Statement of Verification

BREG EN EPD No.: 000649 Issue 02

This is to verify that the

Environmental Product Declaration

provided by:

Centrum Pile Ltd

is in accordance with the requirements of:

EN 15804:2012+A2:2019

and

BRE Global Scheme Document SD207

This declaration is for:

1m of the standard Centrum continuously reinforced precast concrete pile for foundation

Company Address

Centrum Pile Ltd
Hawton Lane,
Balderton,
Newark,
NG24 3BU

CENTRUM

Signed for BRE Global Ltd	Emma Baker Operator	07 March 2025 Date of this Issue
20 December 2024 Date of First Issue		19 December 2029 Expiry Date

Environmental Product Declaration

EPD Number: 000649

General Information

EPD Programme Operator	Applicable Product Category Rules
BRE Global Bucknalls Lane, Watford Hertfordshire WD25 9XX United Kingdom	BRE 2023 Product Category Rules (PN 514 Rev 3.1) for Type III environmental product declaration of construction products to EN 15804:2012 + A2:2019.
Commissioner of LCA study	**LCA consultant/Tool**
Centrum Pile Ltd Hawton Lane, Balderton, Newark, NG24 3BU	LCA Consultant: Chi Zhang LCA Tool: BRE LINA A2
Declared Unit	**Applicability/Coverage**
1m of the standard Centrum continuously reinforced precast concrete pile for foundation	Manufacturer-specific product.
EPD Type	**Background database**
Cradle to Gate with Modules C and D	Ecoinvent v3.8 (2021)

Demonstration of Verification
CEN standard EN 15804 serves as the core PCR [a]
Independent verification of the declaration and data according to EN ISO 14025:2010 ☐Internal ☒ External
(Where appropriate [b]) Third-party verifier: Flavie Lowres
a: Product category rules b: Optional for business-to-business communication; mandatory for business-to-consumer communication (see EN ISO 14025:2010, 9.4)

Comparability
Environmental product declarations of construction products may not be comparable if not compliant with EN 15804:2012+A2:2019. Comparability is further dependent on the specific product category rules, system boundaries and allocations, and background data sources. See Clause 5.3 of EN 15804:2012+A2:2019 for further guidance.

Information modules covered

Product			Construction		Use stage							End-of-life					Benefits and loads beyond the system boundary
					Related to the building fabric					Related to the building							
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4		D
Raw materials supply	Transport	Manufacturing	Transport to site	Construction – Installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction demolition	Transport	Waste processing	Disposal		Reuse, Recovery and/or Recycling potential
☑	☑	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☑	☑	☑		☑

Note: Ticks indicate the Information Modules declared.

Manufacturing site

Centrum Pile Ltd
Hawton Lane,
Balderton,
Newark,
NG24 3BU

Construction Product:

Product Description

The standard Centrum continuously reinforced precast concrete pile is a concrete and reinforcement-based foundation solution. A steel cage is encased in precast concrete, and this can be driven into the ground utilizing a driven piling rig equipped with a hydraulic hammer to form a part of a foundation solution. These types of foundations are applicable in a wide range of ground conditions and sectors to form foundations for buildings, bridges, and other foundation applications.

The Centrum Pile system consists of continuously reinforced precast concrete piles, manufactured in standard square sections ranging from 200mm to 350mm. The EPD covers piles with dimensions of 200x200mm, 250x250mm, 300x300mm, and 350x350mm. Since the raw material proportion per unit is not entirely identical, a sensitivity analysis has been conducted on the ‘Interpretation’ section, confirming that a single declared unit can represent all 4 pile sizes, but the LCA results are presented separately for each size.

Property	Values
Weight per meter (200x200 mm)	100kg/m
Weight per meter (250x250 mm)	156kg/m
Weight per meter (300x300 mm)	225kg/m
Weight per meter (350x350 mm)	306kg/m

Technical Information

Centrum Piles Ltd is ISO 14001 compliant

Property	Values
Density	2500 kg/m^3
Other Technical Information	Specifications | Centrum Pile

Note: For other technical information, please visit the official website of Centrum Pile Ltd listed above.

Main Product Contents

The main materials proportion of the product are listed in the table below. These represent 100% (w/w) of the declared product.

Material Input	200 x200 mm	250 x 250 mm	300 x 300 mm	350 x 350 mm
Sand	31.6%	31.7%	31.6%	31.6%
Aggregate	36.0%	36.1%	36.0%	36.0%
Cement	12.9%	12.9%	12.9%	12.9%
Steel	3.8%	3.3%	3.3%	3.1%
PFA (CEM Minerals)	7.2%	7.2%	7.2%	7.2%
Water	8.4%	8.7%	8.9%	8.9%
Others	<1%	<1%	<1%	<1%

Manufacturing Process

The process begins with the delivery of raw materials, including cement, sand, aggregate, Pulverized Fuel Ash (PFA), Additives, and steel to the site, where water is combined in the production of concrete. The manufacturing is divided into two main areas: cage fabrication in the Robot Shed and concrete manufacturing in the Batching Plant.

1. Cage Fabrication and Concrete Manufacturing:

    - The steel cages are first fabricated and then placed into moulds.
    - Concurrently, concrete is mixed in the Batching Plant and poured into the moulds containing the steel cages.

2. Moulding and Curing:

    - Lifting eyes are placed into the moulds to facilitate handling.
    - The initial curing process occurs in a temperature-controlled curing shed for 24 hours.

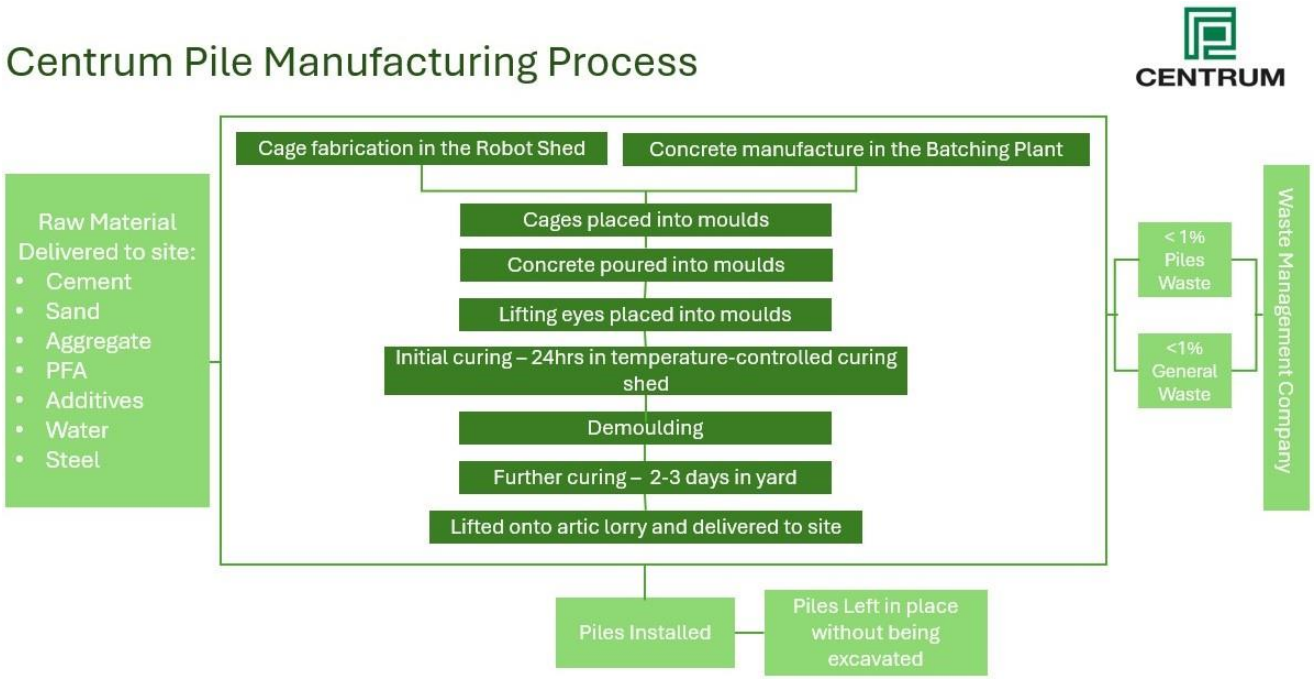
3. Demoulding and Further Curing:
    - After the initial curing, the piles are demoulded.
    - They undergo further curing in the yard for an additional 2-3 days to reach the desired strength and durability.

