

Environmental Product Declaration



Environmental Product Declaration for various ready mix concrete products produced by Holcim Argentina at their KHP2 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)
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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 KHP2-Planta Norte 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	Ho80Ko8P2NN	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	H ₂ O 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	H ₂ O 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	H2O 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	H2O 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:

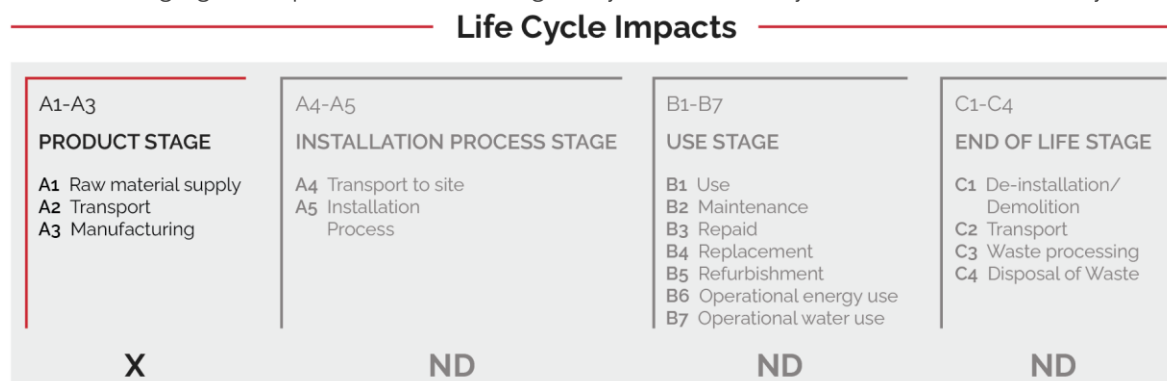


Figure 1: General life cycle phases for consideration in a construction works system

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.

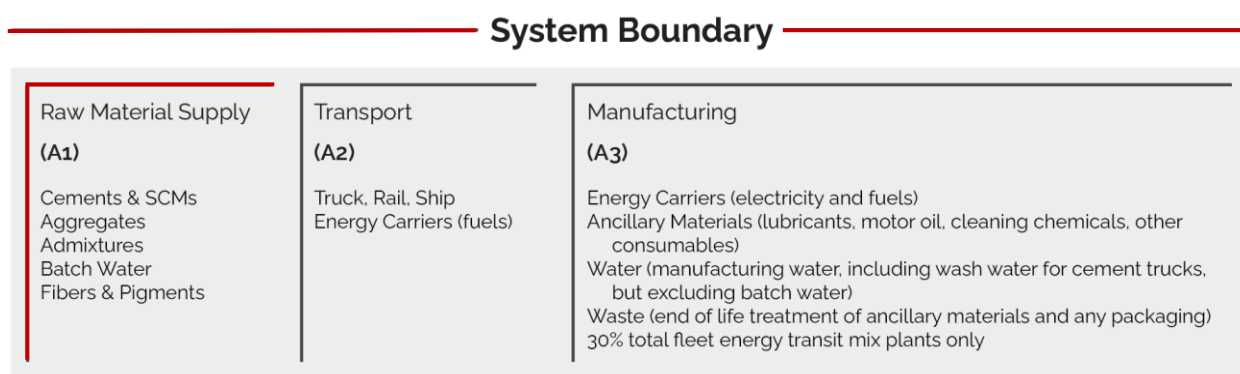


Figure 2: General system inputs considered in the product system and categorized by modules in scope

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 KHP2 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	Cordoba	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 11: 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 CO2-Eq	kg CFC-11-Eq	kg NOx-Eq	kg Sb-Eq	MJ, net calorific value
Minimum	24.1	0.038	155	1.64e-05	0.378	0.000703	1390
Maximum	34.3	0.0477	259	1.92e-05	0.554	0.00111	1810
Mean	26	0.0405	172	1.75e-05	0.407	0.000779	1500
Median	26.2	0.041	174	1.79e-05	0.412	0.000787	1530
ECOPACT8K10P2NN	24.3	0.0383	156	1.65e-05	0.38	0.000713	1410
ECOPACT13K5P4NN	26	0.041	169	1.79e-05	0.404	0.000775	1520
ECOPACT13K5P2NN	26.7	0.0419	177	1.82e-05	0.417	0.000807	1560
ECOPACT13K8P2NN	26.8	0.0419	178	1.82e-05	0.417	0.00081	1570
ECOPACT13K8P4NN	26.8	0.0419	178	1.82e-05	0.417	0.00081	1570
ECOPACT13K10P4NN	26.8	0.0421	178	1.83e-05	0.417	0.000816	1580
ECOPACT13K10P2NN	26	0.041	170	1.79e-05	0.403	0.000781	1540
H08K08P2NN	24.1	0.038	155	1.64e-05	0.378	0.000706	1390
H08K10P2NN	26	0.0394	175	1.66e-05	0.413	0.00078	1450
H08K10-DNV	34.3	0.0477	259	1.92e-05	0.554	0.00111	1810
H08K10P4NN	24.2	0.0381	155	1.64e-05	0.378	0.000707	1400
H08K10P4NNC	24.1	0.0381	156	1.64e-05	0.378	0.00071	1400
H10CK08P2NNC	24.1	0.038	155	1.64e-05	0.378	0.000706	1390
H10CK10P2NNC	24.2	0.0381	155	1.64e-05	0.378	0.000708	1400
H10CK05P4NNC	24.1	0.038	155	1.64e-05	0.378	0.000703	1390
H10CK08P4NNC	24.1	0.038	155	1.64e-05	0.378	0.000706	1390
H10CK10P4NNC	24.2	0.0381	155	1.64e-05	0.379	0.000708	1400
H13K08P2NN	26.7	0.0417	177	1.82e-05	0.415	0.000806	1560
H13K10P2NN	26.7	0.0418	177	1.82e-05	0.416	0.000809	1570
H13K12P2NS	27	0.0425	179	1.85e-05	0.42	0.000822	1600
H13K05P4NN	26.7	0.0419	177	1.82e-05	0.417	0.000806	1560
H13K08P4NN	26.7	0.0417	177	1.82e-05	0.415	0.000806	1560
H13K10P4NN	26.7	0.0418	177	1.82e-05	0.416	0.000809	1570
H13K10P4NNC	26.3	0.0409	174	1.76e-05	0.411	0.000793	1520



b) Inventory Metrics:

