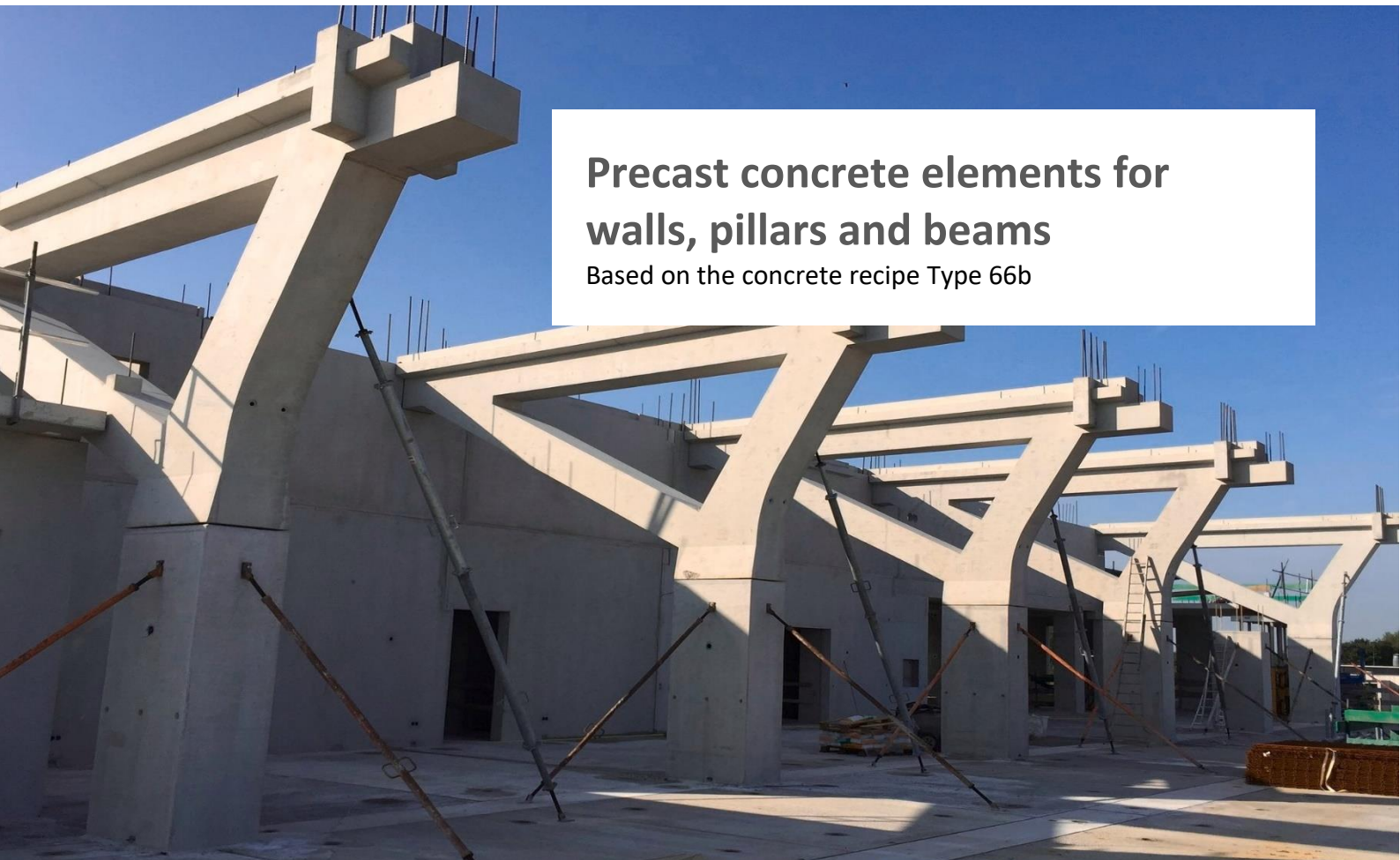
Environmental Product Declaration

as per ISO 14025 and EN 15804

Owner of the declaration:	Holcon GmbH
Publisher:	Kiwa-Ecobility Experts
Programme operator:	Kiwa GmbH - Ecobility Experts
Declaration number:	EPD-Holcon-160-EN (Rev.1_26.04.2023)
Issue date:	17-12-2021
Valid to:	16-12-2026



