

Environmental Product Declaration



Environmental Product Declaration for various ready mix concrete products produced by Holcim Argentina at their KHP3 facility in Cordoba, Argentina

ADMINISTRATIVE INFORMATION

International Certified Environmental Product Declaration

Declared Product:	This Environmental Product Declaration (EPD) covers concrete products produced by Holcim Argentina. Declared unit: 1 m3 of concrete
Declaration Owner:	Holcim Argentina
	6351 Planta Norte ES3
	Cordoba, Argentina
	www.holcim.com.ar
Program Operator:	Labeling Sustainability
	Address, 11670 W Sunset Blvd.
	City, State, 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:	13 July 2023
Period of Validity:	5 years; valid until 12 July 2028
EPD Number:	3b4092af-85d8-4d76-abf7-a113cf19f43a



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COMPANY DESCRIPTION

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

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

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

STUDY GOAL

The intended application of this life cycle assessment (LCA) is to comply with the procedures for creating a Type III environmental product declaration (EPD) and publish the EPD for public review on the website, <http://labelingsustainability.com/>. This level of study is in accordance with EPD Product Category Rule (PCR) for 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 Argentina from their competition for the following reasons: generate an advantage for the organization; offer customers information to help them make informed product decisions; improve the environmental performance of Holcim Argentina by continuously measuring, controlling and reducing the environmental impacts of their products; help project facilitators working on Leadership in Energy and Environmental Design (LEED) projects achieve their credit goal; and to strengthen Holcim Argentina's license to operate in the community. The intended audience for this LCA report is Holcim Argentina's employees, their suppliers, project specifiers of their products, architects, and engineers. The EPD report is also available for policy makers, government officials interested in sustainability, academic professors, and LCA professionals. This LCA report does not include product comparisons from other facilities.



DESCRIPTION OF PRODUCT AND SCOPE

This EPD reports on 176 concrete mixes manufactured at the Holcim Argentina KHP3-Planta Sur Cordoba concrete facility in Cordoba, Argentina.

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 cement products considered in this EPD along with key performance parameters.

Ready Mix 0 to 14 MPa

Table 1: Declared products with Mix designs: 0 to 14MPa 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	ECOPACT8K10P2NN	8 MPa 28d strength ready mix concrete.	Ready Mix	8	1.000000
2	ECOPACT13K5P4NN	13 MPa 28d strength ready mix concrete.	Ready Mix	13	0.772727
3	ECOPACT13K5P2NN	13 MPa 28d strength ready mix concrete.	Ready Mix	13	0.739130
4	ECOPACT13K8P2NN	13 MPa 28d strength ready mix concrete.	Ready Mix	13	0.760870
5	ECOPACT13K8P4NN	13 MPa 28d strength ready mix concrete.	Ready Mix	13	0.760870
6	ECOPACT13K10P4NN	13 MPa 28d strength ready mix concrete.	Ready Mix	13	0.782609
7	ECOPACT13K10P2NN	13 MPa 28d strength ready mix concrete.	Ready Mix	13	0.818182
47	Ho80K08P2NN	8 MPa 28d strength ready mix concrete.	Ready Mix	8	1.000000
48	Ho80K10P2NN	8 MPa 28d strength ready mix concrete.	Ready Mix	8	1.000000
49	Ho80K10P4-DNV	8 MPa 28d strength ready mix concrete.	Ready Mix	8	0.720000
50	Ho80K10P4NN	8 MPa 28d strength ready mix concrete.	Ready Mix	8	1.000000
51	Ho80K10P4NNC	8 MPa 28d strength ready mix concrete.	Ready Mix	8	1.030000
52	H100K08P2NNC	10 MPa 28d strength ready mix concrete.	Ready Mix	10	1.000000



53	H100K10P2NNC	10 MPa 28d strength ready mix concrete.	Ready Mix	10	1.000000
54	H100K05P4NNC	10 MPa 28d strength ready mix concrete.	Ready Mix	10	1.000000
55	H100K08P4NNC	10 MPa 28d strength ready mix concrete.	Ready Mix	10	1.000000
56	H100K10P4NNC	10 MPa 28d strength ready mix concrete.	Ready Mix	10	1.000000
57	H130K08P2NN	13 MPa 28d strength ready mix concrete.	Ready Mix	13	0.780000
58	H130K10P2NN	13 MPa 28d strength ready mix concrete.	Ready Mix	13	0.780000
59	H130K12P2NS	13 MPa 28d strength ready mix concrete.	Ready Mix	13	0.780000
60	H130K05P4NN	13 MPa 28d strength ready mix concrete.	Ready Mix	13	0.740000
61	H130K08P4NN	13 MPa 28d strength ready mix concrete.	Ready Mix	13	0.780000
62	H130K10P4NN	13 MPa 28d strength ready mix concrete.	Ready Mix	13	0.780000
63	H130K10P4NNC	13 MPa 28d strength ready mix concrete.	Ready Mix	13	0.840000

Ready Mix 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
8	ECOPACT15K15P2NS	15 MPa 28d strength ready mix concrete.	Ready Mix	15	0.705882
9	ECOPACT15K12P2NSC	15 MPa 28d strength ready mix concrete.	Ready Mix	15	0.705882
10	ECOPACT17K10P2NN	17 MPa 28d strength ready mix concrete.	Ready Mix	17	0.648148
11	ECOPACT17K10P4NN	17 MPa 28d strength ready mix concrete.	Ready Mix	17	0.641509
12	ECOPACT17K12P2NS	17 MPa 28d strength ready mix concrete.	Ready Mix	17	0.666667
13	ECOPACT17K15P2NS	17 MPa 28d strength ready mix concrete.	Ready Mix	17	0.666667
14	ECOPACT20K10P4NNC	20 MPa 28d strength ready mix concrete.	Ready Mix	20	0.629630
15	ECOPACT20K12P2NSC	20 MPa 28d strength ready mix concrete.	Ready Mix	20	0.679245
64	H150K08P2NNC	15 MPa 28d strength ready mix concrete.	Ready Mix	15	0.770000
65	H150K10P2NNC	15 MPa 28d strength ready mix concrete.	Ready Mix	15	0.770000



66	H150K12P2NSC	15 MPa 28d strength ready mix concrete.	Ready Mix	15	0.730000
67	H150K15P2NSC	15 MPa 28d strength ready mix concrete.	Ready Mix	15	0.730000
68	H150K05P4NNC	15 MPa 28d strength ready mix concrete.	Ready Mix	15	0.770000
69	H150K08P4NNC	15 MPa 28d strength ready mix concrete.	Ready Mix	15	0.770000
70	H150K10P4NNC	15 MPa 28d strength ready mix concrete.	Ready Mix	15	0.770000
71	H170K15P1NS	17 MPa 28d strength ready mix concrete.	Ready Mix	17	0.690000
72	H170K18P1NS	17 MPa 28d strength ready mix concrete.	Ready Mix	17	0.690000
73	H170K08P2NN	17 MPa 28d strength ready mix concrete.	Ready Mix	17	0.700000
74	H170K10P2NN	17 MPa 28d strength ready mix concrete.	Ready Mix	17	0.700000
75	H170K12P2NS	17 MPa 28d strength ready mix concrete.	Ready Mix	17	0.690000
76	H170K15P2NS	17 MPa 28d strength ready mix concrete.	Ready Mix	17	0.690000
77	H170K18P2NS	17 MPa 28d strength ready mix concrete.	Ready Mix	17	0.690000
78	H170K05P4NN	17 MPa 28d strength ready mix concrete.	Ready Mix	17	0.680000
79	H170K08P4NN	17 MPa 28d strength ready mix concrete.	Ready Mix	17	0.680000
80	H170K10P4NN	17 MPa 28d strength ready mix concrete.	Ready Mix	17	0.680000
81	H170K15P2NSC	17 MPa 28d strength ready mix concrete.	Ready Mix	17	0.760000
82	H200K08P2NNC	20 MPa 28d strength ready mix concrete.	Ready Mix	20	0.650000
83	H200K10P2NNC	20 MPa 28d strength ready mix concrete.	Ready Mix	20	0.650000
84	H200K12P2NSC	20 MPa 28d strength ready mix concrete.	Ready Mix	20	0.640000
85	H200K15P2NSC	20 MPa 28d strength ready mix concrete.	Ready Mix	20	0.640000
86	H200K18P2NSC	20 MPa 28d strength ready mix concrete.	Ready Mix	20	0.640000
87	H200K05P4NNC	20 MPa 28d strength ready mix concrete.	Ready Mix	20	0.630000
88	H200K08P4NNC	20 MPa 28d strength ready mix concrete.	Ready Mix	20	0.630000
89	H200K10P4NNC	20 MPa 28d strength ready mix concrete.	Ready Mix	20	0.630000



Ready Mix 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
16	ECOPACT21K15P2NSC	21 MPa 28d strength ready mix concrete.	Ready Mix	21	0.612903
17	ECOPACT21K15P1NS	21 MPa 28d strength ready mix concrete.	Ready Mix	21	0.612903
18	ECOPACT21K15P2NS	21 MPa 28d strength ready mix concrete.	Ready Mix	21	0.644068
19	ECOPACT21K18P2NS	21 MPa 28d strength ready mix concrete.	Ready Mix	21	0.622951
20	ECOPACT21K18P1NS	21 MPa 28d strength ready mix concrete.	Ready Mix	21	0.622951
21	ECOPACT21K12P2NS	21 MPa 28d strength ready mix concrete.	Ready Mix	21	0.644068
22	ECOPACT21K10P2NN	21 MPa 28d strength ready mix concrete.	Ready Mix	21	0.607143
23	ECOPACT21K08P2NN	21 MPa 28d strength ready mix concrete.	Ready Mix	21	0.586207
24	ECOPACT21K10P4NN	21 MPa 28d strength ready mix concrete.	Ready Mix	21	0.586207
25	ECOPACT25K10P2NNC	25 MPa 28d strength ready mix concrete.	Ready Mix	25	0.530303
26	ECOPACT25K8P2NNC	25 MPa 28d strength ready mix concrete.	Ready Mix	25	0.538462
27	ECOPACT25K5P4NNC	25 MPa 28d strength ready mix concrete.	Ready Mix	25	0.492754
28	ECOPACT25K8P4NNC	25 MPa 28d strength ready mix concrete.	Ready Mix	25	0.492754
29	ECOPACT25K10P4NNC	25 MPa 28d strength ready mix concrete.	Ready Mix	25	0.515152
30	ECOPACT25K12P2NSC	25 MPa 28d strength ready mix concrete.	Ready Mix	25	0.537313
31	ECOPACT25K15P2NSC	25 MPa 28d strength ready mix concrete.	Ready Mix	25	0.521739
32	ECOPACT25K18P2NSC	25 MPa 28d strength ready mix concrete.	Ready Mix	25	0.537313
33	ECOPACT25K15P1NSC	25 MPa 28d strength ready mix concrete.	Ready Mix	25	0.521739
34	ECOPACT25K18P1NS	25 MPa 28d strength ready mix concrete.	Ready Mix	25	0.521739
90	H210K12P1NS	21 MPa 28d strength ready mix concrete.	Ready Mix	21	0.620000
91	H210K15P1NS	21 MPa 28d strength ready mix concrete.	Ready Mix	21	0.620000
92	H210K18P1NS	21 MPa 28d strength ready mix concrete.	Ready Mix	21	0.620000