Indicator/LCI Metric	TPE	RE	NRE	NR	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
Minimum	1520	347	1490	364	0.00044	8.5	32.4	0.00277	0.178	4.6e-05	0.445	0.443
Maximum	2000	495	1940	457	0.000541	9.68	41.5	0.00318	0.2	4.6e-05	0.445	0.443
Mean	1650	378	1620	395	0.000499	9.14	38.7	0.00299	0.188	4.6e-05	0.445	0.443
Median	1690	381	1640	404	0.000511	9.16	39.7	0.00304	0.189	4.6e-05	0.445	0.443
ECOPACT8K10P2NN	1550	352	1520	372	0.000495	9.23	37.1	0.00285	0.189	4.6e-05	0.445	0.443
ECOPACT13K5P4NN	1680	378	1640	402	0.000518	9.23	40.7	0.0031	0.178	4.6e-05	0.445	0.443
ECOPACT13K5P2NN	1720	388	1680	41	0.000521	9.11	40.7	0.00312	0.178	4.6e-05	0.445	0.443
ECOPACT13K8P2NN	1720	389	1690	41.1	0.000524	9.07	40.7	0.00312	0.184	4.6e-05	0.445	0.443
ECOPACT13K8P4NN	1720	391	1690	41.3	0.000521	9.07	40.7	0.00312	0.184	4.6e-05	0.445	0.443
ECOPACT13K10P4NN	1740	393	1700	416	0.000532	9.07	40.8	0.00313	0.189	4.6e-05	0.445	0.443
ECOPACT13K10P2NN	1700	379	1650	406	0.000524	9.16	40.5	0.00309	0.189	4.6e-05	0.445	0.443
H08K08P2NN	1530	35	1490	366	0.000472	9.23	37	0.00284	0.189	4.6e-05	0.445	0.443
H08K10P2NN	1600	378	1560	377	0.000447	9.24	34.7	0.00277	0.189	4.6e-05	0.445	0.443
H08K10-DNV	2000	495	1940	457	0.00044	8.5	32.4	0.00289	0.189	4.6e-05	0.445	0.443
H08K10P4NN	1530	35	1500	367	0.000471	9.19	37	0.00283	0.189	4.6e-05	0.445	0.443
H08K10P4NNC	1540	35	1500	368	0.000483	8.98	37.2	0.00284	0.2	4.6e-05	0.445	0.443
H10CK08P2NNC	1530	35	1500	366	0.000471	9.23	37	0.00284	0.189	4.6e-05	0.445	0.443
H10CK10P2NNC	1540	35	1500	368	0.000473	9.23	37.1	0.00284	0.189	4.6e-05	0.445	0.443
H10CK05P4NNC	1520	347	1490	364	0.000472	9.23	37	0.00284	0.189	4.6e-05	0.445	0.443
H10CK08P4NNC	1530	35	1490	366	0.000474	9.23	37.1	0.00284	0.189	4.6e-05	0.445	0.443
H10CK10P4NNC	1540	351	1510	369	0.000471	9.23	37.1	0.00284	0.189	4.6e-05	0.445	0.443
H13K08P2NN	1710	389	1670	409	0.000526	9.07	40.6	0.00312	0.189	4.6e-05	0.445	0.443



H13K10P2NN	172 0	39	168 0	41.1	0.0005 23	9.07	40.7	0.0031 2	0.189	4.6e- 05	0.44 5	0.443
H13K12P2NS	176 0	39. 7	172 0	42. 2	0.0005 41	9.6 8	41.5	0.0031 8	0.189	4.6e- 05	0.44 5	0.443
H13K05P4NN	171 0	38. 9	167 0	40. 9	0.0005 18	9.15	40.9	0.0031 3	0.178	4.6e- 05	0.44 5	0.443
H13K08P4NN	171 0	38. 8	167 0	40. 9	0.0005 21	9.07	40.6	0.0031 2	0.189	4.6e- 05	0.44 5	0.443
H13K10P4NN	172 0	39	169 0	41.1	0.0005 25	9.07	40.7	0.0031 2	0.189	4.6e- 05	0.44 5	0.443
H13K10P4NNC	167 0	38. 3	163 0	40	0.0005 04	8.9	38.9	0.003	0.189	4.6e- 05	0.44 5	0.443

Ready Mix 15 to 20 MPa

Table 12: **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	27	0.042	180	1.82e-05	0.421	0.000818	1560
Maximum	31.5	0.0475	226	2.04e-05	0.499	0.001	1840
Mean	29.2	0.0447	201	1.92e-05	0.456	0.000911	1700
Median	29.4	0.0451	203	1.93e-05	0.46	0.000924	1720
ECOPACT15K15P2NS	28.8	0.044	197	1.87e-05	0.449	9e-04	1680
ECOPACT15K12P2NSC	28.8	0.0439	197	1.87e-05	0.449	0.000897	1670
ECOPACT17K10P2NN	29.7	0.0455	204	1.96e-05	0.462	0.000928	1740
ECOPACT17K10P4NN	29.3	0.0452	201	1.95e-05	0.456	0.000913	1720
ECOPACT17K12P2NS	29.5	0.0451	203	1.93e-05	0.459	0.000926	1730
ECOPACT17K15P2NS	29.6	0.0452	203	1.93e-05	0.46	0.00093	1740
ECOPACT20K10P4NNC	30.4	0.0461	211	1.98e-05	0.475	0.000954	1760
ECOPACT20K12P2NSC	29.4	0.0448	202	1.91e-05	0.458	0.000921	1710
H15CK08P2NNC	27.1	0.0422	181	1.84e-05	0.422	0.000823	1580
H15CK10P2NNC	27.1	0.0423	182	1.84e-05	0.423	0.000827	1590
H15CK12P2NSC	28.3	0.0439	191	1.9e-05	0.439	0.000875	1660
H15CK15P2NSC	28.5	0.0441	192	1.9e-05	0.441	0.000882	1680
H15CK05P4NNC	27	0.042	180	1.82e-05	0.421	0.000818	1560
H15CK08P4NNC	27	0.0421	181	1.83e-05	0.421	0.000821	1570
H15CK10P4NNC	27.1	0.0422	181	1.83e-05	0.422	0.000824	1580
H17K15P1NS	29.4	0.0451	203	1.95e-05	0.46	0.00092	1720
H17K18P1NS	29.6	0.0453	204	1.95e-05	0.461	0.000927	1740
H17K08P2NN	28.3	0.0435	193	1.88e-05	0.442	0.000872	1640
H17K10P2NN	31.4	0.0457	226	1.9e-05	0.499	0.000993	1730
H17K12P2NS	29.6	0.0454	204	1.95e-05	0.461	0.000927	1730
H17K15P2NS	29.8	0.0456	205	1.96e-05	0.462	0.000934	1750
H17K18P2NS	29.9	0.0457	205	1.97e-05	0.463	0.000938	1760



H17K05P4NN	28.4	0.0437	194	1.89e-05	0.444	0.000872	1640
H17K08P4NN	28.5	0.0438	194	1.89e-05	0.445	0.000876	1650
H17K10P4NN	28.5	0.0439	194	1.9e-05	0.445	0.000879	1650
H17K15P2NSC	28.7	0.0442	195	1.9e-05	0.445	0.000896	1690
H20CK08P2NNC	30.1	0.0456	210	1.96e-05	0.471	0.000942	1730
H20CK10P2NNC	30.1	0.0457	210	1.96e-05	0.472	0.000945	1730
H20CK12P2NSC	31.2	0.0472	220	2.03e-05	0.488	0.00099	1810
H20CK15P2NSC	31.4	0.0474	221	2.03e-05	0.49	0.000998	1830
H20CK18P2NSC	31.5	0.0475	221	2.04e-05	0.491	0.001	1840
H20CK05P4NNC	30	0.0455	210	1.96e-05	0.471	0.000938	1720
H20CK08P4NNC	30.1	0.0457	210	1.96e-05	0.472	0.000942	1730
H20CK10P4NNC	30.2	0.0458	211	1.97e-05	0.473	0.000946	1740

b) Inventory Metrics:

Indicator/LCI Metric	TP E	RE	NR E	NR R	RR	WD P	LFW	LFHW	CBW C	CW WC	CH W	CNH W
Unit	MJ-Eq	MJ-Eq	MJ-Eq	kg	m3	m3	kg waste	kg waste	m3	m3	kg	kg
Minimum	1720	39.1	1680	41	0.000483	7.47	36.7	0.00303	0.178	4.6e-05	0.445	0.443
Maximum	2020	46.4	1990	47.9	0.000583	9.14	42.3	0.00335	0.2	4.6e-05	0.445	0.443
Mean	1870	42.8	1830	44.3	0.000544	8.49	41.2	0.00322	0.186	4.6e-05	0.445	0.443
Median	1890	43.3	1850	44.8	0.000544	8.65	41.3	0.00322	0.189	4.6e-05	0.445	0.443
ECOPACT15K15P2NS	1850	42.5	1810	43.8	0.000542	7.67	39.9	0.00312	0.189	4.6e-05	0.445	0.443
ECOPACT15K12P2NSC	1830	42.2	1790	43.6	0.000536	7.71	39.9	0.00312	0.189	4.6e-05	0.445	0.443
ECOPACT17K10P2NN	1910	43.4	1860	45.4	0.000556	8.61	42.2	0.00329	0.184	4.6e-05	0.445	0.443
ECOPACT17K10P4NN	1890	42.8	1850	45.1	0.000552	8.78	42.3	0.00329	0.178	4.6e-05	0.445	0.443
ECOPACT17K12P2NS	1900	43.4	1850	45	0.000558	7.8	41.2	0.00322	0.189	4.6e-05	0.445	0.443
ECOPACT17K15P2NS	1910	43.8	1870	45.2	0.000567	7.81	41.3	0.00322	0.189	4.6e-05	0.445	0.443
ECOPACT20K10P4NNC	1940	44.3	1890	45.8	0.000551	8.74	41.6	0.00328	0.178	4.6e-05	0.445	0.443
ECOPACT20K12P2NSC	1880	43.2	1840	44.7	0.000552	7.8	40.7	0.00318	0.189	4.6e-05	0.445	0.443
H15CK08P2NNC	1740	39.7	1700	41.6	0.00052	9.08	40.8	0.00313	0.189	4.6e-05	0.445	0.443
H15CK10P2NNC	1750	39.5	1710	41.7	0.000529	9.08	40.8	0.00314	0.189	4.6e-05	0.445	0.443
H15CK12P2NSC	1820	41.4	1790	43.6	0.000549	7.71	41.8	0.00321	0.189	4.6e-05	0.445	0.443



H15CK15P2NSC	185 0	41. 9	180 0	43. 9	0.0005 58	7.71	41.9	0.003 22	0.189	4.6e- 05	0.44 5	0.443
H15CK05P4NNC	172 0	39. 1	168 0	41	0.0005 15	8.82	40.4	0.003 11	0.189	4.6e- 05	0.44 5	0.443
H15CK08P4NNC	173 0	39. 2	169 0	41. 2	0.0005 18	8.82	40.5	0.003 11	0.189	4.6e- 05	0.44 5	0.443
H15CK10P4NNC	173 0	39. 5	170 0	41. 3	0.0005 23	8.82	40.5	0.003 12	0.189	4.6e- 05	0.44 5	0.443
H17K15P1NS	189 0	43. 1	185 0	44. 9	0.0005 47	9.0 9	41.6	0.003 25	0.189	4.6e- 05	0.44 5	0.443
H17K18P1NS	192 0	43. 5	187 0	45. 5	0.0005 63	9.0 9	41.7	0.003 26	0.189	4.6e- 05	0.44 5	0.443
H17K08P2NN	181 0	41. 4	176 0	42. 8	0.0005 26	8.6 5	40.7	0.003 17	0.184	4.6e- 05	0.44 5	0.443
H17K10P2NN	190 0	45. 5	186 0	44. 4	0.0004 83	8.57	36.7	0.003 03	0.184	4.6e- 05	0.44 5	0.443
H17K12P2NS	190 0	43. 4	186 0	45. 2	0.0005 61	7.8	42.1	0.003 27	0.189	4.6e- 05	0.44 5	0.443
H17K15P2NS	192 0	43. 8	188 0	45. 5	0.0005 66	7.81	42.2	0.003 28	0.189	4.6e- 05	0.44 5	0.443
H17K18P2NS	193 0	43. 8	189 0	46	0.0005 74	7.81	42.3	0.003 29	0.189	4.6e- 05	0.44 5	0.443
H17K05P4NN	180 0	41. 3	176 0	42. 7	0.0005 25	8.9 4	41.1	0.003 19	0.178	4.6e- 05	0.44 5	0.443
H17K08P4NN	181 0	41. 4	177 0	43	0.0005 32	8.9 4	41.1	0.003 2	0.178	4.6e- 05	0.44 5	0.443
H17K10P4NN	182 0	41. 5	178 0	43. 2	0.0005 35	8.9 4	41.2	0.003 2	0.178	4.6e- 05	0.44 5	0.443
H17K15P2NSC	185 0	42. 4	182 0	44. 3	0.0005 55	7.47	41.4	0.003 2	0.2	4.6e- 05	0.44 5	0.443
H20CK08P2NNC	190 0	43. 9	185 0	44. 8	0.0005 37	8.7	41.4	0.003 26	0.184	4.6e- 05	0.44 5	0.443
H20CK10P2NNC	190 0	43. 9	186 0	45. 1	0.0005 38	8.61	41.3	0.003 25	0.184	4.6e- 05	0.44 5	0.443
H20CK12P2NSC	199 0	46	195 0	47. 2	0.0005 58	9.14	42.1	0.003 34	0.189	4.6e- 05	0.44 5	0.443
H20CK15P2NSC	202 0	46. 1	196 0	47. 6	0.0005 76	9.14	42.2	0.003 35	0.189	4.6e- 05	0.44 5	0.443
H20CK18P2NSC	202 0	46. 4	199 0	47. 9	0.0005 83	9.14	42.3	0.003 35	0.189	4.6e- 05	0.44 5	0.443
H20CK05P4NNC	189 0	43. 4	184 0	44. 6	0.0005 3	8.6 5	41.3	0.003 25	0.178	4.6e- 05	0.44 5	0.443
H20CK08P4NNC	190 0	44	186 0	44. 9	0.0005 35	8.6 5	41.4	0.003 26	0.178	4.6e- 05	0.44 5	0.443
H20CK10P4NNC	191 0	44. 3	187 0	45. 3	0.0005 41	8.6 5	41.4	0.003 26	0.178	4.6e- 05	0.44 5	0.443



