Working Session





the at

Canadian Standard on Embodied Carbon in Construction

20 September 2023

Susan Neil (CACQS) and Anil Sawhney (RICS)

Topics covered







Decarbonization agenda for the built environment



Decarbonizing the built environment—the need

In 2021 built environment sector produced ~43% of the global carbon emissions (15.5 gigatonnes of carbon emissions).

		Whole life carl	e carbon (43%)				
	Operational Carbon		Embodied Carbon				
	Direct	Indirect					
Residential	6%	11%	9%				
Non-residential	3%	8%					
Infrastructure	-	-	6%				
Total 43% (buildings = 37%)	28	3%	15%				

Whole life carbon emissions = Operational Carbon + **Embodied Carbon** + (User carbon|Beyond life cycle carbon)

Source: United Nations Environment Programme (2022). 2022 Global Status Report for Buildings and Construction: Towards a Zero-emission, Efficient and Resilient Buildings and Construction Sector. Nairobi.



Emissions when considering user carbon



Including emissions associated with the user's utilisation of the buildings or infrastructure during the use stage



Source: Thacker S, Adshead D, Fantini C, Palmer R, Ghosal R, Adeoti T, Morgan G, Stratton-Short S. 2021. Infrastructure for climate action. UNOPS, Copenhagen, Denmark.

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Progress {not}made!

The warning

Pace and scale of climate action are insufficient to tackle climate change

ipcc

Figure 2. Direct reference path to a zero-carbon building stock target in 2050 (left); zoom into the period between 2015 and 2021, comparing the observed Global Buildings Climate Tracker to the reference path (right)





Source: United Nations Environment Programme (2022). 2022 Global Status Report for Buildings and Construction: Towards a Zero-emission, Efficient and Resilient Buildings and Construction Sector. Nairobi.



2030 ERP: BUILDINGS

Transitioning Canada's building stock to net-zero over the long term creates new opportunities to promote a low-carbon supply chain, adopt net-zero ready building codes, transform space and water heating, improve affordability through energy efficiency, and accelerate private financing and workforce development to support the sector's transition.



2005 emissions: 84 Mt

2019 emissions: 91 Mt

Estimated change from 2005 to 2030: -37%

Net zero by 2050

 Invest \$150 million to develop a national net zero by 2050 buildings strategy, the Canada Green Buildings Strategy



Environment and Climate Change Canada Environnement et Changement climatique Canada





Source: https://www.canada.ca/en/services/environment/weather/climatechange/climate-plan/climate-plan-overview/emissions-reduction-2030/plan/chapter-3.html



Home > Green Vancouver > Climate Emergency Action Plan > Buildings

Green Vancouver

 Climate Emergency Action Plan

Land use planning

▶ Transportation

Buildings

Natural climate solutions

An equitable plan

In depth

- Zero emissions buildings
- Neighbourhood Energy Strategy
- Climate Change Adaptation Strategy
- Green Operations Plan
- Zero Waste 2040
- Opportunities for climate leaders

Greenest City Action Plan

Solutions Lab



By 2030, indoor air quality will be improved in renovated buildings.

Climate action through buildings

Burning natural gas, a fossil fuel, in buildings (for space and water heating) accounts for 55% of the carbon pollution generated in Vancouver. Construction creates additional emissions locally and globally through the production and transportation of building materials.

2030 targets

- Carbon pollution from buildings will be half what it was in 2007
- There will be 40% less embodied emissions from new buildings and construction projects compared to 2018



Source: https://vancouver.ca/green-

vancouver/buildings.aspx#:~:text=Burning%20natural%20gas%2C%20a%20fossil,and%20transportation%20of%20building%20materials.



Buildings Energy, Emissions & Resilience

Performance measures to optimize energy efficiency, reduce GHG emissions and enhance building resilience to extreme weather.



+

Expand All + Collapse All -

Operational Emissions and Energy

Embodied Emissions In Materials

TIER 2

GHG 2.1 Low Embodied Emissions Materials

Conduct an Upfront Embodied Emissions Assessment for the structure and envelope in accordance with the CaGBC Zero Carbon Building Standard methodology for the Upfront Carbon lifecycle stage (A1-A5). Identify low-carbon sustainable material alternatives to the proposed structure and/or envelope for use in the building project. The report must demonstrate an emissions intensity of equal to or less than 350 kgC02e/m², 1,2,3,56

Source: https://www.toronto.ca/city-government/planning-development/official-plan-guidelines/toronto-green-standard/toronto-green-standar



Findings from RICS sustainability report 2022



Figure 12 Currently, do you measure embodied carbon emissions on your projects and, if so, how significantly does this affect the choice of materials, systems and components?



Source: https://www.rics.org/content/dam/ricsglobal/documents/surveying/2022%20RICS%20Sustainability%20Report.pdf

Findings from RICS sustainability report 2022



sustainability assessments



Source: https://www.rics.org/content/dam/ricsglobal/documents/surveying/2022%20RICS%20Sustainability%20Report.pdf

Findings from RICS sustainability report 2022



Figure 13 Principal barriers inhibiting the construction sector from reducing embodied carbon emissions



Source: https://www.rics.org/content/dam/ricsglobal/documents/surveying/2022%20RICS%20Sustainability%20Report.pdf

Findings from RICS Digitalization in Construction 2022 report





Source: https://www.rics.org/news-insights/wbef/power-of-data-and-technology-for-quantity-surveyors-and-cost-managers

GHG and GWP

CO₂e, Carbon dioxide equivalent, CO₂ equivalent or CO₂eq





Source: https://www.coolerfuture.com/blog/co2e



Carbon dioxide equivalents are commonly expressed as million metric tonnes of carbon dioxide equivalents (MMTCDE).



Source: https://www.epa.gov/greenvehicles/tailpipe-greenhouse-gas-emissions-typical-passenger-vehicle#typical-passenger and https://labs.ece.uw.edu/community/EnvironmentalImpacts/ElectricVehicleCalculations/



Who measures what?

Understanding Scope 1, 2, and 3 Emissions for a Building





Types of emissions





What are life cycle emissions?

BS ISO 21931-1:2022 ISO 21931-1:2022



Emissions over the life of a constructed asset



Adapted from Carbon Leadership Forum 2020.



Focus on embodied carbon





The process







analysis





Concrete BC Member Industry-Wide EPD for **READY-MIXED CONCRETE**

Declared Product:	
Mix GC30E0XB1C08 • North Vancouver Pla	ant Plant
Description: GENERAL CONCRETE 30 M	PA 20 MM NO
AIR EVOBULD BRONZE	
Compressive strength: 30 MPa at 28 days	
Declared Unit: 1 m ³ of concrete	
Declared Unit: 1 m ³ of concrete Gobal Warming Potential (kg CO ₂ -eq)	23
Declared Unit: 1 m ³ of concrete Gobal Warming Potential (kg CO ₂ -eq) Ozone Depletion Potential (kg CFC-11-eq)	23 7.44E-



What is an Environmental product declaration (EPD)?

- EPDs provide verified environmental (performance or impact) data of products based on LCA
- Designers, engineers, cost managers, and other experts use this data to compute carbon footprint of constructed assets
- Third-party verification is required
- Based on ISO 14025 + ISO 21930



ENVIRONMENTAL IMPACTS

Declared Product:

Mix GC30E0XB1C08 • North Vancouver Plant Plant Description: GENERAL CONCRETE 30 MPA 20 MM NON AIR EVOBUILD BRONZE Compressive strength: 30 MPa at 28 days

Declared Unit: 1 m³ of concrete

Global Warming Potential (kg CO2-eq)	231
Ozone Depletion Potential (kg CFC-11-eq)	7.44E-6
Acidification Potential (kg SO ₂ -eq)	0.97
Eutrophication Potential (kg N-eq)	0.24
Photochemical Ozone Creation Potential (kg O3-eq)	26.1
Abiotic Depletion, non-fossil (kg Sb-eq)	7.06E-6
Abiotic Depletion, fossil (MJ)	1,290
Total Waste Disposed (kg)	0.58
Consumption of Freshwater (m ³)	4.35

Product Components: admixture (ASTM C494), crushed aggregate (ASTM C33), natural aggregate (ASTM C33), portland limestone cement (ASTM 595), batch water (ASTM C1602)

Complex world of EPDs

- ISO has three types of environmental claims (all are based on ISO 14020:2000 Environmental labels and declarations — General principles):
 - Type I environmental claims (ISO 14024:2018— Type I environmental labelling)
 - Type II environmental claims (ISO 14021:2016 Self-declared environmental claims)
 - Type III environmental claims (ISO 14025:2006 Type III environmental declarations
 + use LCA described in ISO 14040:2006 and ISO 14044:2006)
 - Several EN standards are also available for EPDs such as EN 15942 and EN 15804
 - Specifically for construction ISO 21930



What do EPDs cover?

Canadian Standard

]	A1-3											
	Product stage	BUILDI	NG AS	SESS	MEN	IT INF	FORM	/IATI	ON			
	A1-A3	DING LIFE	CYCLE	INFOR	MATI	ION						Additional information beyond the building life cycle
AO	u	44-5								1-4		
Pre-construction	ncti	struction ocess						1			ge	Benefits and loads beyond the system boundary
on-physical activities on making, preliminary & ion of land/site, etc.)	nd upstream prod 1sport to factory 1anufacturing	nstallation process, earance, preparation) 5		Maintenance 8	Repair	Replacement of Building components A	Refurbishment 🛱	tion/demolition D	aste processing or R		al of waste	D1 Potential net benefits from reuse, recycling energy recovery and/or other recovery D2 Potential benefits and loads from exported
nt of ne decisic cquisit	on al Trar M	tion - i site cl	B6 Op			rgy use			ort to w di			energy thermal energy, potable water)
essme n and dies, a	acti	uding	B7 0		nal wat	er use						
Asse [desig stuc	Extr	Cor	B8 B	uilding- ctivities	related not co	l users' vered in I	B1-B7		T			

TRACI 2.1 used in North America (CML used elsewhere)

Units kg CO2-eq kg CFC-11-eq kg SO2-eq kg N-eq kg O3-eq
kg CO2-eq kg CFC-11-eq kg SO2-eq kg N-eq kg O3-eq
kg CFC-11-eq kg SO2-eq kg N-eq kg O3-eq
kg SO2-eq kg N-eq kg O3-eq
kg N-eq kg O3-eq
kg O3-eq
MJ (HHV)
MJ (HHV)
MJ (HHV)
kg
kg
m3
m3
m3
kg
kg

Uses—Product Category Rule (PCR) for Environmental Product Declarations, PCR for Concrete



How are EPDs developed?





Industry-wide (regional) EPD versus Product (Plant) specific EPD



Concrete BC Member Industry-Wide EPD for READY-MIXED CONCRETE

Appendix A baseline

ENVIRONMENTAL PRODUCT DECLARATION

This Environmental Product Declaration (EPD) reports the impacts for 1 m³ of ready mixed concrete mix, meeting the following specifications:

- ASTM C94: Ready-Mixed Concrete
- UNSPSC Code 30111505: Ready Mix Concrete
- CSA A23.1/A23.2: Concrete Materials and Methods of Concrete Construction
- CSI Division 03-30-00: Cast-in-Place Concrete

COMPANY

Rempel Bros. Concrete a division of Lehigh Hanson Materials Ltd.

8955 Shaughnessy St Vancouver, BC V6P 3Y7

PLANT

North Vancouver Plant Plant 10 Riverside Dr W North Vancouver, BC V7H 1T4

ENVIRONMENTAL IMPACTS

Declared Product:

Mix GC30E0XB1C08 • North Vancouver Plant Plant Description: GENERAL CONCRETE 30 MPA 20 MM NON AIR EVOBUILD BRONZE Compressive strength: 30 MPa at 28 days

REMPEL

HEIDELBERGCEMENTGrou

Declared Unit: 1 m³ of concrete

Global Warming Potential (kg CO2-eq)	231
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Acidification Potential (kg SO2-eq)	0.97
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Total Waste Disposed (kg)	0.58
Consumption of Freshwater (m ³)	4.35

Appendix B – project mixes



Further guidance on EPDs by Carbon Leadership Forum

EPD checklist: Minimum requirements Independently verified as in accordance with ISO 14025 (Type III) Image: A state of the st

Reports a data uncertainty range

 \checkmark

A **Type III EPD** is one that has been independently verified to be in accordance with *ISO 14025 - Type III environmental declarations – Principles and procedures*.

EPDs are **valid** for five years from the date of issue. All EPDs state the date of issue and period of validity.

A **product-specific** EPD represents a product from a single manufacturer. An industry-wide average EPD is <u>not</u> a product-specific EPD.

An EPD with **facility (plant)-specific data** reports impacts calculated based on inputs collected from the actual facility (or facilities) where the product was manufactured.

Supply chain-specific data is based on inputs from the actual supply chain of a product, rather than generic or industry-wide data. EPDs should report the overall percent (%) supply chain-specific data. Ideally, EPDs should target to include supply chain-specific data for processes or facilities that comprise 80% or more of the cradle-to-gate impacts of a product.



