special concrete	79.2	0.34

READY MIX CONCRETE DESIGN COMPOSITION

The following figures provide mass breakdown (kg per functional unit) of the material composition of each ready mix concrete 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 10: **Design composition**

Product Components	Raw Material, weight%
Cement	Proprietary
Aggregates	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:

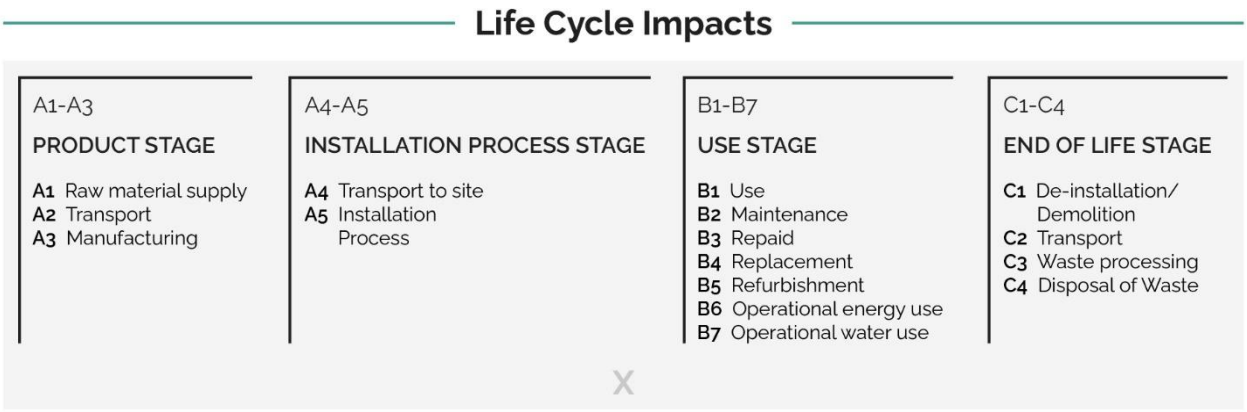


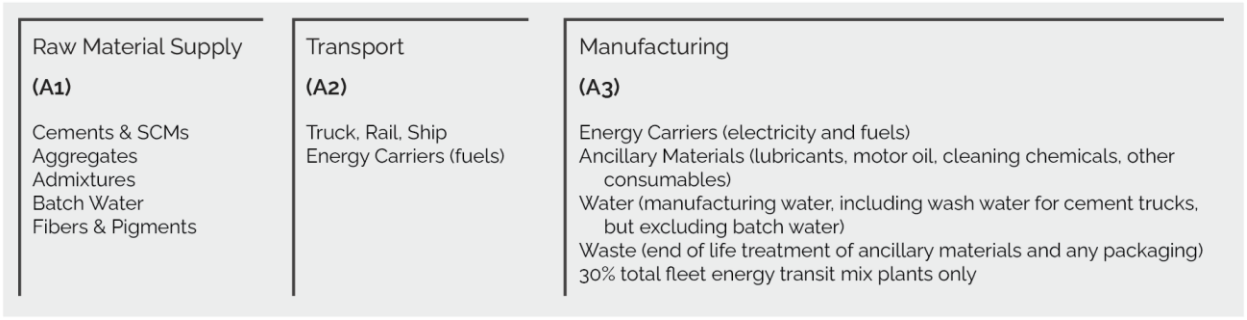
Figure 11: **General life cycle phases for consideration in a construction works system**

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 ready mix concrete products and is not necessarily exhaustive.

Figure 12: **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, earth-moving 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 México Operaciones S.A. de C.V., is located at their Planta Tlaxcalancingo facility in México. All operating data is formulated using the actual data from Holcim México Operaciones S.A. de C.V.'s 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 México Operaciones S.A. de C.V. 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: Electricity consumption values are for Holcim Mexico in calendar year 2022. These values were direct reported from Holcim records. The unit process "market for electricity, medium voltage/electricity, medium voltage/MX/kWh" was used to represent the Mexico grid electricity used by the concrete plant.

Process/space heating: No fuel is used for space heating at this plant.

Fuel required for machinery: Machinery-related fuel requirements were determined from direct Holcim information. The types of machinery used include generators, pumps to pump concrete to higher elevations, and transportation equipment used for moving materials.

