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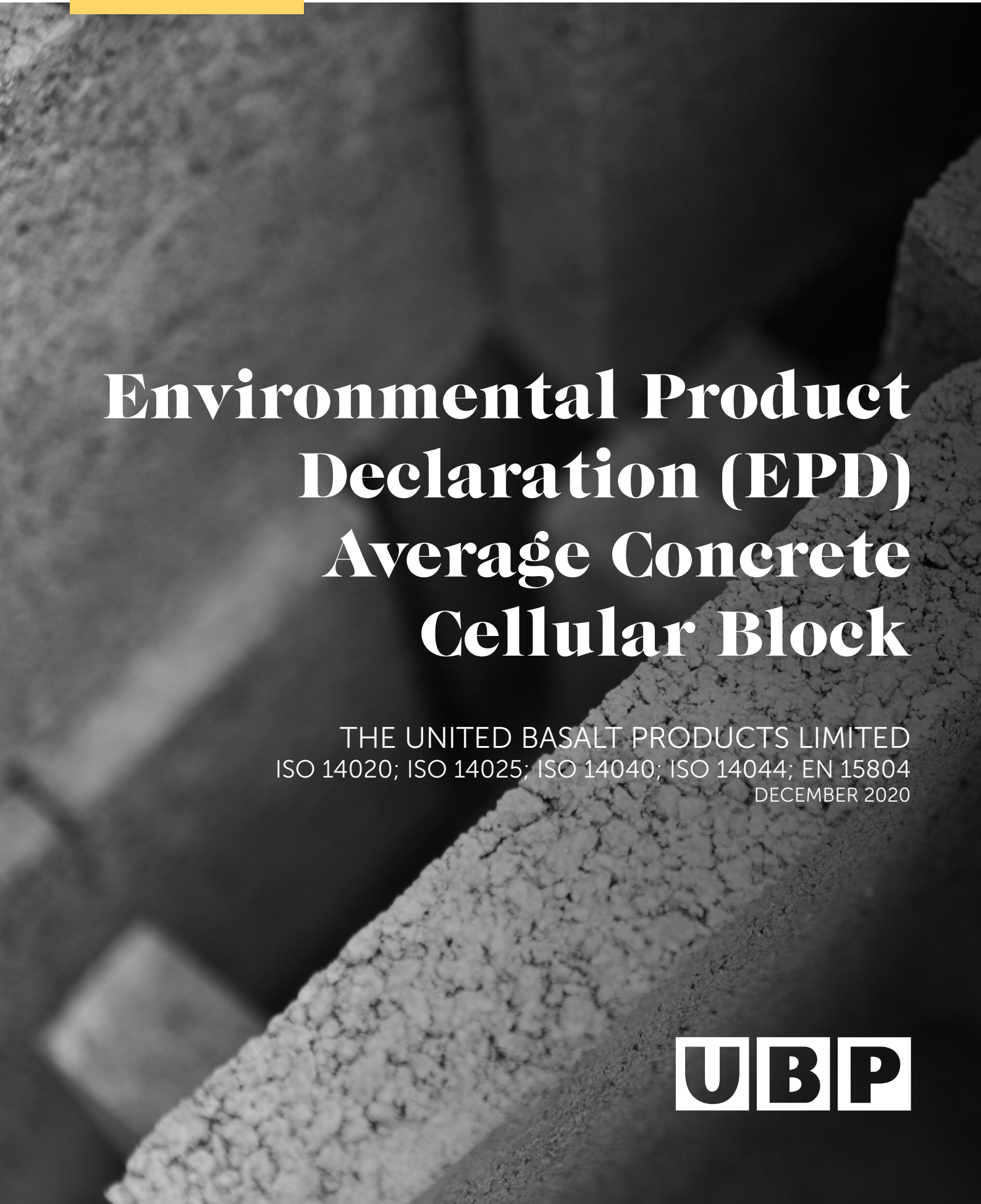

