ENVIRONMENTAL PRODUCT DECLARATION

as per *ISO 14025* and *EN 15804+A2*

Owner of the Declaration	Bundesverband Porenbetonindustrie e.V.
Publisher	Institut Bauen und Umwelt e.V. (IBU)
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
Declaration number	EPD-BPV-20230453-IBG3-EN
Issue date	12.12.2023
Valid to	24.10.2028

Autoclaved aerated concrete

Bundesverband Porenbetonindustrie e.V.

Institut Bauen und Umwelt e.V.

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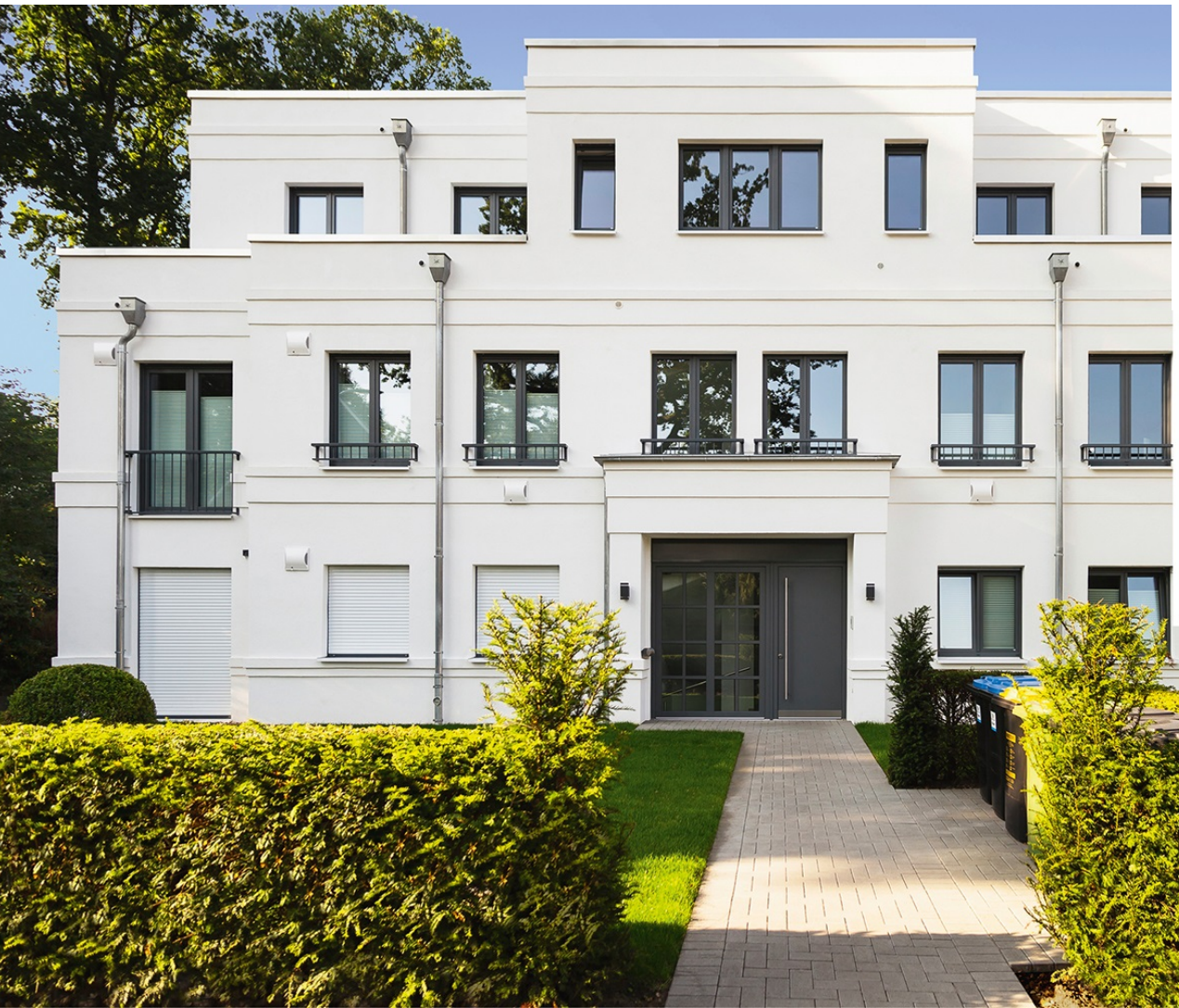

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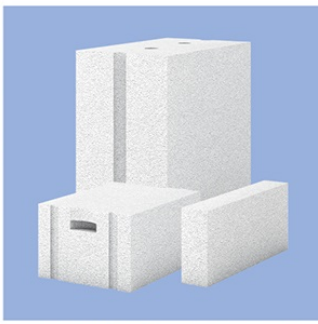

1. General Information

Bundesverband Porenbetonindustrie e.V.

