Statement of Verification

BREG EN EPD No.: 000511 Issue 01

This is to verify that the

Environmental Product Declaration

provided by:

LSI Stones

BRE Global Verified EPD

is in accordance with the requirements of:

EN 15804:2012+A1:2013

and

BRE Global Scheme Document SD207

This declaration is for:

1m³ of Limestone Slabs

Company Address

LSI Stone
IC2 km 104,
2480-093 Pedreiras,
Leiria,
Portugal

Signed for BRE Global Ltd	Emma Baker Operator	21 July 2023 Date of this Issue
21 July 2023 Date of First Issue		20 July 2028 Expiry Date

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ECO PLATFORM EPD VERIFIED

Environmental Product Declaration

EPD Number: 000511

General Information

EPD Programme Operator	Applicable Product Category Rules
BRE Global Watford, Herts WD25 9XX United Kingdom	BRE Environmental Profiles 2013 Product Category Rules for Type III environmental product declaration of construction products to EN 15804:2012+A1:2013
Commissioner of LCA study	**LCA consultant/Tool**
LSI Stone 20 Old Bailey, Suite 523 London EC4M 7BF United Kingdom	LCA consultant: Bala Subramanian Tool: BRE LINA v2.0
Declared/Functional Unit	**Applicability/Coverage**
1 m^3 of Limestone Slabs	Product Average.
EPD Type	**Background database**
Cradle to Gate	ecoinvent

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

Comparability
Environmental product declarations from different programmes may not be comparable if not compliant with EN 15804:2012+A1:2013. Comparability is further dependent on the specific product category rules, system boundaries and allocations, and background data sources. See Clause 5.3 of EN 15804:2012+A1:2013 for further guidance

Information modules covered

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

Note: Ticks indicate the Information Modules declared.

Manufacturing site(s)

LSI Stone
IC2 km 104,
2480-093 Pedreiras,
Leiria,
Portugal

Construction Product

Product Description

Limestone is a common type of carbonate sedimentary rock that is mainly composed of calcium-bearing carbonate minerals such as calcite and dolomite. Impurities such as clay, sand, iron oxide and other minerals cause limestone to exhibit different colours, especially on weathered surfaces. Limestone has high corrosion resistance and is composed of fine-grained particles that may be compacted to increase its overall strength. In line with its physical properties, it is used in the construction industry for various applications such as slabs for cladding, floors and stairs, external paving, tiles and as rough slabs. This EPD represents 1m³ of limestone slabs with a density of 2,430 kg/m³.

Technical Information

Property	Value, Unit
[EN 13501-1] Reaction to fire Class	A1
[EN 12372] Flexural tensile strength	8-16 Mpa
[EN 12371] Flexural strength against freeze thaw (56 cycles)	7-15 Mpa
[EN 1936] Apparent density & Open porosity	2210-2650 kg/m3 & 5-8 %
[EN 13755] Water absorption at atmospheric pressure	1-5 %
[BR141] Saturation coefficient	0.85-0.89
[EN 13364] Determination of breaking load at dowel hole (30 mm)	1700-2100 N
[EN 14157] Abrasion	18-26 mm
[EN 14231] Slip resistance (sandblasted)	55-75 PTV Wet, 65-85 PTV Dry

Property	Value, Unit
[EN 1926] Compressive strength	80-160 Mpa
EN 1469:2015 – Natural stone products	Slabs for cladding
EN 12057:2015 – Natural stone products	Modular tiles
EN 12058:2015 – Natural stone products	Slabs for floors and stairs
EN 1341:2014 – Natural stone products	Slabs of natural stone for external paving
EN 1342:2014 – Natural stone products	Setts of natural stone for external paving
EN 1343:2014 – Natural stone products	Kerbs of natural stone for external paving
EN 1468:2012 – Natural stone products	Rough Slabs

Main Product Contents

Limestone is a chemical sedimentary rock, which forms from the solidification of minerals out of solution into rock form. The main component of limestone is calcium carbonate (CaCO3),

Material/Chemical Input	%
Calcium (ca)	40%
Carbon	12%
Oxygen (O2)	48%

Manufacturing Process

The limestone extraction process involves drilling and cutting large cubes of stone from the rock base.

Block production will be initiated by drilling vertical and horizontal holes in the limestone base with the help of modern equipment equipped with diamond drilling tools and powered through electric power sources. Diamond-wire tools, powered by electric spinning machines, will be passed through these holes in the limestone bed and will separate the natural stone rock, delivering transportable-size blocks of natural limestone. The block manufacturing process will result in dimensional stone-sized blocks, but the extraction process will also deliver small pieces of rock that might not be suitable for dimensional stone products. In this

case, natural material is classified as a sub-product for industrial stone-related industries, such as lime, cement, and aggregate.