Ready Mix 21 to 25 MPa

Table 13: 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 CO ₂ -Eq	kg CFC-11-Eq	kg NO _x -Eq	kg Sb-Eq	MJ, net calorific value
Minimum	30.4	0.0465	210	2.02e-05	0.474	0.000958	1770
Maximum	41.4	0.0561	326	2.32e-05	0.673	0.00136	2130
Mean	33	0.0497	236	2.14e-05	0.515	0.00106	1920
Median	33.7	0.0504	241	2.17e-05	0.524	0.00109	1940
ECOPACT21K15P2NSC	32.6	0.0491	231	2.1e-05	0.507	0.00105	1920
ECOPACT21K15P1NS	32.7	0.0494	233	2.13e-05	0.508	0.00106	1930
ECOPACT21K15P2NS	31.3	0.0476	219	2.05e-05	0.486	0.000999	1850
ECOPACT21K18P2NS	32	0.0482	226	2.06e-05	0.497	0.00103	1880
ECOPACT21K18P1NS	32.3	0.049	229	2.11e-05	0.502	0.00104	1920
ECOPACT21K12P2NS	31.2	0.0475	219	2.05e-05	0.485	0.000995	1840
ECOPACT21K10P2NN	30.5	0.0474	210	2.08e-05	0.474	0.000958	1820
ECOPACT21K08P2NN	30.7	0.0469	214	2.03e-05	0.478	0.000967	1790
ECOPACT21K10P4NN	30.9	0.0472	215	2.04e-05	0.48	0.000975	1810
ECOPACT25K10P2NNC	33.7	0.0506	241	2.18e-05	0.524	0.00109	1970
ECOPACT25K8P2NNC	33	0.0498	236	2.15e-05	0.515	0.00106	1920
ECOPACT25K5P4NNC	35	0.0519	256	2.22e-05	0.549	0.00114	2000
ECOPACT25K8P4NNC	35.1	0.052	256	2.23e-05	0.549	0.00114	2010
ECOPACT25K10P4NNC	34	0.0508	244	2.18e-05	0.53	0.0011	1970
ECOPACT25K12P2NSC	35	0.0527	253	2.28e-05	0.545	0.00114	2070
ECOPACT25K15P2NSC	36	0.0538	262	2.32e-05	0.56	0.00118	2130
ECOPACT25K18P2NSC	34.7	0.0518	250	2.22e-05	0.54	0.00113	2040
ECOPACT25K15P1NSC	35.5	0.0527	258	2.25e-05	0.553	0.00117	2080
ECOPACT25K18P1NS	35.6	0.0528	259	2.26e-05	0.554	0.00117	2090
H21K12P1NS	31.4	0.0476	222	2.05e-05	0.489	0.001	1840
H21K15P1NS	31.6	0.0479	223	2.06e-05	0.491	0.00101	1860
H21K18P1NS	31.7	0.048	223	2.06e-05	0.492	0.00102	1870
H21K05P2NN	30.5	0.0466	213	2.02e-05	0.476	0.000959	1770
H21K08P2NN	30.6	0.0467	214	2.03e-05	0.477	0.000963	1780
H21K10P2NN	30.7	0.0469	214	2.03e-05	0.478	0.000967	1790
H21K12P2NS	30.8	0.0471	215	2.04e-05	0.477	0.000977	1810
H21K15P2NS	31.5	0.048	220	2.08e-05	0.487	0.00101	1860
H21K18P2NS	31.5	0.0481	220	2.08e-05	0.488	0.00101	1870
H21K05P4NN	30.6	0.0468	214	2.03e-05	0.478	0.000961	1770
H21K08P4NN	30.7	0.0469	214	2.03e-05	0.478	0.000965	1780
H21K10P4NN	30.8	0.0471	214	2.04e-05	0.479	0.000969	1800
H21K12P4NN	30.9	0.0473	215	2.04e-05	0.481	0.000976	1810
H21K05P2NNC	30.6	0.0468	214	2.03e-05	0.478	0.000962	1780
H21K10P2NNC	30.8	0.0471	215	2.04e-05	0.479	0.00097	1800
H21K15P2NSC	30.7	0.0471	212	2.04e-05	0.474	0.000974	1830
H21K08P4NNC	30.4	0.0465	213	2.02e-05	0.474	0.000961	1770



H25CK15P1NSC	34.4	0.0514	249	2.21e-05	0.536	0.00112	2000
H25CK05P2NNC	34.1	0.0508	247	2.19e-05	0.533	0.0011	1950
H25CK08P2NNC	33.7	0.0504	244	2.17e-05	0.527	0.00109	1940
H25CK10P2NNC	33.4	0.0501	240	2.16e-05	0.521	0.00107	1930
H25CK12P2NSC	34.5	0.0516	250	2.22e-05	0.538	0.00112	2010
H25CK15P2NSC	34.2	0.0513	246	2.21e-05	0.532	0.00111	2010
H25CK18P2NSC	34.8	0.052	251	2.23e-05	0.54	0.00114	2050
H25CK05P4NNC	34.1	0.0507	247	2.18e-05	0.533	0.0011	1940
H25CK08P4NNC	33.7	0.0504	243	2.17e-05	0.527	0.00109	1940
H25CK10P4NNC	34.2	0.051	248	2.19e-05	0.535	0.00111	1970
H25K15P1NS	34.6	0.0517	250	2.22e-05	0.538	0.00113	2030
H25K18P1NS	34.7	0.0519	251	2.23e-05	0.539	0.00113	2040
H25K02P2NN	41.4	0.0561	326	2.24e-05	0.673	0.00136	2100
H25K08P2NN	34	0.0506	247	2.17e-05	0.532	0.0011	1950
H25K10P2NN	34.1	0.0508	247	2.18e-05	0.533	0.0011	1960
H25K12P2NS	34.1	0.0512	246	2.21e-05	0.531	0.00111	2000
H25K15P2NS	33.9	0.051	243	2.2e-05	0.527	0.0011	2000
H25K18P2NS	34.8	0.0522	251	2.24e-05	0.542	0.00114	2060
H25K05P4NN	34	0.0506	247	2.17e-05	0.533	0.0011	1940
H25K08P4NN	34.1	0.0508	247	2.18e-05	0.534	0.0011	1950
H25K10P4NN	34.2	0.051	248	2.18e-05	0.535	0.00111	1970

b) Inventory Metrics:

Indicator/LCI Metric	TPE	RE	NRE	NR	RR	WDP	LFW	LFH	CBW	CW	CH	CNH
	Eq	Eq	Eq	kg	m3	m3	kg waste	kg waste	m3	m3	kg	kg
Unit	MJ-Eq	MJ-Eq	MJ-Eq	kg	m3	m3	kg waste	kg waste	m3	m3	kg	kg
Minimum	1950	44.6	1900	46.1	0.000452	7.53	35.3	0.00328	0.116	4.6e-05	0.445	0.443
Maximum	2340	59.1	2290	55.2	0.000651	10.4	47.1	0.00377	0.2	4.6e-05	0.445	0.443
Mean	2120	48.6	2070	49.9	0.00059	8.43	44.3	0.00351	0.186	4.6e-05	0.445	0.443
Median	2140	49.4	2090	50.2	0.000591	8.38	44.4	0.00354	0.184	4.6e-05	0.445	0.443
ECOPACT21K15P2NSC	2100	48.3	2060	49.7	0.000598	8.22	43.6	0.00345	0.2	4.6e-05	0.445	0.443
ECOPACT21K15P1NS	2130	48.4	2080	50.3	0.000603	8.73	44.1	0.00349	0.2	4.6e-05	0.445	0.443
ECOPACT21K15P2NS	2040	46.2	2000	48.3	0.000594	8.38	43.4	0.0034	0.2	4.6e-05	0.445	0.443
ECOPACT21K18P2NS	2070	47.4	2030	49	0.000595	7.57	42.7	0.00337	0.2	4.6e-05	0.445	0.443
ECOPACT21K18P1NS	2110	47.9	2070	50.1	0.000605	8.77	44.1	0.00348	0.2	4.6e-05	0.445	0.443
ECOPACT21K12P2NS	2030	46.3	1980	47.9	0.000587	8.38	43.3	0.00339	0.2	4.6e-05	0.445	0.443
ECOPACT21K10P2NN	2010	45	1960	47.8	6e-04	10.4	45.4	0.00352	0.178	4.6e-05	0.445	0.443