Use EC3 to search for EPDs (step 1)

	EC3	ROYA AS Anil Sawhney PILOT USER	
-	Find & Compare Materials	₩ EC3 / Find & Compare Materials	
	Masonry	1 Category 2 Performance Specs	
	Aluminium	SELECT CATEGORY: READYMIX	
	Wood		
	Sheathing	Search category	
	Thermal/Moisture Prot.		
	Cladding	Departul N	
	Openings	Shotcete	
	Finishes	Cement Grout	
	Furnishings Pilot	Flowable Fill (CDF)	
	Conveying Equipment Plot	PavingPilot	
	Plumbing Plot	@Precast Concrete Pilot	
	Mechanical	Scast Decks and UnderlaPliot	
	Network Infrastructure	Concrete	
	Asphalt	Masonry⊕ ★Wire & Mesh	
	Accessories Pilot	Steel KPost-Tensioning Pilot	
	Manufacturing Inputs		
	Bulk Materials Pilot	Sheathing #	
•	Plan & Compare Buildings	Thermal/Moisture Prot.⊕	
	Laval Rids	Cladding	
	Level blus	Openings	
₽	Add EPDs to EC3	AllMaterials Finishes	
•	Manage Data	Furnishings ^{Pilot}	
	United Contracts		
	user Groups	Mechanical Pilot ⊕	
	Organizations	Electrical Pilot	
	How to get an EPD	Network Infrastructure ⊕	
		Asphalt	
	happaged licers	V V V A Dilet or	

Source: <u>EC3 - Find & Compare</u> <u>Materials (buildingtransparency.org)</u>



Use EC3 to search for EPDs (step 2)



Use EC3 to search for EPDs (step 3)

					Ξ	
Compliance	 Cement Type 	•	≤ W/C Ratio	≤ uaGWP / 1 yd3	300 Conservative 26	2021 CLF Baseline
Cement Replacement with Cem	entitious Materials				250 200 150 Achievable = 14	6.7
▼ GEOGRAPHIC					100	
Geography British Columbia		Ţ	Distance Search only availab	le in Building Projects	0	
MORE						
LCIA Method: TRACI 2.1 and Jurisdiction: Ca	nada BC X and Valid after: 20	23-09-17 X and EPD Type: Pro	duct EPDs, Industry EPDs X and	Lightweight - No X	🖉 Copy Shareable Link	Q SEARCH
STATISTICS						
Product EPDs: 1482 Industry EF	PDs: 98 Achievable:	147 kgC02e Avera	age: 213 kgCO2e ± 35.4%	Conservative: 268 kgCO2e	Converted per Unit	: 1 yd3
▼ INDUSTRY EPDS					Impac	ts Participants
Name	Publishers	Jurisdiction	Achievable	Average	Conservative Estimate	
Ready-mixed concrete - 15 MPa without air	BC Ready-Mixed Concrete A	CA-BC	117 kgCO2e	137 kgCO2e	167 kgCO2e	Open Download
Baseline 60 MPa Concrete without air (N) G	BC Ready-Mixed Concrete A	CA-BC	261 kgCO2e	306 kgCO2e	373 kgCO2e	Open Download
Baseline 60 MPa Concrete with air (C-1) GU	BC Ready-Mixed Concrete A	CA-BC	275 kgCO2e	323 kgCO2e	393 kgCO2e	Open Download
Baseline 55 MPa Concrete without air (N) G	BC Ready-Mixed Concrete A	CA-BC	246 kgCO2e	288 kgCO2e	350 kgCO2e	Open Download
Baseline 55 MPa Concrete with air (C- XL) G	BC Ready-Mixed Concrete A	CA-BC	262 kgCO2e	307 kgCO2e	374 kgCO2e	Open Download
Baseline 50 MPa Concrete with air (C- XL) G		CA BC	225 kmCO20	264 kgCO2e	331 km603a	Open Dewaland
Baseline so fin a concrete martan (e 7/2) all	BC Ready-Mixed Concrete A	CA-BC	225 KgCO2e	204 KgC026	521 kgCO2e	Open Download
Baseline 50 MPa Concrete without air (N) G	BC Ready-Mixed Concrete A BC Ready-Mixed Concrete A	СА-ВС	235 kgCO2e	275 kgCO2e	335 kgCO2e	Open Download



Source: <u>EC3 - Find & Compare</u> <u>Materials (buildingtransparency.org)</u>

Sources of industry EPDs

		Newsroom	Events	Contact us	Q Search	in 🎔 Français
Cement Association of Canada	About CAC	The cement and	concrete ind	ustry	Sustainability	Expertise center
EPD General Use and Portland- Lin	mestone Cements	ß	CRMCA Me Mixed Conc	mber Indus trete	try-Wide EPD f	or Canadian Ready- 🛛 🛽
ASTM — Environment Product De	clarations	Ľ				

Provincial and specific product EPDs

Concrete BC — Ready-Mixed Concrete	
Concrete Saskatchewan — Ready-Mixed Concrete	ß
Concrete Ontario — Ready-Mixed Concrete	ß
Concrete Atlantic — Ready-Mixed Concrete	ß
CPCI — Insulated Precast Panel Concrete	ß
CCPPA — Concrete Manholes and Catch Basins	Ľ

Concrete Alberta — Ready-Mixed Concrete	Ľ
Concrete Manitoba — Ready-Mixed Concrete	Ø
Association béton Québec — Ready-Mixed Concrete	ß
CPCI — Structural Precast Concrete	Ľ
CPCI — Below Grade Precast Concrete	Ľ
CCPPA — Concrete Pipe	Ľ



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Sources of product EPDs



Source: https://www.astm.org/products-services/certification/environmental-product-declarations/epd-pcr/epd-lehigh-hanson-vancouver.html





Overview of the Canadian Standard





Standard on Embodied Carbon in Construction

- Issued pursuant to the *Policy on Green Procurement* and is consistent with the *Policy on the Planning and Management of Investments* and the *Directive on the Management of Procurement*
- Sets minimum requirements for the procurement of design and construction services to <u>disclose and reduce the embodied carbon of major construction projects</u>
- Applies to <u>renovation or new construction of buildings or engineering assets</u>
- Standard took effect on December 31, 2022



Organizations covered and requirements to be met

- Applies to organizations described in section 3 of the Policy on Green Procurement (Financial Administration Act Schedule I)
- Organizations must meet:
 - Requirements for <u>design services</u>
 - Requirements for <u>construction services</u>
 - Provide a consolidated report that details the embodied carbon footprint for all construction projects completed in the previous fiscal year



Requirements in the procurement of DESIGN services

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<u>Disclose</u> the carbon footprint of structural materials in accordance with Appendix A



Reduce the carbon footprint of structural materials in accordance with Appendix A

· · ·

<u>Ensure</u> that structural materials are specified by a registered professional engineer



<u>**Review</u>** the completed Appendix B before project completion to ensure compliance</u>


Requirements in the procurement of CONSTRUCTION services

Ensure Appendix B is secured before project completion, and complies with Appendix A



Disclose the embodied carbon footprint of structural materials measured in GWP with EPDs



EPDs should: (a) reference material supplier's name or professional association; (b) comply with international standards; and (c) produced using highest available resolution LCI data



Where EPDs are not readily available, provide LCA report as per ISO 14044, ISO 14025, and ISO 21930 or equivalent and is verified by an LCA reviewer



Appendix A-requirement for the disclosure of and reduction

- Applies to ready mix concrete
- For projects or programs at or above \$10 million where design services are solicited on or after December 31, 2022, and \$5 million where design services are solicited after December 31, 2024.
- Minimum material quantity 100 m³ (sum of all mixes used) {based on Class A estimate}
- Minimum resolution for disclosure is the highest-resolution EPD available (for example, product-specific, regional average, in that order)
- GHG emissions of procured ready-mix concrete shall be disclosed on a project basis and be substantiated with EPDs



Exemptions

• This standard does not apply:

 If the project is in a geographic area (<u>Yukon, Nunavut or the Northwest Territories</u>) excluded from a requirement, as identified in Appendix A.



Disclosure - CO₂e baseline and project

<u>Baseline</u> represents the emissions calculated by the volumes of all the mixes used in the project multiplied by their regional average GWP as represented by:

$$CO^2e Baseline = \sum_{1}^{n} Vol_n \times BaseGWP_n$$

• <u>Project</u> represents the emissions from the concrete used in the project calculated by the volumes of all the mixes used in the project multiplied by their GWP as represented by:

$$CO^2 eProject = \sum_{1}^{n} Vol_n \times GWP_n$$

- Where:
 - n = the total number of concrete mixes used in the project
 - Vol_n = the volume of mix n

- GWP_n = the global warming potential of mix n
- BaseGWP_n = the global warming potential of the regional baseline mix taken from the Regional Industry Average EPD for the strength class of mix n



Reduction

 $GHG Reduction = CO_2 e Baseline - CO_2 e Project$

 $\% GHG Reduction = \frac{(GHG Reduction) \times 100}{CO_2 e Baseline}$

Special application requirements:

- Where a specialized concrete mix is required for high early strength, high or ultra-high performance, or coldweather application, the benchmark BaseGWP used for that mix shall be 130% of the baseline mix in the Regional Industry Average EPD for that strength class.
- Where a lower volume of higher-strength concrete can be substituted for a standard concrete without the addition of other structural materials (for example, additional reinforcing steel), this volume and its associated GWP should be used in the CO₂e project calculation while the initial volume and GWP of the standard mix should be used to calculate the CO₂e baseline.



EPD guidance

- EPDs must follow the current versions of PCRs for Concrete and ISO 14025 Type III.
- Type II EPDs conforming to ISO 14021:2016 and ISO 21930:2017 may be used to substantiate the global warming potential (GWP) of materials used in a project if the Type II EPDs provide higher resolution than the available Type III EPDs and if the Type II EPDs were created using an independently verified tool.
- Where carbon capture utilization and storage technologies are used to reduce the GWP of a portion or all concrete supplied to a project, such as through carbon mineralization, a product-specific EPD shall be provided to substantiate the associated reduction in GHG emissions.



Appendix B

Appendix B: Information for the Embodied Carbon Project Disclosure Template

The Embodied Carbon Project Disclosure Template must be completed for every applicable project to demonstrate that the requirements of the standard were met. The completed template is to be secured by the organization before project completion. The following information must be provided as part of completing the template.

Project Overview

The following project information must be included when completing an Embodied Carbon Project Disclosure Template.

- · Name of client organization
- · Name of client project
- · Client project number
- · Government of Canada Directory of Federal Real Property (DFRP) identification (if available)
- · Prepared by (name of general contractor)
- · Name of general contactor's company
- · General contractor's email
- · General contractor's phone number
- · Date of preparation by contractor (day-month-year)
- · Reviewed by (name of designer)
- · Name of designer's company

- · Designer's email
- · Designer's phone number
- Date of review by designer (day-month-year)
- Project location (street address)
- Project location (city or town)
- Project location (province or territory)
- · Asset archetype (for example, bridge, office, lab)
- · Project footprint or building area (m²)
- Number of floors (if applicable)
- · Project gross floor area (m², if applicable)
- · Anticipated project completion date (day-month-year)
- · Name of material supplier 1
- · Material supplier 1 email
- · Name of material supplier 2
- · Material supplier 2 email
- · Project narrative (designer notes)



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Ready-mix	concrete u	ised in project	Project mix strengths	Baseline gree	nhouse gas (GHG)	calculation	s	GHG calcu mixes	lations for p	project	Reduction	s in GHG err	nissions
Element of building or structure	Special applicatio n requireme nt?	Reduction in volume of mix (yes or no)		Life cycle assessment (LCA) results table number	Baseline global warming potential (GWP) (kg CO2/m3) per mix		Baseline GHG emissions per mix (tonnes CO2)	EPD or mix design reference number for the mix provided	Adjusted volume (m3) Enter an adjusted volume only when	GWP (kg CO2/m3) of the mix provided	GHG emissions per mix provided	GHG emissions reduced compared to the baseline per mix provided	
(for example, walls, foundatio n)	s://www.tbs-sci (yes or no)	Select yes if the volume of a mix was reduced by increasing its compressive strength without adding other structural materials.	Compress ive strength at 28 days (MPa)	(from the regional A STM ; International Environmenta I Product Declaration (EPD))	(using equivalent compressive strength from the regional ASTM International EPD)	Volume (m3)	based on the baseline GWP and volume	(from the supplier's EPD)	"Yes" is selected under Reduction in volume (third column from the left under Ready- mix concrete used in project).	(from the supplier's EPD)	(tonnes CO2)	(tonnes CO2)	Percentage reduction in GHG emissions per mix compared to the baseline
Element 1	Yes/No	Yes/No	хх	x	XXX.XXX	XXX.X	xxx.xx	х	XXX.X	XXX.XX	xxx.xx	xxx.xx	xx.x
Element 2	Yes/No	Yes/No	XX	х	XXX.XXX	XXXX.X	xxx.xx	x	XXXX.X	XXX.XXX	xxx.xx	XXX.XX	xx.x
Element 3	Yes/No	Yes/No	хх	х	XXX.XXX	XXXX.X	xxx.xx	х	XXXX.X	XXX.XXX	xxx.xx	xxx.xx	xx.x
Element 4	Yes/No	Yes/No	хх	x	XXX.XXX	XXXX.X	xxx.xx	х	XXXX.X	XXX.XXX	xxx.xx	xxx.xx	xx.x
Project totals	N/A	Yes/No	N/A	N/A	N/A	xxxx.x	xxx.xx	N/A	xxxx.x	N/A	xxx.xx	xxxx.xx	xx.x
Reduction concrete s	in GHG emi supplied to t	ssions related t the project (toni	to the embo nes)	died carbon of	ready-mix	XXX.XXX	Percentage rec of ready-mix co	luction in GH oncrete supp	IG emission	is related to project	the embod	ied carbon	XX.X

Appendix B

Read	Ready-mix concrete used in project				Baseline greenhouse gas (GHG	calculations (GHG ca	lculations for project	mixes	Reductions in GHG emissions		
Element of building or structure (for example, walls, foundation)	Special application requirement? (Yes or No)	Reduction in volume of mix (yes or no) Select yes if the volume of a mix was reduced by increasing its compressive strength without adding other structural materials.	Compressive strength at 28 days (MPa)	Life cycle assessment (LCA) results table number (from the regional ASTM International Environmental Product Declaration (EPD))	Baseline global warming potential (GWP) (kg CO2/m3) per mix (using equivalent compressive strength from the regional ASTM International EPD)	Volume (m3)	Baseline GHG emissions per mix (tonnes CO2) based on the baseline GWP and volume	EPD or mix design reference number for the mix provided (from the supplier's EPD)	Adjusted volume (m3) Enter an adjusted volume only when "Yes" is selected under Reduction in volume (third column from the left under Ready-mix concrete used in project).	GWP (kg CO2/m3) of the mix provided (from the supplier's EPD)	GHG emissions per mix provided (tonnes CO2)	GHG emissions reduced compared to the baseline per mix provided (tonnes CO2)	Percentage reduction i GHG emissions per mi compared to the baseline
Element 1	Yes/No	Yes/No	хх	х	XXX.XXX	XXXX.X	XXX.XX	x	XXX.X	XXX.XXX	XXX.XX	XXX.XX	XX.X
Element 2	Yes/No	Yes/No	хх	х	XXX,XXX	XXXX.X	XXX.XX	х	XXXX.X	XXX.XXX	XXX.XX	XXX.XX	XX.X
Element 3	Yes/No	Yes/No	хх	х	XXXXXXX	XXXX.X	XXX.XX	х	XXXX.X	XXX.XXX	XXX.XX	XXX.XX	XX.X
Element 4	Yes/No	Yes/No	хх	х	XXX.XXX	XXXX.X	XXX.XX	x	XXX.X	XXX.XXX	XXX.XX	XXX.XX	XX.X
Project totals	N/A	Yes/No	N/A	N/A	N/A	XXXX.X	XXX.XX	N/A	XXXX.X	N/A	XXX.XX	XXXXX.XXX	XX.X
Reduction	GHG emission	s related to the embo	died carbon of	f ready-mix concrete s	upplied to the project (toppes)	~~~~	Percentage reduction in G	HG emissions related to t	he embodied carbon	of ready-mix concrete s	unnlied to the pro	niect	VV V

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	В	С	D	E	F
1			Ready-mix concrete	used in proj	ect
	ICMS Code	ICMS Level 3	Element of building or structure (for example, walls, foundation)	Special application requirement?	Reduction in volume of mix (yes or no).
2				(Yes or No)	[NOTE 1]
3	2.02.020	Substructure	Perimeter grade beam GB1, 254 x 610 mm deep, Concrete, 30 Mpa (138 m)	No	No
1	2.02.020	Substructure	Perimeter grade beam GB2, 457 x 610 mm deep, Concrete, 35 Mpa (6 m)	No	No







