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ECO PLATFORM EPD VERIFIED

Owner: Centrum Pæle A/S
No.: MD-23211-EN
Issued: 07-02-2023
Valid for: 10-03-2026

3rd PARTY **VERIFIED**

EPD

VERIFIED ENVIRONMENTAL PRODUCT DECLARATION | **ISO 14025 & EN 15804**

Owner of the Declaration
Centrum Pæle A/S
Grønlandsvej 96
DK-7100 Vejle
CVR: 27242561

Programme
EPD Denmark
www.epddanmark.dk

☐ Industry EPD
☒ Product EPD

Declared product
1 meter steel reinforced foundation pile in S2 concrete.
Additions in the form of:
- Coating with bitumen
- Addition of extra rebar
- Energy pile hoses for geothermal heating/cooling

Number of declared data sets/product variations: 5
25cm x 25cm, type 6, with 6 rebar
30cm x 30cm, type 8, with 8 rebar
35cm x 35cm, type 12, with 12 rebar
40cm x 40cm, type 12, with 12 rebar
45cm x 45cm, type 16, with 16 rebar

Number of additions: 7
Bitumen on foundation pile 25cm x 25cm
Bitumen on foundation pile 30cm x 30cm
Bitumen on foundation pile 35cm x 35cm
Bitumen on foundation pile 40cm x 40cm
Bitumen on foundation pile 45cm x 45cm
Type +/- 1, i.e. addition/removal of rebar
Hoses for energy pile

Production location
Centrum Pæle, Grønlandsvej 96, DK-7100 Vejle.

Use of Guarantees of Origin
☒ No certificates used
☐ Electricity covered by GoO
☐ Biogas covered by GoO

Declared/functional unit
Declared unit is 1 meter steel reinforced foundation pile in S2 concrete.

Reference year
2020

Issued
07-02-2023

Valid until:
10-03-2026

Basis of calculation
This EPD is developed in accordance with the European standard EN 15804+A2.

Comparability
EPDs of construction products may not be comparable if they do not comply with the requirements in EN 15804. EPD data may not be comparable if the datasets used are not developed in accordance with EN 15804 and if the background systems are not based on the same database.

Validity
This EPD has been verified in accordance with ISO 14025 and is valid for 5 years from the date of issue.

Use
The intended use of an EPD is to communicate scientifically based environmental information for construction products, for the purpose of assessing the environmental performance of buildings.

EPD type
☐Cradle-to-gate
☒Cradle-to-gate with options
☐Cradle-to-grave

CEN standard EN 15804 serves as the core PCR

Independent verification of the declaration and data, according to EN ISO 14025

☐ internal ☒ external

Third party verifier:

Mie Ostenfeldt
FORCE Technology

Martha Sørensen
EPD Danmark

Life cycle stages and modules (MNR = module not relevant, MND = module not declared)																
Product			Construction process		Use							End of life				Outside system boundary
Raw material supply	Transport	Manufacturing	Transport	Installation process	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction/ demolition	Transport	Waste processing	Disposal	Re-use, recovery and recycling potential
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
X	**X**	**X**	**X**	**MND**	**MND**	**MND**	**MND**	**MND**	**MND**	**MND**	**MND**	**X**	**X**	**X**	**X**	**X**

Product information

Product description

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

Material	25x25, type 6	30x30, type 8	35x35, type 12	40x40, type 12	45x45, type 16
Aggregates	46%	46%	46%	47%	47%
Sand	29%	29%	29%	29%	29%
Cement	14%	14%	14%	15%	15%
Water	5,8%	5,8%	5,8%	5,9%	5,9%
Additive, air entrainer	< 1%	< 1%	< 1%	< 1%	< 1%
Additive, superplasticizer	< 1%	< 1%	< 1%	< 1%	< 1%
Additive, plasticizer	< 1%	< 1%	< 1%	< 1%	< 1%
Additive, hardener	< 1%	< 1%	< 1%	< 1%	< 1%
Plastic spacers	0,03%	0,02%	0,02%	0,01%	0,01%
Steel lifting anchor	0,1%	0,1%	0,1%	0,1%	0,1%
Rebar	3,5%	3,2%	3,6%	2,8%	2,9%
Hanger thread	0,8%	0,7%	0,6%	0,6%	0,5%
Plastic label	0,003%	0,002%	0,001%	0,002%	0,002%
Weight	150 kg	217 kg	296 kg	385 kg	487 kg

Additions to foundation piles use the materials listed in the table below. Adding extra rebar (type+/-1) and energy hoses (energy pile) displaces concrete. In this way, the consumption of e.g. sand and stone to produce concrete becomes negative. The changes can only be used in conjunction with a primary foundation pile from the table above, and the total weight is therefore still positive.

The material in 'Type +/-1' must change signs if reinforcing bars are removed. Thus, the use of aggregates is increased by the removal of 2 rebars: (-2) x (-1.25E-01) kg = 0.25kg

Material	Bitumen, 25x25	Bitumen, 30x30	Bitumen, 35x35	Bitumen, 40x40	Bitumen, 45x45	Type +/- 1	Energy pile	Unit
Aggregates	-	-	-	-	-	-1,29E-01	-2,72E+00	kg
Sand	-	-	-	-	-	-8,09E-02	-1,71E+00	kg
Cement	-	-	-	-	-	-4,01E-02	-8,51E-01	kg
Water	-	-	-	-	-	-1,62E-02	-3,43E-01	kg
Additive, air entrainer	-	-	-	-	-	< -1	< -10	g
Additive, superplasticizer	-	-	-	-	-	< -1	< -10	g
Additive, plasticizer	-	-	-	-	-	< -1	< -10	g
Additive, hardener	-	-	-	-	-	< -1	< -10	g
Rebar	-	-	-	-	-	9.10E-01	-	kg
Bitumen	7,08E-01	8,50E-01	9,91E-01	1,13E+00	1,27E+00	-	-	kg
Plastic hose	-	-	-	-	-	-	8,20E-01	kg
Weight	7,08E-01	8,50E-01	9,91E-01	1,13E+00	1,27E+00	6,44E-01	-4,74E+00	kg

Representativeness

The declared unit is 1 meter reinforced foundation pile in S2 concrete, with possible additions.