ECOPACT21K08P2NN	1970	44.9	1920	46.6	0.000564	8.61	43.5	0.0034	0.178	4.6e-05	0.445	0.443
ECOPACT21K10P4NN	1990	45.4	1950	47.3	0.000579	8.57	43.6	0.0034	0.178	4.6e-05	0.445	0.443
ECOPACT25K10P2NNC	2170	49.6	2120	51.1	0.000606	8.34	45.1	0.00357	0.184	4.6e-05	0.445	0.443
ECOPACT25K8P2NNC	2110	48.7	2060	49.9	0.000591	8.29	44.8	0.00354	0.184	4.6e-05	0.445	0.443
ECOPACT25K5P4NNC	2210	51.4	2160	51.7	0.00059	8.16	44.9	0.0036	0.178	4.6e-05	0.445	0.443
ECOPACT25K8P4NNC	2220	51.7	2170	52	0.000588	8.12	44.8	0.0036	0.178	4.6e-05	0.445	0.443
ECOPACT25K10P4NNC	2170	50	2110	51.3	0.000593	8.2	44.7	0.00356	0.178	4.6e-05	0.445	0.443
ECOPACT25K12P2NSC	2280	51.9	2230	53.7	0.000631	9.98	46.9	0.00373	0.189	4.6e-05	0.445	0.443
ECOPACT25K15P2NSC	2340	53.5	2290	55.2	0.000651	9.94	47.1	0.00377	0.189	4.6e-05	0.445	0.443
ECOPACT25K18P2NSC	2250	51.3	2200	53	0.000623	8.43	45.1	0.0036	0.189	4.6e-05	0.445	0.443
ECOPACT25K15P1NSC	2290	52.3	2230	53.7	0.000629	8.35	45.2	0.00363	0.189	4.6e-05	0.445	0.443
ECOPACT25K18P1NS	2300	52.7	2250	54.1	0.000633	8.35	45.3	0.00364	0.189	4.6e-05	0.445	0.443
H21K12P1NS	2020	46.4	1970	47.9	0.000571	8.16	43.1	0.00339	0.194	4.6e-05	0.445	0.443
H21K15P1NS	2050	46.7	1990	48.3	0.000591	8.16	43.2	0.0034	0.194	4.6e-05	0.445	0.443
H21K18P1NS	2060	46.9	2010	48.6	0.000597	8.17	43.3	0.0034	0.194	4.6e-05	0.445	0.443
H21K05P2NN	1950	44.7	1900	46.1	0.000562	8.6	43.4	0.00338	0.184	4.6e-05	0.445	0.443
H21K08P2NN	1960	44.8	1910	46.3	0.000562	8.6	43.4	0.00339	0.184	4.6e-05	0.445	0.443
H21K10P2NN	1970	44.8	1930	46.7	0.000568	8.6	43.5	0.00339	0.184	4.6e-05	0.445	0.443
H21K12P2NS	1990	45.5	1950	47.2	0.000576	7.61	44.1	0.00342	0.2	4.6e-05	0.445	0.443
H21K15P2NS	2050	46.4	2000	48.6	6e-04	7.57	44.4	0.00345	0.2	4.6e-05	0.445	0.443
H21K18P2NS	2060	46.6	2020	48.9	0.000607	7.53	44.3	0.00345	0.2	4.6e-05	0.445	0.443
H21K05P4NN	1960	44.8	1910	46.1	0.000557	8.74	43.6	0.0034	0.178	4.6e-05	0.445	0.443
H21K08P4NN	1960	45.1	1920	46.5	0.000558	8.74	43.6	0.0034	0.178	4.6e-05	0.445	0.443
H21K10P4NN	1970	44.9	1930	46.9	0.000571	8.74	43.7	0.00341	0.178	4.6e-05	0.445	0.443
H21K12P4NN	2000	45.3	1950	47.4	0.000576	8.7	43.7	0.00341	0.178	4.6e-05	0.445	0.443
H21K05P2NNC	1960	44.6	1910	46.3	0.000552	8.7	43.6	0.0034	0.178	4.6e-05	0.445	0.443



H21K10P2NNC	198 0	45	193 0	46. 9	0.0005 67	8.7 9	43.7	0.003 41	0.178	4.6e- 05	0.44 5	0.443
H21K15P2NSC	201 0	45. 4	196 0	47. 8	0.0005 97	7.7	44.2	0.003 42	0.2	4.6e- 05	0.44 5	0.443
H21K08P4NNC	195 0	44. 8	191 0	46. 3	0.0005 58	8.5 9	43.2	0.003 37	0.2	4.6e- 05	0.44 5	0.443
H25CK15P1NSC	221 0	50. 7	216 0	51. 9	0.0005 99	8.2 6	45.1	0.003 59	0.194	4.6e- 05	0.44 5	0.443
H25CK05P2NNC	215 0	49. 8	211 0	50. 5	0.0005 8	8.42	44.7	0.003 56	0.184	4.6e- 05	0.44 5	0.443
H25CK08P2NNC	214 0	49. 4	209 0	50. 4	0.0005 79	8.4 6	44.7	0.003 55	0.184	4.6e- 05	0.44 5	0.443
H25CK10P2NNC	212 0	49	208 0	50. 2	0.0005 88	8.5	44.7	0.003 54	0.184	4.6e- 05	0.44 5	0.443
H25CK12P2NSC	221 0	51	218 0	52. 2	0.0006 14	8.3 9	45.4	0.003 61	0.189	4.6e- 05	0.44 5	0.443
H25CK15P2NSC	222 0	50. 8	216 0	52. 1	0.0006 13	8.3 9	45.3	0.003 6	0.189	4.6e- 05	0.44 5	0.443
H25CK18P2NSC	225 0	51. 5	220 0	53	0.0006 34	8.35	45.5	0.003 63	0.189	4.6e- 05	0.44 5	0.443
H25CK05P4NNC	215 0	50	209 0	50. 3	0.0005 77	8.16	44.5	0.003 55	0.178	4.6e- 05	0.44 5	0.443
H25CK08P4NNC	214 0	49. 5	209 0	50. 1	0.0005 77	8.2	44.5	0.003 54	0.178	4.6e- 05	0.44 5	0.443
H25CK10P4NNC	218 0	50. 1	212 0	51.1	0.0005 93	8.16	44.6	0.003 56	0.178	4.6e- 05	0.44 5	0.443
H25K15P1NS	224 0	51. 3	219 0	52. 6	0.0006 19	8.31	45.3	0.003 61	0.194	4.6e- 05	0.44 5	0.443
H25K18P1NS	226 0	51. 5	220 0	53. 1	0.0006 24	8.31	45.4	0.003 62	0.194	4.6e- 05	0.44 5	0.443
H25K02P2NN	233 0	59. 1	227 0	52. 6	0.0004 52	8.71	35.3	0.003 28	0.116	4.6e- 05	0.44 5	0.443
H25K08P2NN	215 0	49. 8	210 0	50. 3	0.0005 79	7.99	44.3	0.003 53	0.184	4.6e- 05	0.44 5	0.443
H25K10P2NN	216 0	50	212 0	50. 7	0.0005 81	7.99	44.3	0.003 54	0.184	4.6e- 05	0.44 5	0.443
H25K12P2NS	220 0	50. 4	215 0	51. 8	0.0006 14	8.6 4	45.5	0.003 61	0.189	4.6e- 05	0.44 5	0.443
H25K15P2NS	220 0	50. 3	215 0	51. 9	0.0006 24	8.6 9	45.6	0.003 61	0.189	4.6e- 05	0.44 5	0.443
H25K18P2NS	226 0	51. 5	220 0	53. 2	0.0006 28	8.61	45.8	0.003 65	0.189	4.6e- 05	0.44 5	0.443
H25K05P4NN	214 0	49. 7	209 0	50. 2	0.0005 8	8.0 7	44.4	0.003 54	0.178	4.6e- 05	0.44 5	0.443
H25K08P4NN	214 0	50. 2	210 0	50. 6	0.0005 84	8.0 7	44.5	0.003 55	0.178	4.6e- 05	0.44 5	0.443
H25K10P4NN	216 0	50. 3	211 0	51	0.0005 86	8.0 7	44.5	0.003 55	0.178	4.6e- 05	0.44 5	0.443



