

Environmental Product Declaration



Environmental Product Declaration for various ready mix concrete products produced by Holcim México Operaciones S.A. de C.V. at their Iztapalapa facility in Alvaro Obregon

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 Rule (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 <input type="checkbox"/> ; External <input checked="" type="checkbox"/>
	Third Party Verifier Geoffrey Guest, Certified 3rd Party Verifier under the International EPD Program (www.environdec.com), CSA Group (www.csaregistry.ca)
Date of Issue:	29 July 2023
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EPD Number:	ab35fc7f-3717-4c0d-ba3d-3acb792c5aae



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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 61 concrete mixes manufactured at the Holcim Mexico Operaciones S.A. de C.V. Iztapalapa concrete facility in Ciudad de Mexico, 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	H ₂ O to cement ratio
1	3740NB2012	0.04 MPa 28d strength Ready mix concrete	Ready mix concrete	0.04	0.36
2	3742ND2012	0.04 MPa 28d strength Ready mix concrete	Ready mix concrete	0.04	0.38
3	3745ND2012	0.04 MPa 28d strength Ready mix concrete	Ready mix concrete	0.04	0.40
4	6045NB1218	0.04 MPa 28d strength special concrete	special concrete	0.04	0.40
5	3750ND2012	0.05 MPa 28d strength Ready mix concrete	Ready mix concrete	0.05	0.44
6	3755ND2012	0.05 MPa 28d strength Ready mix concrete	Ready mix concrete	0.05	0.48
7	24005NB0520	0.49 MPa 28d strength mortars and fillers	mortars and fillers	0.49	5.26
8	24007NB0520	0.69 MPa 28d strength mortars and fillers	mortars and fillers	0.69	5.26
9	24010NB0520	0.98 MPa 28d strength mortars and fillers	mortars and fillers	0.98	4.52
10	24015NB0520	1.47 MPa 28d strength mortars and fillers	mortars and fillers	1.47	3.65



11	24020NB0518	1.96 MPa 28d strength mortars and fillers	mortars and fillers	1.96	3.26
12	68025NB0518	2.45 MPa 28d strength special concrete	special concrete	2.45	2.75
13	24025NB0520	2.45 MPa 28d strength mortars and fillers	mortars and fillers	2.45	2.92
14	24030NB0520	2.94 MPa 28d strength mortars and fillers	mortars and fillers	2.94	2.65
15	39035ND4010	3.43 MPa 28d strength Ready mix concrete	Ready mix concrete	3.43	0.71
16	68035NB0514	3.43 MPa 28d strength special concrete	special concrete	3.43	2.31
17	24035NB0520	3.43 MPa 28d strength mortars and fillers	mortars and fillers	3.43	2.43
18	77036ND2010	3.53 MPa 28d strength Ready mix concrete	Ready mix concrete	3.53	0.77
19	39038ND2010	3.73 MPa 28d strength Ready mix concrete	Ready mix concrete	3.73	0.67
20	77040ND4010	3.93 MPa 28d strength Ready mix concrete	Ready mix concrete	3.93	0.67
21	68040ND4014	3.93 MPa 28d strength special concrete	special concrete	3.93	0.77
22	24040NB0520	3.93 MPa 28d strength mortars and fillers	mortars and fillers	3.93	2.32
23	39042ND4012	4.12 MPa 28d strength Ready mix concrete	Ready mix concrete	4.12	0.59
24	77045ND2010	4.42 MPa 28d strength Ready mix concrete	Ready mix concrete	4.42	0.63
25	60045ND4012	4.42 MPa 28d strength special concrete	special concrete	4.42	0.59
26	39048ND4010	4.71 MPa 28d strength Ready mix concrete	Ready mix concrete	4.71	0.53
27	39050ND4010	4.91 MPa 28d strength Ready mix concrete	Ready mix concrete	4.91	0.51
28	76050ND1218	4.91 MPa 28d strength special concrete	special concrete	4.91	1.06
29	73050NB0514	4.91 MPa 28d strength mortars and fillers	mortars and fillers	4.91	2.03
30	24075NB0518	7.36 MPa 28d strength mortars and fillers	mortars and fillers	7.36	1.86
31	70100NB2014	9.81 MPa 28d strength Ready mix concrete	Ready mix concrete	9.81	1.43
32	76100ND1218	9.81 MPa 28d strength special concrete	special concrete	9.81	0.95
33	73100NB0518	9.81 MPa 28d strength mortars and fillers	mortars and fillers	9.81	1.48
34	01150NB2018	14.72 MPa 28d strength Ready mix concrete	Ready mix concrete	14.72	1.19
35	27150NB1200	14.72 MPa 28d strength special concrete ,dry mix only	special concrete	14.72	0.00



36	73150NB0514	14.72 MPa 28d strength mortars and fillers	mortars and fillers	14.72	1.18
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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	H ₂ O to cement ratio
37	71175ND1210	17.17 MPa 28d strength Ready mix concrete	Ready mix concrete	17.17	0.90
38	71200ND1214	19.63 MPa 28d strength Ready mix concrete	Ready mix concrete	19.63	0.96
39	27200NB1200	19.63 MPa 28d strength special concrete ,dry mix only	special concrete	19.63	0.00
40	73200NB0518	19.63 MPa 28d strength mortars and fillers	mortars and fillers	19.63	0.98