4. Delivery and Installation:

    - Once fully cured, the piles are lifted onto an articulated lorry and delivered to the site.
    - The piles are then installed, where they remain in place without being excavated.

Throughout the process, both production and general waste are managed by a waste management company. This detailed and controlled process ensures that the Centrum piles, available in dimensions of 200x200mm, 250x250mm, 300x300mm, and 350x350mm, meet the necessary specifications and standards for their intended use.

Process flow diagram



End of Life

Foundation piles left in the ground are explicitly mentioned as examples in the PCR EN16757:2017, chapter 6.3.8.4.2; therefore, no end-of-life scenario is considered for the piles. However, in some cases, heavy machinery such as vibratory extractors or hydraulic jacks can be used to remove piles from demolition sites. Extracted piles can be reused, repurposed, or recycled rather than discarded as waste.

In this LCA analysis, the worst-case scenario has been selected, assuming that the piles are extracted, sent to a recycling facility, and processed as waste.

Life Cycle Assessment Calculation Rules

Declared unit description

1m of the standard Centrum continuously reinforced precast concrete pile for foundation.

System boundary

This is a cradle-to-gate modules A1 -A3 with module C and D, LCA study that follows the modular design defined in EN15804:2012 +A2:2019. And the life cycle assessment study has been performed in accordance with the requirements of BRE 2023 Product Category Rules (PN 514 Rev 3.1).

Data sources, quality, and allocation

Specific primary data derived from Centrum Pile's production process at Balderton, Newark, have been modelled using the BRE LINA A2 version for the period (01/10/2021 – 30/09/2022). Site-wide values for energy, water, and wastewater have been taken from bills. Figures for the raw materials, ancillary materials, and packaging were from actual usages. This LCA covers the manufacturing of Centrum Pile's continuously reinforced precast concrete pile which covers 100% of the factory production. The production distribution for the four pile sizes is allocated based on their respective share of total product mass: 15.6% for the 200x200mm pile, 66.5% for the 250x250mm pile, 16.2% for the 300x300mm pile, and 1.6% for the 350x350mm pile.

In accordance with the requirements of EN15804:2012 + A2:2019, the most current available data has been used. Generic data has been used for all other upstream and downstream processes that are beyond the control of the manufacturer (i.e., raw material production) from the ecoinvent 3.8 database. All ecoinvent datasets are complete within the context used and conform to the system boundary and the criteria for the exclusion of inputs and outputs, according to the requirements specified in EN15804:2012+A2:2019.

Note:

In the raw material input, the manufacturer uses secondary raw material PFA. Pulverized Fuel Ash is a co-product of coal production. Therefore, PFA dataset is economically allocated. PFA is allocated economically by 3.29%, based on the revenue of 1 kg of fly ash and following the guidance of Shi, X et al. (2021), "Life Cycle Assessment and Impact Correlation Analysis of fly ash Geopolymer Concrete. Specific {electricity production, hard coal (UK)} datasets have been selected from the ecoinvent LCI for this LCA.

Data Quality:

Geographical representativeness: Specific UK and European datasets have been selected from the ecoinvent LCI for this LCA. The quality level of geographical representativeness is therefore good.

Technical representativeness: Data from processes and products under study. A proxy dataset 'Plasticise' was used for the additives (Master Matrix). Therefore, technical representativeness is good.

Time representativeness: The quality level of time representativeness is good as the background LCI datasets are based on ecoinvent v3.8 which was compiled in 2021. Therefore, there is less than 1 year between the ecoinvent LCI reference year and the time period (01/10/2021 – 30/09/2022) for which the LCA was undertaken. *Electricity Data:* The GWP of the UK electricity (2022) dataset used for this EPD is 1 kWh UK electricity = 0.239 kgCO2eq (Electricity GB (kWh), market for electricity, medium voltage).

Cut-off criteria

All raw materials, energy, water, ancillary and waste in the factory have been included, except for direct emissions to air, water, and soil, which are not measured.

LCA Results – 1 m of the 200x200mm reinforced precast concrete pile (100 kg/m)

Parameters describing environmental impacts									
			GWP-total	GWP-fossil	GWP-biogenic	GWP-luluc	ODP	AP	EP-freshwater
			kg CO_2 eq	kg CO_2 eq	kg CO_2 eq	kg CO_2 eq	kg CFC11 eq	mol H^+ eq	kg $(PO_4)^{3-}$ eq
Product stage	Raw material supply	A1	2.11E+01	2.09E+01	1.17E-01	1.17E-02	8.43E-07	8.29E-02	6.29E-03
	Transport	A2	1.34E+00	1.34E+00	1.12E-03	5.31E-04	3.09E-07	5.96E-03	8.55E-05
	Manufacturing	A3	5.82E-01	3.89E-01	1.92E-01	1.11E-03	5.00E-08	1.64E-03	8.37E-05
	Total (of product stage)	A1-3	2.30E+01	2.27E+01	3.10E-01	1.33E-02	1.20E-06	9.05E-02	6.46E-03
Scenario: 95% recycling and 5% landfill									
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	8.32E-01	8.31E-01	7.08E-04	3.26E-04	1.92E-07	3.37E-03	5.35E-05
	Waste processing	C3	6.04E-01	6.04E-01	2.13E-04	6.02E-05	1.29E-07	6.27E-03	1.87E-05
	Disposal	C4	2.64E-02	2.63E-02	2.61E-05	2.49E-05	1.07E-08	2.48E-04	2.41E-06
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-5.72E+00	-5.72E+00	5.81E-03	-2.47E-03	-2.59E-07	-2.29E-02	-2.37E-03

GWP-total = Global warming potential, total;
GWP-fossil = Global warming potential, fossil;
GWP-biogenic = Global warming potential, biogenic;
GWP-luluc = Global warming potential, land use and land use change;

ODP = Depletion potential of the stratospheric ozone layer;
AP = Acidification potential, accumulated exceedance; and
EP-freshwater = Eutrophication potential, fraction of nutrients reaching freshwater end compartment

LCA Results – 1 m of the 200x200mm reinforced precast concrete pile (100 kg/m)