Sample Project

CIQS Elemental Summary

		Ratio	EI	ement	Cos
ELE	MENT	to GFA	Quantity		ι
Α	SHELL		1,067	m2	
A1	SUBSTRUCTURE				·····
	A11 Foundations	1.000	1,067	m2	
	A12 Basement Excavation	0.000	0	m3	
	A13 Special Conditions	0.001	1	Sum	
A2	STRUCTURE				
	A21 Lowest Floor Construction	11.947	12,747	m2	20002000200
	A22 Upper Floor Construction	0.000	0	m2	
	A23 Roof Construction	1.616	1,724	m2	
A3	EXTERIOR ENCLOSURE				
	A31 Walls Below Grade	0.000	0	m2	
	A32 Walls Above Grade	0.000	0	m2	
	A33 Windows & Entrances	0.000	0	m2	
	A34 Roof Covering	0.000	0	m2	
	A35 Projections	0.000	0	Sum	
в	INTERIORS		1,067	m2	
B1	PARTITIONS & DOORS				
B2	FINISHES				
	B21 Floor Finishes	1.000	1,067	m2	20002000200
	B22 Ceiling Finishes	1.000	1,067	m2	
	B23 Wall Finishes	0.000	0	m2	
B3	FITTINGS & EQUIPMENT	_			
	B31 Fittings & Fixtures	1.000	1,067	m2	
	B32 Equipment (In-Contract)	1.000	1,067	m2	
	B33 Elevators	0.000	0	No.	
	B34 Escalators	0.000	0	No.	
С	SERVICES		1,067	m2	
C1	MECHANICAL				
	C11 Plumbing & Drainage	1.000	1,067	m2	
	C12 Fire Protection	1.000	1,067	m2	
	C13 HVAC	1.000	1,067	m2	
	C14 Controls	1.000	1,067	m2	
C2	ELECTRICAL				
	C21 Service & Distribution	1.000	1,067	m2	
	C22 Lighting, Devices & Heating	1.000	1,067	m2	
	C23 Systems & Ancillaries	1.000	1.067	m2	

Detailed Elemental Estimate

A1	SUBSTRUCTURE	Quantity
A11	Foundations	1,067 m2
	1 Demolish existing asphalt for new foundation	1,067 m2
	2 Perimeter grade beam GB1, 254 x 610 mm deep	138 m
	- Concrete, 30 MPa	21 m3
	- Rebar, 15 kg/m	2,070 kg
	- Formwork	168 m2
	 Void form, 150 mm shearmat 	35 m2
	 Excavation & removal 	21 m3
	- Ditto, workspace	42 m3
	- Backfill workspace with granular material	42 m3
	3 Perimeter grade beam GB2, 457 x 610 mm deep	6 m
	 Concrete, 35 MPa 	2 m3
	- Rebar, 25 kg/m	138 kg
	- Formwork	7 m2
	 Void form, 150 mm shearmat 	3 m2
	 Excavation & removal 	2 m3
	 Ditto, workspace 	2 m3
	- Backfill workspace with granular material	2 m3
	4 Extra over to exterior face of perimeter grade beam	84 m2
	- Galvanized flashing	7 m2
	- 13 flexcell	25 m2
	 152 mm rigid insulation 	84 m2
	 Damp proofing membrane 	84 m2
	 150 mm overlap wall air/vapour barrier 	21 m2
	5 Four pile caps, 1830 x 1830 x 610 mm deep	3 No.
	 Concrete, 32 MPa 	6 m3
	 Rebar, 253 kg/ No. 	759 kg
	- Formwork	13 m2
	- Void form, 150 mm shearmat	10 m2
	- Excavation & removal	6 m3
	- Ditto, workspace	3 m3
	 Backfill workspace with granular material 	3 m3

Canada's FOCUS is on concrete for embodied and carbon emissions

To calculate carbon, you need concrete volume by strength.

You can consolidate all the concrete by strength

BUT

reporting by item or at least sub-element permits tracking for future benchmarking.

Regardless, the **quantity** of concrete is what matters and Quantity Surveyors are ideally suited to provide them and run the calculations.



	ICMS code	ICMS Level 3	ICMS Level 4	Code 1	Code 2	Code 3	Level 1	Level 2	Item Description	Quantity	Unit
1	2.02.020	Substructure	Foundations up to top of lowest floor slab	A1	A11	2	Substructure	Foundations	Perimeter grade beam GB1, 254 x 610 mm deep, Concrete, 30 Mpa (138 m)	21.4	m3
2	2.02.020	Substructure	Foundations up to top of lowest floor slab	A1	A11	3	Substructure	Foundations	Perimeter grade beam GB2, 457 x 610 mm deep, Concrete, 35 Mpa (6 m)	1.7	m3

		A1	SU	BSTRUCTURE	Quantity
Ste	ep 1:	A11	Fo	undations	1,067 m2
1.	Identify the concrete items in your estimate by		1	Demolish existing asphalt for new foundation	1,067 m2
	item type and concrete strength		2	Perimeter grade beam GB1, 254 x 610 mm deep	138 m
			•	- Concrete, 30 MPa	21 m3
				- Rebar, 15 kg/m	2,070 kg
				- Formwork	168 m2
				- Void form, 150 mm shearmat	35 m2
				- Excavation & removal	21 m3
				- Ditto, workspace	42 m3
				- Backfill workspace with granular material	42 m3
			3	Perimeter grade beam GB2, 457 x 610 mm deep	6 m
				- Concrete, 35 MPa	2 m3
				- Rebar, 25 kg/m	138 kg
				- Formwork	7 m2
				- Void form, 150 mm shearmat	3 m2
				- Excavation & removal	2 m3
				- Ditto, workspace	2 m3
				- Backfill workspace with granular material	2 m3

CS°

48

	ICMS code	ICMS Level 3	ICMS Level 4	Code 1	Code 2	Code 3	Level 1	Level 2	Item Description	Quantity	Unit
1	2.02.020	Substructure	Foundations up to top of lowest	A1	A11	2	Substructure	Foundations	Perimeter grade beam GB1, 254 x 610	21.4	m3
			floor slab	1	1				mm deep, Concrete, 30 Mpa (138 m)		
2	2.02.020	Substructure	Foundations up to top of lowest	A1	A11	3	Substructure	Foundations	Perimeter grade beam GB2, 457 x 610	1.7	m3
			floor slab						mm deep, Concrete, 35 Mpa (6 m)		
<u> </u>	1					A1 S	UBSTRUCTU	RE	Quantity		
	Step 2:				L	A11 F	oundations		1,067 m	2	
	1. Identi	ify the concre	ete items in your estima	ate by			1 Demolish ex	isting asphalt for	new foundation 1,067 m	2	
	item t	ype and con	crete strength	1		2	2 Perimeter gr	ade beam GB1,	254 x 610 mm deep 138 m		
							 Concrete, 	30 MPa	21 m3		
	2. Mapt	he CIQS forn	nat, Uniformat or othei	rs to			- Rebar, 15	kg/m	2,070 kg		
	tho ar	nronriato IC	MS codo				- Formwork		168 m2		
	the ap						- Void form	, 150 mm shearmat	35 m²		
	1.	ICMS Level	3 (i.e., substructure)				- Excavatio	n & removal	21 ma		
	2.	ICMS Level	4 (i.e., foundations)				 Blackfill w 	orkspace with granula	ar material 42 m	1	
							B Perimeter gr	ade beam GB2,	457 x 610 mm deep 6 m	_	
							 Concrete, 	35 MPa	2 m3		
							- Rebar, 25	kg/m	138 kg		
							- Formwork	450	7 m2		
							- voia form	n & romovol	3 m2		
							- Ditto wor	ksnace	2 IIk 2 m ²		
	- Backfill workspace with granular material 2 m3										RICS

	ICMS code	ICMS Level 3	ICMS Level 4	Code 1	Code 2	Code 3	Level 1	Level 2	Item Description	Quantity	Unit
1	2.02.020	Substructure	Foundations up to top of lowest	A1	A11	2	Substructure	Foundations	▶ Perimeter grade beam GB1, 254 x 610	21.4	m3
			floor slab	1	1				mm deep, Concrete, 30 Mpa (138 m)		
2	2.02.020	Substructure	Foundations up to top of lowest floor slab	A1	A11	3	Substructure	Foundations	Perimeter grade beam GB2, 457 x 610 mm deep, Concrete, 35 Mpa (6 m)	1.7	m3
	1					– A1 S	UBSTRUCTU	RE	Quantity		
	Step 3:					— A11 F	oundations		1,067 m2	2	
	1. Ident	ify the concr	ete items in your estima	ate by			1 Demolish exi	sting asphalt f	or new foundation 1,067 m2	2	
	item	ype and con	crete strength	1			2 Perimeter gra	ade beam GB1	, 254 x 610 mm deep 138 m	-	
							- Concrete, Rebar 15	30 MPa	21 III3 2 070 kg		
	2. Map	the CIQS forr	nat, Uniformat or othei	rs to			- Formwork	Ng/III	168 m2		
	the a	opropriate IC	MS code				- Void form,	150 mm shearmat	35 m2		
	1	ICMSTeve	13 (i.e. substructure)				- Excavation	n & removal	21 m3		
	±.						- Ditto, work	space	42 m3		
	۷.	ICIVIS Leve	14 (I.e., foundations)				 Backfill wo 	rkspace with granu	lar material 42 m3		
	3. Input	description	by concrete strength				B Perimeter gra	I ade beam GB2	, 457 x 610 mm deep 6 m	_	
							- Concrete,	<u>35 MPa</u>	2 m3		
							- Rebar, 25	kg/m	138 kg		
							- Formwork	150 mm aboarmat	/ m2		
							- Excavation	so min snearmat % removal	3 m2 2 m3		
							- Ditto, work	space	2 m3		
							- Backfill wo	rkspace with granu	lar material 2 m3		RICS

1 2.02.020 Substructure Foundations up to top of lowest floor slab A1 A11 2 Substructure Foundations Perimeter grade beam GB1, 254 x 610 mm deep, Concrete, 30 Mpa (138 m) -21.4 2 2.02.020 Substructure Foundations up to top of lowest floor slab A1 A11 3 Substructure Foundations Perimeter grade beam GB2, 457 x 610 mm deep, Concrete, 30 Mpa (138 m) -1.7 2 2.02.020 Substructure Foundations up to top of lowest floor slab A1 A11 3 Substructure Foundations Perimeter grade beam GB2, 457 x 610 mm deep, Concrete, 35 Mpa (6 m) -1.7 41 SUBSTRUCTURE A1 SUBSTRUCTURE A1 SUBSTRUCTURE Quantity	m3 m3
1 Image: floor slab Image: floor slab<	m3
2 2.02.020 Substructure Foundations up to top of lowest A1 A11 3 Substructure Foundations Perimeter grade beam GB2, 457 x 610 1.7 V H H H H A11 A	m3
2 2.02.020 Substructure Foundations up to top of lowest floor slab A1 A1 3 Substructure Foundations Perimeter grade beam GB2, 457 x 610 mm deep, Concrete, 35 Mpa (6 m) 1.7 41 Substructure Substructure Foundations Foundations Perimeter grade beam GB2, 457 x 610 mm deep, Concrete, 35 Mpa (6 m) 1.7 41 SUBSTRUCTURE Guantity Substructure Concrete, 35 Mpa (6 m) 1.7	m3
floor slab floor slab A1 SUBSTRUCTURE Quantity	
A1 SUBSTRUCTURE Quantity	
A1 SUBSTRUCTURE Quantity	
A1 SUBSTRUCTURE Quantity	
A11 Foundations 1,067 m2	
Step 3:	
1 Demolish existing asphalt <mark>fo</mark> r new foundation 1,067 m2	
1. Identify the concrete items in your estimate by	
item type and concrete strength	
- Concrete, 50 MP a 21 HS	
2. Wrap the cross format, of normat of others to - Formwork - Formwork 168 m2	
the appropriate ICMS code - Void form, 150 mm shearmat 35 m2	
1. ICMS Level 3 (i.e., substructure) - Excavation & removal 21 m3	
2. ICMS Level 4 (i.e., foundations)	
3. Input description by concrete strength 3 Perimeter grade beam GB2, 457 x 610 mm deep 6 m	
- Concrete, 35 MPa 2 m3	
4. Input quantity (volume) by concrete strength - Rebar, 25 kg/m 138 kg	
- Formwork 7 m2	
- void form, 150 mm snearmat 3 m2 - Excavation & removal 2 m3	
- Ditto, workspace 2 m3	
- Backfill workspace with granular material 2 m3	-

Recall Appendix B

Read	Ready-mix concrete used in project				Baseline greenhouse gas (GHG	calculations (GHG ca	lculations for project	mixes	Reductions in GHG emissions		
Element of building or structure (for example, walls, foundation)	Special application requirement? (Yes or No)	Reduction in volume of mix (yes or no) Select yes if the volume of a mix was reduced by increasing its compressive strength without adding other structural materials.	Compressive strength at 28 days (MPa)	Life cycle assessment (LCA) results table number (from the regional ASTM International Environmental Product Declaration (EPD))	Baseline global warming potential (GWP) (kg CO2/m3) per mix (using equivalent compressive strength from the regional ASTM International EPD)	Volume (m3)	Baseline GHG emissions per mix (tonnes CO2) based on the baseline GWP and volume	EPD or mix design reference number for the mix provided (from the supplier's EPD)	Adjusted volume (m3) Enter an adjusted volume only when "Yes" is selected under Reduction in volume (third column from the left under Ready-mix concrete used in project).	GWP (kg CO2/m3) of the mix provided (from the supplier's EPD)	GHG emissions per mix provided (tonnes CO2)	GHG emissions reduced compared to the baseline per mix provided (tonnes CO2)	Percentage reduction in GHG emissions per min compared to the baseline
Element 1	Yes/No	Yes/No	хх	х	XXX.XX	XXXX.X	XXX.XX	х	XXX.X	XXX.XXX	XXX.XX	XXX.XX	xx.x
Element 2	Yes/No	Yes/No	хх	х	XXX.XXX	XXXX	XXX.XX	х	XXXX.X	XXX.XXX	XXX.XX	XXX.XX	XX.X
Element 3	Yes/No	Yes/No	хх	х	XXLXXX	XXXX.X	XXX.XX	х	XXXX.X	XXX.XXX	XXX.XX	XXX.XX	XX.X
Element 4	Yes/No	Yes/No	хх	х	XXX.XXX	XXX.X	XXX.XX	х	XXXX.X	XXX.XXX	XXX.XX	XXX.XX	xx.x
Project totals	N/A	Yes/No	N/A	N/A	N/A	XXXX.X	XXX.XX	N/A	XXXX.X	N/A	XXX.XX	XXXXX.XX	XX.X
Reduction	GHG emission	s related to the embo	died carbon of	f ready-mix concrete s	supplied to the project (toppes)	~~~~	Percentage reduction in G	HG emissions related to t	he embodied carbon	of ready-mix concrete s	unnlied to the pro	hiert	VV V