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	H ₂ O to cement ratio
41	71210ND1210	20.61 MPa 28d strength Ready mix concrete	Ready mix concrete	20.61	0.82
42	07250ND1212	24.53 MPa 28d strength Ready mix concrete	Ready mix concrete	24.53	0.79
43	68250NB1218	24.53 MPa 28d strength special concrete	special concrete	24.53	0.82
44	73250NB0514	24.53 MPa 28d strength mortars and fillers	mortars and fillers	24.53	0.85

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	H ₂ O to cement ratio
45	70280NB2018	27.48 MPa 28d strength Ready mix concrete	Ready mix concrete	27.48	0.81
46	70300NB2018	29.44 MPa 28d strength Ready mix concrete	Ready mix concrete	29.44	0.77
47	27300NB1200	29.44 MPa 28d strength special concrete ,dry mix only	special concrete	29.44	0.00



48	73300NB0518	29.44 MPa 28d strength mortars and fillers	mortars and fillers	29.44	0.76
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Mix designs: 31 to 35 MPa

Table 5: 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	H ₂ O to cement ratio
49	70320ND2010	31.4 MPa 28d strength Ready mix concrete	Ready mix concrete	31.40	0.71
50	71350NB1218	34.35 MPa 28d strength Ready mix concrete	Ready mix concrete	34.35	0.63
51	40350NB1214	34.35 MPa 28d strength special concrete	special concrete	34.35	0.63
52	73350NB0514	34.35 MPa 28d strength mortars and fillers	mortars and fillers	34.35	0.68

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	H ₂ O to cement ratio
53	71360ND1210	35.33 MPa 28d strength Ready mix concrete	Ready mix concrete	35.33	0.56
54	13400ND1212	39.25 MPa 28d strength Ready mix concrete	Ready mix concrete	39.25	0.43
55	56400NB1265	39.25 MPa 28d strength special concrete	special concrete	39.25	0.39

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	H ₂ O to cement ratio
56	13450ND2010	44.16 MPa 28d strength Ready mix concrete	Ready mix concrete	44.16	0.38
57	56450NB1265	44.16 MPa 28d strength special concrete	special concrete	44.16	0.37



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	H ₂ O to cement ratio
58	13500NB2012	49.07 MPa 28d strength Ready mix concrete	Ready mix concrete	49.07	0.36
59	56500NB1265	49.07 MPa 28d strength special concrete	special concrete	49.07	0.35

Mix designs: 51 to 55 MPa

Table 9: Declared products with Mix designs: 51 to 55MPa considered in this environmental product declaration

Mix#	Unique name/ID	Short description	Product type	28 day strength, MPa	H ₂ O to cement ratio
60	13550ND1212	53.97 MPa 28d strength Ready mix concrete	Ready mix concrete	53.97	0.34

Mix designs: 56 to 60 MPa

Table 10: Declared products with Mix designs: 56 to 60MPa considered in this environmental product declaration

Mix#	Unique name/ID	Short description	Product type	28 day strength, MPa	H ₂ O to cement ratio
61	13600NB1212	58.88 MPa 28d strength Ready mix concrete	Ready mix concrete	58.88	0.32

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 11: 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:

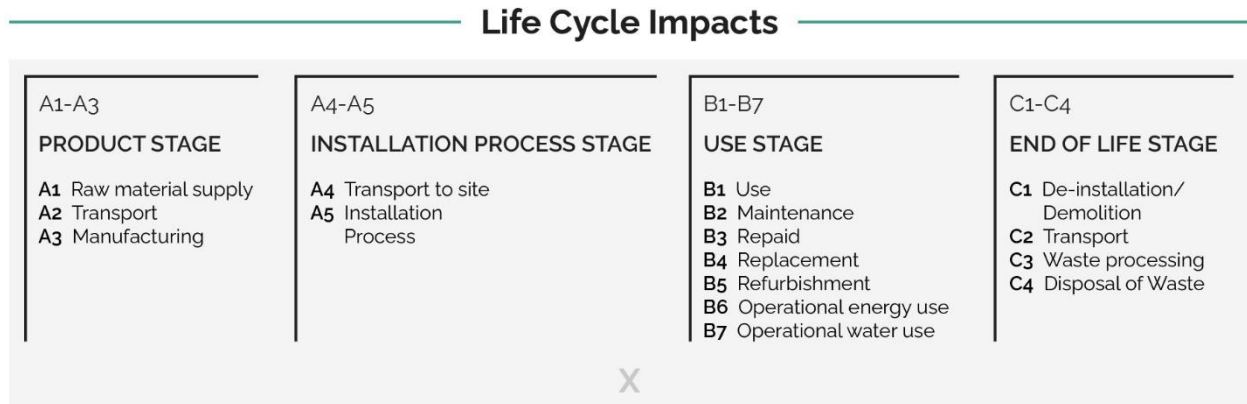


Figure 1: **General life cycle phases for consideration in a construction works system**

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 ready mix concrete products and is not necessarily exhaustive.