Parameters describing environmental impacts									
			EP-marine	EP-terrestrial	POCP	ADP-mineral&metals	ADP-fossil	WDP	PM
			kg N eq	mol N eq	kg NMVOC eq	kg Sb eq	MJ, net calorific value	m^3 world eq deprived	disease incidence
Product stage	Raw material supply	A1	1.95E-02	2.06E-01	7.04E-02	7.76E-05	1.66E+02	7.16E+00	9.23E-07
	Transport	A2	1.76E-03	1.93E-02	5.82E-03	4.61E-06	2.02E+01	9.02E-02	1.14E-07
	Manufacturing	A3	4.98E-04	5.30E-03	2.00E-03	2.21E-06	8.04E+00	1.68E+00	2.85E-08
	Total (of product stage)	A1-3	2.17E-02	2.31E-01	7.82E-02	8.44E-05	1.95E+02	8.93E+00	1.07E-06
Scenario: 95% recycling and 5% landfill									
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	1.02E-03	1.11E-02	3.40E-03	2.89E-06	1.26E+01	5.65E-02	7.17E-08
	Waste processing	C3	2.78E-03	3.04E-02	8.37E-03	3.11E-07	8.28E+00	1.91E-02	8.43E-07
	Disposal	C4	8.61E-05	9.42E-04	2.74E-04	6.01E-08	7.35E-01	3.37E-02	4.99E-09
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-5.39E-03	-5.88E-02	-2.84E-02	-1.09E-05	-6.13E+01	-1.80E+00	-3.94E-07

EP-marine = Eutrophication potential, fraction of nutrients reaching marine end compartment;
EP-terrestrial = Eutrophication potential, accumulated exceedance;
POCP = Formation potential of tropospheric ozone;
ADP-mineral&metals = Abiotic depletion potential for non-fossil resources;
ADP-fossil = Depletion potential of the stratospheric ozone layer;
WDP = Water (user) deprivation potential, deprivation-weighted water consumption; and
PM = Particulate matter.

LCA Results – 1 m of the 200x200mm reinforced precast concrete pile (100 kg/m)

Parameters describing environmental impacts							
			IRP	ETP-fw	HTP-c	HTP-nc	SQP
			kBq U^{235} eq	CTUe	CTUh	CTUh	dimensionless
Product stage	Raw material supply	A1	7.19E-01	4.03E+02	5.53E-08	3.18E-07	6.37E+01
	Transport	A2	1.03E-01	1.57E+01	5.15E-10	1.64E-08	1.37E+01
	Manufacturing	A3	1.71E-01	6.48E+00	4.58E-10	5.24E-09	2.29E+01
	Total (of product stage)	A1-3	9.94E-01	4.25E+02	5.63E-08	3.39E-07	1.00E+02
Scenario: 95% recycling and 5% landfill							
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	6.46E-02	9.81E+00	3.18E-10	1.03E-08	8.63E+00
	Waste processing	C3	3.73E-02	4.85E+00	1.87E-10	3.51E-09	1.05E+00
	Disposal	C4	3.27E-03	4.64E-01	1.18E-11	3.05E-10	1.54E+00
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-2.61E-01	-1.62E+02	-2.73E-08	-1.16E-07	-2.00E+01

IRP = Potential human exposure efficiency relative to U235;
ETP-fw = Potential comparative toxic unit for ecosystems;
HTP-c = Potential comparative toxic unit for humans;
HTP-nc = Potential comparative toxic unit for humans; and
SQP = Potential soil quality index.

LCA Results – 1 m of the 200x200mm reinforced precast concrete pile (100 kg/m)

Parameters describing resource use, primary energy								
			PERE	PERM	PERT	PENRE	PENRM	PENRT
			MJ	MJ	MJ	MJ	MJ	MJ
Product stage	Raw material supply	A1	5.56E+00	1.17E-02	5.57E+00	9.22E+01	5.78E-01	9.28E+01
	Transport	A2	2.82E-01	0.00E+00	2.82E-01	1.98E+01	0.00E+00	1.98E+01
	Manufacturing	A3	-1.30E+00	6.61E+00	5.31E+00	8.02E+00	1.46E+00	9.48E+00
	Total (of product stage)	A1-3	4.54E+00	6.62E+00	1.12E+01	1.20E+02	2.04E+00	1.22E+02
Scenario: 95% recycling and 5% landfill								
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	1.77E-01	0.00E+00	1.77E-01	1.23E+01	0.00E+00	1.23E+01
	Waste processing	C3	4.64E-02	0.00E+00	4.64E-02	8.12E+00	0.00E+00	8.12E+00
	Disposal	C4	6.27E-03	0.00E+00	6.27E-03	7.22E-01	0.00E+00	7.22E-01
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-2.08E+00	0.00E+00	-2.08E+00	-6.09E+01	0.00E+00	-6.09E+01

PERE = Use of renewable primary energy excluding renewable primary energy used as raw materials;
PERM = Use of renewable primary energy resources used as raw materials;
PERT = Total use of renewable primary energy resources;
PENRE = Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials;
PENRM = Use of non-renewable primary energy resources used as raw materials;
PENRT = Total use of non-renewable primary energy resource

LCA Results – 1 m of the 200x200mm reinforced precast concrete pile (100 kg/m)

Parameters describing resource use, secondary materials and fuels, use of water						
			SM	RSF	NRSF	FW
			kg	MJ net calorific value	MJ net calorific value	m^3
Product stage	Raw material supply	A1	1.13E+00	0.00E+00	0.00E+00	1.72E-01
	Transport	A2	0.00E+00	0.00E+00	0.00E+00	2.23E-03
	Manufacturing	A3	1.05E-02	3.91E-06	0.00E+00	3.99E-02
	Total (of product stage)	A1-3	1.14E+00	3.91E-06	0.00E+00	2.14E-01
Scenario: 95% recycling and 5% landfill						
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	0.00E+00	0.00E+00	0.00E+00	1.40E-03
	Waste processing	C3	0.00E+00	0.00E+00	0.00E+00	4.72E-04
	Disposal	C4	0.00E+00	0.00E+00	0.00E+00	7.88E-04
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	0.00E+00	0.00E+00	0.00E+00	-4.29E-02

SM = Use of secondary material;
RSF = Use of renewable secondary fuels;
NRSF = Use of non-renewable secondary fuels;
FW = Net use of fresh water

LCA Results – 1 m of the 200x200mm reinforced precast concrete pile (100 kg/m)

Other environmental information describing waste categories					
			HWD	NHWD	RWD
			kg	kg	kg
Product stage	Raw material supply	A1	2.25E+00	1.54E+01	2.07E-04
	Transport	A2	2.23E-02	3.93E-01	1.36E-04
	Manufacturing	A3	2.15E-02	4.88E-01	5.59E-05
	Total (of product stage)	A1-3	2.30E+00	1.62E+01	4.00E-04
Scenario: 95% recycling and 5% landfill					
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	1.39E-02	2.46E-01	8.50E-05
	Waste processing	C3	1.09E-02	7.63E-02	5.72E-05
	Disposal	C4	7.65E-04	1.08E-02	4.82E-06
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-5.22E-01	-1.14E+01	-1.10E-04

HWD = Hazardous waste disposed;
NHWD = Non-hazardous waste disposed;
RWD = Radioactive waste disposed

LCA Results – 1 m of the 200x200mm reinforced precast concrete pile (100 kg/m)

			Other environmental information describing output flows – at end of life						
			CRU	MFR	MER	EEE	EET	Biogenic carbon (product)	Biogenic carbon (packaging)
			kg	kg	kg	MJ per energy carrier	MJ per energy carrier	kg C	kg C
Product stage	Raw material supply	A1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	A2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Manufacturing	A3	0.00E+00	1.93E-01	3.43E-08	7.13E-04	2.41E-03	2.59E-02	-2.34E-02
	Total (of product stage)	A1-3	0.00E+00	1.93E-01	3.43E-08	7.13E-04	2.41E-03	2.59E-02	-2.34E-02
Scenario: 95% recycling and 5% landfill									
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Waste processing	C3	0.00E+00	6.54E-06	1.04E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Disposal	C4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

CRU = Components for reuse;
MFR = Materials for recycling

MER = Materials for energy recovery;
EE = Exported Energy

LCA Results – 1 m of the 250x250mm reinforced precast concrete pile (156 kg/m)