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	В	С	D	E	F
1			Ready-mix concrete	used in proj	ect
	ICMS Code	ICMS Level 3	Element of building or structure (for example, walls, foundation)	Special application requirement?	Reduction in volume of mix (yes or no).
2				(Yes or No)	[NOTE 1]
3	2.02.020	Substructure	Perimeter grade beam GB1, 254 x 610 mm deep, Concrete, 30 Mpa (138 m)	No	No
1	2.02.020	Substructure	Perimeter grade beam GB2, 457 x 610 mm deep, Concrete, 35 Mpa (6 m)	No	No



	ICMS code	ICMS Level 3	ICMS Level 4	Code 1	Code 2	Code 3	Level 1	Level 2	Item Description	Quantity	Unit
1	2.02.020	Substructure	Foundations up to top of lowest	A1	A11	2	Substructure	Foundations	Perimeter grade beam GB1, 254 x 610	21.4	m3
	-		floor slab						mm deep, Concrete, 30 Mpa (138 m)		
2	2.02.020	Substructure	Foundations up to top of lowest	A1	A11	3	Substructure	Foundations	Perimeter grade beam GB2, 457 x 610	1.7	m3
			floor slab						mm deep, Concrete, 35 Mpa (6 m)		

1. Enter ICMS Code

				Ready-mix concrete	used in proje	ct	Project mix strengths	Bas	eline greenhouse gas	(GHG) cal	culations
		ICMS Code	ICMS Level 3	Element of building or structure (for example, walls, foundation)	Special application requirement? (Yes or No)	Reduction in volume of mix (yes or no). [NOTE 1]	Compressive strength at 28 days (MPa)	Life cycle assessment (LCA) results table number. [NOTE 2]	Baseline global warming potential (GWP) (kg CO2/m3) per mix [NOTE 3]	Volume (m3)	Baseline GHG emissions per mix (tonnes CO2) based on the baseline GWP and volume
1	•	2.02.020	Substructure	Perimeter grade beam GB1, 254 x 610 mm deep, Concrete, 30 Mpa (138 m)	No	No	30	Table 11	258.92	21.38	5.54
2	2 2	2.02.020	Substructure	Perimeter grade beam GB2, 457 x 610 mm deep, Concrete, 35 Mpa (6 m)	No	No	35	Table 15	293.75	1.67	0.49



	ICMS co	ode	ICMS Level 3	ICMS Level 4	Code 1	Code 2	Code 3	Level 1	Level 2	Item Description	Quantity	Unit
1	2.02.020		Substructure	Foundations up to top of lowest	A1	A11	2	Substructure	Foundations	Perimeter grade beam GB1, 254 x 610	21.4	m3
) T			floor slab						mm deep, Concrete, 30 Mpa (138 m)		
2	2.02.020		Substructure	Foundations up to top of lowest	A1	A11	3	Substructure	Foundations	Perimeter grade beam GB2, 457 x 610	1.7	m3
				floor slab						mm deep, Concrete, 35 Mpa (6 m)		

1. Enter ICMS Code

2. Enter ICMS Level 3

				Ready-mix concrete	used in proje	ct	Project mix strengths	Bas	eline greenhouse ga	s (GHG) ca	lculations
		ICMS Code	ICMS Level 3	Element of building or structure (for example, walls, foundation)	Special application requirement? (Yes or No)	Reduction in volume of mix (yes or no). [NOTE 1]	Compressive strength at 28 days (MPa)	Life cycle assessment (LCA) results table number. [NOTE 2]	Baseline global warming potential (GWP) (kg CO2/m3) per mix [NOTE 3]	Volume (m3)	Baseline GHG emissions per mix (tonnes CO2) based on the baseline GWP and volume
:		2.02.020	Substructure	Perimeter grade beam GB1, 254 x 610 mm deep, Concrete, 30 Mpa (138 m)	No	No	30	Table 11	258.92	21.38	5.54
	2	2.02.020	Substructure	Perimeter grade beam GB2, 457 x 610 mm deep, Concrete, 35 Mpa (6 m)	No	No	35	Table 15	293.75	1.67	0.49



		ICMS co	ode	ICMS I	_evel 3	ICMS Level 4	Code 1	Code 2	Code 3	Level 1	Level 2	Item Description	Quantity	Unit
	1	2.02.020		Substruc	ture	Foundations up to top of lowest	A1	A11	2	Substructure	Foundations	Perimeter grade beam GB1, 254 x 610	21.4	m3
ſ				T I		floor slab						mm deep, Concrete, 30 Mpa (138 m)		
	2	2.02.020		Substruc	ture	Foundations up to top of lowest	A1	A11	3	Substructure	Foundations	Perimeter grade beam GB2, 457 x 610	1.7	m3
						floor slab						mm deep, Concrete, 35 Mpa (6 m)		

1. Enter ICMS Code

2. Enter ICMS Level 3

3. Enter details of item description

				Ready-mix concrete	used in proje	ct	Project mix strengths	Bas	eline greenhouse ga	s (GHG) ca	lculations
ICM	S Code	ICMS Level	3	Element of building or structure (for example, walls, foundation)	Special application requirement? (Yes or No)	Reduction in volume of mix (yes or no). [NOTE 1]	Compressive strength at 28 days (MPa)	Life cycle assessment (LCA) results table number. [NOTE 2]	Baseline global warming potential (GWP) (kg CO2/m3) per mix [NOTE 3]	Volume (m3)	Baseline GHG emissions per mix (tonnes CO2) based on the baseline GWP and volume
1 2.02.0	20	Substructure		Perimeter grade beam GB1, 254 x 610 mm deep, Concrete, 30 Mpa (138 m)	No	No	30	Table 11	258.92	21.38	5.54
2 2.02.0	20	Substructure		Perimeter grade beam GB2, 457 x 610 mm deep, Concrete, 35 Mpa (6 m)	No	No	35	Table 15	293.75	1.67	0.49



	ICMS	code	ICMS I	Level 3	ICMS Level 4	Code 1	Code 2	Code 3	Level 1	Level 2	Item Description	Quantity	Unit
	2.02.02	0	Substruc	ture	Foundations up to top of lowest	A1	A11	2	Substructure	Foundations	Perimeter grade beam GB1, 254 x 610	21.4	m3
ſ			T		floor slab						mm deep, Concrete, 30 Mpa (138 m)		
	2 2.02.02	0	Substruc	ture	Foundations up to top of lowest	A1	A11	3	Substructure	Foundations	Perimeter grade beam GB2, 457 x 610	1.7	m3
					floor slab						mm deep, Concrete, 35 Mpa (6 m)		

1. Enter ICMS Code

2. Enter ICMS Level 3

3. Enter details of item description

4. Special Application (assume no)

			Ready-mix concrete	used in proje	ct	Project mix strengths	Bas	eline greenhouse ga	s (GHG) ca	lculations
ICMS Code	e ICMS Level	3	Element of building or structure (for example, walls, foundation)	Special application requirement? (Yes or No)	Reduction in volume of mix (yes or no). [NOTE 1]	Compressive strength at 28 days (MPa)	Life cycle assessment (LCA) results table number. [NOTE 2]	Baseline global warming potential (GWP) (kg CO2/m3) per mix [NOTE 3]	Volume (m3)	Baseline GHG emissions per mix (tonnes CO2) based on the baseline GWP and volume
1 2.02.020	Substructure		Perimeter grade beam GB1, 254 x 610 mm deep, Concrete, 30 Mpa (138 m)	No	No	30	Table 11	258.92	21.38	5.54
2 2.02.020	Substructure		Perimeter grade beam GB2, 457 x 610 mm deep, Concrete, 35 Mpa (6 m)	No	No	35	Table 15	293.75	1.67	0.49



	ICMS co	ode	ICMS I	_evel 3	ICMS Level 4	Code 1	Code 2	Code 3	Level 1	Level 2	Item Description	Quantity	Unit
	2.02.020		Substruc	ture	Foundations up to top of lowest	A1	A11	2	Substructure	Foundations	Perimeter grade beam GB1, 254 x 610	21.4	m3
۱ſ			T I		floor slab						mm deep, Concrete, 30 Mpa (138 m)		
ľ	2 2.02.020		Substruc	ture	Foundations up to top of lowest	A1	A11	3	Substructure	Foundations	Perimeter grade beam GB2, 457 x 610	1.7	m3
					floor slab						mm deep, Concrete, 35 Mpa (6 m)		

- 1. Enter ICMS Code
- 2. Enter ICMS Level 3
- 3. Enter details of item description
- 4. Special Application (assume no)
- 5. Reduction in Volume (yes if volume of mix reduced by increasing its
- compressive strength without adding other structural materials)

				Ready-mix concrete	used in proje	ct	Project mix strengths	Bas	eline greenhouse ga	s (GHG) ca	lculations
	ICMS Code	ICMS Level	3	Element of building or structure (for example, walls, foundation)	Special application requirement? (Yes or No)	Reduction in volume of mix (yes or no). [NOTE 1]	Compressive strength at 28 days (MPa)	Life cycle assessment (LCA) results table number. [NOTE 2]	Baseline global warming potential (GWP) (kg CO2/m3) per mix [NOTE 3]	Volume (m3)	Baseline GHG emissions per mix (tonnes CO2) based on the baseline GWP and volume
1	2.02.020	Substructure	-	Perimeter grade beam GB1, 254 x 610 mm deep, Concrete, 30 Mpa (138 m)	No	No	30	Table 11	258.92	21.38	5.54
2	2.02.020	Substructure		Perimeter grade beam GB2, 457 x 610 mm deep, Concrete, 35 Mpa (6 m)	No	No	35	Table 15	293.75	1.67	0.49



	ICMS co	ode ICMS L	evel 3	ICMS Level 4	Code 1	Code 2	Code 3	Level 1	Level 2	ltem Descript	on	Quantity	Unit
	1 2.02.020	Substruct	ure	Foundations up to top of lowe	est A1	A11	2	Substructure	Foundations	Perimeter grade beam GE	1, 254 x 610	21.4	m3
				floor slab						mm deep, Concrete 30 M	pa (138 m)		
	2 2.02.020	Substruct	ure	Foundations up to top of lowe	est A1	A11	3	Substructure	Foundations	Perimeter grade beam GE	2, 457 x 610	1.7	m3
				floor slab				-		mm deep, Concrete, <mark>35</mark> M	pa (6 m)		
	1. Er 2. Er 3. Er 4. Sp 5. Re cc	nter ICMS Coo Iter ICMS Lev Iter details of Decial Applicate eduction in Vo Impressive str	de rel 3 fitem o tion (as plume rength	description ssume no) (yes if volume of mix redu without adding other str Ready-mix concrete (uced by incr uctural mat	easing its erials)	Proje	6. Enter co	ncrete strengt	h Baseline greenhouse g	as (GHG) ca	lculations	
	ICMS Code	e ICMS Level 3	3 Eleme	ent of building or structure (for example, walls, foundation)	Special application requirement? (Yes or No)	Reduction in volume of mi (yes or no). [NOTE 1]	ix Com	pressive strength 28 days (MPa)	at Life cyu assessmen results t number. [N	cle Baseline global t (LCA) warming potential able (GWP) (kg CO2/m3) OTE 2] per mix [NOTE 3]	Volume (m3)	Baseline GHG per mix (ton based on the ba and vol	emissions ines CO2) aseline GWP ume
	2.02.020	Substructure	Perim mm d	neter grade beam GB1, 254 x 610 leep, Concrete, 30 Mpa (138 m)	No	No		30 🔶	Table 11	258.92	21.38	5.54	1
2	2.02.020	Substructure	Perim mm d	neter grade beam GB2, 457 x 610 leep, Concrete, 35 Mpa (6 m)	No	No		35	Table 15	293.75	1.67	0.49	9



	ICM	IS code	e ICMS	Level 3	ICMS Level 4	Code 1	Code 2	Code 3	Level 1	Leve	12	Item Des	scription	Quantity	Unit
	1 2.02.0	020	Substru	cture	Foundations up to top of lowe	est A1	A11	2	Substructure	Foundatio	ons Perir	neter grade bea	am GB1, 254 x 610	21.4	m3
		Γ			floor slab						mm	deep, Concrete	30 Mpa (138 m)		
	2 2.02.0	020	Substru	ture	Foundations up to top of lowe	est A1	A11	3	Substructure	Foundatio	ons Perir	neter grade bea	m GB2, 457 x 610	1.7	m3
					floor slab						mm	deep, Concrete,	35 Mpa (6 m)		
									ļ				-		
	1 2 3 4 5	. Ente . Ente . Ente . Spec . Redu	r ICMS Co r ICMS Le r details o cial Applic uction in N pressive s	de vel 3 of item (ation (a olume trength	description assume no) (yes if volume of mix red without adding other str	uced by incr uctural mat	easing its		6. Enter co	ncrete sti	rength				
\square					Ready-mix concrete	used in project	rt	Proje	act mix strangt	hs	Ba	seline greenho		culations	
					Ready-mix concrete	useu ili proje		Proje	ett mix strengt	115	Dd	senne greenno	use gas (GHG) ca		
	ICMS	Code	ICMS Leve	Blem 13	nent of building or structure (for example, walls, foundation)	Special application requirement? (Yes or No)	Reduction in volume of mix (yes or no). [NOTE 1]	x Com	pressive strength 28 days (MPa)	at asse re num	Life cycle ssment (LCA) sults table ber. [NOTE 2]	Baseline gl warming pot (GWP) (kg CO per mix [NO	obal ential Volume 2/m3) (m3) TE 3]	Baseline GHG per mix (ton based on the ba and vol	emissions ines CO2) aseline GWP ume
1	2.02.02	0	Substructure	Perim mm c	neter grade beam GB1, 254 x 610 deep, Concrete, 30 Mpa (138 m)	No	No		30 ┥	Table :	11	258.92	21.38	5.54	1
2	2.02.02	0	Substructure	Perim mm c	neter grade beam GB2, 457 x 610 deep, Concrete, 35 Mpa (6 m)	No	No		35	Table :	15	293.75	1.67	0.49	9





Declared Product	This Environmental Product Declaration (EPD) covers of Concrete BC members.	concrete mixes produced by
Declaration Owner	Concrete BC Suite 1300, 1500 West Georgia St. Vancouver, BC V6G 226 Phone: 604-626-4141 Website: www.concretebc.ca	CONCRETEBC
Program Operator	ASTM International 100 Bar Harbor Drive West Conshohocken, PA 19428-2959, USA Website: www.astm.org	ASTM INTERNATIONAL Helping our world work better
LCA and EPD Developer	Athena Sustainable Materials Institute 280 Albert Street, Suite 404 Ottawa, ON KIP 5G8, Canada Website: www.athenasmi.org	Athena Sustainable Materials Institute
Core PCR	ISO 21930:2017 Sustainability in Building Construction of Building Products	- Environmental Declaration
Sub-category PCR	NSF International Product Category Rule (PCR) for Cor 2021), Verified by Thomas P. Gloria, Ph.D., Industrial E	ncrete Version 2.1 (August Scology Consultants
Independent LCA Reviewer and EPD Verifier	Independent verification of the declaration and data, ISO 14025:2006 Internal x Exte	according to ISO 21930:2017 and ernal
	Thomas P. Gloria, Ph.D., Industrial Ecology Consultant	is, ASTM International
Date of Issue	July 27, 2022	
Period of Validity	5 Years – Valid until July 27, 2027	
EPD Number	EPD 348	