Programme holder

IBU – Institut Bauen und Umwelt e.V.
Hegelplatz 1
10117 Berlin
Germany

Declaration number

EPD-BPV-20230453-IBG3-EN

This declaration is based on the product category rules:

Aereated Concrete, 01.08.2021
(PCR checked and approved by the SVR)

Issue date

12.12.2023

Valid to

24.10.2028

Dipl.-Ing. Hans Peters
(Chairman of Institut Bauen und Umwelt e.V.)

Florian Pronold
(Managing Director Institut Bauen und Umwelt e.V.)

Autoclaved aerated concrete

Owner of the declaration

Bundesverband Porenbetonindustrie e.V.
Kochstraße 6-7
10969 Berlin
Germany

Declared product / declared unit

1 m³ non-reinforced autoclaved aerated concrete with an average gross density of 428 kg/m³.

Scope:

The life-cycle assessment is based on the consumption data of member companies in the Bundesverband Porenbetonindustrie e.V. with 11 autoclaved aerated concrete plants and in the Verband Bauen in Weiß e.V. with 10 autoclaved aerated concrete plants, as well as the data base for 2021.
These autoclaved aerated concrete plants have a production volume according to production output of more than 80% of the German market.

The owner of the declaration shall be liable for the underlying information and evidence; the IBU shall not be liable with respect to manufacturer information, life cycle assessment data and evidences.

The EPD was created according to the specifications of EN 15804+A2. In the following, the standard will be simplified as *EN 15804*.

Verification

The standard EN 15804 serves as the core PCR
Independent verification of the declaration and data according to ISO 14025:2011
☐ internally ☒ externally

Matthias Klingler,
(Independent verifier)

2. Product

2.1 Product description/Product definition

The products referred to above are non-reinforced autoclaved aerated concrete products with different formats. Autoclaved aerated concrete belongs to the group of the porous, steam-cured lightweight concretes. EU regulation no. 305/2011 (*CPR*) applies for placing the product on the market in the EU/EFTA (with the exception of Switzerland). The product requires a declaration of performance based on *DIN EN 771- 4:2015-11*, *Specification for masonry units – Part 4: Autoclaved aerated concrete masonry units* and the CE label. Usage of the product is subject to the applicable national regulations.

2.2 Application

Non-reinforced products for brick-built, monolithic, load-bearing and non-load-bearing walls. Direct exposure to water is structurally avoided if used as intended.

2.3 Technical Data

Refer to the declaration of performance for the respective product. General information can be found in the table below.

Technical Data

Name	Value	Unit
Gross density	250 - 800	kg/m^3
Compressive strength	1.6 - 10	N/mm^2
Tensile strength	0.24 - 1.2	N/mm^2
Bending strength (longitudinal)	0.44 - 2.2	N/mm^2
Modulus of elasticity	750 - 3250	N/mm^2
Moisture content at 23 °C, 80%	< 4	M.-%
Shrinkage: drying shrinkage total value acc. to DIN EN 680	≤ 0.4	mm/m
Thermal conductivity acc. EN 12664	0.07 - 0.18	W/(mK)
Water vapour diffusion resistance factor acc. DIN 4108-4	5/10	-
Airborne sound insulation acc. DIN 4109-32 for m' ≤ 150 [kg/m²]	32-48	[dB]
Airborne sound insulation acc. DIN 4109-32 for m' > 150 [kg/m²]	48-56	[dB]

Performance values of the product corresponding to the declaration of performance for the Essential Characteristics acc. to *DIN EN 771-4: 2015-11, Specification for masonry units – Part 4: Autoclaved aerated concrete masonry units*.

2.4 Delivery status

Products acc. to *DIN 20000-404* and *DIN 4166*
Formats: L · W · H
L = 304–999 mm
W = 50–500 mm
H = 124–624 mm

2.5 Base materials/Ancillary materials

Name	Value	Unit
Quartz sand	50–70	M.-%
Cement	15–30	M.-%
Quicklime	10–20	M.-%
Anhydrite/Gypsum	2–5	M.-%
Aluminium	0.05–0.1	M.-%
Mould oil as an accessory material	-	

In addition, 50–75 mass % of water (in relation to the solids) is used.