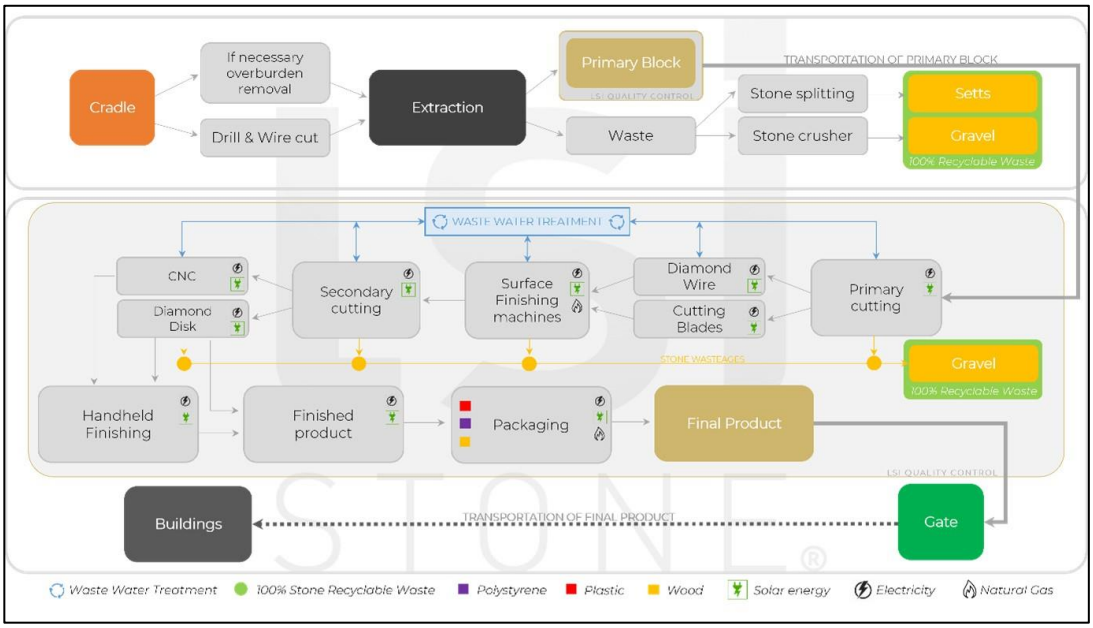
Natural stone blocks of different sizes will be moved inside the limestone extraction area with heavy transport equipment powered by diesel motors and parked for inspection and preparation that might require the use, once again, of diamond cutting wire tools and electric power that will split and "clean" the block of natural material. The waste resulting from this process might once again be used in industrial applications.

Transport of the block from the extraction area to the processing plant will start with the loading of the natural stone blocks into road transport trucks, which will be accomplished with the help of electric-powered cranes or of heavy diesel-powered loading equipment. The LSI Stone processing plant will be no more than 25 kilometers away, and all transportation will be done by road, using diesel-powered trucks. At the LSI processing plant, natural limestone will be unloaded and redirected to electric cranes that will park the block inside the factory floor.

Block processing will be initiated following specific project requirements, therefore minimizing waste factors. Block will be moved to the slabbing area, requiring the use of electric cranes. Slabbing equipment will once again resource diamond-equipped tools to separate block-shaped natural material into specific-sized slabs; electric-powered tools will resource blades or wires to accomplish the process. The next step in the manufacturing process will be surface finishing, which will be done according to the specific project requirements, and diamond tools will be used to process the stone surface in search of the desired natural stone finish. Natural material with the appropriate surface finish will then be transported to the cutting area.

Different cut-to-size machines will proceed with cutting and carving depending on project requirements. The waste resulting from this process could be in the form of sludge or rock. Sludge will be processed in LSI's water recycling unit, which will separate water from stone residues. Water will be reused in the system, and sludge will be dried and used for industrial uses. Rock-shaped waste will be transported with the help of underground conveyors to a crushing unit at the factory that will transform this waste into aggregate size, also ready to be used for industrial applications. Stone will be transported to the packaging area, where custom-made wood crates will be used to carefully pack the natural stone products.

Process flow diagram



Life Cycle Assessment Calculation Rules

Declared unit description

1 m^3 of Limestone Slabs

System boundary

This is a cradle-to-gate EPD, reporting all production life cycle stages (modules A1 to A3) in accordance with EN 15804:2012+A1:2013.

Data sources, quality and allocation

Datasets are derived from ecoinvent v3.2 (2015) and the LCA tool used was BRE LINA v2.0. The LCA models and reports the production stage modules, A1 to A3 and includes limestone extraction and quarry processing.