93	H210K05P2NN	21 MPa 28d strength ready mix concrete.	Ready Mix	21	0.600000
94	H210K08P2NN	21 MPa 28d strength ready mix concrete.	Ready Mix	21	0.600000
95	H210K10P2NN	21 MPa 28d strength ready mix concrete.	Ready Mix	21	0.600000
96	H210K12P2NS	21 MPa 28d strength ready mix concrete.	Ready Mix	21	0.660000
97	H210K15P2NS	21 MPa 28d strength ready mix concrete.	Ready Mix	21	0.640000
98	H210K18P2NS	21 MPa 28d strength ready mix concrete.	Ready Mix	21	0.640000
99	H210K05P4NN	21 MPa 28d strength ready mix concrete.	Ready Mix	21	0.590000
100	H210K08P4NN	21 MPa 28d strength ready mix concrete.	Ready Mix	21	0.590000
101	H210K10P4NN	21 MPa 28d strength ready mix concrete.	Ready Mix	21	0.590000
102	H210K12P4NN	21 MPa 28d strength ready mix concrete.	Ready Mix	21	0.590000
103	H210K05P2NNC	21 MPa 28d strength ready mix concrete.	Ready Mix	21	0.590000
104	H210K10P2NNC	21 MPa 28d strength ready mix concrete.	Ready Mix	21	0.590000
105	H210K15P2NSC	21 MPa 28d strength ready mix concrete.	Ready Mix	21	0.670000
106	H210K08P4NNC	21 MPa 28d strength ready mix concrete.	Ready Mix	21	0.660000
107	H250K15P1NSC	25 MPa 28d strength ready mix concrete.	Ready Mix	25	0.540000
108	H250K05P2NNC	25 MPa 28d strength ready mix concrete.	Ready Mix	25	0.520000
109	H250K08P2NNC	25 MPa 28d strength ready mix concrete.	Ready Mix	25	0.530000
110	H250K10P2NNC	25 MPa 28d strength ready mix concrete.	Ready Mix	25	0.540000
111	H250K12P2NSC	25 MPa 28d strength ready mix concrete.	Ready Mix	25	0.530000
112	H250K15P2NSC	25 MPa 28d strength ready mix concrete.	Ready Mix	25	0.540000
113	H250K18P2NSC	25 MPa 28d strength ready mix concrete.	Ready Mix	25	0.530000
114	H250K05P4NNC	25 MPa 28d strength ready mix concrete.	Ready Mix	25	0.510000
115	H250K08P4NNC	25 MPa 28d strength ready mix concrete.	Ready Mix	25	0.520000
116	H250K10P4NNC	25 MPa 28d strength ready mix concrete.	Ready Mix	25	0.510000
117	H250K15P1NS	25 MPa 28d strength ready mix concrete.	Ready Mix	25	0.540000
118	H250K18P1NS	25 MPa 28d strength ready mix concrete.	Ready Mix	25	0.540000



119	H250K02P2NN	25 MPa 28d strength ready mix concrete.	Ready Mix	25	0.330000
120	H250K08P2NN	25 MPa 28d strength ready mix concrete.	Ready Mix	25	0.520000
121	H250K10P2NN	25 MPa 28d strength ready mix concrete.	Ready Mix	25	0.520000
122	H250K12P2NS	25 MPa 28d strength ready mix concrete.	Ready Mix	25	0.540000
123	H250K15P2NS	25 MPa 28d strength ready mix concrete.	Ready Mix	25	0.550000
124	H250K18P2NS	25 MPa 28d strength ready mix concrete.	Ready Mix	25	0.530000
125	H250K05P4NN	25 MPa 28d strength ready mix concrete.	Ready Mix	25	0.510000
126	H250K08P4NN	25 MPa 28d strength ready mix concrete.	Ready Mix	25	0.510000
127	H250K10P4NN	25 MPa 28d strength ready mix concrete.	Ready Mix	25	0.510000

Ready Mix 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
35	ECOPACT30K12P1NSC	30 MPa 28d strength ready mix concrete.	Ready Mix	30	0.455696
36	ECOPACT30K15P1NS	30 MPa 28d strength ready mix concrete.	Ready Mix	30	0.455696
37	ECOPACT30K18P1NS	30 MPa 28d strength ready mix concrete.	Ready Mix	30	0.467532
38	ECOPACT30K12P2NSC	30 MPa 28d strength ready mix concrete.	Ready Mix	30	0.455696
39	ECOPACT30K15P2NSC	30 MPa 28d strength ready mix concrete.	Ready Mix	30	0.455696
40	ECOPACT30K18P2NSC	30 MPa 28d strength ready mix concrete.	Ready Mix	30	0.467532
41	ECOPACT30K8P4NNC	30 MPa 28d strength ready mix concrete.	Ready Mix	30	0.465753
42	ECOPACT30K10P4NNC	30 MPa 28d strength ready mix concrete.	Ready Mix	30	0.485714
43	ECOPACT30K10P4NNC-7D	30 MPa 28d strength ready mix concrete.	Ready Mix	30	0.425000
128	H300K15P1NS	30 MPa 28d strength ready mix concrete.	Ready Mix	30	0.500000
129	H300K18P1NS	30 MPa 28d strength ready mix concrete.	Ready Mix	30	0.500000
130	H300K10P2NN	30 MPa 28d strength ready mix concrete.	Ready Mix	30	0.490000



131	H300K12P2NS	30 MPa 28d strength ready mix concrete.	Ready Mix	30	0.490000
132	H300K15P2NS	30 MPa 28d strength ready mix concrete.	Ready Mix	30	0.490000
133	H300K18P2NS	30 MPa 28d strength ready mix concrete.	Ready Mix	30	0.490000
134	H300K08P4NN	30 MPa 28d strength ready mix concrete.	Ready Mix	30	0.490000
135	H300K10P4NN	30 MPa 28d strength ready mix concrete.	Ready Mix	30	0.490000
136	H300K12P1NSC	30 MPa 28d strength ready mix concrete.	Ready Mix	30	0.500000
137	H300K18P1NSC	30 MPa 28d strength ready mix concrete.	Ready Mix	30	0.500000
138	H300K08P2NNC	30 MPa 28d strength ready mix concrete.	Ready Mix	30	0.490000
139	H300K10P2NNC	30 MPa 28d strength ready mix concrete.	Ready Mix	30	0.490000
140	H300K12P2NSC	30 MPa 28d strength ready mix concrete.	Ready Mix	30	0.490000
141	H300K15P2NSC	30 MPa 28d strength ready mix concrete.	Ready Mix	30	0.490000
142	H300K18P2NSC	30 MPa 28d strength ready mix concrete.	Ready Mix	30	0.490000
143	H300K05P4NNC	30 MPa 28d strength ready mix concrete.	Ready Mix	30	0.470000
144	H300K08P4NNC	30 MPa 28d strength ready mix concrete.	Ready Mix	30	0.470000
145	H300K10P4NNC	30 MPa 28d strength ready mix concrete.	Ready Mix	30	0.470000
146	H300K10P4NNC-7D	30 MPa 28d strength ready mix concrete.	Ready Mix	30	0.450000

Ready Mix 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	H ₂ O to cement ratio
44	ECOPACT35K10P4NNC	35 MPa 28d strength ready mix concrete.	Ready Mix	35	0.369565
45	ECOPACT35K15P1NS	35 MPa 28d strength ready mix concrete.	Ready Mix	35	0.400000
46	ECOPACT35K12P2NS	35 MPa 28d strength ready mix concrete.	Ready Mix	35	0.418605
147	H320K12P1NS	32 MPa 28d strength ready mix concrete.	Ready Mix	32	0.480000
148	H320K10P4NN	32 MPa 28d strength ready mix concrete.	Ready Mix	32	0.430000



149	H350K10P2NN	35 MPa 28d strength ready mix concrete.	Ready Mix	35	0.410000
150	H350K15P2NS	35 MPa 28d strength ready mix concrete.	Ready Mix	35	0.410000
151	H350K05P4NN	35 MPa 28d strength ready mix concrete.	Ready Mix	35	0.410000
152	H350K08P4NN	35 MPa 28d strength ready mix concrete.	Ready Mix	35	0.410000
153	H350K10P4NN	35 MPa 28d strength ready mix concrete.	Ready Mix	35	0.410000
154	H350K15P1NSC	35 MPa 28d strength ready mix concrete.	Ready Mix	35	0.390000
155	H350K18P1NSC	35 MPa 28d strength ready mix concrete.	Ready Mix	35	0.390000
156	H350K10P2NNC	35 MPa 28d strength ready mix concrete.	Ready Mix	35	0.410000
157	H350K12P2NSC	35 MPa 28d strength ready mix concrete.	Ready Mix	35	0.390000
158	H350K15P2NSC	35 MPa 28d strength ready mix concrete.	Ready Mix	35	0.390000
159	H350K18P2NSC	35 MPa 28d strength ready mix concrete.	Ready Mix	35	0.390000
160	H350K05P4NNC	35 MPa 28d strength ready mix concrete.	Ready Mix	35	0.400000
161	H350K08P4NNC	35 MPa 28d strength ready mix concrete.	Ready Mix	35	0.400000
162	H350K10P4NNC	35 MPa 28d strength ready mix concrete.	Ready Mix	35	0.400000
163	H350K08P4-DNV	35 MPa 28d strength ready mix concrete.	Ready Mix	35	0.350000