Environmental Product Declaration (EPD) Average Concrete Cellular Block

THE UNITED BASALT PRODUCTS LIMITED

ISO 14020; ISO 14025; ISO 14040; ISO 14044; EN 15804

DECEMBER 2020

UBP

1 Programme Information

Programme Operator	**The International EPD System** EPD International AB Box 210 60 SE-100 31 Stockholm Sweden www.environdec.com info@environdec.com
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Product group classification	UN CPC 375 concrete
Product category rules (PCR)	CEN Standard EN 15804 served as the core PCR. PCR 2012:01. Construction products and construction services version 2.3, The International EPD System.
PCR review was conducted by	The Technical Committee of the International EPD System.
Chair	Massimo Marino. Contact via info@environdec.com
Independent third-party verification of the declaration and data, according to ISO 14025:2006:	☑ EPD process certification ☐ EPD verification
Procedure for follow-up of data during EPD validity involves third party verifier:	☐ Yes ☑ No

The EPD owner has the sole ownership, liability and responsibility for the EPD. EPDs within the same product category but from different programmes may not be comparable. EPDs of construction projects may not be comparable if they do not comply with EN 15804.

2 Company Information

This cradle-to-gate environmental product declaration is for 1000 kg of concrete cellular blocks from the locations fully or partly owned and operated by the United Basalt Products Ltd (UBP) in Mauritius.

The United Basalt Products Ltd (UBP) is a publicly listed company based in Mauritius, with nearly 4500 shareholders. Since 1953, the company/Group has played an important role and been involved in most major infrastructure and building projects of the country.

UBP's core business activity is the manufacturing and sale of concrete blocks, aggregates and rocksand. It also manufactures and markets a variety of additional concrete products, such as precast pavements, roof tiles, concrete pipes, slabs and kerbs, to name a few.

For the past two years, UBP has strived to explore avenues to better manage its environmental impact. We believe that it is crucial that we, as individuals, companies and consumers, become more mindful in our strategic management, as well as day-to-day decisions and activities. We also believe in offering products and services that are both innovative and more environmentally friendly; hence this EPD was commissioned.

Further information about UBP can be accessed from www.ubp.mu

3 Product Information

This report serves as the basis for an EPD of 1000 kg of average concrete cellular blocks production from the seven locations fully/partly owned and operated by UBP in Mauritius as follows:

1. Geoffroy
2. Terrarock
3. Poudre D'Or
4. St Julien
5. Flacq Associated Stone Masters Ltd (FAST)
6. Plaine Magnien
7. Ste Marie

3.1 Function of the product systems

The product systems are concrete cellular blocks that are widely used in Mauritius for construction of load bearing and non-load bearing walls. They are used in conjunction with cement-based mortar and sometimes with reinforcing steels. See Figure 1 for a visual representation of a typical concrete cellular block

3.2 Product Definitions and Standards

Description

The Cellular Block is an aggregate concrete masonry unit carved or moulded and it has two or three formed holes which do not pass through the block. This block is mainly used for general block walling. The cellular blocks have standard length of 450mm and depth of 200mm and are produced into three different widths namely 100mm, 150mm and 200mm.

The cellular blocks can also have two different external shell and web thickness namely 25mm and 32mm. All UBP's production units manufacture the 3 types of cellular blocks below:

- 100mm: commonly known as 4"
- 150mm: commonly known as 6"
- 200mm: commonly known as 8"

Figure 1 : UBP Cellular Block

Normative Reference

BS 6073: Part 1: 1981 - Specification for precast masonry units

BS 6073: Part 2: 1981 - Methods for specifying concrete masonry units

Technical Specifications

- External shell and web thickness of concrete cellular blocks available: 25mm thick, 32mm thick
- Weight of UBP Concrete Cellular Blocks

Type of Block	External Shell and Web Thickness	
	25mm	32mm
100 mm thick	±13 kg	± 14 kg
150 mm thick	± 17 kg	± 20 kg
200 mm thick	± 21 kg	± 23 kg