The LSI Stone factory produces other products in addition to limestone slabs. An allocation to fuel consumption, water consumption & discharge, and waste was required. The allocation factor was based on the total production output of the limestone slabs compared to the total production output of the LSI Stone site over the data collection period (01/01/21 - 31/12/21).

Unprocessed limestone blocks are the raw material input to the LSI factory, though there was no limestone dataset in the background database. However, data was obtained for the extraction of limestone from the quarry, so with the use of the given data, a specific "limestone quarry process" dataset was modelled and fed into LINA to represent limestone as a raw material.

In this EPD, two results tables have been displayed: limestone processing impacts from green electricity and impacts from national grid. The LSI Stones confirmed (by submitting external and independent certification) that they are using green electricity and that they shared the green electricity contract with the mix percentage of renewables. By using that, a new green electricity dataset was modelled in SimaPro and fed into LINA to represent the Green electricity.

However, accrding to the EN 15804, when calculating impacts associated with standard energy supply national or regional average energy models shall be used. In line with that, the impacts are analysed for national electricity and displayed in another table. The dataset used for calculating the impacts from national grid was Electricity, Portugal (kWh) {Ecoinvent 3.6}.

The quality level of geographical and technical representativeness is therefore Very Good. The quality level of time representativeness is Fair as the background LCI datasets are based on ecoinvent v3.2 which was compiled in 2015. Therefore, there is approximately 5-6 years between the ecoinvent LCI reference year and the time for which the LCA was undertaken.

Cut-off criteria

All the raw materials, ancillary materials, process energy, general energy, water use/discharge and production waste have been included during the limestone extraction and processing. Direct emissions to air, water, and soil are not measured.

LCA Results – Limestone Processing using the Green Electricity

Parameters describing environmental impacts

			GWP	ODP	AP	EP	POCP	ADPE	ADPF
			kg CO_2 equiv.	kg CFC 11 equiv.	kg SO_2 equiv.	kg $(PO_4)^{3-}$ equiv.	kg C_2H_4 equiv.	kg Sb equiv.	MJ, net calorific value.
Product stage	Raw material supply	A1	3.67E+01	6.47E-06	2.70E-01	6.46E-02	4.38E-02	2.30E-05	5.32E+02
	Transport	A2	2.96E+01	5.44E-06	1.00E-01	2.67E-02	1.78E-02	7.88E-05	4.47E+02
	Manufacturing	A3	-1.97E+00	1.93E-05	9.81E-01	4.40E-01	1.93E-01	1.82E-03	3.27E+03
	Total (of product stage)	A1-3	6.43E+01	3.12E-05	1.35E+00	5.31E-01	2.54E-01	1.92E-03	4.25E+03

GWP = Global Warming Potential;
ODP = Ozone Depletion Potential;
AP = Acidification Potential for Soil and Water;
EP = Eutrophication Potential;
POCP = Formation potential of tropospheric Ozone;
ADPE = Abiotic Depletion Potential – Elements;
ADPF = Abiotic Depletion Potential – Fossil Fuels;

Parameters describing resource use, primary energy

			PERE	PERM	PERT	PENRE	PENRM	PENRT
			MJ	MJ	MJ	MJ	MJ	MJ
Product stage	Raw material supply	A1	1.80E+01	6.72E-01	1.87E+01	5.28E+02	0.00E+00	5.28E+02
	Transport	A2	6.12E+00	2.47E-05	6.12E+00	4.44E+02	0.00E+00	4.44E+02
	Manufacturing	A3	7.66E+03	3.14E-02	7.66E+03	3.32E+03	9.57E+01	3.42E+03
	Total (of product stage)	A1-3	7.68E+03	7.03E-01	7.68E+03	4.29E+03	9.57E+01	4.39E+03

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

Parameters describing resource use, secondary materials and fuels, use of water

			SM	RSF	NRSF	FW
			kg	MJ net calorific value	MJ net calorific value	m^3
Product stage	Raw material supply	A1	0.00E+00	0.00E+00	0.00E+00	1.16E-01
	Transport	A2	0.00E+00	0.00E+00	0.00E+00	9.81E-02
	Manufacturing	A3	0.00E+00	0.00E+00	0.00E+00	2.06E+01
	Total (of product stage)	A1-3	0.00E+00	0.00E+00	0.00E+00	2.08E+01

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

LCA Results (continued)

Other environmental information describing waste categories					
			HWD	NHWD	RWD
			kg	kg	Kg
Product stage	Raw material supply	A1	3.83E-01	3.83E-01	0.00E+00
	Transport	A2	1.96E-01	2.05E+01	3.08E-03
	Manufacturing	A3	1.31E+01	2.53E+01	8.93E-03
	Total (of product stage)	A1-3	1.37E+01	4.62E+01	1.20E-02