Parameters describing environmental impacts									
			GWP-total	GWP-fossil	GWP-biogenic	GWP-luluc	ODP	AP	EP-freshwater
			kg CO_2 eq	kg CO_2 eq	kg CO_2 eq	kg CO_2 eq	kg CFC11 eq	mol H^+ eq	kg $(PO_4)^{3-}$ eq
Product stage	Raw material supply	A1	3.13E+01	3.11E+01	1.85E-01	1.71E-02	1.23E-06	1.23E-01	9.05E-03
	Transport	A2	2.04E+00	2.04E+00	1.71E-03	8.09E-04	4.71E-07	9.00E-03	1.30E-04
	Manufacturing	A3	9.75E-01	5.44E-01	4.29E-01	1.22E-03	6.40E-08	2.14E-03	1.04E-04
	Total (of product stage)	A1-3	3.43E+01	3.37E+01	6.15E-01	1.91E-02	1.77E-06	1.34E-01	9.28E-03
Scenario: 95% recycling and 5% landfill									
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	1.30E+00	1.30E+00	1.11E-03	5.09E-04	3.00E-07	5.26E-03	8.35E-05
	Waste processing	C3	8.96E-01	8.95E-01	3.16E-04	8.93E-05	1.91E-07	9.30E-03	2.77E-05
	Disposal	C4	4.12E-02	4.11E-02	4.07E-05	3.88E-05	1.66E-08	3.86E-04	3.76E-06
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-7.89E+00	-7.89E+00	5.70E-03	-3.57E-03	-3.63E-07	-3.20E-02	-3.29E-03

GWP-total = Global warming potential, total;
GWP-fossil = Global warming potential, fossil;
GWP-biogenic = Global warming potential, biogenic;
GWP-luluc = Global warming potential, land use and land use change;

ODP = Depletion potential of the stratospheric ozone layer;
AP = Acidification potential, accumulated exceedance; and
EP-freshwater = Eutrophication potential, fraction of nutrients reaching freshwater end compartment

LCA Results – 1 m of the 250x250mm reinforced precast concrete pile (156 kg/m)

Parameters describing environmental impacts									
			EP-marine	EP-terrestrial	POCP	ADP-mineral&metals	ADP-fossil	WDP	PM
			kg N eq	mol N eq	kg NMVOC eq	kg Sb eq	MJ, net calorific value	m^3 world eq deprived	disease incidence
Product stage	Raw material supply	A1	2.88E-02	3.06E-01	1.02E-01	1.12E-04	2.43E+02	1.05E+01	1.31E-06
	Transport	A2	2.66E-03	2.91E-02	8.82E-03	7.03E-06	3.08E+01	1.38E-01	1.75E-07
	Manufacturing	A3	6.79E-04	7.26E-03	2.53E-03	2.86E-06	1.11E+01	2.54E+00	3.66E-08
	Total (of product stage)	A1-3	3.22E-02	3.42E-01	1.13E-01	1.22E-04	2.85E+02	1.32E+01	1.52E-06
Scenario: 95% recycling and 5% landfill									
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	1.58E-03	1.73E-02	5.30E-03	4.51E-06	1.96E+01	8.82E-02	1.12E-07
	Waste processing	C3	4.12E-03	4.51E-02	1.24E-02	4.60E-07	1.23E+01	2.84E-02	1.31E-06
	Disposal	C4	1.34E-04	1.47E-03	4.28E-04	9.37E-08	1.15E+00	5.26E-02	7.78E-09
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-7.53E-03	-8.24E-02	-3.91E-02	-1.62E-05	-8.53E+01	-2.76E+00	-5.45E-07

EP-marine = Eutrophication potential, fraction of nutrients reaching marine end compartment;
EP-terrestrial = Eutrophication potential, accumulated exceedance;
POCP = Formation potential of tropospheric ozone;
ADP-mineral&metals = Abiotic depletion potential for non-fossil resources;
ADP-fossil = Depletion potential of the stratospheric ozone layer;
WDP = Water (user) deprivation potential, deprivation-weighted water consumption; and
PM = Particulate matter.

LCA Results – 1 m of the 250x250mm reinforced precast concrete pile (156 kg/m)

Parameters describing environmental impacts							
			IRP	ETP-fw	HTP-c	HTP-nc	SQP
			kBq U^{235} eq	CTUe	CTUh	CTUh	dimensionless
Product stage	Raw material supply	A1	1.04E+00	5.81E+02	7.51E-08	4.53E-07	9.44E+01
	Transport	A2	1.58E-01	2.40E+01	7.85E-10	2.50E-08	2.10E+01
	Manufacturing	A3	2.59E-01	8.07E+00	5.33E-10	6.81E-09	2.40E+01
	Total (of product stage)	A1-3	1.46E+00	6.13E+02	7.64E-08	4.85E-07	1.39E+02
Scenario: 95% recycling and 5% landfill							
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	1.01E-01	1.53E+01	4.95E-10	1.60E-08	1.35E+01
	Waste processing	C3	5.54E-02	7.19E+00	2.78E-10	5.21E-09	1.56E+00
	Disposal	C4	5.09E-03	7.25E-01	1.84E-11	4.77E-10	2.41E+00
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-3.90E-01	-2.21E+02	-3.70E-08	-1.59E-07	-2.93E+01

IRP = Potential human exposure efficiency relative to U235;
ETP-fw = Potential comparative toxic unit for ecosystems;
HTP-c = Potential comparative toxic unit for humans;
HTP-nc = Potential comparative toxic unit for humans; and
SQP = Potential soil quality index.

LCA Results – 1 m of the 250x250mm reinforced precast concrete pile (156 kg/m)

Parameters describing resource use, primary energy								
			PERE	PERM	PERT	PENRE	PENRM	PENRT
			MJ	MJ	MJ	MJ	MJ	MJ
Product stage	Raw material supply	A1	7.60E+00	2.22E-02	7.62E+00	1.26E+02	1.10E+00	1.27E+02
	Transport	A2	4.31E-01	0.00E+00	4.31E-01	3.02E+01	0.00E+00	3.02E+01
	Manufacturing	A3	-3.18E+00	9.12E+00	5.94E+00	1.16E+01	1.77E+00	1.33E+01
	Total (of product stage)	A1-3	4.85E+00	9.14E+00	1.40E+01	1.68E+02	2.87E+00	1.71E+02
Scenario: 95% recycling and 5% landfill								
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	2.76E-01	0.00E+00	2.76E-01	1.92E+01	0.00E+00	1.92E+01
	Waste processing	C3	6.88E-02	0.00E+00	6.88E-02	1.20E+01	0.00E+00	1.20E+01
	Disposal	C4	9.78E-03	0.00E+00	9.78E-03	1.13E+00	0.00E+00	1.13E+00
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-3.03E+00	0.00E+00	-3.03E+00	-8.46E+01	0.00E+00	-8.46E+01

PERE = Use of renewable primary energy excluding renewable primary energy used as raw materials;
PERM = Use of renewable primary energy resources used as raw materials;
PERT = Total use of renewable primary energy resources;

PENRE = Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials;
PENRM = Use of non-renewable primary energy resources used as raw materials;
PENRT = Total use of non-renewable primary energy resource

LCA Results – 1 m of the 250x250mm reinforced precast concrete pile (156 kg/m)