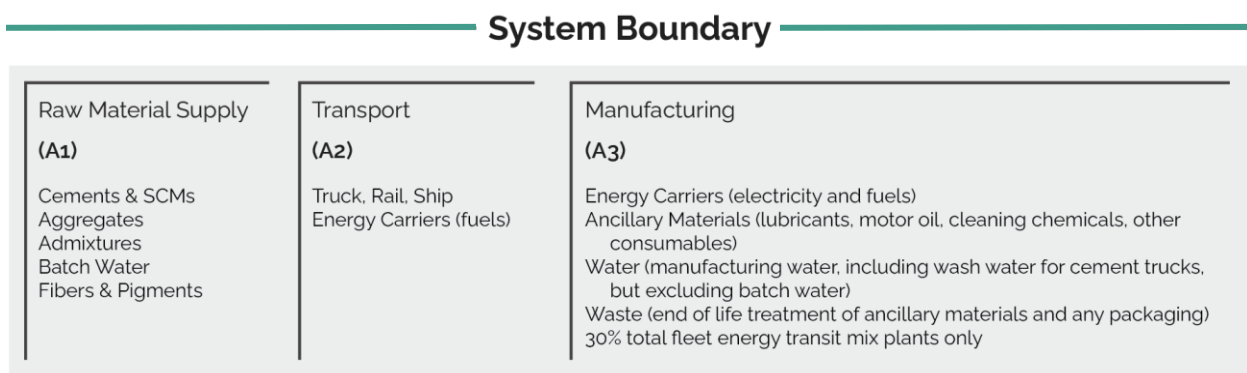


Figure 2: **General system inputs considered in the product system and categorized by modules in scope**

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, 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 Iztapalapa 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 12: **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
Andesite sand	basalt quarry operation/basalt/RoW/kg; Note: modifications made (see ecoinvent activity changes table)	ecoinvent v3.8	Estado de México	v3.8 in 2021	2	3	1	3	3
Water	tap water production, conventional with biological treatment/tap water/RoW/kg	ecoinvent v3.8	Estado de Mexico	v3.8 in 2021	2	3	1	3	3
Limestone Gravel	limestone quarry operation/limestone, unprocessed/RoW/kg;	ecoinvent v3.8	Estado de Mexico	v3.8 in 2021	2	3	1	3	3



	Note: modifications made (see ecoinvent activity changes table)								
Additives	market for chemical, organic/chemical, organic/GLO/kg	ecoinvent v3.8	Estado de Mexico	v3.8 in 2021	2	3	1	3	3
Cement (CPC 40) Apaxco	CPC 40	Progam Operator: Labeling Sustainability - EPD ID: e38f688d-1fa5-41b0-a9b1-e5b1422ea654	Estado de México	very good, 3rd party verified facility-specific EPD dataset	3	N A	3	3	3
Cement (CPO 30R R) PROVEEDOR : HOLCI Orizaba	CPC 30R	Progam Operator: Labeling Sustainability - EPD ID: 565b7deb-ebd6-4cb3-9aa6-a585381c41f3	Veracruz	25 February 2023	3	3	3	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	Morelos	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 13: **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 CO ₂ -Eq	kg CFC-11-Eq	kg NO _x -Eq	kg Sb-Eq	MJ, net calorific value
Minimum	32.8	0.0584	93	6.64e-06	0.38	0.000373	597
Maximum	624	0.68	582	4.76e-05	14.8	0.0022	3660
Mean	229	0.256	288	1.48e-05	5.31	0.000951	1240
Median	182	0.2	301	1.04e-05	4.24	0.000783	909
3740NB2012	624	0.68	578	1.77e-05	14.8	0.0022	1610
3742ND2012	559	0.611	523	1.71e-05	13.2	0.00201	1540
3745ND2012	504	0.552	477	1.67e-05	11.9	0.00184	1480
6045NB1218	48.1	0.0846	582	4.76e-05	0.516	0.000873	3660
3750ND2012	453	0.497	433	1.63e-05	10.7	0.00168	1430
3755ND2012	403	0.444	392	1.59e-05	9.5	0.00154	1380
24005NB0520	78	0.0882	93	6.64e-06	1.76	0.000373	597