Precast concrete elements for walls, pillars and beams

Based on the concrete recipe Type 66b

1. General information

Holcon GmbH

Programme operator
Kiwa-Ecobility Experts
Kiwa GmbH
Voltastr. 5
13355 Berlin
Germany

Declaration number
EPD-Holcon-160-EN (Rev.1_26.04.2023)

This declaration is based on the Product Category Rules
PCR B - Product Category Rules for concrete and concrete elements; German version EN 16757:2017

Issue date
17.12.2021

Valid to
16.12.2026

Frank Huppertz
(Head of Kiwa-Ecobility Experts)

Prof. Dr. Frank Heimbecher
(Chairman of the independent expert committee - Ecobility Experts)

Precast concrete

Owner of the declaration
Holcon GmbH
(formerly STF Holterman GmbH)
Trajanring 25
46509 Xanten
Germany

Declared product / declared unit
1 m³ of precast concrete

Scope
The average EPD (type: Cradle to gate with modules C1–C4 and module D) is about custom made precast concrete based on the concrete recipe type 66b, manufactured in Hattersheim, Germany. The calculation is based on 1 m³ of concrete with a share of 6 m% reinforcing and prestressed steel.
Kiwa-Ecobility Experts shall not be liable with respect to manufacturer information, life cycle assessment data and evidences.

Verification
The standard EN 15804+A2:2019 serves as the core PCR

Independent verification of the declaration and data according to ISO 14025:2011-10

☐internally ☒externally

Max Sonnen
(External verifier – Ecomatters)

2. Product

2.1 Product description

The products are reinforced and prestressed precast concrete elements in various formats, sizes and applications. The elements are used as columns, walls and beams. The concrete type 66b has compressive strength class of C 55/67.

2.2 Application

The products are prefabricated elements for building, civil engineering and bridge construction, balconies, solid ceilings.

2.3 Placing on the market / Application rules

- EN 1168 Precast concrete products - Hollow core slabs
- EN 13224 Ribbed floor elements
- EN 13225 Precast concrete products - Linear structural elements
- EN 14992 Precast concrete products - Wall elements

2.4 Technical Data

Technical Data – Concrete type 66b

Name	Value	Unit
Compressive strength	C 55/67	-
Target value of the initial test (28 d)	71	N/mm²
Consistency class	F6(>630)	-
Maximum w/c ratio	0,45	-
Maximum aggregate size (D_{max})	16	mm
Air content	1,6	%
Workability time	0,5	h
Steel grade	B500B and B500A	-

2.5 Base materials / Ancillary materials concrete type 66b

Name	Value	Unit
Cement	16	%
Aggregates	72	%
Addition (lime)	6	%
Water	7	%
Admixture	<1	%
Prestressing steel (average)	6	%

There is no biogenic carbon in the product.

2.6 Manufacturing

The manufacturing contains the following processes:

- Delivery of raw materials
- Preparation of the moulds (formwork, cutting and laying of the probation steel elements, placeholders)
- Concrete mixing and filling into the mould, curing
- Removal of the formwork, finishing, storage