Quartz sand: The quartz sand used is a natural raw material that contains natural secondary and trace minerals in addition to the main mineral quartz (SiO_2). It is an essential raw material for the hydrothermal reaction during steam curing.

Cement: Acc. to *EN 197-1*; cement functions as a binding agent and is mainly produced from limestone marl or a mixture of limestone and clay. The natural raw materials are burnt and ground.

Quicklime: Acc. to *EN 459-1*; quicklime serves as a binding agent and is obtained by burning natural limestone.

Anhydrite/Gypsum: Acc. to *EN 13279-1*; the sulphate carrier used serves to influence the curing time of the autoclaved aerated concrete and comes from natural sources or is produced technically.

Aluminium: Aluminium powder or paste is used as aeration agent. The metallic aluminium reacts in an alkaline environment to release hydrogen gas that forms the pores and escapes after the aeration process is complete.

Water: The presence of water is the basis for the hydraulic reaction of the binders. Water is also required to generate a homogeneous solution.

Mould oil:
Mould oil is used as a separating agent between the mould and autoclaved aerated concrete mass. PAH (polycyclic aromatic hydrocarbons) – free mineral oils are used with the addition of long-chain additives to boost viscosity. This serves to prevent running down into the mould and ensures economic use.

The product/at least one partial product contains materials included in the ECHA list of candidate substances of very high concern (SVHC) at a mass % of more than 0.1: no.
Does the product or at least one partial product contain further CMR Category 1A or 1B substances which are not in the candidate list in doses above 0.1 mass % in at least one part product: no.
The construction product in question has biocides added or was treated with biocidal products (making it a treated good in the meaning of the Biocidal Products Regulation (EU) No 528/2012): no.

2.6 Manufacture

Ground quartz sand is mixed with quicklime, cement, a small amount of a sulphate carrier in the form of gypsum or anhydrite, aluminium powder or paste, production residues in the form of recirculated sludge (non-autoclaved aerated concrete cuttings mixed with water) and/or autoclaved aerated concrete rubble/dust (from autoclaved aerated concrete) with the addition of water in a mixer to form an aqueous suspension and poured into casting moulds. The water slakes the Quicklime, generating heat. The aluminium reacts in the alkaline milieu, generating hydrogen gas which forms the pores in the mass und escapes without residues. The pores have a diameter of mostly 0.5–1.5 mm, and are always filled with air. After the initial setting, semi-solid raw blocks are produced from which the autoclaved aerated concrete products are mechanically cut with high precision.

The final autoclaved aerated concrete properties are formed during the subsequent steam curing process over 5–12 hours at approx. 190°C and a pressure of approx. 12 bar in the steam pressure vessel, the so-called autoclave. Calcium silicate hydrates are formed from the substances used, which correspond to the naturally occurring mineral tobermorite. The reaction of the material is complete when removed from the autoclave. The steam is used for further autoclave cycles after the completion of the autoclaving process. The condensate generated is used as process heat, thus saving energy and avoiding environmental impacts through hot exhaust steam and waste water.

Autoclaved aerated concrete products are then stacked on wooden pallets and shrink-wrapped in recyclable polyethylene (PE) shrink film.

2.7 Environment and health during manufacturing

The regulations of the employers' liability insurance associations apply; no special measures to protect the health of employees are required.

2.8 Product processing/Installation

Autoclaved aerated concrete masonry units are processed by hand; lifting equipment is required for products weighing more than 25 kg. Stones are cut using band saws or by hand with carbide saws, because these generate practically only coarse dust and no fine dust. High-speed tools, such as cut-off grinders, must be equipped with an appropriate extraction system due to the release of fine dust!

Autoclaved aerated concrete products are linked to each other and to other standardised building materials using the thin-bed method in accordance with *EN 1996-1-1* in conjunction with *EN 1996-1-1/NA* and *EN 1996-2* in conjunction with *EN 1996-2/NA* with or without butt joint mortar. In special cases also with normal or lightweight mortar (11 kg mortar / m³). The autoclaved aerated concrete elements can be plastered, coated or painted. Cladding with small-format parts or the installation of facing shells is also possible.

The regulations of the employers' liability insurance associations apply. No particular steps need to be taken to protect the environment when working with the construction product.

2.9 Packaging

Packaging and pallets arising on the construction site must be collected separately. The polyethylene shrink film can be recycled. Clean polyethylene (PE) film and reusable wooden pallets are accepted back by building materials traders (reusable pallets against refund under the deposit-refund system), who will return them to the autoclaved aerated concrete plants. The plants forward the shrink film to the film manufacturers to be recycled.