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

Other environmental information describing output flows – at end of life						
			CRU	MFR	MER	EE
			kg	kg	kg	MJ per energy carrier
Product stage	Raw material supply	A1	1.64E+03	0.00E+00	0.00E+00	0.00E+00
	Transport	A2	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Manufacturing	A3	4.85E+03	9.78E-02	0.00E+00	0.00E+00
	Total (of product stage)	A1-3	6.49E+03	9.78E-02	0.00E+00	0.00E+00

CRU = Components for reuse;
MFR = Materials for recycling
MER = Materials for energy recovery;
EE = Exported Energy

LCA Results – Limestone Processing using the National Grid

Parameters describing environmental impacts

			GWP	ODP	AP	EP	POCP	ADPE	ADPF
			kg CO_2 equiv.	kg CFC 11 equiv.	kg SO_2 equiv.	kg $(PO_4)^{3-}$ equiv.	kg C_2H_4 equiv.	kg Sb equiv.	MJ, net calorific value.
Product stage	Raw material supply	A1	3.67E+01	6.47E-06	2.70E-01	6.46E-02	4.38E-02	2.30E-05	5.32E+02
	Transport	A2	2.96E+01	5.43E-06	1.00E-01	2.66E-02	1.78E-02	7.87E-05	4.46E+02
	Manufacturing	A3	4.76E+02	5.60E-05	4.34E+00	9.90E-01	3.86E-01	1.91E-03	1.02E+04
	Total (of product stage)	A1-3	5.42E+02	6.79E-05	4.71E+00	1.08E+00	4.48E-01	2.02E-03	1.12E+04

GWP = Global Warming Potential;
ODP = Ozone Depletion Potential;
AP = Acidification Potential for Soil and Water;
EP = Eutrophication Potential;
POCP = Formation potential of tropospheric Ozone;
ADPE = Abiotic Depletion Potential – Elements;
ADPF = Abiotic Depletion Potential – Fossil Fuels;

Parameters describing resource use, primary energy

			PERE	PERM	PERT	PENRE	PENRM	PENRT
			MJ	MJ	MJ	MJ	MJ	MJ
Product stage	Raw material supply	A1	1.80E+01	6.72E-01	1.87E+01	5.28E+02	0.00E+00	5.28E+02
	Transport	A2	6.11E+00	2.47E-05	6.11E+00	4.44E+02	0.00E+00	4.44E+02
	Manufacturing	A3	6.08E+03	3.17E-02	6.08E+03	1.09E+04	9.57E+01	1.10E+04
	Total (of product stage)	A1-3	6.11E+03	7.03E-01	6.11E+03	1.19E+04	9.57E+01	1.20E+04

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

Parameters describing resource use, secondary materials and fuels, use of water

			SM	RSF	NRSF	FW
			kg	MJ net calorific value	MJ net calorific value	m^3
Product stage	Raw material supply	A1	0.00E+00	0.00E+00	0.00E+00	1.16E-01
	Transport	A2	0.00E+00	0.00E+00	0.00E+00	9.80E-02
	Manufacturing	A3	0.00E+00	0.00E+00	0.00E+00	7.10E+00
	Total (of product stage)	A1-3	0.00E+00	0.00E+00	0.00E+00	7.31E+00

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

LCA Results (continued)

Other environmental information describing waste categories					
			HWD	NHWD	RWD
			kg	kg	Kg
Product stage	Raw material supply	A1	3.83E-01	3.83E-01	0.00E+00
	Transport	A2	1.95E-01	2.05E+01	3.07E-03
	Manufacturing	A3	1.28E+01	3.40E+01	2.46E-02
	Total (of product stage)	A1-3	1.34E+01	5.49E+01	2.77E-02

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

Other environmental information describing output flows – at end of life						
			CRU	MFR	MER	EE
			kg	kg	kg	MJ per energy carrier
Product stage	Raw material supply	A1	1.64E+03	0.00E+00	0.00E+00	0.00E+00
	Transport	A2	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Manufacturing	A3	4.85E+03	9.78E-02	0.00E+00	0.00E+00
	Total (of product stage)	A1-3	6.49E+03	9.78E-02	0.00E+00	0.00E+00

CRU = Components for reuse;
MFR = Materials for recycling
MER = Materials for energy recovery;
EE = Exported Energy

Interpretation of results:

The bulk of the environmental impacts and primary energy demand are attributed to the extraction and processing of the limestone slabs, covered by information modules A1-A3 of EN15804:2012+A1:2013.

References

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

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