Parameters describing resource use, secondary materials and fuels, use of water						
			SM	RSF	NRSF	FW
			kg	MJ net calorific value	MJ net calorific value	m^3
Product stage	Raw material supply	A1	1.52E+00	0.00E+00	0.00E+00	2.51E-01
	Transport	A2	0.00E+00	0.00E+00	0.00E+00	3.41E-03
	Manufacturing	A3	1.13E-02	6.10E-06	0.00E+00	6.04E-02
	Total (of product stage)	A1-3	1.53E+00	6.10E-06	0.00E+00	3.15E-01
Scenario: 95% recycling and 5% landfill						
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	0.00E+00	0.00E+00	0.00E+00	2.18E-03
	Waste processing	C3	0.00E+00	0.00E+00	0.00E+00	7.01E-04
	Disposal	C4	0.00E+00	0.00E+00	0.00E+00	1.23E-03
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	0.00E+00	0.00E+00	0.00E+00	-6.54E-02

SM = Use of secondary material;
RSF = Use of renewable secondary fuels;
NRSF = Use of non-renewable secondary fuels;
FW = Net use of fresh water

LCA Results – 1 m of the 250x250mm reinforced precast concrete pile (156 kg/m)

Other environmental information describing waste categories					
			HWD	NHWD	RWD
			kg	kg	kg
Product stage	Raw material supply	A1	3.05E+00	2.11E+01	2.86E-04
	Transport	A2	3.40E-02	5.99E-01	2.08E-04
	Manufacturing	A3	2.89E-02	6.45E-01	8.08E-05
	Total (of product stage)	A1-3	3.11E+00	2.23E+01	5.75E-04
Scenario: 95% recycling and 5% landfill					
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	2.16E-02	3.84E-01	1.33E-04
	Waste processing	C3	1.61E-02	1.13E-01	8.49E-05
	Disposal	C4	1.19E-03	1.68E-02	7.52E-06
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-7.20E-01	-1.58E+01	-1.61E-04

HWD = Hazardous waste disposed;
NHWD = Non-hazardous waste disposed;
RWD = Radioactive waste disposed

LCA Results – 1 m of the 250x250mm reinforced precast concrete pile (156 kg/m)

			Other environmental information describing output flows – at end of life						
			CRU	MFR	MER	EEE	EET	Biogenic carbon (product)	Biogenic carbon (packaging)
			kg	kg	kg	MJ per energy carrier	MJ per energy carrier	kg C	kg C
Product stage	Raw material supply	A1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	A2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Manufacturing	A3	0.00E+00	3.01E-01	5.35E-08	1.11E-03	3.76E-03	4.03E-02	1.48E-03
	Total (of product stage)	A1-3	0.00E+00	3.01E-01	5.35E-08	1.11E-03	3.76E-03	4.03E-02	1.48E-03
Scenario: 95% recycling and 5% landfill									
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Waste processing	C3	0.00E+00	1.03E-05	1.64E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Disposal	C4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

CRU = Components for reuse;
MFR = Materials for recycling

MER = Materials for energy recovery;
EE = Exported Energy

LCA Results – 1 m of the 300x300mm reinforced precast concrete pile (225 kg/m)

Parameters describing environmental impacts									
			GWP-total	GWP-fossil	GWP-biogenic	GWP-luluc	ODP	AP	EP-freshwater
			kg CO_2 eq	kg CO_2 eq	kg CO_2 eq	kg CO_2 eq	kg CFC11 eq	mol H^+ eq	kg $(PO_4)^{3-}$ eq
Product stage	Raw material supply	A1	4.50E+01	4.47E+01	2.67E-01	2.45E-02	1.77E-06	1.77E-01	1.30E-02
	Transport	A2	2.94E+00	2.93E+00	2.46E-03	1.16E-03	6.77E-07	1.29E-02	1.88E-04
	Manufacturing	A3	1.46E+00	7.34E-01	7.22E-01	1.37E-03	8.11E-08	2.76E-03	1.30E-04
	Total (of product stage)	A1-3	4.94E+01	4.84E+01	9.91E-01	2.70E-02	2.53E-06	1.92E-01	1.33E-02
Scenario: 95% recycling and 5% landfill									
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	1.87E+00	1.87E+00	1.59E-03	7.34E-04	4.33E-07	7.59E-03	1.20E-04
	Waste processing	C3	1.29E+00	1.29E+00	4.54E-04	1.28E-04	2.75E-07	1.34E-02	3.99E-05
	Disposal	C4	5.94E-02	5.92E-02	5.87E-05	5.60E-05	2.40E-08	5.57E-04	5.42E-06
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-1.13E+01	-1.13E+01	8.03E-03	-5.13E-03	-5.21E-07	-4.59E-02	-4.73E-03

GWP-total = Global warming potential, total;
GWP-fossil = Global warming potential, fossil;
GWP-biogenic = Global warming potential, biogenic;
GWP-luluc = Global warming potential, land use and land use change;

ODP = Depletion potential of the stratospheric ozone layer;
AP = Acidification potential, accumulated exceedance; and
EP-freshwater = Eutrophication potential, fraction of nutrients reaching freshwater end compartment

LCA Results – 1 m of the 300x300mm reinforced precast concrete pile (225 kg/m)

Parameters describing environmental impacts									
			EP-marine	EP-terrestrial	POCP	ADP-mineral&metals	ADP-fossil	WDP	PM
			kg N eq	mol N eq	kg NMVOC eq	kg Sb eq	MJ, net calorific value	m^3 world eq deprived	disease incidence
Product stage	Raw material supply	A1	4.15E-02	4.40E-01	1.46E-01	1.61E-04	3.50E+02	1.51E+01	1.87E-06
	Transport	A2	3.83E-03	4.19E-02	1.27E-02	1.01E-05	4.43E+01	1.98E-01	2.51E-07
	Manufacturing	A3	9.02E-04	9.67E-03	3.18E-03	3.65E-06	1.48E+01	3.61E+00	4.66E-08
	Total (of product stage)	A1-3	4.62E-02	4.91E-01	1.62E-01	1.74E-04	4.09E+02	1.89E+01	2.17E-06
Scenario: 95% recycling and 5% landfill									
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	2.29E-03	2.50E-02	7.65E-03	6.50E-06	2.83E+01	1.27E-01	1.61E-07
	Waste processing	C3	5.93E-03	6.49E-02	1.79E-02	6.62E-07	1.77E+01	4.08E-02	1.89E-06
	Disposal	C4	1.94E-04	2.12E-03	6.17E-04	1.35E-07	1.65E+00	7.59E-02	1.12E-08
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-1.08E-02	-1.18E-01	-5.61E-02	-2.34E-05	-1.22E+02	-3.97E+00	-7.82E-07

EP-marine = Eutrophication potential, fraction of nutrients reaching marine end compartment;
EP-terrestrial = Eutrophication potential, accumulated exceedance;
POCP = Formation potential of tropospheric ozone;
ADP-mineral&metals = Abiotic depletion potential for non-fossil resources;
ADP-fossil = Depletion potential of the stratospheric ozone layer;
WDP = Water (user) deprivation potential, deprivation-weighted water consumption; and
PM = Particulate matter.

LCA Results – 1 m of the 300x300mm reinforced precast concrete pile (225 kg/m)

Parameters describing environmental impacts							
			IRP	ETP-fw	HTP-c	HTP-nc	SQP
			kBq U^{235} eq	CTUe	CTUh	CTUh	dimensionless
Product stage	Raw material supply	A1	1.50E+00	8.33E+02	1.07E-07	6.50E-07	1.36E+02
	Transport	A2	2.27E-01	3.45E+01	1.13E-09	3.60E-08	3.01E+01
	Manufacturing	A3	3.66E-01	1.00E+01	6.26E-10	8.74E-09	2.53E+01
	Total (of product stage)	A1-3	2.09E+00	8.78E+02	1.09E-07	6.94E-07	1.91E+02
Scenario: 95% recycling and 5% landfill							
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	1.45E-01	2.21E+01	7.14E-10	2.31E-08	1.94E+01
	Waste processing	C3	7.96E-02	1.03E+01	4.00E-10	7.49E-09	2.25E+00
	Disposal	C4	7.35E-03	1.04E+00	2.65E-11	6.87E-10	3.47E+00
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-5.61E-01	-3.17E+02	-5.31E-08	-2.28E-07	-4.21E+01

IRP = Potential human exposure efficiency relative to U235;
ETP-fw = Potential comparative toxic unit for ecosystems;
HTP-c = Potential comparative toxic unit for humans;
HTP-nc = Potential comparative toxic unit for humans; and
SQP = Potential soil quality index.