Data for the underlying LCA are based on annual averages for the production of foundation piles in the year 2020.

Background data is based on the GaBi database version 2020.2. Most data is less than 5 years old, and all data is less than 10 years old in accordance with EN15804:2012+A2:2019. The exception is additives in concrete, where the total quantity is less than 0.2% (w/w).

Content of dangerous substances

The product does not contain substances from the REACH Candidate List, the "Candidate List of Substances of Very High Concern for Authorisation" (as viewed online on December 10th, 2023), in concentrations which exceeds 0.1% (http://echa.europa.eu/candidate-list-table).

Product use

Foundation for buildings and construction works. The product can be used where there are no elevated salt concentrations from intruding seawater.

Essential properties (CE)

The foundation piles comply with the requirements of DS/EN 12794 + /A1:2007 + AC:2008; Prefabricated concrete elements - Foundation piles.
Performance declarations on each pole can be found here: https://www.centrumpaele.dk/paele.aspx

Reference Service Life (RSL)

Lifetime is counted as 100 years (RSL) cf. Annex AA in "DS/EN 16757:2022 – "Sustainability in construction and construction – environmental product declarations – Product category rules for concrete and concrete elements".

Photo of product

LCA background

Declared unit

LCI and LCIA results in this EPD relate to the declared unit 1 meter foundation pile, indicated in the table below, with weight per meter and a conversion factor to 1 kg.

Name	25x25, type 6	30x30, type 8	35x35, type 12	40x40, type 12	45x45, type 16
Declared unit	1 meter	1 meter	1 meter	1 meter	1 meter
Weight, kg	1,50E+02	2,17E+02	2,96E+02	3,85E+02	4,87E+02
Conversion factor to 1 kg	0,006666	0,004614	0,003381	0,002599	0,002053

Additions to the base models are given in the table below, indicating weight and conversion to 1 kg.

Name	Bitumen, 25x25	Bitumen, 30x30	Bitumen, 35x35	Bitumen, 40x40	Bitumen, 45x45	Type +/- 1	Energy pile
Declared unit	1 meter	1 meter	1 meter	1 meter	1 meter	1 meter	1 meter
Weight, kg	7,08E-01	8,50E-01	9,91E-01	1,13E+00	1,27E+00	6,44E-01	-4,74E+00
Conversion factor to 1 kg	1,4125	1,1771	1,0089	0,8828	0,7847	1,5522	-0,2110

Functional unit

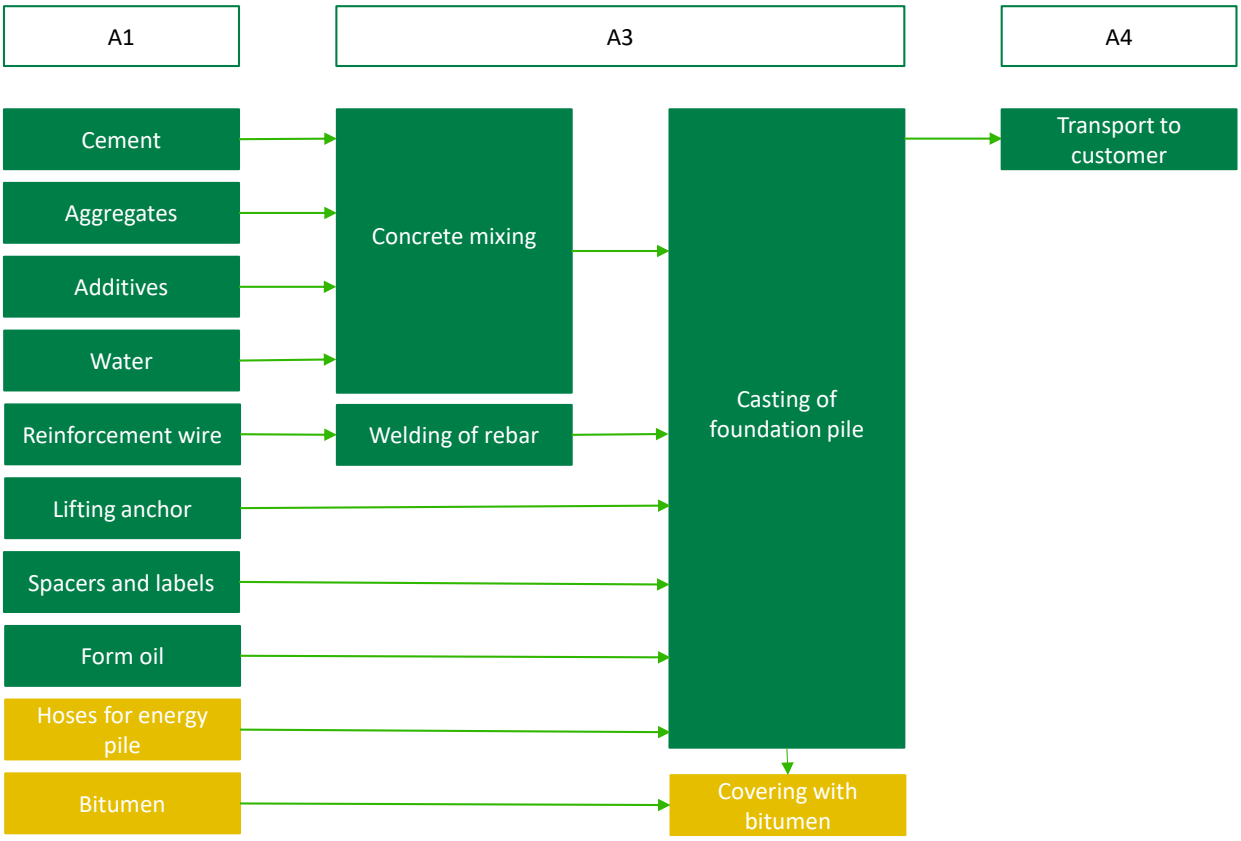
Not defined.