2.10 Condition of use

As explained under 2.6 'Manufacture', autoclaved aerated concrete consists mainly of tobermorite. It also contains unreacted starting materials, mainly coarse quartz and possibly carbonates. Once removed from the autoclave, autoclaved aerated concrete will recarbonate in the course of decades which, however, will not have an adverse effect on the product characteristics. The pores are completely filled with air.

2.11 Environment and health during use

Based on today's knowledge autoclaved aerated concrete does not emit any harmful substances such as volatile organic compounds.
The autoclaved aerated concrete products' natural ionising radiation is minuscule and, from a radiological perspective, necessitates no restrictions in the use of this material (cf. 7.1 'Radioactivity').

2.12 Reference service life

If used as intended, autoclaved aerated concrete lasts indefinitely. The average service life of solid autoclaved aerated concrete buildings corresponds to that of solid buildings in general. The reference service life (RSL) is estimated to be 80 years, according to existing data (*Xella 2021*).

2.13 Extraordinary effects

Fire

No toxic gases and fumes will develop in case of fire.

Fire protection acc. to EN 13501-1

Name	Value
Building material class	A1
Smoke gas development	s1
Burning droplets	d0

Water

When exposed to water (e.g., flooding), autoclaved aerated concrete will undergo a slightly alkaline reaction. There is no wash-out of substances potentially hazardous to water.

Mechanical destruction

Not relevant.

2.14 Re-use phase

Autoclaved aerated concrete cuttings from construction sites can be taken back by the autoclaved aerated concrete factory via a return system (e.g. BigBag system). Other unmixed autoclaved aerated concrete residues can also be taken back by the autoclaved aerated concrete manufacturers for recycling or reuse. This is already practice for production waste and construction site cuttings. This material is either processed into granulated products or added as sand substitute to the autoclaved aerated concrete mixture.

Autoclaved aerated concrete products are fully recyclable. Based on research results, processed autoclaved aerated concrete demolition material can be used along various recycling paths: e.g. for the bio-activation of autoclaved aerated concrete and sand-lime brick recycling granulates with methane-oxidising bacteria to reduce methane emissions from household waste landfills (*Fb 118 2015; Hlawatsch et al. 2018*).

2.15 Disposal

According to the German Landfill Ordinance of 27 April 2009 (*DepV – Deponieverordnung*), autoclaved aerated concrete must be deposited in Class I landfills (see 7.2 'Leaching behaviour').
Waste key acc. to EAKV: 17 01 01

2.16 Further information

Additional information can be found at www.bv-porenbeton.de.

3. LCA: Calculation rules

3.1 Declared Unit

The declared unit is 1 m³ of non-reinforced autoclaved aerated concrete with a gross density of 428 kg/m³. This average gross density was calculated by dividing the total material input in the reference year and the production quantities of unreinforced autoclaved aerated concrete.
To convert the results to one tonne of autoclaved aerated concrete, the LCA results can be divided by the gross density (428 kg/m^3) of the autoclaved aerated concrete and multiplied by 1,000.

Declared unit

Name	Value	Unit
Declared unit	1	m^3
Gross density	428	kg/m^3
Conversion factor to 1 kg	0.00234	-
Conversion factor to 1 t	2.34	-

3.2 System boundary

EPD type: cradle to factory gate with options.

Description of the life cycle phases:

Production stage (A1-A3)
Provision of raw materials and road transport of the raw materials to the factory. Production costs, in particular the provision and use of energy sources and auxiliary materials, as well as packaging materials. Treatment of production waste and waste water. Allocation of all environmental burdens by mass between associated co-products (e.g. broken material for use and commercialisation as cat litter or oil binder) and the main product.

Building construction stage (A4-A5)
Module A4: road transport to construction site (100 km). Transport distance can be adjusted at building level if necessary (e.g. for an actual transport distance of 200 km: multiply the LCA values by a factor of 2).
Module A5: Thermal packaging treatment and resulting credits in module D. Cuttings were not taken into account, as these depend heavily on the constructional context. Cuttings can be estimated approximately using the declared values for the production stage (e.g. 5% offcuts: multiplication of the LCA values by a factor of 0.05).
The products are typically installed by hand (no burdens). Mortar was not accounted for in this EPD.

Usage stage (B1)
Recarbonation of reactive product components (e.g., CaO). A recarbonation rate of 95% is assumed (*Walther 2022*).