Ready Mix 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
164	H380K08P2NN	38 MPa 28d strength ready mix concrete.	Ready Mix	38	0.38
165	H380K12P2NS	38 MPa 28d strength ready mix concrete.	Ready Mix	38	0.40
166	H380K15P2NS	38 MPa 28d strength ready mix concrete.	Ready Mix	38	0.40
167	H380K05P4NN	38 MPa 28d strength ready mix concrete.	Ready Mix	38	0.37
168	H400K10P2NNC	40 MPa 28d strength ready mix concrete.	Ready Mix	40	0.37
169	H400K12P2NSC	40 MPa 28d strength ready mix concrete.	Ready Mix	40	0.38



170	H400K15P2NSC	40 MPa 28d strength ready mix concrete.	Ready Mix	40	0.38
171	H400K18P2NSC	40 MPa 28d strength ready mix concrete.	Ready Mix	40	0.38
172	H400K05P4NNC	40 MPa 28d strength ready mix concrete.	Ready Mix	40	0.37
173	H400K08P4NNC	40 MPa 28d strength ready mix concrete.	Ready Mix	40	0.37
174	H400K10P4NNC	40 MPa 28d strength ready mix concrete.	Ready Mix	40	0.37

Ready Mix 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
175	H420K15P2NS	42 MPa 28d strength ready mix concrete.	Ready Mix	42	0.36

Ready Mix 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
176	H470K10P4NN	47 MPa 28d strength ready mix concrete.	Ready Mix	47	0.31

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 9: Ready mix concrete 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:

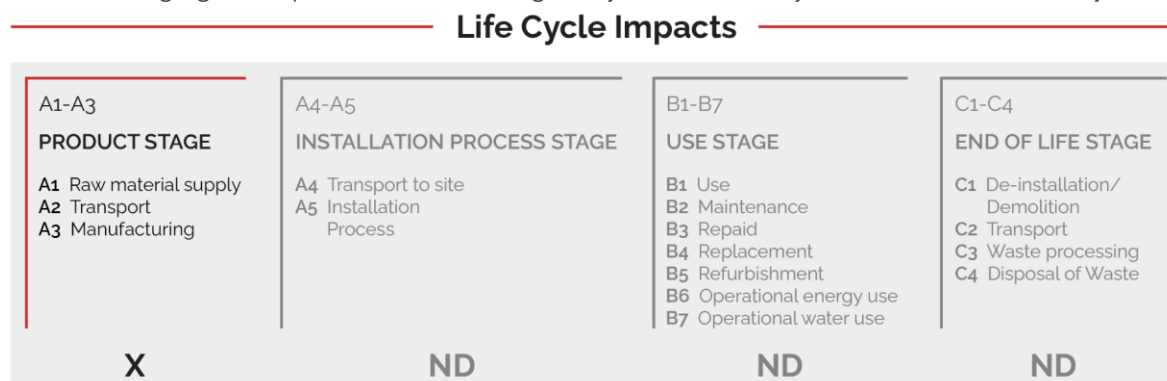


Figure 1: General life cycle phases for consideration in a construction works system

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 cement products and is not necessarily exhaustive.

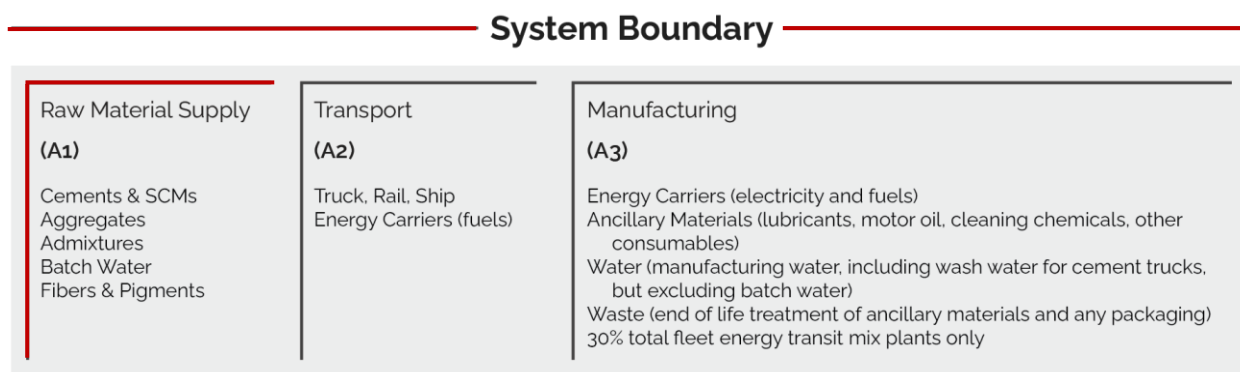


Figure 2: General system inputs considered in the product system and categorized by modules in scope

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

- Production, manufacture, and construction of A3 building/capital goods and infrastructure.
- Production and manufacture of steel production equipment, steel delivery vehicles, 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 Argentina, is located at their KHP3 facility in Argentina. All operating data is formulated using the actual data from Holcim Argentina'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 Argentina were utilized. Explanations of the contribution of each data source to this study are outlined in the section 'Data Sources and Quality'. Further LCI details for each declared product are provided in the sections 'Detailed LCI tables' and 'Transport tables' of the detailed LCA report. A parameter uncertainty analysis was also performed where key statistical results (e.g. min/mean/max etc.) are provided in the detailed LCA report.

CUT-OFF CRITERIA

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

DATA SOURCES AND DATA QUALITY ASSESSMENT

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

Electricity: Electricity consumption values are for Argentina in calendar year 2021. These values were direct reported from Argentina records. The unit process market for electricity, medium voltage/electricity, medium voltage/AR/kWh" was used to represent the Argentina 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. This plant does not have electricity therefore it uses diesel to power generators.



Waste generation: Waste generation values are directly reported from Holcim operations for bulk waste. No hazardous or high-level radioactive waste is generated on-site at this facility. Wash water for trucks was also primary reported data for 2021.

Recovered energy: not applicable.

Recycled/reused material/components: The amount of returned concrete is based on Holcim primary data for the reference year, 2021.

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

Direct A3 emissions accounting: Direct emissions for the on-site machinery use the actual fuel consumption and the ecoinvent database to calculate those emissions..

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 2021.

Product transport requirements: The diesel fuel used by the mixing trucks is direct primary information reported from Holcim Argentina records for the year 2021. Holcim records their fuel for their trucks in L/km and therefore the information was converted with the following formula: (Ave. km to site)* 2 for return L diesel/km /(ave. m3 of concrete in a load) total concrete volume in m3 * fraction allocated to A3. A4 is outside the scope of this study.

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 10: 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 treatment/tap water/RoW/kg	ecoinvent v3.8	Buenos Aires	v3.8 in 2021	2	3	2	3	3
Gravel	limestone quarry operation/limestone, unprocessed/RoW/kg	ecoinvent v3.8	Cordoba	v3.8 in 2021	2	3	2	3	3
Additives	market for chemical, organic/chemical, organic/GLO/kg	ecoinvent v3.8	Buenos Aires	v3.8 in 2021	2	3	2	3	3

CPF 40 Cement	Cemento CP40 (bulk)	Progam Operator: Labeling Sustainability- EPD ID: f2621473-b677-4e9d-9047-0a38323ea4ee	Cordoba	24 January 2023	3	3	3	3	3
River Sand	sand quarry operation, extraction from river bed/sand/BR/kg	ecoinvent v3.8	Cordoba	v3.8 in 2021	2	3	2	3	3
Fly Ash	Waste input produced off-site	See A3 inputs	Buenos Aires	See A3 inputs	2	A3	2	A3	A3

DATA QUALITY ASSESSMENT

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

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

Completeness: All relevant specific processes, including inputs (raw materials, energy, and ancillary materials) and outputs (emissions and production volume) were considered and modeled to represent the specified and declared products. 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 Cement 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 2021-01-01 to 2021-12-31.
- 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

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.

TOTAL IMPACT SUMMARY

The following table reports the total LCA results for each product produced at the given cement facility on a per 1m³ of concrete basis.



Ready Mix 0 to 14 MPa

Table 12: Total life cycle (across modules in scope) impact results for Mix designs: 0 to 14MPa, 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	23.5	0.036	149	1.56e-05	0.371	0.00067	1320
Maximum	33.8	0.046	255	1.84e-05	0.549	0.00108	1750
Mean	25.3	0.0384	166	1.66e-05	0.399	0.000745	1430
Median	25.5	0.0389	170	1.7e-05	0.406	0.000754	1460
ECOPACT8K10P2NN	23.6	0.0362	150	1.57e-05	0.373	0.00068	1340
ECOPACT13K5P4NN	25.3	0.0389	163	1.7e-05	0.396	0.000739	1450
ECOPACT13K5P2NN	26.1	0.0398	171	1.74e-05	0.409	0.000772	1490
ECOPACT13K8P2NN	26.1	0.0398	171	1.73e-05	0.409	0.000774	1490
ECOPACT13K8P4NN	26.1	0.0398	171	1.73e-05	0.409	0.000774	1490
ECOPACT13K10P4NN	26.2	0.0399	172	1.74e-05	0.41	0.00078	1510
ECOPACT13K10P2NN	25.3	0.0389	164	1.7e-05	0.395	0.000745	1470
H08K08P2NN	23.5	0.036	149	1.56e-05	0.371	0.000673	1320
H08K10P2NN	25.4	0.0375	170	1.58e-05	0.407	0.000749	1390
H08K10-DNV	33.8	0.046	255	1.84e-05	0.549	0.00108	1750
H08K10P4NN	23.6	0.0361	150	1.56e-05	0.372	0.000675	1330
H08K10P4NNC	23.5	0.0361	150	1.56e-05	0.371	0.000676	1330
H10CK08P2NNC	23.5	0.036	149	1.56e-05	0.371	0.000673	1320
H10CK10P2NNC	23.5	0.0361	150	1.56e-05	0.372	0.000675	1330
H10CK05P4NNC	23.5	0.036	149	1.56e-05	0.371	0.00067	1320
H10CK08P4NNC	23.5	0.036	150	1.56e-05	0.371	0.000673	1320
H10CK10P4NNC	23.6	0.0361	150	1.56e-05	0.372	0.000675	1330
H13K08P2NN	26	0.0396	171	1.73e-05	0.408	0.000771	1480
H13K10P2NN	26	0.0397	171	1.73e-05	0.408	0.000774	1490
H13K12P2NS	26.3	0.0403	173	1.76e-05	0.412	0.000785	1530
H13K05P4NN	26.1	0.0397	171	1.73e-05	0.409	0.00077	1480
H13K08P4NN	26	0.0396	171	1.73e-05	0.408	0.000771	1480
H13K10P4NN	26	0.0397	171	1.73e-05	0.408	0.000774	1490
H13K10P4NNC	25.7	0.0388	169	1.68e-05	0.404	0.000759	1450



b) Inventory Metrics:

Indicator/LC I Metric	TPE	RE	NRE	NRR	RR	WDP	LFW	LFH W	CBW C	CW WC	CHW	CNH W
Unit	MJ-Eq	MJ-Eq	MJ-Eq	kg	m3	m3	kg waste	kg waste	m3	m3	kg	kg
Minimum	1450	33.7	1420	34.4	0.00 0411	8.48	28.7	0.00 259	0.178	5.42e -05	0.02 05	0.246
Maximum	1950	48.8	1900	44	0.00 0498	9.65	36.3	0.00 297	0.2	5.42e -05	0.02 05	0.246
Mean	1580	36.8	1540	37.3	0.00 0459	9.11	33.9	0.00 279	0.188	5.42e -05	0.02 05	0.246
Median	1610	37.2	1580	38.2	0.00 0472	9.12	34.8	0.00 284	0.189	5.42e -05	0.02 05	0.246
ECOPACT8K1oP2NN	1480	34.4	1440	35	0.00 0448	9.21	32.4	0.00 265	0.189	5.42e -05	0.02 05	0.246
ECOPACT13K5P4NN	1600	36.6	1560	38	0.00 048	9.21	35.6	0.00 289	0.178	5.42e -05	0.02 05	0.246
ECOPACT13K5P2NN	1640	37.8	1600	38.7	0.00 0479	9.08	35.7	0.00 292	0.178	5.42e -05	0.02 05	0.246
ECOPACT13K8P2NN	1650	38	1610	38.9	0.00 048	9.05	35.6	0.00 292	0.184	5.42e -05	0.02 05	0.246
ECOPACT13K8P4NN	1640	37.9	1610	39	0.00 0486	9.05	35.6	0.00 292	0.184	5.42e -05	0.02 05	0.246
ECOPACT13K10P4NN	1660	38.4	1620	39.2	0.00 0492	9.05	35.7	0.00 292	0.189	5.42e -05	0.02 05	0.246
ECOPACT13K10P2NN	1620	36.9	1580	38.3	0.00 0485	9.13	35.5	0.00 288	0.189	5.42e -05	0.02 05	0.246
H08K08P2NN	1460	34	1420	34.6	0.00 0434	9.21	32.3	0.00 264	0.189	5.42e -05	0.02 05	0.246
H08K10P2NN	1530	36.8	1500	35.7	0.00 0412	9.21	30.4	0.00 259	0.189	5.42e -05	0.02 05	0.246
H08K10-DNV	1950	48.8	1900	44	0.00 0411	8.48	28.7	0.00 273	0.189	5.42e -05	0.02 05	0.246
H08K10P4NN	1460	34.1	1430	34.5	0.00 0438	9.16	32.4	0.00 265	0.189	5.42e -05	0.02 05	0.246
H08K10P4NNC	1470	34.2	1430	34.7	0.00 0438	8.96	32.5	0.00 265	0.2	5.42e -05	0.02 05	0.246
H10CK08P2NNC	1460	33.7	1420	34.5	0.00 0434	9.21	32.3	0.00 264	0.189	5.42e -05	0.02 05	0.246
H10CK10P2NNC	1470	34	1430	34.7	0.00 0436	9.21	32.4	0.00 265	0.189	5.42e -05	0.02 05	0.246
H10CK05P4NNC	1450	33.8	1420	34.4	0.00 0431	9.21	32.3	0.00 264	0.189	5.42e -05	0.02 05	0.246
H10CK08P4NNC	1460	34	1430	34.4	0.00 0435	9.21	32.4	0.00 265	0.189	5.42e -05	0.02 05	0.246
H10CK10P4NNC	1470	34	1430	34.5	0.00 0442	9.21	32.4	0.00 265	0.189	5.42e -05	0.02 05	0.246
H13K08P2NN	1640	37.8	1600	38.7	0.00 0476	9.05	35.6	0.00 291	0.189	5.42e -05	0.02 05	0.246



H13K10P2NN	1650	38	1610	38.9	0.00 048	9.05	35.6	0.00 291	0.189	5.42e -05	0.02 05	0.246
H13K12P2NS	1680	38.5	1640	39.9	0.00 0498	9.65	36.3	0.00 297	0.189	5.42e -05	0.02 05	0.246
H13K05P4NN	1640	37.9	1600	38.5	0.00 0477	9.12	35.7	0.00 292	0.178	5.42e -05	0.02 05	0.246
H13K08P4NN	1640	37.7	1600	38.7	0.00 0478	9.05	35.6	0.00 291	0.189	5.42e -05	0.02 05	0.246
H13K10P4NN	1650	37.9	1610	39	0.00 0483	9.05	35.6	0.00 291	0.189	5.42e -05	0.02 05	0.246
H13K10P4NN C	1600	37.4	1570	37.8	0.00 0467	8.88	34	0.00 28	0.189	5.42e -05	0.02 05	0.246

Ready Mix 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 CO ₂ - Eq	kg CFC- 11-Eq	kg NO _x - Eq	kg Sb-Eq	MJ, net calorific value
Minimum	26.3	0.0399	175	1.74e-05	0.413	0.000783	1490
Maximum	30.8	0.0454	221	1.95e-05	0.493	0.000966	1770
Mean	28.6	0.0426	195	1.84e-05	0.449	0.000876	1630
Median	28.8	0.043	197	1.84e-05	0.452	0.000888	1650
ECOPACT15K15P2NS	28.2	0.0419	191	1.79e-05	0.442	0.000865	1610
ECOPACT15K12P2NSC	28.2	0.0419	191	1.79e-05	0.442	0.000862	1600
ECOPACT17K10P2NN	29	0.0433	198	1.87e-05	0.454	0.000892	1660
ECOPACT17K10P4NN	28.7	0.043	194	1.86e-05	0.449	0.000877	1650
ECOPACT17K12P2NS	28.9	0.043	197	1.84e-05	0.452	0.000891	1650
ECOPACT17K15P2NS	29	0.0431	197	1.85e-05	0.453	0.000895	1660
ECOPACT20K10P4NNC	29.7	0.044	205	1.89e-05	0.468	0.000918	1690
ECOPACT20K12P2NSC	28.8	0.0427	196	1.83e-05	0.451	0.000886	1640
H15CK08P2NNC	26.4	0.0401	175	1.75e-05	0.414	0.000788	1510
H15CK10P2NNC	26.5	0.0402	176	1.75e-05	0.415	0.000791	1520
H15CK12P2NSC	27.7	0.0417	185	1.81e-05	0.432	0.000839	1590
H15CK15P2NSC	27.8	0.0419	186	1.81e-05	0.434	0.000846	1600
H15CK05P4NNC	26.3	0.0399	175	1.74e-05	0.413	0.000783	1490
H15CK08P4NNC	26.4	0.04	175	1.74e-05	0.414	0.000786	1500
H15CK10P4NNC	26.4	0.0401	175	1.74e-05	0.415	0.000789	1510
H17K15P1NS	28.8	0.0429	197	1.86e-05	0.452	0.000884	1650
H17K18P1NS	28.9	0.0432	198	1.86e-05	0.454	0.000891	1660
H17K08P2NN	27.7	0.0414	187	1.79e-05	0.435	0.000837	1560
H17K10P2NN	30.8	0.0439	221	1.82e-05	0.493	0.000962	1660
H17K12P2NS	29	0.0432	198	1.86e-05	0.453	0.000891	1650
H17K15P2NS	29.1	0.0434	198	1.87e-05	0.455	0.000897	1670
H17K18P2NS	29.2	0.0436	199	1.88e-05	0.456	0.000901	1680
H17K05P4NN	27.7	0.0416	188	1.8e-05	0.436	0.000837	1560



H17K08P4NN	27.8	0.0417	188	1.81e-05	0.437	0.000841	1570
H17K10P4NN	27.9	0.0418	188	1.81e-05	0.438	0.000843	1580
H17K15P2NSC	28.1	0.0421	189	1.82e-05	0.438	0.00086	1620
H20CK08P2NNC	29.4	0.0435	204	1.87e-05	0.464	0.000906	1650
H20CK10P2NNC	29.5	0.0436	204	1.87e-05	0.464	0.000909	1660
H20CK12P2NSC	30.6	0.0451	214	1.94e-05	0.481	0.000955	1740
H20CK15P2NSC	30.7	0.0453	215	1.95e-05	0.483	0.000962	1760
H20CK18P2NSC	30.8	0.0454	215	1.95e-05	0.484	0.000966	1770
H20CK05P4NNC	29.4	0.0434	204	1.87e-05	0.464	0.000903	1640
H20CK08P4NNC	29.5	0.0436	204	1.87e-05	0.465	0.000907	1650
H20CK10P4NNC	29.5	0.0437	205	1.88e-05	0.466	0.00091	1660

b) Inventory Metrics:

Indicator/LC I Metric	TPE	RE	NRE	NRR	RR	WDP	LFW	LFH W	CBW C	CW WC	CHW	CNH W
Unit	MJ-Eq	MJ-Eq	MJ-Eq	kg	m3	m3	kg waste	kg waste	m3	m3	kg	kg
Minimum	1650	38.2	1600	38.8	0.000453	7.45	32.3	0.00285	0.178	5.42e-05	0.0205	0.246
Maximum	1960	45.3	1910	45.7	0.00053	9.12	37.3	0.00315	0.2	5.42e-05	0.0205	0.246
Mean	1800	41.8	1750	42.1	0.000504	8.47	36.2	0.00301	0.186	5.42e-05	0.0205	0.246
Median	1820	42.3	1770	42.5	0.000507	8.63	36.3	0.00302	0.189	5.42e-05	0.0205	0.246
ECOPACT15K15P2NS	1780	41.6	1730	41.6	0.000504	7.65	35.1	0.00292	0.189	5.42e-05	0.0205	0.246
ECOPACT15K12P2NSC	1770	41.3	1720	41.4	0.000506	7.69	35.1	0.00292	0.189	5.42e-05	0.0205	0.246
ECOPACT17K10P2NN	1840	42.3	1790	43.1	0.000518	8.59	37	0.00308	0.184	5.42e-05	0.0205	0.246
ECOPACT17K10P4NN	1820	41.8	1770	42.7	0.000515	8.76	37.1	0.00308	0.178	5.42e-05	0.0205	0.246
ECOPACT17K12P2NS	1830	42.4	1780	42.8	0.000517	7.78	36.3	0.00302	0.189	5.42e-05	0.0205	0.246
ECOPACT17K15P2NS	1840	42.6	1800	43.1	0.000526	7.78	36.3	0.00302	0.189	5.42e-05	0.0205	0.246
ECOPACT20K10P4NNC	1860	43.5	1810	43.6	0.000514	8.72	36.6	0.00307	0.178	5.42e-05	0.0205	0.246
ECOPACT20K12P2NSC	1810	42.3	1760	42.4	0.000514	7.78	35.8	0.00298	0.189	5.42e-05	0.0205	0.246
H15CK08P2NNC	1660	38.5	1630	39.2	0.000481	9.05	35.7	0.00293	0.189	5.42e-05	0.0205	0.246
H15CK10P2NNC	1670	38.7	1640	39.4	0.000487	9.05	35.7	0.00293	0.189	5.42e-05	0.0205	0.246
H15CK12P2NSC	1750	40.5	1710	41.2	0.000508	7.69	36.6	0.003	0.189	5.42e-05	0.0205	0.246
H15CK15P2NSC	1770	40.9	1730	41.6	0.000519	7.69	36.7	0.00301	0.189	5.42e-05	0.0205	0.246