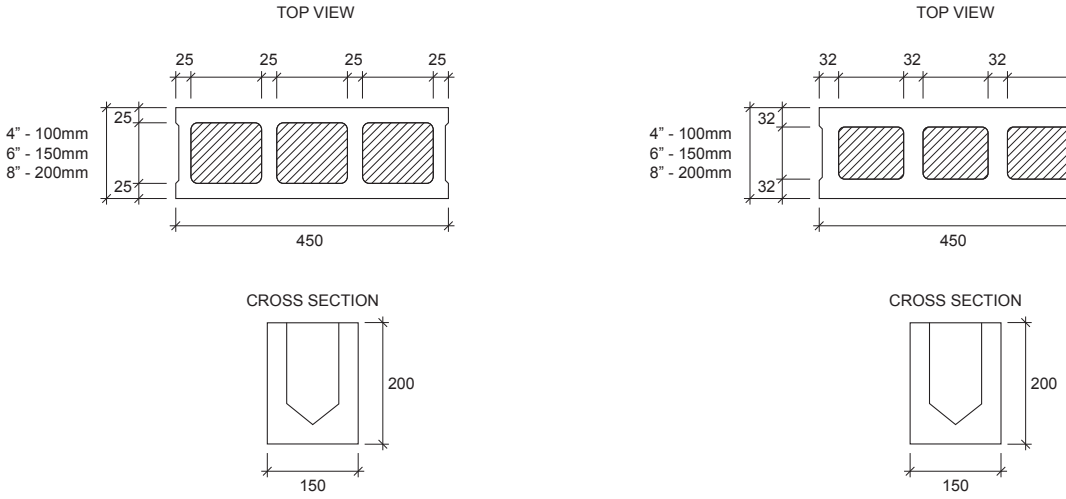


Figure 2 : Typical dimensions of UBP blocks

- Compressive strength of UBP Concrete Cellular Blocks

  The average crushing strength of 10 blocks shall not be less than 3.5MPa at delivery. The corresponding lowest crushing strength of any individual block shall not be less than 2.8MPa.

- Overall heat coefficient factor

  U value block only: 2.46 W/m^{2}k

  U value with ±15mm plaster each side: 2.27 W/m^{2}k

Materials Specifications

- Cement: Ordinary Portland Cement (CEM I – 42.5N)
- Compliance with BS EN 197-1:2000 – Cement. Composition, specifications and conformity criteria for common cements.
- Aggregates: UBP Aggregates (Rocksand 0-4mm & Coarse Aggregate 4-6mm & 6-10mm) Compliance with BS 882: 1992 – Specification for aggregates from natural sources for concrete.
- Water: Borehole – Clean and free from any harmful amounts of deleterious matter, either in suspension or in solution controlled each month by external laboratories.

3.3 Material Contents

Table 1 and Table 2 below present the typical concrete mix and the material content for an average block by input material. The typical number of blocks that would be produced from 1m^3 of the given mix is as follows:

- No. of 100mm blocks = 197
- No. of 150mm blocks = 156
- No. of 200mm blocks = 130

Table 1 : Typical Concrete mix- kg per m^3

Material	Mass (kg)
Cement	180-230
0-4 mm aggregates	1000-1100
4-6 mm aggregates	70-100
6-10 mm aggregates	1100-1400
Water	100-150 L
Admixture	1-2 L

Note 1 : For confidentiality purposes, a range of values are given

Table 2 : Material Content for an average concrete cellular block

Material	Mass, % of block
Cement	5-8%
Aggregate	80-90%
Admixture	0.01-0.1%
Batch water	3-6 %

Note 2 : For confidentiality purposes, a range of values are given

Products do not contain any substances that can be included in "Candidate List of Substances of Very High Concern for Authorization"

4 LCA Information

4.1 Goal of Study

The goal of this study is to provide information to support the development of an EPD of average concrete cellular blocks produced and delivered from the locations owned and operated by UBP, according to ISO 14025:2006, EN15804 and the International EPD system product category rules (PCR) for preparing an environmental product declaration for Construction products and construction services 2012:01 version 2.3.

4.2 Intended Application

This EPD is intended for use in business-to-business (B-to-B) communication. The intended audience for this LCA report and associated EPD includes manufacturer suppliers, architectural, engineering, and specifying professionals, LCA practitioners and tool developers, academia, governmental organizations, policy makers and other interested value-chain parties who require reliable information on concrete cellular blocks.

4.3 Declared unit

The declared unit of the EPD is 1000 kg of concrete cellular blocks produced and delivered from the locations owned and operated by UBP. The declared unit is equivalent to about 77 blocks of 100 mm width; or 59 blocks of 150 mm width; or 48 blocks of 200 mm width.

The composition of the average product modelled is obtained from the total raw material usages supplied by the main production site, Geoffroy (accounting for about 30% of the overall production). The EPD is established for the average product of this production unit.

The average is based on the mass of blocks produced at the plant. The concrete mix design is expected to be similar for the other production units.