Disposal stage (C1-C4)
Module C1: mechanical deconstruction (excavator).
Module C2: road transport to waste treatment site (50 km). Transport distance can be adjusted at building level if necessary (e.g. for a transport distance of 100 km: multiply the LCA values by a factor of 2).
Module C3: (material recycling scenario): Waste processing and material recycling as filler (incl. credits for gravel substitution in Module D). Module C4: (disposal scenario): Average emissions from disposal.

Credits and burdens outside the system boundaries (D)
Credits from saved expenses due to substitution of gravel as backfill material (from module C3) and credits for energy substitution from packaging treatment.

3.3 Estimates and assumptions

The product system involves no critical assumptions or estimates in relation to the interpretation of the life-cycle assessment results. Few accessory materials with an aggregate mass fraction of less than one mass per cent of the overall system were estimated on the basis of technologically comparable upstream processes.

3.4 Cut-off criteria

All data from the operating data collection, i.e. all raw materials used according to recipe, the thermal energy used, electricity consumption and diesel consumption was taken into account in the life-cycle assessment.
Specific transport distances were taken into account for all raw materials, including material and energy flows with a share of < 1%.
The manufacture of the equipment, plants and other infrastructure needed to produce the article in question were not included in the life-cycle assessment.
It can be assumed that the neglected processes would have contributed less than 5% to the effect categories considered.

3.5 Background data

The software system 'GaBi 10.5' (*GaBi ts*) developed by Sphera Solutions GmbH for integral life-cycle assessment was used to model the production of autoclaved aerated concrete. In terms of the background system, GaBi data sets with the Content Update (CUP) 2021.1 were used.

3.6 Data quality

All background data sets relevant for production were taken from the GaBi 10.5 CUP 2021.1 (*GaBi ts*) software database. The background data used was last revised less than 3 years ago.

3.7 Period under review

The data basis for this life-cycle assessment is based on data collected for autoclaved aerated concrete production in 2021 from member companies of the Bundesverband Porenbetonindustrie e.V. with 11 autoclaved aerated concrete plants and the Verband Bauen in Weiß e.V. with 10 autoclaved aerated concrete plants.

3.8 Geographic Representativeness

Land or region, in which the declared product system is manufactured, used or handled at the end of the product´s lifespan: Germany

3.9 Allocation

During production, autoclaved aerated concrete rubble is produced, which is further processed into autoclaved aerated concrete granulate. The environmental impacts of autoclaved aerated concrete block production and the rubble used to produce autoclaved aerated concrete granulate were allocated by mass. The production process also produces autoclaved aerated concrete rubble and autoclaved aerated concrete powder, which is fed back into the production process (closed-loop recycling). This internal utilisation was included in the calculation.

3.10 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 taken into account. The software system 'GaBi 10.5' (*GaBi ts*) developed by Sphera Solutions GmbH for integral life-cycle assessment was used to model the production of autoclaved aerated concrete. In terms of the background system, GaBi data sets with the Content Update (CUP) 2021.1 were used.

4. LCA: Scenarios and additional technical information

Characteristic product properties of biogenic carbon

2.087 kg of reusable wooden pallets (packaging material) are included in the assessment.

Data used to describe the biogenic carbon content at the factory gate

Name	Value	Unit
Biogenic carbon contained in product	-	kg
Biogenic carbon contained in packaging (wooden pallet)	0.87	kg

Note: 1 kg of biogenic carbon is equivalent to 44/12 kg of CO_2.

The following technical information is used as the basis of the declared modules or can be used to derive specific scenarios under a building assessment if modules are not declared (ND).

Transport to construction site (A4)

Name	Value	Unit
Litres of fuel	0.597	l per 100 km
Transport distance	100	km
Capacity utilisation (including empty runs)	61	%
Gross density of products transported	428	kg/m^3

Installation in building (module A5)

Packaging materials are subjected to thermal treatment in module A5. The credits secured through avoided expenses are allocated to module D.

Use (B1)

Refer to 2.10 Condition of use and 2.12 Reference service life.

Recarbonation rate

Name	Value	Unit
Racarbonation (Walther 2022)	95	%

Reference life span

Name	Value	Unit
Life Span (Xella 2021)	80	a

End of life (C1–C4)

Name	Value	Unit
Diesel fuel consumption during deconstruction (excavator) Modul C1	0.06	kg per declared Unit
Transport distance to site of disposal/waste treatment (Modul C2)	50	km
Recycling (Modul C3, net flow volume)	415	kg
Landfilling (module C4)	428	kg

Additional details of the scenarios can be found in chapter 3.2 System boundary.