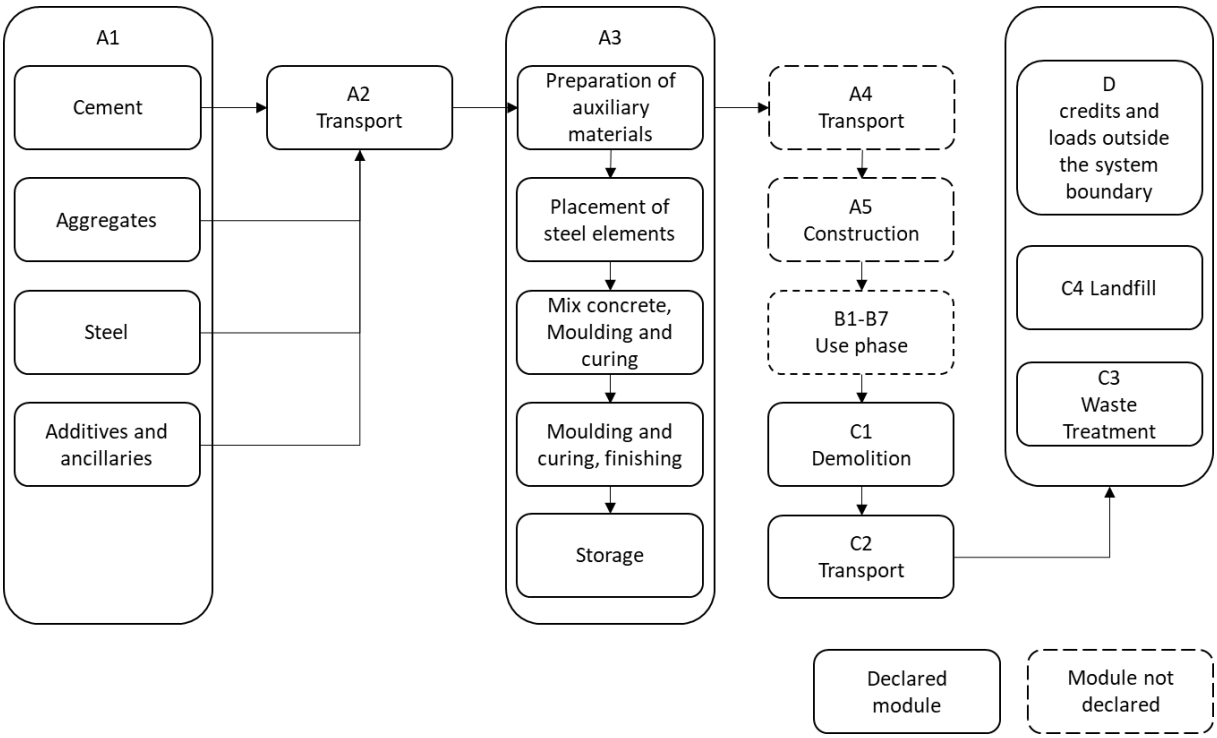


Figure 1: Overview about the production route precast concrete (A1 - A3, C1-C4, D)

2.7 Packaging

No packaging materials are used.

2.8 Production waste

The production process generates production residues and waste: Metal scrap and scale and ancillary materials (lubricating oil, electrode copper).

3. LCA: Calculation rules

3.1 Declared unit

The EPD refers to the declared the product system of 1 cubic meter precast concrete.

Name	Value	Unit
Declared unit	1	m^3 Concrete Element
Weight per Unit:	2.417,1	kg
Compressive strength class	C55/67	-
Content of reinforcing steel and precast steel	6	m%
Steel grade	B500B / B500A	-

3.2 System boundary

This EPD was created in accordance with EN 15804 and monitors the production stage and the end-of-life stage. According to EN 15804 this corresponds to product phases A1-A3, C1-C4 and D (EPD type "Cradle to gate with modules C1–C4 and module D"). All inputs including raw materials, primary products, energy and auxiliary materials as well as the accumulated waste are considered in the assessment. The installation and the use of the final product is not within the manufacturer's sphere of influence. Therefore, modules A4, A5 and B1-B7 have not been considered. The effect of CO_2 absorption through the carbonization process is not taken into account in the LCA. The reference year is 2020. The geographical reference area is Germany.

3.3 Estimates and assumptions

The average proportion of prestressing steel at the Hattersheim site (type 66b) is 27,7 kg of steel.
Modules B1 to B7: For concrete components, maintenance and repair measures are generally not necessary during the reference service life, so that no environmental burdens arise in these modules. In addition, no energy or water is consumed.

3.4 Cut-off criteria

All material flows that contribute to more than 1% of the total mass, energy or environmental impact of the system have been considered in the LCA. It can be assumed that the neglected processes in total contributed less than 5% to the considered impact categories.
The production of the machines, plants and other infrastructure required to produce the reinforcement steel products were not taken into account in the LCA.

3.5 Background Data

The background data is taken from Ecoinvent database version 3.6. The life cycle assessment was modeled with the NIBE tool. Geographical reference space of the background data is Germany. Almost all consistent datasets contained in the Ecoinvent database are documented and can be viewed in the online Ecoinvent documentation.

3.6 Data quality

Overall, the quality of the data can be considered as good. In the operating data survey all relevant process-specific data could be collected. The data relating to the manufacturing phase of the construction steel are determined by Holcon and refers to the production site in Hattersheim.

The LCA study by STF Holterman Wapeninsstaal BV (Tauw 2020) provides primary data (steel production, transport, processing) on the probationary steel used, which was integrated in this study. As the

LCA study uses the calculation method EN15804+A1, the LCA results could not be used. In the LCI, the data used for the calculation of the semi-finished product reinforcing steel are also listed.