4.4 System Boundary

The assessment system boundary defines which life cycle activities are included in the analysis. Figure 3 outlines the modules included in the LCA. This EPD covers the Cradle to Gate stage (A1 to A3). Life cycle stages that are not covered by the EPD are indicated as MND (Modules Not Declared). The Product Stage includes the following processes:

- Raw material supply (A1)-Extraction and processing of raw materials (cement, basalt rock, admixture), including fuels used in extraction and transport within the process;
- Transportation of the raw materials from suppliers to the plant (A2)-Average or specific transportation of raw materials from extraction site or source to manufacturing site and including empty backhauls;
- Manufacturing (A3) -Manufacturing of the product, including aggregate production, batching and mixing of the concrete, forming units and curing of units. This includes average or specific transportation from manufacturing site to disposal for pre-consumer wastes and unutilized by-products from manufacturing, including empty backhauls. No secondary materials, secondary fuels and waste has been used in the manufacturing.

Product stage			**Construction process stage**		**Use stage**							**End of life stage**				**Resource recovery stage**
Raw materials	Transport	Manufacturing	Transport	Construction installation	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	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND

X - module that are included in the life cycle assessment **MND** - module that is not declared in the life cycle assessment

Figure 3: Modules included in the LCA (MND: Modules Not Declared)

Figure 4 shows the flow diagram of the life stages considered in the study.