5. LCA: Results

The environmental impacts for 1 m³ of unreinforced autoclaved aerated concrete with a gross density of 428 kg/m³ are shown below. The modules labelled 'x' in the overview in accordance with *EN 15804+A2* are addressed here; the modules labelled 'MND' (module not declared) are not included in the analysis.
The following tables show the results of the impact assessment indicators, resource use, waste and other output flows in relation to the declared unit.

DESCRIPTION OF THE SYSTEM BOUNDARY (X = INCLUDED IN LCA; MND = MODULE OR INDICATOR NOT DECLARED; MNR = MODULE NOT RELEVANT)

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 the gate to the site	Assembly	Use	Maintenance	Repair	Replacement	Refurbishment	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	X	X	X	MND	MNR	MNR	MNR	MND	MND	X	X	X	X	X

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT according to EN 15804+A2: 1m³ of non-reinforced autoclaved aerated concrete with a gross density of 428 kg/m³

Parameter	Unit	A1-A3	A4	A5	B1	C1	C2	C3	C4	D
GWP-total	kg CO_2 eq	2.07E+02	2.63E+00	5.75E+00	-8.01E+01	2.8E-01	1.31E+00	1.15E+00	6.5E+00	-3.21E+00
GWP-fossil	kg CO_2 eq	2.1E+02	2.58E+00	1.95E+00	-8.01E+01	2.77E-01	1.28E+00	1.14E+00	6.48E+00	-3.22E+00
GWP-biogenic	kg CO_2 eq	-2.87E+00	2.78E-02	3.8E+00	0	4.13E-04	1.38E-02	2.94E-03	2.57E-04	1.32E-02
GWP-luluc	kg CO_2 eq	7.43E-02	2.14E-02	4.65E-05	0	2.18E-03	1.06E-02	6.26E-03	1.9E-02	-3.96E-03
ODP	kg CFC11 eq	4.73E-13	5.16E-16	6.45E-16	0	5.26E-17	2.56E-16	5.1E-15	2.52E-14	-2.19E-14
AP	mol H^+ eq	1.67E-01	2.77E-03	7.34E-04	0	1.34E-03	1.38E-03	1.07E-02	4.61E-02	-8.69E-03
EP-freshwater	kg P eq	9.6E-05	7.76E-06	8.79E-08	0	7.92E-07	3.86E-06	2.6E-06	1.09E-05	-4.25E-06
EP-marine	kg N eq	5.86E-02	8.85E-04	2.19E-04	0	6.26E-04	4.4E-04	5.27E-03	1.2E-02	-3.24E-03
EP-terrestrial	mol N eq	6.4E-01	1.05E-02	3.48E-03	0	6.93E-03	5.22E-03	5.79E-02	1.32E-01	-3.55E-02
POCP	kg NMVOC eq	1.71E-01	2.41E-03	6.05E-04	0	1.75E-03	1.2E-03	1.53E-02	3.63E-02	-9.31E-03
ADPE	kg Sb eq	1.18E-05	2.32E-07	9.81E-09	0	2.36E-08	1.15E-07	1.26E-06	6.11E-07	-3.59E-07
ADPF	MJ	1.38E+03	3.48E+01	1.07E+00	0	3.55E+00	1.73E+01	2.16E+01	8.6E+01	-5.72E+01
WDP	m^3 world eq deprived	2.27E+01	2.42E-02	5.71E-01	0	2.47E-03	1.2E-02	1.92E-01	6.95E-01	-1.76E-01

GWP = Global warming potential; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential of land and water; EP = Eutrophication potential; POCP = Formation potential of tropospheric ozone photochemical oxidants; ADPE = Abiotic depletion potential for non-fossil resources; ADPF = Abiotic depletion potential for fossil resources; WDP = Water (user) deprivation potential)

RESULTS OF THE LCA - INDICATORS TO DESCRIBE RESOURCE USE according to EN 15804+A2: 1m³ of non-reinforced autoclaved aerated concrete with a gross density of 428 kg/m³