7. Enter LCA Table No. from regional ASTM International EPD





	ICMS code	e ICMS Lev	rel 3 ICMS Level 4	Code 1	Code 2	Code 3	Level 1	Level 2	Item Descriptio	n	Quantity	Unit
1	2.02.020	Substructur	re Foundations up to top of low floor slab	est A1	A11	2	Substructure	Foundations	Perimeter grade beam GB1 mm deep, Concrete, 30 Mp	, 254 x 610 a (138 m)	21.4	m3
2	2.02.020	Substructur	Foundations up to top of low floor slab	est A1	A11	3	Substructure	Foundations	Perimeter grade beam GB2 mm deep, Concrete, 35 Mp	, 457 x 610 a (6 m)	1.7	m3
				Environment GWP	CA Results 3	O MPa Cor iaseline 30 MPa Concrete vithout air (N) GU 20 SCM 258.92	6. Enter co 7. Enter LC	ncrete strengt A Table No. fro	n om regional ASTM Interr	national E	PD	
			Ready-mix concrete	used in proje	ct	Proj	ect mix strengt	hs	Baseline greenhouse ga	s (GHG) ca	Iculations	
	ICMS Code	ICMS Level 3	Element of building or structure (for example, walls, foundation)	Special application requirement? (Yes or No)	Reduction i volume of m (yes or no) [NOTE 1]	in nix Com).	pressive strength 28 days (MPa)	at Life cyc assessment results ta number. [N	le Baseline global (LCA) warming potential (ble (GWP) (kg CO2/m3) OTE 2] per mix [NOTE 3]	Volume (m3)	Baseline GHG per mix (ton based on the ba and vol	emissions ines CO2) aseline GWP ume
1	2.02.020	Substructure	Perimeter grade beam GB1, 254 x 610 mm deep, Concrete, 30 Mpa (138 m)	No	No		30	Table 11	258.92	21.38	5.54	4
2	2.02.020	Substructure	Perimeter grade beam GB2, 457 x 610 mm deep, Concrete, 35 Mpa (6 m)	No	No		35	Table 15	293.75	1.67	0.49	9



		ICMS code	e ICMS Lev	vel 3 ICMS Level 4	Code 1	Code 2	Code 3	Level 1	Level 2	Item Description	n	Quantity	Unit
	1	2.02.020	Substructur	Foundations up to top of lowe	est A1	A11	2	Substructure	Foundations	Perimeter grade beam GB1,	254 x 610	21.4	m3
										min deep, concrete, 30 Mpa	a (138111)		
	2	2.02.020	Substructur	Foundations up to top of lowe	est A1	A11	3	Substructure	Foundations	Perimeter grade beam GB2,	457 x 610	1.7	m3
				lioor siab						mm deep, Concrete, 35 Mpa	a (6 m)		
-					Table 11.	LCA Results 3	0 MPa Cor			1		1	
					E	Baseline 30 MPa	6. Enter cor 7. Provide <i>A</i>	ASTM Internation	i onal EPD Table used				
					Unit	Concrete vithout air	8. Enter bas	seline GWP for	30 MPa from Table 11				
							(NI) GLI 20						
							SCM						
					Environment	al impacts	SCM	`					
Г				Ready-mix concrete	Environment GWP used in proje	al impacts kg CO2 eq. (Ct	258.92 Proj	ect mix strengtl	ns 🗸	Baseline greenhouse gas	s (GHG) cal	culations	
				Ready-mix concrete	Environment GWP used in proje Special	al impacts kg CO2 eq. (Ct Reduction	258.92 Proj	ect mix strengt	ns Life cycle	Baseline greenhouse gas	s (GHG) cal	culations Baseline GHG	emissions
		ICMS Code	ICMS Level 3	Ready-mix concrete Element of building or structure (for example, walls, foundation)	Environment GWP used in proje Special application requirement?	al impacts kg CO2 eq. (ct Reduction i volume of n (yes or no	258.92 Proj	ect mix strengtl pressive strength 28 days (MPa)	ns Life cycl at assessment results.tal	Baseline greenhouse gas e Baseline global (LCA) warming potential (GWP) (kg CO2/m3)	s (GHG) cal Volume (m3)	culations Baseline GHG per mix (ton based on the ba	emissions nes CO2) aseline GWP
		ICMS Code	ICMS Level 3	Ready-mix concrete Element of building or structure (for example, walls, foundation)	Environment GWP used in proje Special application requirement? (Yes or No)	al impacts kg CO2 eq. (ct Reduction i volume of n (yes or no [NOTE 1]	258.92 Projinnix Com	ect mix strengtl pressive strength 28 days (MPa)	hs Life cycle at assessment results tal number. [NC	Baseline greenhouse gas e Baseline global (LCA) warming potential (GWP) (kg CO2/m3) per mix [NOTE 3]	s (GHG) cal Volume (m3)	Culations Baseline GHG per mix (ton based on the ba and vol	emissions nes CO2) aseline GWP ume
	1	ICMS Code	ICMS Level 3	Ready-mix concrete Element of building or structure (for example, walls, foundation) Perimeter grade beam GB1, 254 x 610	Environment GWP used in proje Special application requirement? (Yes or No)	al impacts kg CO2 eq. (Ct Reduction i volume of n (yes or no) [NOTE 1]	258.92 Proj	ect mix strength pressive strength 28 days (MPa)	hs Life cycle at assessment results.tal number. [NC	Baseline greenhouse gas e (LCA) ole (GWP) (kg CO2/m3) per mix [NOTE 3]	s (GHG) cal Volume (m3)	Baseline GHG per mix (ton based on the ba and vol	emissions nes CO2) aseline GWP ume
	1	ICMS Code 2.02.020	ICMS Level 3 Substructure	Ready-mix concrete Element of building or structure (for example, walls, foundation) Perimeter grade beam GB1, 254 x 610 mm deep, Concrete, 30 Mpa (138 m)	Environment GWP used in proje Special application requirement? (Yes or No)	al impacts kg CO2 eq. (Ct Reduction i volume of n (yes or no) [NOTE 1] No	258.92 Proj in nix Com	ect mix strength pressive strength 28 days (MPa) 30	at Life cycle at assessment results tal number. [NC Table 11	Baseline greenhouse gas Baseline global warming potential (GWP) (kg CO2/m3) per mix [NOTE 3]	s (GHG) cal Volume (m3) 21.38	Baseline GHG per mix (ton based on the ba and vol	emissions nes CO2) aseline GWP ume
	1	ICMS Code 2.02.020	ICMS Level 3 Substructure	Ready-mix concrete Element of building or structure (for example, walls, foundation) Perimeter grade beam GB1, 254 x 610 mm deep, Concrete, 30 Mpa (138 m)	Environment GWP used in proje Special application requirement? (Yes or No)	al impacts kg CO2 eq. (Ct Reduction i volume of n (yes or no [NOTE 1] No	258.92 Proju in nix Com	ect mix strength pressive strength 28 days (MPa) 30	hs Life cycle at assessment results tal number. [NC Table 11	Baseline greenhouse gas e (LCA) ole DTE-2] Baseline global warming potential (GWP) (kg CO2/m3) per mix [NOTE 3] 258.92	s (GHG) cal Volume (m3) 21.38	Baseline GHG per mix (ton based on the ba and vol	em nes asel ume



		ICMS code	ICMS Lev	/el 3 ICMS Level 4	Code 1	Code 2	Code 3	Level 1	Level 2	Item Description	n	Quantity	Unit
	1	2.02.020	Substructur	e Foundations up to top of lowe floor slab	est A1	A11	2	Substructure	Foundations	Perimeter grade beam GB1, mm deep, Concrete, 30 Mpa	, 254 x 610 a (138 m)	21.4	m3
	2	2.02.020	Substructur	e Foundations up to top of lowe floor slab	est A1	A11	3	Substructure	Foundations	Perimeter grade beam GB2, mm deep, Concrete, 35 Mpa	, 457 x 610 a (6 m)	1.7	m3
		-			Table 11. I Environment GWP	Unit unit kg CO2 eq.	O MPa Cor Baseline 30 MPa Concrete without air (N) GU 20 SCM 258.92	6. Enter co 7. Provide / 8. Enter ba 9. Enter vo	ncrete strengt ASTM Internat seline GWP for lume of concre	h ional EPD Table used r 30 MPa from Table 11 ete from estimate			
				Ready-mix concrete	used in proje	ct	Proj	ect mix strengt	hs	Baseline greenhouse ga	s (GHG) cal	culations	
		ICMS Code	ICMS Level 3	Element of building or structure (for example, walls, foundation)	Special application requirement? (Yes or No)	Reduction volume of n (yes or no [NOTE 1]	in nix Com).	pressive strength 28 days (MPa)	at assessment results ta number. [N	le Baseline global : (LCA) warming potential uble (GWP) (kg CO2/m3) OTE-21 per mix [NOTE 3]	Volume (m3)	Baseline GHG per mix (ton based on the ba and vol	emissions ines CO2) aseline GWP ume
	1	2.02.020	Substructure	Perimeter grade beam GB1, 254 x 610 mm deep, Concrete, 30 Mpa (138 m)	No	No		30	Table 11	258.92	21.38	5.54	4
-	2	2.02.020	Substructure	Perimeter grade beam GB2, 457 x 610 mm deep, Concrete, 35 Mpa (6 m)	No	No		35	Table 15	293.75	1.67	0.49	9



		ICMS code	ICMS Lev	vel 3 ICMS Level 4	Code 1	Code 2	Code 3	Level 1	Level 2	Item Description	า	Quantity	Unit
	1	2.02.020	Substructur	Foundations up to top of lowe floor slab	est A1	A11	2	Substructure	Foundations	Perimeter grade beam GB1, mm deep, Concrete, 30 Mpa	254 x 610 a (138 m)	21.4	m3
	2	2.02.020	Substructur	e Foundations up to top of lowe floor slab	est A1	A11	3	Substructure	Foundations	Perimeter grade beam GB2, mm deep, Concrete, 35 Mpa	457 x 610 a (6 m)	1.7	m3
-		1	1	i	Table 11. I	LCA Results 3	0 MPa Cor	I	1			1	
					Environment GWP	Unit Unit al impacts kg CO2 eq. (Baseline 30 MPa Concrete without air (N) GU 20 SCM	6. Enter con 7. Provide A 8. Enter bas 9. Enter volu 10. Baseline	Crete strength STM Internatio eline GWP for 3 ume of concret GHG = <u>GWP x 1</u> 100	nal EPD Table used 80 MPa from Table 11 e from estimate volume = <u>258.92 x 21.3</u> 0 1000	: <u>8</u> =5.54 t	cnnes CO2	
Г				Ready-mix concrete	used in proie	ct	Proi	ect mix strength		Baseline greenhouse gas	s (GHG) cal	culations	
		ICMS Code	ICMS Level 3	Element of building or structure (for example, walls, foundation)	Special application requirement? (Yes or No)	Reduction volume of r (yes or no [NOTE 1]	in nix Com).	pressive strength a 28 days (MPa)	Life cycle assessment (I results tabl number. [NO	CA) Baseline global warming potential e (GWP) (kg CO2/m3) E-2] per mix [NOTE 3]	Volume (m3)	Baseline GHG per mix (ton based on the ba and vol	emissions nes CO2) aseline GWP ume
	1	2.02.020	Substructure	Perimeter grade beam GB1, 254 x 610 mm deep, Concrete, 30 Mpa (138 m)	No	No		30	Table 11	258.92	21.38	5.54	D
	2	2.02.020	Substructure	Perimeter grade beam GB2, 457 x 610 mm deep, Concrete, 35 Mpa (6 m)	No	No		35	Table 15	293.75	1.67	0.49)



	ICMS code	ICMS Level 3	ICMS Level 4	Code 1	Code 2	Code 3	Level 1	Level 2	Item Description	Quantity	Unit
1	2.02.020	Substructure	Foundations up to top of lowest	A1	A11	2	Substructure	Foundations	Perimeter grade beam GB1, 254 x 610	21.4	m3
			floor slab						mm deep, Concrete, 30 Mpa (138 m)		
2	2.02.020	Substructure	Foundations up to top of lowest	A1	A11	3	Substructure	Foundations	Perimeter grade beam GB2, 457 x 610	1.7	m3
			floor slab						mm deep, Concrete, 35 Mpa (6 m)		