Ready Mix 26 to 30 MPa

Table 14: 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	35.1	0.0524	255	2.25e-05	0.547	0.00114	2040
Maximum	45.6	0.0607	368	2.44e-05	0.739	0.00155	2370
Mean	37.3	0.0548	276	2.34e-05	0.582	0.00123	2150
Median	37.2	0.0546	275	2.33e-05	0.58	0.00123	2160
ECOPACT30K12P1NSC	38.4	0.0567	284	2.44e-05	0.596	0.00128	2260
ECOPACT30K15P1NS	38.5	0.0569	284	2.44e-05	0.597	0.00128	2270
ECOPACT30K18P1NS	37.7	0.056	276	2.41e-05	0.584	0.00125	2240
ECOPACT30K12P2NSC	38.3	0.0566	284	2.43e-05	0.596	0.00128	2250
ECOPACT30K15P2NSC	38.4	0.0568	284	2.44e-05	0.597	0.00128	2270
ECOPACT30K18P2NSC	37.6	0.056	276	2.41e-05	0.584	0.00125	2240
ECOPACT30K8P4NNC	35.9	0.0533	263	2.29e-05	0.561	0.00117	2070
ECOPACT30K10P4NNC	35.1	0.0524	255	2.25e-05	0.547	0.00114	2040
ECOPACT30K10P4NNC-7D	38.6	0.0568	287	2.43e-05	0.601	0.00128	2240
H30K15P1NS	37.2	0.0546	275	2.33e-05	0.58	0.00123	2160
H30K18P1NS	37.3	0.0548	276	2.33e-05	0.581	0.00124	2170
H30K10P2NN	36	0.053	265	2.27e-05	0.563	0.00118	2060
H30K12P2NS	37.1	0.0544	274	2.32e-05	0.579	0.00122	2140
H30K15P2NS	36.8	0.0543	271	2.32e-05	0.575	0.00122	2140
H30K18P2NS	37.4	0.055	276	2.34e-05	0.583	0.00124	2180
H30K08P4NN	35.9	0.0528	264	2.26e-05	0.562	0.00117	2050



H30K10P4NN	36	0.053	265	2.26e-05	0.563	0.00118	2060
H30CK12P1NSC	37.1	0.0546	275	2.34e-05	0.58	0.00123	2150
H30CK18P1NSC	37.4	0.0551	276	2.35e-05	0.583	0.00124	2190
H30CK08P2NNC	35.9	0.053	265	2.27e-05	0.562	0.00117	2050
H30CK10P2NNC	36	0.0531	265	2.27e-05	0.563	0.00118	2070
H30CK12P2NSC	37.2	0.0547	275	2.34e-05	0.581	0.00123	2150
H30CK15P2NSC	37.4	0.0551	276	2.35e-05	0.583	0.00124	2180
H30CK18P2NSC	37	0.0547	272	2.34e-05	0.577	0.00123	2170
H30CK05P4NNC	35.9	0.0529	264	2.26e-05	0.562	0.00117	2040
H30CK08P4NNC	36	0.053	265	2.27e-05	0.563	0.00117	2050
H30CK10P4NNC	36.1	0.0532	265	2.27e-05	0.564	0.00118	2070
H30CK10P4NNC-7D	45.6	0.0607	368	2.39e-05	0.739	0.00155	2370

b) Inventory Metrics:

Indicator/LCI Metric	TP E	RE	NR E	NR R	RR	WD P	LFW	LFHW	CBW C	CW WC	CH W	CNH W
Unit	MJ-Eq	MJ-Eq	MJ-Eq	kg	m3	m3	kg waste	kg waste	m3	m3	kg	kg
Minimum	2250	51.6	2200	52.5	0.000503	7.79	35.1	0.00339	0.178	4.6e-05	0.445	0.443
Maximum	2630	66.7	2560	59.2	0.000679	8.49	48.7	0.00392	0.194	4.6e-05	0.445	0.443
Mean	2380	55.1	2320	55.6	0.000626	8.14	46.1	0.00374	0.186	4.6e-05	0.445	0.443
Median	2380	55	2320	55.6	0.00063	8.09	46	0.00372	0.189	4.6e-05	0.445	0.443
ECOPACT30K12P1NSC	2480	56.8	2420	58.2	0.000669	8.37	48.6	0.00391	0.189	4.6e-05	0.445	0.443
ECOPACT30K15P1NS	2500	57.4	2440	58.6	0.000674	8.37	48.7	0.00392	0.189	4.6e-05	0.445	0.443
ECOPACT30K18P1NS	2470	56.5	2410	57.9	0.000666	8.41	48.5	0.00388	0.189	4.6e-05	0.445	0.443
ECOPACT30K12P2NSC	2480	56.7	2430	58.2	0.000664	8.28	48.5	0.0039	0.189	4.6e-05	0.445	0.443
ECOPACT30K15P2NSC	2500	57.2	2450	58.6	0.000679	8.28	48.6	0.00391	0.189	4.6e-05	0.445	0.443