24007NB0520	78	0.0882	93	6.64e-06	1.76	0.000373	597
24010NB0520	88.3	0.0993	102	6.77e-06	2.01	0.000405	610
24015NB0520	105	0.118	117	6.98e-06	2.42	0.000459	632
24020NB0518	115	0.128	125	7.16e-06	2.65	0.00049	650
68025NB0518	137	0.151	143	7.2e-06	3.17	0.000552	659
24025NB0520	128	0.141	135	7.26e-06	2.95	0.000527	661
24030NB0520	139	0.153	145	7.39e-06	3.21	0.000561	675
39035ND4010	32.8	0.0584	344	3.19e-05	0.38	0.000621	2400
68035NB0514	155	0.171	159	7.57e-06	3.6	0.000611	693
24035NB0520	150	0.165	154	7.52e-06	3.47	0.000595	688
77036ND2010	309	0.34	299	1.19e-05	7.27	0.00116	1040
39038ND2010	34.6	0.0614	372	3.37e-05	0.396	0.000649	2540
77040ND4010	343	0.376	329	1.24e-05	8.08	0.00127	1090
68040ND4014	338	0.371	323	1.21e-05	7.96	0.00125	1060
24040NB0520	156	0.172	160	7.6e-06	3.63	0.000615	696
39042ND4012	36.5	0.0648	404	3.58e-05	0.413	0.000677	2690
77045ND2010	375	0.41	355	1.26e-05	8.84	0.00136	1110
60045ND4012	388	0.424	368	1.31e-05	9.14	0.00142	1170
39048ND4010	38.6	0.0684	435	3.8e-05	0.432	0.000709	2860
39050ND4010	39.6	0.0702	451	3.9e-05	0.442	0.000726	2940
76050ND1218	333	0.36	303	8.02e-06	7.86	0.00112	775
73050NB0514	173	0.19	176	8.23e-06	4.01	0.000678	759
24075NB0518	191	0.21	190	7.96e-06	4.47	0.000722	735
70100NB2014	208	0.23	211	1.03e-05	4.84	0.000841	896
76100ND1218	368	0.398	333	8.4e-06	8.7	0.00123	816
73100NB0518	236	0.258	230	8.84e-06	5.54	0.000867	816
01150NB2018	240	0.265	239	1.05e-05	5.63	0.000937	922
27150NB1200	370	0.402	344	1.09e-05	8.72	0.00127	952
73150NB0514	282	0.308	269	9.43e-06	6.63	0.00101	877

b) Inventory Metrics:

Indicator/L CI Metric	TPE	RE	NR E	NR R	RR	WD P	LFW	LFHW	CBW C	CWW C	CH W	CNH W
Unit	MJ- Eq	MJ- Eq	MJ- Eq	kg	m3	m3	kg waste	kg waste	m3	m3	kg	kg
Minimum	657	27.7	630	17.7	0.000702	0.459	15.4	0.00128	0	3.11e-05	0.116	0.0133
Maximum	4020	112	3920	96.7	0.00813	7.74	61.7	0.00475	0.369	3.11e-05	0.116	0.0133
Mean	1380	56.6	1320	35.9	0.00311	2.51	30.8	0.00233	0.292	3.11e-05	0.116	0.0133
Median	1020	53	966	27.4	0.00245	0.692	27	0.00202	0.298	3.11e-05	0.116	0.0133
3740NB2012	1840	112	1720	49.3	0.00813	6.37	48.1	0.0034	0.246	3.11e-05	0.116	0.0133
3742ND2012	1760	102	1640	46.8	0.0075	6.39	46.7	0.0033	0.232	3.11e-05	0.116	0.0133
3745ND2012	1680	91.9	1580	44.8	0.00652	6.77	45.6	0.00323	0.224	3.11e-05	0.116	0.0133



6045NB1218	4020	73.2	3920	96.7	0.000942	5.53	61.7	0.00475	0.238	3.11e-05	0.116	0.0133
3750ND2012	1610	83.1	1530	42.9	0.00608	7.16	44.5	0.00317	0.221	3.11e-05	0.116	0.0133
3755ND2012	1550	76.8	1460	41	0.00546	7.57	43.5	0.00311	0.214	3.11e-05	0.116	0.0133
24005NB0520	657	27.8	630	17.7	0.00118	0.535	15.4	0.00128	0.369	3.11e-05	0.116	0.0133
24007NB0520	661	27.7	634	17.8	0.00116	0.535	15.4	0.00128	0.369	3.11e-05	0.116	0.0133
24010NB0520	677	29.4	645	18.2	0.00128	0.544	15.7	0.00131	0.367	3.11e-05	0.116	0.0133
24015NB0520	704	32.2	669	18.9	0.00145	0.56	16.3	0.00134	0.364	3.11e-05	0.116	0.0133
24020NB0518	724	33.5	689	19.6	0.00157	0.564	16.8	0.00138	0.357	3.11e-05	0.116	0.0133
68025NB0518	732	36.6	699	20	0.0019	0.594	17	0.00138	0.365	3.11e-05	0.116	0.0133
24025NB0520	740	36.2	703	20	0.0018	0.579	17.1	0.00139	0.359	3.11e-05	0.116	0.0133
24030NB0520	752	36.9	715	20.4	0.00192	0.59	17.5	0.00142	0.358	3.11e-05	0.116	0.0133
39035ND4010	2610	46.1	2570	63.6	0.000702	7.74	49.6	0.00378	0.23	3.11e-05	0.116	0.0133
68035NB0514	775	40.3	734	21	0.00214	0.601	18	0.00145	0.352	3.11e-05	0.116	0.0133
24035NB0520	768	39.2	733	20.9	0.00209	0.6	17.8	0.00144	0.356	3.11e-05	0.116	0.0133
77036ND2010	1170	61.9	1100	31.3	0.00416	0.661	31.4	0.0023	0.254	3.11e-05	0.116	0.0133
39038ND2010	2770	49.4	2710	67.7	0.00071	6.76	50.8	0.00387	0.237	3.11e-05	0.116	0.0133
77040ND4010	1230	68.3	1160	32.9	0.00449	0.691	32.9	0.00239	0.249	3.11e-05	0.116	0.0133
68040ND4014	1200	66.8	1130	32.1	0.00439	0.712	32.1	0.00233	0.276	3.11e-05	0.116	0.0133
24040NB0520	779	40.3	737	21.2	0.00218	0.607	18	0.00146	0.356	3.11e-05	0.116	0.0133
39042ND4012	2930	52.8	2890	71.4	0.000746	7.07	52.7	0.00402	0.232	3.11e-05	0.116	0.0133
77045ND2010	1260	72.5	1180	33.7	0.00482	0.727	33.6	0.00243	0.253	3.11e-05	0.116	0.0133
60045ND4012	1330	75.9	1250	35.6	0.00516	0.737	34.8	0.00251	0.247	3.11e-05	0.116	0.0133
39048ND4010	3130	56.4	3040	75.8	0.000783	6.66	54.5	0.00416	0.229	3.11e-05	0.116	0.0133
39050ND4010	3220	57.5	3150	78.1	0.000796	6.49	55.4	0.00424	0.23	3.11e-05	0.116	0.0133
76050ND1218	893	63.6	830	24.6	0.0043	0.786	20	0.00151	0.365	3.11e-05	0.116	0.0133
73050NB0514	857	44.1	807	23.1	0.00237	0.62	19.5	0.00158	0.346	3.11e-05	0.116	0.0133