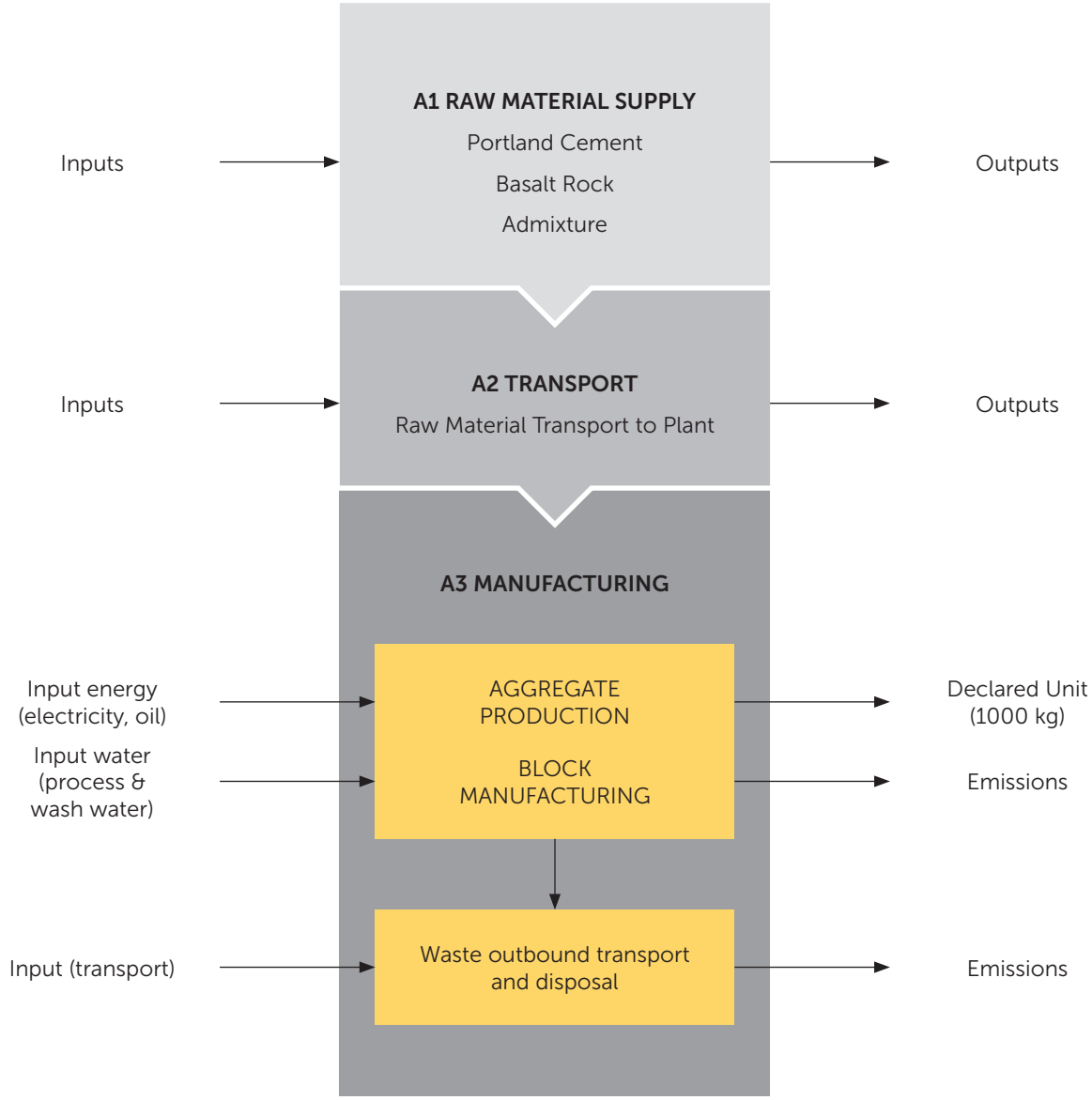


Figure 4: Product Stage (module A1 to A3) System Boundary

Environmental impacts relating to personnel, infrastructure and production equipment not directly consumed in the process are excluded from the system boundary as per the PCR.

The model only takes into account processes associated with infrastructures that are already included in ecoinvent modules.

4.5 Data sources and quality

Data quality rules, as specified in section 7.8 of the PCR were observed. Data quality is judged on the basis of its precision (measured, calculated or estimated), completeness (e.g., unreported emissions), consistency (degree of uniformity of the methodology applied within a study serving as a data source) and representativeness (geographical, temporal, and technological).

Precision	UBP production managers, through measurement and calculation, collected primary and economic data on their production of concrete blocks. For accuracy the LCA team individually validated these plant gate-to-gate input and output data.
Completeness	All relevant, specific processes, including inputs (raw materials, energy and ancillary materials) and outputs (emissions and production volume) were considered. The relevant background materials and processes were generally taken from the Ecoinvent v 3.3 LCI database, and modeled in SimaPro software v.9.1
Consistency	System boundaries, and allocation and cut-off rules have been uniformly applied across the product life cycles and the concrete blocks. The study predominantly relies on the Ecoinvent databases; Mauritian LCI electricity was taken from the study published in the Journal of Cleaner Production. Crosschecks concerning the plausibility of mass and energy flows were continuously conducted.
Reproducibility	Internal reproducibility is possible since the data and the models are stored and available in the LCI database developed in SimaPro. A high level of transparency is provided throughout the report as the LCI profile is presented for the declared product. Key secondary (generic) LCI data sources are given in the LCA report.
Representativeness	Overall, the data is representative according to the following temporal, geographical and technological criteria: • **Temporal:** Manufacturing process inputs and outputs were obtained for the latest available financial year (i.e. July 2018 to June 2019); • **Geographical:** The geographical system boundary of the LCA is Mauritius. All processes (including electricity mix) are valid for the production sites in Mauritius. The facility where data on resources consumption was collected was for the main production plant (which accounts for about 30 % of UBP blocks production) and is representative of the seven UBP production plants; and • **Technological:** Data represents contemporary technologies in use in Mauritius.

During the LCA a number of assumptions were made, which are documented below for transparency:

- The average concrete batch wastage was estimated to be 1 %.
- No packaging of the final product has been included as concrete blocks are delivered in bulk.
- Since the wastes produced in the plant are used mostly for landfilling in sugarcane fields where rocks are extracted, the distance to transport these waste is assumed to be same as the distance to transport the basalt rocks to the plant. The materials reused as backfill on nearby sugar cane fields are reported as inert waste against the nonhazardous waste reporting parameter
- The best available data from literature was used when dealing with missing data such as hazardous waste generation and particulate matter emissions. The literature-based data is documented in the LCA report and meets the data quality requirements of the PCR.

Modelling of the life cycle was performed using SimaPro 9.1 LCA software from Pre. All relevant background LCI datasets are taken from the ecoinvent database v 3.3. The foreground data has been collected onsite and validated based on mass balances. The background data is based on reviewed data from life cycle inventories. As all datasets are validated, the data quality for the entire study can be judged as very good.

4.6 Cut-off and Allocation Rules

Allocation procedures observed the requirements and guidance of ISO 14044:2006, clause 4.3. and those specified in section 7.7 of the PCR. The allocation of material inputs (e.g. cement, aggregate, batch water, etc.) to the products is based on the assumed concrete mix designs; therefore, no allocation is required. According to the PCR, if a mass flow or energy flow represents less than 1% of the cumulative mass or energy flow of the system, it may be excluded from system boundaries. However, these flows should not have a relevant environmental impact. Also, at least 95% of the energy usage and mass flow shall be included. In the present study, for the foreground process, no cut-off has been necessary. All raw materials and associated transport to the plant, process energy and water use are included.