ECOPACT30K18P2 NSC	247 0	56	241 0	57. 9	0.0006 68	8.32	48.4	0.003 87	0.189	4.6e- 05	0.44 5	0.443
ECOPACT30K8P4 NNC	229 0	52. 8	223 0	53. 6	0.0006 11	8.0 4	46.5	0.003 72	0.178	4.6e- 05	0.44 5	0.443
ECOPACT30K10P4 NNC	225 0	51. 6	220 0	53	0.0006 17	8.0 8	45.9	0.003 66	0.178	4.6e- 05	0.44 5	0.443
ECOPACT30K10P4 NNC-7D	248 0	57. 1	241 0	57. 8	0.0006 51	7.93	48.2	0.003 89	0.178	4.6e- 05	0.44 5	0.443
H30K15P1NS	238 0	55. 2	233 0	55. 7	0.0006 34	8.0 2	45.8	0.003 71	0.194	4.6e- 05	0.44 5	0.443
H30K18P1NS	240 0	55. 4	234 0	56	0.0006 32	8.0 2	45.9	0.003 72	0.194	4.6e- 05	0.44 5	0.443
H30K10P2NN	226 0	53	222 0	53. 1	0.0005 97	7.83	45.2	0.003 64	0.184	4.6e- 05	0.44 5	0.443
H30K12P2NS	236 0	54. 9	230 0	55. 1	0.0006 18	8.1	45.9	0.003 72	0.189	4.6e- 05	0.44 5	0.443
H30K15P2NS	236 0	54. 5	231 0	55. 4	0.0006 32	8.14	45.9	0.003 71	0.189	4.6e- 05	0.44 5	0.443
H30K18P2NS	240 0	55. 3	234 0	56. 3	0.0006 39	8.1	46.1	0.003 74	0.189	4.6e- 05	0.44 5	0.443
H30K08P4NN	226 0	52. 6	220 0	52. 8	0.0005 98	7.79	45.1	0.003 64	0.184	4.6e- 05	0.44 5	0.443
H30K10P4NN	227 0	52. 7	222 0	53. 2	0.0005 98	7.79	45.2	0.003 64	0.184	4.6e- 05	0.44 5	0.443
H30CK12P1NSC	236 0	54. 9	232 0	55. 4	0.0006 23	8.45	46.2	0.003 74	0.194	4.6e- 05	0.44 5	0.443
H30CK18P1NSC	241 0	55. 7	236 0	56. 6	0.0006 43	8.45	46.4	0.003 76	0.194	4.6e- 05	0.44 5	0.443
H30CK08P2NNC	226 0	52. 7	220 0	53. 2	0.0005 96	8	45.4	0.003 65	0.184	4.6e- 05	0.44 5	0.443
H30CK10P2NNC	228 0	53. 1	223 0	53. 3	0.0006 04	8	45.4	0.003 66	0.184	4.6e- 05	0.44 5	0.443
H30CK12P2NSC	237 0	54. 7	232 0	55. 5	0.0006 28	8.4 9	46.3	0.003 75	0.189	4.6e- 05	0.44 5	0.443
H30CK15P2NSC	240 0	55. 3	234 0	56	0.0006 42	8.4 9	46.5	0.003 76	0.189	4.6e- 05	0.44 5	0.443
H30CK18P2NSC	239 0	55. 1	233 0	55. 9	0.0006 42	8.4 9	46.4	0.003 75	0.189	4.6e- 05	0.44 5	0.443
H30CK05P4NNC	225 0	52. 4	220 0	52. 5	0.0005 89	7.91	45.3	0.003 65	0.178	4.6e- 05	0.44 5	0.443
H30CK08P4NNC	226 0	52. 9	221 0	52. 9	0.0005 97	7.91	45.4	0.003 65	0.178	4.6e- 05	0.44 5	0.443
H30CK10P4NNC	228 0	52. 8	223 0	53. 5	0.0006 03	7.91	45.4	0.003 66	0.178	4.6e- 05	0.44 5	0.443
H30CK10P4NNC- 7D	263 0	66. 7	256 0	59. 2	0.0005 03	7.82	35.1	0.003 39	0.178	4.6e- 05	0.44 5	0.443



Ready Mix 31 to 35 MPa

Table 15: 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	38.8	0.0566	292	2.41e-05	0.607	0.00129	2220
Maximum	53	0.0699	436	2.76e-05	0.853	0.00185	2790
Mean	41.6	0.06	316	2.55e-05	0.65	0.0014	2380
Median	40.8	0.0593	309	2.53e-05	0.638	0.00137	2360
ECOPACT35K10P4NNC	42.7	0.0616	325	2.62e-05	0.666	0.00145	2460
ECOPACT35K15P1NS	42.5	0.0617	323	2.63e-05	0.662	0.00145	2490
ECOPACT35K12P2NS	40.8	0.0597	306	2.55e-05	0.634	0.00137	2390
H32K12P1NS	38.8	0.0566	292	2.41e-05	0.607	0.0013	2240
H32K10P4NN	38.9	0.0567	292	2.42e-05	0.609	0.00129	2220
H35K10P2NN	40.7	0.0589	309	2.51e-05	0.638	0.00137	2320
H35K15P2NS	41.6	0.0606	314	2.59e-05	0.647	0.00141	2430
H35K05P4NN	40.4	0.0583	307	2.48e-05	0.633	0.00135	2280
H35K08P4NN	40.5	0.0585	308	2.48e-05	0.635	0.00136	2290
H35K10P4NN	40.6	0.0587	308	2.49e-05	0.636	0.00136	2310
H35CK15P1NSC	41.5	0.0604	314	2.59e-05	0.647	0.0014	2400
H35CK18P1NSC	41.8	0.0609	315	2.6e-05	0.65	0.00142	2450
H35CK10P2NNC	40.7	0.0587	309	2.5e-05	0.636	0.00137	2310
H35CK12P2NSC	41.5	0.0604	314	2.59e-05	0.647	0.0014	2400
H35CK15P2NSC	41.7	0.0608	315	2.6e-05	0.649	0.00141	2440
H35CK18P2NSC	41.8	0.061	315	2.61e-05	0.651	0.00142	2450
H35CK05P4NNC	40.5	0.0584	308	2.49e-05	0.635	0.00135	2280
H35CK08P4NNC	40.6	0.0586	308	2.49e-05	0.636	0.00136	2300
H35CK10P4NNC	40.7	0.0588	309	2.5e-05	0.638	0.00137	2320
H35CK08P4-DNV	53	0.0699	436	2.76e-05	0.853	0.00185	2790

b) Inventory Metrics:

Indicator/LCI Metric	TPE	RE	NR E	NR R	RR	WD P	LFW	LFHW	CBW C	CW WC	CH W	CNH W
Unit	MJ-Eq	MJ-Eq	MJ-Eq	kg	m3	m3	kg waste	kg waste	m3	m3	kg	kg
Minimum	2450	57.4	2390	57.1	0.000585	6.91	39.3	0.00382	0.178	4.6e-05	0.445	0.443
Maximum	3100	77.9	3020	69.6	0.000706	7.91	50.4	0.00413	0.2	4.6e-05	0.445	0.443
Mean	2630	61.4	2560	61.1	0.00066	7.44	48.3	0.00399	0.182	4.6e-05	0.445	0.443
Median	2600	60.4	2540	60.6	0.000644	7.5	48	0.00394	0.178	4.6e-05	0.445	0.443