H15CK05P4N NC	1650	38.2	1600	38.8	0.00 0477	8.79	35.4	0.00 291	0.189	5.42e -05	0.02 05	0.246
H15CK08P4N NC	1650	38.4	1620	39	0.00 0482	8.8	35.5	0.00 291	0.189	5.42e -05	0.02 05	0.246
H15CK10P4N NC	1670	38.5	1630	39.3	0.00 0482	8.8	35.5	0.00 291	0.189	5.42e -05	0.02 05	0.246
H17K15P1NS	1810	42.1	1770	42.6	0.00 0509	9.07	36.5	0.00 305	0.189	5.42e -05	0.02 05	0.246
H17K18P1NS	1840	42.3	1800	43.2	0.00 0521	9.07	36.6	0.00 305	0.189	5.42e -05	0.02 05	0.246
H17K08P2NN	1730	40.4	1690	40.5	0.00 0486	8.63	35.7	0.00 296	0.184	5.42e -05	0.02 05	0.246
H17K10P2NN	1840	44.6	1790	42.4	0.00 0453	8.55	32.3	0.00 285	0.184	5.42e -05	0.02 05	0.246
H17K12P2NS	1820	42.6	1780	42.7	0.00 0516	7.78	37	0.00 306	0.189	5.42e -05	0.02 05	0.246
H17K15P2NS	1840	42.6	1800	43.2	0.00 0526	7.79	37.1	0.00 307	0.189	5.42e -05	0.02 05	0.246
H17K18P2NS	1850	42.8	1820	43.6	0.00 053	7.79	37.1	0.00 308	0.189	5.42e -05	0.02 05	0.246
H17K05P4NN	1730	40.3	1680	40.6	0.00 0481	8.92	36.1	0.00 299	0.178	5.42e -05	0.02 05	0.246
H17K08P4NN	1740	40.4	1700	40.8	0.00 0491	8.92	36.1	0.00 299	0.178	5.42e -05	0.02 05	0.246
H17K10P4NN	1750	40.7	1700	41	0.00 0494	8.92	36.1	0.00 3	0.178	5.42e -05	0.02 05	0.246
H17K15P2NS C	1780	41.3	1740	41.9	0.00 0517	7.45	36.4	0.00 3	0.2	5.42e -05	0.02 05	0.246
H20CK08P2 NNC	1820	42.6	1780	42.6	0.00 0497	8.68	36.3	0.00 305	0.184	5.42e -05	0.02 05	0.246
H20CK10P2N NC	1830	42.9	1790	42.9	0.00 0493	8.59	36.3	0.00 305	0.184	5.42e -05	0.02 05	0.246
H20CK12P2N SC	1920	44.8	1880	44.9	0.00 0521	9.12	37.1	0.00 314	0.189	5.42e -05	0.02 05	0.246
H20CK15P2N SC	1950	45.2	1900	45.4	0.00 0529	9.12	37.2	0.00 315	0.189	5.42e -05	0.02 05	0.246
H20CK18P2N SC	1960	45.3	1910	45.7	0.00 053	9.12	37.3	0.00 315	0.189	5.42e -05	0.02 05	0.246
H20CK05P4N NC	1810	42.5	1770	42.4	0.00 0487	8.63	36.3	0.00 305	0.178	5.42e -05	0.02 05	0.246
H20CK08P4 NNC	1830	42.8	1780	42.6	0.00 0499	8.63	36.4	0.00 305	0.178	5.42e -05	0.02 05	0.246
H20CK10P4N NC	1840	42.9	1790	42.9	0.00 0506	8.63	36.4	0.00 306	0.178	5.42e -05	0.02 05	0.246



Ready Mix 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	29.8	0.0443	204	1.93e-05	0.465	0.000918	1690
Maximum	40.9	0.0543	321	2.23e-05	0.668	0.00133	2050
Mean	32.3	0.0475	230	2.05e-05	0.507	0.00102	1850
Median	33	0.0482	235	2.07e-05	0.517	0.00105	1860
ECOPACT21K15P2NSC	31.9	0.0469	225	2.01e-05	0.499	0.00101	1840
ECOPACT21K15P1NS	32	0.0472	226	2.04e-05	0.501	0.00102	1860
ECOPACT21K15P2NS	30.6	0.0455	213	1.96e-05	0.478	0.000962	1780
ECOPACT21K18P2NS	31.4	0.0461	220	1.97e-05	0.49	0.000994	1810
ECOPACT21K18P1NS	31.7	0.0468	223	2.02e-05	0.495	0.001	1850
ECOPACT21K12P2NS	30.5	0.0453	213	1.96e-05	0.477	0.000958	1770
ECOPACT21K10P2NN	29.8	0.0451	204	1.98e-05	0.465	0.000918	1740
ECOPACT21K08P2NN	30	0.0447	208	1.94e-05	0.471	0.00093	1710
ECOPACT21K10P4NN	30.2	0.045	209	1.95e-05	0.473	0.000938	1730
ECOPACT25K10P2NNC	33	0.0484	235	2.09e-05	0.517	0.00105	1890
ECOPACT25K8P2NNC	32.4	0.0476	230	2.06e-05	0.507	0.00102	1840
ECOPACT25K5P4NNC	34.4	0.0497	250	2.13e-05	0.541	0.0011	1930
ECOPACT25K8P4NNC	34.4	0.0498	250	2.13e-05	0.542	0.0011	1940
ECOPACT25K10P4NNC	33.3	0.0486	238	2.09e-05	0.523	0.00106	1900
ECOPACT25K12P2NSC	34.3	0.0504	247	2.19e-05	0.536	0.0011	1990
ECOPACT25K15P2NSC	35.3	0.0516	256	2.23e-05	0.552	0.00114	2050
ECOPACT25K18P2NSC	34	0.0496	244	2.13e-05	0.532	0.00109	1960
ECOPACT25K15P1NSC	34.8	0.0505	252	2.16e-05	0.545	0.00113	2000
ECOPACT25K18P1NS	34.9	0.0507	253	2.17e-05	0.547	0.00113	2010
H21K12P1NS	30.8	0.0455	216	1.96e-05	0.482	0.000966	1760
H21K15P1NS	30.9	0.0457	216	1.97e-05	0.484	0.000974	1780
H21K18P1NS	31	0.0459	217	1.97e-05	0.485	0.000978	1790
H21K05P2NN	29.8	0.0444	207	1.93e-05	0.468	0.000922	1690
H21K08P2NN	29.9	0.0446	207	1.94e-05	0.469	0.000926	1700
H21K10P2NN	30	0.0447	208	1.94e-05	0.47	0.00093	1710
H21K12P2NS	30.1	0.0449	209	1.95e-05	0.47	0.00094	1730
H21K15P2NS	30.8	0.0458	214	1.98e-05	0.48	0.000968	1790
H21K18P2NS	30.9	0.0459	214	1.98e-05	0.48	0.000972	1790
H21K05P4NN	29.9	0.0446	207	1.94e-05	0.47	0.000924	1700
H21K08P4NN	30	0.0447	208	1.94e-05	0.471	0.000928	1710
H21K10P4NN	30.1	0.0449	208	1.95e-05	0.472	0.000932	1720
H21K12P4NN	30.2	0.0451	209	1.95e-05	0.473	0.000939	1740
H21K05P2NNC	29.9	0.0446	208	1.94e-05	0.47	0.000925	1700
H21K10P2NNC	30.1	0.0449	208	1.95e-05	0.472	0.000933	1720
H21K15P2NSC	30	0.0449	206	1.95e-05	0.466	0.000936	1750
H21K08P4NNC	29.8	0.0443	207	1.93e-05	0.467	0.000924	1700



H25CK15P1NSC	33.7	0.0492	243	2.12e-05	0.528	0.00108	1930
H25CK05P2NNC	33.4	0.0486	241	2.09e-05	0.525	0.00106	1870
H25CK08P2NNC	33	0.0482	237	2.08e-05	0.519	0.00105	1860
H25CK10P2NNC	32.7	0.0479	234	2.07e-05	0.514	0.00104	1860
H25CK12P2NSC	33.8	0.0494	243	2.13e-05	0.53	0.00108	1930
H25CK15P2NSC	33.5	0.0491	240	2.11e-05	0.525	0.00108	1930
H25CK18P2NSC	34.1	0.0498	245	2.14e-05	0.533	0.0011	1970
H25CK05P4NNC	33.4	0.0485	241	2.09e-05	0.526	0.00106	1870
H25CK08P4NNC	33	0.0482	237	2.07e-05	0.52	0.00105	1860
H25CK10P4NNC	33.6	0.0488	242	2.1e-05	0.528	0.00107	1890
H25K15P1NS	33.9	0.0495	244	2.13e-05	0.531	0.00109	1950
H25K18P1NS	34	0.0497	244	2.13e-05	0.532	0.0011	1970
H25K02P2NN	40.9	0.0543	321	2.16e-05	0.668	0.00133	2040
H25K08P2NN	33.3	0.0484	241	2.08e-05	0.525	0.00106	1870
H25K10P2NN	33.4	0.0486	241	2.08e-05	0.526	0.00107	1880
H25K12P2NS	33.4	0.049	240	2.12e-05	0.524	0.00107	1920
H25K15P2NS	33.2	0.0488	236	2.11e-05	0.519	0.00106	1920
H25K18P2NS	34.1	0.0499	245	2.15e-05	0.534	0.0011	1980
H25K05P4NN	33.4	0.0485	240	2.08e-05	0.525	0.00106	1870
H25K08P4NN	33.4	0.0486	241	2.09e-05	0.526	0.00106	1880
H25K10P4NN	33.5	0.0488	241	2.09e-05	0.527	0.00107	1890

b) Inventory Metrics:

Indicator/LC I Metric	TPE	RE	NRE	NRR	RR	WDP	LFW	LFH W	CBW C	CW WC	CHW	CNH W
Unit	MJ-Eq	MJ-Eq	MJ-Eq	kg	m3	m3	kg waste	kg waste	m3	m3	kg	kg
Minimum	1870	43.2	1830	43.7	0.00042	7.51	31.4	0.00311	0.116	5.42e-05	0.0205	0.246
Maximum	2270	58.2	2210	52.5	0.000591	10.3	41.6	0.00355	0.2	5.42e-05	0.0205	0.246
Mean	2040	47.5	1990	47.6	0.000547	8.41	39	0.00329	0.186	5.42e-05	0.0205	0.246
Median	2060	48.5	2010	47.9	0.000546	8.36	39.1	0.00332	0.184	5.42e-05	0.0205	0.246
ECOPACT21K15P2NSC	2040	47.3	1990	47.4	0.000556	8.2	38.4	0.00324	0.2	5.42e-05	0.0205	0.246
ECOPACT21K15P1NS	2050	47.3	2000	47.9	0.000559	8.71	38.9	0.00328	0.2	5.42e-05	0.0205	0.246
ECOPACT21K15P2NS	1960	45.2	1920	46.1	0.000546	8.36	38.2	0.00319	0.2	5.42e-05	0.0205	0.246
ECOPACT21K18P2NS	2000	46.4	1950	46.7	0.000551	7.55	37.7	0.00317	0.2	5.42e-05	0.0205	0.246
ECOPACT21K18P1NS	2040	47	2000	47.7	0.000557	8.75	38.9	0.00327	0.2	5.42e-05	0.0205	0.246
ECOPACT21K12P2NS	1950	45.1	1910	45.8	0.000542	8.36	38.1	0.00318	0.2	5.42e-05	0.0205	0.246
ECOPACT21K10P2NN	1920	43.6	1870	45.2	0.000549	10.3	39.8	0.00329	0.178	5.42e-05	0.0205	0.246



ECOPACT21K o8P2NN	1890	43.8	1850	44.2	0.00 0523	8.59	38.2	0.00 318	0.178	5.42e -05	0.02 05	0.246
ECOPACT21K 10P4NN	1910	44.3	1870	44.9	0.00 0536	8.55	38.3	0.00 319	0.178	5.42e -05	0.02 05	0.246
ECOPACT25 K10P2NNC	2090	48.6	2030	48.6	0.00 0563	8.31	39.8	0.00 336	0.184	5.42e -05	0.02 05	0.246
ECOPACT25 K8P2NNC	2040	47.6	1990	47.3	0.00 0543	8.27	39.5	0.00 332	0.184	5.42e -05	0.02 05	0.246
ECOPACT25 K5P4NNC	2140	49.7	2080	49.3	0.00 0548	8.14	39.6	0.00 339	0.178	5.42e -05	0.02 05	0.246
ECOPACT25 K8P4NNC	2140	50.3	2090	49.8	0.00 0553	8.1	39.6	0.00 339	0.178	5.42e -05	0.02 05	0.246
ECOPACT25 K10P4NNC	2100	48.8	2050	48.8	0.00 0556	8.18	39.4	0.00 334	0.178	5.42e -05	0.02 05	0.246
ECOPACT25 K12P2NSC	2200	50.6	2160	51.4	0.00 0591	9.95	41.3	0.00 351	0.189	5.42e -05	0.02 05	0.246
ECOPACT25 K15P2NSC	2270	52.3	2210	52.5	0.00 0591	9.92	41.6	0.00 355	0.189	5.42e -05	0.02 05	0.246
ECOPACT25 K18P2NSC	2180	50.7	2120	50.5	0.00 058	8.41	39.8	0.00 339	0.189	5.42e -05	0.02 05	0.246
ECOPACT25 K15P1NSC	2220	51.4	2160	51.5	0.00 0584	8.33	40	0.00 342	0.189	5.42e -05	0.02 05	0.246
ECOPACT25 K18P1NS	2230	51.9	2170	51.8	0.00 0589	8.33	40	0.00 343	0.189	5.42e -05	0.02 05	0.246
H21K12P1NS	1950	45.3	1900	45.6	0.00 0534	8.14	38	0.00 318	0.194	5.42e -05	0.02 05	0.246
H21K15P1NS	1970	45.6	1920	46	0.00 0544	8.14	38.1	0.00 319	0.194	5.42e -05	0.02 05	0.246
H21K18P1NS	1980	46	1940	46.3	0.00 055	8.14	38.1	0.00 319	0.194	5.42e -05	0.02 05	0.246
H21K05P2NN	1870	43.2	1830	43.7	0.00 0506	8.64	38.1	0.00 317	0.184	5.42e -05	0.02 05	0.246
H21K08P2NN	1880	43.7	1840	44	0.00 0515	8.64	38.2	0.00 318	0.184	5.42e -05	0.02 05	0.246
H21K10P2NN	1900	43.7	1850	44.4	0.00 053	8.64	38.2	0.00 318	0.184	5.42e -05	0.02 05	0.246
H21K12P2NS	1910	44.3	1860	44.9	0.00 0539	7.59	38.8	0.00 32	0.2	5.42e -05	0.02 05	0.246
H21K15P2NS	1970	45.4	1920	46.2	0.00 0557	7.55	39	0.00 324	0.2	5.42e -05	0.02 05	0.246
H21K18P2NS	1990	45.7	1940	46.5	0.00 0559	7.51	39	0.00 324	0.2	5.42e -05	0.02 05	0.246
H21K05P4NN	1880	43.7	1830	43.9	0.00 0519	8.72	38.3	0.00 318	0.178	5.42e -05	0.02 05	0.246
H21K08P4NN	1890	43.6	1840	44.3	0.00 052	8.72	38.4	0.00 319	0.178	5.42e -05	0.02 05	0.246
H21K10P4NN	1900	43.9	1860	44.3	0.00 0529	8.72	38.4	0.00 319	0.178	5.42e -05	0.02 05	0.246
H21K12P4NN	1930	44.1	1870	45.1	0.00 0538	8.68	38.4	0.00 32	0.178	5.42e -05	0.02 05	0.246
H21K05P2NN C	1870	43.6	1830	44.1	0.00 0517	8.76	38.3	0.00 319	0.178	5.42e -05	0.02 05	0.246



H21K10P2NN C	1910	44.2	1860	44.7	0.00 0526	8.76	38.4	0.00 32	0.178	5.42e -05	0.02 05	0.246
H21K15P2NS C	1930	44.3	1880	45.4	0.00 0555	7.67	38.9	0.00 32	0.2	5.42e -05	0.02 05	0.246
H21K08P4NN C	1880	43.6	1830	43.9	0.00 0514	8.57	38	0.00 316	0.2	5.42e -05	0.02 05	0.246
H25CK15P1N SC	2130	49.9	2080	49.5	0.00 0561	8.24	39.8	0.00 338	0.194	5.42e -05	0.02 05	0.246
H25CK05P2N NC	2070	48.6	2030	48.2	0.00 0541	8.4	39.4	0.00 335	0.184	5.42e -05	0.02 05	0.246
H25CK08P2N NC	2060	48.5	2010	48	0.00 0541	8.44	39.4	0.00 334	0.184	5.42e -05	0.02 05	0.246
H25CK10P2N NC	2060	48	2010	47.7	0.00 0544	8.48	39.4	0.00 333	0.184	5.42e -05	0.02 05	0.246
H25CK12P2N SC	2130	49.7	2090	49.8	0.00 0566	8.37	40	0.00 34	0.189	5.42e -05	0.02 05	0.246
H25CK15P2N SC	2130	49.7	2090	50	0.00 0574	8.37	40	0.00 339	0.189	5.42e -05	0.02 05	0.246
H25CK18P2N SC	2170	50.2	2120	50.6	0.00 0585	8.33	40.2	0.00 341	0.189	5.42e -05	0.02 05	0.246
H25CK05P4N NC	2060	48.7	2020	48	0.00 053	8.14	39.2	0.00 333	0.178	5.42e -05	0.02 05	0.246
H25CK08P4N NC	2060	48.5	2010	47.8	0.00 0544	8.18	39.2	0.00 332	0.178	5.42e -05	0.02 05	0.246
H25CK10P4N NC	2100	48.9	2050	48.6	0.00 0545	8.14	39.4	0.00 335	0.178	5.42e -05	0.02 05	0.246
H25K15P1NS	2160	50.2	2110	50.3	0.00 0569	8.29	40	0.00 34	0.194	5.42e -05	0.02 05	0.246
H25K18P1NS	2180	50.3	2120	50.5	0.00 0579	8.29	40.1	0.00 34	0.194	5.42e -05	0.02 05	0.246
H25K02P2N N	2270	58.2	2210	50.8	0.00 042	8.69	31.4	0.00 311	0.116	5.42e -05	0.02 05	0.246
H25K08P2N N	2070	48.8	2020	48.1	0.00 0538	7.97	39	0.00 332	0.184	5.42e -05	0.02 05	0.246
H25K10P2NN	2080	48.9	2040	48.5	0.00 0543	7.97	39.1	0.00 333	0.184	5.42e -05	0.02 05	0.246
H25K12P2NS	2120	49.2	2070	49.4	0.00 0566	8.62	40.2	0.00 34	0.189	5.42e -05	0.02 05	0.246
H25K15P2NS	2120	49.1	2080	49.6	0.00 0571	8.66	40.2	0.00 339	0.189	5.42e -05	0.02 05	0.246
H25K18P2NS	2190	50.6	2130	50.9	0.00 0582	8.58	40.4	0.00 343	0.189	5.42e -05	0.02 05	0.246
H25K05P4N N	2060	48.6	2010	47.9	0.00 0536	8.05	39.1	0.00 333	0.178	5.42e -05	0.02 05	0.246
H25K08P4N N	2080	48.6	2030	48.1	0.00 054	8.05	39.2	0.00 333	0.178	5.42e -05	0.02 05	0.246
H25K10P4NN	2090	49	2040	48.6	0.00 0549	8.05	39.3	0.00 334	0.178	5.42e -05	0.02 05	0.246