4.7 Comparability

EPDs within the same product category but from different programmes may not be comparable. EPDs of construction products may not be comparable if they do not comply with EN 15804.

5 Environmental Performance

The environmental impacts are declared and reported using the parameters and units shown in Table 3. Impact categories and baseline characterization factors are taken from CML-IA version 3.04/World 2000 as they provide a global context for the mandatory category indicators as per the PCR to be included in this EPD.

The impact categories presented in the following table refer to 1000 kg of the average concrete cellular block produced from the locations fully owned and operated by UBP in Mauritius.

Table 3 : Life Cycle Impact Assessment (LCIA) Category Indicators

Parameter	Unit	A1-A3
Parameters describing environmental impacts		
Global warming Potential (GWP)	kg CO_2 equiv.	97.4
Ozone Depletion Potential (ODP)	kg CFC -11	4.47E-6
Acidification Potential for Soil and Water (AP)	kg SO_2 equiv.	0.478
Eutrophication Potential (EP)	kg PO_4^{3-} equivalents	0.0711
Photochemical ozone creation (POCP)	kg C_2H_4 equivalents	0.0182
Abiotic Depletion Potential (ADPE)	kg Sb equivalents	6.84E-5
Abiotic Depletion Potential (ADPF)	MJ net calorific value	606
Human Toxicity	kg 1.4-DB eq	13.8
Freshwater aquatic ecotoxicity	kg 1.4-DB eq	7.28
Marine water aquatic ecotoxicity	kg 1.4-DB eq	3.83E 4
Terrestrial ecotoxicity	kg 1.4-DB eq	0.129
Parameters describing resource use, primary energy		
Use of renewable primary energy excluding renewable primary energy used as raw materials (PERE)	MJ	6
Use of renewable primary energy resources used as raw materials (PERM)	MJ	0
Total use of renewable primary energy resources (PERT)	MJ	6
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials (PENRE)	MJ	606
Use of non-renewable primary energy resources used as raw materials (PENRM)	MJ	0
Total use of non-renewable primary energy resources (PENRT)	MJ	606
Parameters describing resource use, secondary materials and fuels, use of water		
Use of secondary material (SM)	kg	0
Use of renewable secondary fuels (RSF)	MJ	0
Use of non-renewable secondary fuels (NRSF)	MJ	0
Net use of fresh water (FW)	m^3	0.419
Other environmental information describing waste categories		
Hazardous waste disposed (HWD)	kg	0.051
Non-hazardous waste disposed (NHWD)	kg	126
Radioactive waste disposed (RWD)	kg	0.0014
Other environmental Information describing output flows		
Components for re-use (CRU)	kg	0
Materials for recycling (MRF)	kg	0
Materials for energy recovery (MER)	kg	0
Exported Energy (EE)	MJ per energy carrier	0