ICMS code	ICMS I	_evel 3	ICMS Level 4		Code 1 C	Code 2	Code 3	Level 1	l	_evel 2	Item Desci	ription	Quantity	Unit
2.02.020	Substruc	ture f	oundations up to top c	of lowest	A1	A11	2 9	Substructure	e Found	dations Per	meter grade beam	n GB1, 254 x 610	21.4	m3
		f	loor slab							mm	deep, Concrete, 3	0 Mpa (138 m)		
						ENVI	RONMENTAL I	MPACTS						
2.02.020	Substruc	ture F	Foundations up to top o	of lowest	A1	A11 Mix GO	C30E0XB1C08 • N	North Vancouver Pla	nt Plant	ations Peri	meter grade beam	n GB2, 457 x 610	1.7	m3
		f	loor slab			AIR EV Comp	OBUILD BRONZE	E 0 MPa at 28 days		mm	deep, Concrete, 3	5 Mpa (6 m)		
						Decla	ared Unit: 1 m ³ c	of concrete						
e 11. LCA Results 3	30 MPa Cor					Global	Warming Potential (kg	(CO ₂ -eq)	231					
	Baseline 30	11 Ente	r FPD or mix design	referenc	е ——	Ozone	Depletion Potential (kg) CFC-11-eq)	7.44E-6					
1	MPa	num	her from the suppl	lier		Extrop	hication Potential (kg N	v-eq)	0.24					
Unit	Concrete	mann	ber nom the suppl			Photoc	hemical Ozone Creation Depletion, non-fossil (I	on Potential (kg O ₃ -eq) (kg Sb-eq)	26.1 7.06E-6					
$\langle \rangle$	(N) GU 20					Abiotic	Depletion, fossil (MJ)		1,290					
$\langle \rangle$	SCM					Consur	nption of Freshwater ((m ³)	4.35					
onmental impacts						Produ	ct Components:	admixture (ASTM C494	l), crushed					
kg CO2 eq.	258.92					aggrega	ite (ASTM C33), natur ne cement (ASTM 595	ral aggregate (ASTM C33 5), batch water (ASTM C	3), portland 1602)					
	X					Additional of	detail and impacts are	reported on page three	of this EDD					
oject mix strengt	:hs	Ba	aseline greenhouse gas	s (GHG) ca	lculations		GH	IG calculation	ons for pro	oject mixes	R	eductions in GHG e	nissions	
ompressive strength 28 days (MPa)	at asses res numb	ife cycle sment (LCA) sults table per. [NOTE 2]	Baseline global warming potential (GWP) (kg CO2/m3) per mix [NOTE 3]	Volume (m3)	Baseline GH per mix (to based on the b and vo	G emissions nnes CO2) paseline GW plume	EPD or r reference for the m (from the	mix design ce number nix provided e supplier's IPD)	Adjusted volume (m3) [NOTE 4]	GWP (kg CO2/m3) of the mix provided (from the supplier's EPD)	GHG emissions per mix provided (tonnes CO2)	GHG emissions reduced compared to the baseline per mix provided (tonnes CO2	Percentage GHG emiss compared to	reduction in ions per mix the baseline
			•				MixGC30E	EOXB1C08						
30	Table 1	1	258.92	21.38	5.5	64	(North Va Plant)	ncouver	0.00	231.00	4.94	0.60	10.	78%
							Mix GC35	EOXB1C08						
35	Table 1	5	293.75	1.67	0.4	19	(North Va	ncouver	0.00	275.00	0.46	0.03	6.3	88%
	ICMS code 2.02.020 2.02.020 e 11. LCA Results : Unit Unit Unit impressive strength 28 days (MPa) 30 35	ICMS code ICMS I 2.02.020 Substruct 2.02.020 Substruct 2.02.020 Substruct e 11. LCA Results 30 MPa Cor Baseline 30 MPa Concrete without air (N) GU 20 SCM unit Baseline 30 MPa Concrete without air (N) GU 20 SCM pmmental impacts kg CO2 eq. 258.92 oject mix strengths 28 days (MPa) L asses res numb 30 Table 1 35 Table 1	ICMS code ICMS Level 3 2.02.020 Substructure F 2.02.020 Substructure F 2.02.020 Substructure F 2.02.020 Substructure F e 11. LCA Results 30 MPa Cor F unit Baseline 30 MPa Concrete without air (N) GU 20 SCM 11. Enter pmmental impacts SCM kg CO2 eq. 258.92 oject mix strengths Basessment (LCA) results table assessment (LCA) Results table 30 Table 11 35 Table 15	ICMS codeICMS Level 3ICMS Level 42.02.020SubstructureFoundations up to top of floor slab2.02.020SubstructureFoundations up to top of floor slab2.02.020SubstructureFoundations up to top of floor slabe 11. LCA Results 30 MPa Cor UnitBaseline 30 MPa Concrete without air (N) GU 20 SCM11. Enter EPD or mix design number from the suppleoject mix strengthsBaseline greenhouse gas assessment (LCA) results table number. [NOTE 2]30Table 11258.9230Table 11258.92	ICMS codeICMS Level 3ICMS Level 42.02.020SubstructureFoundations up to top of lowest floor slab2.02.020SubstructureFoundations up to top of lowest floor slab2.02.020SubstructureFoundations up to top of lowest floor slabe 11. LCA Results 30 MPa Cor UnitBaseline 30 MPa Concrete without air (N) GU 20 SCM11. Enter EPD or mix design reference number from the supplieroject mix strengthsBaseline greenhouse gas (GHG) ca umpressive strength at 28 days (MPa)Life cycle assessment (LCA) results table number. [NOTE 2]Baseline global warming potential (GWP) (kg C02/m3) per mix [NOTE 3]Volume (m3)30Table 11258.9221.3835Table 15293.751.67	ICMS codeICMS Level 3ICMS Level 4Code 1C2.02.020SubstructureFoundations up to top of lowestA1A12.02.020SubstructureFoundations up to top of lowestA12.02.020SubstructureFoundations up to top of lowestA1e 11. ICA Results 30 MPa Cor UnitBaseline 30 MPa Concrete without air (N GU 20 SCM11. Enter EPD or mix design reference number from the supplierunitBaseline 30 MPa Concrete scmMPa Concrete number from the supplierSee See See See See See See See See See	ICMS code ICMS Level 3 ICMS Level 4 Code 1 Code 2 2.02.020 Substructure Foundations up to top of lowest A1 A11 2.02.020 Substructure Foundations up to top of lowest A1 A11 2.02.020 Substructure Foundations up to top of lowest A1 A11 2.02.020 Substructure Foundations up to top of lowest A1 A11 2.02.020 Substructure Foundations up to top of lowest A1 A11 2.02.020 Substructure Foundations up to top of lowest A1 A11 e11. ICA results 30 MPa Cor I1. Enter EPD or mix design reference MPa 0 mmental impacts Inumber from the supplier Mater 0 oject mix strengths Baseline greenhouse gas (GHG) calculations Baseline GHG emissions mpressive strength at 28 days (MPa) Life cycle assessment (ICA) results table number. [NOTE 3] Volume (m3) Baseline GHG emissions per mix (tornes CO2) 30 Table 11 258.92 21.38 5.54 35 Table 15 293.75 1.67 0.49	ICMS code ICMS Level 3 ICMS Level 4 Code 1 Code 2 Code 3 2.02.020 Substructure Foundations up to top of lowest floor slab A1 A11 2 2.02.020 Substructure Foundations up to top of lowest floor slab A1 A11 A11 2 2.02.020 Substructure Foundations up to top of lowest floor slab A1 A11 A11 A11 Beclared Product McGoseBoxBiole CBENK Concrete 2.02.020 Substructure Foundations up to top of lowest floor slab A1 A11 A11 Baseline 30 MPa Concrete without air (N) GU 20 SCM Baseline 30 MPa Concrete without air (N) GU 20 SCM 11. Enter EPD or mix design reference number from the supplier Baseline 30 MBaseline 30 MBaseline 30 MBaseline greenhouse gas (GHG) calculations Concrete Mate Baseline 30 MBaseline 30 MBaseline GHG emissions per mix (tornes CO2) based on the baseline GWP and volume Concrete Missions per mix (tornes CO2) based on the baseline GWP and volume Concrete Missions per mix (tornes CO2) based on the baseline GWP and volume CH Missions per mix (tornes CO2) based on the baseline GWP and volume Missions per mix (tornes CO2) based on the baseline GWP and volume CH Missions per mix (tornes CO2) based on the baseline GWP and volume Missions per mix (tornes CO2) based on the baseline GWP and volume Missions per mix (tornes CO2) based on the baseline GWP and volume	ICMS code ICMS Level 3 ICMS Level 4 Code 1 Code 2 Code 3 Level 1 2.02.020 Substructure Foundations up to top of lowest floor slab A1 A11 2 Substructure 2.02.020 Substructure Foundations up to top of lowest floor slab A1 A11 2 Substructure 2.02.020 Substructure Foundations up to top of lowest floor slab A1 A11 A11 2 Substructure 0 Galaxies Foundations up to top of lowest floor slab A1 A11 A11 Compace Substructure Foundations up to top of lowest floor slab A1 A11 A11 Compace Substructure Foundations up to top of lowest floor slab A1 A11 A11 Compace Substructure Foundations up to top of lowest floor slab A1 A11 A11 Code 22 days Compace Substructure Foundations up to top of lowest floor slab A1 A11 A11 Code 22 days Code 20 days	ICMS code ICMS Level 3 ICMS Level 4 Code 1 Code 2 Code 3 Level 1 I 2.02.020 Substructure Foundations up to top of lowest floor slab A1 A11 2 Substructure Foundations up to top of lowest floor slab A1 A11 2 Substructure Foundations up to top of lowest floor slab A1 A11 2 Substructure Foundations up to top of lowest floor slab A1 A11 2 Substructure Foundations up to top of lowest floor slab A1 A11 A11 Commentation floor slab Foundations up to top of lowest floor slab A1 A11 A11 Commentation floor slab Foundation floor floor slab Foundatio	ICMS code ICMS Level 3 ICMS Level 4 Code 1 Code 2 Code 3 Level 1 Level 2 2.02.020 Substructure Foundations up to top of lowest floor slab A1 A11 2 Substructure Foundations up to top of lowest floor slab A1 A11 2 Substructure Foundations up to top of lowest floor slab A1 A11 2 Substructure Foundations up to top of lowest floor slab A1 A11 2 Substructure Foundations up to top of lowest floor slab A1 A11 Concerve floor slab Periodicitie ENVIRONMENTAL IMPACTS Concerve floor slab Periodicitie ENVIRONMENTAL IMPACTS Concerve floor slab Periodicitie Foundations floor slab F	ICMS code ICMS Level 3 ICMS Level 4 Code 1 Code 2 Code 3 Level 1 Level 2 Item Desc 2.02.020 Substructure Foundations up to top of lowest floor slab A1 A11 2 Substructure Foundations up to top of lowest floor slab A1 A11 2 Substructure Foundations up to top of lowest floor slab A1 A11 2 Substructure Foundations up to top of lowest floor slab A1 A11 A11	ICMS code ICMS Level 3 ICMS Level 4 Code 1 Code 2 Code 3 Level 1 Level 2 Item Description 2.02.020 Substructure Foundations up to top of lowest floor slab A1 A11 2 Substructure Foundations Perimeter grade beam GB1, 254 x 610 mm deep, Concrete, 30 Mpa (138 m) 2.02.020 Substructure Foundations up to top of lowest floor slab A1 A11 A14 Perimeter grade beam GB1, 254 x 610 mm deep, Concrete, 30 Mpa (138 m) 2.02.020 Substructure Foundations up to top of lowest floor slab A1 A14 A14 Perimeter grade beam GB2, 457 x 610 mm deep, Concrete, 35 Mpa (6 m) 0 ILICAR escults 30 MPa Concerter without arr top of slab ILI Enter EPD or mix design reference number from the supplier Perimeter grade beam GB2, 457 x 610 mm deep, Concrete, 35 Mpa (6 m) 0 ILICAR escults 30 MPa Concerter without arr top of scate grade meansate tig fore 28 dog mm deep (Concerte grade meansate grade meansate grade	ICMS code ICMS Level 3 ICMS Level 4 Code 1 Code 2 Code 3 Level 1 Level 2 Item Description Quantity 2.02 020 Substructure Foundations up to top of lowest floor slab A1 A1 A1 2 Substructure Perimeter grade beam GB1, 254 x 610 21.4 2.02 020 Substructure Foundations up to top of lowest floor slab A1 A1 A1 A1 A1 Perimeter grade beam GB2, 257 x 610 1.7 2.02 020 Substructure Foundations up to top of lowest floor slab A1 A1



	ICMS code	ICMS Level 3	ICMS Level 4	Code 1	Code 2	Code 3	Level 1	1 1	Level 2	Item Desc	ription	Quantity	Unit
1	2.02.020	Substructure	Foundations up to top of lowe	est A1	A11	2	Substructu	ire Foun	dations Per	meter grade bean	n GB1, 254 x 610	21.4	m3
			floor slab		- r			REMPEL	mm	deep, Concrete, 3	0 Mpa (138 m)		
						ENVIRONMENTA		Concrete Heldel Berg Clave Ni Croce					
Ž	2 2.02.020	Substructure	Foundations up to top of lowe	est A1	A11	Mix GC30E0XB1C0	8 • North Vancouver P	Plant Plant	ations Per	meter grade bean	n GB2, 457 x 610	1.7	m3
			floor slab			AIR EVOBULD BRO	NZE	IPA 20 MIM NON	mm	deep, Concrete, 3	5 Mpa (6 m)		
						Declared Unit: 1	m ³ of concrete						
Tab	le 11 I CA Results 3	0 MPa Cor	1	1	· · · · ·	Gobal Warming Potentia	il (kg CO>eq)	231			1		
Tub	ie II. Lea nesuits s		or EDD or mix design refer			Ozone Depletion Potentia	al (kg CFC-11-eq)	7.44E-6					
	۴ (۲۰۰۱)	MPa	er EPD or mix design reier	ence		Acidification Potential (k	g SO ₂ -eq) (kg N-eq)	0.97					
	11.54	Concrete	nber from the supplier	- 1		Photochemical Ozone C	reation Potential (kg O3-eq)	26.1					
	Unit	vithout air 12. Ent	er adjusted volume (assu	ıme 0)——		Abiotic Depletion, non-fo	eell (kg Sh-eq) MJ)	7.06E-6 1,290					
	$\langle \rangle$	(N) GU 20				Total Waste Disposed (k	g)	0.58					
	$\langle \rangle$	SCM				Consumption of Freshwa	ater (m ³)	4.35					
Envir	onmental impacts					Product Componer aggregate (ASTM C33), r	nts: admixture (ASTM C4 natural aggregate (ASTM C	94), crushed 33), portland					
GWP	kg CO2 eq.	258.92				limestone cement (ASTN	1 595), batch water (ASTM	C1602)					
					Add	ational detail and impacts			ale at weives				
	roject mix strengt	ns	Baseline greennouse gas (GHG) calculation	S	F00	SHG calculat	ions for pr	oject mixes	ĸ	eductions in GHG ei	nissions	
c	ompressive strength 28 days (MPa)	Life cycle assessment (LC results table number. [NOTE	A) Baseline global Warming potential Volu (GWP) (kg CO2/m3) (m per mix [NOTE 3]	Baselin ime per m 3) based on a	e GHG emiss ix (tonnes CC the baseline nd volume	GWP	ence number mix provided the supplier's EPD)	Adjusted volume (m3) [NOTE 4]	GWP (kg CO2/m3) of the mix provided (from the supplier's EPD)	GHG emissions per mix provided (tonnes CO2)	GHG emissions reduced compared to the baseline per mix provided (tonnes CO2	Percentage GHG emiss compared to	reduction in ions per mix o the baseline
			X			MixGC	BOEOXB1C08						
	30	Table 11	258.92 21.	38	5.54	(North Plant)	Vancouver	•••• 0.00	231.00	4.94	0.60	10.	78%
						Mix GC	35E0XB1C08						
	35	Table 15	293.75 1.6	57	0.49	(North	Vancouver	0.00	275.00	0.46	0.03	6.3	38%
						Plant)							