Secondary data were taken from the Ecoinvent 3.6 database. The database is regularly checked and thus complies with the requirements of ISO 14040/44 (background data not older than 10 years). The background data meets the requirements of EN 15804. The quantities of raw materials, consumables and supplies used as well as the energy consumption have been recorded and averaged over the entire year of operation.

The general rule has been that specific data from specific production processes or average data derived from specific processes must be given priority when calculating an EPD or Life Cycle Assessment. Data for processes that the manufacturer cannot influence or choose, were backed up with generic data.

EPDs of raw materials (Cement) were partly available but not usable, as they were calculated according to EN 15804:2014 (+A1) and not according to the EN 15804:2020 (+A2) standard used here.

3.7 Period Under review

All process-specific data was collected for the operating year 2020. The quantities of raw and auxiliary materials as well as energy consumption have been recorded and averaged over the entire operating year 2020.

3.8 Allocation

There are no co-products in the raw material supply phase, so no allocation methods were used at this stage. There are no allocations during the manufacturing phase at the plant. The preparation of the construction product is an independent process.

3.9 Calculation methods

For life cycle assessment, the calculation methods described in ISO 14040 have been applied. The evaluation is based on the phases in the system boundaries.

3.10 Mix of electricity and CO_2-Certificates

The electricity mix was chosen according to the energy grid mix in Germany (reference year 2018). No CO_2 certificates were counted.

3.11 Comparability

Basically, a comparison or an evaluation of EPD data is only possible if all the data sets to be compared were created according to EN 15804 and the building context, respectively the product-specific characteristics of performance, are considered.

3.12 Reference Service Life (RSL)

The lifetime of reinforcement will be limited by the service life of the construction. The concrete composition limits given in EN 206-1 are specified for an intended service life of at least 50 years under the respective exposure classes/ environmental conditions.

4. LCA: Scenarios and additional technical information

C1 Demolition: According to the current state of the art, the demolition of concrete and reinforced concrete structures is mainly carried out with longfront excavators equipped with demolition clamps. The concrete buildings are demolished by so-called "press cutting", i.e. the crushing of concrete by

applying a compressive force. It is estimated that one site vehicle is in operation for 30 minutes per sqm of concrete element (conservative assumption).

C2 - C4 and D: It is assumed that concrete and reinforcement material are separated after deconstruction. For both waste groups, a waste scenario according to the Dutch National Environmental Database (NMD) (SBK 2019) is applied:

- Concrete (i.a. elements, brickwork): 99% of concrete is recycled and reused as aggregate.
- Steel, reinforcement: 95% of reinforcing steel is marketed as scrap metal.

5. LCA: Results

The following tables show the results of the impact assessment indicators, resource use, waste and other output streams. The results presented here refer to the declared average product.

Description of the system boundary

Product stage			Construction process stage		Use stage							End of life stage				Benefits and loads beyond the system boundaries
Raw material supply	Transport	Manufacturing	Transport from manufacturer to place of use	Construction-installation process	Use	Maintenance	Repair	Replacement	Refurbishmen	Operational energy use	Operational water use	De-construction / demolition	Transport	Waste processing	Disposal	Reuse-Recovery-Recycling-potential
A1	**A2**	**A3**	**A4**	**A5**	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**C1**	**C2**	**C3**	**C4**	**D**
X	X	X	MND	MND	MND	MND	MND	MND	MND	MND	MND	X	X	X	X	X