PCR

This environmental product declaration is based on the requirements of EN 15804:2012+A2:2019 and the product-specific PCR: "DS/EN 16757:2022 – "Sustainability in construction and construction – environmental product declarations – Product category rules for concrete and concrete elements".

Flow diagram

The flow diagram below covers raw materials (A1), production (A3) and outbound transport (A4) at Centrum Pæle in Vejle. Inbound and internal transport (A2) is done at the arrows. Yellow color indicates extensions.



Energy modelling principles

Foreground system: The product is produced using residual electricity mix from the background database.

Background system: Upstream and downstream processes are modelled using average electricity grid mix from the background database.

System boundaries

The EPD is based on cradle-to-gate with options, module C1-C4 and module D. Options consist of including module A4.

All relevant processes from the modules covered are included.

The general rules for omitting inputs and outputs in the LCA follow the provisions of EN 15804:2012+A2:2019, 6.3.5, where the total omission of input flow per module may not exceed 5% of energy consumption and mass and a maximum of 1% per unit process.

Key assumptions are described for each life cycle stage below.

The product phase (A1-A3):
The product phase includes the provision of all raw materials, products and energy, transport to production, mixing process, internal transport and waste treatment up to "end-of-waste" or final disposal.

The LCA results are indicated in aggregated form of the product phase, which means that modules A1, A2 and A3 are considered as a single module A1-A3.

The foundation piles are made by mixing concrete and pouring into molds where the necessary reinforcement, casting parts etc. have been laid down according to current standards.

The molds are designed in steel and applied form oil to enable reuse after cleaning. The concrete elements are deformed the day after casting, after which they are driven to storage space. After hardening they are driven to the construction site.

Construction process phase (A4-A5):
The construction process phase includes transport from the factory gate to the construction site (by truck).

Installation of foundation piles (module A5) is not included but must be including in LCA calculations on complete building or installation.

End of life (C1-C4) and potential for recycling, and energy recovery (D):
The C and D modules are without impact as it is considered that there is no excavation of foundation piles in concrete with associated elements such as joints and rock shoes. All materials are inert in buried condition, and it will be associated with high energy consumption to excavate the elements. In addition, it is rare for built-up areas to be returned to natural condition, as these areas are usually redeveloped. When rebuilding, foundation piles can be included in the new construction if they are not damaged during demolition and data on the piles is known.

In this EPD, the piles are not considered recycled. Foundation piles left in the ground are specifically mentioned as examples in the PCR EN 16757:2022, chapter 6.3.8.4.2: "The EPD may specify a scenario whether no deconstruction/demolition or disposal takes place (e.g. disused underground foundation piles left without being exhumed)".

LCA results

For the calculation of LCIA results, the characterization model CML 2001 is used with GaBi 10.0 with database version 2020.0 for classifying and characterizing input and output flows.

Module A4 is indicated per kg of product for 100 km of transport. The results must therefore be multiplied by the weight of the product, and can multiplied with the distance relative to 100 km. Thus, for a product of 10 kg transported 200 km, all A4 results must be multiplied by 10 x 2 = 20.

The results are given first for the main products and then for additions. Results for additions should be added to the results for the main products. For example, the addition of 2 sets of additional reinforcing bars (corresponding to change +2 in Type) should be added 2 times the results for "Type +/-1".