	ICMS code	ICMS Level 3	ICMS Level 4	Code 1	Code 2	2 Code 3	Level 1	l	evel 2	Item Desc	ription	Quantity	Unit
1	2.02.020	Substructure	Foundations up to top of low	vest A1	A11	2	Substructu	re Found	dations Peri	meter grade bean	n GB1, 254 x 610	21.4	m3
			floor slab		- r				mm	deep, Concrete, 3	30 Mpa (138 m)		
						ENVIRONMENTA	L IMPACTS	Concrete Heidelbergolementionup					
2	2.02.020	Substructure	Foundations up to top of low	vest A1	A <mark>11</mark>	Mix GC30E0XB1C0	8 • North Vancouver Pl AL CONCRETE 30 M	lant Plant PA 20 MM NON	ations Peri	meter grade bean	n GB2, 457 x 610	1.7	m3
			floor slab			AIR EVOBUILD BRO	NZE h: 30 MPa at 28 days		mm	deep, Concrete, 3	35 Mpa (6 m)		
						Declared Unit: 1	m ³ of concrete						
Tabl	e 11. LCA Results 30) MPa Cor				Global Warming Potentia	ıl (kg CO ₂ -eq)	231					
	В	aseline 30 11. Ent	er EPD or mix design refe	erence —		Ozone Depletion Potential	al (kg CFC-11-eq) g SO ₂ -eq)	7.44E-6 0.97	13. Enter G	WP from supp	lier		
	_ _	MPa nu	mber from the supplier			Eutrophication Potential	(kg N-eq)	0.24					
	Unit	Concrete	er adjusted volume (ass	ume 0)——		Abiotic Depletion, non-fo	eall (kg Sb-eq)	7.06E-6					
		(N) GU 20		/		Abiotic Depletion, fossil ((MJ) a)	1,290					
	$\langle \rangle$	SCM				Consumption of Freshwa	ater (m ³)	4.35					
Envir	onmental impacts					Product Componer aggregate (ASTM C33), r	nts: admixture (ASTM C4 natural aggregate (ASTM C	94), crushed 33), portland					
GWP	kg CO2 eq.	258.92			L	limestone cement (ASTN	1 595), batch water (ASTM	C1602)]				
Dr	oject mix strength		Basalina graanhausa gas (GH	(G) calculation	Adx	citional detail and impacts		ons for pr	piect mixes	P	aductions in CHC o	nissions	
PI	oject mix strengti	15	baselille greelillouse gas (Gh		15	EPD C	or mix design	ons for pro	oject mixes	ĸ		1115510115	
		Life cycle	Baseline global	Baselin	e GHG emiss	sions refer	ence number	Adjusted	GWP (kg CO2/m3)	GHG emissions per	GHG emissions	Percentage	reduction in
	28 days (MPa)	results table	(GWP) (kg CO2/m3) (n	n3) based or	the baseline	e GWP	mix provided	(m3)	provided (from	mix provided	the baseline per mix	GHG emiss	ions per mix
	, , ,	number. [NOTE	2] per mix [NOTE 3]	a	ind volume	(from	the supplier's EPD)	[NOTE 4]	the supplier's EPD)	(tonnes CO2)	provided (tonnes CO2) compared to	the baseline
			*			MixGC	BOEOXB1C08						
	30	Table 11	258.92 21	L.38	5.54	(North	Vancouver	0.00	231.00	4.94	0.60	10.	78%
						Mix GC	35E0XB1C08						
	35	Table 15	293.75 1.	.67	0.49	(North	Vancouver	0.00	275.00	0.46	0.03	6.3	88%
						Plant)							

		ICMS code	ICMS Level 3	ICMS Level 4		Code 1	Code 2	Code 3	Level 1	L	evel 2	ltem	Description	Quantity	Unit
	1	2.02.020	Substructure	Foundations up to top of lo	owest	A1	A11	2	Substructu	re Found	dations	Perimeter grade	beam GB1, 254 x 610	21.4	m3
							EN	VIRONMENTA	L IMPACTS	REMPEL		nin deep, conci	сте, 50 мра (150 m)		
	2	2.02.020	Substructure	Foundations up to top of lo	owest	A1	A11 Mix Des	GC30E0XB1C08 cription: GENERA	AL CONCRETE 30 MI	ant Plant PA 20 MM NON	ations	Perimeter grade	beam GB2, 457 x 610	1.7	m3
							Con Dec	npressive strength clared Unit: 1 n	n: 30 MPa at 28 days			nin deep, conci	etc, 55 liipa (6 lii)		
	[able]	11. LCA Results 30	MPa Cor				Glob Ozo	al Warming Potential ne Depletion Potential	(kg CO ₂ -eq) (kg CFC-11-eq)	231 7.44E-6					
		Bas	MPa Du	er EPD or mix design re	eference	2	Acid	ification Potential (kg ophication Potential (l	SO₂-eq) kg N-eq)	0.97 0.24	13. Ente	r GWP from s	supplier - 4 94 - 21 38 m3 x 23	21 kg CO2/g	n3
		Unit Co Wit	thout air 12. Ent	er adjusted volume (as	ssume	0)	Pho Abic	tochemical Ozone Cre atic Depletion, non-fos atic Depletion, fossil (h	sil (kg Sb-eq)	26.1 7.06E-6	14. 1100		1000 to conve	rt kg to ton	nes
		(N	I) GU 20 SCM				Tota	l Waste Disposed (kg sumption of Freshwat) ter (m ³)	0.58					
E	nviron	mental impacts					Pro	duct Componen egate (ASTM C33), n	i ts: admixture (ASTM C49 atural aggregate (ASTM C	94), crushed 33), portland					
9	IVVP	kg CO2/eq.	258.92				Additiona	stone cement (ASTM al detail and impacts	595), batch water (ASTM are reported on page three	C1602) of this EPD	J				
	Proj	ect mix strengths	;	Baseline greenhouse gas (C	GHG) cal	culations		G	HG calculati	ons for pro	oject mixes		Reductions in GHG e	missions	>
	Com	pressive strength at 28 days (MPa)	Life cycle assessment (LC results table number. [NOTE	Baseline global A) warming potential (GWP) (kg CO2/m3) 2] per mix [NOTE 3]	Volume (m3)	Baseline per mix based on t and	GHG emissior (tonnes CO2) he baseline G d volume	EPD o refere for the (from t	r mix design ence number mix provided the supplier's EPD)	Adjusted volume (m3) [NOTE 4]	GWP (kg CO2/ of the mix provided (fro the supplier's l	m3) GHG emissio mix provis (tonnes C	GHG emissions reduced compared to the baseline per mix provided (tonnes CO	Percentage GHG emiss compared to	reduction in ions per mix o the baseline
		30	Table 11	258.92	21.38	•	5.54	MixGC3 (North \ Plant)	0E0XB1C08 /ancouver	0.00	231.00	4.94	0.60	10.	.78%
		35	Table 15	293.75	1.67		0.49	Mix GC3 (North \ Plant)	35E0XB1C08 /ancouver	0.00	275.00	0.46	0.03	6.3	38%

	ICMS code	ICMS L	evel 3	ICMS Level 4		Code 1	Code 2	Code 3	Level 1	L	evel 2	Item Desc	ription	Quantity	Unit
1	2.02.020	Substruct	ture F	oundations up to top o	of lowest	A1	A11	2	Substructur	re Found	dations Pe	rimeter grade bear	n GB1, 254 x 610	21.4	m3
			f	loor slab			EN	VIRONMENTAI		REMPEL	mr	n deep, Concrete, 3	30 Mpa (138 m)		
2	2.02.020	Substruct	ture F f	oundations up to top c loor slab	of lowest	A1	A11 Mix Des AIR Cor	clared Product GC30E0XB1C08 scription: GENERA EVOBULD BROM mpressive strength	: • North Vancouver Plancouver P	ant Plant PA 20 MM NON	ations Pe mr	rimeter grade bear n deep, Concrete, 3	n GB2, 457 x 610 35 Mpa (6 m)	1.7	m3
Table Enviro GWP	Unit w nmental impacts kg CO2 eq.	O MPa Cor Baseline 30 MPa Concrete without air (N) GU 20 SCM 258.92	11. Ente num 12. Ente	r EPD or mix design ber from the suppl r adjusted volume	referenc ier (assume	e 0)	De Gaid Caz Act Bata Piro Ass Toto Cor O Pro agg Pro addition	Clared Unit: 1 m bal Warming Potential me Depletion Potential diffaction Potential (g rophication Potential (g declemental Occore Or otic Depletion, nor-fois dic Depletion, n	** Of concretes ligg CO2-eq.) gg CFC-11-eq.) SO2-eq.) gl N-eq.) ation Potential (ligg CO2-eq.) all (ligg SD-eq.) 0) r (m ²) Sts: admixture (ASTM C46 Stb, batch water (ASTM C46 Stb, batch water (ASTM C46	231 7.445-6 0.97 0.24 28-1 7.065-6 1.220 0.58 4.35 4.35 4.35 4.35 4.35 4.35 4.35 9.014rd 6.052 9.014rd 6.052 9.014rd 6.052 9.014rd 6.057 0.97 0.97 0.97 0.97 0.97 0.97 0.97 0.9	13. Enter (14. Reduc 15. Varian	GWP from supp ttion GHG = 4.9 ce GHGe = 5.9	lier 94 = <u>21.38 m3 x 23</u> 1000 to conve 54 - 4.94 = 0.60 tor	11 kg CO2/n rt kg to toni nnes CO2	<u>13</u> nes
Pro	ject mix strength	hs	Ba	seline greenhouse gas	s (GHG) cal	culations		G	HG calculati	ons for pro	oject mixes	R	eductions in GHG e	missions	>
Co	mpressive strength 28 days (MPa)	Li at assess res numb	ife cycle sment (LCA) sults table er. [NOTE 2]	Baseline global warming potential (GWP) (kg CO2/m3) per mix [NOTE 3]	Volume (m3)	Baseline per mix based on t an	GHG emission (tonnes CO2) he baseline G d volume	EPD of refere for the (from t	r mix design nce number mix provided he supplier's EPD)	Adjusted volume (m3) [NOTE 4]	GWP (kg CO2/m3 of the mix provided (from the supplier's EPI	GHG emissions per mix provided (tonnes CO2)	GHG emissions reduced compared to the baseline per mix provided (tonnes CO2	Percentage GHG emissi compared to	reduction in ons per mix the baseline
	30	Table 11	1	258.92	21.38	<	5.54	MixGC3 (North \ Plant)	0E0XB1C08 /ancouver	0.00	231.00	4.94	0.60	10.	78%
	35	Table 15	5	293.75	1.67		0.49	Mix GC3 (North V Plant)	35E0XB1C08 /ancouver	0.00	275.00	0.46	0.03	6.3	8%

	ICMS code	ICMS Level 3	ICMS Level 4	Code 1	Code 2	Code 3	Level 1	l	_evel 2	Item Description		Quantity	Unit
1	2.02.020	Substructure	Foundations up to top of lowe	est A1	A11	2	Substructur	e Found	dations P	erimeter grade bean	n GB1, 254 x 610	21.4	m3
			floor slab		EN	VIRONMENTA	L IMPACTS	REMPEL	 "	m deep, Concrete, 3	80 Mpa (138 m)		
2	2.02.020	Substructure	Foundations up to top of lowe floor slab	est A1	A11 Mix Des AIR Con	Declared Product: Mix GC30E0X81008 - North Vancouver Plant Plant Description: GENERAL CONCRETE 30 MPA 20 MM NON AIR EVOBULD BRONZE Compressive strength: 30 MPa at 28 days		ations P m	Perimeter grade beam GB2, 457 x 610 mm deep, Concrete, 35 Mpa (6 m)		1.7	m3	
Table 11. LCA Results 30 MPa Cor Baseline 30 MPa Concrete without air (N) GU 20 SCM Environmental impacts GWP kg CO2 eq. 258.92						Declared Unit: 1 m ³ of concrete Gobal Warming Potential (ig CO2-cq) 231 Coron Depletion Potential (ig CO2-cq) 2,416 Aciditication Potential (ig CO2-cq) 0.97 Extraphication Potential (ig Vo2-q) 0.97 Extraphication Potential (ig Vo2-q) 0.24 Photochemical Cone Creation Potential (ig O2-cq) 0.24 Abidito Expletion, ren-focal (ig St-cq) 7.065-6 Abidito Expletion, focal (id,l) 1.290 Total Wates Biopend (ig) 0.58 Consumption of Preshwater (m ⁻¹) 4.35 Product Components: admixture (ASTM C184), cneshed aggregate (ASTM C33), netural aggregate (ASTM C382) Additional deali and impacts are reported on page three of this EPD Additional deali and impacts			 13. Enter GWP from supplier 14. Reduction GHG = 4.94 = <u>21.38 m3 x 231 kg CO2/m3</u> 1000 to convert kg to tonnes 15. Variance GHGe = 5.54 - 4.94 = 0.60 tonnes CO2 16. %Variance GHGe = <u>0.60 tonnes CO2</u> x 100% = 10.78% 5.54 tonnes CO2 				
Pr	oject mix strengt	ıs	Baseline greenhouse gas (GHG	a) calculation	IS	G	HG calculatio	ons for pro	oject mixes	R	eductions in GHG e	emissions	\triangleright
Co	ompressive strength 28 days (MPa)	Life cycle assessment (LC results table number. [NOTE	Baseline global A) warming potential Volu (GWP) (kg CO2/m3) (m2 2] per mix [NOTE 3]	Baselin me per n 3) based or a	e GHG emission nix (tonnes CO2) n the baseline G nnd volume	NS FEPD o refere for the (from t	r mix design ence number mix provided the supplier's EPD)	Adjusted volume (m3) [NOTE 4]	GWP (kg CO2/m of the mix provided (fror the supplier's EF	3) GHG emissions per mix provided (tonnes CO2)	GHG emissions reduced compared t the baseline per mi provided (tonnes CO	Percentage GHG emiss compared to	reduction in ions per mix the baseline
	30	Table 11	258.92 21.3	38	5.54	MixGC3 (North V Plant)	0E0XB1C08 /ancouver	0.00	231.00	4.94	0.60	10.	78%
	35	Table 15	293.75 1.6	57	0.49	Mix GC3 (North V Plant)	35E0XB1C08 /ancouver	0.00	275.00	0.46	0.03	6.3	38%

Sample Project – Key Findings

KEY FINDINGS FOR 1 ITEM:

Baseline GHG	5.54 tonnes CO2
GHG Emissions per mix	4.94 tonnes CO2
GHG Emissions Reduction	0.60 tonnes CO2
% Reduction	10.78%

OBJECTIVE is to find cumulative Reduction for the Project

14. Reduction GHG = 4.94 = <u>21.38 m3 x 231 kg CO2/m3</u> 1000 to convert kg to tonnes

15. Variance GHGe = 5.54 - 4.94 = 0.60 tonnes CO2

16. %Variance GHGe = <u>0.60 tonnes CO2</u> x 100% = 10.78% 5.54 tonnes CO2

Project mix strengths	igths Baseline greenhouse gas (GHG) calculations					GHG calculations for project mixes			Reductions in GHG emissions			
Compressive strength at 28 days (MPa)	Life cycle assessment (LCA) results table number. [NOTE 2]	Baseline global warming potential (GWP) (kg CO2/m3) per mix [NOTE 3]	Volume (m3)	Baseline GHG emissions per mix (tonnes CO2) based on the baseline GWP and volume	EPD or mix design reference number for the mix provided (from the supplier's EPD)	Adjusted volume (m3) [NOTE 4]	GWP (kg CO2/m3) of the mix provided (from the supplier's EPD)	GHG emissions per mix provided (tonnes CO2)	GHG emissions reduced compared to the baseline per mix provided (tonnes CO2)	Percentage reduction in GHG emissions per mix compared to the baseline		
30	Table 11	258.92	21.38	5.54	MixGC30E0XB1C08 (North Vancouver Plant)	0.00	231.00	4.94	0.60	10.78%		
35	Table 15	293.75	1.67	0.49	Mix GC35E0XB1C08 (North Vancouver Plant)	0.00	275.00	0.46	0.03	6.38%		