Parameter	Unit	A1-A3	A4	A5	B1	C1	C2	C3	C4	D
PERE	MJ	1.4E+02	2E+00	3.15E+01	0	2.04E-01	9.95E-01	1.91E+00	1.16E+01	-5.97E+00
PERM	MJ	3.13E+01	0	-3.13E+01	0	0	0	0	0	0
PERT	MJ	1.72E+02	2E+00	2.07E-01	0	2.04E-01	9.95E-01	1.91E+00	1.16E+01	-5.97E+00
PENRE	MJ	1.36E+03	3.49E+01	2.89E+01	0	3.56E+00	1.74E+01	2.16E+01	8.6E+01	-5.72E+01
PENRM	MJ	2.78E+01	0	-2.78E+01	0	0	0	0	0	0
PENRT	MJ	1.38E+03	3.49E+01	1.07E+00	0	3.56E+00	1.74E+01	2.16E+01	8.6E+01	-5.72E+01
SM	kg	2.95E+01	0	0	0	0	0	0	0	4.16E+02
RSF	MJ	0	0	0	0	0	0	0	0	0
NRSF	MJ	0	0	0	0	0	0	0	0	0
FW	m^3	6.5E-01	2.29E-03	1.34E-02	0	2.34E-04	1.14E-03	5.59E-03	2.12E-02	-9.26E-03

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 = Use of net fresh water

RESULTS OF THE LCA – WASTE CATEGORIES AND OUTPUT FLOWS according to EN 15804+A2: 1m³ of non-reinforced autoclaved aerated concrete with a gross density of 428 kg/m³

Parameter	Unit	A1-A3	A4	A5	B1	C1	C2	C3	C4	D
HWD	kg	2.67E-07	1.84E-09	1.92E-10	0	1.88E-10	9.15E-10	1.25E-09	9.13E-09	-8.64E-09
NHWD	kg	2.19E+00	5.48E-03	3.5E-02	0	5.59E-04	2.72E-03	6.21E-03	4.29E+02	-1.73E+01
RWD	kg	3.64E-02	6.34E-05	5.94E-05	0	6.46E-06	3.15E-05	1.59E-04	9.03E-04	-4.83E-03

CRU	kg	0	0	0	0	0	0	0	0	0
MFR	kg	0	0	0	0	0	0	4.28E+02	0	0
MER	kg	0	0	0	0	0	0	0	0	0
EEE	MJ	0	0	9.58E+00	0	0	0	0	0	0
EET	MJ	0	0	1.71E+01	0	0	0	0	0	0

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; EEE = Exported electrical energy; EET = Exported thermal energy

RESULTS OF THE LCA – additional impact categories according to EN 15804+A2-optional:
1m³ of non-reinforced autoclaved aerated concrete with a gross density of 428 kg/m³

Parameter	Unit	A1-A3	A4	A5	B1	C1	C2	C3	C4	D
PM	Disease incidence	ND	ND	ND	ND	ND	ND	ND	ND	ND
IR	kBq U235 eq	ND	ND	ND	ND	ND	ND	ND	ND	ND
ETP-fw	CTUe	ND	ND	ND	ND	ND	ND	ND	ND	ND
HTP-c	CTUh	ND	ND	ND	ND	ND	ND	ND	ND	ND
HTP-nc	CTUh	ND	ND	ND	ND	ND	ND	ND	ND	ND
SQP	SQP	ND	ND	ND	ND	ND	ND	ND	ND	ND

PM = Potential incidence of disease due to PM emissions; IR = Potential Human exposure efficiency relative to U235; ETP-fw = Potential comparative Toxic Unit for ecosystems; HTP-c = Potential comparative Toxic Unit for humans (cancerogenic); HTP-nc = Potential comparative Toxic Unit for humans (not cancerogenic); SQP = Potential soil quality index

Qualifier 1 – applies to indicator IR: This effect category mainly covers the possible impact of low-dosage ionising radiation on human health in the nuclear fuel cycle. It does not account for effects caused by possible nuclear accidents and occupational exposure nor for the disposal of radioactive waste in subterranean installations. This indicator also does not cover the potential ionising radiation emitted by the ground, radon and certain construction materials.

Qualifier 2 – applies to the indicators: ADPE, ADPF, WDP, ETP-fw, HTP-c, HTP-nc, SQP: Diligence must be applied when using the results of the environmental impact indicator because they are fraught with high uncertainties or experience with the indicator is limited.

This EPD was created using a software tool.

6. LCA: Interpretation

The manufacturing phase (modules A1-A3) is of the utmost importance for the environmental profile of the product. All effect categories with the exception of GWP-biog. are dominated by the binders used.

The energy sources used continue to be of great importance for the environmental profile. Both the use of thermal energy and electrical energy contribute relevantly in all impact categories.

The biogenic global warming potential shows the absorption of atmospheric carbon dioxide during plant growth in connection with the packaging (wooden pallet).

Packaging makes moderate contributions in all impact categories.