LCA Results – 1 m of the 300x300mm reinforced precast concrete pile (225 kg/m)

Parameters describing resource use, primary energy								
			PERE	PERM	PERT	PENRE	PENRM	PENRT
			MJ	MJ	MJ	MJ	MJ	MJ
Product stage	Raw material supply	A1	1.09E+01	3.51E-02	1.09E+01	1.80E+02	1.73E+00	1.82E+02
	Transport	A2	6.20E-01	0.00E+00	6.20E-01	4.35E+01	0.00E+00	4.35E+01
	Manufacturing	A3	-5.50E+00	1.22E+01	6.71E+00	1.59E+01	2.15E+00	1.81E+01
	Total (of product stage)	A1-3	5.99E+00	1.22E+01	1.82E+01	2.40E+02	3.88E+00	2.44E+02
Scenario: 95% recycling and 5% landfill								
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	3.98E-01	0.00E+00	3.98E-01	2.78E+01	0.00E+00	2.78E+01
	Waste processing	C3	9.90E-02	0.00E+00	9.90E-02	1.73E+01	0.00E+00	1.73E+01
	Disposal	C4	1.41E-02	0.00E+00	1.41E-02	1.62E+00	0.00E+00	1.62E+00
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-4.37E+00	0.00E+00	-4.37E+00	-1.21E+02	0.00E+00	-1.21E+02

PERE = Use of renewable primary energy excluding renewable primary energy used as raw materials;
PERM = Use of renewable primary energy resources used as raw materials;
PERT = Total use of renewable primary energy resources;
PENRE = Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials;
PENRM = Use of non-renewable primary energy resources used as raw materials;
PENRT = Total use of non-renewable primary energy resource

LCA Results – 1 m of the 300x300mm reinforced precast concrete pile (225 kg/m)

Parameters describing resource use, secondary materials and fuels, use of water						
			SM	RSF	NRSF	FW
			kg	MJ net calorific value	MJ net calorific value	m^3
Product stage	Raw material supply	A1	2.17E+00	0.00E+00	0.00E+00	3.61E-01
	Transport	A2	0.00E+00	0.00E+00	0.00E+00	4.91E-03
	Manufacturing	A3	1.23E-02	8.80E-06	0.00E+00	8.57E-02
	Total (of product stage)	A1-3	2.18E+00	8.80E-06	0.00E+00	4.52E-01
Scenario: 95% recycling and 5% landfill						
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	0.00E+00	0.00E+00	0.00E+00	3.15E-03
	Waste processing	C3	0.00E+00	0.00E+00	0.00E+00	1.01E-03
	Disposal	C4	0.00E+00	0.00E+00	0.00E+00	1.77E-03
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	0.00E+00	0.00E+00	0.00E+00	-9.43E-02

SM = Use of secondary material;
RSF = Use of renewable secondary fuels;
NRSF = Use of non-renewable secondary fuels;
FW = Net use of fresh water

LCA Results – 1 m of the 300x300mm reinforced precast concrete pile (225 kg/m)

Other environmental information describing waste categories					
			HWD	NHWD	RWD
			kg	kg	kg
Product stage	Raw material supply	A1	4.36E+00	3.01E+01	4.09E-04
	Transport	A2	4.89E-02	8.62E-01	2.99E-04
	Manufacturing	A3	3.80E-02	8.37E-01	1.12E-04
	Total (of product stage)	A1-3	4.45E+00	3.18E+01	8.20E-04
Scenario: 95% recycling and 5% landfill					
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	3.12E-02	5.54E-01	1.91E-04
	Waste processing	C3	2.32E-02	1.63E-01	1.22E-04
	Disposal	C4	1.72E-03	2.43E-02	1.08E-05
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-1.03E+00	-2.27E+01	-2.31E-04

HWD = Hazardous waste disposed;
NHWD = Non-hazardous waste disposed;
RWD = Radioactive waste disposed

LCA Results – 1 m of the 300x300mm reinforced precast concrete pile (225 kg/m)

			Other environmental information describing output flows – at end of life						
			CRU	MFR	MER	EEE	EET	Biogenic carbon (product)	Biogenic carbon (packaging)
			kg	kg	kg	MJ per energy carrier	MJ per energy carrier	kg C	kg C
Product stage	Raw material supply	A1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	A2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Manufacturing	A3	0.00E+00	4.34E-01	7.72E-08	1.60E-03	5.42E-03	5.82E-02	3.21E-02
	Total (of product stage)	A1-3	0.00E+00	4.34E-01	7.72E-08	1.60E-03	5.42E-03	5.82E-02	3.21E-02
Scenario: 95% recycling and 5% landfill									
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Waste processing	C3	0.00E+00	1.48E-05	2.37E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Disposal	C4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

CRU = Components for reuse;
MFR = Materials for recycling

MER = Materials for energy recovery;
EE = Exported Energy

LCA Results – 1 m of the 350x350mm reinforced precast concrete pile (306 kg/m)

Parameters describing environmental impacts									
			GWP-total	GWP-fossil	GWP-biogenic	GWP-luluc	ODP	AP	EP-freshwater
			kg CO_2 eq	kg CO_2 eq	kg CO_2 eq	kg CO_2 eq	kg CFC11 eq	mol H^+ eq	kg $(PO_4)^{3-}$ eq
Product stage	Raw material supply	A1	6.03E+01	5.99E+01	3.61E-01	3.27E-02	2.36E-06	2.37E-01	1.73E-02
	Transport	A2	3.97E+00	3.96E+00	3.33E-03	1.57E-03	9.16E-07	1.74E-02	2.54E-04
	Manufacturing	A3	2.02E+00	9.58E-01	1.07E+00	1.53E-03	1.01E-07	3.49E-03	1.60E-04
	Total (of product stage)	A1-3	6.63E+01	6.48E+01	1.43E+00	3.58E-02	3.38E-06	2.57E-01	1.77E-02
Scenario: 95% recycling and 5% landfill									
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	2.55E+00	2.54E+00	2.17E-03	9.98E-04	5.88E-07	1.03E-02	1.64E-04
	Waste processing	C3	1.73E+00	1.73E+00	6.10E-04	1.72E-04	3.69E-07	1.80E-02	5.35E-05
	Disposal	C4	8.07E-02	8.06E-02	7.99E-05	7.61E-05	3.26E-08	7.58E-04	7.38E-06
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-1.49E+01	-1.49E+01	9.24E-03	-6.84E-03	-6.89E-07	-6.05E-02	-6.22E-03

GWP-total = Global warming potential, total;
GWP-fossil = Global warming potential, fossil;
GWP-biogenic = Global warming potential, biogenic;
GWP-luluc = Global warming potential, land use and land use change;

ODP = Depletion potential of the stratospheric ozone layer;
AP = Acidification potential, accumulated exceedance; and
EP-freshwater = Eutrophication potential, fraction of nutrients reaching freshwater end compartment

LCA Results – 1 m of the 350x350mm reinforced precast concrete pile (306 kg/m)