ECOPACT35K10P4NNC	2710	63.2	2650	63.1	0.000689	7.01	50	0.00411	0.178	4.6e-05	0.445	0.443
ECOPACT35K15P1NS	2740	63.3	2690	64.3	0.000701	7.71	50.3	0.00413	0.189	4.6e-05	0.445	0.443
ECOPACT35K12P2NS	2630	60.8	2570	61.6	0.000698	7.91	49.9	0.00405	0.189	4.6e-05	0.445	0.443
H32K12P1NS	2470	57.8	2410	57.7	0.00064	7.69	46.9	0.00382	0.2	4.6e-05	0.445	0.443
H32K10P4NN	2450	57.4	2390	57.1	0.000625	7.76	47.1	0.00384	0.178	4.6e-05	0.445	0.443
H35K10P2NN	2570	60.1	2500	59.5	0.000644	7.26	48	0.00394	0.184	4.6e-05	0.445	0.443
H35K15P2NS	2680	61.7	2610	62.5	0.000701	7.79	50	0.00408	0.189	4.6e-05	0.445	0.443
H35K05P4NN	2520	59.4	2460	58.3	0.000627	6.91	47.5	0.0039	0.184	4.6e-05	0.445	0.443
H35K08P4NN	2540	59.7	2480	58.9	0.000635	6.91	47.6	0.0039	0.184	4.6e-05	0.445	0.443
H35K10P4NN	2550	59.8	2490	59.1	0.000638	6.91	47.6	0.00391	0.184	4.6e-05	0.445	0.443
H35CK15P1NSC	2650	61.3	2580	61.8	0.000688	7.9	50.2	0.00409	0.178	4.6e-05	0.445	0.443
H35CK18P1NSC	2710	62.3	2640	63.2	0.000706	7.86	50.3	0.00411	0.178	4.6e-05	0.445	0.443
H35CK10P2NNC	2560	59.5	2500	59.4	0.000636	7.09	47.8	0.00392	0.184	4.6e-05	0.445	0.443
H35CK12P2NSC	2660	61.2	2590	62	0.000676	7.9	50.2	0.00409	0.178	4.6e-05	0.445	0.443
H35CK15P2NSC	2690	61.9	2620	62.9	0.000699	7.9	50.3	0.00411	0.178	4.6e-05	0.445	0.443
H35CK18P2NSC	2710	61.9	2640	63.4	0.000702	7.9	50.4	0.00411	0.178	4.6e-05	0.445	0.443
H35CK05P4NNC	2520	59.3	2460	58.4	0.000624	7.04	47.7	0.00391	0.178	4.6e-05	0.445	0.443
H35CK08P4NNC	2550	59.6	2480	58.9	0.000641	7.04	47.8	0.00392	0.178	4.6e-05	0.445	0.443
H35CK10P4NNC	2550	60	2500	59.4	0.000644	7.04	47.9	0.00393	0.178	4.6e-05	0.445	0.443
H35CK08P4-DNV	3100	77.9	3020	69.6	0.000585	7.3	39.3	0.00385	0.178	4.6e-05	0.445	0.443



Ready Mix 36 to 40 MPa

Table 16: Total life cycle (across modules in scope) impact results for Mix designs: 36 to 40MPa, assuming the geometric mean point values on a per 1 m3 of concrete basis.

a) Midpoint Impact Categories:

Indicator/LCI Metric	AP	EP	GWP	ODP	PCOP	ADPe	ADPf
Unit	moles of H+-Eq	kg N	kg CO2-Eq	kg CFC-11-Eq	kg NOx-Eq	kg Sb-Eq	MJ, net calorific value
Minimum	41.8	0.0604	319	2.58e-05	0.654	0.00141	2370
Maximum	43.5	0.0629	332	2.68e-05	0.677	0.00149	2540
Mean	42.7	0.0618	327	2.64e-05	0.667	0.00145	2460
Median	42.8	0.0619	328	2.64e-05	0.669	0.00145	2460
H38K08P2NN	41.8	0.0605	319	2.58e-05	0.654	0.00141	2380
H38K12P2NS	42.4	0.0616	323	2.64e-05	0.661	0.00144	2460
H38K15P2NS	42.7	0.0621	324	2.65e-05	0.664	0.00145	2500
H38K05P4NN	41.8	0.0604	319	2.58e-05	0.654	0.00141	2370
H40CK10P2NNC	42.9	0.0619	329	2.64e-05	0.67	0.00145	2450
H40CK12P2NSC	43.1	0.0623	330	2.65e-05	0.673	0.00147	2490
H40CK15P2NSC	43.4	0.0627	331	2.67e-05	0.676	0.00148	2530
H40CK18P2NSC	43.5	0.0629	332	2.68e-05	0.677	0.00149	2540
H40CK05P4NNC	42.7	0.0615	328	2.63e-05	0.668	0.00144	2420
H40CK08P4NNC	42.8	0.0617	328	2.63e-05	0.669	0.00145	2440
H40CK10P4NNC	42.9	0.0619	329	2.64e-05	0.671	0.00146	2460

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	m3	m3	kg waste	kg waste	m3	m3	kg	kg
Minimum	2620	61.5	2570	60.9	0.000651	6.84	49.6	0.00406	0.178	4.6e-05	0.445	0.443
Maximum	2800	65	2740	65.4	0.000718	8.05	51.1	0.00418	0.189	4.6e-05	0.445	0.443
Mean	2720	63.3	2650	63.1	0.000682	7.2	50.4	0.00414	0.186	4.6e-05	0.445	0.443
Median	2720	63.4	2650	63.1	0.00068	7.07	50.4	0.00414	0.184	4.6e-05	0.445	0.443
H38K08P2NN	2630	61.7	2570	61.3	0.000652	7.09	49.6	0.00406	0.184	4.6e-05	0.445	0.443
H38K12P2NS	2720	62.7	2660	63.3	0.000694	8.05	50.9	0.00416	0.189	4.6e-05	0.445	0.443
H38K15P2NS	2750	63.7	2700	64.1	0.000705	8.05	51.1	0.00418	0.189	4.6e-05	0.445	0.443
H38K05P4NN	2620	61.5	2570	60.9	0.000651	7.17	49.7	0.00407	0.178	4.6e-05	0.445	0.443



H40CK10P2N NC	270 0	63. 4	264 0	62. 9	0.0006 76	6.84	50.3	0.0041 3	0.184	4.6e- 05	0.44 5	0.443
H40CK12P2N SC	276 0	64. 1	268 0	64	0.0006 9	7.06	50.6	0.0041 6	0.189	4.6e- 05	0.44 5	0.443
H40CK15P2N SC	279 0	64. 4	272 0	64. 9	0.00071 1	7.07	50.8	0.0041 7	0.189	4.6e- 05	0.44 5	0.443
H40CK18P2N SC	280 0	65	274 0	65. 4	0.00071 8	7.07	50.9	0.0041 8	0.189	4.6e- 05	0.44 5	0.443
H40CK05P4N NC	267 0	62. 8	262 0	62	0.0006 52	6.93	50.2	0.0041 2	0.184	4.6e- 05	0.44 5	0.443
H40CK08P4N NC	270 0	62. 9	262 0	62. 6	0.0006 73	6.93	50.3	0.0041 3	0.184	4.6e- 05	0.44 5	0.443
H40CK10P4N NC	273 0	63. 8	265 0	63.1	0.0006 8	6.93	50.4	0.0041 4	0.184	4.6e- 05	0.44 5	0.443

Ready Mix 41 to 45 MPa

Table 17: 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	44.3	0.0638	340	2.71e-05	0.691	0.00152	2570

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
H42K15P2NS	283 0	65. 8	278 0	66.1	0.00071 2	7.02	51.1	0.0042 2	0.184	4.6e- 05	0.44 5	0.443

Ready Mix 46 to 50 MPa

Table 18: 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	46.5	0.0666	359	2.82e-05	0.725	0.0016	2690



b) Inventory Metrics:

Indicator/L CI 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
H47K10P4NN	2970	69.1	2900	69.1	0.000737	6.76	52.6	0.00437	0.168	4.6e-05	0.445	0.443

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>