Relevant contributions to the indicators: acidification, resource consumption (minerals and metals) and water consumption arise from the use of aluminium powder.

The upstream processes of the aggregates used make small contributions overall in all impact categories, although they are the largest fraction in terms of mass.

7. Requisite evidence

Manufacturer's declarations are available stating that the basic material composition, the manufacturing process, and the product properties of the autoclaved aerated concrete products mentioned have remained unchanged since the date of issue of the certificates referred to below. The references are hence fully valid.

7.1 Radioactivity
Method: measurement of the nuclide content in Bq/kg, determination of the activity index I.
Summary report: *BfS-SW-14/12*, Salzgitter, November 2012.
Result: The samples were assessed in accordance with the European Commission's '*Radiation Protection 112*' directive (Radiological Protection Principles concerning the Natural Radioactivity of Building Materials, 1999). The index values I determined are lower than the exclusion level in all cases, so no further checks are necessary. The natural radioactivity of this building material allows its unrestricted use from a radiological point of view.

7.2 Leaching behaviour
The leaching behaviour of autoclaved aerated concrete is important for assessing its environmental impact after use in landfill. *LGA 2007, LGA 2011*
Measuring body: LGA
Institut für Umweltgeologie und Altlasten GmbH, Nürnberg
Result:
All criteria for landfilling in Class I landfills in accordance with the German Landfill Ordinance of 27 April 2009 (*DepV*) are met. According to the Council Decision (2003/33/EC) of 19 December 2002, autoclaved aerated concrete is to be assigned to the landfill class 'non-hazardous waste'.

8. References

Standards, guidelines and regulations

Biocidal Product Regulation
Regulation (EU) No. 528/2012 concerning the making available

on the market and use of biocidal products.

CPR
Construction Products Regulation: Regulation (EU) No. 305/2011 of the European Parliament and Council of 9th March 2011 laying down harmonised conditions for the marketing of construction products and repealing Council Directive 89/106/EEC of the Council.

DepV
Verordnung über Deponien und Langzeitlager – Deponieverordnung of 27 April 2009 (BGBl I S.900); last amended by art. 7 V of 26 November 2010.

DIN 4108-4
DIN 4108-4:2020-11, Thermal insulation and energy economy in buildings – Part 4: Hygrothermal design values.

DIN 4109-32
DIN 4109-32:2016-07, Sound insulation in buildings – Part 32: Data for verification of sound insulation (component catalogue) – Solid construction.

DIN 4166
DIN 4166:1997-10, Autoclaved aerated concrete slabs and panels.

DIN 20000-404
DIN 20000-404:2018-04, Application of building products in structures - Part 404: Rules for the application of autoclaved aerated concrete masonry units according to DIN EN 771-4:2015-11.

EWC
European Waste Catalogue EWC as amended by Commission Decision 2001/118/EC of 16 January 2001 amending Decision 2000/532/EC establishing a list of waste.

ECHA List
List of substances of very high concern for authorisation (published in accordance with Article 59(10) of the REACH Regulation) https://echa.europa.eu/de/candidate-list-table, as of 13 December 2021.

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EN 459-1
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EN 771-4
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EN 13279-1
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EN 13501-1
DIN EN 13501-1:2010-01+ A1:2009, Fire classification of construction products and building elements – Part 1: Classification using data from reaction to fire tests.

EN 15804
DIN EN 15804:2022-03, Sustainability of construction works – Environmental product declarations – Fundamental rules for the product category construction products.

EN 1996-1-1
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EN 1996-1-1/NA
DIN EN 1996-1-1/NA:2019-12, National Annex – Nationally determined parameters- Eurocode 6: Design of masonry structures – Part 1-1: General rules for reinforced and unreinforced masonry structures.

EN 1996-2
DIN EN 1996-2:2010-12, Eurocode 6: Design of masonry structures – Part 2: Design considerations, selection of materials and execution of masonry.

EN 1996-2/NA
DIN EN 1996-2/NA:2012-01, National Annex – Nationally determined parameters – Eurocode 6: Design of masonry structures – Part 2: Design considerations, selection of materials and execution of masonry.

ISO 14025
DIN EN ISO 14025:2011-10, Environmental labels and declarations – Type III environmental declarations – Principles and procedures.

PCR: Porenbeton
Produktkategorie-Regeln für gebäudebezogene Produkte und Dienstleistungen. Teil B: Anforderungen an eine EPD für Porenbeton, version 01-08-2021. Berlin: Institut Bauen und Umwelt e.V. (ed.). www.ibu-epd.com.

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