Parameters describing environmental impacts									
			EP-marine	EP-terrestrial	POCP	ADP-mineral&metals	ADP-fossil	WDP	PM
			kg N eq	mol N eq	kg NMVOC eq	kg Sb eq	MJ, net calorific value	m^3 world eq deprived	disease incidence
Product stage	Raw material supply	A1	5.55E-02	5.90E-01	1.95E-01	2.14E-04	4.66E+02	2.01E+01	2.48E-06
	Transport	A2	5.17E-03	5.65E-02	1.71E-02	1.37E-05	5.98E+01	2.68E-01	3.39E-07
	Manufacturing	A3	1.16E-03	1.25E-02	3.94E-03	4.59E-06	1.92E+01	4.85E+00	5.83E-08
	Total (of product stage)	A1-3	6.19E-02	6.59E-01	2.16E-01	2.32E-04	5.45E+02	2.53E+01	2.88E-06
Scenario: 95% recycling and 5% landfill									
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	3.11E-03	3.40E-02	1.04E-02	8.84E-06	3.84E+01	1.73E-01	2.19E-07
	Waste processing	C3	7.95E-03	8.71E-02	2.40E-02	8.89E-07	2.37E+01	5.48E-02	2.56E-06
	Disposal	C4	2.63E-04	2.88E-03	8.39E-04	1.84E-07	2.25E+00	1.03E-01	1.53E-08
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-1.43E-02	-1.56E-01	-7.38E-02	-3.14E-05	-1.61E+02	-5.37E+00	-1.03E-06

EP-marine = Eutrophication potential, fraction of nutrients reaching marine end compartment;
EP-terrestrial = Eutrophication potential, accumulated exceedance;
POCP = Formation potential of tropospheric ozone;
ADP-mineral&metals = Abiotic depletion potential for non-fossil resources;
ADP-fossil = Depletion potential of the stratospheric ozone layer;
WDP = Water (user) deprivation potential, deprivation-weighted water consumption; and
PM = Particulate matter.

LCA Results – 1 m of the 350x350mm reinforced precast concrete pile (306 kg/m)

Parameters describing environmental impacts							
			IRP	ETP-fw	HTP-c	HTP-nc	SQP
			kBq U^{235} eq	CTUe	CTUh	CTUh	dimensionless
Product stage	Raw material supply	A1	2.00E+00	1.11E+03	1.41E-07	8.63E-07	1.82E+02
	Transport	A2	3.07E-01	4.66E+01	1.53E-09	4.87E-08	4.08E+01
	Manufacturing	A3	4.92E-01	1.23E+01	7.35E-10	1.10E-08	2.69E+01
	Total (of product stage)	A1-3	2.80E+00	1.17E+03	1.43E-07	9.22E-07	2.50E+02
Scenario: 95% recycling and 5% landfill							
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	1.98E-01	3.00E+01	9.72E-10	3.15E-08	2.64E+01
	Waste processing	C3	1.07E-01	1.39E+01	5.36E-10	1.01E-08	3.02E+00
	Disposal	C4	9.99E-03	1.42E+00	3.61E-11	9.35E-10	4.72E+00
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-7.55E-01	-4.15E+02	-6.94E-08	-3.00E-07	-5.63E+01

IRP = Potential human exposure efficiency relative to U235;
ETP-fw = Potential comparative toxic unit for ecosystems;
HTP-c = Potential comparative toxic unit for humans;
HTP-nc = Potential comparative toxic unit for humans; and
SQP = Potential soil quality index.

LCA Results – 1 m of the 350x350mm reinforced precast concrete pile (306 kg/m)

Parameters describing resource use, primary energy								
			PERE	PERM	PERT	PENRE	PENRM	PENRT
			MJ	MJ	MJ	MJ	MJ	MJ
Product stage	Raw material supply	A1	1.43E+01	4.33E-02	1.43E+01	2.37E+02	2.14E+00	2.39E+02
	Transport	A2	8.38E-01	0.00E+00	8.38E-01	5.87E+01	0.00E+00	5.87E+01
	Manufacturing	A3	-8.22E+00	1.58E+01	7.61E+00	2.10E+01	2.60E+00	2.36E+01
	Total (of product stage)	A1-3	6.88E+00	1.59E+01	2.27E+01	3.16E+02	4.73E+00	3.21E+02
Scenario: 95% recycling and 5% landfill								
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	5.42E-01	0.00E+00	5.42E-01	3.77E+01	0.00E+00	3.77E+01
	Waste processing	C3	1.33E-01	0.00E+00	1.33E-01	2.32E+01	0.00E+00	2.32E+01
	Disposal	C4	1.92E-02	0.00E+00	1.92E-02	2.21E+00	0.00E+00	2.21E+00
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-5.83E+00	0.00E+00	-5.83E+00	-1.60E+02	0.00E+00	-1.60E+02

PERE = Use of renewable primary energy excluding renewable primary energy used as raw materials;
PERM = Use of renewable primary energy resources used as raw materials;
PERT = Total use of renewable primary energy resources;

PENRE = Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials;
PENRM = Use of non-renewable primary energy resources used as raw materials;
PENRT = Total use of non-renewable primary energy resource

LCA Results – 1 m of the 350x350mm reinforced precast concrete pile (306 kg/m)

Parameters describing resource use, secondary materials and fuels, use of water						
			SM	RSF	NRSF	FW
			kg	MJ net calorific value	MJ net calorific value	m^3
Product stage	Raw material supply	A1	2.83E+00	0.00E+00	0.00E+00	4.82E-01
	Transport	A2	0.00E+00	0.00E+00	0.00E+00	6.64E-03
	Manufacturing	A3	1.34E-02	1.20E-05	0.00E+00	1.15E-01
	Total (of product stage)	A1-3	2.84E+00	1.20E-05	0.00E+00	6.05E-01
Scenario: 95% recycling and 5% landfill						
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	0.00E+00	0.00E+00	0.00E+00	4.29E-03
	Waste processing	C3	0.00E+00	0.00E+00	0.00E+00	1.35E-03
	Disposal	C4	0.00E+00	0.00E+00	0.00E+00	2.41E-03
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	0.00E+00	0.00E+00	0.00E+00	-1.27E-01

SM = Use of secondary material;
RSF = Use of renewable secondary fuels;
NRSF = Use of non-renewable secondary fuels;
FW = Net use of fresh water

LCA Results – 1 m of the 350x350mm reinforced precast concrete pile (306 kg/m)

Other environmental information describing waste categories					
			HWD	NHWD	RWD
			kg	kg	kg
Product stage	Raw material supply	A1	5.71E+00	3.95E+01	5.38E-04
	Transport	A2	6.61E-02	1.17E+00	4.05E-04
	Manufacturing	A3	4.87E-02	1.06E+00	1.48E-04
	Total (of product stage)	A1-3	5.82E+00	4.18E+01	1.09E-03
Scenario: 95% recycling and 5% landfill					
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	4.24E-02	7.53E-01	2.60E-04
	Waste processing	C3	3.11E-02	2.18E-01	1.64E-04
	Disposal	C4	2.34E-03	3.30E-02	1.47E-05
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	-1.36E+00	-2.98E+01	-3.09E-04

HWD = Hazardous waste disposed;
NHWD = Non-hazardous waste disposed;
RWD = Radioactive waste disposed

LCA Results – 1 m of the 350x350mm reinforced precast concrete pile (306 kg/m)