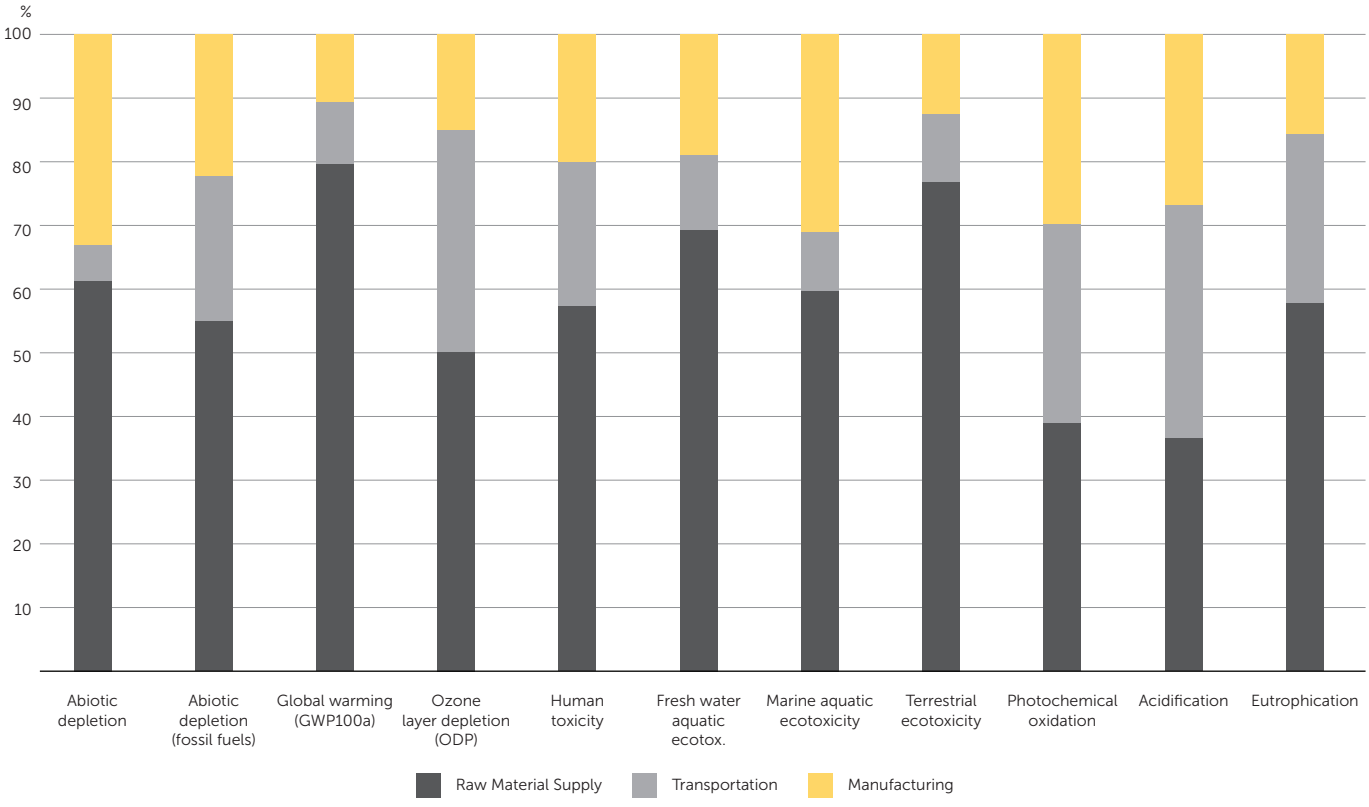
Note: The estimated results are only relative statements which do not indicate the end points of the impact categories, exceeding threshold values, safety margins or risks

6 Interpretation

Table 4 and Figure 5 presents the relative contributions the three production stage information modules (A1 Raw Material Supply, Transport, and A3 Manufacturing) make to total impact for each impact category.

Table 4 : Contributions of modules A1 to A3 to each impact category

Impact category	Unit	Total	Raw Material Supply	Transportation	Manufacturing
Abiotic depletion	%	100	61.3	5.5	33.2
Abiotic depletion (fossil fuels)	%	100	54.9	22.9	22.2
Global warming (GWP100a)	%	100	79.6	9.7	10.7
Ozone layer depletion (ODP)	%	100	50.1	34.8	15.2
Human toxicity	%	100	57.3	22.7	20.0
Fresh water aquatic ecotox.	%	100	69.3	11.7	19.0
Marine aquatic ecotoxicity	%	100	59.7	9.2	31.1
Terrestrial ecotoxicity	%	100	76.8	10.7	12.5
Photochemical oxidation	%	100	38.9	31.3	29.8
Acidification	%	100	36.5	36.6	26.9
Eutrophication	%	100	57.7	26.6	15.7



Method: CML-IA baseline V3.04 / World 2000 / Characterization / Excluding infrastructure processes
Analyzing 1 p 'Concrete block 1000kg'

Figure 5: Process contribution to impact categories

Across the three production modules, A1 Raw Material Supply contributes the largest share of impact category results, between 36.5% and 79.6%. This finding can be attributed primarily to the production of Portland Cement.

The following table provides an identification of the most significant contributors to parameters describing environmental impacts.