LCA results, main products

ENVIRONMENTAL EFFECTS PER METER									
Parameter	**Unit**	**25x25 type 6**	**30x30 type 8**	**35x35 type 12**	**40x40 type 12**	**45x45 type 16**	**Transport per kg pr 100 km**	**All types and dimensions**	
		A1-A3	**A1-A3**	**A1-A3**	**A1-A3**	**A1-A3**	**A4**	**C1-C4**	**D**
GWP-total	[kg CO_2 eq.]	2,10E+01	3,00E+01	4,12E+01	5,25E+01	6,65E+01	6,66E-03	0,00E+00	0,00E+00
GWP-fossil	[kg CO_2 eq.]	2,10E+01	3,00E+01	4,12E+01	5,25E+01	6,65E+01	6,61E-03	0,00E+00	0,00E+00
GWP-bio	[kg CO_2 eq.]	-8,06E-03	-1,47E-02	-1,82E-02	-3,30E-02	-4,16E-02	-7,87E-06	0,00E+00	0,00E+00
GWP-luluc	[kg CO_2 eq.]	8,57E-03	1,20E-02	1,66E-02	2,03E-02	2,57E-02	5,40E-05	0,00E+00	0,00E+00
ODP	[kg CFC 11 eq.]	2,05E-07	2,97E-07	4,04E-07	5,30E-07	6,71E-07	1,30E-18	0,00E+00	0,00E+00
AP	[mol H^+ eq.]	3,43E-02	4,86E-02	6,70E-02	8,39E-02	1,06E-01	7,03E-06	0,00E+00	0,00E+00
EP-fw	[kg PO_4 eq.]	2,69E-03	3,90E-03	5,31E-03	6,96E-03	8,81E-03	1,96E-08	0,00E+00	0,00E+00
EP-mar	[kg N eq.]	3,61E-03	4,95E-03	6,94E-03	8,15E-03	1,04E-02	2,24E-06	0,00E+00	0,00E+00
EP-ter	[mol N eq.]	1,08E-01	1,53E-01	2,11E-01	2,66E-01	3,38E-01	2,66E-05	0,00E+00	0,00E+00
POCP	[kg NMVOC eq.]	2,86E-02	4,04E-02	5,58E-02	6,97E-02	8,83E-02	6,10E-06	0,00E+00	0,00E+00
ADP-mm[1]	[kg Sb eq.]	6,72E-06	9,64E-06	1,32E-05	1,69E-05	2,15E-05	5,86E-10	0,00E+00	0,00E+00
ADP-fos[1]	[MJ]	1,01E+02	1,38E+02	1,92E+02	2,27E+02	2,88E+02	8,80E-02	0,00E+00	0,00E+00
WDP[1]	[m^3]	1,08E+00	1,47E+00	2,07E+00	2,38E+00	3,04E+00	6,13E-05	0,00E+00	0,00E+00
Caption	GWP-total = Globale Warming Potential - total; GWP-fossil = Global Warming Potential - fossil fuels; GWP-bio = Global Warming Potential - biogenic; GWP-luluc = Global Warming Potential - land use and land use change; ODP = Ozone Depletion; AP = Acidifcation; EP-freshwater = Eutrophication – aquatic freshwater; EP-marine = Eutrophication – aquatic marine; EP-terrestrial = Eutrophication – terrestrial; POCP = Photochemical zone formation; ADPm = Abiotic Depletion Potential – minerals and metals; ADPf = Abiotic Depletion Potential – fossil fuels; WDP = water use								
Disclaimer	[1] The results of this environmental indicator shall be used with care as the uncertainties on these results are high or as there is limited experienced with the indicator.								

ADDITIONAL ENVIRONMENTAL EFFECTS PER METER									
Parameter	**Unit**	**25x25 type 6**	**30x30 type 8**	**35x35 type 12**	**40x40 type 12**	**45x45 type 16**	**Transport per kg pr 100 km**	**All types and dimensions**	
		A1-A3	**A1-A3**	**A1-A3**	**A1-A3**	**A1-A3**	**A4**	**C1-C4**	**D**
PM	[Disease incidence]	3,13E-07	4,39E-07	6,08E-07	7,48E-07	9,49E-07	4,82E-11	0,00E+00	0,00E+00
IRP[2]	[kBq U235 eq.]	4,17E+02	6,04E+02	8,23E+02	1,08E+03	1,37E+03	2,34E-05	0,00E+00	0,00E+00
ETP-fw[1]	[CTUe]	2,35E+01	3,11E+01	4,34E+01	4,88E+01	6,17E+01	6,53E-02	0,00E+00	0,00E+00
HTP-c[1]	[CTUh]	3,18E-08	4,60E-08	6,27E-08	8,17E-08	1,03E-07	1,32E-12	0,00E+00	0,00E+00
HTP-nc[1]	[CTUh]	7,61E-07	1,09E-06	1,49E-06	1,90E-06	2,41E-06	6,85E-11	0,00E+00	0,00E+00
SQP[1]	-	8,61E+01	1,23E+02	1,69E+02	2,16E+02	2,73E+02	3,02E-02	0,00E+00	0,00E+00
Caption	PM = Particulate Matter emissions; IRP = Ionizing radiation – human health; ETP-fw = Eco toxicity – freshwater; HTP-c = Human toxicity – cancer effects; HTP-nc = Human toxicity – non cancer effects; SQP = Soil Quality (dimensionless)								
Disclaimers	[1] The results of this environmental indicator shall be used with care as the uncertainties on these results are high or as there is limited experienced with the indicator.								
	[2] This impact category deals mainly with the eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure nor due to radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, from radon and from some construction materials is also not measured by this indicator.								

RESSOURCE CONSUMPTION PER METER									
Parameter	**Unit**	**25x25 type 6**	**30x30 type 8**	**35x35 type 12**	**40x40 type 12**	**45x45 type 16**	**Transport per kg pr 100 km**	**All types and dimensions**	
		A1-A3	**A1-A3**	**A1-A3**	**A1-A3**	**A1-A3**	**A4**	**C1-C4**	**D**
PERE	[MJ]	2,94E+01	4,03E+01	5,64E+01	6,64E+01	8,44E+01	5,06E-03	0,00E+00	0,00E+00
PERM	[MJ]	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
PERT	[MJ]	2,94E+01	4,03E+01	5,64E+01	6,64E+01	8,44E+01	5,06E-03	0,00E+00	0,00E+00
PENRE	[MJ]	1,10E+02	1,51E+02	2,09E+02	2,49E+02	3,16E+02	8,83E-02	0,00E+00	0,00E+00
PENRM	[MJ]	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
PENRT	[MJ]	1,10E+02	1,51E+02	2,09E+02	2,49E+02	3,16E+02	8,83E-02	0,00E+00	0,00E+00
SM	[kg]	7,86E+00	1,05E+01	1,50E+01	1,63E+01	2,09E+01	0,00E+00	0,00E+00	0,00E+00
RSF	[MJ]	1,73E+01	2,51E+01	3,42E+01	4,48E+01	5,67E+01	0,00E+00	0,00E+00	0,00E+00
NRSF	[MJ]	4,38E+01	6,35E+01	8,64E+01	1,13E+02	1,43E+02	0,00E+00	0,00E+00	0,00E+00
FW	[m^3]	3,58E-02	4,83E-02	6,83E-02	7,77E-02	9,90E-02	5,80E-06	0,00E+00	0,00E+00
Caption	PERE = Use of renewable primary energy excluding renewable primary energy resources 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 resources; SM = Use of secondary material; RSF = Use of renewable secondary fuels; NRSF = Use of non renewable secondary fuels; FW = Net use of fresh water								