Waste generation: Waste generation values are directly reported from Holcim operations for both bulk waste and hazardous waste. No High-level radioactive waste is generated on-site at this facility. Wash water values are direct reported water use from Holcim México for 2022.

Recovered energy: Not applicable.

Recycled/reused material/components: The amount of returned concrete is based on Holcim primary data for the reference year, 2022..

Module A1 material losses: Due to lack of data, default loss factors of 5% were assumed. The PCR states" A3 shall include an assumption of 5% material loss unless product specific data is available and transparently reported in the project LCA report underlying the EPD;"

Direct A3 emissions accounting: Direct emissions are modeled using fuel and technology appropriate ecoinvent activities. See LCI input tables for details.

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 waste disposal sites are near the plant therefore the 25 km distance is a representative estimate. Returned concrete and wash water, measured in kilograms, is based on direct Holcim reporting for the reference year 2022.

Product transport requirements: The diesel fuel used by the mixing trucks is direct primary information reported from Holcim México records for the year 2022. The concrete PCR allots 30% of the overall mixing truck total for stage A3 (manufacturing) for mixing the materials.

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 11: **LCI inputs assumed for module A1 (i.e. raw material supply)** ***Data Quality Assessment Key Fair=1, Good=2, Very Good =3.***

Input	LCI.activity	Data.source	Geo	Year	Technology	Time	Geography	Reliability	Completeness
Water	tap water production, conventional with biological treatment/tap water/RoW/kg	ecoinvent v3.8	Puebla	v3.8 in 2021	2	3	1	3	3
Limestone Gravel	limestone quarry operation/limestone, unprocessed/RoW/kg ; Note: modifications made (see ecoinvent activity changes table)	ecoinvent v3.8	Puebla	v3.8 in 2021	2	3	1	3	3
Additives	market for chemical, organic/chemical, organic/GLO/kg	ecoinvent v3.8	EDO, DE MEXICO, QUERETARO	v3.8 in 2021	2	3	1	3	3
Cement (CPC 40) - PROVEEDOR: HOLCIM orizaba	CPC 40	Progam Operator: Labeling Sustainability- EPD ID: 565b7deb-ebd6-4cb3-	VERACRUZ	25 February 2023	3	NA	3	3	3

		9aa6-a585381c41f3							
Cement (CPO 30R RS BRA) - PROVEEDOR: HOLCI Orizaba	CPC 30R	Progam Operator: Labeling Sustainability- EPD ID: 565b7deb-ebd6-4cb3-9aa6-a585381c41f3	VERACRUZ	25 February 2023	2	3	1	3	3
Natural River sand	sand quarry operation, extraction from river bed/sand/BR/kg; Note: modifications made (see ecoinvent activity changes table)	ecoinvent v3.8	TLAXCALA	v3.8 in 2021	2	3	1	3	3

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. The majority of relevant background materials and processes were taken from ecoinvent v3.8 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 Ready Mix Concrete materials, emissions to air, water and soil, and waste recycling and treatment. The same background LCI datasets from the ecoinvent v3.8 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 Labeling Sustainability's proprietary Ready Mix Concrete 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.

*Labeling Sustainability has developed a proprietary tool that allows the calculation of PCR-compliant LCA results for Ready Mix Concrete 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 2022-01-01 to 2022-12-31.
- Upstream (background) LCI data was either the PCR specified default (if applicable) or more appropriate LCI datasets as found in the country-adjusted ecoinvent v3.8 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 (see tables below).

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 ready mix concrete facility on a per 1m3 of concrete basis.