24075NB0518	823	46	786	22.6	0.00253	0.644	19.1	0.00152	0.356	3.11e-05	0.116	0.0133
70100NB2014	998	47.3	950	26.6	0.00287	0.603	26.7	0.002	0.301	3.11e-05	0.116	0.0133
76100ND1218	946	69.5	873	26	0.00483	0.819	21.1	0.00158	0.362	3.11e-05	0.116	0.0133
73100NB0518	923	53.2	870	25.1	0.00317	0.693	21.4	0.00169	0.353	3.11e-05	0.116	0.0133
01150NB2018	1040	52.2	981	27.6	0.0032	0.631	27.4	0.00204	0.295	3.11e-05	0.116	0.0133
27150NB1200	1090	73.5	1010	29.9	0.00489	0.459	28	0.00211	0	3.11e-05	0.116	0.0133
73150NB0514	997	59.9	934	27.3	0.00361	0.73	23	0.0018	0.34	3.11e-05	0.116	0.0133

Mix designs: 15 to 20 MPa

Table 14: 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 CO ₂ -Eq	kg CFC-11-Eq	kg NO _x -Eq	kg Sb-Eq	MJ, net calorific value
Minimum	283	0.311	277	1.02e-05	6.64	0.00109	970
Maximum	401	0.436	371	1.14e-05	9.48	0.00137	1040
Mean	329	0.36	313	1.11e-05	7.75	0.00119	998
Median	316	0.346	302	1.13e-05	7.44	0.00116	992
71175ND1210	287	0.315	279	1.13e-05	6.72	0.00109	997
71200ND1214	283	0.311	277	1.14e-05	6.64	0.0011	1040
27200NB1200	401	0.436	371	1.13e-05	9.48	0.00137	986
73200NB0518	346	0.377	324	1.02e-05	8.16	0.00121	970

b) Inventory Metrics:

Indicator/LCI Metric	TPE	RE	NRE	NR	RR	WD P	LFW	LFHW	CBW C	CWW C	CH W	CNH W
Unit	MJ-Eq	MJ-Eq	MJ-Eq	kg	m ³	m ³	kg waste	kg waste	m ³	m ³	kg	kg
Minimum	1110	59.8	1040	30.1	0.00382	0.492	24.9	0.00192	0	3.11e-05	0.116	0.0133
Maximum	1180	77	1110	31.3	0.00526	0.806	29.8	0.00219	0.348	3.11e-05	0.116	0.0133
Mean	1140	67	1060	30.7	0.00438	0.655	28.4	0.00212	0.226	3.11e-05	0.116	0.0133
Median	1120	65.6	1060	30.7	0.00422	0.662	29.4	0.00219	0.277	3.11e-05	0.116	0.0133



71175ND1210	1120	60.2	1060	30.1	0.0039	0.655	29.8	0.00219	0.271	3.11e-05	0.116	0.0133
71200ND1214	1180	59.8	1110	31.3	0.00382	0.668	29.6	0.00219	0.284	3.11e-05	0.116	0.0133
27200NB1200	1130	77	1050	31.1	0.00526	0.492	29.2	0.00218	0	3.11e-05	0.116	0.0133
73200NB0518	1110	71.1	1040	30.3	0.00453	0.806	24.9	0.00192	0.348	3.11e-05	0.116	0.0133

Mix designs: 21 to 25 MPa

Table 15: 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	310	0.339	299	1.06e-05	7.27	0.00116	1020
Maximum	387	0.42	358	1.2e-05	9.13	0.00133	1110
Mean	350	0.382	331	1.15e-05	8.24	0.00127	1060
Median	352	0.385	334	1.18e-05	8.28	0.00129	1040
71210ND1210	310	0.339	299	1.16e-05	7.27	0.00116	1030
07250ND1212	349	0.382	331	1.19e-05	8.22	0.00127	1060
68250NB1218	355	0.388	337	1.2e-05	8.35	0.00131	1110
73250NB0514	387	0.42	358	1.06e-05	9.13	0.00133	1020

b) Inventory Metrics:

Indicator/LCI Metric	TPE	RE	NRE	NR	RR	WD P	LFW	LFHW	CBW C	CWW C	CH W	CNH W
Unit	MJ-Eq	MJ-Eq	MJ-Eq	kg	m3	m3	kg waste	kg waste	m3	m3	kg	kg
Minimum	1160	61.9	1090	31	0.00412	0.677	26.2	0.00201	0.269	3.11e-05	0.116	0.0133
Maximum	1250	78.3	1190	33.8	0.00501	0.84	31.6	0.0023	0.339	3.11e-05	0.116	0.0133
Mean	1200	69.8	1120	32.2	0.00456	0.754	29.9	0.00222	0.3	3.11e-05	0.116	0.0133
Median	1180	69.4	1110	32	0.00455	0.75	31	0.00228	0.296	3.11e-05	0.116	0.0133
71210ND1210	1160	61.9	1090	31	0.00412	0.677	30.6	0.00225	0.269	3.11e-05	0.116	0.0133
07250ND1212	1200	67.8	1130	32.2	0.00449	0.736	31.6	0.0023	0.289	3.11e-05	0.116	0.0133
68250NB1218	1250	71	1190	33.8	0.00461	0.763	31.3	0.0023	0.304	3.11e-05	0.116	0.0133



73250NB0514	1170	78.3	1090	31.9	0.00501	0.84	26.2	0.00201	0.339	3.11e-05	0.116	0.0133
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Mix designs: 26 to 30 MPa

Table 16: 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 CO ₂ -Eq	kg CFC-11-Eq	kg NO _x -Eq	kg Sb-Eq	MJ, net calorific value
Minimum	360	0.393	341	1.11e-05	8.48	0.00131	1040
Maximum	476	0.516	434	1.23e-05	11.3	0.00159	1100
Mean	416	0.452	385	1.19e-05	9.82	0.00144	1070
Median	414	0.45	383	1.21e-05	9.75	0.00144	1060
70280NB2018	360	0.393	341	1.2e-05	8.48	0.00131	1070
70300NB2018	382	0.417	360	1.23e-05	9	0.00138	1100
27300NB1200	476	0.516	434	1.22e-05	11.3	0.00159	1060
73300NB0518	445	0.482	406	1.11e-05	10.5	0.0015	1040

b) Inventory Metrics:

Indicator/LCI Metric	TPE	RE	NR E	NR R	RR	WD P	LFW	LFHW	CBW C	CWW C	CH W	CNH W
Unit	MJ-Eq	MJ-Eq	MJ-Eq	kg	m ³	m ³	kg waste	kg waste	m ³	m ³	kg	kg
Minimum	1200	70.5	1110	32.7	0.00485	0.567	27.7	0.00209	0	3.11e-05	0.116	0.0133
Maximum	1250	89.4	1180	33.7	0.00624	0.91	32.5	0.00236	0.351	3.11e-05	0.116	0.0133
Mean	1220	79.8	1140	33.3	0.00546	0.759	31	0.00228	0.242	3.11e-05	0.116	0.0133
Median	1220	79.6	1140	33.4	0.00538	0.78	31.8	0.00233	0.308	3.11e-05	0.116	0.0133
70280NB2018	1220	70.5	1140	32.7	0.00485	0.768	31.8	0.00232	0.307	3.11e-05	0.116	0.0133
70300NB2018	1250	73.9	1180	33.7	0.0051	0.791	32.5	0.00236	0.308	3.11e-05	0.116	0.0133
27300NB1200	1230	89.4	1130	33.7	0.00624	0.567	31.8	0.00234	0	3.11e-05	0.116	0.0133
73300NB0518	1200	85.2	1110	33	0.00567	0.91	27.7	0.00209	0.351	3.11e-05	0.116	0.0133



Mix designs: 31 to 35 MPa

Table 17: 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 CO ₂ -Eq	kg CFC-11-Eq	kg NO _x -Eq	kg Sb-Eq	MJ, net calorific value
Minimum	379	0.415	359	1.18e-05	8.94	0.00138	1120
Maximum	486	0.526	443	1.3e-05	11.5	0.00164	1240
Mean	443	0.482	410	1.24e-05	10.5	0.00155	1160
Median	454	0.494	420	1.25e-05	10.7	0.00159	1150
70320ND2010	379	0.415	359	1.26e-05	8.94	0.00138	1120
71350NB1218	437	0.477	408	1.3e-05	10.3	0.00157	1240
40350NB1214	470	0.511	432	1.24e-05	11.1	0.00161	1150
73350NB0514	486	0.526	443	1.18e-05	11.5	0.00164	1150

b) Inventory Metrics:

Indicator/LCI Metric	TPE	RE	NRE	NR R	RR	WDP	LFW	LFHW	CBW C	CWW C	CH W	CNH W
Unit	MJ-Eq	MJ-Eq	MJ-Eq	kg	m ³	m ³	kg waste	kg waste	m ³	m ³	kg	kg
Minimum	1270	73.9	1190	34.1	0.00486	0.767	29.2	0.00221	0.286	3.11e-05	0.116	0.0133
Maximum	1410	92.2	1320	37.8	0.00625	0.949	34	0.00247	0.343	3.11e-05	0.116	0.0133
Mean	1330	84.6	1240	36	0.00575	0.862	32.2	0.00236	0.309	3.11e-05	0.116	0.0133
Median	1320	86.2	1220	36	0.00595	0.866	32.8	0.00238	0.303	3.11e-05	0.116	0.0133
70320ND2010	1270	73.9	1190	34.1	0.00486	0.767	33.4	0.00242	0.286	3.11e-05	0.116	0.0133
71350NB1218	1410	84.7	1320	37.8	0.00564	0.839	34	0.00247	0.292	3.11e-05	0.116	0.0133
40350NB1214	1320	87.6	1220	35.9	0.00625	0.894	32.1	0.00235	0.314	3.11e-05	0.116	0.0133
73350NB0514	1320	92.2	1230	36.1	0.00625	0.949	29.2	0.00221	0.343	3.11e-05	0.116	0.0133



Mix designs: 36 to 40 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 CO ₂ -Eq	kg CFC-11-Eq	kg NO _x -Eq	kg Sb-Eq	MJ, net calorific value
Minimum	450	0.49	418	1.32e-05	10.6	0.00158	1180
Maximum	635	0.692	590	1.82e-05	15	0.00228	1770
Mean	533	0.581	497	1.59e-05	12.6	0.00191	1480
Median	514	0.561	483	1.64e-05	12.1	0.00187	1490
71360ND1210	450	0.49	418	1.32e-05	10.6	0.00158	1180
13400ND1212	514	0.561	483	1.64e-05	12.1	0.00187	1490
56400NB1265	635	0.692	590	1.82e-05	15	0.00228	1770

b) Inventory Metrics:

Indicator/LCI Metric	TPE	RE	NR E	NR R	RR	WD P	LFW	LFHW	CBW C	CWW C	CH W	CNH W
Unit	MJ-Eq	MJ-Eq	MJ-Eq	kg	m ³	m ³	kg waste	kg waste	m ³	m ³	kg	kg
Minimum	1350	85.6	1270	36.4	0.00581	0.825	35.2	0.00253	0.244	3.11e-05	0.116	0.0133
Maximum	2010	115	1900	53.8	0.00859	7.37	48.2	0.00343	0.272	3.11e-05	0.116	0.0133
Mean	1680	98.1	1590	45.1	0.00704	4.75	42.7	0.00304	0.262	3.11e-05	0.116	0.0133
Median	1690	93.7	1600	45	0.00672	6.05	44.6	0.00316	0.27	3.11e-05	0.116	0.0133
71360ND1210	1350	85.6	1270	36.4	0.00581	0.825	35.2	0.00253	0.272	3.11e-05	0.116	0.0133
13400ND1212	1690	93.7	1600	45	0.00672	6.05	44.6	0.00316	0.244	3.11e-05	0.116	0.0133
56400NB1265	2010	115	1900	53.8	0.00859	7.37	48.2	0.00343	0.27	3.11e-05	0.116	0.0133



Mix designs: 41 to 45 MPa

Table 19: 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	ADP _f
Unit	moles of H ⁺ -Eq	kg N	kg CO ₂ -Eq	kg CFC-11-Eq	kg NO _x -Eq	kg Sb-Eq	MJ, net calorific value
Minimum	575	0.627	537	1.72e-05	13.6	0.00206	1580
Maximum	685	0.746	633	1.86e-05	16.2	0.00244	1830
Mean	630	0.686	585	1.79e-05	14.9	0.00225	1700
Median	630	0.686	585	1.79e-05	14.9	0.00225	1700
13450ND2010	575	0.627	537	1.72e-05	13.6	0.00206	1580
56450NB1265	685	0.746	633	1.86e-05	16.2	0.00244	1830

b) Inventory Metrics:

Indicator/LCI Metric	TPE	RE	NRE	NR	RR	WD	LFW	LFHW	CBW	CWW	CH	CNH
Unit	MJ-Eq	MJ-Eq	MJ-Eq	kg	m ³	m ³	kg waste	kg waste	m ³	m ³	kg	kg
Minimum	1790	103	1690	48.1	0.00745	6.32	46.8	0.00331	0.239	3.11e-05	0.116	0.0133
Maximum	2100	124	1970	56.1	0.00919	7.03	49.3	0.0035	0.272	3.11e-05	0.116	0.0133
Mean	1940	114	1830	52.1	0.00832	6.68	48	0.0034	0.256	3.11e-05	0.116	0.0133
Median	1940	114	1830	52.1	0.00832	6.68	48	0.0034	0.256	3.11e-05	0.116	0.0133
13450ND2010	1790	103	1690	48.1	0.00745	6.32	46.8	0.00331	0.239	3.11e-05	0.116	0.0133
56450NB1265	2100	124	1970	56.1	0.00919	7.03	49.3	0.0035	0.272	3.11e-05	0.116	0.0133