X=Module declared | MND=Module not declared

Results of the LCA – Environmental impact: 1m³ of concrete type 66b

Parameter	Unit	A1	A2	A3	C1	C2	C3	C4	D	Total
Core environmental impact indicators (EN 15804)										
ADP-mm	kg Sb-eqv.	4,44E-03	1,44E-03	3,03E-04	8,03E-05	8,06E-04	2,17E-05	2,79E-06	-1,07E-03	6,03E-03
ADP-f	MJ	5,98E+03	1,10E+03	1,44E+03	7,21E+02	4,80E+02	1,03E+02	8,51E+00	-7,22E+02	9,11E+03
AP	mol H+ eqv.	2,85E+00	5,77E-01	2,58E-01	5,48E-01	1,85E-01	4,83E-02	2,89E-03	-4,15E-01	4,05E+00
EP-fw	kg P eqv.	2,12E-02	8,45E-04	1,03E-02	1,91E-04	3,21E-04	2,40E-04	3,41E-06	-3,17E-03	2,99E-02
EP-m	kg N eqv.	6,81E-01	2,26E-01	6,58E-02	2,42E-01	6,50E-02	1,92E-02	9,94E-04	-9,25E-02	1,21E+00
EP-T	mol N eqv.	7,87E+00	2,49E+00	7,78E-01	2,65E+00	7,17E-01	2,13E-01	1,10E-02	-1,08E+00	1,37E+01
GWP-b	kg CO2 eqv.	1,13E+01	7,12E-02	5,42E+00	1,46E-02	1,47E-02	4,45E-02	6,04E-04	7,08E-01	1,76E+01
GWP-f	kg CO2 eqv.	9,23E+02	7,79E+01	1,05E+02	5,24E+01	3,18E+01	7,70E+00	3,04E-01	-9,27E+01	1,11E+03
GWP-luluc	kg CO2 eqv.	3,02E-01	7,40E-02	8,10E-02	4,13E-03	1,17E-02	1,46E-03	8,49E-05	4,25E-02	5,17E-01
GWP-total	kg CO2 eqv.	9,35E+02	7,80E+01	1,10E+02	5,24E+01	3,18E+01	7,74E+00	3,05E-01	-9,19E+01	1,12E+03
ODP	kg CFC 11 eqv.	4,25E-05	1,58E-05	7,90E-06	1,13E-05	7,02E-06	9,98E-07	1,25E-07	-3,54E-06	8,21E-05
POCP	kg NMVOC eqv.	2,48E+00	6,72E-01	1,78E-01	7,30E-01	2,05E-01	5,80E-02	3,18E-03	-5,50E-01	3,78E+00
WDP	m3 world eqv.	2,96E+02	4,38E+00	3,73E+00	9,66E-01	1,72E+00	4,69E-01	3,81E-01	-3,09E+02	-9,84E-01
Additional environmental impact indicators (EN 15804)										
ETP-fw	CTUe	1,19E+04	9,79E+02	8,84E+02	4,35E+02	4,28E+02	8,38E+01	5,52E+00	-2,86E+03	1,19E+04
HTP-c	CTUh	2,24E-06	3,51E-08	2,44E-08	1,52E-08	1,39E-08	1,99E-09	1,28E-10	3,96E-08	2,37E-06
HTP-nc	CTUh	5,01E-05	9,32E-07	8,03E-07	3,73E-07	4,68E-07	5,62E-08	3,92E-09	1,64E-05	6,91E-05
IR	kBq U235 eqv.	2,36E+01	4,67E+00	3,42E+00	3,09E+00	2,01E+00	3,28E-01	3,49E-02	5,35E-01	3,76E+01
PM	disease incidence	3,22E-05	4,97E-06	1,87E-06	1,45E-05	2,86E-06	1,07E-06	5,62E-08	-6,39E-06	5,12E-05
SQP	Pt	1,88E+03	9,16E+02	1,99E+02	9,20E+01	4,16E+02	1,73E+01	1,78E+01	-4,34E+02	3,11E+03

ADP-mm=Depletion of abiotic resources- minerals and metal| **ADP-f**=Depletion of abiotic resources - fossil fuels | **AP**=Acidification of soil and water | **EP-fw** =Eutrophication, freshwater | **EP-m**=Eutrophication marine | **EP-T**=Eutrophication, terrestrial | **GWP-b**=Global warming potential - Biogenic | **GWP-f**=Global warming potential - Fossil | **GWP-luluc**=Global warming potential - Land use and land use change |**GWP-total**=Global warming potential |**ODP**=Ozone layer depletion |**POCP**=Photochemical oxidants creation | **WDP**=Water use | **ETP-fw**=Ecotoxicity, freshwater | **HTP-c**=Human toxicity, cancer | **HTP-nc**=Human toxicity, non-cancer | **IR**=Ionising radiation, human health | **PM**=Particulate Matter | **SQP**=Land use

Disclaimer on ADP-mm, ADP-f, WDP, ETP-fw, HTP-c, HTP-nc, SQP: The results of these environmental impact indicators must be used with caution, as the uncertainties in these results are high or as there is limited experience with the indicator.

Disclaimer on IR: This impact category mainly addresses the potential effect of low dose ionizing radiation on human health in the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents and occupational exposures, nor does it consider radioactive waste disposal in underground facilities. Potential ionizing radiation from soil, radon, and some building materials is also not measured by this indicator.