Ready Mix 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 CO ₂ -Eq	kg CFC-11-Eq	kg NO _x -Eq	kg Sb-Eq	MJ, net calorific value
Minimum	34.4	0.0502	248	2.15e-05	0.54	0.00111	1960
Maximum	45.2	0.0591	363	2.34e-05	0.734	0.00152	2320
Mean	36.6	0.0526	270	2.24e-05	0.575	0.00119	2080
Median	36.4	0.0524	269	2.24e-05	0.572	0.00119	2080
ECOPACT30K12P1NSC	37.6	0.0544	277	2.34e-05	0.588	0.00124	2170
ECOPACT30K15P1NS	37.7	0.0546	278	2.34e-05	0.589	0.00124	2190
ECOPACT30K18P1NS	36.9	0.0537	270	2.31e-05	0.576	0.00121	2160
ECOPACT30K12P2NSC	37.6	0.0543	277	2.34e-05	0.588	0.00124	2170
ECOPACT30K15P2NSC	37.7	0.0545	278	2.34e-05	0.589	0.00124	2190
ECOPACT30K18P2NSC	36.9	0.0537	270	2.31e-05	0.576	0.00121	2150
ECOPACT30K8P4NNC	35.2	0.0511	256	2.2e-05	0.553	0.00114	2000
ECOPACT30K10P4NNC	34.4	0.0502	248	2.15e-05	0.54	0.00111	1960
ECOPACT30K10P4NNC-7D	37.9	0.0545	280	2.33e-05	0.593	0.00124	2160
H30K15P1NS	36.5	0.0524	269	2.24e-05	0.573	0.00119	2080
H30K18P1NS	36.6	0.0526	269	2.24e-05	0.574	0.0012	2100
H30K10P2NN	35.3	0.0508	258	2.17e-05	0.555	0.00114	1980
H30K12P2NS	36.4	0.0522	268	2.23e-05	0.572	0.00119	2060
H30K15P2NS	36.2	0.0521	265	2.22e-05	0.567	0.00118	2070
H30K18P2NS	36.7	0.0527	270	2.25e-05	0.575	0.0012	2100
H30K08P4NN	35.2	0.0507	258	2.17e-05	0.554	0.00114	1970
H30K10P4NN	35.3	0.0508	258	2.17e-05	0.555	0.00114	1980
H30CK12P1NSC	36.4	0.0524	269	2.24e-05	0.572	0.00119	2070
H30CK18P1NSC	36.7	0.0529	270	2.26e-05	0.576	0.0012	2110
H30CK08P2NNC	35.2	0.0508	258	2.17e-05	0.555	0.00114	1970
H30CK10P2NNC	35.3	0.0509	259	2.18e-05	0.556	0.00114	1990
H30CK12P2NSC	36.5	0.0525	269	2.25e-05	0.573	0.00119	2070
H30CK15P2NSC	36.7	0.0528	270	2.26e-05	0.575	0.0012	2100
H30CK18P2NSC	36.3	0.0525	266	2.24e-05	0.569	0.00119	2090
H30CK05P4NNC	35.2	0.0507	258	2.17e-05	0.554	0.00113	1960
H30CK08P4NNC	35.3	0.0508	258	2.17e-05	0.556	0.00114	1970
H30CK10P4NNC	35.4	0.051	259	2.18e-05	0.557	0.00114	1990
H30CK10P4NNC-7D	45.2	0.0591	363	2.32e-05	0.734	0.00152	2320



b) Inventory Metrics:

Indicator/LC I Metric	TPE	RE	NRE	NRR	RR	WDP	LFW	LFH W	CBW C	CW WC	CHW	CNH W
Unit	MJ-Eq	MJ-Eq	MJ-Eq	kg	m3	m3	kg waste	kg waste	m3	m3	kg	kg
Minimum	2170	50.4	2120	50.1	0.00047	7.77	31.4	0.00324	0.178	5.42e-05	0.0205	0.246
Maximum	2570	65.6	2510	57.3	0.000634	8.47	43	0.00369	0.194	5.42e-05	0.0205	0.246
Mean	2300	53.9	2240	53.1	0.000584	8.12	40.8	0.00352	0.186	5.42e-05	0.0205	0.246
Median	2300	53.8	2240	53.3	0.000586	8.07	40.7	0.00351	0.189	5.42e-05	0.0205	0.246
ECOPACT30 K12P1NSC	2400	55.9	2340	55.7	0.000619	8.35	43	0.00368	0.189	5.42e-05	0.0205	0.246
ECOPACT30 K15P1NS	2420	56	2360	56.1	0.000629	8.35	43	0.00369	0.189	5.42e-05	0.0205	0.246
ECOPACT30 K18P1NS	2380	54.9	2330	55.3	0.000634	8.39	42.8	0.00365	0.189	5.42e-05	0.0205	0.246
ECOPACT30 K12P2NSC	2400	55.8	2350	55.8	0.000622	8.26	42.9	0.00368	0.189	5.42e-05	0.0205	0.246
ECOPACT30 K15P2NSC	2420	55.9	2360	56	0.000634	8.26	43	0.00368	0.189	5.42e-05	0.0205	0.246
ECOPACT30 K18P2NSC	2370	55	2330	55.5	0.000634	8.3	42.8	0.00365	0.189	5.42e-05	0.0205	0.246
ECOPACT30 K8P4NNC	2200	51.5	2160	51.2	0.000567	8.02	41.1	0.0035	0.178	5.42e-05	0.0205	0.246
ECOPACT30 K10P4NNC	2170	50.4	2130	50.5	0.000573	8.06	40.5	0.00344	0.178	5.42e-05	0.0205	0.246
ECOPACT30 K10P4NNC-7D	2390	55.5	2340	55.3	0.000608	7.91	42.7	0.00367	0.178	5.42e-05	0.0205	0.246
H30K15P1NS	2310	54.1	2250	53.5	0.00059	8	40.5	0.0035	0.194	5.42e-05	0.0205	0.246
H30K18P1NS	2320	54.2	2270	53.7	0.000594	8	40.6	0.00351	0.194	5.42e-05	0.0205	0.246
H30K10P2NN	2200	51.7	2140	50.8	0.000556	7.81	39.9	0.00343	0.184	5.42e-05	0.0205	0.246
H30K12P2NS	2280	53.3	2230	52.7	0.000583	8.08	40.6	0.0035	0.189	5.42e-05	0.0205	0.246
H30K15P2NS	2280	53.4	2230	52.9	0.000589	8.12	40.6	0.0035	0.189	5.42e-05	0.0205	0.246
H30K18P2NS	2320	54.4	2270	53.8	0.000599	8.08	40.8	0.00352	0.189	5.42e-05	0.0205	0.246
H30K08P4NN	2180	51.6	2120	50.2	0.000557	7.77	39.9	0.00342	0.184	5.42e-05	0.0205	0.246
H30K10P4NN	2190	51.5	2140	50.7	0.000557	7.77	39.9	0.00343	0.184	5.42e-05	0.0205	0.246



H30CK12P1N SC	2300	53.6	2240	53.1	0.00 0584	8.43	40.9	0.00 353	0.194	5.42e -05	0.02 05	0.246
H30CK18P1N SC	2330	54.6	2280	54.1	0.00 0598	8.43	41.1	0.00 354	0.194	5.42e -05	0.02 05	0.246
H30CK08P2 NNC	2190	51.3	2140	50.5	0.00 0553	7.98	40.1	0.00 344	0.184	5.42e -05	0.02 05	0.246
H30CK10P2N NC	2200	51.8	2160	51.1	0.00 0561	7.98	40.1	0.00 344	0.184	5.42e -05	0.02 05	0.246
H30CK12P2N SC	2290	53.9	2240	53	0.00 0577	8.47	41	0.00 353	0.189	5.42e -05	0.02 05	0.246
H30CK15P2N SC	2320	54.2	2260	53.8	0.00 0599	8.47	41.1	0.00 355	0.189	5.42e -05	0.02 05	0.246
H30CK18P2N SC	2310	53.6	2260	53.6	0.00 0599	8.47	41	0.00 353	0.189	5.42e -05	0.02 05	0.246
H30CK05P4N NC	2170	51	2120	50.1	0.00 055	7.89	40	0.00 343	0.178	5.42e -05	0.02 05	0.246
H30CK08P4 NNC	2190	51.6	2130	50.7	0.00 0557	7.89	40.1	0.00 344	0.178	5.42e -05	0.02 05	0.246
H30CK10P4N NC	2200	51.7	2150	51	0.00 0562	7.89	40.1	0.00 344	0.178	5.42e -05	0.02 05	0.246
H30CK10P4N NC-7D	2570	65.6	2510	57.3	0.00 047	7.8	31.4	0.00 324	0.178	5.42e -05	0.02 05	0.246

Ready Mix 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
Minimum	38.2	0.0544	285	2.32e-05	0.599	0.00125	2140
Maximum	52.5	0.0682	431	2.68e-05	0.848	0.00182	2740
Mean	40.9	0.0577	310	2.45e-05	0.643	0.00136	2300
Median	40	0.057	302	2.43e-05	0.63	0.00133	2270
ECOPACT35K10P4NNC	42	0.0594	319	2.52e-05	0.659	0.00141	2380
ECOPACT35K15P1NS	41.8	0.0594	317	2.53e-05	0.654	0.00141	2400
ECOPACT35K12P2NS	40	0.0573	299	2.45e-05	0.625	0.00133	2300
H32K12P1NS	38.2	0.0544	286	2.32e-05	0.599	0.00126	2160
H32K10P4NN	38.2	0.0545	285	2.32e-05	0.602	0.00125	2140
H35K10P2NN	40	0.0567	303	2.41e-05	0.63	0.00133	2240
H35K15P2NS	40.8	0.0582	308	2.49e-05	0.639	0.00137	2350
H35K05P4NN	39.7	0.056	301	2.38e-05	0.626	0.00131	2200
H35K08P4NN	39.8	0.0562	301	2.39e-05	0.627	0.00132	2210
H35K10P4NN	39.9	0.0564	302	2.39e-05	0.629	0.00133	2230
H35CK15P1NSC	40.7	0.0581	307	2.48e-05	0.638	0.00136	2320
H35CK18P1NSC	41.1	0.0586	309	2.5e-05	0.642	0.00137	2370
H35CK10P2NNC	40	0.0565	302	2.4e-05	0.629	0.00133	2240