Table 5 : Contributors to environmental impact categories

Parameter	Most significant contributors
Global warming Potential (GWP)	Dominated by the use of cement and to a lesser extent by ship transportation, diesel use and grid electricity.
Ozone Depletion Potential (ODP)	Dominated by use of cement, ship transportation and diesel oil.
Acidification Potential for Soil and Water (AP)	Dominated by use of cement, ship transportation and grid electricity.
Eutrophication Potential (EP)	Dominated by use of cement, ship transportation and grid electricity
Photochemical ozone creation (POCP)	Dominated by use of cement, ship transportation, grid electricity and diesel oil.
Abiotic Depletion Potential (ADPE)	Dominated by use of diesel oil, cement and admixture.
Abiotic Depletion Potential Fossil Fuels (ADPF)	Dominated by use of cement, ship transportation, diesel oil and grid electricity
Non-Hazardous waste disposed	Generated from aggregate production from basalt rocks

The most pertinent conclusions drawn for the LCA results are as follows:

- The amount of portland cement in the concrete formulations has a significant influence on the environmental profile of the concrete cellular blocks. Use of SCMs such as fly ash and slag cement, or blended cement with a high proportion of SCM can play a noteworthy role in impact reduction.

- As the manufacturing stage is a significant consumer of energy and responsible for a significant share of the impacts, any process or energy conservation improvement would directly and significantly lower the environmental profile for the product.

This LCA study reports cradle-to-gate results concrete cellular blocks produced by UBP, with no assumptions made on intended end-use. The LCA results therefore do not provide information on the environmental performance or preference of end-use products without consideration of the full life cycle of those products.

7 Other Environmental Information

The production of concrete blocks is subject to Mauritian legislation, which addresses all environmental effects like water and waste management, the emissions of noise and dust. UBP, being aware of its responsibility as construction materials manufacturer towards the environment, has implemented as part of its management system, an environmental management system. Thus, all activities that could have a significant impact on the environment are kept under control. We measure, monitor, assess and continuously improve our environmental performance.

References

Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products, BS EN 15804:2012+A1:2013. BSI Standards Limited.

PCR 2012:01 Construction products and construction services version 2.3, The International EPD System.

Life-cycle assessment software and database:

- SimaPro 9 LCA software from PRé.
- Eco9nvent database v3.3 - released in 2017, contains life cycle inventory datasets
- CML-IA database version 3. – released in 2012, The Centrum voor Milieuwetenschappen Leiden Impact Assessment (CML-IA), contains characterisation factors for life cycle impact assessment (LCIA)

ISO 14020:2000	Environmental labels and declarations - General principles
ISO 14025:2006	Environmental labels and declarations - Type III environmental declarations - Principles and procedures
ISO 14044:2006+A1:2018	Environmental management - life cycle assessment - requirements and guidelines, International Organisation for Standardisation (ISO), Geneva.
ISO 14040:2008	Environmental management - Life cycle assessment - principles and framework, International Organisation for Standardisation (ISO), Geneva.
ISO 21930:2017	Sustainability in buildings and civil engineering works - Core rules for environmental product declarations of construction products and services.

Annexure

Characterisation results and network diagram for the Global Warming Potential

(GWP) impact category from Simapro 9.1 software
SimaPro 9.1.1.1 Impact assessment
Project EPD UBP
Date: 11/24/2020
Time: 18:59

Calculation	Analyze
Results	Impact assessment
Product	1 p Concrete Block 1000 kg (of project EPD UBP)
Method	CML-IA baseline V3.04 / World 2000
Indicator	Characterization
Skip categories	Never
Exclude infrastructure processes	Yes
Exclude long-term emissions	No
Sorted on item	Impact category
Sort order	Ascending

Impact category	Unit	Total	Raw Material	Transport	Manufacturing
Abiotic depletion	kg Sb eq	6.84E-05	4.1827E-05	3.8E-06	2.27E-05
Abiotic depletion (fossil fuels)	MJ	606.4775	333.182486	138.8246	134.4704
Global warming (GWP100a)	kg CO2 eq	97.40744	77.5606394	9.434092	10.4127
Ozone layer depletion (ODP)	kg CFC-11	4.47E-06	2.2369E-06	1.55E-06	6.77E-07
Human toxicity	kg 1,4-DB	13.78297	7.89646245	3.123791	2.762716
Fresh water aquatic ecotox.	kg 1,4-DB	7.28249	5.04383909	0.854084	1.384567
Marine aquatic ecotoxicity	kg 1,4-DB	38309.29	22858.1356	3520.384	11930.77
Terrestrial ecotoxicity	kg 1,4-DB	0.128782	0.09884591	0.01372	0.016216
Photochemical oxidation	kg C2H4 eq	0.018234	0.00709663	0.005698	0.00544
Acidification	kg SO2 eq	0.477679	0.17424677	0.17482	0.128612
Eutrophication	kg PO4	0.07114	0.04102305	0.018913	0.011204