Resource use and environmental information: 1m³ of concrete type 66b										
Parameter	**Unit**	**A1**	**A2**	**A3**	**C1**	**C2**	**C3**	**C4**	**D**	**Total**
PERE	MJ	4,16E+02	1,80E+01	1,13E+02	3,90E+00	6,01E+00	5,88E+00	6,88E-02	1,75E+00	5,64E+02
PERM	MJ	0,00E+00	0,00E+00	2,92E-01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	-4,62E-04	2,92E-01
PERT	MJ	4,16E+02	1,80E+01	1,13E+02	3,90E+00	6,01E+00	5,88E+00	6,88E-02	1,75E+00	5,65E+02
PENRE	MJ	6,33E+03	1,17E+03	1,56E+03	7,66E+02	5,10E+02	1,10E+02	9,04E+00	-7,53E+02	9,70E+03
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	0,00E+00
PENRT	MJ	6,33E+03	1,17E+03	1,56E+03	7,66E+02	5,10E+02	1,10E+02	9,04E+00	-7,53E+02	9,70E+03
SM	Kg	1,39E+02	0,00E+00	1,64E-01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	1,39E+02
RSF	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	0,00E+00
NRSF	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	0,00E+00
FW	m3	1,01E+01	1,61E-01	4,37E-01	3,71E-02	5,85E-02	3,45E-02	9,09E-03	-7,15E+00	3,64E+00
HWD	Kg	1,69E-02	2,82E-03	1,13E-03	1,96E-03	1,22E-03	1,80E-04	1,27E-05	-9,40E-03	1,48E-02
NHWD	Kg	8,13E+01	4,73E+01	5,63E+00	8,54E-01	3,04E+01	1,44E+01	5,78E+01	-1,05E+01	2,27E+02
RWD	Kg	2,52E-02	7,20E-03	4,48E-03	5,01E-03	3,15E-03	4,64E-04	5,59E-05	-4,63E-04	4,51E-02
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	0,00E+00
MFR	Kg	0,00E+00	0,00E+00	4,78E+01	0,00E+00	0,00E+00	4,92E+03	0,00E+00	0,00E+00	4,97E+03
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	0,00E+00
EE	MJ	0,00E+00	0,00E+00	1,28E-01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	3,85E-03	1,32E-01
EET	MJ	0,00E+00	0,00E+00	8,11E-02	0,00E+00	0,00E+00	0,00E+00	0,00E+00	2,43E-03	8,35E-02
EEE	MJ	0,00E+00	0,00E+00	4,71E-02	0,00E+00	0,00E+00	0,00E+00	0,00E+00	1,41E-03	4,85E-02

PERE=renewable primary energy ex. raw materials | **PERM**=renewable primary energy used as raw materials | **PERT**=renewable primary energy total | **PENRE**=non-renewable primary energy ex. raw materials | **PENRM**=non-renewable primary energy used as raw materials | **PENRT**=non-renewable primary energy total | **SM**=use of secondary material | **RSF**=use of renewable secondary fuels | **NRSF**=use of non-renewable secondary fuels | **FW**=use of net fresh water | **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 | **EET**=Exported Energy Thermic | **EEE**=Exported Energy Electric

6. LCA: Interpretation

The following figures shows the influence of the different life stages on the environmental core indicators for concrete type 66b produced in Hattersheim. Since the Global Warming Potential biogen (GWP-b) and Global Warming Potential resulting from land use and land use (GWP-luluc) change have only a minor impact, only total Global Warming Potential (GWP-total) is shown. As shown in Figure 1 the majority of the environmental impact is attributed to row material processing phase (A1), followed by the transports of raw materials (A2) and production (A3).