WASTE CATEGORIES AND OUTPUT FLOWS PER METER									
Parameter	**Unit**	**25x25 type 6**	**30x30 type 8**	**35x35 type 12**	**40x40 type 12**	**45x45 type 16**	**Transport per kg pr 100 km**	**All types and dimensions**	
		A1-A3	**A1-A3**	**A1-A3**	**A1-A3**	**A1-A3**	**A4**	**C1-C4**	**D**
HWD	[kg]	3,82E-06	5,54E-06	7,55E-06	9,90E-06	1,25E-05	4,65E-12	0,00E+00	0,00E+00
NHWD	[kg]	4,97E+00	7,20E+00	9,81E+00	1,28E+01	1,62E+01	1,39E-05	0,00E+00	0,00E+00
RWD	[kg]	6,14E-03	8,23E-03	1,17E-02	1,30E-02	1,66E-02	1,60E-07	0,00E+00	0,00E+00
CRU	[kg]	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
MFR	[kg]	5,26E-01	7,54E-01	1,03E+00	1,33E+00	1,68E+00	0,00E+00	0,00E+00	0,00E+00
MER	[kg]	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
EEE	[MJ]	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
EET	[MJ]	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Caption	HWD = Hazardous waste disposed; NHWD = Non hazardous waste disposed; RWD = Radioactive waste disposed; CRU = Components for re-use; MFR = Materials for recycling; MER = Materials for energy recovery; EE = Exported energy								

BIOGENIC CARBON CONTENT PER METER AT FACTORY GATE						
Parameter	**Unit**	**25x25 type 6**	**30x30 type 8**	**35x35 type 12**	**40x40 type 12**	**45x45 type 16**
In product	kg C	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
In packaging	kg C	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00

LCA results, modifications

ENVIRONMENTAL EFFECTS PER METER											
Parameter	Unit	Bitumen covering					Type +/- 1	Energy pile	Transport per kg pr 100 km	All types and dimensions	
		25x25	30x30	35x35	40x40	45x45					
		A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A4	C1-C4	D
GWP-total	[kg CO_2 eq.]	7,53E-01	9,04E-01	1,05E+00	1,20E+00	1,36E+00	4,14E-01	1,12E+00	6,66E-03	0,0E+0	0,0E+0
GWP-fossil	[kg CO_2 eq.]	7,39E-01	8,87E-01	1,04E+00	1,18E+00	1,33E+00	4,11E-01	1,11E+00	6,61E-03	0,0E+0	0,0E+0
GWP-bio	[kg CO_2 eq.]	1,05E-02	1,26E-02	1,46E-02	1,67E-02	1,89E-02	2,64E-03	1,41E-02	-7,87E-06	0,0E+0	0,0E+0
GWP-luluc	[kg CO_2 eq.]	3,39E-03	4,07E-03	4,75E-03	5,43E-03	6,12E-03	4,28E-04	9,80E-04	5,40E-05	0,0E+0	0,0E+0
ODP	[kg CFC 11 eq.]	4,65E-15	5,58E-15	6,52E-15	7,44E-15	8,38E-15	-3,80E-10	-8,05E-09	1,30E-18	0,0E+0	0,0E+0
AP	[mol H^+ eq.]	1,54E-03	1,85E-03	2,15E-03	2,46E-03	2,77E-03	1,08E-03	1,64E-03	7,03E-06	0,0E+0	0,0E+0
EP-fw	[kg PO_4 eq.]	5,29E-06	6,35E-06	7,41E-06	8,47E-06	9,55E-06	-3,96E-06	-1,02E-04	1,96E-08	0,0E+0	0,0E+0
EP-mar	[kg N eq.]	4,75E-04	5,70E-04	6,65E-04	7,60E-04	8,56E-04	2,71E-04	7,11E-04	2,24E-06	0,0E+0	0,0E+0
EP-ter	[mol N eq.]	5,70E-03	6,84E-03	7,98E-03	9,12E-03	1,03E-02	2,77E-03	4,69E-03	2,66E-05	0,0E+0	0,0E+0
POCP	[kg NMVOC eq.]	1,38E-03	1,66E-03	1,93E-03	2,21E-03	2,49E-03	9,68E-04	2,11E-03	6,10E-06	0,0E+0	0,0E+0
ADP-mm[1]	[kg Sb eq.]	1,07E-07	1,28E-07	1,49E-07	1,71E-07	1,92E-07	8,96E-08	1,38E-07	5,86E-10	0,0E+0	0,0E+0
ADP-fos[1]	[MJ]	2,36E+01	2,83E+01	3,31E+01	3,78E+01	4,25E+01	6,92E+00	6,27E+01	8,80E-02	0,0E+0	0,0E+0
WDP[1]	[m^3]	4,73E-02	5,67E-02	6,62E-02	7,56E-02	8,51E-02	9,65E-02	7,08E-02	6,13E-05	0,0E+0	0,0E+0
Caption	GWP-total = Globale Warming Potential - total; GWP-fossil = Global Warming Potential - fossil fuels; GWP-bio = Global Warming Potential - biogenic; GWP-luluc = Global Warming Potential - land use and land use change; ODP = Ozone Depletion; AP = Acidifcation; EP-freshwater = Eutrophication – aquatic freshwater; EP-marine = Eutrophication – aquatic marine; EP-terrestrial = Eutrophication – terrestrial; POCP = Photochemical zone formation; ADPm = Abiotic Depletion Potential – minerals and metals; ADPf = Abiotic Depletion Potential – fossil fuels; WDP = water use										
Disclaimer	[1] The results of this environmental indicator shall be used with care as the uncertainties on these results are high or as there is limited experienced with the indicator.										