Mix designs: 0 to 15 MPa

Table 12: **Total life cycle (across modules in scope) impact results for Mix designs: 0 to 15MPa, assuming the geometric mean point values on a per 1 m3 of concrete 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	13.2	0.0226	107	1.15e-05	0.181	0.00027	873
Maximum	33.8	0.0547	383	2.89e-05	0.393	0.000697	2270
Mean	24.1	0.0397	252	2.09e-05	0.293	0.000492	1630
Median	23.6	0.0394	246	2.12e-05	0.292	0.00047	1640
24005NB0520	13.2	0.0226	107	1.15e-05	0.181	0.00027	873
24007NB0520	13.9	0.0238	117	1.22e-05	0.189	0.000286	927
24010NB0520	14.6	0.025	127	1.29e-05	0.196	0.000302	980
24015NB0520	15.3	0.0261	136	1.35e-05	0.203	0.000319	1030
24020NB0520	16	0.0273	146	1.42e-05	0.21	0.000335	1090
24025NB0520	17.2	0.0291	162	1.53e-05	0.221	0.000359	1170
24030NB0520	18.5	0.0312	181	1.65e-05	0.234	0.000389	1270
24035NB0520	19.8	0.0334	200	1.78e-05	0.248	0.00042	1370
39035ND4010	28.7	0.0466	343	2.43e-05	0.33	0.000401	1970
77036ND4014	28.5	0.0462	305	2.4e-05	0.343	0.000578	1880
77038NB4014	29.9	0.0484	325	2.54e-05	0.356	0.00061	1990
77040ND4014	30	0.0486	327	2.54e-05	0.358	0.000612	1990
24040NB0520	21.3	0.0357	220	1.91e-05	0.261	0.000452	1470
77042NB4014	31.4	0.0509	347	2.68e-05	0.37	0.000644	2100
68042ND4010	31.3	0.0506	340	2.63e-05	0.37	0.000653	2110
77045ND4014	31.9	0.0517	355	2.72e-05	0.376	0.000654	2130
68045ND4010	32.6	0.0528	360	2.76e-05	0.383	0.000684	2220
77048ND4014	33.1	0.0535	372	2.82e-05	0.386	0.00068	2220

77050ND4014	33.8	0.0547	383	2.89e-05	0.393	0.000697	2270
24050NB0518	21.8	0.0367	227	1.97e-05	0.268	0.000465	1520
60080NB0518	22.4	0.0376	234	2.02e-05	0.275	0.000476	1560
70100NB2018	22.5	0.0368	222	1.89e-05	0.283	0.000451	1460
11100NB0514	24.6	0.0413	257	2.21e-05	0.301	0.00053	1720
11125ND0514	25.2	0.0423	266	2.27e-05	0.306	0.000545	1770

b) Inventory Metrics:

Indicator/LCI Metric	**TPE**	**RE**	**NRE**	**NRR**	**RR**	**WDP**	**LFW**	**LFHW**	**CBWC**	**CWWC**	**CHW**	**CNHW**
Unit	**MJ-Eq**	**MJ-Eq**	**MJ-Eq**	**kg**	**m3**	**m3**	**kg waste**	**kg waste**	**m3**	**m3**	**kg**	**kg**
Minimum	954	18.1	939	23.6	0.000299	5.44	18.6	0.00159	0.22	3.41e-05	0	0.028
Maximum	2500	44.9	2450	61.2	0.000658	12.7	128	0.00256	0.336	3.41e-05	0	0.0287
Mean	1790	32.9	1750	43.8	0.000492	9.3	83.5	0.00213	0.298	3.41e-05	0	0.0287
Median	1800	34.4	1760	44.2	0.000472	11.6	81.6	0.00215	0.332	3.41e-05	0	0.0287
24005NB0520	954	18.1	939	23.6	0.000299	11.8	40.9	0.00159	0.336	3.41e-05	0	0.0287
24007NB0520	1020	19.3	993	25.1	0.000315	11.8	44.2	0.00163	0.335	3.41e-05	0	0.0287
24010NB0520	1070	20.7	1050	26.5	0.00033	11.8	47.4	0.00168	0.334	3.41e-05	0	0.0287
24015NB0520	1130	21.9	1110	27.9	0.000346	11.9	50.6	0.00173	0.333	3.41e-05	0	0.0287
24020NB0520	1190	23	1170	29.4	0.000359	11.9	53.8	0.00177	0.332	3.41e-05	0	0.0287
24025NB0520	1280	25.2	1250	31.6	0.000378	11.8	59.1	0.00184	0.333	3.41e-05	0	0.0287
24030NB0520	1390	27.7	1360	34.1	0.000405	11.7	65.3	0.00191	0.334	3.41e-05	0	0.0287
24035NB0520	1500	30.3	1470	37	0.00043	11.6	71.5	0.002	0.335	3.41e-05	0	0.0287
39035ND4010	2160	32.3	2110	51.5	0.000457	6.38	18.6	0.00184	0.22	3.41e-05	0	0.0287
77036ND4014	2060	35	2020	50.8	0.00056	6.53	104	0.00229	0.255	3.41e-05	0	0.0287
77038NB4014	2170	38.4	2140	53.5	0.000586	6.7	110	0.00238	0.258	3.41e-05	0	0.0287
77040ND4014	2180	38	2150	53.5	0.000586	6.2	111	0.00237	0.253	3.41e-05	0	0.0287
24040NB0520	1620	32.7	1590	39.7	0.000453	11.5	78	0.00208	0.336	3.41e-05	0	0.0287
77042NB4014	2300	40.7	2260	56.3	0.000609	6.37	117	0.00246	0.257	3.41e-05	0	0.0287