Mix designs: 46 to 50 MPa

Table 20: 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	ADP _f
Unit	moles of H ⁺ -Eq	kg N	kg CO ₂ -Eq	kg CFC-11-Eq	kg NO _x -Eq	kg Sb-Eq	MJ, net calorific value
Minimum	640	0.697	591	1.78e-05	15.1	0.00225	1640
Maximum	735	0.799	675	1.91e-05	17.4	0.00259	1900



Mean	688	0.748	633	1.84e-05	16.2	0.00242	1770
Median	688	0.748	633	1.84e-05	16.2	0.00242	1770
13500NB2012	640	0.697	591	1.78e-05	15.1	0.00225	1640
56500NB1265	735	0.799	675	1.91e-05	17.4	0.00259	1900

b) Inventory Metrics:

Indicator/LCI Metric	TPE	RE	NRE	NR R	RR	WD P	LFW	LFHW	CBW C	CWW C	CH W	CNH W
Unit	MJ-Eq	MJ-Eq	MJ-Eq	kg	m3	m3	kg waste	kg waste	m3	m3	kg	kg
Minimum	1880	115	1750	50.3	0.00828	6.34	48.1	0.0034	0.25	3.11e-05	0.116	0.0133
Maximum	2180	132	2030	58.1	0.00936	6.67	50.4	0.00358	0.274	3.11e-05	0.116	0.0133
Mean	2030	124	1890	54.2	0.00882	6.5	49.2	0.00349	0.262	3.11e-05	0.116	0.0133
Median	2030	124	1890	54.2	0.00882	6.5	49.2	0.00349	0.262	3.11e-05	0.116	0.0133
13500NB2012	1880	115	1750	50.3	0.00828	6.34	48.1	0.0034	0.25	3.11e-05	0.116	0.0133
56500NB1265	2180	132	2030	58.1	0.00936	6.67	50.4	0.00358	0.274	3.11e-05	0.116	0.0133

Mix designs: 51 to 55 MPa

Table 21: Total life cycle (across modules in scope) impact results for Mix designs: 51 to 55MPa, 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	673	0.732	618	1.79e-05	15.9	0.00236	1680
Maximum	673	0.732	618	1.79e-05	15.9	0.00236	1680
Mean	673	0.732	618	1.79e-05	15.9	0.00236	1680
Median	673	0.732	618	1.79e-05	15.9	0.00236	1680
13550ND1212	673	0.732	618	1.79e-05	15.9	0.00236	1680

b) Inventory Metrics:

Indicator/LCI Metric	TPE	RE	NRE	NR R	RR	WD P	LFW	LFH W	CBW C	CWW C	CH W	CNH W
Unit	MJ-Eq	MJ-Eq	MJ-Eq	kg	m3	m3	kg waste	kg waste	m3	m3	kg	kg



Minimum	1930	121	1800	51.7	0.00866	5.26	48.3	0.0034	0.248	3.11e-05	0.116	0.0133
Maximum	1930	121	1800	51.7	0.00866	5.26	48.3	0.0034	0.248	3.11e-05	0.116	0.0133
Mean	1930	121	1800	51.7	0.00866	5.26	48.3	0.0034	0.248	3.11e-05	0.116	0.0133
Median	1930	121	1800	51.7	0.00866	5.26	48.3	0.0034	0.248	3.11e-05	0.116	0.0133
13550ND1212	1930	121	1800	51.7	0.00866	5.26	48.3	0.0034	0.248	3.11e-05	0.116	0.0133

Mix designs: 56 to 60 MPa

Table 22: Total life cycle (across modules in scope) impact results for Mix designs: 56 to 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	731	0.794	667	1.85e-05	17.3	0.00254	1760
Maximum	731	0.794	667	1.85e-05	17.3	0.00254	1760
Mean	731	0.794	667	1.85e-05	17.3	0.00254	1760
Median	731	0.794	667	1.85e-05	17.3	0.00254	1760
13600NB1212	731	0.794	667	1.85e-05	17.3	0.00254	1760

b) Inventory Metrics:

Indicator/LCI Metric	TPE	RE	NRE	NR R	RR	WD P	LFW	LFH W	CBW C	CWW C	CH W	CNH W
Unit	MJ-Eq	MJ-Eq	MJ-Eq	kg	m3	m3	kg waste	kg waste	m3	m3	kg	kg
Minimum	2030	129	1890	54.4	0.00958	5.35	49.7	0.0035	0.253	3.11e-05	0.116	0.0133
Maximum	2030	129	1890	54.4	0.00958	5.35	49.7	0.0035	0.253	3.11e-05	0.116	0.0133
Mean	2030	129	1890	54.4	0.00958	5.35	49.7	0.0035	0.253	3.11e-05	0.116	0.0133
Median	2030	129	1890	54.4	0.00958	5.35	49.7	0.0035	0.253	3.11e-05	0.116	0.0133
13600NB1212	2030	129	1890	54.4	0.00958	5.35	49.7	0.0035	0.253	3.11e-05	0.116	0.0133



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>.