ADDITIONAL ENVIRONMENTAL EFFECTS PER METER											
Parameter	Unit	Bitumen covering					Type +/- 1	Energy pile	Transport per kg pr 100 km	All types and dimensions	
		25x25	30x30	35x35	40x40	45x45					
		A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A4	C1-C4	D
PM	[Disease incidence]	1,46E-08	1,75E-08	2,04E-08	2,33E-08	2,63E-08	1,40E-08	1,21E-08	4,82E-11	0,0E+0	0,0E+0
IRP[2]	[kBq U235 eq.]	1,85E-01	2,22E-01	2,59E-01	2,96E-01	3,33E-01	-6,62E-01	-1,63E+01	2,34E-05	0,0E+0	0,0E+0
ETP-fw[1]	[CTUe]	1,25E+01	1,51E+01	1,76E+01	2,01E+01	2,26E+01	2,22E+00	3,17E+01	6,53E-02	0,0E+0	0,0E+0
HTP-c[1]	[CTUh]	2,54E-10	3,05E-10	3,56E-10	4,07E-10	4,58E-10	8,35E-11	-3,63E-10	1,32E-12	0,0E+0	0,0E+0
HTP-nc[1]	[CTUh]	1,50E-08	1,80E-08	2,10E-08	2,40E-08	2,70E-08	1,47E-08	1,35E-08	6,85E-11	0,0E+0	0,0E+0
SQP[1]	-	6,75E+00	8,11E+00	9,46E+00	1,08E+01	1,22E+01	1,46E+00	2,26E+00	3,02E-02	0,0E+0	0,0E+0
Caption	PM = Particulate Matter emissions; IRP = Ionizing radiation – human health; ETP-fw = Eco toxicity – freshwater; HTP-c = Human toxicity – cancer effects; HTP-nc = Human toxicity – non cancer effects; SQP = Soil Quality (dimensionless)										
Disclaimers	[1] The results of this environmental indicator shall be used with care as the uncertainties on these results are high or as there is limited experienced with the indicator.										
	[2] This impact category deals mainly with the eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure nor due to radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, from radon and from some construction materials is also not measured by this indicator.										

RESSOURCE CONSUMPTION PER METER											
Parameter	Unit	Bitumen covering					Type +/- 1	Energy pile	Transport per kg pr 100 km	All types and dimensions	
		25x25	30x30	35x35	40x40	45x45					
		A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A4	C1-C4	D
PERE	[MJ]	1,83E+00	2,20E+00	2,56E+00	2,93E+00	3,30E+00	2,11E+00	5,92E+00	5,06E-03	0,0E+0	0,0E+0
PERM	[MJ]	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,0E+0	0,0E+0
PERT	[MJ]	1,83E+00	2,20E+00	2,56E+00	2,93E+00	3,30E+00	2,11E+00	5,92E+00	5,06E-03	0,0E+0	0,0E+0
PENRE	[MJ]	2,36E+01	2,84E+01	3,31E+01	3,78E+01	4,26E+01	6,91E+00	6,24E+01	8,83E-02	0,0E+0	0,0E+0
PENRM	[MJ]	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,0E+0	0,0E+0
PENRT	[MJ]	2,36E+01	2,84E+01	3,31E+01	3,78E+01	4,26E+01	6,91E+00	6,24E+01	8,83E-02	0,0E+0	0,0E+0
SM	[kg]	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	9,68E-01	-1,22E-02	0,00E+00	0,0E+0	0,0E+0
RSF	[MJ]	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	-3,22E-02	-6,81E-01	0,00E+00	0,0E+0	0,0E+0
NRSF	[MJ]	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	-8,13E-02	-1,72E+00	0,00E+00	0,0E+0	0,0E+0
FW	[m^3]	3,66E-03	4,39E-03	5,12E-03	5,85E-03	6,59E-03	3,36E-03	7,88E-03	5,80E-06	0,0E+0	0,0E+0
Caption	PERE = Use of renewable primary energy excluding renewable primary energy resources 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 resources; SM = Use of secondary material; RSF = Use of renewable secondary fuels; NRSF = Use of non renewable secondary fuels; FW = Net use of fresh water										