			Other environmental information describing output flows – at end of life						
			CRU	MFR	MER	EEE	EET	Biogenic carbon (product)	Biogenic carbon (packaging)
			kg	kg	kg	MJ per energy carrier	MJ per energy carrier	kg C	kg C
Product stage	Raw material supply	A1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	A2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Manufacturing	A3	0.00E+00	5.91E-01	1.05E-07	2.18E-03	7.37E-03	7.91E-02	6.81E-02
	Total (of product stage)	A1-3	0.00E+00	5.91E-01	1.05E-07	2.18E-03	7.37E-03	7.91E-02	6.81E-02
Scenario: 95% recycling and 5% landfill									
End of life	Deconstruction, demolition	C1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Transport	C2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Waste processing	C3	0.00E+00	2.02E-05	3.22E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Disposal	C4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Potential benefits and loads beyond the system boundaries	Reuse, recovery, recycling potential	D	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

CRU = Components for reuse;
MFR = Materials for recycling

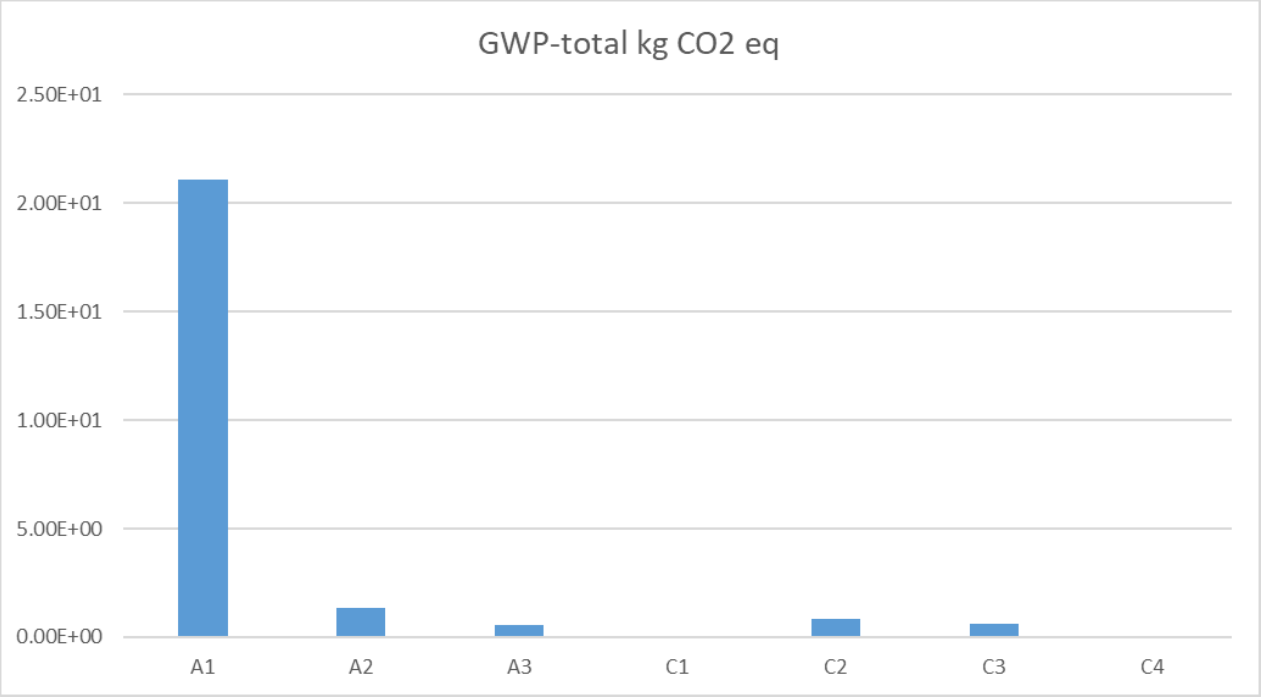
MER = Materials for energy recovery;
EE = Exported Energy

Scenarios and additional technical information

Scenarios and additional technical information				
Scenario	Description		Units	Results
C1 – Deconstruction	Foundation piles left in the ground are explicitly mentioned as examples in the PCR EN16757:2017, chapter 6.3.8.4.2; therefore, no end-of-life scenario is considered for the piles. However, in some cases, heavy machinery such as vibratory extractors or hydraulic jacks can be used to remove piles from demolition sites. Extracted piles can be reused, repurposed, or recycled rather than discarded as waste. In this LCA analysis, the worst-case scenario has been selected, assuming that the piles are extracted, sent to a recycling facility, and processed as waste. The energy used for pile extraction is not included in the analysis; therefore, no impacts are considered for C1.			
C2 – End-of-Life Transport	50km by road has been modelled for module C2 as a typical distance from the demolition site to the disposal unit. However, end-users of the EPD can use this information to calculate the impacts of a bespoke transport distance for module C2 if required.			
	Road transport, Lorry 16-32 tonne		Km	50
C3 – Waste Processing	Once the recovered waste piles reach the waste processing facility, they undergo a crushing process where the steel is separated from the final waste. The remaining concrete blocks are then crushed and reused as aggregates. According to the BRE PCR EN15804 3.1, the end-of-life scenario for Structure (floor), concrete (precast) has been selected, which assumes 95% recycling and 5% landfill. Based on the material composition of the piles, each 1m pile consists of approximately 97% concrete and 3% reinforcement steel. It is assumed that 95% of the concrete block and the steel can be recycled at the waste processing facility, while 5% of the concrete block is considered a natural loss during processing.			
	200 x 200 mm Pile – Concrete waste			90.8 kg
	200 x 200 mm Pile – steel waste			4.15 kg
	250 x 250 mm Pile - Concrete waste			142.6 kg
	250 x 250 mm Pile – Steel waste			5.60 kg
	300 x 300 mm Pile - Concrete waste			205.7 kg
	300 x 300 mm Pile – Steel waste			8.01 kg
	350 x 350 mm Pile – Concrete waste			280.2 kg
	350 x 350 mm Pile – Steel waste			10.46
C4 - Disposal	Unrecovered waste sent to landfill	200 x 200 mm Pile - Concrete waste		5 kg
		250 x 250 mm Pile - Concrete waste		7.80 kg
		300 x 300 mm Pile - Concrete waste		11.25 kg
		350 x 350 mm Pile - Concrete waste		15.30 kg
Module D	The environmental benefits of recycled materials are reported in Module D, in compliance with EN15804+A2:2019, representing the potential future avoidance of raw material extraction and processing due to the recycling of both reinforcement steel and concrete. Module D can only consider the future benefits of virgin materials. Concrete is 100% virgin, and the dataset used for reinforcement steel which comes from Ecoinvent 3.8 states that 29% of the steel is derived from secondary materials. As a result, the 100% recycling scenario reports the following benefits (per 1m).			
	Benefits of recycling - 200 x 200 mm Pile – Concrete waste			90.8 kg
	Benefits of recycling - 200 x 200 mm Pile – virgin steel waste			2.94 kg
	Benefits of recycling - 250 x 250 mm Pile – Concrete waste			205.7 kg
	Benefits of recycling - 250 x 250 mm Pile – virgin steel waste			3.97 kg
	Benefits of recycling - 300 x 300 mm Pile – Concrete waste			205.7 kg
	Benefits of recycling - 300 x 300 mm Pile – virgin steel waste			5.69 kg
	Benefits of recycling - 350 x 350 mm Pile – Concrete waste			280.2 kg
	Benefits of recycling - 350 x 350 mm Pile – virgin steel waste			7.43 kg

Interpretation

The majority of the environmental impacts are attributed to the processing and waste treatment of piles, covered by information modules A1–A3 and C1–C4 of EN15804:2012+A2:2019. The graph below illustrates the GWP contribution of a 200x200mm pile, where the highest impacts originate from the A1 stage—Raw Material Supply. Within this stage, cement and steel are the primary contributors to environmental impacts. A similar trend is observed for the 250x250mm, 300x300mm, and 350x350mm piles.



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