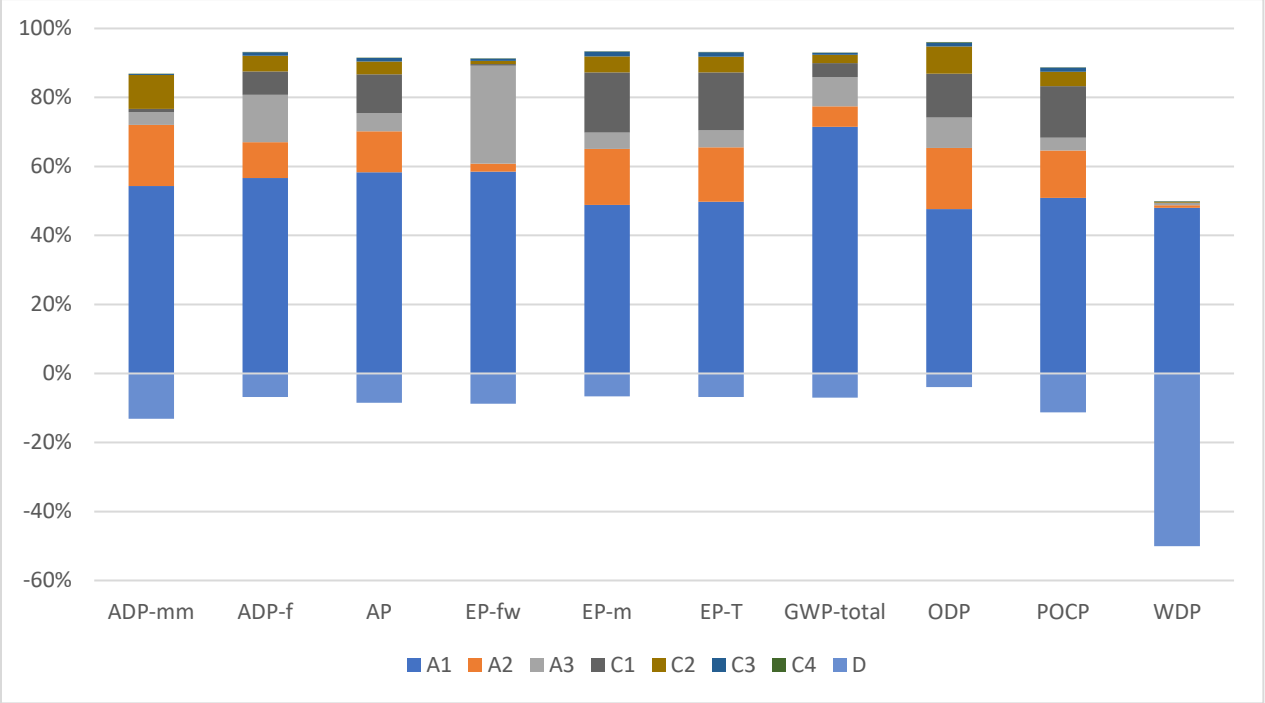


Figure 1: Influence of the modules on the environmental core indicators for type 66b

Overall, the quality of the data can be considered as good. In the operating data survey all relevant process-specific data could be collected. The data relating to the manufacturing phase of the precast concrete are determined by Holcon and refers to the production site in Hattersheim (Germany). Secondary data were taken from the Ecoinvent 3.6 database. The database is regularly checked and thus complies with the requirements of ISO 14040/44 (background data not old-er than 10 years). The background data meets the requirements of EN 15804. The quantities of raw materials, consumables and supplies used as well as the energy consumption have been recorded and averaged over the entire year of operation.

EPDs of raw materials could not be used because they were still calculated according to the old standard (EN 15804+A1), therefore secondary data had to be used. As all reinforcing steel products (except prestressing steel) were supplied by the steel processor Holterman Wapeningsstaal BV, accurate data on the production process as well as the origin of the steel could be used.

Data quality was calculated using the Data Quality Rating method according to the PEF approach. The DQRs range from 1,75 to 2,25 for the most abundant inputs in terms of mass. The expenses for dismantling (C1) could only be estimated, which is why the DQR value here is 3.0. However, the impact of the module on the overall Life Cycle Assessment is very low.

7. References

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Stichting Bouwkwaliteit: verification protocol - inclusion data in the Dutch environmental database, Rijswijk, Final Version 3.0, January 2019

TAUW 2020: LCA en MKI-berekening voor wapeningsstaal van Holterman Wapeningsstaal BV, TAUW bv, Deventer (NL) October 2020,

Standards and laws

ISO 14040:2006-10, Environmental management - Life cycle assessment - Principles and framework; EN ISO 14040:2006

ISO 14044:2006, Environmental management - Life cycle assessment - Requirements and guidelines; EN ISO 14040:2006

ISO 14025:2011-10: Environmental labels and declarations — Type III environmental declarations — Principles and procedures EN 13249

EN 15804:2014 (+A1): Sustainability of construction works — Environmental Product Declarations — Core rules for the product category of construction products

EN 15804:2020 (+A2): Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction products

EN 16757:2017: Sustainability of construction works – Environmental product declarations – Product Category Rules for concrete and concrete elements

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