WASTE CATEGORIES AND OUTPUT FLOWS PER METER											
Parameter	Unit	Bitumen covering					Type +/- 1	Energy pile	Transport per kg pr 100 km	All types and dimensions	
		25x25	30x30	35x35	40x40	45x45					
		A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A1-A3	A4	C1-C4	D
HWD	[kg]	2,56E-09	3,07E-09	3,58E-09	4,10E-09	4,61E-09	-5,54E-09	-1,38E-07	4,65E-12	0,0E+0	0,0E+0
NHWD	[kg]	5,89E-03	7,07E-03	8,25E-03	9,43E-03	1,06E-02	-1,11E-03	-1,69E-01	1,39E-05	0,0E+0	0,0E+0
RWD	[kg]	1,56E-03	1,88E-03	2,19E-03	2,50E-03	2,81E-03	6,80E-04	4,86E-04	1,60E-07	0,0E+0	0,0E+0
CRU	[kg]	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,0E+0	0,0E+0
MFR	[kg]	3,33E-02	3,99E-02	4,66E-02	5,32E-02	5,99E-02	7,31E-03	-1,20E-02	0,00E+00	0,0E+0	0,0E+0
MER	[kg]	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,0E+0	0,0E+0
EEE	[MJ]	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,0E+0	0,0E+0
EET	[MJ]	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,0E+0	0,0E+0
Caption	HWD = Hazardous waste disposed; NHWD = Non hazardous waste disposed; RWD = Radioactive waste disposed; CRU = Components for re-use; MFR = Materials for recycling; MER = Materials for energy recovery; EE = Exported energy										

BIOGENIC CARBON CONTENT PER METER AT FACTORY GATE								
Parameter	Unit	Bitumen covering					Type +/- 1	Energy pile
		25x25	30x30	35x35	40x40	45x45		
C in product	kg C	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
C in packaging	kg C	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00

Additional information

LCA interpretation

The largest contribution to environmental impact categories on foundation piles is from raw materials. The processes that contribute most to the individual impacts are listed in the table below:

- The greatest impact is from the production of cement. It has the highest impact in 8 out of 14 impacts; including GWP-total and GWP-fossil.
- The second largest impact is the production of reinforcing steel, which is highest in 3 impacts: marine nutrient load (EP-mar), fossil resource load (ADP-fos) and water consumption (WDP).
- The greatest impact in the bio-based climate impact comes from the burning of bio-based fuel during internal transport. Bio-uptake is dominated by the production of vegetable form oil.
- The biggest impact in the land-use climate impact comes from the use of agricultural land to the production of biodiesel for transportation.

Foundation pile														
Impact Category	**Unit**	**Total**				**Dominant**				**% of category**				**Process**
GWP-total	[kg CO2 eq.]	22	-	70		17	-	55		76%	-	79%		Cement
GWP-fossil	[kg CO2 eq.]	22	-	70		17	-	55		76%	-	79%		Cement
GWP-bio emission	[kg CO2 eq.]	-0,045	-	-0,009		0,030	-	0,098		-323%	-	-214%		Biodiesel combustion
GWP-bio uptake	[kg CO2 eq.]	-0,045	-	-0,009		-0,123	-	-0,038		0%	-	407%		Biobasered lubricant
GWP-luluc	[kg CO2 eq.]	0,017	-	0,052		0,008	-	0,026		49%	-	51%		Biodiesel
ODP	[kg CFC_{11} eq.]	2,05E-07	-	6,71E-07		2,04E-07	-	6,70E-07		100%	-	100%		Cement
AP	[mol H+ eq.]	0,035	-	0,110		0,023	-	0,075		64%	-	68%		Cement
EP-fw	[kg P eq.]	2,69E-03	-	8,81E-03		2,67E-03	-	8,75E-03		99%	-	99%		Cement
EP-mar	[kg N eq.]	0,004	-	0,011		0,002	-	0,004		36%	-	42%		Steel rebar
EP-ter	[mol N eq.]	0,112	-	0,351		0,073	-	0,238		65%	-	68%		Cement
POCP	[kg NMVOC eq.]	0,030	-	0,091		0,018	-	0,059		61%	-	65%		Cement
ADP-mm	[kg Sb eq.]	6,81E-06	-	2,17E-05		5,78E-06	-	1,89E-05		85%	-	87%		Cement
ADP-fos	[MJ]	114	-	331		41	-	110		32%	-	37%		Steel rebar
WDP	[m3]	1,1	-	3,1		0,6	-	1,5		48%	-	54%		Steel rebar

For bitumen coating, the impacts are evenly distributed between A1, A2 and A3 depending on the environmental category:

- A1 is related to the production of bitumen.
- A2 is the production of bio-based fuel for internal transport.
- A3 is the consumption of electricity when applying bitumen.

Bitumenbelægning												
Impact Category	**Unit**	**Total**			**Dominant**			**% of category**			**Process**
GWP-total	[kg CO2 eq.]	0,76	-	1,36	0,52	-	0,94	69%	-	69%	Electricity
GWP-fossil	[kg CO2 eq.]	0,74	-	1,34	0,52	-	0,94	70%	-	70%	
GWP-bio emission	[kg CO2 eq.]	0,0105	-	0,0189	0,0566	-	0,1021	541%	-	542%	Biodiesel combustion
GWP-bio uptake	[kg CO2 eq.]	0,0105	-	0,0189	-0,0869	-	-0,0481	-461%	-	0%	Biodiesel production
GWP-luluc	[kg CO2 eq.]	0,0034	-	0,0062	0,0031	-	0,0056	91%	-	91%	Biodiesel production
ODP	[kg CFC_{11} eq.]	4,65E-15	-	8,38E-15	2,54E-15	-	4,57E-15	55%	-	55%	Electricity
AP	[mol H+ eq.]	0,0015	-	0,0028	0,0006	-	0,0011	38%	-	38%	Bitumen
EP-fw	[kg P eq.]	5,31E-06	-	9,57E-06	4,82E-06	-	8,69E-06	91%	-	91%	Biodiesel production
EP-mar	[kg N eq.]	0,00048	-	0,00086	0,00016	-	0,00029	33%	-	33%	Electricity
EP-ter	[mol N eq.]	0,0057	-	0,0103	0,0017	-	0,0031	30%	-	30%	
POCP	[kg NMVOC eq.]	0,0014	-	0,0025	0,0005	-	0,0009	36%	-	36%	Bitumen
ADP-mm	[kg Sb eq.]	1,07E-07	-	1,93E-07	5,58E-08	-	1,00E-07	52%	-	52%	
ADP-fos	[MJ]	23,69	-	42,65	14,23	-	25,62	60%	-	60%	
WDP	[m3]	0,0473	-	0,0852	0,0337	-	0,0606	71%	-	71%	

For type changes, the dominant influence is from the production of steel bars. There is a slight decrease in the consumption of concrete due to increased steel volume.