Sample Project – Key Findings

KEY FINDING	KEY FINDINGS FOR 1 ITEM:				D INFORMA						
Baseline GHG5.54 tonnes CO2GHG Emissions per mix4.94 tonnes CO2GHG Emissions Reduction0.60 tonnes CO2		Reporting Sta Volume of Co	Reporting StandardICMSVolume of Concrete by StrengthESTIMATE								
% Reduction		10.78	%	EPDs for Base	aseline and Product		CHALLENGE				
OBJECTIVE is to fin	nd cumulative R	eduction for the I	Project								
							14. Reduct	ion GHG =	4.94 = <u>21.38 m3 x 23:</u> 1000 to conver	1 kg CO2/m3 t kg to tonnes	
							15. Varianc	e GHGe =	5.54 - 4.94 = 0.60 ton	nes CO2	
							16. %Varia	nce GHGe =	<u>0.60 tonnes CO2</u> x 10 5.54 tonnes CO2	00% = 10.78%	
Project mix strengths	Bas	eline greenhouse ga	s (GHG) ca	lculations	GHG calculat	ions for pr	oject mixes		Reductions in GHG en	nissions	
Compressive strength at 28 days (MPa)	Life cycle assessment (LCA) results table number. [NOTE 2]	Baseline global warming potential (GWP) (kg CO2/m3) per mix [NOTE 3]	Volume (m3)	Baseline GHG emissions per mix (tonnes CO2) based on the baseline GWP and volume	EPD or mix design reference number for the mix provided (from the supplier's EPD)	Adjusted volume (m3) [NOTE 4]	GWP (kg CO2/m3) of the mix provided (from the supplier's EPD)	GHG emissions mix provideo (tonnes CO2)	GHG emissions reduced compared to the baseline per mix provided (tonnes CO2)	Percentage reduction in GHG emissions per mix compared to the baseline	
30	Table 11	258.92	21.38	5.54	MixGC30E0XB1C08 (North Vancouver Plant)	0.00	231.00	4.94	0.60	10.78%	
35	Table 15	293.75	1.67	0.49	Mix GC35E0XB1C08 (North Vancouver Plant)	0.00	275.00	0.46	0.03	6.38%	



Baseline and reduced projects in EC3

EC3

Find & Compare Materials

- Plan & Compare Buildings
 - My buildings Templates Shared with Me Public Org Buildings
 - All buildings
- Level Bids

ROY	A AS Anil Sawhney PILOT USER	Mea	surement Units: USA	注 🌲 🌣
6 E(C3 / Plan & Compare Buildings		Τοι	Ir: BUILDING LIST
Q	Type to search			
1	EC3 Building Projects (My Buildings)	+ Super Folder + Folder + Build	ling Project + Impo	rt From Autodesk
	Name 1	Address ↑↓	Last Updated	Details
Φ	CACQS Building 52 - reduced SHARE	10 Riverside Dr W, North Vancouver, BC V7H 1T4, Canada	1 day ago	◎ 📽 🏥 🗹 🧵
Φ	CACQS Building 52 - baseline SHARE	10 Riverside Dr W, North Vancouver, BC V7H 1T4, Canada	1 day ago	• • 🖡 🗹 📋
	ROY,	ROYA AS Anil Sawhney PILOT USER Image: EC3 / Plan & Compare Buildings Image: Compare Buildings Image: Compare Building Structure Image: C3 Building Projects (My Buildings) Image: CacQS Building 52 - reduced SHARED Image: CacQS Building 52 - baseline SHARED SHARED	ROYA As Anil Sawhney PILOT USER Meas Image: EC3 / Plan & Compare Buildings Image: EC3 / Plan & Compare B	ROYA AS Anil Sawhney PILOT USER Measurement Units: USA * EC3 / Plan & Compare Buildings Tot • Type to search • Super Folder + Folder + Building Projects + Building Projects + Impo • Name 1 Address 1 Last Updated 1 • CACQS Building 52 - reduced SHARED 10 Riverside Dr W, North Vancouver, BC V7H 1T4, Canada 1 day ago



Add elements and assign ICMS classification

EC3 E ROYA AS Anil Sawhney PILOT USER							Measure	ment Units: USA	553	Ξ
CACQS BUILDING 52 - BASELINE							ANONYMIZE & PUBLISH	VE CANC	al X	>
100% Mapped Reorganize This View Source: EC3 - Plan & Compare Buildings (buildingtra	anspai	rency.org)								
✓ NAME		QUANTITY	UNIT	Collection	Selected (0/13)	*	ICMS GROUP	Realized	%-	
V Substructure								13.9k kgCO2e		:
	Ð							13.9k kgCO2e		:
 Perimeter grade beam GB1, 254 x 610 mm deep, Concrete, 30 Mpa (138 m) 		21.4	m3	ReadyMix			CE02 Substructure rela× 👻	6.74k kgCO2e	48 %	:
 Perimeter grade beam GB2, 457 x 610 mm deep, Concrete, 35 Mpa (6 m) 		1.67	m3	ReadyMix			CE02 Substructure rela× 👻	631 kgCO2e	5 96	:
 Four pile caps, 1830 x 1830 x 610 mm deep, Concrete, 32 Mpa (3 No.) 		6.13	m3	ReadyMix			CE02 Substructure rela× 👻	2.15k kgCO2e	15 %	:
— • Triple pile caps, 1573 x 1573 x 610 mm deep, Concrete, 32 Mpa, (1 No.)		1.51	m3	ReadyMix			CE02 Substructure rela× 💌	530 kgCO2e	4 96	:
 Concrete pilaster PIL-1 406 mm thick total, 152 x 1829 x 483 mm deep, Concrete, 35 Mpa, (9 No.) 		1.02	m3	ReadyMix			CE02 Substructure rela× 👻	385 kgCO2e	3 96	:
 Concrete pilaster PIL-2 356 mm thick total, 102 x 457 x 483 mm deep, Concrete, 35 Mpa, (11 No.) 		1	m3	ReadyMix			CE02 Substructure rela× 💌	378 kgCO2e	3 %	:
 Concrete pilaster PIL-3 457 mm thick total, 203 x 203 x 483 mm deep, Concrete, 35 Mpa, (5 No.) 		1	m3	ReadyMix			CE02 Substructure rela× 👻	378 kgCO2e	3 %	:
— Concrete pilaster PIL-4 457 mm thick total, 153 x 764 x 483 mm deep, Concrete, 35 Mpa, (11 No.)		1	m3	ReadyMix			CE02 Substructure rela× 👻	378 kgCO2e	3 96	:
 CIP place pile, 406 mm dia x 11.0 m long, Concrete 30 Mpa, (57 No.) 		7.5	m3	ReadyMix			CE02 Substructure rela× 👻	2.36k kgCO2e	1796	:
V Shell -	3 🗑							51.4k kgCO2e		:
Structure -								51.4k kgCO2e		:
— 🌒 127 mm thick concrete slab SL-1, Concrete, 32 Mpa (1000 m2)		127	m3	ReadyMix			CE03 Structure related × 👻	44.6k kgCO2e	87 %	÷
— 🔵 203 mm thick concrete slab SL-2, Concrete, 32 Mpa (67 m2)		15	m3	ReadyMix			CE03 Structure related $\times{\scriptstyle \bigtriangledown}$	5.67k kgCO2e	11 96	:
 Allow for grease interceptor pit, assumed 4 m, Concrete, 32 MPa 		1	m3	ReadyMix			CE03 Structure related × 👻	351 kgCO2e	1 96	:
Concrete wall 254 x 1220 mm deep c/w rigid insulation & plywood sheathing, Concrete, 35 Mpa (7 r	m)	2	m3	ReadyMix			CE03 Structure related \times \neg	756 kgCO2e	1 96	:

Search Industry and Product EPDs by location and concrete type

▼ INDUSTRY EPDS									
Name	Publishers	Jurisdiction	Achievable	Average	Conservative Estimate				
Baseline 30 MPa Concrete without air (N) G	BC Ready-Mixed Concrete As	CA-BC	169 kgCO2e	198 kgCO2e	241 kgCO2e	-s- 0	pen Download		

PRODUCT EPDS	Q Type to search							Download
Subcategory 💌	Manufacturer	Plant or Plant Gro	✓ Product ↑↓ ★ Compare	✓ Description 1	≅ Compressive Stre)↑↓	≤ Straight-line Dista ↑↓	≤ uaGWP / 1 yd3	Columns ↑↓ Manufacturer
🗙 ReadyMix	Heidelberg Materials	North Vancouver	Mix GC30E0XB1C08	Plant Description: GEN	4350 psi		193.2 kgCO2e	Details Open



Export results for completing Appendix B

EC3 Building Project	CACQS Building 52 - reduced	1	Date of Report	2023-09-17								
Level of Development	LOD 300: Detailed Design		Source of Data	Construction E	Estimate							
Area	1,067	′ m2	Project Notes	Project Record	Created by asawhney@rics.org on 24/03/2023,	66.7	61.6	42.2		33.6	kgCO2e/m	2
Totals	21					71139.8	65735.3	45032.7	37%	35847.4	kgCO2e	
Subassembly	Element	Material	Quantity	unit	Masterformat	Baseline (kgCO2e)	Conservative (kgCO2e)	Realized (kgCO2e)	Reduction from Baseline		GWP unit	Selected Material Manufacturer
Substructure->Foundations	Perimeter grade beam GB1,	ReadyMix: Lightweight - No; Jurisdiction - C	21.4	1 m3	03 30 00 Cast-in-Place Concrete	8124.4	7507.2	5403.5	33%	4093.9	kgCO2e	Heidelberg Materials
Substructure->Foundations	Perimeter grade beam GB2,	ReadyMix: Lightweight - No; Jurisdiction - C	1.7	7 1 m3	03 30 00 Cast-in-Place Concrete	634.6	586.4	503.3	21%	319.8	kgCO2e	Heidelberg Materials
Substructure->Foundations	Four pile caps, 1830 x 1830 x	ReadyMix: Lightweight - No; Jurisdiction - C	6.1	l 1 m3	03 30 00 Cast-in-Place Concrete	2329.4	2152.4	1445.1	38%	1173.8	kgCO2e	
Substructure->Foundations	Triple pile caps, 1573 x 1573	ReadyMix: Lightweight - No; Jurisdiction - C	1.5	5 1 m3	03 30 00 Cast-in-Place Concrete	573.8	530.2	356.0	38%	289.1	kgCO2e	
Substructure->Foundations	Concrete pilaster PIL-1 406 r	r ReadyMix: Lightweight - No; Jurisdiction - C	1.0	0 1 m3	03 30 00 Cast-in-Place Concrete	387.6	358.2	307.4	21%	195.3	kgCO2e	Heidelberg Materials
Substructure->Foundations	Concrete pilaster PIL-2 356 r	r ReadyMix: Lightweight - No; Jurisdiction - C	1.0) 1 m3	03 30 00 Cast-in-Place Concrete	380.0	351.1	301.4	21%	191.5	kgCO2e	Heidelberg Materials
Substructure->Foundations	Concrete pilaster PIL-3 457 r	r ReadyMix: Lightweight - No; Jurisdiction - C	1.0) 1 m3	03 30 00 Cast-in-Place Concrete	380.0	351.1	301.4	21%	191.5	kgCO2e	Heidelberg Materials
Substructure->Foundations	Concrete pilaster PIL-4 457 r	r ReadyMix: Lightweight - No; Jurisdiction - C	1.0) 1 m3	03 30 00 Cast-in-Place Concrete	380.0	351.1	301.4	21%	191.5	kgCO2e	Heidelberg Materials
Substructure->Foundations	CIP place pile, 406 mm dia x	ReadyMix: Lightweight - No; Jurisdiction - C	7.5	5 1 m3	03 30 00 Cast-in-Place Concrete	2850.0	2633.5	1895.5	33%	1436.1	kgCO2e	Heidelberg Materials
Shell->Structure	127 mm thick concrete slab	S ReadyMix: Lightweight - No; Jurisdiction - C	127.0) 1 m3	03 30 00 Cast-in-Place Concrete	48260.0	44593.7	29940.2	38%	24318.2	kgCO2e	
Shell->Structure	203 mm thick concrete slab	S ReadyMix: Lightweight - No; Jurisdiction - C	15.0) 1 m3	03 30 00 Cast-in-Place Concrete	5700.0	5267.0	3536.2	38%	2872.2	kgCO2e	
Shell->Structure	Allow for grease intercepto	r ReadyMix: Lightweight - No; Jurisdiction - C	1.0	0 1 m3	03 30 00 Cast-in-Place Concrete	380.0	351.1	235.7	38%	191.5	kgCO2e	
Shell->Structure	Concrete wall 254 x 1220 mr	n ReadyMix: Lightweight - No; Jurisdiction - C	2.0) 1 m3	03 30 00 Cast-in-Place Concrete	760.0	702.3	505.5	33%	383.0	kgCO2e	Heidelberg Materials
A5 Construction	e.g. mains supply	Electricity	0.0	1 kWh	00 00 00 No Masterformat Code		0.0	0.0	#DIV/0!	0.0	kgCO2e	
A5 Construction	e.g. heating, generator	NaturalGas	0.0) 1 ng_scf	00 00 00 No Masterformat Code		0.0	0.0	#DIV/0!	0.0	kgCO2e	
A5 Construction	e.g. trucks, generators	Diesel	0.0) 1 gal	00 00 00 No Masterformat Code		0.0	0.0	#DIV/0!	0.0	kgCO2e	
A5 Construction	e ø vehicles	Gasoline	0.0	1 1 gal	00 00 00 No Masterformat Code		0.0	0.0	#niv/ni	0.0	kø€02e	



Additional issues to consider





Sounds familiar!





Managing uncertainty







80 Source: https://buildingtransparency.org/ec3/methodology/uncertainty





Data and information



Integrating workflows





Carbon is the loudest but not the only voice

Data and digital tools central to decarbonization

Things We Need to Address



Common principles and standards are needed



Information management is a key driver



Information about emerging laws, regulations, and policies



Focus on performance and outcomes (reduce emissions, reduce waste, etc.)



Role of cost managers (QSs) and others is crucial



- Questions.
- Thank you for attending!
- Additional resources



Whole life carbon assessment for the built environment

Global 2nd edition, September 2023 Effective from 1 July 2024





ICMS: Global Consistency in Presenting Construction Life Cycle Costs and Carbon Emissions

3rd edition, November 2021 ICMS Coalition