68042ND4010	2310	40.6	2280	56.7	0.000633	5.68	114	0.00241	0.252	3.41e-05	0	0.0287
77045ND4014	2340	41.1	2290	57.4	0.000623	5.82	120	0.00247	0.254	3.41e-05	0	0.0287
68045ND4010	2420	43	2390	59.7	0.000655	5.67	121	0.00249	0.255	3.41e-05	0	0.0287
77048ND4014	2440	43.5	2390	59.7	0.000648	5.6	125	0.00252	0.255	3.41e-05	0	0.0287
77050ND4014	2500	44.9	2450	61.2	0.000658	5.44	128	0.00256	0.256	3.41e-05	0	0.0287
24050NB0518	1670	33.9	1630	40.7	0.000466	11.7	80.4	0.00213	0.333	3.41e-05	0	0.0287
60080NB0518	1700	34.9	1670	41.9	0.000479	11.9	82.9	0.00218	0.334	3.41e-05	0	0.0287
70100NB2018	1600	26.6	1570	39.3	0.000455	8.17	77.6	0.002	0.285	3.41e-05	0	0.0287
11100NB0514	1900	38.3	1860	46.4	0.000528	12.7	90.5	0.00237	0.336	3.41e-05	0	0.0287
11125ND0514	1940	39.2	1910	47.8	0.000548	12.6	93.5	0.0024	0.336	3.41e-05	0	0.0287

Mix designs: 15 to 20 MPa

Table 13: **Total life cycle (across modules in scope) impact results for Mix designs: 15 to 20MPa, assuming the geometric mean point values on a per 1 m3 of concrete 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**
01150NB2014	24.8	0.0404	247	2.06e-05	0.308	0.000512	1650

b) Inventory Metrics:

Indicator/LCI Metric	**TPE**	**RE**	**NRE**	**NRR**	**RR**	**WDP**	**LFW**	**LFHW**	**CBWC**	**CWWC**	**CHW**	**CNHW**
Unit	**MJ-Eq**	**MJ-Eq**	**MJ-Eq**	**kg**	**m3**	**m3**	**kg waste**	**kg waste**	**m3**	**m3**	**kg**	**kg**
01150NB2014	1800	30.2	1780	44.4	0.000519	7.96	85.3	0.00213	0.27	3.41e-05	0	0.0287

Mix designs: 21 to 25 MPa

Table 14: **Total life cycle (across modules in scope) impact results for Mix designs: 21 to 25MPa, assuming the geometric mean point values on a per 1 m3 of concrete 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	26.3	0.0428	277	2.23e-05	0.319	0.000534	1740
Maximum	29.3	0.0481	341	2.63e-05	0.339	6e-04	1990
Mean	27.8	0.0454	309	2.43e-05	0.329	0.000567	1860
Median	27.8	0.0454	309	2.43e-05	0.329	0.000567	1860
71200NB1214	26.3	0.0428	277	2.23e-05	0.319	0.000534	1740
27200NB1200	29.3	0.0481	341	2.63e-05	0.339	6e-04	1990

b) Inventory Metrics:

Indicator/LCI Metric	TPE	RE	NRE	NRR	RR	WDP	LFW	LFHW	CBWC	CWWC	CHW	CNHW
Unit	MJ-Eq	MJ-Eq	MJ-Eq	kg	m3	m3	kg waste	kg waste	m3	m3	kg	kg
Minimum	1910	33.4	1870	46.9	0.000522	7.62	95	0.0022	0	3.41e-05	0	0.0287
Maximum	2200	43.8	2130	53.4	0.000546	8.13	117	0.0024	0.276	3.41e-05	0	0.0287
Mean	2060	38.6	2000	50.2	0.000534	7.88	106	0.0023	0.138	3.41e-05	0	0.0287
Median	2060	38.6	2000	50.2	0.000534	7.88	106	0.0023	0.138	3.41e-05	0	0.0287
71200NB1214	1910	33.4	1870	46.9	0.000522	7.62	95	0.0022	0.276	3.41e-05	0	0.0287
27200NB1200	2200	43.8	2130	53.4	0.000546	8.13	117	0.0024	0	3.41e-05	0	0.0287

Mix designs: 26 to 30 MPa

Table 15: **Total life cycle (across modules in scope) impact results for Mix designs: 26 to 30MPa, assuming the geometric mean point values on a per 1 m3 of concrete 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	28.8	0.0468	311	2.45e-05	0.344	0.000588	1920
Maximum	30.7	0.0499	333	2.61e-05	0.362	0.000651	2110
Mean	29.8	0.0484	322	2.53e-05	0.353	0.00062	2020
Median	29.8	0.0484	322	2.53e-05	0.353	0.00062	2020
70250NB2018	28.8	0.0468	311	2.45e-05	0.344	0.000588	1920
60250NB1222	30.7	0.0499	333	2.61e-05	0.362	0.000651	2110

b) Inventory Metrics:

Indicator/LCI Metric	TPE	RE	NRE	NRR	RR	WDP	LFW	LFHW	CBWC	CWWC	CHW	CNHW
Unit	MJ-Eq	MJ-Eq	MJ-Eq	kg	m3	m3	kg waste	kg waste	m3	m3	kg	kg
Minimum	2100	37.4	2070	51.5	0.000569	7.06	106	0.00233	0.264	3.41e-05	0	0.0287
Maximum	2320	41.9	2260	56.6	0.000637	7.23	113	0.00245	0.267	3.41e-05	0	0.0287
Mean	2210	39.6	2160	54	0.000603	7.14	110	0.00239	0.266	3.41e-05	0	0.0287
Median	2210	39.6	2160	54	0.000603	7.14	110	0.00239	0.266	3.41e-05	0	0.0287
70250NB2018	2100	37.4	2070	51.5	0.000569	7.06	106	0.00233	0.267	3.41e-05	0	0.0287
60250NB1222	2320	41.9	2260	56.6	0.000637	7.23	113	0.00245	0.264	3.41e-05	0	0.0287

Mix designs: 31 to 35 MPa

Table 16: **Total life cycle (across modules in scope) impact results for Mix designs: 31 to 35MPa, assuming the geometric mean point values on a per 1 m3 of concrete 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
71300NB1214	31.8	0.0517	356	2.74e-05	0.372	0.000658	2150

b) Inventory Metrics:

Indicator/LCI Metric	TPE	RE	NRE	NRR	RR	WDP	LFW	LFHW	CBWC	CWWC	CHW	CNHW
Unit	MJ-Eq	MJ-Eq	MJ-Eq	kg	m3	m3	kg waste	kg waste	m3	m3	kg	kg
71300NB1214	2350	43.3	2320	57.8	0.000626	6.82	121	0.0025	0.272	3.41e-05	0	0.0287

Mix designs: 36 to 40 MPa

Table 17: **Total life cycle (across modules in scope) impact results for Mix designs: 36 to 40MPa, assuming the geometric mean point values on a per 1 m3 of concrete 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	34	0.0555	405	2.97e-05	0.376	0.000474	2400
Maximum	35.9	0.0583	432	3.09e-05	0.413	0.000773	2510
Mean	35	0.057	415	3.04e-05	0.398	0.00066	2440
Median	35.1	0.0571	409	3.06e-05	0.404	0.000733	2410
19.55NB2014	34	0.0555	432	2.97e-05	0.376	0.000474	2410
71350NB1214	35.1	0.0571	405	3.06e-05	0.404	0.000733	2400
60350NB1222	35.9	0.0583	409	3.09e-05	0.413	0.000773	2510

b) Inventory Metrics:

Indicator/LCI Metric	TPE	RE	NRE	NRR	RR	WDP	LFW	LFHW	CBWC	CWWC	CHW	CNHW
Unit	MJ-Eq	MJ-Eq	MJ-Eq	kg	m3	m3	kg waste	kg waste	m3	m3	kg	kg
Minimum	2630	43.5	2580	62.9	0.000525	6.08	20.9	0.00208	0.244	3.41e-05	0	0.0287
Maximum	2750	51.1	2710	67	0.000734	7.25	136	0.00271	0.274	3.41e-05	0	0.0287
Mean	2670	48.2	2630	64.8	0.000647	6.58	97.6	0.00249	0.26	3.41e-05	0	0.0287
Median	2640	49.9	2590	64.4	0.000683	6.41	136	0.00269	0.261	3.41e-05	0	0.0287
19.55NB2014	2640	43.5	2590	62.9	0.000525	7.25	20.9	0.00208	0.244	3.41e-05	0	0.0287
71350NB1214	2630	49.9	2580	64.4	0.000683	6.41	136	0.00269	0.274	3.41e-05	0	0.0287
60350NB1222	2750	51.1	2710	67	0.000734	6.08	136	0.00271	0.261	3.41e-05	0	0.0287

Mix designs: 41 to 45 MPa

Table 18: **Total life cycle (across modules in scope) impact results for Mix designs: 41 to 45MPa, assuming the geometric mean point values on a per 1 m3 of concrete 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	36	0.0587	449	3.15e-05	0.394	0.000499	2570
Maximum	38.3	0.062	465	3.33e-05	0.436	8e-04	2620
Mean	37.2	0.0604	457	3.24e-05	0.415	0.00065	2600
Median	37.2	0.0604	457	3.24e-05	0.415	0.00065	2600
19.50NB2014	36	0.0587	465	3.15e-05	0.394	0.000499	2570
70400ND2014	38.3	0.062	449	3.33e-05	0.436	8e-04	2620

b) Inventory Metrics:

Indicator/LCI Metric	TPE	RE	NRE	NRR	RR	WDP	LFW	LFHW	CBWC	CWWC	CHW	CNHW
Unit	MJ-Eq	MJ-Eq	MJ-Eq	kg	m3	m3	kg waste	kg waste	m3	m3	kg	kg
Minimum	2820	46.6	2770	67.1	0.000555	5.58	21.2	0.00213	0.238	3.41e-05	0	0.0287
Maximum	2870	54	2820	70.3	0.000734	6.88	150	0.00284	0.26	3.41e-05	0	0.0287
Mean	2840	50.3	2800	68.7	0.000644	6.23	85.6	0.00249	0.249	3.41e-05	0	0.0287
Median	2840	50.3	2800	68.7	0.000644	6.23	85.6	0.00249	0.249	3.41e-05	0	0.0287
19.50NB2014	2820	46.6	2770	67.1	0.000555	6.88	21.2	0.00213	0.238	3.41e-05	0	0.0287
70400ND2014	2870	54	2820	70.3	0.000734	5.58	150	0.00284	0.26	3.41e-05	0	0.0287

Mix designs: 46 to 50 MPa

Table 19: **Total life cycle (across modules in scope) impact results for Mix designs: 46 to 50MPa, assuming the geometric mean point values on a per 1 m3 of concrete 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
13450NB2018	42.8	0.0694	503	3.73e-05	0.481	0.000927	3020

b) Inventory Metrics:

Indicator/LCI Metric	TPE	RE	NRE	NRR	RR	WDP	LFW	LFHW	CBWC	CWWC	CHW	CNHW
Unit	MJ-Eq	MJ-Eq	MJ-Eq	kg	m3	m3	kg waste	kg waste	m3	m3	kg	kg
13450NB2018	3330	63.8	3250	80.7	0.000862	6.29	167	0.00315	0.265	3.41e-05	0	0.0287

Mix designs: >60 MPa

Table 20: **Total life cycle (across modules in scope) impact results for Mix designs: >60MPa, assuming the geometric mean point values on a per 1 m3 of concrete 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	48.9	0.0795	591	4.33e-05	0.542	0.00106	3460
Maximum	54.4	0.0885	672	4.85e-05	0.595	0.00118	3880
Mean	51.6	0.084	632	4.59e-05	0.568	0.00112	3670
Median	51.6	0.084	632	4.59e-05	0.568	0.00112	3670
60400NB1265	48.9	0.0795	591	4.33e-05	0.542	0.00106	3460
60500NB1265	54.4	0.0885	672	4.85e-05	0.595	0.00118	3880

b) Inventory Metrics:

Indicator/LCI Metric	TPE	RE	NRE	NRR	RR	WDP	LFW	LFHW	CBWC	CWWC	CHW	CNHW
Unit	MJ-Eq	MJ-Eq	MJ-Eq	kg	m3	m3	kg waste	kg waste	m3	m3	kg	kg
Minimum	3810	75.3	3720	92.5	0.000967	6.48	196	0.0036	0.24	3.41e-05	0	0.0287
Maximum	4280	86	4180	104	0.00107	7.17	222	0.0039	0.24	3.41e-05	0	0.0287
Mean	4040	80.6	3950	98.2	0.00102	6.82	209	0.00375	0.24	3.41e-05	0	0.0287
Median	4040	80.6	3950	98.2	0.00102	6.82	209	0.00375	0.24	3.41e-05	0	0.0287
60400NB1265	3810	75.3	3720	92.5	0.000967	7.17	196	0.0036	0.24	3.41e-05	0	0.0287
60500NB1265	4280	86	4180	104	0.00107	6.48	222	0.0039	0.24	3.41e-05	0	0.0287

ADDITIONAL ENVIRONMENTAL INFO

No regulated substances of very high concern are utilized on site.

REFERENCES

ASTM Standards:

- ASTM A36/A36M Standard Specification for Carbon Structural Steel
- ASTM A108 Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished

- ASTM A123/A123M Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- ASTM A153/A153M Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
- ASTM A184 Standard Specification for Welded Deformed Steel Bar Mats for Concrete Reinforcement
- ASTM A307 Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength
- ASTM A416/A416M Standard Specification for Steel Strand, Uncoated Seven-Wire for Prestressed Concrete
- ASTM A555/A555M Standard Specification for General Requirements for Stainless Steel Wire and Wire Rods
- ASTM A615/A615M Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
- ASTM A666 Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar
- ASTM A706/A706M Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement
- ASTM A767/A767M Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement
- ASTM A775/A775M Standard Specification for Epoxy-Coated Steel Reinforcing Bars
- ASTM A820/A820M Standard Specification for Steel Fibers for Fiber-Reinforced Concrete
- ASTM A884/A884M Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement
- ASTM A934/A934M Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars
- ASTM A1064/A1064M Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
- ASTM C33/C33M Standard Specification for Concrete Aggregates
- ASTM C94 Standard Specification for Ready-Mixed Concrete
- 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
- ASTM C330/C330M Standard Specification for Lightweight Aggregates for Structural Concrete
- ASTM C494/C494M Standard Specification for Chemical Admixtures for Concrete

CSA Standards:

- CAN/CGSB-1.40 Anticorrosive Structural Steel Alkyd Primer
- CAN/CSA G30.18 Carbon steel bars for concrete reinforcement
- CAN/CSA A3000 Cementitious Materials Compendium
- CAN/CSA G40.20/G40.21 General requirements for rolled or welded structural quality steel / Structural quality steel
- CAN/CSA A23.1/A23.2 Concrete Materials and Methods of Concrete Construction/Test methods and Standard Practices for Concrete
- CAN/CSA A23.4 Precast concrete - Materials and construction
- CSA S806 Design and construction of building structures with fiber-reinforced polymers

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
- American Concrete Institute (ACI) 211: Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete.
- ACI 318-14 Building Code Requirements for Structural Concrete and Commentary. American Concrete Institute. Farmington Hills, MI, USA available at https://www.concrete.org/store/
- Mather, B & Ozyildirim, C. (2002). SP-1(02) : Concrete Primer. American Concrete Institute: SP0102. American Concrete Institute. Farmington Hills, MI, USA available at https://www.concrete.org/store/
- NSF International (February 2019). Product Category Rules (PCR) for ISO 14025 Type III Environmental Product Declarations (EPDs) of Concrete v1.2.
- Product Category Rules for Preparing an Environmental Product Declaration for Precast Concrete (UN CPC 37550), ASTM International, March 2015. https://www.astm.org/CERTIFICATION/DOCS/266.PCR_for_Precast_Concrete.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.