Type +/- 1 change					
Impact Category	**Unit**	**Total**	**Dominant**	**% of category**	**Process**
GWP-total	[kg CO2 eq.]	0,42	0,45	107%	Steel rebar
GWP-fossil	[kg CO2 eq.]	0,42	0,44	107%	
GWP-bio emission	[kg CO2 eq.]	0,0026	0,0026	98%	
GWP-bio uptake	[kg CO2 eq.]	0,0026	0,0000	0%	Plasticizer
GWP-luluc	[kg CO2 eq.]	0,00046	0,00043	94%	Steel rebar
ODP	[kg CFC_{11} eq.]	-3,80E-10	6,18E-15	0%	
AP	[mol H+ eq.]	0,0011	0,0011	104%	
EP-fw	[kg P eq.]	-3,95E-06	1,01E-06	-26%	
EP-mar	[kg N eq.]	0,0003	0,0003	100%	
EP-ter	[mol N eq.]	0,0028	0,0029	105%	
POCP	[kg NMVOC eq.]	0,0010	0,0010	104%	
ADP-mm	[kg Sb eq.]	8,99E-08	1,01E-07	112%	
ADP-fos	[MJ]	6,98	7,01	100%	
WDP	[m3]	0,10	0,10	101%	

For the addition of energy hoses, the dominant influence is from the production of plastic hoses. There is a slight decrease in the consumption of concrete due to the volume of the plastic hoses

Energislanger					
Impact Category	**Unit**	**Total**	**Dominant**	**% of category**	**Process**
GWP-total	[kg CO2 eq.]	1,09	1,68	154%	Plastic hose
GWP-fossil	[kg CO2 eq.]	1,08	1,67	155%	
GWP-bio emission	[kg CO2 eq.]	0,014	0,012	84%	
GWP-bio uptake	[kg CO2 eq.]	1,41E-02	-1,23E-03	-9%	Biodiesel internal transport
GWP-luluc	[kg CO2 eq.]	0,0007	0,0011	150%	Plastic hose
ODP	[kg CFC_{11} eq.]	-8,05E-09	1,27E-14	0%	
AP	[mol H+ eq.]	0,0016	0,0025	153%	
EP-fw	[kg P eq.]	-1,02E-04	2,91E-06	-3%	
EP-mar	[kg N eq.]	0,0007	0,0007	102%	
EP-ter	[mol N eq.]	0,0046	0,0074	163%	
POCP	[kg NMVOC eq.]	0,0021	0,0027	130%	
ADP-mm	[kg Sb eq.]	1,35E-07	3,40E-07	251%	
ADP-fos	[MJ]	62,31	59,50	95%	
WDP	[m3]	0,071	0,082	116%	

Technical information on underlying scenarios

Transport to the construction site (A4)

Name	Value	Unit
Fuel quantity and type (alternatively: type of transport)	Diesel	-
Transport types	*Truck trailer, Euro 6, 28 - 34t gross weight / 22t payload capacity*	
Transport distance	100	km
Capacity utilisation (including empty return journey)	61	%
Gross mass fill of transported product	2,41E2	kg/m^3
Capacity utilisation, volume factor	1	-

Reference service life

Name		Unit
Reference Service Life - Lifetime RSL	100	Year
Declared product characteristics (at port) etc.	https://www.centrumpaele.dk/paele.aspx	-
Instructions for use (if given by the manufacturer)	https://www.centrumpaele.dk/statiske-beregninger.aspx	-
Presumed quality of installation work, according to manufacturer instructions	https://www.centrumpaele.dk/statiske-beregninger.aspx	-
Outdoor environment (outdoor use) – e.g. weather resistance, wind, pollution, UV, etc.	https://www.centrumpaele.dk/paele.aspx	-
Conditions of use - e.g. mechanical influences, frequency of use, etc.	https://www.centrumpaele.dk/statiske-beregninger.aspx	-
Maintain (frequency, type, quality, parts replacement)	*Not applicable*	-

End of life/Disposal (C1-C4)

Name	Value	Unit
Sorted construction waste	0	kg
Mixed construction waste	0	kg
For reuse	0	kg
For recycling	0	kg
For energy recovery	0	kg
For landfill	0	kg
Prerequisites for end-of-life scenarios	-	-

Recycling, recycling and/or recycling potential (D)

Name	Value	Unit
Displaced material	0	kg
Recycling potential	0	kg

Indoor air

Not applicable.

Soil and water

The EPD does not indicate anything about the release of hazardous substances to soil and water, as the horizontal standards for measuring the release of regulated hazardous substances from construction products using harmonised testing methods under the provisions of the respective Technical Committees for European Product Standards are not available.

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LCA-practitioner	Danish Technological Institute Buildings & Environment Gregersensvej 1 DK-2630 Taastrup www.teknologisk.dk
LCA software/background data	Thinkstep GaBi 10.0 Database version 2020.2 www.gabi-software.com
3rd Party Verifier	Mie Ostenfeldt FORCE Technology Park Allé 345 2605 Brøndby Denmark https://forcetechnology.com/

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