H35CK12P2NSC	40.7	0.0581	307	2.48e-05	0.638	0.00136	2320
H35CK15P2NSC	41	0.0584	308	2.5e-05	0.641	0.00137	2350
H35CK18P2NSC	41.1	0.0586	309	2.5e-05	0.642	0.00137	2370
H35CK05P4NNC	39.8	0.0562	301	2.39e-05	0.627	0.00132	2210
H35CK08P4NNC	39.9	0.0564	302	2.4e-05	0.629	0.00132	2220
H35CK10P4NNC	40	0.0566	302	2.4e-05	0.63	0.00133	2240
H35CK08P4-DNV	52.5	0.0682	431	2.68e-05	0.848	0.00182	2740

b) Inventory Metrics:

Indicator/LC I Metric	TPE	RE	NRE	NRR	RR	WDP	LFW	LFH W	CBW C	CW WC	CHW	CNH W
Unit	MJ-Eq	MJ-Eq	MJ-Eq	kg	m3	m3	kg waste	kg waste	m3	m3	kg	kg
Minimum	2370	56.2	2320	54.7	0.000552	6.89	35.4	0.00361	0.178	5.42e-05	0.0205	0.246
Maximum	3040	76.7	2960	68.1	0.00067	7.89	44.6	0.00389	0.2	5.42e-05	0.0205	0.246
Mean	2540	60.3	2490	58.6	0.000618	7.42	42.9	0.00376	0.182	5.42e-05	0.0205	0.246
Median	2520	59.2	2460	58	0.000605	7.48	42.5	0.00372	0.178	5.42e-05	0.0205	0.246
ECOPACT35 K10P4NNC	2630	62	2580	60.6	0.000644	6.99	44.5	0.00389	0.178	5.42e-05	0.0205	0.246
ECOPACT35 K15P1NS	2670	62.2	2600	61.5	0.000661	7.68	44.6	0.00389	0.189	5.42e-05	0.0205	0.246
ECOPACT35 K12P2NS	2560	59.2	2490	59	0.000647	7.89	44.2	0.00382	0.189	5.42e-05	0.0205	0.246
H32K12P1NS	2390	56.2	2340	55.2	0.000592	7.67	41.5	0.00361	0.2	5.42e-05	0.0205	0.246
H32K10P4NN	2370	56.3	2320	54.7	0.000587	7.74	41.7	0.00362	0.178	5.42e-05	0.0205	0.246
H35K10P2NN	2480	58.6	2430	57.1	0.000606	7.24	42.6	0.00372	0.184	5.42e-05	0.0205	0.246
H35K15P2NS	2590	60.7	2540	60	0.00065	7.76	44.3	0.00385	0.189	5.42e-05	0.0205	0.246
H35K05P4NN	2430	58.4	2380	56.1	0.000581	6.89	42.1	0.00368	0.184	5.42e-05	0.0205	0.246
H35K08P4NN	2450	58.5	2390	56.4	0.000592	6.89	42.1	0.00368	0.184	5.42e-05	0.0205	0.246
H35K10P4NN	2470	58.7	2400	56.9	0.000604	6.89	42.2	0.00369	0.184	5.42e-05	0.0205	0.246
H35CK15P1NSC	2560	60.3	2510	59.3	0.000635	7.88	44.4	0.00386	0.178	5.42e-05	0.0205	0.246
H35CK18P1NSC	2620	60.9	2560	60.3	0.000667	7.84	44.6	0.00387	0.178	5.42e-05	0.0205	0.246
H35CK10P2NNC	2480	59	2410	56.9	6e-04	7.07	42.4	0.0037	0.184	5.42e-05	0.0205	0.246
H35CK12P2NNC	2570	60.5	2510	59.1	0.000634	7.88	44.4	0.00386	0.178	5.42e-05	0.0205	0.246



H35CK15P2N SC	2600	60.6	2540	60.1	0.00 0658	7.88	44.5	0.00 387	0.178	5.42e -05	0.02 05	0.246
H35CK18P2N SC	2620	61.2	2560	60.4	0.00 067	7.88	44.6	0.00 388	0.178	5.42e -05	0.02 05	0.246
H35CK05P4N NC	2440	58.1	2380	56	0.00 0581	7.02	42.3	0.00 369	0.178	5.42e -05	0.02 05	0.246
H35CK08P4N NC	2450	58.2	2400	56.6	0.00 0589	7.02	42.3	0.00 37	0.178	5.42e -05	0.02 05	0.246
H35CK10P4N NC	2480	59.1	2420	56.8	0.00 0602	7.02	42.4	0.00 371	0.178	5.42e -05	0.02 05	0.246
H35CK08P4- DNV	3040	76.7	2960	68.1	0.00 0552	7.28	35.4	0.00 368	0.178	5.42e -05	0.02 05	0.246

Ready Mix 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 CO ₂ - Eq	kg CFC- 11-Eq	kg NO _x - Eq	kg Sb-Eq	MJ, net calorific value
Minimum	41.1	0.0582	313	2.49e-05	0.646	0.00137	2290
Maximum	42.8	0.0606	326	2.58e-05	0.669	0.00145	2460
Mean	42	0.0595	320	2.54e-05	0.659	0.00141	2380
Median	42.1	0.0596	322	2.54e-05	0.661	0.00141	2370
H38K08P2NN	41.1	0.0583	313	2.49e-05	0.647	0.00137	2310
H38K12P2NS	41.7	0.0594	317	2.54e-05	0.653	0.0014	2380
H38K15P2NS	42	0.0598	318	2.56e-05	0.656	0.00141	2420
H38K05P4NN	41.1	0.0582	313	2.49e-05	0.646	0.00137	2290
H40CK10P2NNC	42.2	0.0596	322	2.54e-05	0.663	0.00141	2370
H40CK12P2NSC	42.4	0.06	324	2.55e-05	0.665	0.00143	2410
H40CK15P2NSC	42.7	0.0604	325	2.57e-05	0.668	0.00144	2440
H40CK18P2NSC	42.8	0.0606	326	2.58e-05	0.669	0.00145	2460
H40CK05P4NNC	42	0.0592	321	2.53e-05	0.66	0.0014	2340
H40CK08P4NNC	42.1	0.0594	322	2.53e-05	0.661	0.00141	2360
H40CK10P4NNC	42.2	0.0596	322	2.54e-05	0.663	0.00142	2370



b) Inventory Metrics:

Indicator/LC I Metric	TPE	RE	NRE	NRR	RR	WDP	LFW	LFH W	CBW C	CW WC	CHW	CNH W
Unit	MJ-Eq	MJ-Eq	MJ-Eq	kg	m3	m3	kg waste	kg waste	m3	m3	kg	kg
Minimum	2550	60.2	2480	58.5	0.000611	6.82	44.1	0.00384	0.178	5.42e-05	0.0205	0.246
Maximum	2740	63.8	2660	62.8	0.000674	8.03	45.4	0.00396	0.189	5.42e-05	0.0205	0.246
Mean	2630	62	2570	60.7	0.000639	7.18	44.8	0.00391	0.186	5.42e-05	0.0205	0.246
Median	2630	62.2	2570	60.6	0.000634	7.05	44.7	0.00391	0.184	5.42e-05	0.0205	0.246
H38K08P2NN	2550	60.4	2490	59	0.000611	7.07	44.1	0.00384	0.184	5.42e-05	0.0205	0.246
H38K12P2NS	2640	61.6	2580	60.9	0.000648	8.02	45.3	0.00394	0.189	5.42e-05	0.0205	0.246
H38K15P2NS	2670	62.4	2610	61.9	0.000661	8.03	45.4	0.00396	0.189	5.42e-05	0.0205	0.246
H38K05P4NN	2550	60.2	2480	58.5	0.000611	7.15	44.2	0.00385	0.178	5.42e-05	0.0205	0.246
H40CK10P2NNC	2620	62.2	2570	60.4	0.000634	6.82	44.6	0.0039	0.184	5.42e-05	0.0205	0.246
H40CK12P2NSC	2670	62.8	2610	61.5	0.000652	7.04	44.9	0.00393	0.189	5.42e-05	0.0205	0.246
H40CK15P2NSC	2710	63.4	2640	62.4	0.000657	7.05	45.1	0.00394	0.189	5.42e-05	0.0205	0.246
H40CK18P2NSC	2740	63.8	2660	62.8	0.000674	7.05	45.2	0.00395	0.189	5.42e-05	0.0205	0.246
H40CK05P4NNC	2580	61.1	2530	59.5	0.000617	6.91	44.6	0.00389	0.184	5.42e-05	0.0205	0.246
H40CK08P4NNC	2610	61.8	2550	60	0.00063	6.91	44.6	0.0039	0.184	5.42e-05	0.0205	0.246
H40CK10P4NNC	2630	62.3	2550	60.6	0.00063	6.91	44.7	0.00391	0.184	5.42e-05	0.0205	0.246



Ready Mix 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 CO ₂ -Eq	kg CFC-11-Eq	kg NO _x -Eq	kg Sb-Eq	MJ, net calorific value
H42K15P2NS	43.6	0.0615	333	2.61e-05	0.683	0.00148	2490

b) Inventory Metrics:

Indicator/LCI Metric	TPE	RE	NRE	NRR	RR	WDP	LFW	LFHW	CBWC	CWWC	CHW	CNH
Unit	MJ-Eq	MJ-Eq	MJ-Eq	kg	m3	m3	kg waste	kg waste	m3	m3	kg	kg
H42K15P2NS	2760	64.7	2690	63.7	0.000671	7	45.4	0.00399	0.184	5.42e-05	0.0205	0.246

Ready Mix 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 CO ₂ -Eq	kg CFC-11-Eq	kg NO _x -Eq	kg Sb-Eq	MJ, net calorific value
H47K10P4NN	45.8	0.0643	352	2.72e-05	0.717	0.00156	2610

b) Inventory Metrics:

Indicator/LCI Metric	TPE	RE	NRE	NRR	RR	WDP	LFW	LFHW	CBWC	CWWC	CHW	CNH
Unit	MJ-Eq	MJ-Eq	MJ-Eq	kg	m3	m3	kg waste	kg waste	m3	m3	kg	kg
H47K10P4NN	2890	68.2	2810	66.5	0.000699	6.74	46.9	0.00414	0.168	5.42e-05	0.0205	0.246



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>.

